

Projeto de ESTABILIDADE e Contenção Periférica



TOPO NORTE
MUNICÍPIO DE LEIRIA

PROJETO DE EXECUÇÃO

NOTA DE CÁLCULO
CORPO 3

PROJETO DE ESTABILIDADE E CONTENÇÃO PERIFÉRICA

MEMÓRIA DESCRITIVA E JUSTIFICATIVA

REQUERENTE: Câmara Municipal de Leiria

TIPO DE OBRA: Topo Norte

LOCALIZAÇÃO DA OBRA: Arrabalde d'Aquém - Leiria

PROJETO: Estabilidade - Execução

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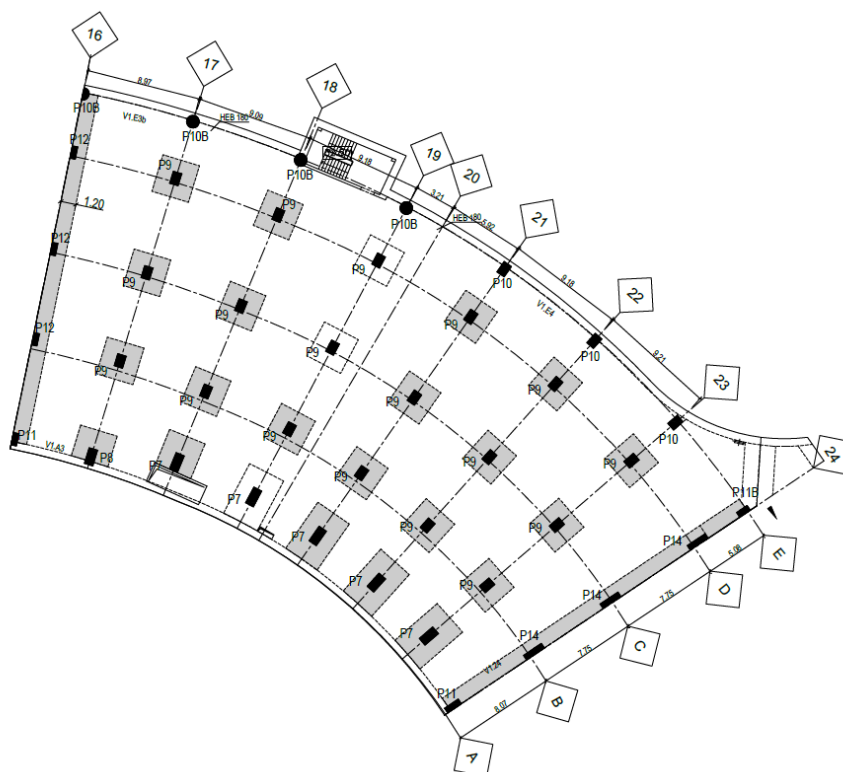
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1 INTRODUÇÃO

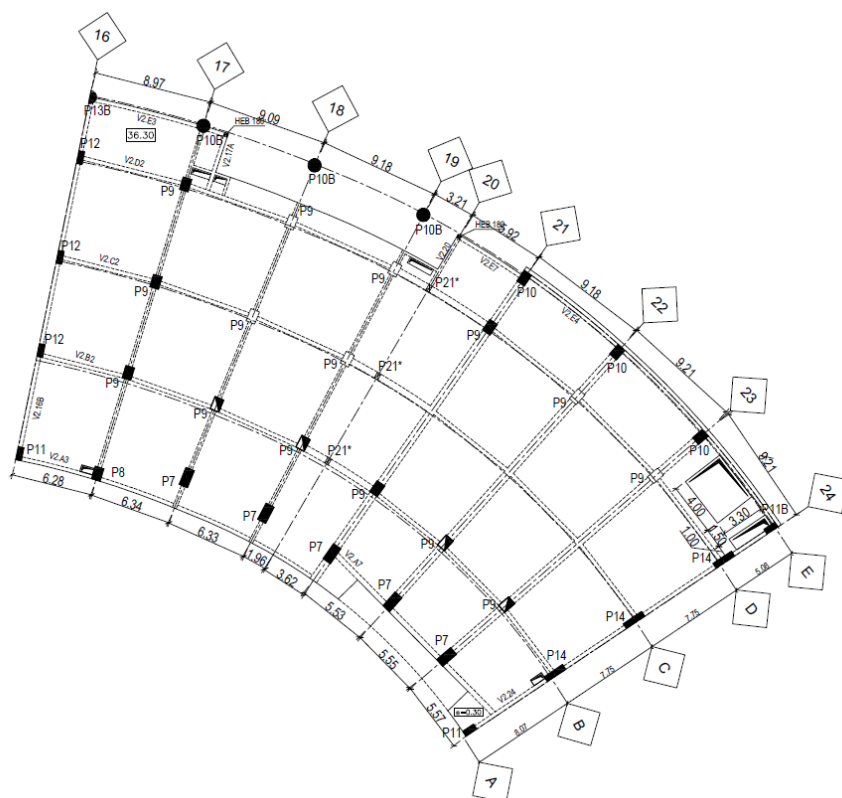
Refere-se a presente Nota de Cálculo ao projeto Estabilidade e Verificação Estrutural relativo à obra de Reabilitação e Reforço do **CORPO 3** do edifício do Topo Norte do Estádio Municipal de Leiria a construir em Arrabalde d'Aquém, freguesia e concelho de Leiria, cujo processo de licenciamento e execução foi requerido pelo Município de Leiria.

Trata-se de um edifício com 3 caves destinadas a estacionamento e 4 pisos acima do solo (um deles a construir) com espaço de lazer e restauração numa das coberturas e possui ainda dois pisos recuados virados a Sul (um deles cobertura não acessível).

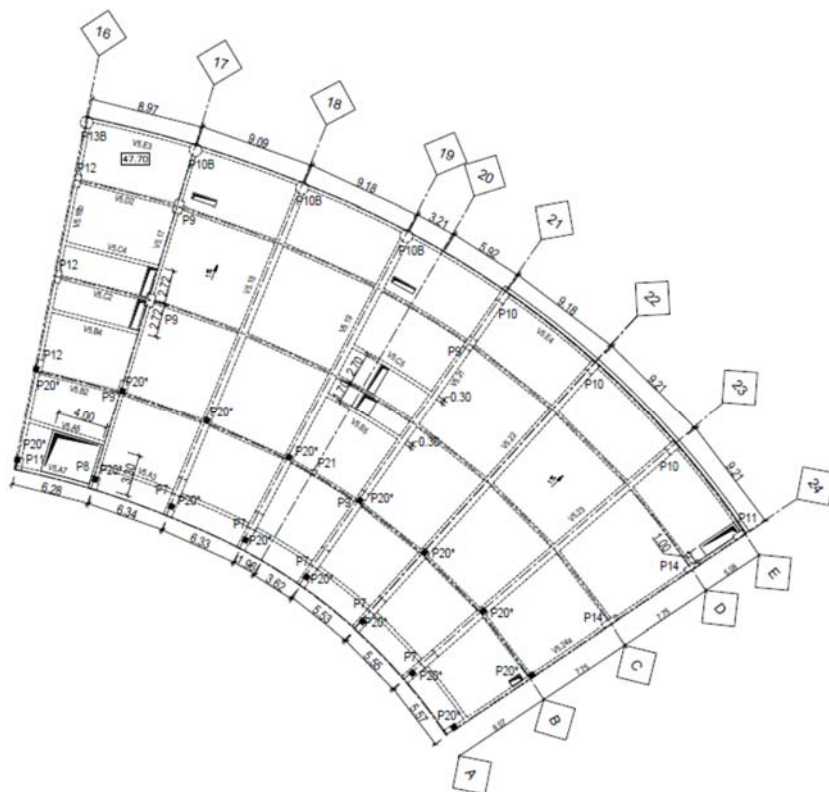
O edifício apresenta uma estrutura mista. Nos pisos enterrados e até à laje do 1º piso (inclusive) apresenta uma estrutura fungiforme com vigas de bordadura e nos restantes pisos uma estrutura porticada com lajes maciças. Nos pisos 2 e 5 os vãos maiores são suportados com vigas pré-esforçadas. Na Figura 1 são apresentadas plantas tipo com a solução estrutural existente.



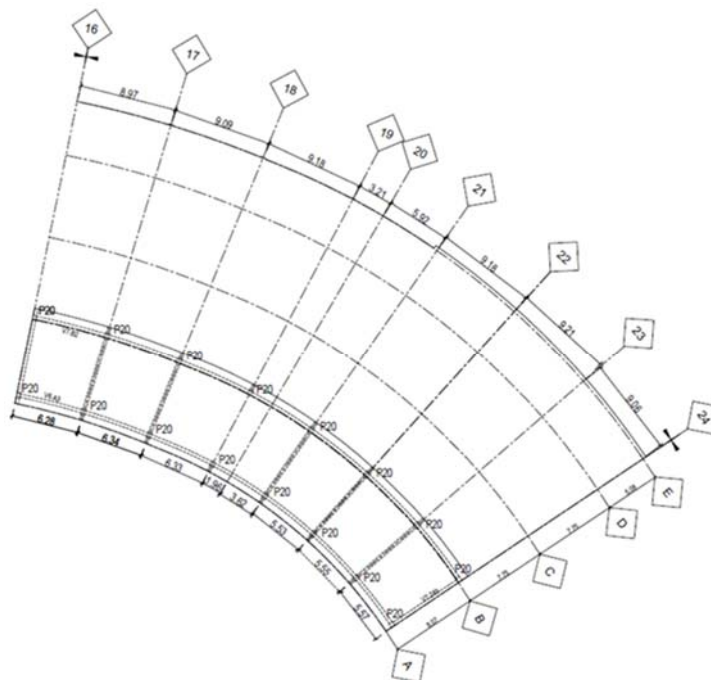
a) Planta estrutural da estrutura existente do PISO 0



b) Planta estrutural da estrutura existente do PISO 2



c) Planta estrutural da estrutura existente do PISO 5 (Cobertura)



d) Planta estrutural da estrutura existente da Cobertura

Figura 1 – Plantas estruturais existentes do edifício da CORPO 3

2 INTERVENÇÃO ESTRUTURAL PROPOSTA

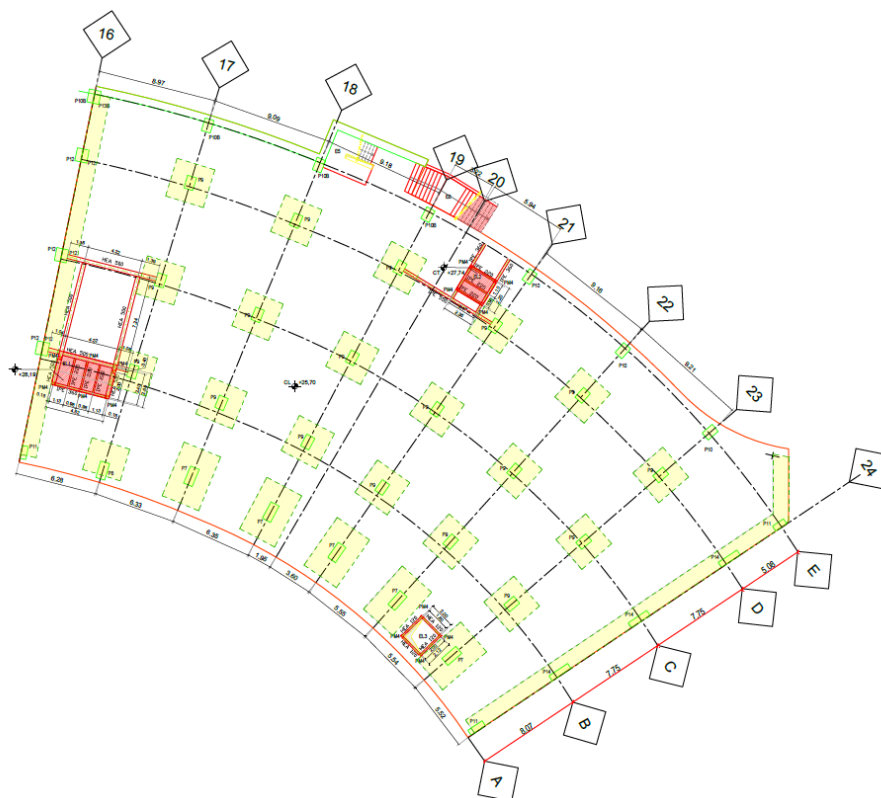
As alterações estruturais propostas para este corpo são confinadas aos pisos acima do solo, nomeadamente:

- Piso 0 (cota 28,80 - ver Figura 2 b):
 - Fecho das aberturas existentes na laje com uma estrutura de suporte executada com vigas metálicas ligadas à estrutura existente e lajes mistas com espessura $e=0,13$ m (lâmina de compressão com 6,5 cm);
 - Arranque de escada de betão armado em caracol com viga central, entre os alinhamentos C | D e alinhamentos 18 | 19, escada de acesso ao Piso 1 e ao Piso 2;
 - Execução de uma saída para o exterior dos núcleos de escadas dos pisos enterrados. Esta saída inclui a execução de um lanço de escadas no exterior e paredes de contenção em betão armado ligadas às paredes moldadas existentes;
 - Arranque da caixa de escada E11. A escada E11 será executada em estrutura metálica, com pilares e vigas HEB com revestimento dos degraus e dos patamares intermédios em chapa. A escada E11 termina no PISO 6;
 - Execução de lajes do poço dos elevadores E11 à cota 28,19, E12 à cota 27,74 e E13 à cota 24,45m (cotas do tosco).

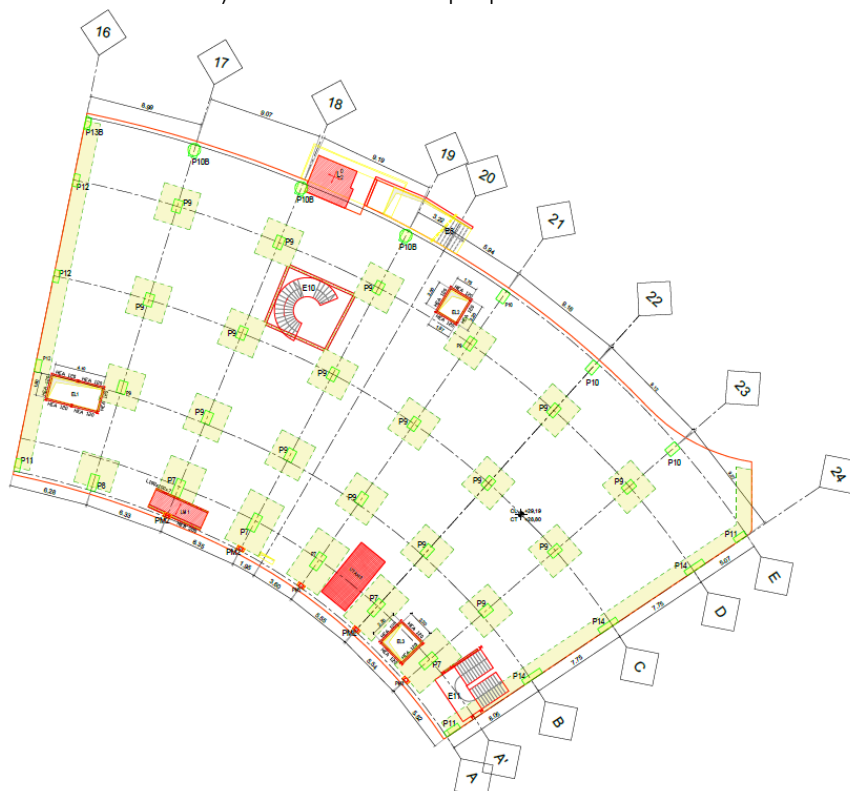
- PISO 2 (cota 36,30 – ver Figura 2 c):
 - Fecho das aberturas existentes na laje com uma estrutura de suporte executada com vigas metálicas ligadas à estrutura existente e lajes mistas com espessura $e=0,13$ m (lâmina de compressão com 6,5 cm).
- PISO 4 a construir (cota 41,80 – ver Figura 2 d):
 - Execução de um novo piso com uma estrutura metálica porticada assente no PISO 2 (cota 36,30) existente. Esta estrutura é constituída por pilares RHS (400×300×10), vigas principais IPE 450, vigas secundárias IPE 330 e lajes mistas com espessura $e=0,13$ m (lâmina de compressão com 6,5 cm). A generalidade dos pilares metálicos assenta nos pilares de betão armado existentes e nos alinhamentos 10, 11 e 12 assentam nas vigas pré-esforçadas existentes entre os alinhamentos B e D;
- PISO 5 (cota 47,70) e PISO 6 (cota 51,50):
 - Execução de uma estrutura metálica porticada assente no PISO 5 (cota 47,70) existente. É constituída por pilares RHS (400×300×10) e CHS (273×12,5), vigas principais IPE 300 e HEB 300, vigas secundárias HEA 200, cobertura em painel tipo Sandwich com contraventamentos horizontais em perfis SHS (120×120×4 e 140×140×6). Os pilares da periferia assentam nos pilares existentes e os interiores nas vigas de betão armado e pré-esforçado existentes.

Para a execução dos elevadores El1, El2, El3 e da escada em caracol será necessário executar aberturas nas lajes existentes nos pisos -1 ao piso 6 (inclusive) e para a escada E11 no piso 1 ao piso 6 e proceder a correções nos capiteis no pilar P7 (al A' | al 23).

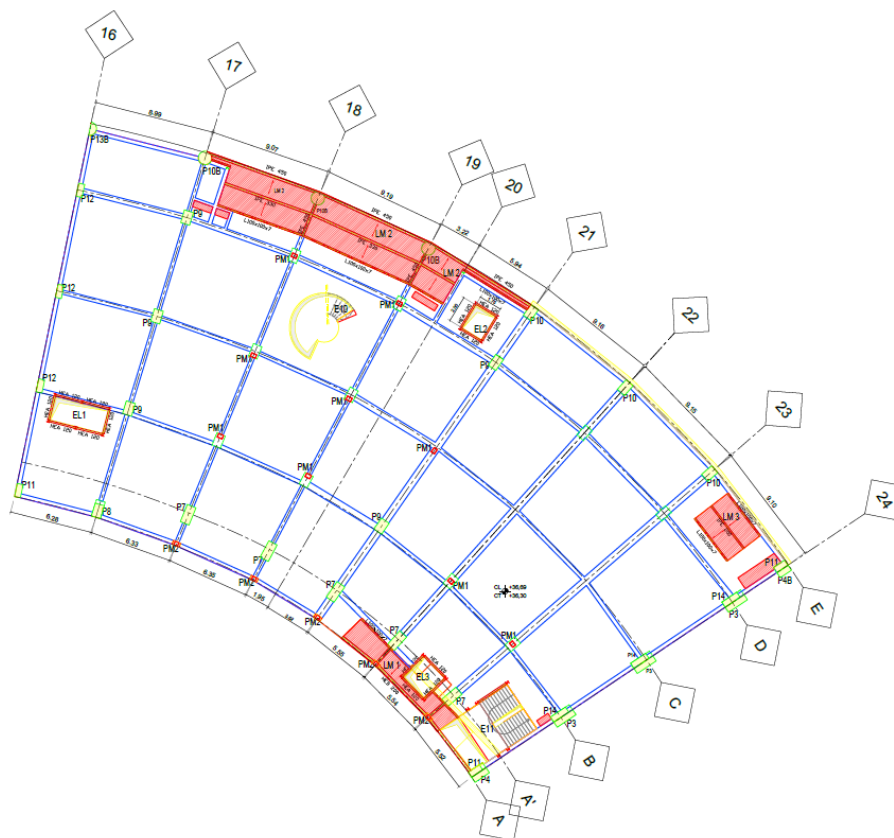
Existem ainda várias aberturas de pequenas dimensões nas lajes de vários pisos que serão preenchidas com betão armado, suportado em perfis metálicos L100x100x3.



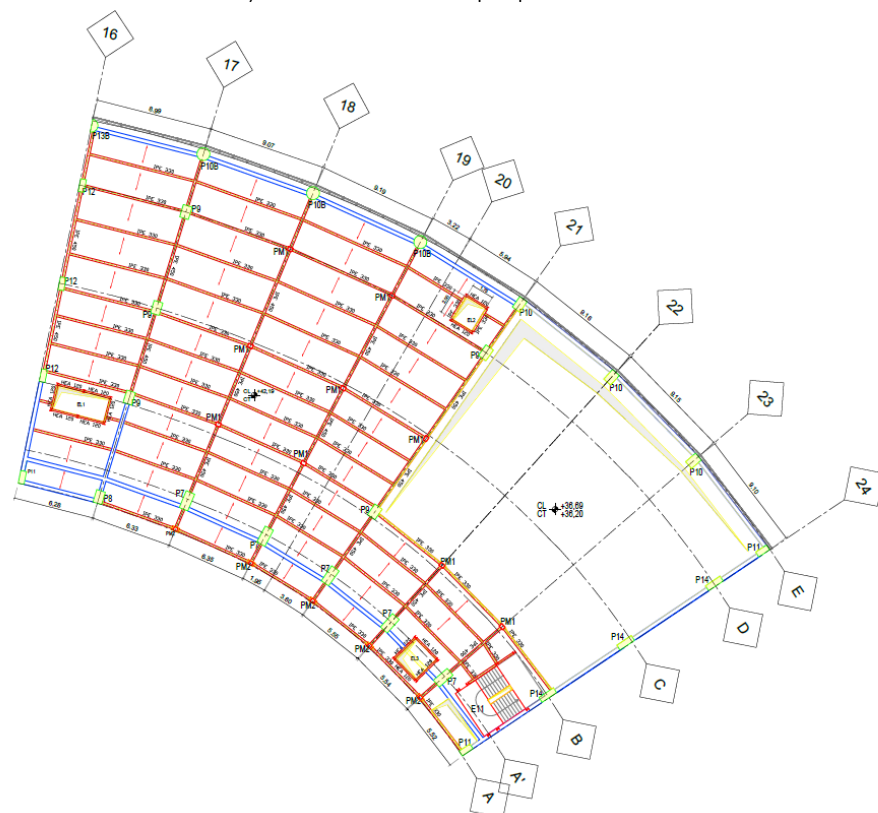
a) Planta estrutural proposta - PISO -1



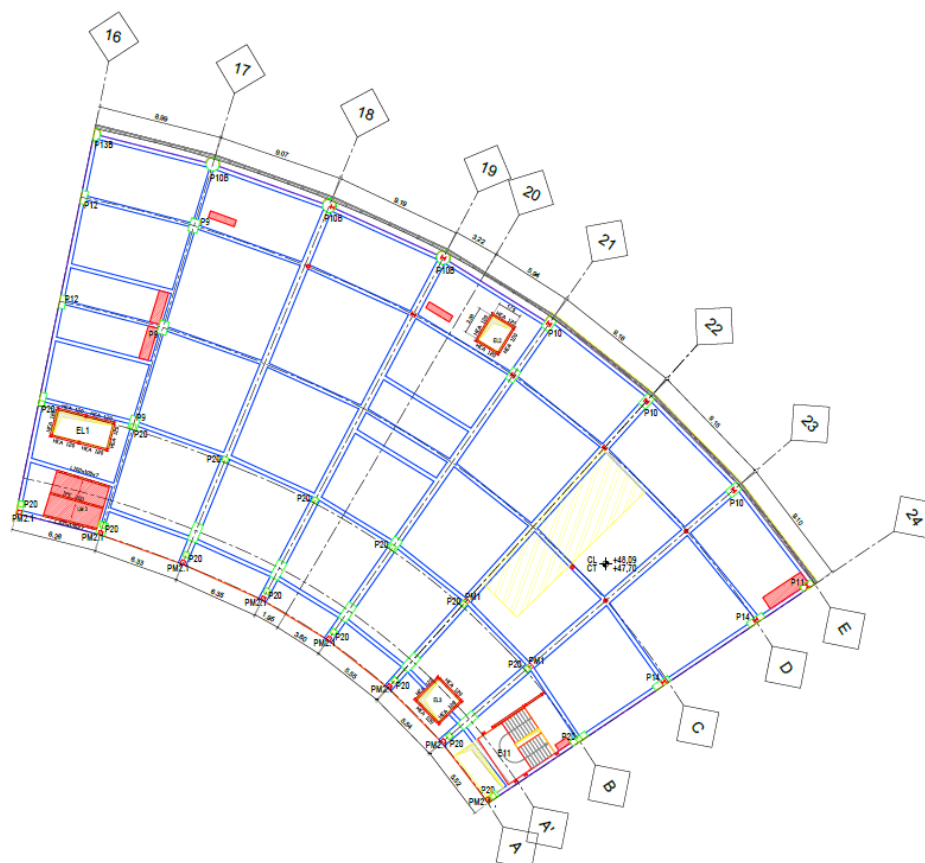
b) Planta estrutural proposta - PISO 0



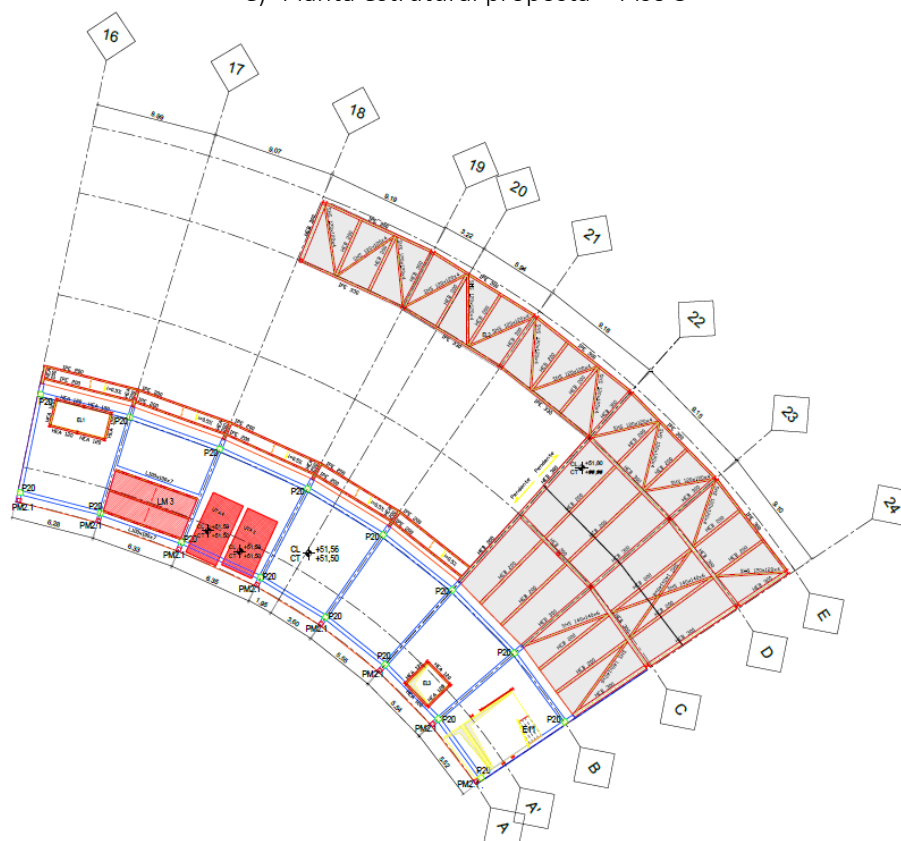
c) Planta estrutural proposta - PISO 2



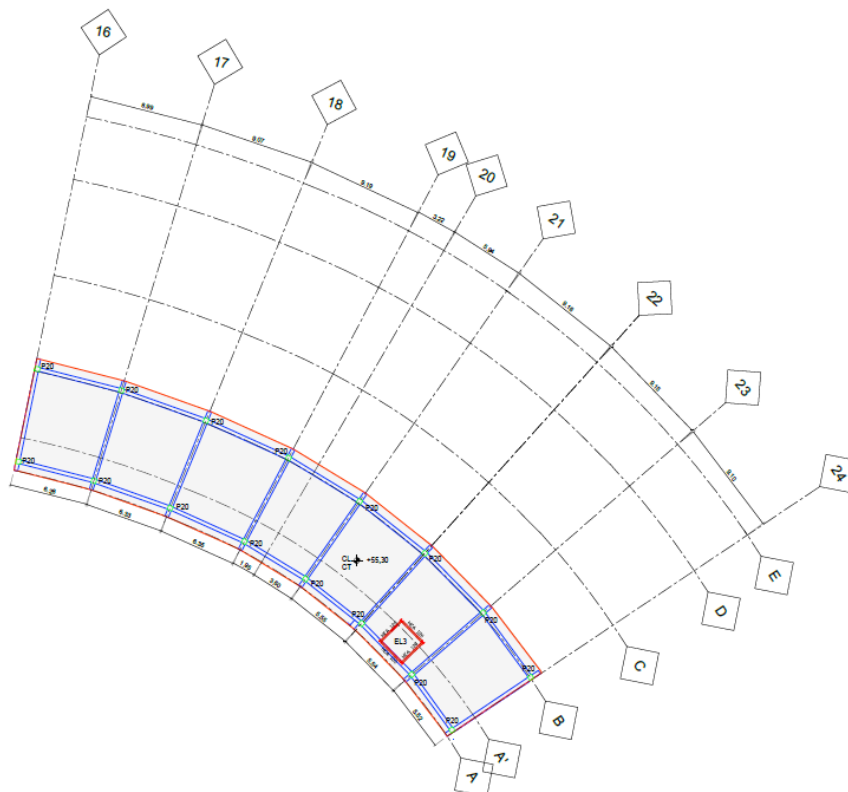
d) Planta estrutural proposta - Piso 4



e) Planta estrutural proposta – Piso 5



f) Planta estrutural proposta – Piso 6 (Cobertura)



g) Planta estrutural proposta - Cobertura

Figura 2 – Plantas estruturais com as soluções propostas para o CORPO 3

3 AÇÕES

A quantificação de ações foi efetuada de acordo com as normas portuguesas e europeias nomeadamente: NP EN 1991-1-1:2009; NP EN 1991-1-4:2010; NP EN 1991-1-5:2009; NP EN 1997-1:2010; NP EN 1998-1:2010; e NP EN 1998-5:2010.

3.1 AÇÕES PERMANENTES

3.1.1 PESOS PRÓPRIOS

O peso próprio dos elementos estruturais foi calculado com base nas suas características geométricas e nos seus pesos volúnicos e são apresentados na Tabela 1.

Tabela 1 – Pesos específicos dos materiais

Material	Peso Específico [kN/m ³]
Betão Armado	25,00
Betão Celular	6,00
Batão leve	12,00
Aço	78,00

Terras (saturado)	20,00
Terras (submerso)	10,00
Água	10,00

3.1.2 RESTANTES AÇÕES PERMANENTES

As restantes cargas permanentes incluem os revestimentos de pisos e tetos, as paredes exteriores e equipamentos fixos. Os revestimentos foram quantificados com base nos pormenores fornecidos no projeto de arquitetura. Os valores apurados para estas ações são apresentados na Tabela 2.

Tabela 2 – Peso das restantes cargas permanentes do CORPO 3

Zona	Descrição	Peso (kN/m ²)
Pisos -3 a -1	Revestimento de piso	2,00
Piso 0 a 4	Paredes exteriores: fachada envidraçada	0,50
	Revestimento de piso	0,50
	Revestimentos de pisos (piso técnico madeira)	0,50
	Revestimentos de pisos (piso técnico pedra)	1,20
	Revestimentos de pisos (betonilha afagada)	1,20
	Tetos e equipamentos suspensos	0,50
	Estrutura do auditório (Piso 0)	2,50
Cobertura (Piso 5)	Cobertura verde	2,50
	Restante Piso 5	1,20
Piso 0 a 7	UTA's	5,50 *
Cobertura (Piso 6 e 7)	Painel sandwich (e=0,10 m)	0,30
	Equipamento luz e som	0,60
Cobertura (Piso 7)	Painéis Solares e Fotovoltaicos	0,15
Caixas de Escadas e Núcleos de Elevadores	Paredes de alvenaria (e=0,15 m)	1,80

As cargas das UTA's foram aplicadas nos modelos de cálculo como cargas concentradas nos cantos correspondentes à sua área de implantação.

3.1.3 AÇÃO ESTATICA DAS TERRAS

Na determinação da ação estática da terra foram considerados coeficientes de impulso de terras em repouso (K_0), considerando uma estrutura de contenção com deslocamentos condicionados, calculado pela teoria de Rankine de acordo com a seguinte expressão:

$$K_0 = (1 - \sin \phi') \cdot (1 + \sin \beta) \quad (1)$$

em que:

ϕ' – ângulo de atrito interno (em termos de tensões efetivas, em graus;

β - inclinação do terrapleno

Para a terminação do coeficiente de impulso em repouso foi considerado um ângulo de atrito interno de 30° e um terrapleno horizontal.

A pressão das terras e da água foi calculada de acordo com as seguintes expressões:

$$\sigma_h = K_0 \cdot \gamma_{sat} \cdot H \text{ acima do nível freático} \quad (2)$$

$$\sigma_h = K_0 \cdot \gamma' \cdot H \text{ acima do nível freático} \quad (3)$$

$$\sigma_{hw} = K_0 \cdot \gamma_w \cdot h_w \text{ acima do nível freático} \quad (4)$$

em que:

γ_{sat} - peso volúmico do solo saturado;

γ' - peso volúmico do solo submerso;

γ_w - peso volúmico da água;

H - altura da estrutura de contenção acima da base de escavação;

h_w - altura da água

3.2 AÇÕES VARIÁVEIS

3.2.1 SOBRECARGAS DE UTILIZAÇÃO

A definição das ações variáveis teve em conta a utilização da estrutura, a sua geometria e a localização da estrutura no território Nacional. A sua quantificação foi efetuada com base no estabelecido na norma NP EN 1991 -1 -1:2009. Na Tabela 3, são apresentados os valores das sobrecargas considerados.

Tabela 3 – Ações variáveis do CORPO 3

Piso	Categoria	Utilização específica	Valor característico da ação [kN/m²]
Piso -3 a -1	Categoria F	Estacionamento	2,50
Piso 0	Categoria C2	Salas de conferência e reuniões	4,00
	Categoria D	Lojas	4,00
Piso 1 a 3	Categoria B	Escritórios	3,00
Piso 5 (Cobertura)	Categoria I	Coberturas acessíveis	3,00
		Cobertura faixa de 1 m	5,00
	Categoria C1	Restaurante	3,00
		Guarda Corps	1,00 (kN/m)
Cobertura	Categoria H	Coberturas não acessíveis	0,40
	Categoria C2	Escadas	4,00

O peso próprio das paredes divisórias amovíveis, foi considerado como uma carga uniformemente distribuída adicionada às sobrecargas dos pavimentos de acordo com a cláusula 6.3.1.2 (7) da NP EN 1991-1:2009 nos pisos em que estas paredes são utilizadas. Na Tabela 4, são apresentados os valores considerados.

Tabela 4 – Peso Próprio das divisórias amovíveis

Zona	Descrição	Peso (kN/m ²)
CORPO 3	Paredes divisórias amovíveis	0,80

Além destas sobrecargas foi considerada uma sobrecarga uniformemente distribuída, de valor igual a 5 kN/m², a atuar nos arruamentos adjacentes.

3.2.2 AÇÃO VARIÁVEL DO VENTO

Os efeitos da ação do vento são condicionantes para o dimensionamento dos elementos em estrutura metálica da cobertura do CORPO 3. Os dados que serviram de base à quantificação da ação do vento são os indicados na Tabela 5.

Tabela 5 - Parâmetros considerados para a ação do vento (NP EN 1991-1-4)

Zona	A	
Altura do Edifício	30,00m	
Categoria de terreno	III - Zona com uma cobertura regular de vegetação ou edifícios, ou com obstáculos isolados com separações entre si de, no máximo, 20 vezes a sua altura (ex:zonas suburbanas)	
$v_{b,0}$ - Valor básico da velocidade de referência do vento		27,00 m/s
c_{dir} - Coeficiente de direção		1,00
c_{season} - Coeficiente de sazão		1,00
v_b - Valor de referência da velocidade do vento		27,00 m/s
z_0 - Comprimento de rugosidade		0,300 m
z_{min} - Altura mínima		8,00 m
k_r - Coeficiente de terreno		0,22
c_r - Coeficiente de rugosidade		0,97
c_o - Coeficiente de orografia		1,00
v_m - Velocidade média do vento		26,17 m/s
I_v - Intensidade de turbulência do vento		0,22
q_p - Pressão dinâmica de pico		1,07 kN/m ²

Para simular a ação do vento no edifício utilizaram-se os coeficientes de pressão obtidos atendendo à geometria do mesmo, de acordo com o prescrito na norma NP EN 1991-4. Os valores correspondentes à pressão estática exercida pelo vento foram calculados através da multiplicação do valor da pressão dinâmica do vento pelos respetivos coeficientes de pressão. Os valores dos coeficientes de pressão foram calculados tendo em conta as relações geométricas do edifício, a inclinação da vertente da cobertura, a direção do vento e consoante se trate de edifício fechado ou aberto.

3.2.3 TEMPERATURA

Tal como no projeto inicial não foram consideradas as ações térmicas para a estrutura de betão.

Para as novas estruturas metálicas as ações térmicas foram quantificadas segundo a norma NP EN 1991-5:2009, tendo em conta a localização do edifício, os materiais utilizados, exposição destes elementos e pormenorização estrutural (juntas de dilatação).

A variação uniforme de temperatura é dada por:

$$\Delta T_U = T - T_0 \text{ onde } T = T_{med}; T_0 = T_{ini}, \text{ sendo } T = (T_{in} + T_{out}) / 2 \quad (5)$$

Contudo, como os elementos em estrutura metálica estão em ambiente exclusivamente interior, considera-se que $T = T_{in}$.

Os valores de T_{in} diferem consoante se trate de inverno ou de verão. Assim, os valores de T_{in} são:

- Inverno: 18°C;
- Verão: 25°C.

O valor de T_0 , temperatura inicial de um elemento estrutural, é 15°C.

Assim, os valores da variação uniforme a considerar nos elementos estruturais metálicos são:

- Inverno: $18 - 15 = 3^\circ\text{C}$;
- Verão: $25 - 15 = 10^\circ\text{C}$.

3.2.4 RETRAÇÃO

Para a verificação da segurança estrutural esta ação não foi considerada por se tratar de um edifício existente construído em 2003.

3.2.5 SISMO

3.2.5.1 AÇÃO SÍSMICA

A ação sísmica foi considerada de acordo com o disposto na norma portuguesa Eurocódigo 8, Parte 1: Regras gerais, ações sísmicas e regras para edifícios.

O edifício localiza-se no concelho de Leiria pertencendo à zona sísmica 1.5 para um sismo do tipo 1 e na zona 2.4 para um sismo do tipo 2 respetivamente sismos de magnitude elevada a uma maior distância focal e sismos de magnitude moderada e pequena distância focal sendo ambas as hipóteses tidas em conta no dimensionamento. Foi considerado que as fundações assentam num solo do tipo B, uma classe de importância III e um coeficiente de amortecimento de 5% para estruturas de betão armado.

O comportamento não linear das secções de betão armado foi tido em conta com a adoção de um coeficiente de comportamento. Tratando-se de um edifício corrente, adotou-se para as direções horizontais um coeficiente de comportamento de 2.0 (ductilidade normal).

Consideram-se ambas as hipóteses de Ação Sísmica: Ação Sísmica Tipo 1 e Ação Sísmica Tipo 2.

Considerou-se igualmente a redução da rigidez dos elementos de betão armado tendo em conta o efeito da fendilhação, através da redução em 50% do módulo de elasticidade.

Os dados que serviram de base à quantificação da ação do sismo são os indicados na Tabela 6.

Tabela 6 - Parâmetros considerados para o cálculo dos espectros de resposta (NP EN 1998-1)

Localidade		Leiria	
Tipo de Terreno		B	
Classe de Importância		III	
Coeficiente de comportamento [q]		2	
Coeficiente de amortecimento [ξ]		5 %	

		Sismo Tipo 1	Sismo Tipo 2
Zona Sísmica		1.5	2.4
Coeficiente de Importância	γ_I	1.45	1.25
Aceleração máxima na base	a_{gR}	0.60 m/s ²	1.10 m/s ²
Aceleração à superfície do terreno	a_g	0.87 m/s ²	1.38 m/s ²
Aceleração à superfície do terreno na direção vertical	a_{vg}	0.65 m/s ²	1.31 m/s ²
Coeficiente de correção do amortecimento	η	1.00	
Componente horizontal	T_B	0.10	0.10
	T_C	0.60	0.25
	T_D	2.00	2.00
	S	1.35	1.31
Componente vertical	T_B	0.05	
	T_C	0.25	0.15
	T_D	1.00	
	S	1.00	

Na determinação das forças incidentes na estrutura, resultantes da Ação Sísmica, foi realizada uma Análise Dinâmica por espectro de resposta baseado no princípio da sobreposição modal (método Combinação Quadrática Completa) tendo-se considerado a ação horizontal e vertical do sismo. Foram consideradas as três combinações seguintes para o cálculo dos esforços:

$$E_{Edx} "+" 0,30E_{Edy} "+" 0,30E_{Edz} \quad (6)$$

$$0,30E_{Edx} "+" E_{Edy} "+" 0,30E_{Edz} \quad (7)$$

$$0,30E_{Edx} "+" 0,30E_{Edy} "+" E_{Edz} \quad (8)$$

em que:

E_{Edx} – esforços de cálculo devidos à aplicação da ação sísmica segundo o eixo horizontal X;

E_{Edy} – esforços de cálculo devidos à aplicação da ação sísmica segundo o eixo horizontal Y;

E_{Edz} – esforços de cálculo devidos à aplicação da componente vertical da ação sísmica de cálculo.

3.2.5.2 ACRÉSCIMO DE IMPULSO SÍSMICO

Para as paredes de contenção a executar nas escadas exteriores (escadas E8) o acréscimo de impulso sísmico foi calculado com base nas prescrições do Eurocódigo 8- parte 5. A Tabela 7 apresenta os parâmetros adotados e a os valores obtidos dos coeficientes de impulso em condições sísmicas para cada um dos tipos de ação sísmica.

Tabela 7 – Coeficientes impulso em condições sísmicas

CÁLCULO DO ACRÉSCIMO DE IMPULSO SÍSMICO (Mononobe-Okabe)													
Peso volúmico do solo										$\gamma =$	20.0	[kN/m³]	
Ângulo de atrito do solo										$\varnothing' =$	30.0	[°]	
Ângulo de atrito solo-paramento										$\delta =$	0.0	[°]	
Ângulo do paramento do muro com a vertical										$\lambda =$	0.0	[°]	
Ângulo do terrapleno inclinado com a horizontal										$\beta =$	0.0	[°]	
Altura do paramento										$h =$	3.3	[m]	
Sismo	a_g [m/s²]	g [m/s²]	α	r	S	a_{vg}/a_g	k_h	k_v	θ	K_a	K_{as}	ΔK_{as}	
Tipo 1	0.87	9.81	0.089	1.0	1.35	0.75	0.12	0.06	6.45	0.333	0.406	0.097	
									7.26		0.416	0.058	
Tipo 2	1.38		0.140		1.31	0.95	0.18	0.09	9.52		0.447	0.154	
									11.40		0.475	0.098	

3.3 ELEVADORES

Os pesos que os elevadores e respetivos passageiros / carga exercem nas lajes de fundo dos poços e nos tetos das caixas dos elevadores, bem como nas lajes de piso, foram calculadas em função da informação fornecida por uma marca e instalador oficial e resumem-se na Tabela 8. Admitiram-se as combinações de carga mais desfavoráveis para o cálculo desta ação e consideraram-se as combinações de ações mais desfavoráveis para efetuar o dimensionamento / verificação dos vários elementos estruturais.

Adotaram-se as cargas indicadas para as guias aplicadas horizontalmente nas lajes e guias horizontais que compõem a estrutura do elevador, as cargas indicadas no teto da caixa dos elevadores que representam os ganchos necessários à montagem dos elevadores e, nas lajes de fundo dos poços, adotou-se conservativamente uma carga distribuída de 40 kN/m².

Tabela 8 – Cargas devido aos elevadores

Elevador				
Designação	Nº Cabinas	Carga (kg)	Nº Pessoas	Nº Pisos
EL1 (Duplo)	2	1000 x 2	13	6
EL2 (Panorâmico)	1	700	9	5
EL3 (MC)	1	1000	13	10

Elevador	Poço						Casos Carga			
Designação	F9 (N)	F10 (N)	F11 (N)	F12 (N)	F13 (N)	F14 (N)	Caso 1 Cabina (kN)		Caso 2 (kN) Contrapeso	
EL1 (Duplo)	36787	23485	26000	51900	52000	52000	F13+F9+F9+F14	177.57	F13+F10+F10+F14	150.97
EL2 (Panorâmico)	36265	29435	33610	33610	31029	31029	F12+F9+F9+F11	139.75	F13+F10+F10+F14	120.93
EL3 (MC)	42300	43909	34400	47300	27100	27100	F13+F9+F9+F14	138.80	F13+F10+F14	98.11

Elevador		Dimensionamento laje fundo	
Designação	Carga mais desfavorável (kN)	Área fundo elevador (m²)	Carga distribuída (kN/m²)
EL1 (Duplo)	177.57	6.97	25.48
EL2 (Panorâmico)	139.75	3.50	39.93
EL3 (MC)	138.80	3.60	38.56

Elevador		Guias							Teto		
Designação	FF1 (N) Cabina	FF2 (N) Cabina	FF1 (N) Contrapeso	FF2 (N) Contrapeso	F50x (N)	F50y (N)	F52x (N)	F52y (N)	Gancho f (N)	Gancho g (N)	Gancho h (N)
EL1 (Duplo)	2558	1705	809	89	3213	1705	4898	1661	20000	20000	20000
EL2 (Panorâmico)	1092	682	1173	157	-	-	-	-	30000	20000	20000
EL3 (MC)	2549	1705	540	89	3213	1705	4366	1392	20000	20000	20000

4 COMBINAÇÕES DE AÇÕES

As combinações de ações utilizadas, foram as necessárias para verificar os Estados Limites Últimos (ELU) e os Estados Limites de Utilização (ELS) de acordo com as prescrições da NP EN 1990:2009.

4.1 ESTADOS LIMITES ÚLTIMOS

- Combinação de ações para situações de projeto persistentes ou transitórias (combinações fundamentais):

$$E_d = \sum_{j \geq 1} \gamma_{G,j} G_{k,j} + \gamma_P P + \gamma_{Q,1} Q_{k,1} + \sum_{i > 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \quad (9)$$

- Combinação de ações para situações de projeto sísmicas

$$E_d = \sum_{j \geq 1} G_{k,j} + P + A_{Ed} + \sum_{i \geq 1} \psi_{2,i} Q_{k,i} \quad (10)$$

- Combinação de ações para situações de projeto acidentais

$$E_d = \sum_{j \geq 1} G_{k,j} + P + A + (\psi_{1,1} \text{ ou } \psi_{2,1}) Q_{k,1} + \sum_{i > 1} \psi_{2,i} Q_{k,i} \quad (11)$$

em que:

$\gamma_{G,j}$ – Coeficiente parcial relativo à ação permanente j ;

$G_{k,j}$ – Valor característico da ação permanente j ;

$\gamma_{Q,1}$ – Coeficiente parcial relativo à ação variável de base;

$Q_{k,1}$ – Valor característico da ação variável de base da combinação 1;

$\gamma_{Q,i}$ – Coeficiente parcial relativo à ação variável i ;

$\psi_{0,i}$ – Coeficiente para a determinação do valor de combinação de uma ação variável i ;

$Q_{k,i}$ – Valor característico da ação variável acompanhante i ;

A_{Ed} – Valor de cálculo de uma ação sísmica;

A – Valor de cálculo da ação de acidente (Fogo);

P – Valor representativo de uma ação de pré-esforço;

$\psi_{1,i}$ – Coeficiente para a determinação do valor frequente de uma ação variável i .

$\psi_{2,i}$ – Coeficiente para a determinação do valor quase-permanente de uma ação variável i .

Foram consideradas as hipóteses de carregamento mais desfavoráveis, para se obter os esforços para verificação da segurança aos Estados Limites Últimos que se encontram indicados na nota de cálculo.

Os coeficientes de segurança γ_{Gi} e γ_{Qi} considerados, respetivamente, para ações permanentes e ações variáveis, consoante a sua atuação seja favorável ou desfavorável são os indicados na Tabela 9.

Tabela 9 – Coeficientes de Segurança

Ações	Desfavoráveis	Favorável
Peso próprio dos materiais	1,35	1,00
Restantes cargas permanentes	1,35	1,00
Pré-esforço	1,10	0,90
Variáveis	1,50	0,00
Sismo	1,00	1,00
Acidentais	1,00	1,00

Os valores adotados para os coeficientes para a determinação do valor de combinação (ψ_0), do valor frequente (ψ_1) e quase permanente (ψ_2) de uma ação variável são apresentados na Tabela 10.

Tabela 10 – Coeficientes ψ adotados

Ação	Descrição	ψ_0	ψ_1	ψ_2
Sobrecargas				
Categoria C	Zonas de reunião de pessoas	0,7	0,7	0,6
Categoria D	Zonas comerciais	0,7	0,7	0,6
Categoria F	Zonas de tráfego	0,7	0,7	0,6
Categoria H	Coberturas	0	0	0
Categoria I	Coberturas	*	*	*
Vento		0,6	0,2	0

Temperatura		0,6	0,5	0

* coeficientes a adotar de acordo com a utilização específica

4.2 ESTADOS LIMITES DE UTILIZAÇÃO

As combinações a considerar para os Estados Limites de Utilização são as seguintes.

- Combinação de ações quase-permanente:

$$E_d = \sum_{j \geq 1} G_{k,j} + P + Q_{k,1} + \sum_{i > 1} \psi_{0,i} Q_{k,i} \quad (12)$$

- Combinação frequente:

$$E_d = \sum_{j \geq 1} G_{k,j} + P + \psi_{1,1} Q_{k,1} + \sum_{i > 1} \psi_{2,i} Q_{k,i} \quad (13)$$

- Combinação de ações característica:

$$E_d = \sum_{j \geq 1} G_{k,j} + P + \sum_{i > 1} \psi_{2,i} Q_{k,i} \quad (14)$$

em que:

$G_{k,j}$ – Valor característico da ação permanente j ;

$Q_{k,1}$ – Valor característico da ação variável de base da combinação 1;

$Q_{k,i}$ – Valor característico da ação variável acompanhante i ;

P – Valor representativo de uma ação de pré-esforço;

$\psi_{0,i}$ – Coeficiente para a determinação do valor de combinação de uma ação variável i ;

$\psi_{1,i}$ – Coeficiente para a determinação do valor frequente de uma ação variável i ;

$\psi_{2,i}$ – Coeficiente para a determinação do valor quase-permanente de uma ação variável i .

5 CRITÉRIOS PARA A VERIFICAÇÃO ESTRUTURAL

5.1 GENERALIDADES

A verificação da segurança dos elementos estruturais obedeceu na sua generalidade aos princípios e requisitos de segurança e de utilização da estrutura de acordo com as bases para o seu projeto e verificação da segurança definidos nos seguintes Eurocódigos:

- NP EN 1990:2009, Eurocódigo — Bases para o projeto de estruturas;
- NP EN 1991 -1 -1:2009, Eurocódigo 1 — Ações em estruturas — Parte 1 -1: Ações gerais — Pesos volúmicos, pesos próprios, sobrecargas em edifícios;

- NP EN 1991 -1 -2:2010, Eurocódigo 1 — Ações em estruturas — Parte 1 -2: Ações gerais — Ações em estruturas expostas ao fogo;
- NP EN 1991 -1 -3:2009, Eurocódigo 1 — Ações em estruturas — Parte 1 -3: Ações gerais — Ações da neve;
- NP EN 1991 -1 -4:2010, Eurocódigo 1 — Ações em estruturas — Parte 1 -4: Ações gerais — Ações do vento;
- NP EN 1991 -1 -5:2009, Eurocódigo 1 — Ações em estruturas — Parte 1 -5: Ações gerais — Ações térmicas;
- NP EN 1997 -1:2010, Eurocódigo 7 — Projeto geotécnico — Parte 1: Regras gerais;
- NP EN 1998 -1:2010, Eurocódigo 8 — Projeto de estruturas para resistência aos sismos — Parte 1: Regras gerais, ações sísmicas e regras para edifícios;
- NP EN 1998 -5:2010, Eurocódigo 8 — Projeto de estruturas para resistência aos sismos — Parte 5: Fundações, estruturas de suporte e aspetos geotécnicos.

Em relação ao Betão Armado e pré-esforçado foram considerados os princípios definidos, no Eurocódigo 2:

- NP EN 1992-1-1:2010, Eurocódigo 2: Projecto de estruturas de betão, Parte 1-1: Regras gerais e regras para edifícios;
- NP EN 1992-1-2:2010, Eurocódigo 2: Projecto de estruturas de betão, Parte 1-2: Regras Gerais. Verificação da resistência ao fogo.

Em relação às estruturas Metálicas foram considerados os princípios definidos no Eurocódigo 3:

- NP EN 1993-1-1:2010, Eurocódigo 3: Projeto de estruturas de aço. Parte 1-1: Regras gerais e regras para edifícios;
- NP EN 1993 -1 -2:2010, Eurocódigo 3 — Projeto de estruturas de aço — Parte 1 -2: Regras gerais — Verificação da resistência ao fogo;
- NP EN 1993-1-8:2010, Eurocódigo 3: Projecto de estruturas de aço. Parte 1-8: Projecto de Ligações.

5.2 MODELOS DE CÁLCULO

Foi considerado um modelo de análise tridimensional tendo-se obtido os esforços através de um programa de elementos finitos (Robot Structural Analysis Professional, licença nº 570-52067258).

A determinação dos esforços atuantes teve em conta as condições de equilíbrio e a compatibilidade de deformações. O desempenho da estrutura e a sua análise foi realizado com base num modelo numérico constituído por elementos de barra, no caso de vigas, e por elementos finitos no caso das lajes e paredes de contenção. A geometria da malha de elementos finitos foi definida com base na distribuição de esforços limitando a sua máxima dimensão a 1/8 do vão, tendo-se adotado malhas com máxima dimensão iguais ou inferiores a 1,0 m, com refinamentos nas zonas dos capitéis.

Nas fundações foram considerados apoios simples nos pilares e encastramento na parede de contenção (parede moldada) considerando uma ficha superior a 3 vezes a sua largura. Considerou-se igualmente que a estrutura está bloqueada na direção circunferencial ao nível dos pisos enterrados.

Os efeitos produzidos pelas ações nos elementos estruturais, considerando os vários cenários de carregamento, foram quantificados admitindo um comportamento elástico linear nos materiais envolvidos e no caso da análise sísmica foi tido em conta o comportamento não linear dos materiais tendo-se adotado um coeficiente de comportamento igual a 2.

Na Figura 3 exemplifica-se o modelo estrutural considerado para a determinação dos esforços e avaliação estrutural do edifício.

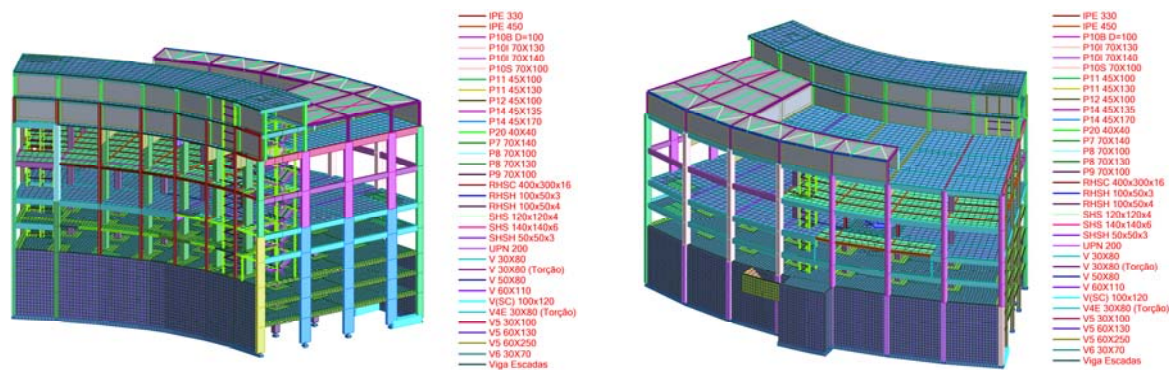


Figura 3 – Modelo estrutural do edifício (CORPO 3)

Os valores das frequências próprias (considerando metade da rigidez dos elementos estruturais de betão armado) correspondentes aos três primeiros modos de vibração em cada uma das direções e os fatores de participação modal obtidos são os indicados na Tabela 11.

Tabela 11 – Frequências Próprias, Períodos e Fatores de Participação Modal (CORPO 3)

CORPO	Modo de Vibração	Frequência f [Hz]	Período T (s)	Fatores de Participação Modal (%)					
				% acumulada			% do respetivo modo		
				X-X	Y-Y	Z-Z	X-X	Y-Y	Z-Z
CORPO 2	1	0.70	1.42	36.02	2.28	0.00	36.02	2.28	0.00
	2	0.79	1.27	37.51	45.93	0.00	1.49	43.64	0.00
	43	3.75	0.27	54.74	75.49	15.95	0.00	0.04	10.68

Na Figura 4 são ilustrados os modos de vibração, em cada direção, resultantes da análise modal efetuada.

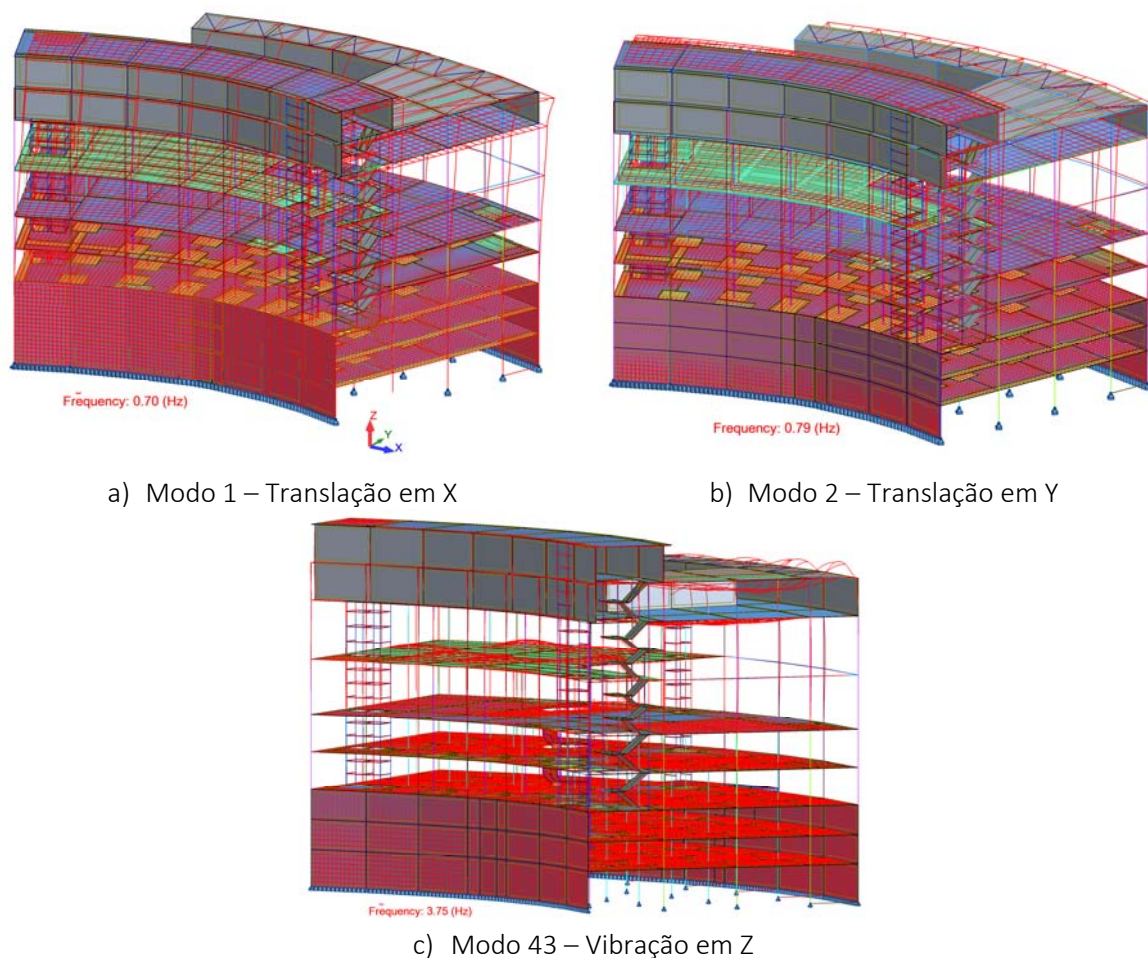


Figura 4 – Modos de Vibração CORPO 3

Os primeiros modos de vibração são predominantemente modos de translação na direção X e Y respetivamente. No Anexo 9.2 são apresentados os resultados dos modos de vibração (250).

6 VERIFICAÇÃO DA SEGURANÇA DOS ELEMENTOS DE BETÃO ARMADO

A verificação da segurança dos elementos estruturais obedeceu na sua generalidade aos princípios e requisitos de segurança e de utilização definidos no Eurocódigo 2 - Projecto de estruturas de betão, Parte 1-1 e Parte 1-2 (Parte 1-1: Regras gerais e regras para edifícios; Parte 1-2: Regras Gerais. Verificação da resistência ao fogo).

A verificação da segurança estrutural, e o dimensionamento das armaduras dos novos elementos de betão armado, foi realizada em relação aos Estados Limites Últimos (Resistência e de Encurvadura) e aos Estados Limites de Utilização (Deformação, Fendilhação e Vibração).

Os esforços foram obtidos com recurso a um programa de cálculo automático (ROBOT Structural Analysis). Foram consideradas as combinações regulamentares para as situações de carga mais desfavoráveis.

6.1 LAJES DE PISO E LAJES DE ESCADAS

A verificação da segurança das lajes foi realizada com base nos esforços de cálculos obtidos no modelo numérico, nos desenhos de pormenor de lajes e na distribuição de armaduras adotadas que constam do projeto inicial da autoria da PROENGEL.

6.1.1 ESFORÇOS DE FLEXÃO

A verificação da segurança ao Estado Limite Último de Flexão das lajes de escadas e de piso, foi realizada com a seguinte condição:

$$M_{Ed} \leq M_{Rd} \quad (15)$$

em que:

M_{Ed} - Valor de cálculo do momento atuante;

M_{Rd} - valor de cálculo do momento resistente.

A determinação da capacidade resistente das secções das lajes à flexão baseou-se nas seguintes hipóteses:

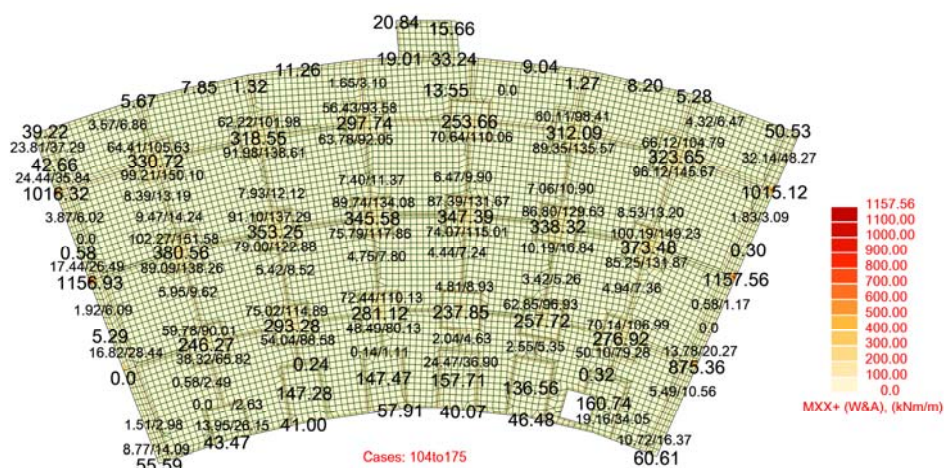
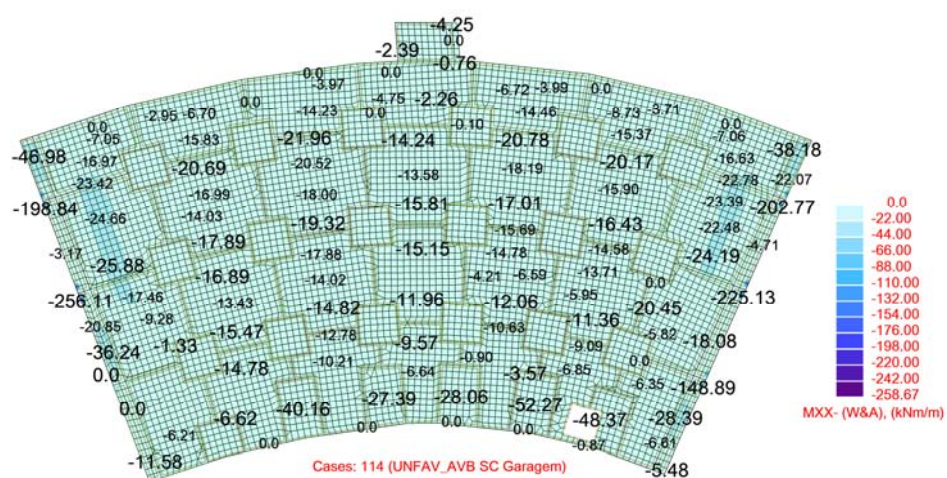
- As secções mantêm-se planas após deformação;
- Aderência perfeita entre o aço e o betão envolvente;
- O betão tem uma resistência nula à tração;
- Para o betão comprimido a utilização do diagrama parábola-retângulo;
- Para o aço a utilização de um diagrama bilinear sem endurecimento, diagrama elasto-plástico perfeito.

Na verificação da segurança ao Estado Limite Último de Flexão considerou-se para esforços de cálculo os momentos em cada uma das direcções acrescidos do momento torsor (em módulo) de acordo com a seguinte expressão:

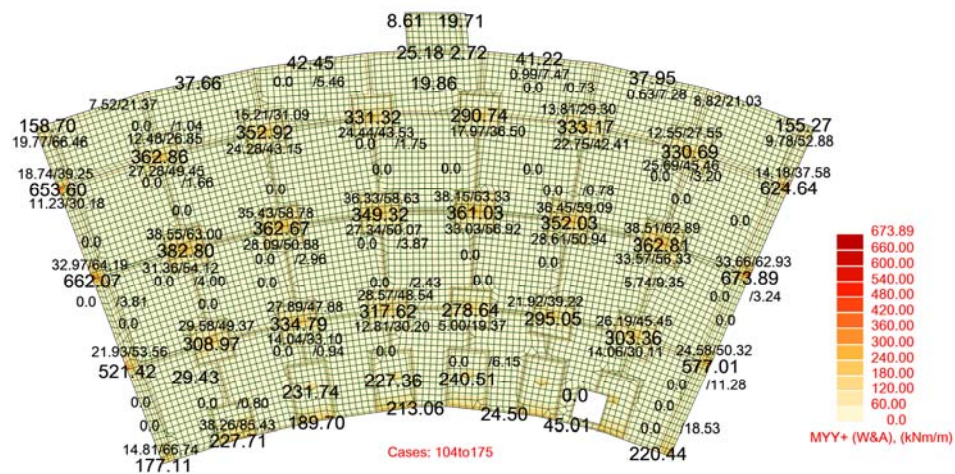
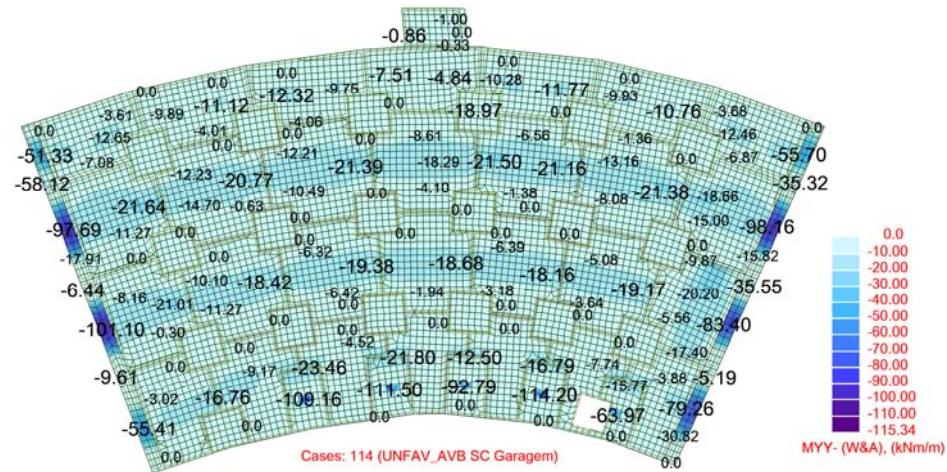
$$\begin{cases} m_{Ed, \text{fletor}} = m_{Ed} + |m_{Ed, \text{torsor}}| & \text{para } m_{E, XY} \geq 0 \\ m_{Ed, \text{fletor}} = m_{Ed} - |m_{Ed, \text{torsor}}| & \text{para } m_{E, XY} \leq 0 \end{cases}$$

Tratando-se de lajes betonadas monoliticamente com os apoios, os momentos de cálculo nas lajes fungiformes, para a verificação das secções foram obtidos à face do pilar de acordo com as prescrições do Eurocódigo 2.

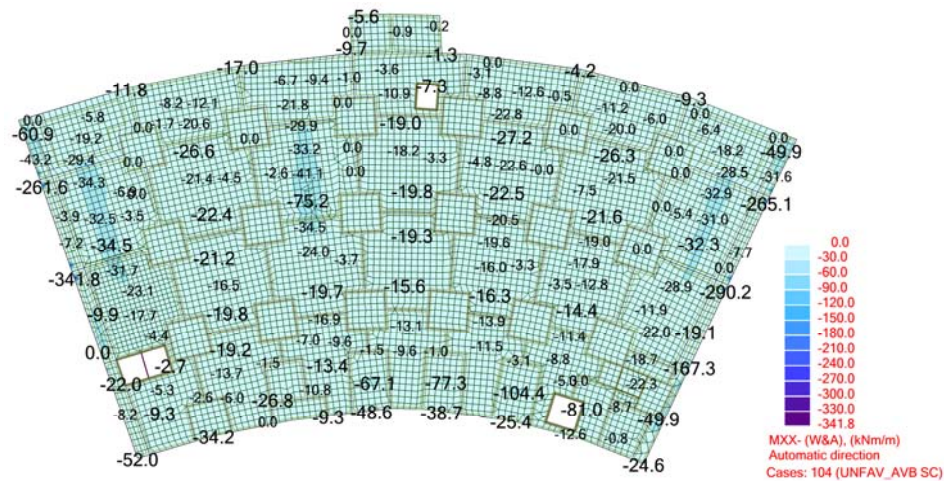
Nas figuras seguintes são apresentados a distribuição dos momentos fletores e torsores obtidos, nas lajes de piso e de cobertura.

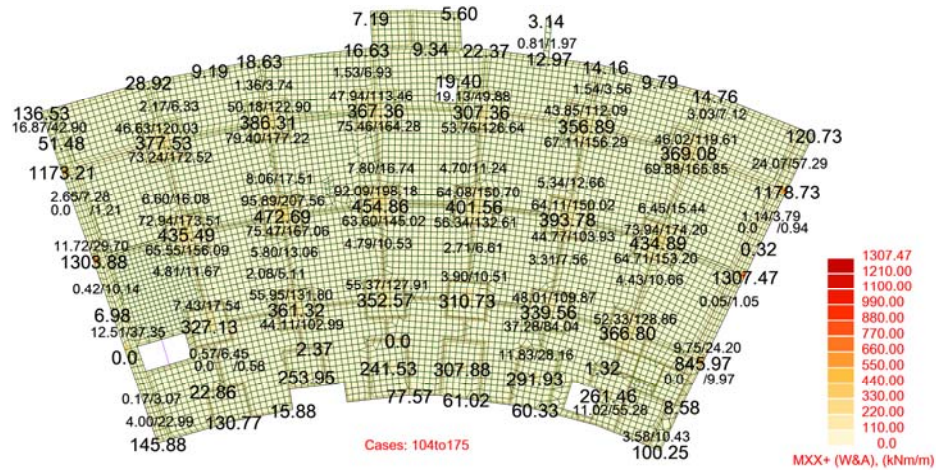


a) PISO -2 e PISO -1 - $M_{Ed,XX} + |M_{Ed,XY}|$

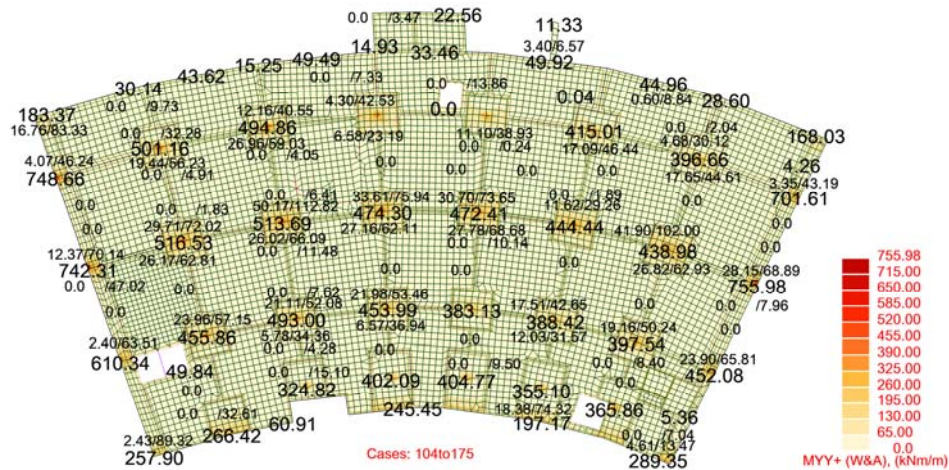
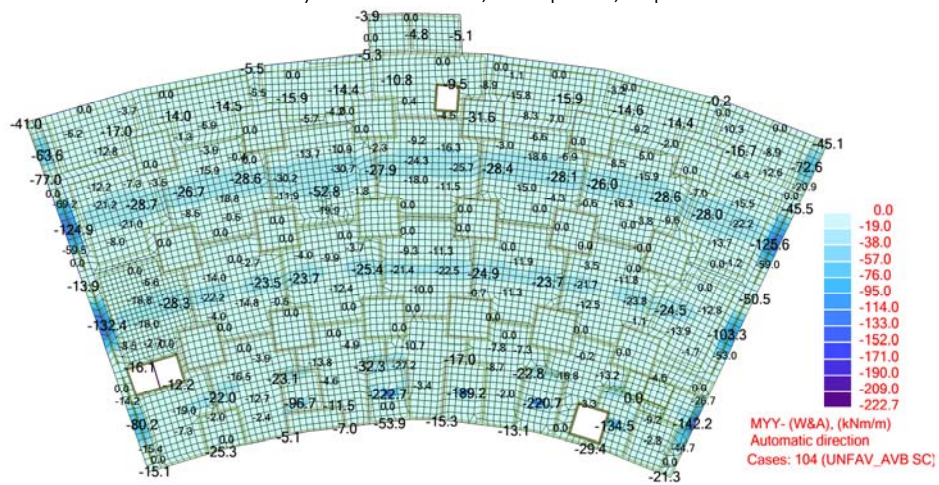


b) PISO -2 e PISO -1 - Med,YY + |Med,XY|

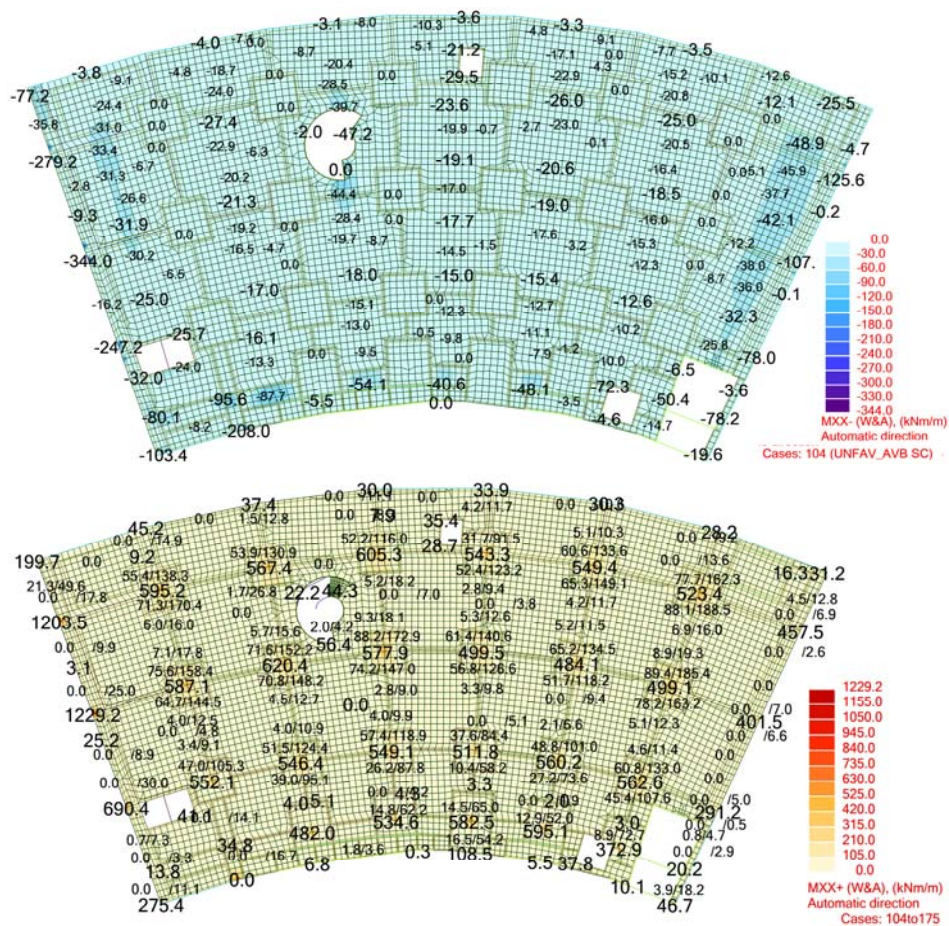




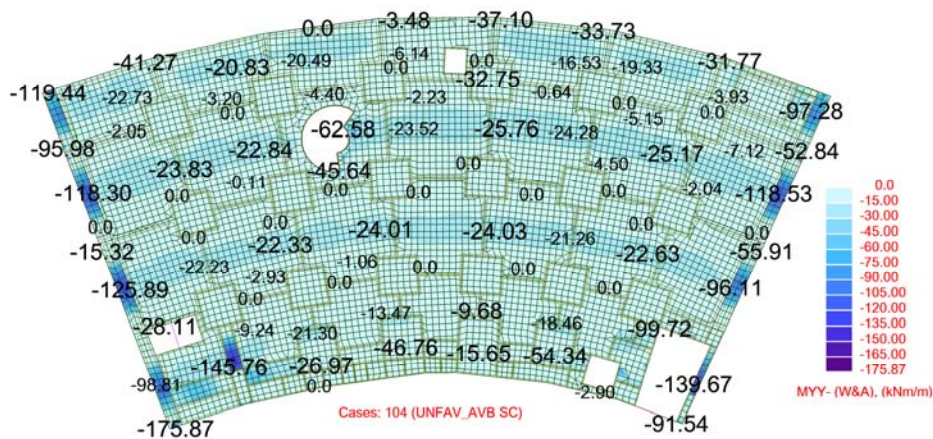
c) PISO 0 - Med,XX + |Med,XY|

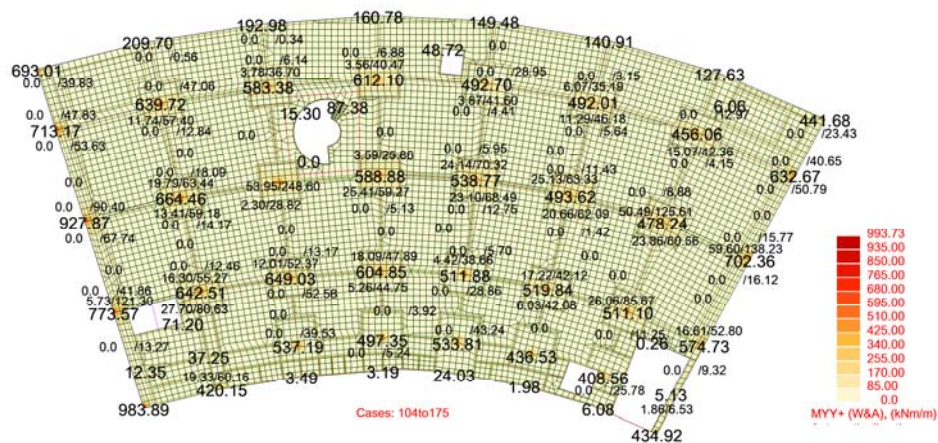


d) PISO 0 - Med,YY + |Med,XY|

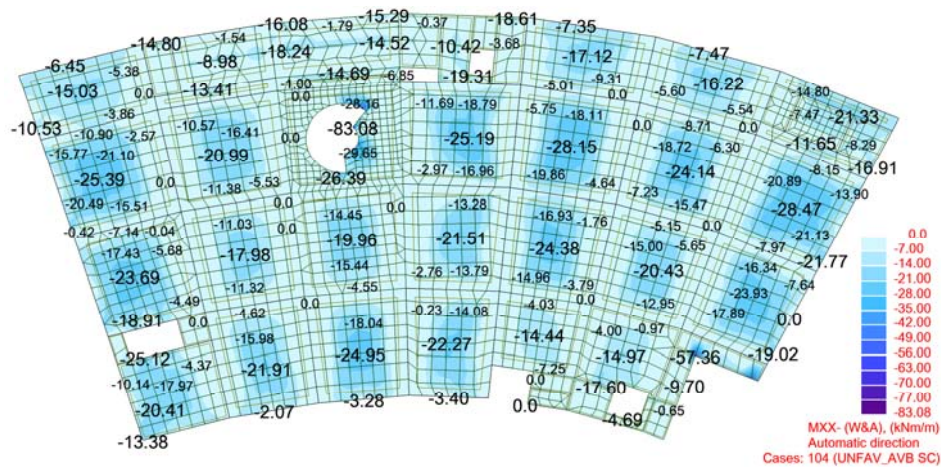


e) PISO 1 - Med,XX + |Med,XY|

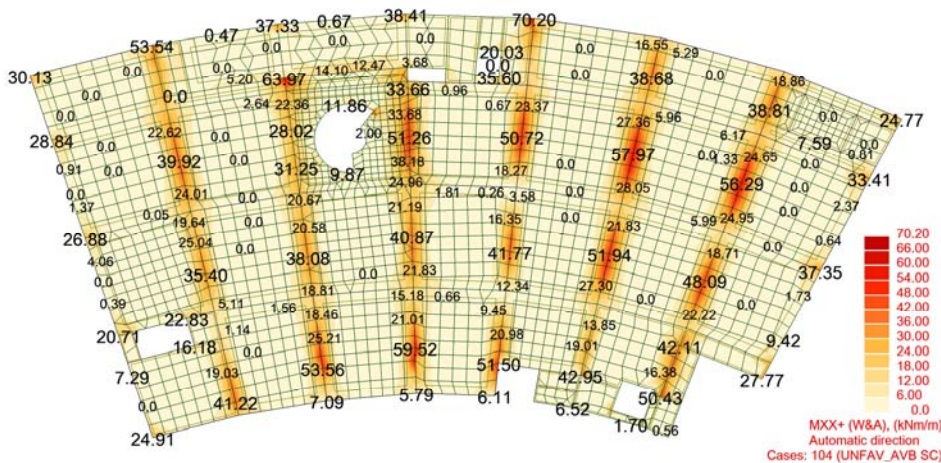


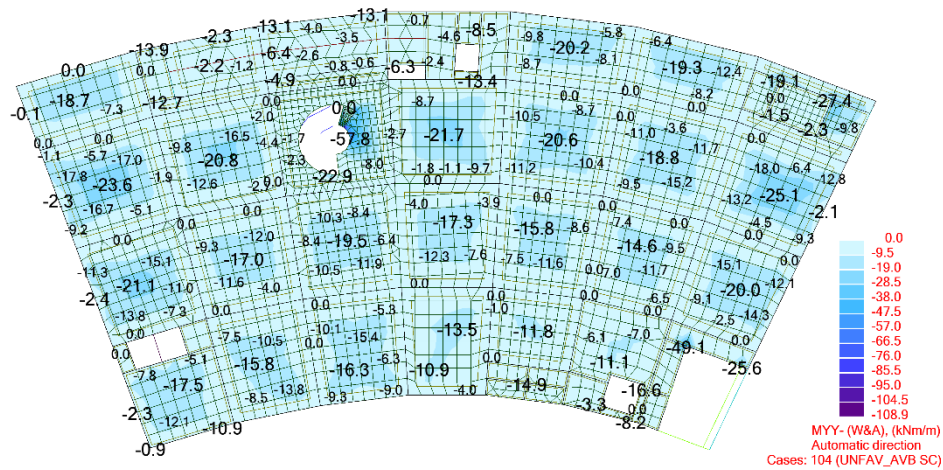


f) PISO 1 - MED,YY + |MED,XY|

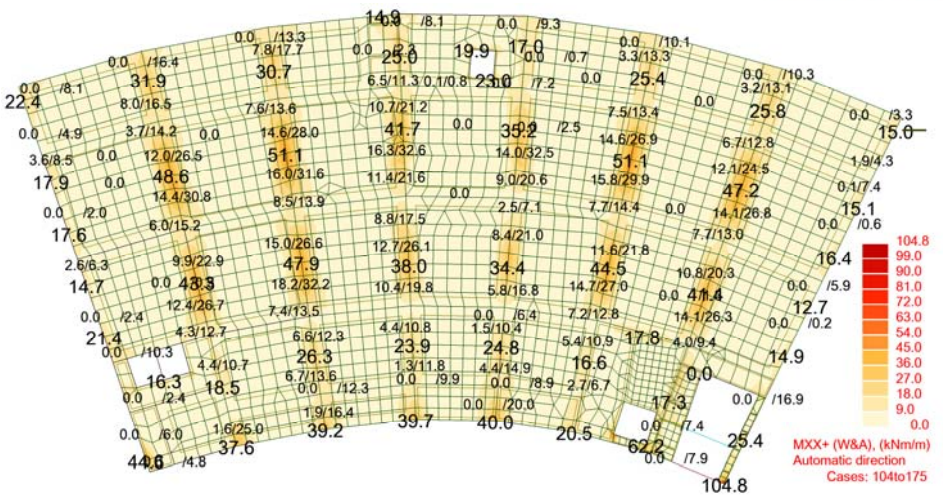
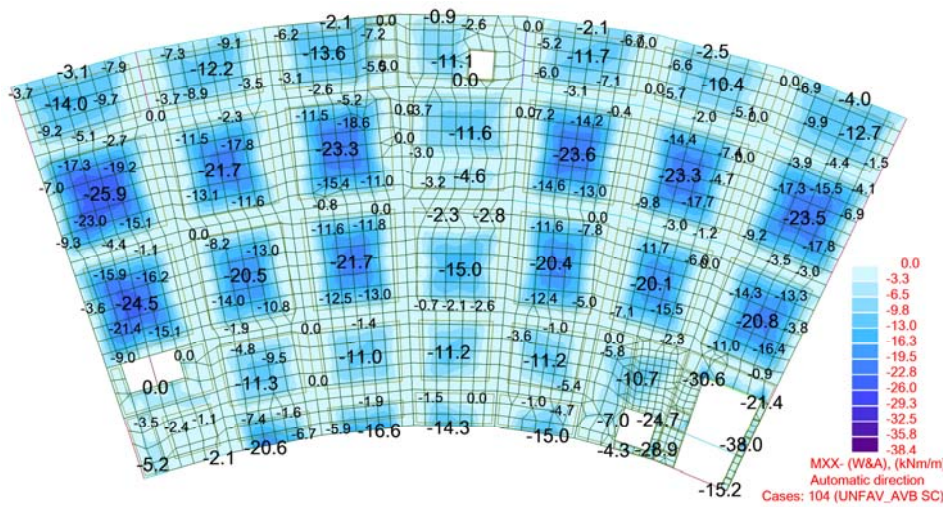


g) PISO 2 – MED,XX + |MED,XY|

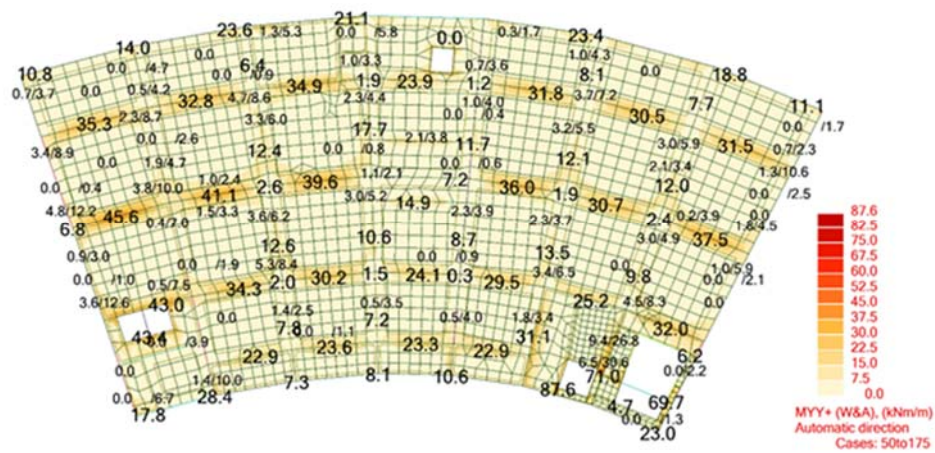
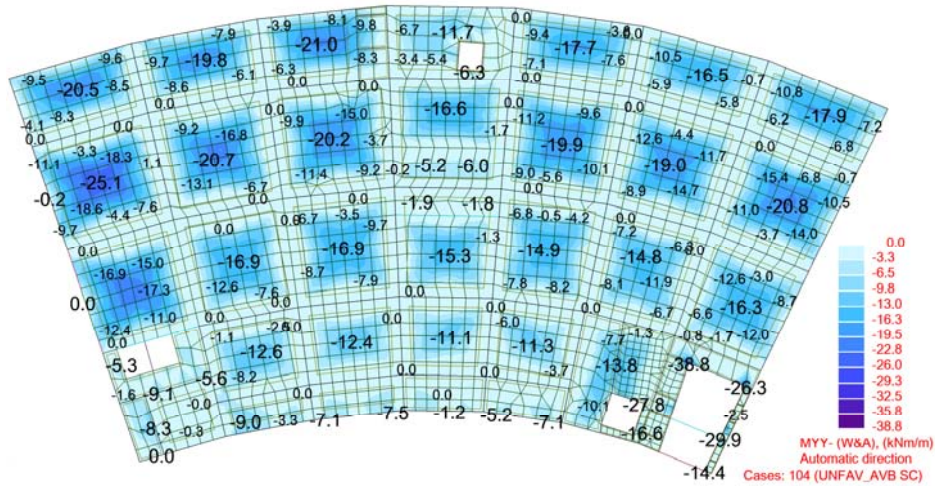




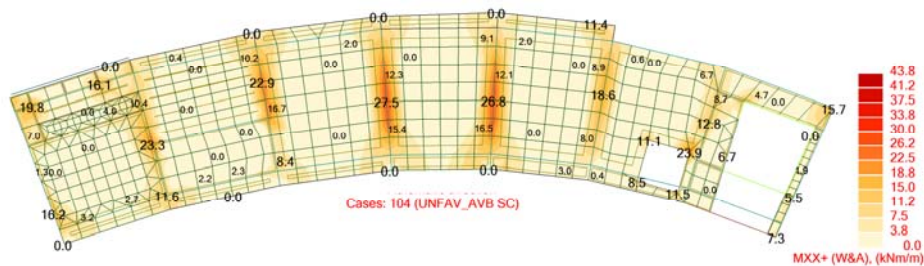
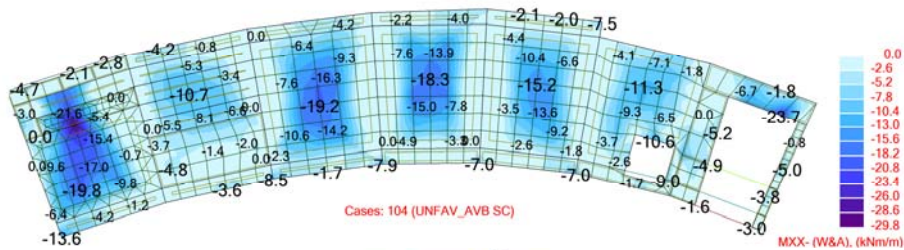
h) PISO 2 – MED,YY + |MED,XY|



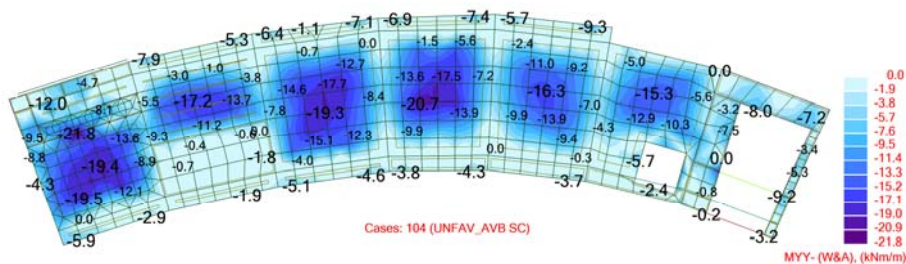
i) PISO 5 - MED,XX + |MED,XY|

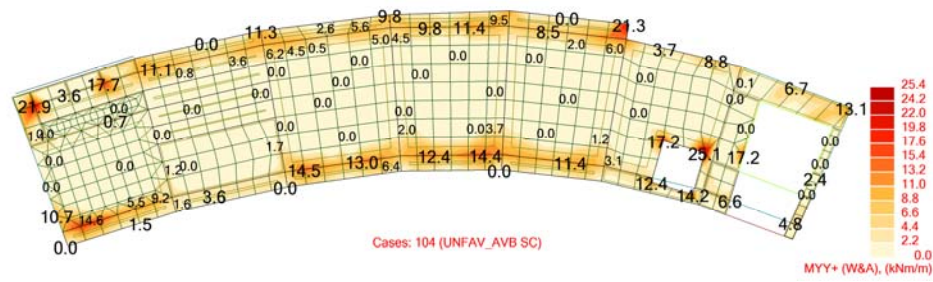


j) PISO 5 - Med,YY + |MED,XY|

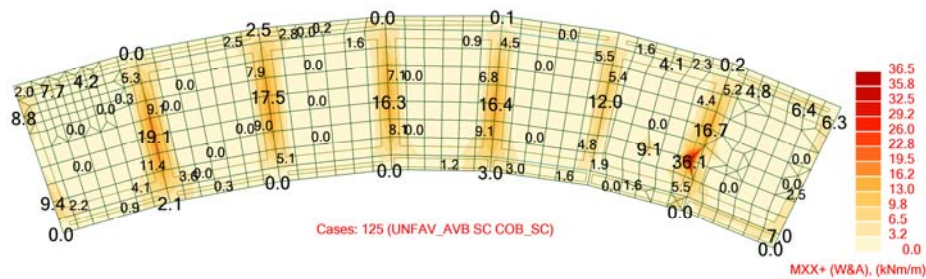
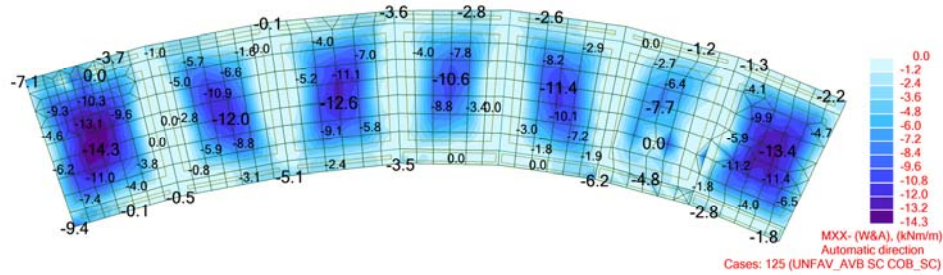


a) PISO 6 - Med,XX + |MED,XY|

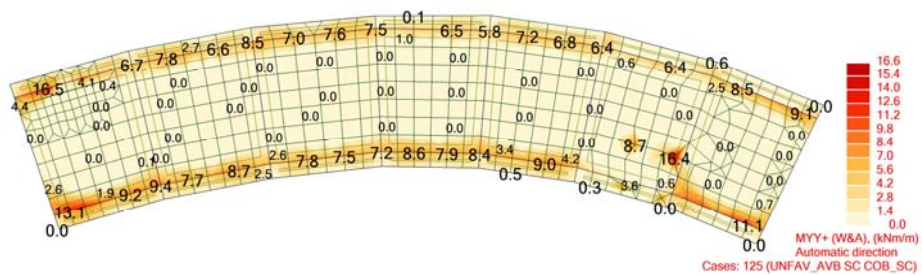
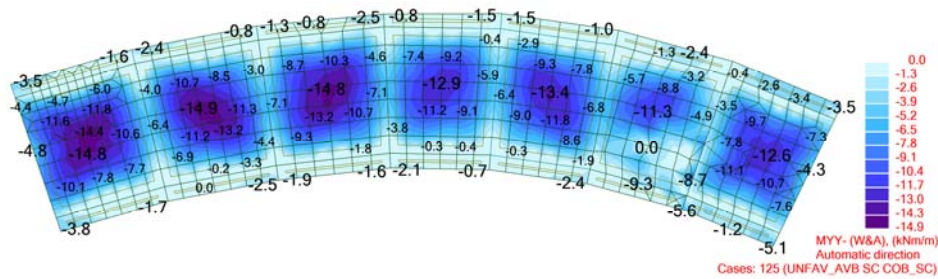




k) PISO 6 - MED,YY + |MED,XY|



b) Cobertura - MED,XX + |MED,XY|



l) Cobertura - MED,YY + |MED,XY|

Figura 5 – Distribuição de momentos fletores e torsores nas lajes do CORPO 3

A verificação estrutural efetuada para as lajes de betão armado e os cálculos efetuados encontram-se no Anexo 9.3. Os cálculos da laje mista do piso 4 encontram-se no Anexo 9.9.6.

6.1.2 ESFORÇO TRANSVERSO

A verificação da segurança ao Estado Limite Último de Esforço Transverso das lajes de escadas e de piso, foi realizada com a seguinte condição:

$$V_{Ed} \leq V_{Rd,c} \quad (16)$$

em que:

V_{Ed} - valor de cálculo do esforço transverso atuante;

$V_{Rd,c}$ - valor de cálculo do esforço transverso resistente sem armadura específica.

A verificação da segurança foi efetuada considerando elementos sem armadura de esforço transverso de acordo com as seguintes expressões:

$$V_{Ed} \leq \max \begin{cases} V_{Rd,c} = \left[C_{Rd,c} \cdot k \cdot (100 \cdot \rho_l \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp} \right] \cdot b_w \cdot d \\ V_{Rd,c} = (v_{\min} + k_1 \cdot \sigma_{cp}) \cdot b_w \cdot d \end{cases} \quad (17)$$

em que:

$C_{Rd,c}=0.12$; $k=1+\sqrt{200/d} \leq 2.0$ com d em mm; $v_{\min}=0.035 \cdot k^{3/2} \cdot f_{ck}^{1/2}$

$\rho_l = A_{sl} / (b_w \cdot d) \leq 0,02$ percentagem de armadura de tração na direção considerada;

A_{sl} área da armadura de tração prolongada de um comprimento $\geq (l_{bd}+d)$ para além da secção em análise;

$\sigma_{cp} = N_{Ed} / A_c < 0.2 f_{cd}$ valores das tensões normais no betão;

N_{Ed} esforço normal na secção devido às ações aplicadas ou ao pré-esforço

f_{ck} – valor característico da tensão de rotura à compressão do betão;

b_w menor dimensão da secção transversal;

d altura útil da secção

A verificação deste estado limite e os cálculos efetuados encontram-se no Anexo 9.3.

6.1.3 PUNÇOAMENTO

Nas lajes fungiformes dos pisos enterrados e do PISO 0 e PISO 1 na verificação da segurança ao Estado Limite Último de Punçoamento foram tidas em conta, as prescrições do Eurocódigo 2, tendo em conta os seguintes critérios:

1. No perímetro do pilar ou do perímetro da área carregada será necessário verificar a seguinte condição:

$$v_{Ed} \leq v_{Rd,max} \quad (18)$$

2. Adotar armaduras específicas de punçoamento ou um capitel, no caso de:

$$v_{Ed} > v_{Rd,c} \quad (19)$$

em que:

v_{Ed} – valor de cálculo da tensão actuante de punçoamento;

$v_{Ed,max}$ – valor de cálculo da resistência máxima ao punçoamento;

$v_{Rd,c}$ – valor de cálculo da resistência ao punçoamento de uma laje sem armadura de punçoamento.

No caso mais geral de punçoamento excêntrico o valor de cálculo da tensão atuante de punçoamento é dado pela seguinte expressão:

$$v_{Ed} = \beta \frac{V_{Ed}}{u_1 \cdot d} \quad (20)$$

em que:

V_{Ed} – valor de cálculo do esforço atuante de punçoamento;

d – altura útil;

u – perímetro do primeiro perímetro de controlo definido a uma distância de $2.0d$ da área carregada

β – coeficiente que tem em conta a excentricidade da carga;

Neste projeto as zonas mais suscetíveis a esforços de punçoamento são as ligações da laje aos pilares interiores onde não existem vigas. Para pilares retangulares interiores com cargas excêntricas nas duas direções o valor de cálculo do esforço atuante v_{Ed} pode ser obtido pela seguinte expressão:

$$v_{Ed} = \left(1 + 1.8 \sqrt{\left(\frac{e_x}{b_x} \right)^2 + \left(\frac{e_y}{b_y} \right)^2} \right) \cdot \frac{V_{Ed}}{u_1 \cdot d} \quad (21)$$

em que:

e_y, e_z – excentricidades M_{Ed}/V_{Ed} segundo os eixos X e Y;

b_y, b_z – dimensões do perímetro de controlo;

No caso dos pilares de bordo com excentricidade nas duas direções ortogonais. Foi determinado pela seguinte expressão:

$$\beta = \frac{u_1}{u_1^*} + k \frac{u_1}{W_1} e_{par} \quad (22)$$

em que:

u_1 - perímetro do primeiro perímetro de controlo;

u_1^* - perímetro do primeiro perímetro de controlo reduzido;

e_{par} - excentricidade na direção paralela ao bordo da laje;

k - parâmetro que depende da geometria da área carregada;

W_1 calculado pela seguinte expressão:

$$W_1 = \frac{c_2^2}{4} + c_1 \cdot c_2 + 4 \cdot c_1 \cdot d + 8 \cdot d^2 + \pi \cdot d \cdot c_2 \quad (23)$$

O valor de cálculo da resistência ao punçoamento (sem colocação de armadura específica) é dado pela seguinte expressão:

$$v_{Rd,c} = 0.12 \cdot k \cdot (100 \cdot \rho_l \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp} \geq (v_{min} + 0.1 \cdot \sigma_{cp}) \quad (24)$$

em que:

$$k = 1 + \sqrt{200/d} \leq 2.0, \text{ com } d \text{ em mm};$$

$$\rho_l = \sqrt{\rho_{lx} \cdot \rho_{ly}} \leq 0.02 \text{ percentagem de armadura de tração nas direções X e Y.}$$

$$\sigma_{cp} = (\sigma_{cx} \cdot \sigma_{cy}) / 2 \text{ valores das tensões normais no betão na secção segundo as direções X e Y;}$$

f_{ck} – valor característico da tensão de rotura à compressão do betão;

$$v_{min} = 0.035 \cdot k^{3/2} \cdot f_{ck}^{1/2}$$

Em caso algum a capacidade resistente ao punçoamento poderá ser superior ao seguinte valor:

$$v_{Ed} = \beta \frac{V_{Ed}}{u_0 \cdot d} \leq v_{Rd,max} = 0.5 \cdot \left[0.6 \left(1 - \frac{f_{ck}}{250} \right) \right] \cdot f_{cd} \quad (25)$$

em que:

u_0 – perímetro de controlo do pilar.

f_{ck} – valor característico da tensão de rotura à compressão do betão;

f_{cd} – valor de cálculo da tensão de rotura à compressão do betão.

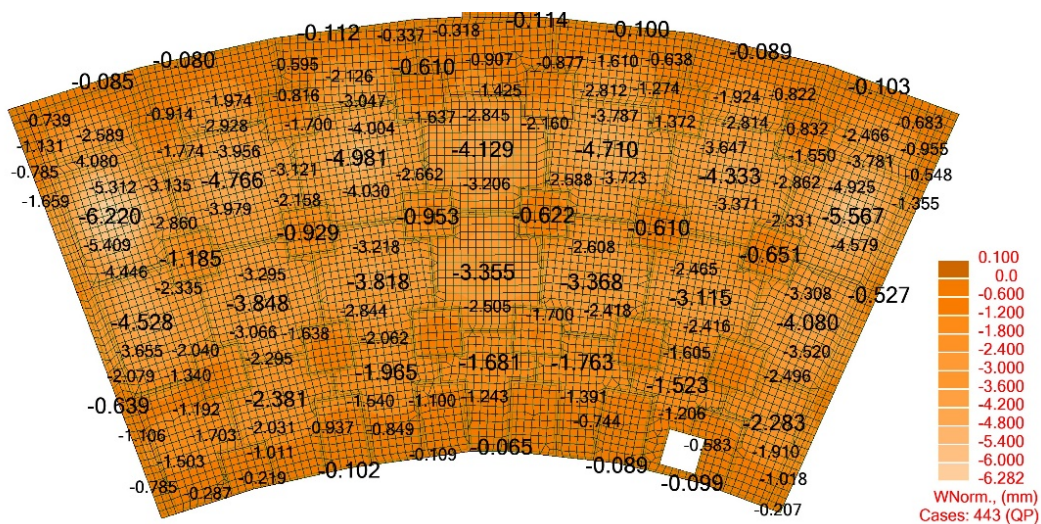
A verificação deste estado limite e os cálculos efetuados encontram-se no Anexo 9.3.

6.1.4 CONTROLO DA DEFORMAÇÃO

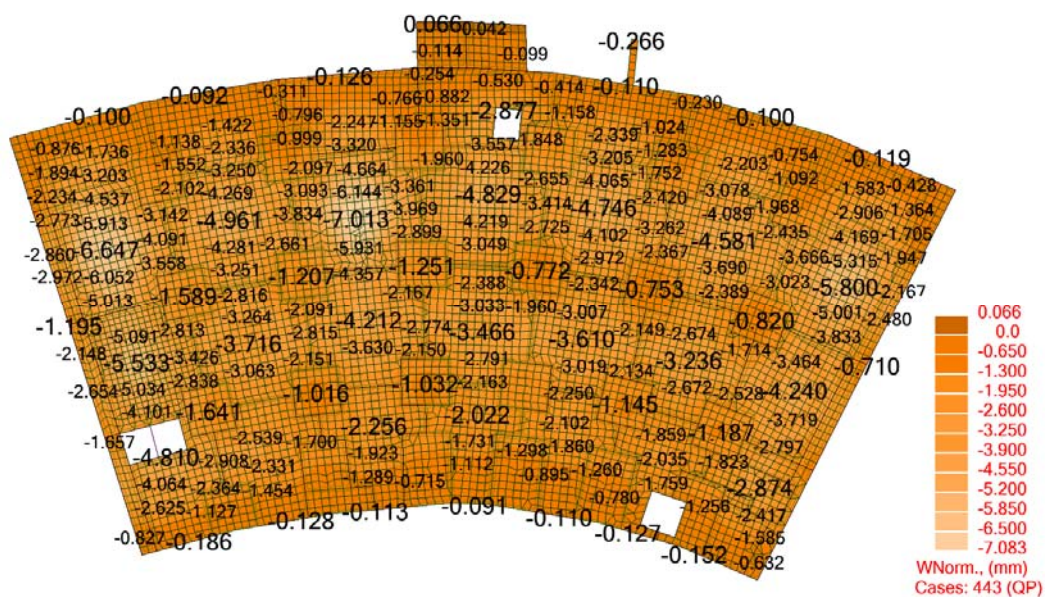
A alteração de uso proposta no projeto de arquitetura não altera na generalidade as condições de serviço do edifício existente. Tratando-se de um edifício de 2004 admitiu-se que as deformações a longo prazo devidas ao peso próprio da estrutura encontram-se atualmente instaladas.

O controlo das flechas a longo prazo foi realizado de uma forma simplificada considerando o efeito da fluência $\delta_{\infty} \leq \delta_{elastico} (1 + \varphi)$. Foi considerado um coeficiente de fluência de 2.5. Para as flechas que ocorram após a alteração de uso do edifício considerou-se um limite da deformação $\delta_{\infty} \leq L / 500$ para ações quase-permanentes.

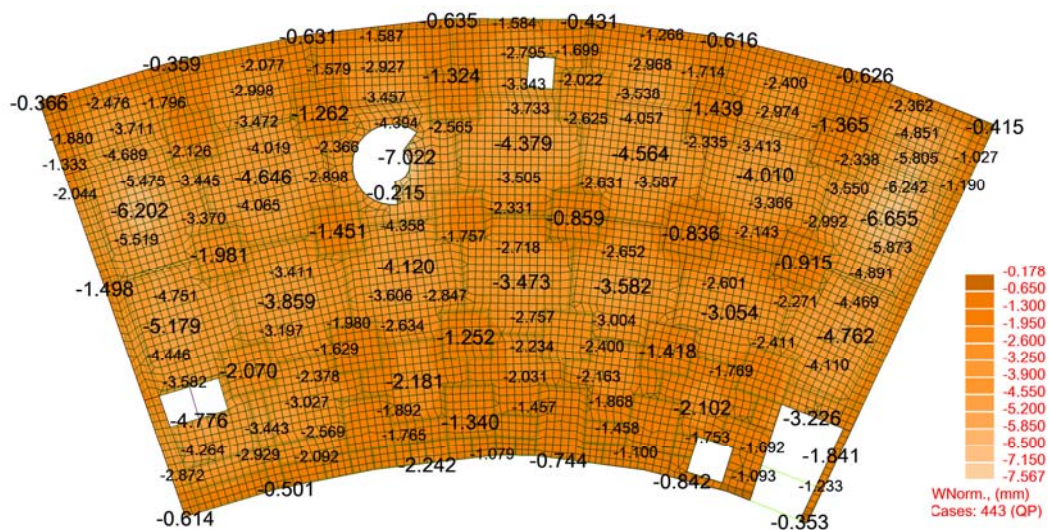
Na Figura 6 é ilustrado o mapa dos valores das deformações máximas absolutas nas lajes de cada um dos corpos do edifício.



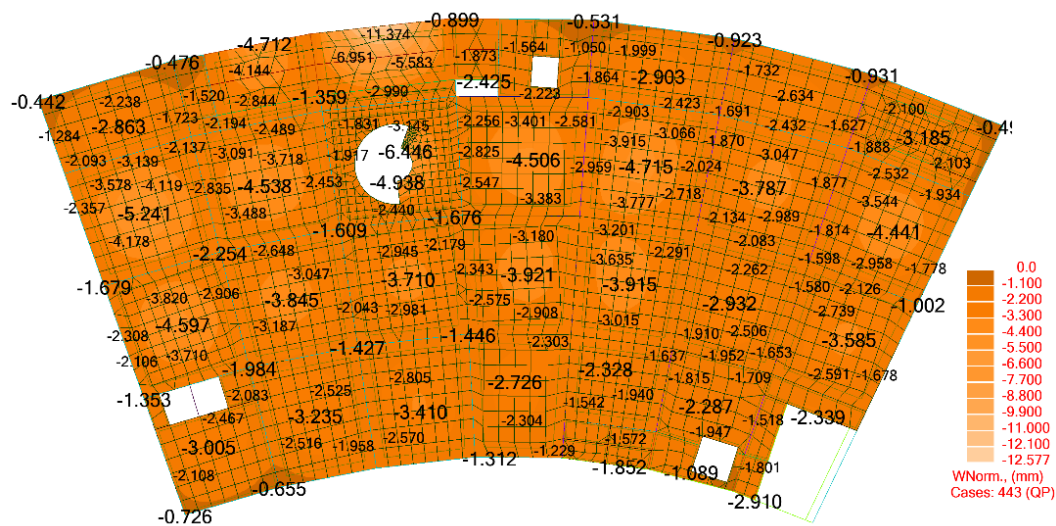
a) Laje do PISO -1



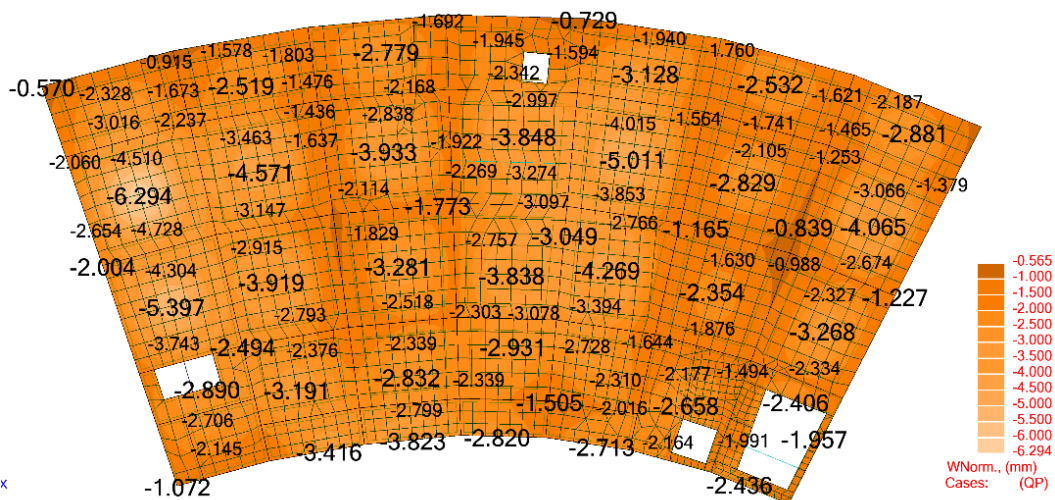
b) Laje do PISO 0



c) Laje do PISO 1



d) Laje do PISO 2



e) Laje do PISO 5

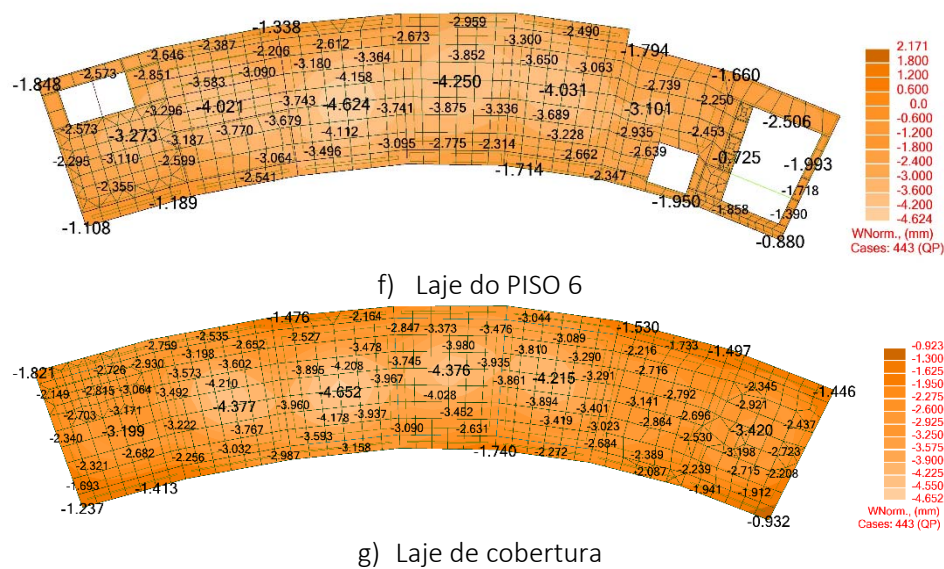


Figura 6 – Deformações elásticas nas lajes de piso do CORPO 3

O deslocamento elástico máximo absoluto verifica-se no painel de laje do piso 0 (arranque da escada de betão armado) entre os alinhamentos C e D e os alinhamentos 18 e 19 e tem um valor de 7.013 mm. O deslocamento elástico relativo, considerando a deformação dos apoios, é de 2,880 mm. Na Tabela 12 é apresentada a verificação efetuada.

Tabela 12 – Verificação da flecha na laje do piso 0

PISO	Painel		$\delta_{c,abs.}$	$\delta_{c,rel.}$	δ_{∞}	$L_{menor}/500$	Verificação
	L_{menor} (m)	L_{maior} (m)	(mm)	(mm)	(mm)	(mm)	
Piso 0	7,75	8,00	7,013	2,880	10,080	15,500	OK

Os valores estimados da flecha a longo prazo para as lajes do CORPO 3 encontram-se dentro dos limites regulamentares.

No caso da laje mista a construir as deformações são controladas com uma contraflecha nas vigas principais correspondente ao valor da deformação originada pelas cargas permanentes. Os cálculos das deformações na laje mista encontram-se no Anexo 9.9.6.

6.1.5 CONTROLO DA VIBRAÇÃO

No CORPO 3 as utilizações tipo dos pisos superiores espaços destinados a salas de reuniões, escritórios, salão de eventos e na cobertura um espaço destinado a restauração. Está previsto neste corpo para o piso 4 a execução de um pavimento com uma estrutura mista (estrutura metálica e lajes mistas aço-betão com espessura de 13 cm). Tratando-se de um pavimento de grande esbelteza foi avaliada a

suscetibilidade de vibração deste pavimento em condições de serviço tendo em conta os efeitos dinâmicos das ações induzidas pelos peões.

A estimativa inicial da frequência natural do pavimento foi obtida considerando a deformação devida ao peso próprio (e restantes cargas permanentes) através da seguinte expressão (ref. Projeto HIVOSS):

$$f \geq \frac{18}{\sqrt{\delta_{\max}}} \quad (26)$$

em que:

$\delta_{\max}$ – deslocamento máximo devido ao peso próprio, em mm.

, tendo-se obtido para o piso 4 um valor de 6,07 Hz considerando uma deformação de 8,80 mm.

Para caracterizar as vibrações neste piso adotou-se o valor “One-step RMS” (OS-RMS₉₀), ref. Projeto HIVOSS, correspondente à vibração causada no pavimento por peões. Com base neste valor foi classificado o pavimento e a sua adequabilidade para o uso proposto. Para o cálculo da frequência considerou-se um painel de laje simplesmente apoiado e um amortecimento de 2%. Na Tabela 13 são apresentados os valores das características modais para a verificação das vibrações.

Tabela 13 – Verificação das vibrações na laje do piso 4

Laje		Cargas (kN/m ²)	Massa Total (kg)	Massa Modal (kg)	Frequência (Hz)	OS- RMS ₉₀ (mm/s)	Categoria	Obs.
B(m)	L(m)							
2,70	8,00	4,10	8 856	4 584	7,03	3,5	D-E	Adequado

O valor de obtido de OS_RMS90 está no limite da classe D-E (ref. Projeto HIVOSS) aceitável para edifícios escritórios considerando-se satisfeitos os requisitos de conforto para este pavimento.

6.1.6 DIMENSIONAMENTO DE LAJES DE ESCADAS

6.1.6.1 ESCADAS EM CARACOL

A escada de caracol em betão armado a construir no CORPO 3 entre os alinhamentos C | D e os alinhamentos 18| 19 tem arranque no piso 0 e termina no piso 2.

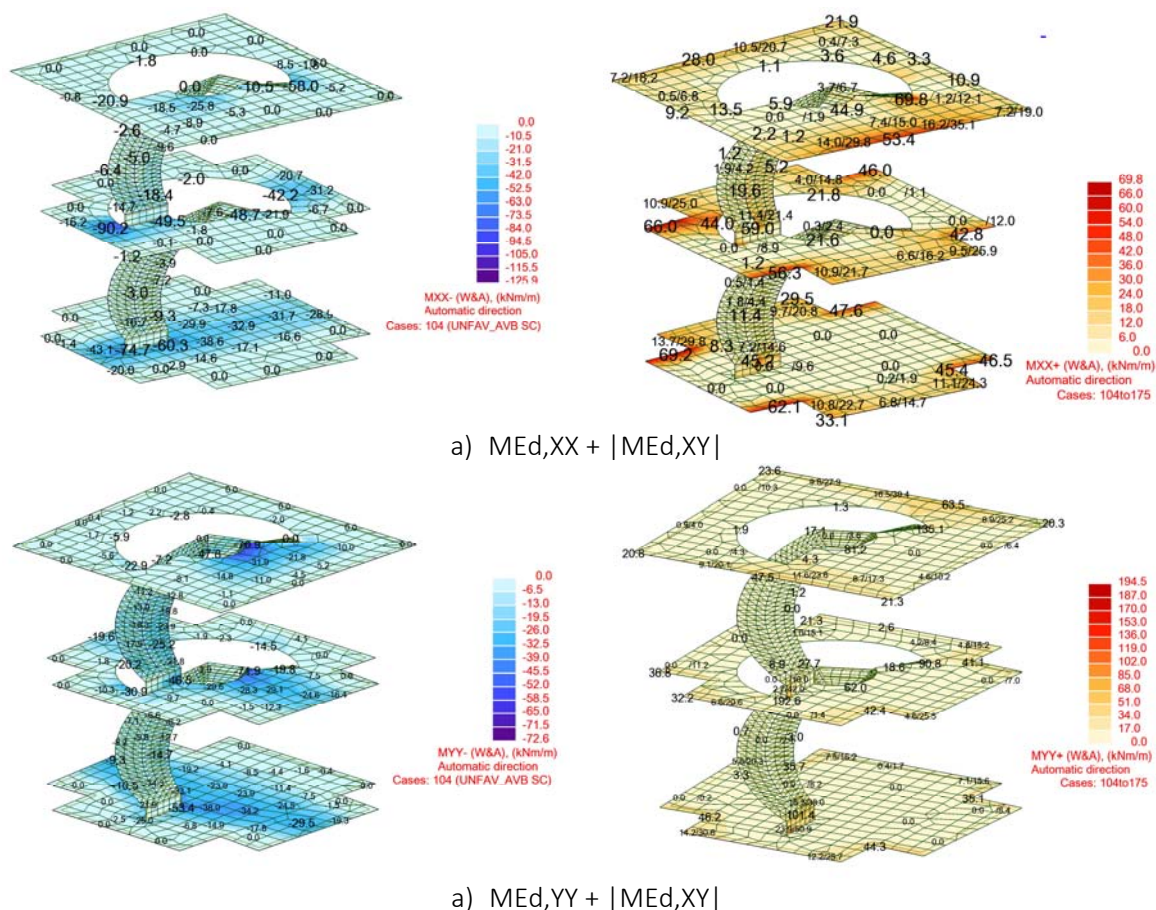
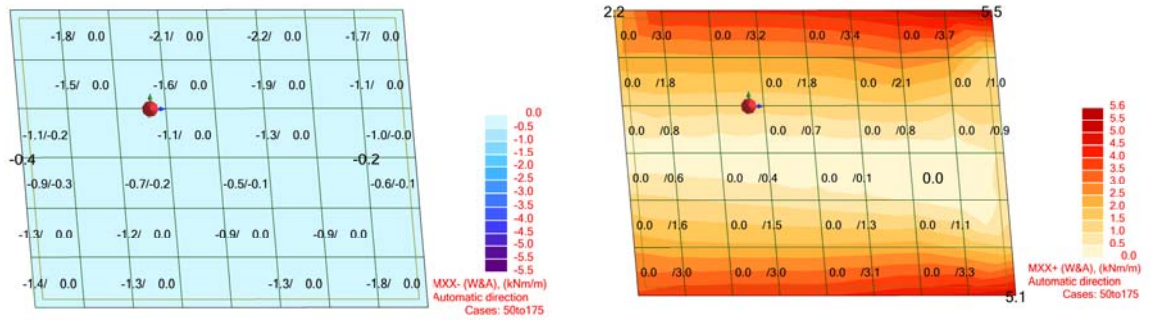


Figura 7 – Distribuição de momentos fletores e torsores na Laje de Caracol (CORPO 3)

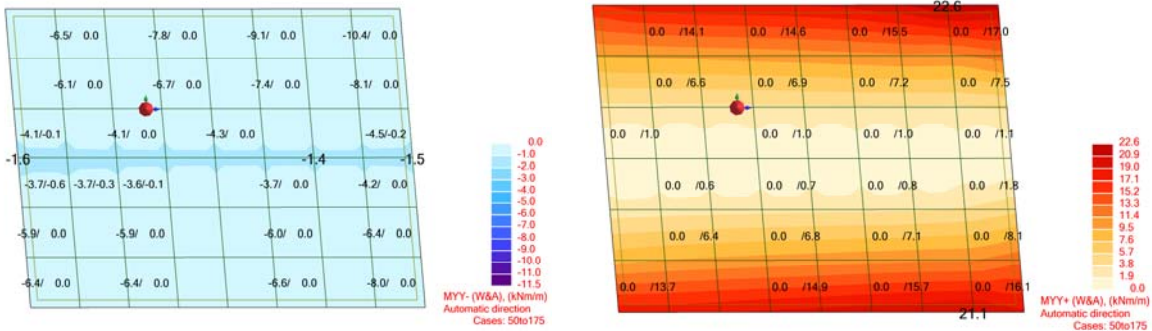
O dimensionamento das escadas E10 encontra-se no Anexo 9.3.

6.1.6.2 ESCADAS DE EXTERIORES (E8)

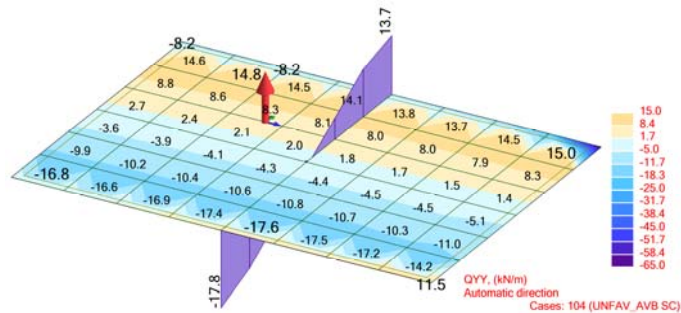
No CORPO 3 será executada uma laje de escada (E8) para acesso ao exterior entre os alinhamentos 18 | 20. A laje de escadas apoia na laje existente no piso -1, na parede de contenção a construir, o patamar apoia na parede existente e na parede a construir. Existe a necessidade de construir uma parede de contenção de terras (em L) que funciona em consola apoiada nas paredes moldadas existentes. Para a cobertura do patamar do piso -1 é necessário executar uma laje em betão armado que liga às paredes moldadas existentes. Nas figuras seguintes são apresentadas as distribuições dos esforços de dimensionamento obtidos para os elementos estruturais da caixa de escadas.



b) $M_{Ed,XX} + |M_{Ed,XY}|$

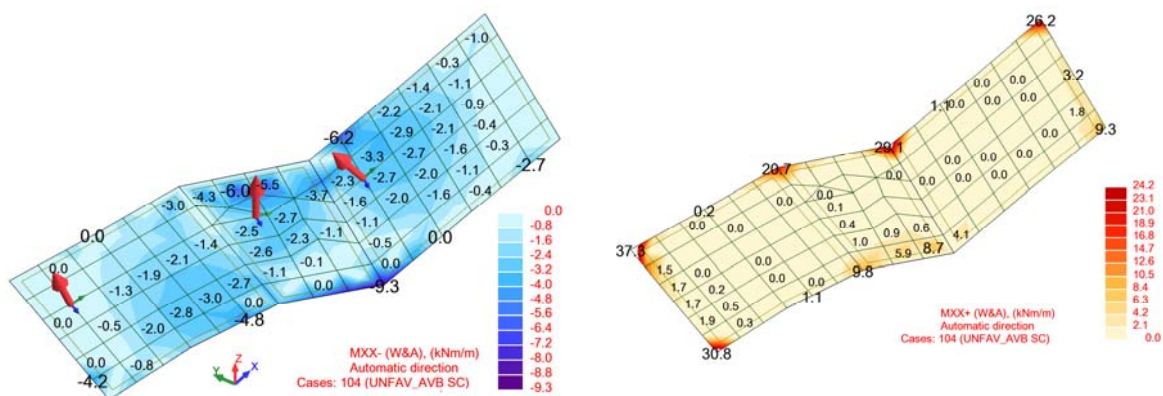


c) $M_{Ed,YY} + |M_{Ed,XY}|$

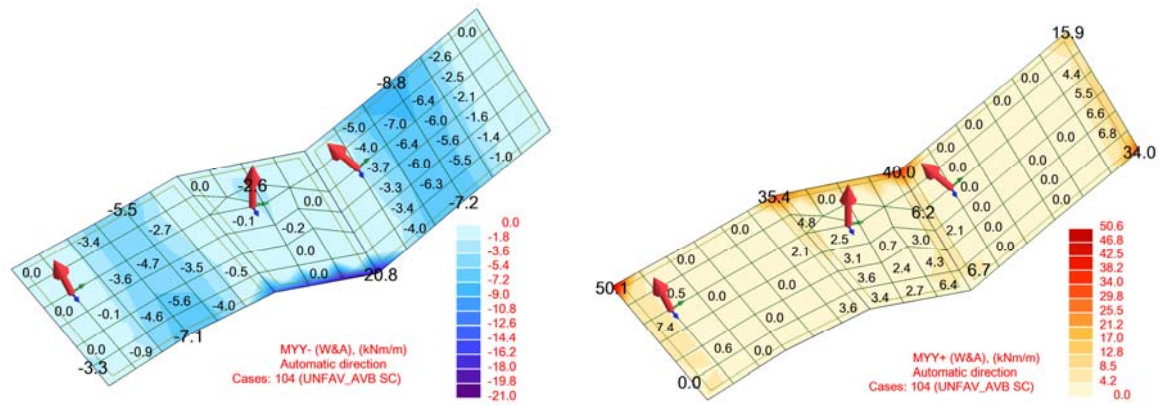


d) Q_{YY}

Figura 8 – Distribuição de momentos flectores e torsores na laje de cobertura da Escada E8

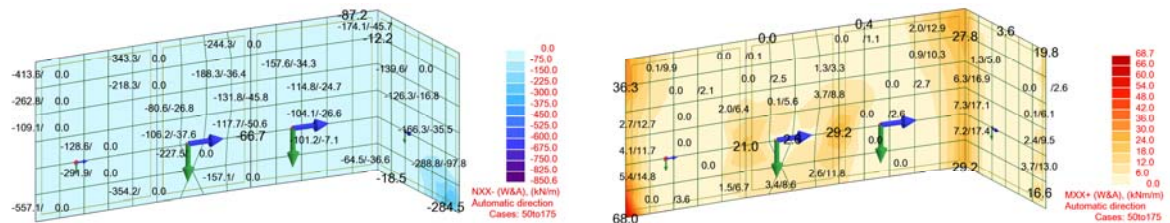


b) $M_{Ed,XX} + |M_{Ed,XY}|$

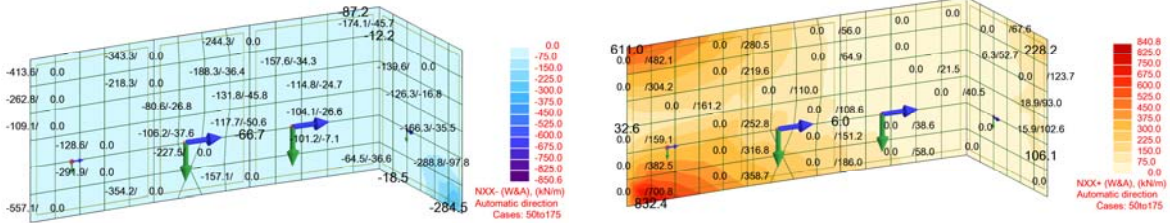


c) $M_{Ed,YY} + |M_{Ed,XY}|$

Figura 9 – Distribuição de momentos flectores e torsores na Laje de Escada E8

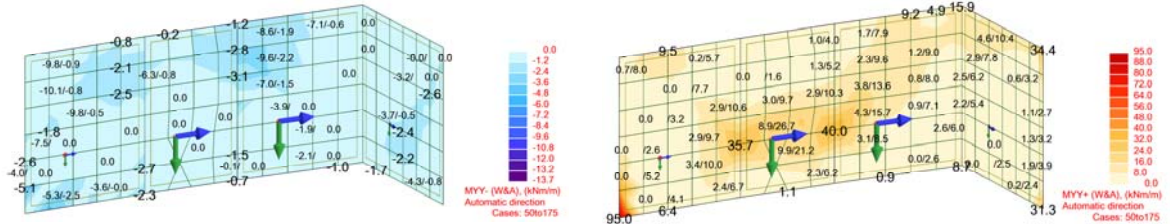


a) $M_{Ed,XX} + |M_{Ed,XY}|$

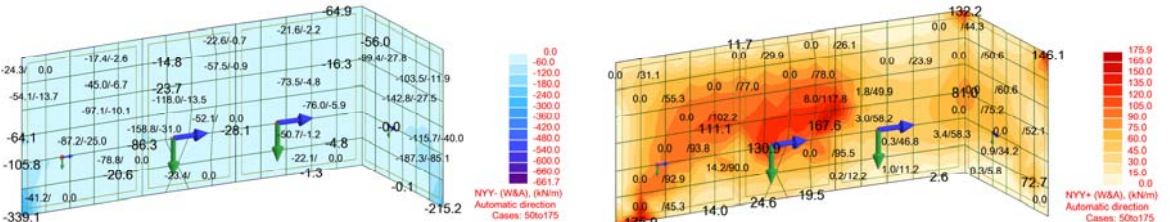


b) $N_{Ed,YY} + |N_{Ed,XY}|$ (compressão)

c) $N_{Ed,XX} + |N_{Ed,XY}|$ (tração)



d) $M_{Ed,YY} + |M_{Ed,XY}|$



e) $N_{Ed,YY} + |N_{Ed,XY}|$ (compressão)

f) $N_{Ed,YY} + |N_{Ed,XY}|$ (tração)

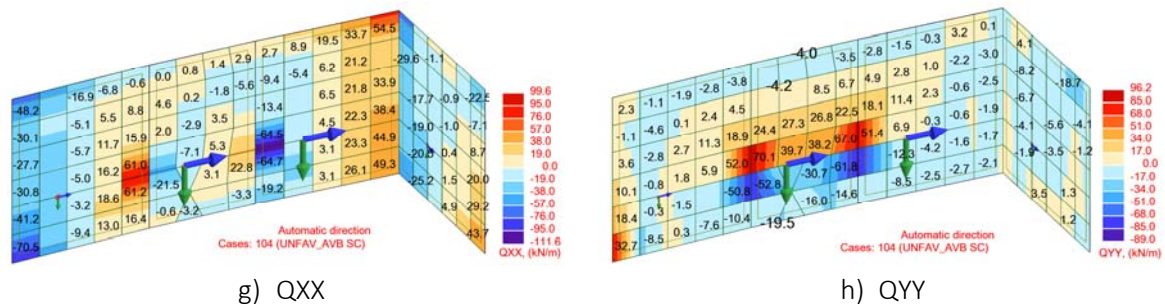


Figura 10 – Distribuição de momentos fletores e torsores na parede de contenção da Escada E8

A ligação do patamar à parede moldada existente será realizada por varões selados e a ligação à parede a construir através de varões de espera. Utilizou-se a mesma solução para a ligação da parede de contenção a construir e para a ligação da laje de cobertura. Esta ligação foi dimensionada ao corte através da seguinte expressão:

$$V_{Ed} \leq V_{Rd} = A_v \cdot f_{yd} / (1.1\sqrt{3}) \quad (27)$$

Em que:

A – área do varão

A_v – área de corte $A_v = 2A / \pi$

O dimensionamento das escadas E8 encontra-se no Anexo 9.3.

6.1.7 REFORÇO ESTRUTURAL DE LAJES DE PISO

Com base na verificação estrutural efetuada é necessário o reforço das lajes do piso 0 e do piso 1, na direção circunferencial, devido a construção de uma escada em caracol entre os alinhamentos 18 | 19 e entre os alinhamentos C | D, reforço da armadura inferior com fibras de carbono inseridas. A localização e as características são definidas nas peças desenhadas.

Com base na verificação estrutural efetuada é necessário o reforço da laje do piso 5 na direção circunferencial sobre os apoios dos alinhamentos 18, 19, 21, 23 entre os alinhamentos B | C e C | D. O reforço destas lajes será executado com fibras de carbono com a localização e as características definidas nas peças desenhadas.

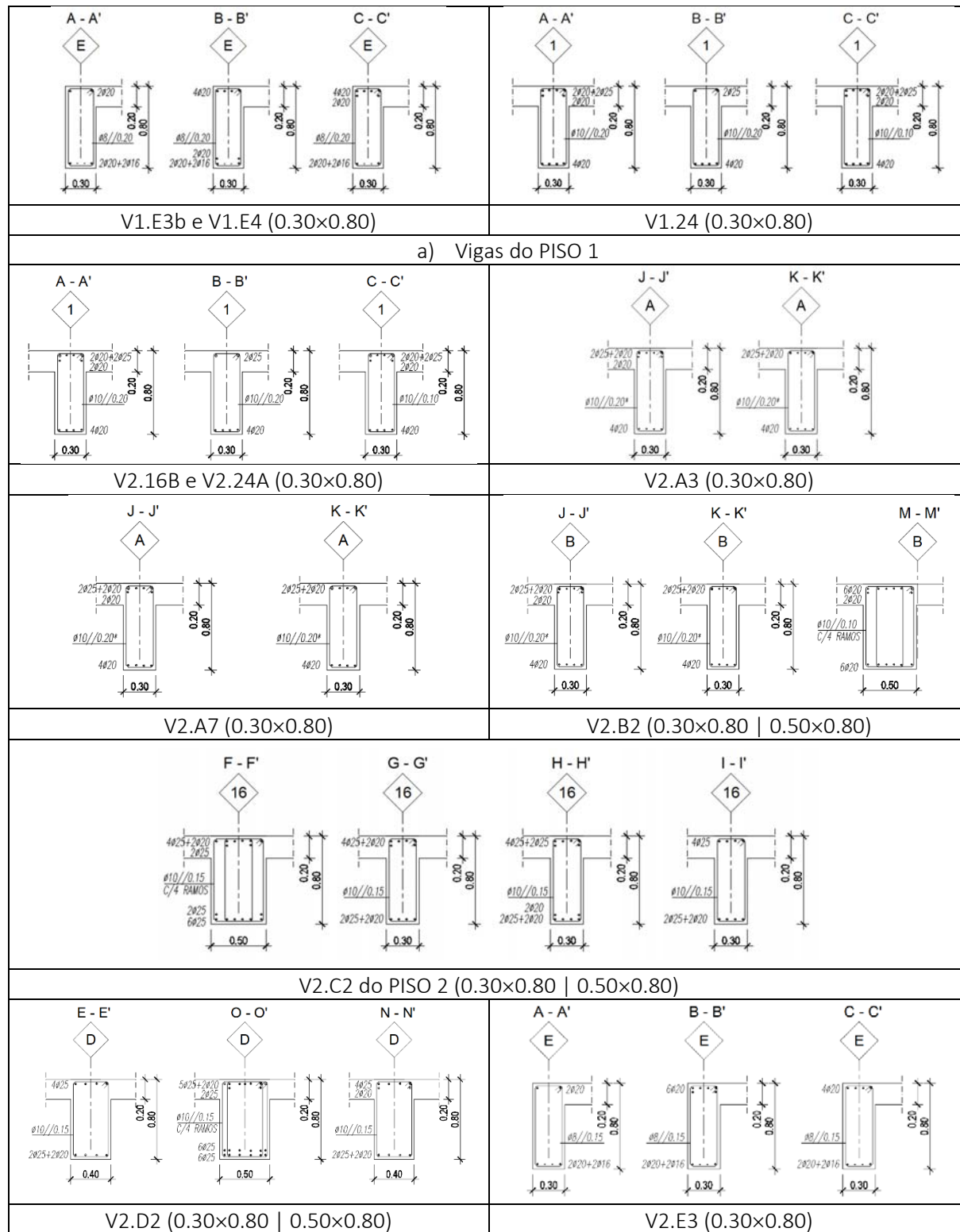
Os cálculos efetuados do reforço encontram-se no Anexo 9.8.1.

6.2 VIGAS DE BETÃO ARMADO

A verificação das vigas foi realizada para os Estados Limites Últimos de Flexão e de Esforço Transverso com base nas prescrições do Eurocódigo 2, tendo em conta a geometria da secção, os esforços de

cálculo para as situações de carregamento mais desfavoráveis. A envolvente de momentos fletores e de esforços transversos foi obtida da modelação efetuada no programa de elementos finitos.

Na Figura 11 são apresentadas as secções tipo das vigas existentes no CORPO 3.



V2.E3a e V2.E3b (0.30x0.80)	V2.E7 (0.30x0.80)
V2.17, V2.18, V2.19	V2.17A, V2.20
1 CABO 12C15 = 1 CABO DE 12 CORDÕES DE 15mm com 1.4cm A>16.8cm	
V2.21, V2.22, V2.23	
b) Vigas do PISO 2	
V4.A3 (0.30x0.80)	V4.A6 (0.30x0.80)
V4.24a (0.30x0.80)	
c) Vigas do PISO 4	

V5.A3 (0.30x0.80)	V5.B2 (0.30x0.80)
V5.C2 (0.30x0.80)	V5.D2 (0.30x0.80)
V5.E3 (0.30x0.80)	V5.11 (0.30x0.80)
V5.16b (0.30x1.00) e V24a (0.30x1.00)	
d) Vigas do PISO 5	
V6.16b, V6.17, V6.18, V6.19, V6.21, V6.22 V6.23 e V6.24a (0.30x0.80)	V7.16b, V7.17, V7.18, V7.19, V7.21, V7.22 V7.23 e V7.24a (0.30x0.80)

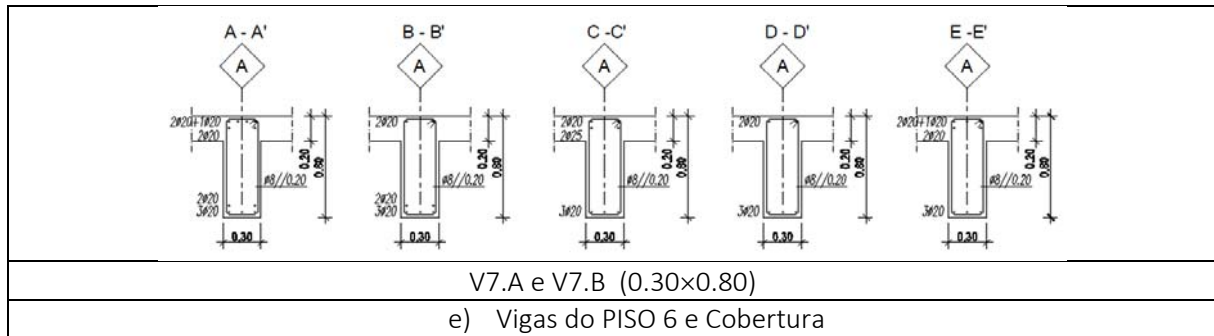


Figura 11 – Secções tipo das vigas do CORPO 3

6.2.1 FLEXÃO E TORÇÃO

A verificação da segurança ao Estado Limite Último de Flexão das vigas, foi realizada com base na seguinte condição:

$$M_{Ed} \leq M_{Rd} \quad (28)$$

em que:

M_{Ed} - Valor de cálculo do momento atuante;

M_{Rd} - valor de cálculo do momento resistente.

A determinação da capacidade resistente das secções das lajes à flexão baseou-se nas seguintes hipóteses:

- As secções mantêm-se planas após deformação;
- Aderência perfeita entre o aço e o betão envolvente;
- O betão tem uma resistência nula à tração;
- Para o betão comprimido a utilização do diagrama parábola-retângulo;
- Para o aço a utilização de um diagrama bilinear sem endurecimento, diagrama elasto-plástico perfeito.

Para vigas sem rigidez de torção, considerando o esforço axial desprezável, o Momento Fletor resistente foi determinado com base nas seguintes expressões:

$$\omega = \frac{A_{sl,F}}{b \cdot d} \frac{f_{yd}}{f_{cd}} \rightarrow \begin{cases} k = 1.235\omega \\ \mu = \omega(1 - 0.514\omega) \end{cases} \rightarrow \begin{cases} x = k \cdot d \\ M_{Rd} = \mu \cdot b \cdot d^2 \cdot f_{cd} \end{cases} \quad (29)$$

em que:

ω é a percentagem mecânica das armaduras;

μ momento fletor reduzido;

- b – menor dimensão da secção transversal;
- d – altura útil da secção;
- A_{sl} – área da armadura de tração;
- f_{yd} – valor de cálculo da tensão de cedência à tração do aço
- f_{ck} – valor característico da tensão de rotura à compressão do betão;

Para vigas com rigidez de torção (vigas do piso 4) a armadura de flexão foi calculada com base na envolvente de momentos fletores e torsões de acordo com as seguintes expressões:

$$\begin{cases} A_{sl,F} = \omega \cdot b \cdot d \cdot \frac{f_{cd}}{f_{yd}} \\ A_{sl,T} = u_k \cdot \frac{T_{Ed}}{2 \cdot A_k} \cdot \cot \theta \cdot f_{yd} \end{cases} \rightarrow A_{sl} = A_{sl,F} + A_{sl,T} \quad (30)$$

Em algumas vigas o esforço axial de tração combinado com o momento fletor para a combinação correspondente condiciona a verificação da segurança. Nestas situações a verificação da segurança foi realizada à flexão composta com o auxílio do software de cálculo Galileu da autoria do Eng. Eduardo Monteiro.

Com base na formulação anterior e na envolvente de esforços, correspondentes as combinações mais desfavoráveis, foi verificada a segurança para as secções mais condicionantes considerando todas as disposições construtivas do EC2.

A verificação deste estado limite e os cálculos efetuados encontram-se no Anexo 9.4.

6.2.2 ESFORÇO TRANSVERSO

No dimensionamento das secções ao esforço transversal considerou-se um modelo de viga fendilhada, com base no modelo simplificado da treliça de Morsch de acordo com as prescrições do Eurocódigo 2.

Nas vigas sem rigidez de torção e para elementos com armadura de esforço transversal constituída por estribos verticais, o valor resistente do esforço transversal é dado pelo menor dos seguintes valores:

$$V_{Rd} \leq \begin{cases} \frac{A_{sw}}{s} \cdot f_{ywd} \cdot \cot \theta \\ b_w \cdot z \cdot v_1 \cdot f_{cd} \cdot (\cot \theta + \tan \theta) \end{cases} \quad (31)$$

em que:

- A_{sw} – área total da secção transversal das armaduras de esforço transversal;
- s – espaçamento longitudinal dos estribos;
- f_{ywd} – valor de cálculo da tensão de cedência das armaduras de esforço transversal.

$$v_1 = 0.6 \left(1 - \frac{f_{ck}}{250} \right)$$

θ - ângulo de inclinação das escoras de betão. Neste projeto o valor adotado foi de 30°.

Nas vigas com rigidez de torção foi considerada a ação conjunta do esforço transversal e da torção. Para esta situação foi realizando uma verificação complementar, da compressão nas escoras de betão, com base na seguinte equação:

$$T_{Ed} / T_{Rd,max} + V_{Ed} / V_{Rd,max} \leq 1 \quad (32)$$

em que:

T_{Ed} - valor de cálculo do momento torsor;

V_{Ed} - valor de cálculo do esforço transversal;

$T_{Rd,max}$ - valor de cálculo do momento torsor resistente obtido por:

$$T_{Rd,max} = 2\alpha_{cc} \cdot \nu \cdot A_k \cdot t_{ef,i} \cdot \cos \theta \cdot \sin \theta \quad (33)$$

$V_{Rd,max}$ - valor de cálculo do esforço transversal resistente máximo

Com base na formulação anterior e na envolvente de esforços, correspondentes as combinações mais desfavoráveis, foram verificadas as armaduras transversais para as secções mais condicionantes considerando todas as disposições construtivas do EC2.

A verificação deste estado limite e os cálculos efetuados encontram-se no Anexo 9.4.

6.2.3 CONTROLO DA DEFORMAÇÃO

A alteração de uso proposta no projeto de arquitetura não altera na generalidade as condições de serviço do edifício existente. Admitiu-se que as deformações a longo prazo devidas ao peso próprio da estrutura não afetam os elementos não estruturais a executar.

O controlo das flechas a longo prazo foi realizado de uma forma simplificada considerando o efeito da fluência $\delta_{\infty} \leq \delta_{elastico} (1 + \varphi)$. Foi considerado um coeficiente de fluência de 2.5.

Para as flechas que ocorram após a alteração de uso do edifício considerou-se um limite da deformação $\delta_{\infty} \leq L / 500$ para ações quase-permanentes.

Os valores estimados da flecha a longo prazo para as vigas do CORPO 3 encontram-se dentro dos limites regulamentares.

6.2.4 REFORÇO ESTRUTURAL DE VIGAS

Com base na verificação estrutural efetuada não é necessário o reforço de vigas do CORPO 3.

6.3 VIGAS DE BETÃO PRÉ-ESFORÇADO

A verificação da capacidade resistente das vigas de betão pré-esforçadas para os Estados Limites Últimos foi feita através das equações de equilíbrio da secção, obtidas pelo método do diagrama retangular simplificado, conforme Figura 12.

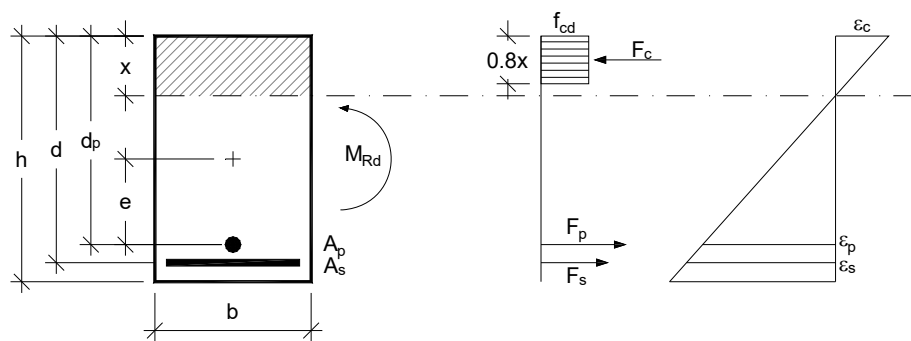


Figura 12 - Diagrama retangular simplificado – Vigas Pré-Esforçadas

Foram verificados os Estados Limite de Flexão e de Esforço Transverso, segundo as prescrições do Eurocódigo 2 (EC2).

A verificação dos Estados Limites de Serviço teve em conta os níveis de tensões atuantes no betão, a verificação das extensões no aço e betão, bem como foram analisados o Estado Limite de Descompressão e de Formação de Fendas.

Na verificação dos Estados Limites de Serviço foram tidos em conta os seguintes estados limite:

- Limitação das tensões

A tensão de compressão no betão deve ser limitada a fim de evitar fendas longitudinais, a micro-fendilhação ou níveis de fluência elevados. Desta forma, verificou-se se a tensão do betão era inferior a $k_1 \cdot f_{ck}$ ($k_1=0.60$), para a combinação característica de ações, de forma a evitar fendas longitudinais e a $k_2 \cdot f_{ck}$ ($k_2=0.45$), para a combinação quase-permanente, de forma a garantir uma fluência linear.

De igual forma, para garantir níveis de fendilhação e deformação aceitáveis, para a combinação característica de ações, verificou-se se as tensões de tração no aço eram inferiores a $k_3 \cdot f_{yk}$

($k_3=0.80$) e se as tensões médias nas armaduras de pré-esforço eram inferiores a $k_5 \cdot f_{pk}$ ($k_5=0.75$).

- Estado Limite de Descompressão

Por simplificação, e uma vez que as bainhas de pré-esforço se encontram todas no interior do betão mais de 25 mm, verificou-se apenas se a secção se encontra toda comprimida para garantir este estado limite. Procedeu-se ainda à verificação do estado Limite de Formação de fendas para complementar esta verificação e para os casos onde se detetou a descompressão da secção.

- Estado Limite de Formação de Fendas

É habitual admitir-se que, em estruturas de betão pré-esforçado, a secção se encontra não fendilhada. Em termos práticos tal condição pode ser obtida se, para a combinação característica de ações, o valor da máxima tensão de tração for inferior a f_{ctm} . Por outro lado, o EC2 recomenda que, para a combinação frequente de ações, a largura máxima das fendas seja inferior a 0.2 mm e que se garanta simultaneamente o estado limite de descompressão para a combinação de ações quase-permanente.

As vigas pré-esforçadas possuem reserva de resistência suficiente para a utilização proposta. Os cálculos efetuados encontram-se no Anexo 9.5.

6.4 PILARES

A verificação da segurança dos pilares foi feita tendo em consideração se a estrutura é contraventada ou não e, no caso de não ser, levando em conta os efeitos de segunda ordem.

A verificação da segurança ao Estado Limite de Encurvadura foi primeiramente efetuada pela verificação da possibilidade de desprezar os efeitos de segunda ordem através das seguintes condições:

- Para elementos isolados

$$\lambda \leq \lambda_{lim}$$

$$\lambda = \frac{l_0}{i} \quad (34)$$

$$\lambda_{lim} = \frac{20 \cdot A \cdot B \cdot C}{\sqrt{\nu}} \quad (35)$$

Onde,

λ – Coeficiente de esbelteza

λ_{lim} – Valor limite do coeficiente de esbelteza

l_0 – Comprimento efetivo, conforme Figura 13

i – Raio de giração da secção não fendilhada

$$A = 1 / (1 + 0.2\phi_{ef})$$

$$B = \sqrt{1 + 2\omega}$$

$$C = 1.7 - r_m$$

ϕ_{ef} – Coeficiente efetivo de fluência

ω – Taxa mecânica de armadura

r_m – M_{01}/M_{02} ; razão de momentos

υ – Esforço normal reduzido

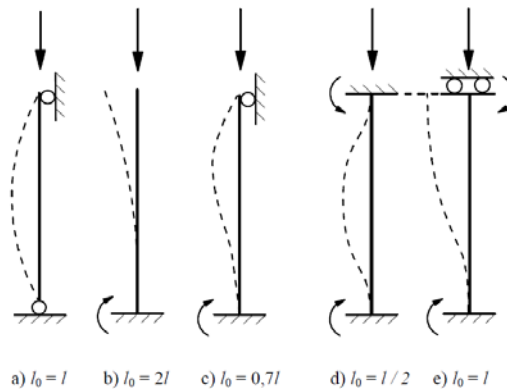


Figura 13 – Comprimentos efetivos de encurvadura

- Para edifícios

$$F_{V,Ed} \leq k_1 \cdot \frac{n_s}{n_s + 1.6} \cdot \frac{\sum E_{cd} \cdot I_c}{L^2} \quad (36)$$

Onde,

$F_{V,Ed}$ – Carga vertical total (nos elementos contraventados e de contraventamento)

n_s – Nº de pisos

L – Altura total do edifício ao nível do encastramento

E_{cd} – Valor de cálculo do módulo de elasticidade

I_c – Momento de inércia do elemento de contraventamento

$K_1 = 0.31$ ou $K_1 = K_2 = 0.62$ (elementos de contraventamento não fendilhados)

Quando estas condições não são verificadas, o método de análise utilizado para levar em conta os efeitos de segunda ordem é o Método baseado numa curvatura nominal.

Este método parte dos resultados de uma análise linear de primeira ordem, corrigindo os esforços atuantes para ter em conta os efeitos de segunda ordem. Na prática, o momento de cálculo é obtido

somando ao momento de primeira ordem (já incluindo o efeito das imperfeições), o momento nominal de segunda ordem, conforme indicado na expressão seguinte.

$$M_{Ed} = M_{0Ed} + M_2 \quad (37)$$

Onde,

M_{0Ed} – Momento de primeira ordem incluindo o efeito de imperfeições

M_2 – Momento nominal de segunda ordem

As imperfeições poderão ser representadas por uma inclinação, θ_i , obtida por:

$$\theta_i = \theta_0 \cdot \alpha_h \cdot \alpha_m$$

Com,

θ_0 – Valor básico (1/200)

α_h – Coeficiente de redução relativo ao comprimento ou à altura

α_m – Coeficiente de redução relativo ao número de elementos

E o efeito das imperfeições é obtido através de uma excentricidade, pela expressão seguinte:

$$e_i = \theta_i \cdot l_0 / 2 \quad (38)$$

Desta forma ao momento de primeira ordem é adicionado o momento causado por esta excentricidade, obtendo-se M_{0Ed} .

O momento nominal de segunda ordem é obtido através da seguinte expressão:

$$M_2 = N_{Ed} \cdot e_2 \quad (39)$$

E a excentricidade de segunda ordem (e_2) por:

$$e_2 = \left(\frac{1}{r} \right) \cdot l_0^2 / c \quad (40)$$

Com a curvatura definida por,

$$\left(\frac{1}{r} \right) = K_r \cdot K_\phi \cdot (1/r_0) \quad (41)$$

em que,

c – Coeficiente dependente da distribuição da curvatura

K_r – Fator de correção dependente do esforço normal

K_ϕ – Coeficiente que tem em conta a fluência

$$(1/r_0) = \varepsilon_{yd} / (0.45d)$$

com,

$$K_r = (\nu_u - \nu) / (\nu_u - \nu_{bal}) \leq 1 \quad (42)$$

$$K_\varphi = 1 + \beta \cdot \varphi_{ef} \geq 1 \quad (43)$$

em que,

ν - Esforço normal reduzido

$$\nu_u = 1 + \omega$$

ν_{bal} - Valor de ν correspondente ao momento máximo resistente

$$\beta = 0.35 + f_{ck} / 200 - \lambda / 150$$

6.4.1 FLEXÃO DESVIADA

Para os pilares foi feita a verificação da segurança ao Estado Limite Último de Encurvadura, tendo sido considerada uma estrutura contraventada.

Os esforços foram obtidos através do programa de cálculo automático tendo sido consideradas as combinações mais desfavoráveis.

Os pilares foram verificados como elementos isolados sujeitos a flexão desviada. Os esforços de dimensionamento adotados para a verificação das armaduras tiveram em conta as excentricidades adicionais prescritas no Eurocódigo 2, excentricidade geométrica e excentricidade de 2ª ordem.

Os cálculos efetuados encontram-se no Anexo 9.6.

6.4.2 ESFORÇO TRANSVERSO

Os esforços foram obtidos através do programa de cálculo automático tendo sido consideradas as combinações mais desfavoráveis. As taxas de armaduras transversais (cintas) foram verificadas de acordo com as prescrições do EC2.

No Anexo 9.6 apresentam-se os resultados obtidos e os cálculos efetuados.

6.4.3 REFORÇO ESTRUTURAL DE PILARES

Com base na verificação estrutural efetuada não é necessário o reforço dos pilares do CORPO 3.

Contudo, após inspeção visual aos pilares redondos na zona exterior do Piso 0 foram detetadas regiões onde as cintas estão à vista, já com alguma delaminação do betão. Como tal, os pilares que apresentem esta patologia, terão de ser alvo de reparação e para o efeito será proposta a remoção de todo o material solto, tratamento das armaduras e reconstrução do pilar com argamassa de reparação e

reforço com malha de carbono. Através da inspeção visual efetuada não se pressupõe a perda de capacidade resistente dos pilares e, nesse sentido, a intervenção proposta tem como principal objetivo o tratamento das armaduras e reconstrução das zonas afetadas do pilar para garantir a durabilidade destes elementos, sendo a aplicação da malha de carbono uma medida adicional preventiva. No caso de as armaduras apresentarem perda significativa de secção, os projetistas deverão ser informados.

6.5 ESTADO DE LIMITAÇÃO DE DANOS – (DESLOCAMENTO ENTRE PISOS)

Para satisfazer o requisito de “limitação de danos”, os deslocamentos entre pisos, sob uma ação sísmica, deverão ser limitados a um valor limite, definido em função dos elementos não estruturais. Para o edifício em questão esse limite é verificado pela expressão abaixo:

$$d_r.v \leq 0,005.h \quad (44)$$

em que,

d_r – Valor de cálculo do deslocamento entre pisos.

h – Altura entre pisos.

v – Coeficiente de redução que tem em conta o mais baixo período de retorno da ação sísmica associada ao requisito de limitação de danos.

Ação sísmica	v
Tipo 1	0,40
Tipo 2	0,55

O deslocamento horizontal (d_e) de um ponto do sistema estrutural devido à ação sísmica de cálculo foi determinado de acordo com a seguinte expressão.

$$d_e = \sqrt{d_{e,x}^2 + d_{e,y}^2} \quad (45)$$

em que, $d_{e,x}$ e $d_{e,y}$ são os deslocamentos nas duas direções ortogonais.

Na Tabela 14 é apresentada a verificação da limitação de danos efetuada para o CORPO 3 para a combinação de ações mais condicionante.

Tabela 14 – Verificação da limitação de danos do CORPO 3

Limitação de danos - Deslocamento entre pisos – TN CORPO 3								
Sismo Tipo 1_Caso condicionante: 160 (0.3X+Y+0.3Z)								
PISO	H (mm)	d_e (mm)	$d_{e,rel}$ (mm)	Ação Tipo 1	Ação Tipo 2	0,005.h (mm)	Verif. Ação Tipo 1	Verif. Ação Tipo 2
				$d_r.v$ (mm)	$d_r.v$ (mm)			
Cob.	26.6	128.355	16.386	6.554	-	19.000	OK	-

Piso 6	22.8	111.969	23.010	9.204	-	19.000	OK	-
Piso 5	19.0	88.959	28.102	11.241	-	28.500	OK	-
Piso 4	13.3	60.857	31.139	12.456	-	28.500	OK	-
Piso 2	7.6	29.718	16.950	6.780	-	19.000	OK	-
Piso 1	3.8	12.768	12.768	5.107	-	19.000	OK	-
Piso 0	0.0	0.000	-	-	-	-	-	-

6.6 CONDIÇÃO DE JUNTA SÍSMICA

No projeto inicial existem três juntas a separar os quatro corpos do edifício e duas juntas nas interfaces com o estádio. As juntas interiores (juntas 2, 3 e 4) têm uma largura de 20 mm e as juntas na interface com o estádio (juntas 1 e 5) uma largura de 150 mm. Na Figura 14 é apresentada a localização das juntas existentes no edifício do Topo Norte.

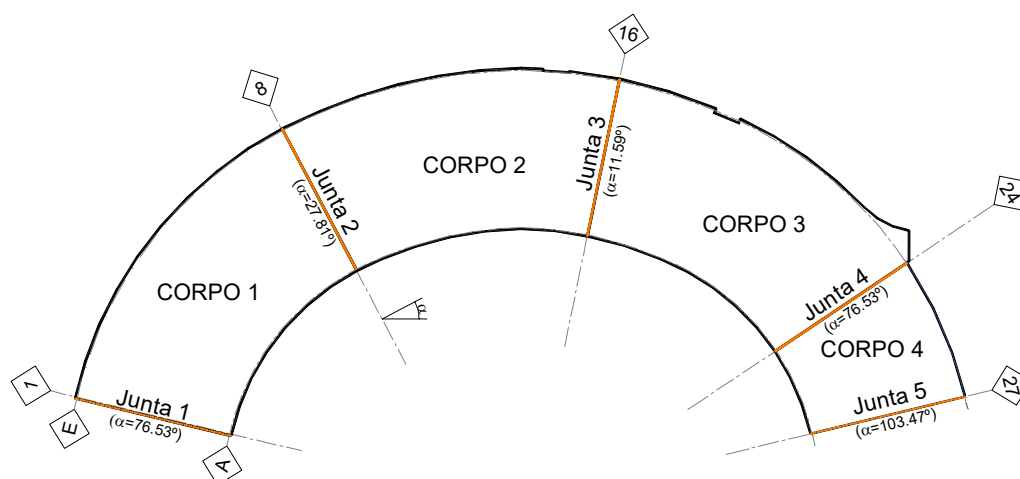


Figura 14 – Localização das juntas no edifício do Topo Norte

A verificação da condição de junta sísmica pressupõe que os edifícios devem ser protegidos do entrechoque provocado pelo sismo entre unidades estruturalmente independentes do mesmo edifício.

Na secção 6.6 da Nota de Cálculo referente ao CORPO 2 foram apresentados os resultados desta verificação para a Junta 3 (CORPO 2-CORPO 3) para os alinhamentos A e E respetivamente tendo-se concluído não haver risco de entrechoque.

Na Tabela 15 e na

Tabela 16 apresentam-se os resultados desta verificação para a Junta 4 (CORPO 3-CORPO 4) para os alinhamentos A e E respetivamente. O deslocamento horizontal (d_e) de um ponto do sistema estrutural devido à ação sísmica de cálculo foi calculado de acordo com a equação (45) da secção anterior. Para obter o deslocamento na junta (d_{junta}) estes deslocamentos foram corrigidos tendo em conta a inclinação da junta e reduzidos por um fator de 0.7 considerando que os pisos das unidades

independentes se encontrarem à mesma cota. O valor do deslocamento relativo (d_{REL}), foi obtido pela diferença dos deslocamentos da junta dos dois corpos acrescido de 20 mm da junta existente, representando desta forma o afastamento real entre os dois corpos durante a vibração.

Tabela 15 – Verificação da Condição de Junta Sísmica (Junta 4-Alinhamento A)

Junta sísmica CORPO 3-CORPO 4 _al A						
Sismo Tipo 1 Case 156 (X+0.3Y+0.3Z)						
PISO	CORPO 3		CORPO 4		d_{REL} (mm)	Entrechoque
	de	d _{junta}	de	d _{junta}		
	(mm)	(mm)	(mm)	(mm)		
Cobertura	96.949	66.618	80.838	56.082	9.464	NÃO
Piso 6	85.486	58.615	70.785	49.116	10.501	NÃO
Piso 5	69.804	47.828	60.107	41.730	13.902	NÃO
Piso 4	45.766	31.271	48.461	33.666	22.137	NÃO
Piso 3			35.390	24.602		
Piso 2	21.168	14.508	21.752	15.116	20.608	NÃO
Piso 1	8.703	5.984	9.195	6.382	20.398	NÃO
Piso 0	0.000	0.000	0.000	0.000	0.000	NÃO
Sismo Tipo 1 Case 159 (-X-0.3Y+0.3Z)						
PISO	CORPO 3		CORPO 4		d_{REL} (mm)	Entrechoque
	de	d _{junta}	de	d _{junta}		
	(mm)	(mm)	(mm)	(mm)		
Cobertura	-95.334	-65.343	-77.114	-52.882	32.461	NÃO
Piso 6	-85.334	-58.399	-67.682	-46.460	31.939	NÃO
Piso 5	-71.146	-48.574	-57.603	-39.590	28.984	NÃO
Piso 4	-47.028	-32.111	-46.462	-31.977	15.609	NÃO
Piso 3			-34.032	-23.461		
Piso 2	-21.827	-14.899	-20.906	-14.405	20.494	NÃO
Piso 1	-9.063	-6.237	-8.914	-6.130	20.107	NÃO
Piso 0	0.000	0.000	0.000	0.000	0.000	NÃO

Tabela 16 – Verificação da Condição de Junta Sísmica (Junta 4-Alinhamento E)

Junta sísmica CORPO 3-CORPO 4 _al E						
Sismo Tipo 1 Case 156 (X+0.3Y+0.3Z)						
PISO	CORPO 3		CORPO 4		d_{REL} (mm)	Entrechoque
	de	d _{junta}	de	d _{junta}		
	(mm)	(mm)	(mm)	(mm)		
Piso 6 (Cob.)	93.438	64.410	88.835	56.568	12.158	NÃO
Piso 5	77.692	53.450	76.377	48.264	14.814	NÃO
Piso 4	50.528	34.700	62.336	39.106	20.632	NÃO
Piso 3			46.385	29.029		
Piso 2	22.519	15.475	29.031	18.399	22.924	NÃO
Piso 1	10.109	6.951	12.874	8.437	21.486	NÃO
Piso 0	0.000	0.000	0.000	0.000	0.000	NÃO
Sismo Tipo 1 Case 159 (-X-0.3Y+0.3Z)						
PISO	CORPO 3		CORPO 4		d_{REL} (mm)	Entrechoque
	de	d _{junta}	de	d _{junta}		
	(mm)	(mm)	(mm)	(mm)		
Piso 6 (Cob.)	-93.564	-64.515	-87.028	-53.643	30.873	NÃO
Piso 5	-79.783	-54.980	-74.842	-45.835	29.145	NÃO
Piso 4	-52.079	-35.869	-61.101	-37.196	16.537	NÃO
Piso 3			-45.416	-27.617		
Piso 2	-23.473	-16.157	-28.368	-17.445	18.712	NÃO
Piso 1	-10.384	-7.160	-12.442	-7.911	19.249	NÃO

Piso 0	0.000	0.000	0.000	0.000	0.000	NÃO

Na Figura 15 são ilustrados os deslocamentos nos pisos do CORPO 3 e do CORPO 4 na Junta 4. De salientar que aos valores dos deslocamentos do CORPO 4 representados na figura correspondem ao valor do deslocamento da junta nesse corpo acrescidos do valor de 20 mm para ter em conta a junta existente.

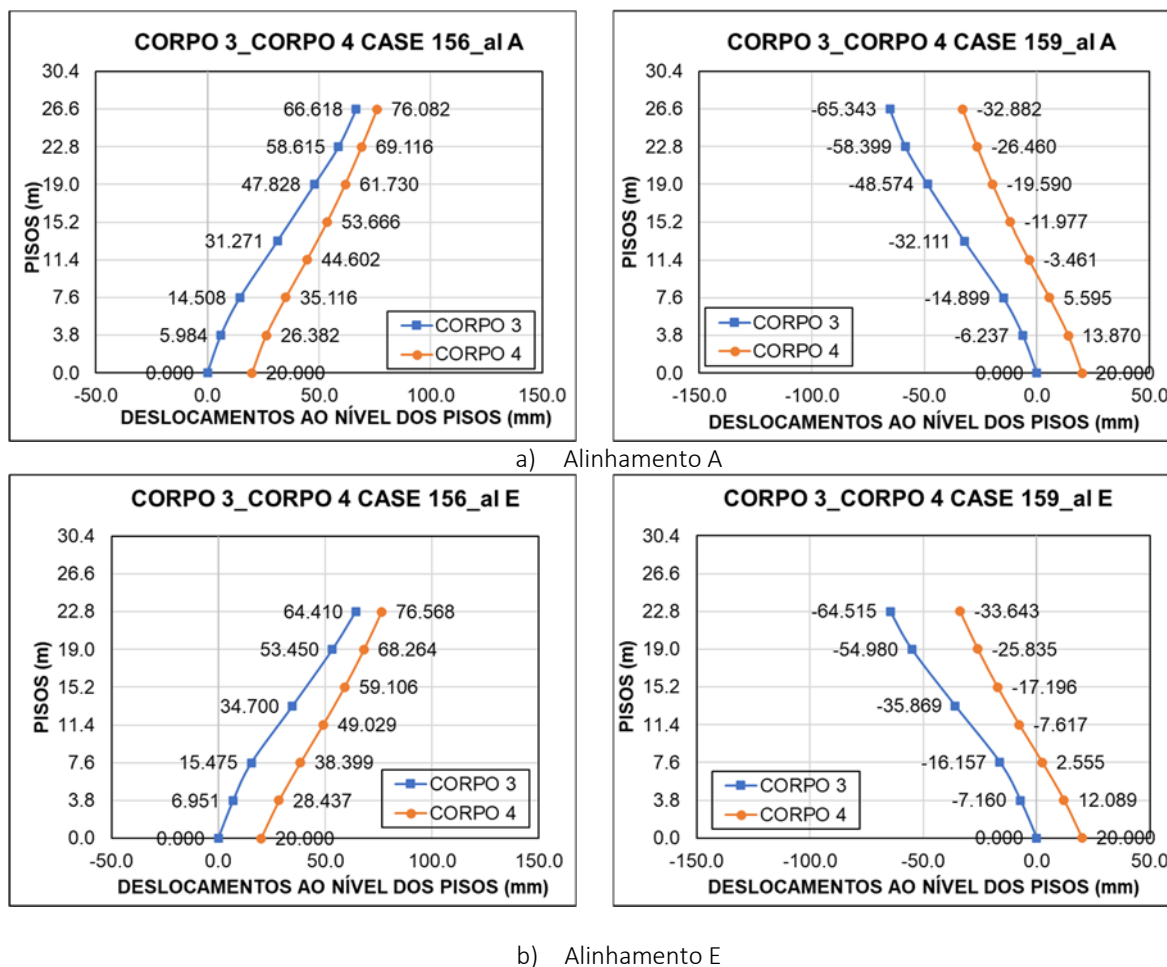


Figura 15 – Deslocamentos ao nível dos pisos na Junta 4

A distância de 20 mm entre juntas existente era uma situação corrente no projeto de edifícios dimensionados de acordo com a regulamentação existente (RSA e REBAP).

De acordo com as análises sísmicas efetuadas verifica-se que o modo de vibração fundamental é o modo circunferencial o que pressupõe que os edifícios estão em fase e verifica-se não existir o risco de entrechoque entre o CORPO 3 e o CORPO 4.

6.7 FUNDAÇÕES

As fundações existentes no CORPO 3 são fundações superficiais, constituídas por sapatas isoladas (Sapatas S6 e S7), sapatas combinadas (S5) e sapatas contínuas (S3). Todas as fundações estão implantadas à cota 19.70. Na Figura 16 são apresentados os desenhos de pormenores das fundações do CORPO 3.

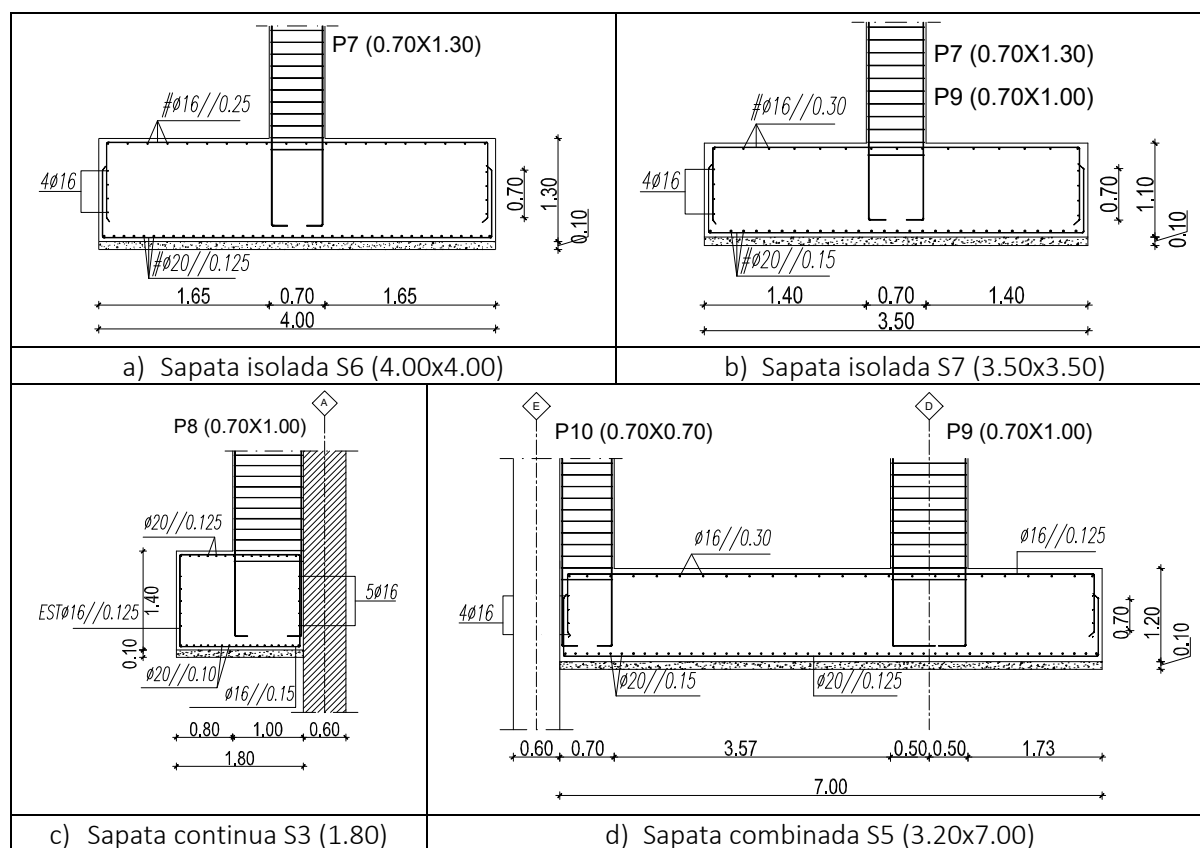


Figura 16– Desenhos de pormenor das sapatas do CORPO 3

A capacidade resistente do solo de fundação foi calculada com base nas características dos solos que constam no relatório Geológico-Geotécnico, tendo-se admitido uma tensão de segurança à rotura de 400 kPa.

A segurança das fundações foi verificada ao Estado Limite Último de Rotura por Insuficiente Capacidade Resistente ao Carregamento do Solo, ao Estado Limite Último de Flexão e Estado Limite Último de Punçoamento e no caso de sapatas combinadas igualmente ao Estado Limite Último de Esforço Transverso.

6.7.1 SAPATAS ISOLADAS

Para a verificação da segurança das sapatas isoladas existentes foram adotados modelos de escoras e tirantes, tendo em conta a geometria das sapatas e as armaduras existentes. Admitiu-se um

comportamento de corpo rígido da sapata. Foi considerada na base de cada sapata uma distribuição uniforme de tensões.

De acordo com as prescrições da norma NP EN 1998-1 os esforços de cálculo nos elementos de fundação foram determinados com base no cálculo da capacidade real com base na seguinte expressão:

$$E_{Fd} = E_{F,G} + \gamma_{Rd} \cdot \Omega \cdot E_{F,E} \quad (46)$$

em que:

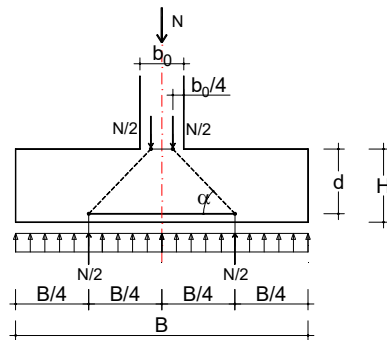
γ_{Rd} - coeficiente de sobrerresistência. Este coeficiente foi considerado igual a 1,0;

$E_{F,G}$ - efeito da ação devido às ações não sísmicas incluídas na combinação de ações para a situação sísmica de cálculo;

$E_{F,E}$ - efeito da ação resultante da análise para a ação sísmica de cálculo;

Ω - valor de $(R_{di}/E_{di}) \leq q$. Neste projeto este coeficiente foi considerado igual a 2;

A Figura 17 ilustra o modelo do campo de tensão adotado para a verificação da segurança em relação às tensões de tração a suportar pelas armaduras.



$$F_t = \frac{N_{Ed} \cdot (B - b_o)}{8d} \quad (47)$$

$$A_s = \frac{F_t}{f_{yd}} \rightarrow \left(\frac{A_s}{s} \right) = \frac{F_t}{f_{yd}} \cdot \frac{1}{y} \quad (48)$$

Figura 17– Modelo de cálculo adotado para verificação da força de tração nas armaduras nas sapatas isoladas

A verificação da segurança das sapatas isoladas encontra-se no Anexo 9.7.

6.7.2 SAPATAS COMBINADAS

No projeto do CORPO 3 foram adotadas sapatas combinadas para executar as fundações dos pilares do Eixo E (P₁₀, P₁₁ e P₁₃) e os pilares do Eixo D (Pilares P₉, P₁₄ e P₁₂).

A Figura 18 ilustra os modelos adotados para a verificação da segurança em relação a rotura do solo de fundação, verificação de armadura e verificação da segurança em relação ao Estados Limites Últimos de Esforço Transverso e Punção.

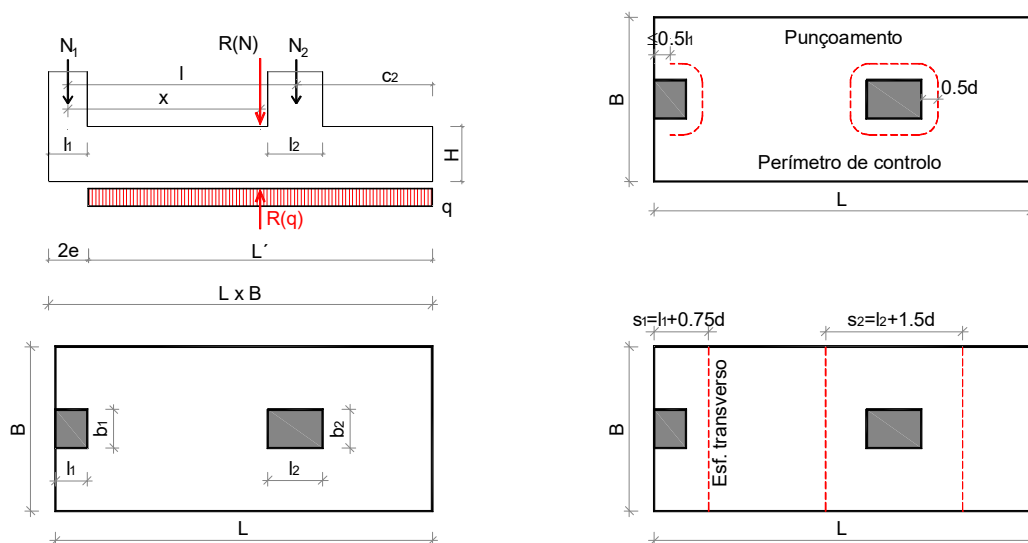


Figura 18– Modelo de cálculo adotado para verificação da segurança das sapatas combinadas

A verificação da segurança das sapatas combinadas encontra-se no Anexo 9.7.

6.7.3 REFORÇO DE FUNDAÇÕES

Com base na verificação das fundações deste corpo verifica-se que estes elementos têm reserva de capacidade suficiente para suportar as cargas a que estão submetidas.

6.8 VERIFICAÇÃO DA SEGURANÇA AO FOGO

6.8.1 INTRODUÇÃO

No projeto de SCIE foram estabelecidas as Utilizações Tipo e as Categoria de Riscos associadas ao projeto em estudo tendo sido estabelecida para a resistência ao fogo padrão mínima dos elementos estruturais os que constam na Tabela 17.

Tabela 17 – Resistência ao fogo padrão mínima dos elementos estruturais

UT	Categoria de Risco		Função do elemento estrutural
	1ª	2ª	
III, IV, VI, VII, VIII, IX	R 30	R 60	Apenas Suporte
	REI 30	REI 60	Suporte e Compartimentação

No caso das envolventes de locais de risco do tipo C, C agravado (definido no projeto de SCIE de C+) e do tipo F, os pavimentos e as paredes resistentes deverão apresentar uma classe de resistência ao fogo padrão mínima indicadas na Tabela 18.

Tabela 18 – Resistência ao fogo padrão mínima dos elementos estruturais envolventes de locais de risco C, C+ e F

Elemento de construção	Local de Risco		
	C	C+	F
Pavimentos e paredes resistentes	REI 60	REI 90	REI 90

Para os elementos estruturais de betão armado será considerada uma verificação com base em medidas prescritivas e com base em métodos de cálculo simplificados de acordo com os requisitos prescritos na norma NP EN 1992-1-2, considerando os diferentes tipos de elementos, os níveis máximos dos esforços em situação de incêndio, as dimensões e recobrimentos mínimos dos elementos, a sua exposição ao fogo e as diferentes zonas da estrutura.

Para os elementos estruturais em que é possível aplicar uma abordagem prescritiva, foram verificados nos elementos existentes os requisitos das dimensões mínimas e a distância da face dos elementos exposta ao fogo ao eixo das armaduras longitudinais. No entanto, os recobrimentos mínimos das armaduras exigidos para a classe de exposição ambiental adotada no projeto inicial garantem na generalidade dos casos este requisito.

Os valores de cálculo dos esforços atuantes foram determinados com base nas combinações de ações correspondentes de acordo com o estipulado na norma NP EN 1992-1 e EN1992-1-2. Foram consideradas as hipóteses de carregamento mais desfavoráveis para se obter os esforços para Verificação da Segurança aos Estados Limites Últimos.

Para garantir a função de resistência destes elementos além das espessuras / larguras mínimas ($e_{\min} / b_{\min}$) foram considerados os valores mínimos da distância das faces dos elementos expostos ao fogo e o centro de gravidade das armaduras longitudinais (distância a). É igualmente necessário considerar outra variável relacionada com o nível do esforço atuante (η), que relaciona o esforço axial para situação de incêndio e o seu valor para estados limites últimos. O valor de η pode aproximadamente considerar-se igual ao valor de (μ_{fi}). Para as ações consideradas neste projeto, e para a situação mais desfavorável (pisos de escritórios) o valor de μ_{fi} calculado pela expressão (49) é igual a:

$$\eta_{fi} = \frac{G_k + \psi_{fi} Q_{k,1}}{\gamma_G G_k + \gamma_Q Q_{k,1}} = \frac{7 + 0.7 \cdot 4}{1.35 \cdot 7 + 1.5 \cdot 4} = 0.634 \quad (49)$$

Para as verificações seguintes foi considerado um valor de $\eta=0.7$ situação mais conservativa.

6.8.2 LAJES

O edifício em estudo apresenta dois tipos de lajes: lajes vigadas maciças armadas em duas direções e lajes fungiformes maciças com capitéis. A Torre Poente (CORPO 1) tem lajes fungiformes com vigas de

bordadura. Os CORPOS 2 e 3 apresentam dois tipos de lajes: lajes fungiformes maciças do Piso -2 ao Piso 1 e lajes vigadas maciças nos restantes pisos.

Estes elementos têm na estrutura uma função de suporte e compartimentação e deverão ser da classe de resistência ao fogo REI 60 e nos locais de risco C+ e F da classe de resistência ao fogo REI 90.

Na Tabela 19 são apresentadas as espessuras mínimas das lajes a adotar e as existentes, com função de compartimentação.

Tabela 19 – Resistência ao fogo padrão de lajes com função de compartimentação

Designação	Resistência ao Fogo Padrão	NP EN 1992-1-2 e_{min}/a (mm)	Existente e / a (mm)	Observação
Lajes de Piso	EI 60	80	200, 400*	Verifica
	EI 90	100	200, 400*	Verifica
Lajes de Escadas	EI 60	80	200	Verifica

e_{min} - espessura mínima; a - distância das faces dos elementos expostos ao fogo e o centro de gravidade das armaduras longitudinais; * aumento localizado da espessura da laje na zona dos capiteis.

Na Tabela 20 são apresentados os valores mínimos a adotar e o existente para as lajes vigadas maciças de acordo com a prescrição da NP EN 1992-1-2.

Tabela 20 – Resistência ao fogo padrão para lajes vigadas maciças armadas em duas direções ($L_{maior}/L_{menor} \leq 1.5$) com funções de suporte

Local	Resistência ao fogo padrão	NP EN 1992-1-2 e_{min}/a (mm)	Existente e / a (mm)	Obs
Piso 2	REI 60	80/10	200/36	Verifica
Piso 5 e 6	REI 90	100/15	200/36	Verifica
Piso 7	REI 60	80/10	200/36	Verifica

e_{min} - espessura mínima; a - distância das faces dos elementos expostos ao fogo e o centro de gravidade das armaduras longitudinais

Na Tabela 21 são apresentados os valores mínimos a adotar e o existente para as lajes fungiformes maciças de acordo com a prescrição da NP EN 1992-1-2.

Tabela 21 – Resistência ao fogo padrão para lajes fungiformes maciças com funções de suporte

Local	Resistência ao fogo padrão	NP EN 1992-1-2 e_{min}/a (mm)	Existente e / a (mm)	Obs
Piso -2 ao Piso1	REI 60	180/15	200/36	Verifica

e_{min} - espessura mínima; a - distância das faces dos elementos expostos ao fogo e o centro de gravidade das armaduras longitudinais

Para além dos valores mínimos tabelados, e de acordo com as peças desenhadas existentes, a pormenorização de armaduras cumpre as disposições construtivas exigidas pela NP EN 1992-1-1. Neste contexto e de acordo com os desenhos de pormenor das armaduras das lajes fungiformes do projeto inicial, verifica-se que pelo menos 20% da armadura superior total em cada direção sobre os apoios

intermédios, é prolongada ao longo de todo o vão na faixa sobre os pilares, cumprindo assim as disposições construtivas para a classe de resistência ao fogo REI 90.

Para a classe de resistência ao fogo requerida as lajes do edifício em estudo cumprem os requisitos da regulamentação.

6.8.3 VIGAS

O projeto em estudo apresenta vigas de betão armado e vigas de betão pré-esforçadas. Todas as vigas de betão armado existentes neste projeto são vigas contínuas. As vigas pré-esforçadas localizadas no Piso 2 e Piso 5 do CORPO 2 e 3 são contínuas no Piso 2 e contínuas e simplesmente apoiadas no Piso 5. Foi considerada a situação mais desfavorável em situação de incêndio que considera as vigas expostas às ações de incêndio em 3 faces.

Na Figura 11 (ver Secção 6.2) são apresentadas as secções tipo das vigas de betão armado e as secções tipo das vigas pré-esforçadas.

Na Tabela 22 são apresentados os valores mínimos da largura a respeitar para as vigas de betão armado para a resistência ao fogo padrão e a geometria existente.

Tabela 22 – Resistência ao fogo padrão para as vigas de betão armado

Local de Risco	Viga	Resistência ao fogo padrão	Secção (m ²)	NP EN 1992-1-2 b_{min}/a (mm)	Existente b / a (mm)	Obs
Armaduras ordinárias (varões Ø20 e Ø25)						
A, B, C	contínua	R 60	0,30×0,80	300/25	300/50	Verifica
	contínua		0,30×1,00	300/25	300/50	Verifica
C+ e F	contínua	R 90	0,30×0,80	300/40	300/50	Verifica
	contínua		0,30×1,00	300/40	300/50	Verifica

b_{min} - largura mínima; a - distância das faces dos elementos expostos ao fogo e o centro de gravidade das armaduras longitudinais

Na Tabela 23 são apresentados os valores mínimos a respeitar para as vigas de betão pré-esforçado para a resistência ao fogo padrão e a geometria existente. Foi considerada a classe de resistência ao fogo mais gravosa (loais de risco C+ e F).

Tabela 23 – Resistência ao fogo padrão para as vigas de betão pré-esforçado

Local	Viga	Resistência ao fogo padrão	Secção (m ²)	NP EN 1992-1-2 b_{min}/a (mm)	Existente b / a (mm)	Obs
Armaduras ordinárias (varões Ø20 e Ø25)						
PISO 2	contínua	R 90	0,70×1,10	400/35	700/50	Verifica
PISO 5	contínua	R 90	0,70×1,30	400/35	700/50	Verifica
	Simplesmente apoiada	R 90	0,70×2,50	400/35	700/50	Verifica
Armaduras pré-esforçadas (cabos 12 Cordões de 15mm)						
PISO 2	contínua	R 90	0,70×1,10	400/35	700/120	Verifica

PISO 5	contínua	R 90	0,70×1,30	400/35	700/120	Verifica
	Simplesmente apoiada	R 90	0,70×2,50	400/35	700/120	Verifica

b_{min} - largura mínima; a - distância das faces dos elementos expostos ao fogo e o centro de gravidade das armaduras longitudinais ordinárias ou de pré-esforço

No caso das vigas pré-esforçadas e atendendo à dimensão da largura das vigas pré-esforçadas existentes ($b > 400$ mm) não foram considerados quaisquer aumentos da distância a (distância das faces dos elementos expostos ao fogo e o centro de gravidade das armaduras).

De acordo com os desenhos de pormenor do projeto inicial as disposições de armaduras garantem a capacidade resistente destes elementos em situação de incêndio, nomeadamente a distância e as percentagens mínimas da armadura a dispensar sobre os apoios tendo em conta a redistribuição de esforços adotada.

6.8.4 PILARES

Para cada uma das secções de pilares adotadas neste projeto foram consideradas as diferentes zonas do edifício, os respetivos locais e categorias de risco.

Para a verificação da resistência ao fogo dos Pilares foi considerado um método simplificado, o Método da Isotérmica de 500°C. Neste método é admitida uma variação de temperatura na secção do elemento que admite uma redução da resistência do betão e das armaduras.

Com base na redução de resistência da secção de betão e do aço é possível avaliar a capacidade resistente dos elementos, aplicando os métodos prescritos nos códigos estruturais para a temperatura ambiente.

Os requisitos considerados para garantir a segurança ao fogo basearam-se para um nível de carga definido (η_{fi}), nas dimensões e recobrimentos mínimos, na espessura do betão danificado (x), na redução da resistência do aço em função da temperatura, na distância ao centro de gravidade das armaduras (a) e no número de faces do elemento de suporte expostas ao fogo.

No Anexo 9.6 é apresentada uma tabela com as verificações de cada uma das secções dos elementos de suporte. De acordo com os cálculos efetuados em todos os pilares verifica-se uma reserva de resistência superior a 50%.

7 VERIFICAÇÃO DA SEGURANÇA DOS ELEMENTOS DA ESTRUTURA METÁLICA

7.1 VERIFICAÇÃO DOS ESTADOS LIMITES ÚLTIMOS

Os coeficientes parciais de segurança considerados foram os seguintes:

$$\gamma_{M0} = \gamma_{M1} = 1.0$$

7.1.1 VERIFICAÇÃO DA SECÇÃO À TRAÇÃO

Para os elementos sujeitos à tração, o valor de cálculo do esforço de tração N_{Ed} em cada secção transversal deve satisfazer:

$$N_{Ed} \leq N_{t,Rd} \quad (50)$$

em que $N_{t,Rd}$ corresponde ao valor de cálculo de resistência à tração da secção transversal.

$$N_{t,Rd} = N_{pl,Rd} = \frac{A \cdot f_y}{\gamma_{M0}} \quad (51)$$

, em que $N_{pl,Rd}$ corresponde ao valor de cálculo de resistência plástica da secção bruta.

7.1.2 VERIFICAÇÃO DA SECÇÃO À COMPRESSÃO

Para os elementos sujeitos à compressão, o valor de cálculo do esforço de compressão N_{Ed} em cada secção transversal deve satisfazer:

$$N_{Ed} \leq N_{c,Rd} \quad (52)$$

Em que $N_{c,Rd}$ corresponde ao valor de cálculo da resistência à compressão da secção transversal.

$$N_{c,Rd} = N_{pl,Rd} = \frac{A \cdot f_y}{\gamma_{M0}} \quad (53)$$

, em que $N_{pl,Rd}$ corresponde ao valor de cálculo da resistência plástica da secção bruta.

7.1.3 VERIFICAÇÃO DA SECÇÃO À ENCURVADURA

O valor de cálculo da resistência à curvatura de um elemento comprimido deverá ser considerado como:

$$N_{b,Rd} = \chi \cdot \beta_A \cdot A \cdot f_y / \gamma_{M1} \quad (54)$$

, em que $\beta_A = 1$ para as secções transversais de Classe 1, 2 ou 3.

$$\chi = \frac{1}{\Phi + [\Phi^2 - \bar{\lambda}^2]^{0.5}} \leq 1 \quad (55)$$

$$\Phi = 0.5 \cdot [1 + \alpha \cdot (\bar{\lambda} - 0.2) + \bar{\lambda}^2] \quad (56)$$

$$\bar{\lambda} = \left(\frac{\lambda}{\lambda_1} \right) \cdot \beta_A^{0.5} \quad (57)$$

$$\lambda_1 = 93.9 \times \varepsilon \quad (58)$$

, em que χ corresponde ao fator redução para o modo de encurvadura relevante.

7.1.4 VERIFICAÇÃO DA SECÇÃO À FLEXÃO SIMPLES

Para as secções transversais de classe 1 e 2, o critério a satisfazer na ausência do esforço transversal é:

$$M_{Ed} \leq M_{N,Rd} = M_{pl,Rd} = \frac{W_{pl} \cdot f_y}{\gamma_{M0}} \quad (59)$$

, em que $M_{pl,Rd}$ corresponde ao valor de cálculo do momento resistente plástico da secção bruta.

7.1.5 VERIFICAÇÃO DA SECÇÃO À ENCURVADURA LATERAL

Foi efetuada a verificação à encurvadura lateral de vigas devendo os elementos satisfazer a seguinte condição:

$$M_{Ed} \leq M_{b,Rd} = \frac{\chi_{lt} \cdot \beta_w \cdot W_{pl,y} \cdot f_y}{\gamma_{M1}} \quad (60)$$

$\beta_w = 1$ para as secções transversais de Classe 1, 2 ou 3.

$$\chi = \frac{1}{\Phi_{LT} + [\Phi_{LT}^2 - \bar{\lambda}_{LT}^2]^{0.5}} \leq 1 \quad (61)$$

$$\Phi_{LT} = 0.5 \cdot [1 + \alpha_{LT} \cdot (\bar{\lambda}_{LT} - 0.2) + \bar{\lambda}_{LT}^2] \quad (62)$$

$$\bar{\lambda}_{LT} = \left[\frac{\beta_w \cdot W_{pl,y} \cdot f_y}{M_{cr}} \right]^{0.5} \quad (63)$$

7.1.6 VERIFICAÇÃO DA SECÇÃO À FLEXÃO COMPOSTA COM COMPRESSÃO

Foi efetuada a verificação à flexão composta com compressão, devendo os elementos satisfazer as seguintes condições:

$$\frac{N_{Ed}}{\chi_y \cdot N_{Rk} / \gamma_{M1}} + k_{yy} \frac{M_{y,Ed} + \Delta M_{y,Ed}}{\chi_{LT} \cdot M_{y,Rk} / \gamma_{M1}} + k_{yz} \frac{M_{z,Ed} + \Delta M_{z,Ed}}{M_{z,Rk} / \gamma_{M1}} \leq 1 \quad (64)$$

$$\frac{N_{Ed}}{\chi_z \cdot N_{Rk} / \gamma_{M1}} + k_{zy} \frac{M_{y,Ed} + \Delta M_{y,Ed}}{\chi_{LT} \cdot M_{y,Rk} / \gamma_{M1}} + k_{zz} \frac{M_{z,Ed} + \Delta M_{z,Ed}}{M_{z,Rk} / \gamma_{M1}} \leq 1 \quad (65)$$

em que:

N_{Ed} , $M_{y,Ed}$ e $M_{z,Ed}$ são os valores de cálculo do esforço de compressão e dos momentos máximos no elemento, respetivamente, em relação aos eixos y-y e z-z;

$\Delta M_{y,Ed}$, $\Delta M_{z,Ed}$ são os momentos devidos ao deslocamento do eixo neutro;

χ_y e χ_z são os coeficientes de redução devidos à encurvadura por flexão;

χ_{LT} é o coeficiente de redução devido à encurvadura por lateral;

k_{yy} , k_{yz} , k_{zy} , k_{zz} são fatores de interação.

7.1.7 VERIFICAÇÃO DA SECÇÃO À FLEXÃO DESVIADA

A verificação também foi efetuada à flexão desviada pela secção transversal em análise. Esta é dada por:

$$\left[\frac{M_{y,Ed}}{M_{N,y,Rd}} \right]^\alpha + \left[\frac{M_{z,Ed}}{M_{N,z,Rd}} \right]^\beta \leq 1 \quad (66)$$

7.1.8 VERIFICAÇÃO DA SECÇÃO À FLEXÃO DESVIADA

A verificação também foi efetuada à flexão desviada pela secção transversal em análise. Esta é dada por:

$$\left[\frac{M_{y,Ed}}{M_{Ny,Rd}} \right]^\alpha + \left[\frac{M_{z,Ed}}{M_{Nz,Rd}} \right]^\beta \leq 1$$

7.1.9 VERIFICAÇÃO DA SECÇÃO À FLEXÃO COM ESFORÇO TRANSVERSO

Quando o valor de V_{Ed} excede 50%, do valor de cálculo da resistência plástica ao esforço transversal $V_{pl,Rd}$, o valor de cálculo reduzido do momento resistente plástico da secção é obtido do seguinte modo:

$$M_{v,Rd} = \frac{\left(W_{pl,y} - \frac{\rho \cdot A_v^2}{4 \cdot t_w} \right) \cdot f_y}{\gamma_{M0}} \leq M_{c,Rd} \quad (67)$$

7.1.10 VERIFICAÇÃO DA SECÇÃO AO ESFORÇO TRANSVERSO

O valor de cálculo do esforço transverso V_{Ed} , em cada secção transversal deve satisfazer:

$$V_{Ed} \leq V_{pl,Rd} \quad (68)$$

, em que $V_{pl,Rd}$ corresponde ao valor de cálculo da resistência plástica ao esforço transversal dado por:

$$V_{pl,Rd} = \frac{A_v \cdot (f_y / \sqrt{3})}{\gamma_{M0}} \quad (69)$$

, em que A_v corresponde à área de corte.

7.2 VERIFICAÇÃO DOS ESTADOS LIMITES DE SERVIÇO

7.2.1 DESLOCAMENTO VERTICAIS

Os valores recomendados para os deslocamentos verticais em edifícios são os indicados na tabela abaixo, tendo-se:

$$\delta_{max} = \delta_1 + \delta_2 - \delta_0 \quad (70)$$

em que:

δ_{max} – flecha no estado final relativamente à linha reta que une os apoios;

δ_0 – contra-flecha da viga no estado não carregado;

δ_1 – variação da flecha da viga devida às ações permanentes imediatamente após a sua aplicação;

δ_2 – variação da flecha da viga devida à ação variável de base associada aos valores de combinação das restantes ações variáveis (combinações características).

Na Tabela 24 são apresentados os valores recomendados para os limites dos deslocamentos verticais.

Tabela 24 – Valores recomendados para os limites dos deslocamentos verticais

Condições	Limites	
	δ_{max}	δ_2
Coberturas em geral	L/200	L/250
Coberturas utilizadas frequentemente por pessoas, para além do pessoal de manutenção	L/250	L/300
Pavimentos em geral	L/250	L/300
Pavimentos e coberturas que suportem rebocos ou outros acabamentos frágeis ou divisórias não flexíveis	L/250	L/350
Pavimentos que suportem colunas (a não ser que o deslocamento tenha sido incluído na análise global para o estado limite último)	L/400	L/500
Quando δ_{max} possa afetar o aspeto do edifício	L/250	-

Nota: No caso geral, L representa o vão da viga. No caso de vigas em consola, L representa duas vezes o vão real da consola.

7.2.2 DESLOCAMENTOS HORIZONTAIS

Os valores recomendados para os deslocamentos horizontais no topo das colunas para as combinações características são os seguintes:

- Pórticos sem aparelhos de elevação: $h/150$
- Outros edifícios de um só piso: $h/300$
- Em edifícios de vários pisos:
 - Em cada piso: $h/300$
 - Na estrutura globalmente: $h_0/500$

, em que:

h – altura da coluna ou do piso;

h_0 – altura da estrutura.

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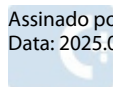
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Leiria, 24-09-2025

O Técnico,

Assinado por: **NUNO MIGUEL DE FIGUEIREDO ALMEIDA**
Data: 2025.09.25 14:07:53+01'00'



Nuno Almeida

Eng. Civil

9 ANEXOS

9.1 COMBINAÇÕES DE AÇÕES

AÇÕES E COMBINAÇÕES

Case	Case name	Nature
1	PP	Structural
2	RCP_Paredes Divisórias 1	Structural
3	RCP_Paredes Divisórias 2	Structural
4	RCP_Paredes Divisórias 3	Structural
5	RCP_Paredes Exteriores 1	Structural
6	RCP_Paredes Exteriores 2	Structural
7	RCP_Paredes Exteriores 3	Structural
8	RCP_Revest Cobertura 1	Structural
9	RCP_Revest Cobertura 2	Structural
10	RCP_Painéis Solares	Structural
11	RCP_Equip. AVAC	Structural
12	RCP_Equip. Som	Structural
13	RCP_Equip. Iluminação	Structural
14	RCP_Equip. Portões	Structural
15	RCP_Equip. Diversos	Structural
16	RCP_Revest Pavimento 1	Structural
17	RCP_Revest Pavimento 2	Structural
18	RCP_Revest Pavimento 3	Structural
19	RCP_Diversos 1	Structural
20	RCP_Diversos 2	Structural
21	TERRAS	Structural
22	ÁGUA	Structural
23	ACRÉSCIMO IMP SÍSMICO	Structural
24	SC_Pavimento Cat.C1	Category C
25	SC_Pavimento Cat.B	Category B
26	SC_CC3_Pavimento	Category C
27	SC_Bancadas	Category C
28	SC_Garagem Cat.F	Category F
29	SC_Escadas Cat.B	Category B
30	SC_Escadas Cat.C1	Category C
31	SC_Cargas horizontais-Guarda corpos Cat.C1	Category C
32	SC_Cobertura	Category H
33	W0 (XX)	wind
34	W180 (-XX)	wind
35	W90 (YY)	wind
36	W270 (-YY)	wind
37	TEMP (+)	temperature
38	TEMP (-)	temperature
39	Pré-Esforço	Structural
40	RETRAÇÃO	Structural
41	NEVE <1000	snow
42	NEVE >1000	snow
43	MODAL	
44	Sismo Tipo1 Direction_X	seismic
45	Sismo Tipo1 Direction_Y	seismic
46	Sismo Tipo1 Direction_Z	seismic
47	Sismo Tipo 2 Direction_X	seismic
48	Sismo Tipo 2 Direction_Y	seismic
49	Sismo Tipo 2 Direction_Z	seismic

Combinations	Name	Analysis type	Combination type	Definition
50 (C)	FAV_SÓ PERMANENTES	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00$
51 (C)	FAV_AVB SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50$
52 (C)	FAV_AVB SC_SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+28^*1.05$
53 (C)	FAV_AVB SC_W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+33^*0.90$
54 (C)	FAV_AVB SC_W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+34^*0.90$
55 (C)	FAV_AVB SC_W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+35^*0.90$
56 (C)	FAV_AVB SC_W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+36^*0.90$
57 (C)	FAV_AVB SC_SC Garagem+W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+28^*1.05+33^*0.90$
58 (C)	FAV_AVB SC_SC Garagem+W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+28^*1.05+34^*0.90$
59 (C)	FAV_AVB SC_SC Garagem+W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+28^*1.05+35^*0.90$
60 (C)	FAV_AVB SC_SC Garagem+W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+(24+25+26+27+29+30+31)^*1.50+28^*1.05+36^*0.90$
61 (C)	FAV_AVB SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50$
62 (C)	FAV_AVB SC Garagem_SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+(24+25+26+27+29+30+31)^*1.05$
63 (C)	FAV_AVB SC Garagem_W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+33^*0.90$
64 (C)	FAV_AVB SC Garagem_W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+34^*0.90$
65 (C)	FAV_AVB SC Garagem_W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+35^*0.90$
66 (C)	FAV_AVB SC Garagem_W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+36^*0.90$
67 (C)	FAV_AVB SC Garagem_SC+W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+(24+25+26+27+29+30+31)^*1.05+33^*0.90$
68 (C)	FAV_AVB SC Garagem_SC+W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+(24+25+26+27+29+30+31)^*1.05+34^*0.90$
69 (C)	FAV_AVB SC Garagem_SC+W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+(24+25+26+27+29+30+31)^*1.05+35^*0.90$
70 (C)	FAV_AVB SC Garagem_SC+W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+28^*1.50+(24+25+26+27+29+30+31)^*1.05+36^*0.90$
71 (C)	FAV_AVB SC COB	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50$
72 (C)	FAV_AVB SC COB_SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31)^*1.05$
73 (C)	FAV_AVB SC COB_SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+28^*1.05$
74 (C)	FAV_AVB SC COB_W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+33^*0.90$
75 (C)	FAV_AVB SC COB_W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+34^*0.90$
76 (C)	FAV_AVB SC COB_W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+35^*0.90$
77 (C)	FAV_AVB SC COB_W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+36^*0.90$
78 (C)	FAV_AVB SC COB_SC+SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31+28)^*1.05$
79 (C)	FAV_AVB SC COB_SC+W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31)^*1.05+33^*0.90$
80 (C)	FAV_AVB SC COB_SC+W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31)^*1.05+34^*0.90$
81 (C)	FAV_AVB SC COB_SC+W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31)^*1.05+35^*0.90$
82 (C)	FAV_AVB SC COB_SC+W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31)^*1.05+36^*0.90$
83 (C)	FAV_AVB SC COB_SC+SC Garagem+W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31+28)^*1.05+33^*0.90$
84 (C)	FAV_AVB SC COB_SC+SC Garagem+W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31+28)^*1.05+34^*0.90$
85 (C)	FAV_AVB SC COB_SC+SC Garagem+W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31+28)^*1.05+35^*0.90$
86 (C)	FAV_AVB SC COB_SC+SC Garagem+W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+32^*1.50+(24+25+26+27+29+30+31+28)^*1.05+36^*0.90$
87 (C)	FAV_AVB W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+33^*1.50$
88 (C)	FAV_AVB W0_SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+33^*1.50+(24+25+26+27+29+30+31)^*1.05$
89 (C)	FAV_AVB W0_SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+33^*1.50+28^*1.05$
90 (C)	FAV_AVB W0_SC+SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+33^*1.50+(24+25+26+27+29+30+31+28)^*1.05$
91 (C)	FAV_AVB W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+34^*1.50$
92 (C)	FAV_AVB W180_SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+34^*1.50+(24+25+26+27+29+30+31)^*1.05$
93 (C)	FAV_AVB W180_SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+34^*1.50+28^*1.05$
94 (C)	FAV_AVB W180_SC+SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+34^*1.50+(24+25+26+27+29+30+31+28)^*1.05$
95 (C)	FAV_AVB W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+35^*1.50$
96 (C)	FAV_AVB W90_SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+35^*1.50+(24+25+26+27+29+30+31)^*1.05$
97 (C)	FAV_AVB W90_SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+35^*1.50+28^*1.05$
98 (C)	FAV_AVB W90_SC+SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+35^*1.50+(24+25+26+27+29+30+31+28)^*1.05$
99 (C)	FAV_AVB W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+36^*1.50$
100 (C)	FAV_AVB W270_SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+36^*1.50+(24+25+26+27+29+30+31)^*1.05$
101 (C)	FAV_AVB W270_SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+36^*1.50+28^*1.05$
102 (C)	FAV_AVB W270_SC+SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)^*1.00+36^*1.50+(24+25+26+27+29+30+31+28)^*1.05$
103 (C)	UNFAV_SÓ PERMANENTES	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30$
104 (C)	UNFAV_AVB SC	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30+(24+25+26+27+29+30+31)^*1.50$
105 (C)	UNFAV_AVB SC_SC Garagem	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30+(24+25+26+27+29+30+31)^*1.50+28^*1.05$
106 (C)	UNFAV_AVB SC_W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30+(24+25+26+27+29+30+31)^*1.50+33^*0.90$
107 (C)	UNFAV_AVB SC_W180	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30+(24+25+26+27+29+30+31)^*1.50+34^*0.90$
108 (C)	UNFAV_AVB SC_W90	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30+(24+25+26+27+29+30+31)^*1.50+35^*0.90$
109 (C)	UNFAV_AVB SC_W270	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30+(24+25+26+27+29+30+31)^*1.50+36^*0.90$
110 (C)	UNFAV_AVB SC_SC Garagem+W0	Linear Combination	ULS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)^*1.35+39^*1.30+(24+25+26+27+29+30+31)^*1.50+28^*1.05+33^*0.90$

111 (C)	UNFAV_AVB SC_SC Garagem+W180	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+(24+25+26+27+29+30+31)*1.50+28*1.05+34*0.90
112 (C)	UNFAV_AVB SC_SC Garagem+W90	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+(24+25+26+27+29+30+31)*1.50+28*1.05+35*0.90
113 (C)	UNFAV_AVB SC_SC Garagem+W270	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+(24+25+26+27+29+30+31)*1.50+28*1.05+36*0.90
114 (C)	UNFAV_AVB SC Garagem	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50
115 (C)	UNFAV_AVB SC Garagem_SC	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+(24+25+26+27+29+30+31)*1.05
116 (C)	UNFAV_AVB SC Garagem_W0	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+33*0.90
117 (C)	UNFAV_AVB SC Garagem_W180	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+34*0.90
118 (C)	UNFAV_AVB SC Garagem_W90	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+35*0.90
119 (C)	UNFAV_AVB SC Garagem_W270	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+36*0.90
120 (C)	UNFAV_AVB SC Garagem_SC+W0	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+(24+25+26+27+29+30+31)*1.05+33*0.90
121 (C)	UNFAV_AVB SC Garagem_SC+W180	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+(24+25+26+27+29+30+31)*1.05+34*0.90
122 (C)	UNFAV_AVB SC Garagem_SC+W90	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+(24+25+26+27+29+30+31)*1.05+35*0.90
123 (C)	UNFAV_AVB SC Garagem_SC+W270	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*1.50+(24+25+26+27+29+30+31)*1.05+36*0.90
124 (C)	UNFAV_AVB SC COB	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50
125 (C)	UNFAV_AVB SC COB_SC	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31)*1.05
126 (C)	UNFAV_AVB SC COB_SC Garagem	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+28*1.05
127 (C)	UNFAV_AVB SC COB_W0	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+33*0.90
128 (C)	UNFAV_AVB SC COB_W180	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+34*0.90
129 (C)	UNFAV_AVB SC COB_W90	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+35*0.90
130 (C)	UNFAV_AVB SC COB_W270	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+36*0.90
131 (C)	UNFAV_AVB SC COB_SC+SC Garagem	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31+28)*1.05
132 (C)	UNFAV_AVB SC COB_SC+W0	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31)*1.05+33*0.90
133 (C)	UNFAV_AVB SC COB_SC+W180	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31)*1.05+34*0.90
134 (C)	UNFAV_AVB SC COB_SC+W90	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31)*1.05+35*0.90
135 (C)	UNFAV_AVB SC COB_SC+W270	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31)*1.05+36*0.90
136 (C)	UNFAV_AVB SC COB_SC+SC Garagem+W0	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31+28)*1.05+33*0.90
137 (C)	UNFAV_AVB SC COB_SC+SC Garagem+W180	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*1.50+(24+25+26+27+29+30+31+28)*1.05+34*0.90
138 (C)	UNFAV_AVB SC COB_SC+SC Garagem+W90	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+32*

173 (C) (CQC)	Sismo Tipo 2_-0.3X-Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29)*0.30+47*-0.15+48*-0.50+49*0.15
174 (C) (CQC)	Sismo Tipo 2_-0.3X+0.3Y+Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29)*0.30+(47+48)*0.15+49*0.50
175 (C) (CQC)	Sismo Tipo 2_+0.3X+0.3Y-Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29)*0.30+(47+48)*0.15+49*-0.50
176 (C)	RARA_SÓ PERMANENTES	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00
177 (C)	RARA_AVB SC	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00
178 (C)	RARA_AVB SC_SC Garagem	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+28*0.70
179 (C)	RARA_AVB SC_W0	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+33*0.60
180 (C)	RARA_AVB SC_W180	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+34*0.60
181 (C)	RARA_AVB SC_W90	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+35*0.60
182 (C)	RARA_AVB SC_W270	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+36*0.60
183 (C)	RARA_AVB SC_SC Garagem+W0	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+28*0.70+33*0.60
184 (C)	RARA_AVB SC_SC Garagem+W180	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+28*0.70+34*0.60
185 (C)	RARA_AVB SC_SC Garagem+W90	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+28*0.70+35*0.60
186 (C)	RARA_AVB SC_SC Garagem+W270	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+28*0.70+36*0.60
187 (C)	RARA_AVB SC Garagem	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00
188 (C)	RARA_AVB SC Garagem_SC	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+(24+25+26+27+29+30+31)*0.70
189 (C)	RARA_AVB SC Garagem_W0	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+33*0.60
190 (C)	RARA_AVB SC Garagem_W180	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+34*0.60
191 (C)	RARA_AVB SC Garagem_W90	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+35*0.60
192 (C)	RARA_AVB SC Garagem_W270	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+36*0.60
193 (C)	RARA_AVB SC Garagem_SC+W0	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+(24+25+26+27+29+30+31)*0.70+33*0.60
194 (C)	RARA_AVB SC Garagem_SC+W180	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+(24+25+26+27+29+30+31)*0.70+34*0.60
195 (C)	RARA_AVB SC Garagem_SC+W90	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+(24+25+26+27+29+30+31)*0.70+35*0.60
196 (C)	RARA_AVB SC Garagem_SC+W270	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+28)*1.00+(24+25+26+27+29+30+31)*0.70+36*0.60
197 (C)	RARA_AVB SC COBERTURA	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00
198 (C)	RARA_AVB SC COBERTURA_SC	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31)*0.70
199 (C)	RARA_AVB SC COBERTURA_SC Garagem	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+28*0.70
200 (C)	RARA_AVB SC COBERTURA_W0	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+33*0.60
201 (C)	RARA_AVB SC COBERTURA_W180	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+34*0.60
202 (C)	RARA_AVB SC COBERTURA_W90	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32

232 (C) (CQC)	FUND_Sismo Tipo 1_-X+0.3Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+45+46)*0.30+44*-1.00
236 (C) (CQC)	FUND_Sismo Tipo 1_-X-0.3Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+46)*0.30+44*-1.00+45*-0.30
237 (C) (CQC)	FUND_Sismo Tipo 1_0.3X+Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+45)*1.00+(24+27+28+30+31)*0.60+(25+26+29+44+46)*0.30
238 (C) (CQC)	FUND_Sismo Tipo 1_0.3X+Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+45)*1.00+(24+27+28+30+31)*0.60+(25+26+29+46)*0.30+44*-0.30
239 (C) (CQC)	FUND_Sismo Tipo 1_+0.3X-Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+44+46)*0.30+45*-1.00
240 (C) (CQC)	FUND_Sismo Tipo 1_0.3X-Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+46)*0.30+44*-0.30+45*-1.00
241 (C) (CQC)	FUND_Sismo Tipo 1_+0.3X+0.3Y+Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+46)*1.00+(24+27+28+30+31)*0.60+(25+26+29+44+45)*0.30
242 (C) (CQC)	FUND_Sismo Tipo 1_+0.3X+0.3Y-Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+44+45)*0.30+46*-1.00
243 (C) (CQC)	FUND_Sismo Tipo 2_+X+0.3Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+47)*1.00+(24+27+28+30+31)*0.60+(25+26+29+48+49)*0.30
244 (C) (CQC)	FUND_Sismo Tipo 2_+X-0.3Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+47)*1.00+(24+27+28+30+31)*0.60+(25+26+29+49)*0.30+48*-0.30
245 (C) (CQC)	FUND_Sismo Tipo 2_-X+0.3Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+48+49)*0.30+47*-1.00
246 (C) (CQC)	FUND_Sismo Tipo 2_-X-0.3Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+49)*0.30+47*-1.00+48*-0.30
247 (C) (CQC)	FUND_Sismo Tipo 2_+0.3X+Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+47+49)*0.30+48*0.50
248 (C) (CQC)	FUND_Sismo Tipo 2_0.3X+Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+48)*1.00+(24+27+28+30+31)*0.60+(25+26+29+49)*0.30+47*-0.30
249 (C) (CQC)	FUND_Sismo Tipo 2_+0.3X-Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+47+49)*0.30+48*-1.00
250 (C) (CQC)	FUND_Sismo Tipo 2_0.3X-Y+0.3Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+49)*0.30+47*-0.30+48*-1.00
251 (C) (CQC)	FUND_Sismo Tipo 2_+0.3X+0.3Y+Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+49)*1.00+(24+27+28+30+31)*0.60+(25+26+29+47+48)*0.30
252 (C) (CQC)	FUND_Sismo Tipo 2_+0.3X+0.3Y-Z	Linear Combination	ULS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+47+48)*0.30+49*-1.00
253 (C)	RARA_AVB SC_TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+37*0.60
254 (C)	RARA_AVB SC_TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+38*0.60
255 (C)	RARA_AVB SC_SC Garagem+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+28*0.70+37*0.60
256 (C)	RARA_AVB SC_SC Garagem+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+28*0.70+38*0.60
257 (C)	RARA_AVB SC_W0+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+(33+37)*0.60
258 (C)	RARA_AVB SC_W0+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)*1.00+(33+38)*0.60
259 (C)	RARA_AVB SC_W180+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+1

297	(C)	RARA_AVB SC COBERTURA_WO+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(33+37)*0.60
298	(C)	RARA_AVB SC COBERTURA_WO+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(33+38)*0.60
299	(C)	RARA_AVB SC COBERTURA_W180+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(34+37)*0.60
300	(C)	RARA_AVB SC COBERTURA_W180+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(34+38)*0.60
301	(C)	RARA_AVB SC COBERTURA_W90+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(35+37)*0.60
302	(C)	RARA_AVB SC COBERTURA_W90+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(35+38)*0.60
303	(C)	RARA_AVB SC COBERTURA_W180+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(36+37)*0.60
304	(C)	RARA_AVB SC COBERTURA_W180+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(36+38)*0.60
305	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+37*0.60
306	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+38*0.60
307	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W0+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(33+37)*0.60
308	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W0+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(33+38)*0.60
309	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W180+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(34+37)*0.60
310	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W180+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(34+38)*0.60
311	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W90+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(35+37)*0.60
312	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W90+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(35+38)*0.60
313	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W270+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(36+37)*0.60
314	(C)	RARA_AVB SC COBERTURA_SC+SC Garagem+W270+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32)*1.00+(24+25+26+27+29+30+31+28)*0.70+(36+38)*0.60
315	(C)	RARA_AVB W0_TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+33)*1.00+37*0.60
316	(C)	RARA_AVB W0_TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+33)*1.00+38*0.60
317	(C)	RARA_AVB W180_TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+34)*1.00+37*0.60
318	(C)	RARA_AVB W180_TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+34)*1.00+38*0.60
319	(C)	RARA_AVB W90_TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+35)*1.00+37*0.60
320	(C)	RARA_AVB W90_TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+35)*1.00+38*0.60
321	(C)	RARA_AVB W270_TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36)*1.00+37*0.60
322	(C)	RARA_AVB W270_TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36)*1.00+38*0.60
323	(C)	RARA_AVB W0_SC+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+33)*1.00+(24+25+26+27+29+30+31)*0.70+37*0.60
324	(C)	RARA_AVB W0_SC+TEMP(-)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+33)*1.00+(24+25+26+27+29+30+31)*0.70+38*0.60
325	(C)	RARA_AVB W0_SC Garagem+TEMP(+)	Linear Combination	SLS	(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+1

[illegible]

421 (C)	ACID_AVB TEMP(+)	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+37*0.50$
422 (C)	ACID_AVB TEMP(-)	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+38*0.50$
423 (C)	ACID_AVB SC_SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+(24+26+27+30+31)*0.70+(25+29)*0.50+28*0.60$
424 (C)	ACID_AVB SC Garagem_SC	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+28*0.70+(24+26+27+30+31)*0.60+(25+29)*0.30$
425 (C)	ACID_AVB W0_SC	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+33*0.20+(24+26+27+30+31)*0.60+(25+29)*0.30$
426 (C)	ACID_AVB W0_SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+33*0.20+28*0.60$
427 (C)	ACID_AVB W0_SC+SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+33*0.20+(24+26+27+30+31+28)*0.60+(25+29)*0.30$
428 (C)	ACID_AVB W180_SC	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+34*0.20+(24+26+27+30+31)*0.60+(25+29)*0.30$
429 (C)	ACID_AVB W180_SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+34*0.20+28*0.60$
430 (C)	ACID_AVB W180_SC+SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+34*0.20+(24+26+27+30+31+28)*0.60+(25+29)*0.30$
431 (C)	ACID_AVB W90_SC	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+35*0.20+(24+26+27+30+31)*0.60+(25+29)*0.30$
432 (C)	ACID_AVB W90_SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+35*0.20+28*0.60$
433 (C)	ACID_AVB W90_SC+SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+35*0.20+(24+26+27+30+31+28)*0.60+(25+29)*0.30$
434 (C)	ACID_AVB W270_SC	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+36*0.20+(24+26+27+30+31)*0.60+(25+29)*0.30$
435 (C)	ACID_AVB W270_SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+36*0.20+28*0.60$
436 (C)	ACID_AVB W270_SC+SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+36*0.20+(24+26+27+30+31+28)*0.60+(25+29)*0.30$
437 (C)	ACID_AVB TEMP(+)_SC	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+37*0.50+(24+26+27+30+31)*0.60+(25+29)*0.30$
438 (C)	ACID_AVB TEMP(+)_SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+37*0.50+28*0.60$
439 (C)	ACID_AVB TEMP(+)_SC+SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+37*0.50+(24+26+27+30+31+28)*0.60+(25+29)*0.30$
440 (C)	ACID_AVB TEMP(-)_SC	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+38*0.50+(24+26+27+30+31)*0.60+(25+29)*0.30$
441 (C)	ACID_AVB TEMP(-)_SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+38*0.50+28*0.60$
442 (C)	ACID_AVB TEMP(-)_SC+SC Garagem	Linear Combination	FIRE	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+38*0.50+(24+26+27+30+31+28)*0.60+(25+29)*0.30$
443 (C)	QP	Linear Combination	SLS	$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+(24+26+27+30+31+28)*0.60+(25+29)*0.30$

9.2 MODOS DE VIBRAÇÃO E MASSAS PARTICIPATIVAS

TN_CORPO 3_MODOS DE VIBRAÇÃO

Case	Mode	Frequency (Hz)	Period (sec)	Rel.mas.U X (%)	Rel.mas.U Y (%)	Rel.mas.U Z (%)	Cur.mas.U X (%)	Cur.mas.U Y (%)	Cur.mas.U Z (%)	Total mass UX (kg)	Total mass UY (kg)	Total mass UZ (kg)
43	1	0.7	1.42	36.02	2.28	0	36.02	2.28	0	30186595.99	30186595.99	30186595.99
43	2	0.79	1.27	37.5	45.93	0	1.49	43.64	0	30186595.99	30186595.99	30186595.99
43	3	0.98	1.02	37.52	45.96	0	0.01	0.03	0	30186595.99	30186595.99	30186595.99
43	4	0.99	1.01	37.79	49.54	0	0.27	3.58	0	30186595.99	30186595.99	30186595.99
43	5	1.15	0.87	38.51	49.69	0	0.72	0.15	0	30186595.99	30186595.99	30186595.99
43	6	1.24	0.81	38.52	49.69	0	0.01	0	0	30186595.99	30186595.99	30186595.99
43	7	1.61	0.62	38.67	49.72	0	0.16	0.03	0	30186595.99	30186595.99	30186595.99
43	8	1.62	0.62	38.73	49.74	0	0.05	0.01	0	30186595.99	30186595.99	30186595.99
43	9	1.65	0.6	38.74	49.74	0	0.01	0	0	30186595.99	30186595.99	30186595.99
43	10	1.82	0.55	39.17	58.41	0.07	0.43	8.67	0.06	30186595.99	30186595.99	30186595.99
43	11	1.86	0.54	41.54	58.7	0.07	2.36	0.29	0	30186595.99	30186595.99	30186595.99
43	12	1.88	0.53	42.03	58.78	0.07	0.5	0.08	0	30186595.99	30186595.99	30186595.99
43	13	1.9	0.53	42.53	58.79	0.07	0.49	0.02	0	30186595.99	30186595.99	30186595.99
43	14	2.05	0.49	42.64	58.8	0.07	0.11	0.01	0	30186595.99	30186595.99	30186595.99
43	15	2.2	0.45	43.81	60.29	0.09	1.17	1.49	0.02	30186595.99	30186595.99	30186595.99
43	16	2.34	0.43	43.81	60.29	0.29	0	0	0.2	30186595.99	30186595.99	30186595.99
43	17	2.4	0.42	43.81	60.29	0.3	0	0	0.01	30186595.99	30186595.99	30186595.99
43	18	2.47	0.4	50.1	66.3	0.37	6.29	6.01	0.08	30186595.99	30186595.99	30186595.99
43	19	2.5	0.4	50.46	66.46	1.47	0.36	0.16	1.1	30186595.99	30186595.99	30186595.99
43	20	2.56	0.39	54.26	74.72	1.48	3.81	8.26	0.01	30186595.99	30186595.99	30186595.99
43	21	2.64	0.38	54.28	74.75	2.37	0.01	0.03	0.9	30186595.99	30186595.99	30186595.99
43	22	2.69	0.37	54.28	74.76	2.78	0	0.01	0.4	30186595.99	30186595.99	30186595.99
43	23	2.69	0.37	54.3	74.76	2.78	0.02	0	0	30186595.99	30186595.99	30186595.99
43	24	2.79	0.36	54.3	74.76	2.91	0	0	0.13	30186595.99	30186595.99	30186595.99
43	25	2.97	0.34	54.3	74.77	3.07	0	0.01	0.17	30186595.99	30186595.99	30186595.99
43	26	3.02	0.33	54.3	74.77	3.08	0	0	0.01	30186595.99	30186595.99	30186595.99
43	27	3.08	0.32	54.3	74.85	3.15	0	0.08	0.07	30186595.99	30186595.99	30186595.99
43	28	3.1	0.32	54.3	74.91	3.16	0	0.05	0.01	30186595.99	30186595.99	30186595.99
43	29	3.41	0.29	54.35	75	3.16	0.04	0.09	0	30186595.99	30186595.99	30186595.99
43	30	3.44	0.29	54.46	75.13	3.16	0.11	0.13	0	30186595.99	30186595.99	30186595.99
43	31	3.44	0.29	54.73	75.45	3.17	0.27	0.32	0	30186595.99	30186595.99	30186595.99
43	32	3.5	0.29	54.73	75.45	3.22	0	0	0.06	30186595.99	30186595.99	30186595.99
43	33	3.5	0.29	54.73	75.45	3.22	0	0	0	30186595.99	30186595.99	30186595.99
43	34	3.53	0.28	54.73	75.45	3.29	0	0	0.07	30186595.99	30186595.99	30186595.99
43	35	3.53	0.28	54.73	75.45	3.31	0	0	0.01	30186595.99	30186595.99	30186595.99
43	36	3.54	0.28	54.73	75.45	3.32	0	0	0.01	30186595.99	30186595.99	30186595.99
43	37	3.59	0.28	54.73	75.45	3.58	0	0	0.26	30186595.99	30186595.99	30186595.99
43	38	3.67	0.27	54.73	75.45	3.6	0	0	0.02	30186595.99	30186595.99	30186595.99
43	39	3.68	0.27	54.73	75.45	4.69	0	0	1.09	30186595.99	30186595.99	30186595.99
43	40	3.73	0.27	54.74	75.45	4.69	0	0	0.01	30186595.99	30186595.99	30186595.99
43	41	3.73	0.27	54.74	75.45	5.28	0	0	0.59	30186595.99	30186595.99	30186595.99
43	42	3.75	0.27	54.74	75.49	15.95	0	0.04	10.68	30186595.99	30186595.99	30186595.99
43	43	3.81	0.26	54.88	75.49	15.95	0.14	0	0	30186595.99	30186595.99	30186595.99
43	44	3.92	0.25	54.88	75.49	16.17	0	0	0.22	30186595.99	30186595.99	30186595.99
43	45	3.97	0.25	54.92	75.75	16.2	0.04	0.26	0.03	30186595.99	30186595.99	30186595.99
43	46	4.23	0.24	54.92	75.75	16.21	0	0	0	30186595.99	30186595.99	30186595.99
43	47	4.27	0.23	54.92	75.75	16.21	0	0	0	30186595.99	30186595.99	30186595.99
43	48	4.28	0.23	54.92	75.75	16.21	0	0	0	30186595.99	30186595.99	30186595.99
43	49	4.33	0.23	54.94	75.78	16.71	0.02	0.03	0.5	30186595.99	30186595.99	30186595.99
43	50	4.34	0.23	54.95	75.79	16.9	0	0.01	0.19	30186595.99	30186595.99	30186595.99
43	51	4.38	0.23	54.95	75.92	16.9	0	0.13	0	30186595.99	30186595.99	30186595.99
43	52	4.38	0.23	54.95	75.99	16.91	0	0.07	0.01	30186595.99	30186595.99	30186595.99
43	53	4.42	0.23	54.95	75.99	16.96	0	0	0.05	30186595.99	30186595.99	30186595.99
43	54	4.44	0.23	54.95	75.99	17.46	0	0	0.49	30186595.99	30186595.99	30186595.99
43	55	4.46	0.22	54.95	76	17.95	0	0	0.49	30186595.99	30186595.99	30186595.99
43	56	4.51	0.22	55.07	76	17.96	0.13	0	0.02	30186595.99	30186595.99	30186595.99
43	57	4.52	0.22	55.08	76	18.1	0.01	0.01	0.14	30186595.99	30186595.99	30186595.99
43	58	4.59	0.22	55.09	76.02	18.13	0.01	0.01	0.04	30186595.99	30186595.99	30186595.99
43	59	4.6	0.22	55.09	76.02	19.33	0	0	1.2	30186595.99	30186595.99	30186595.99
43	60	4.74	0.21	55.09	76.02	19.34	0	0	0	30186595.99	30186595.99	30186595.99
43	61	4.82	0.21	55.15	76.02	20.11	0.06	0	0.78	30186595.99	30186595.99	30186595.99
43	62	4.89	0.2	55.15	76.02	20.33	0.01	0	0.22	30186595.99	30186595.99	30186595.99

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43	63	4.91	0.2	55.23	76.02	22.31	0.07	0	1.98	30186595.99	30186595.99	30186595.99
43	64	4.92	0.2	55.23	76.04	22.38	0.01	0.02	0.08	30186595.99	30186595.99	30186595.99
43	65	4.93	0.2	55.25	76.05	22.41	0.02	0.01	0.03	30186595.99	30186595.99	30186595.99
43	66	5.01	0.2	55.25	76.24	22.42	0.01	0.19	0.01	30186595.99	30186595.99	30186595.99
43	67	5.04	0.2	55.26	76.82	24.3	0	0.58	1.88	30186595.99	30186595.99	30186595.99
43	68	5.07	0.2	55.33	76.92	24.3	0.07	0.1	0	30186595.99	30186595.99	30186595.99
43	69	5.12	0.2	55.38	79.55	24.55	0.05	2.64	0.24	30186595.99	30186595.99	30186595.99
43	70	5.15	0.19	55.38	80.4	24.68	0	0.85	0.13	30186595.99	30186595.99	30186595.99
43	71	5.21	0.19	55.4	80.41	25.01	0.02	0.01	0.33	30186595.99	30186595.99	30186595.99
43	72	5.25	0.19	55.58	80.47	25.2	0.18	0.06	0.19	30186595.99	30186595.99	30186595.99
43	73	5.29	0.19	56.01	80.84	25.26	0.43	0.37	0.05	30186595.99	30186595.99	30186595.99
43	74	5.31	0.19	56.01	82.42	25.33	0	1.58	0.07	30186595.99	30186595.99	30186595.99
43	75	5.31	0.19	56.56	86.74	25.45	0.55	4.33	0.12	30186595.99	30186595.99	30186595.99
43	76	5.36	0.19	56.87	86.9	25.57	0.31	0.16	0.12	30186595.99	30186595.99	30186595.99
43	77	5.41	0.18	56.93	87.16	27.02	0.05	0.26	1.44	30186595.99	30186595.99	30186595.99
43	78	5.44	0.18	56.95	89.07	28.06	0.02	1.9	1.05	30186595.99	30186595.99	30186595.99
43	79	5.46	0.18	56.97	89.58	28.08	0.02	0.51	0.02	30186595.99	30186595.99	30186595.99
43	80	5.51	0.18	56.99	89.61	28.08	0.01	0.02	0	30186595.99	30186595.99	30186595.99
43	81	5.53	0.18	56.99	89.65	28.08	0	0.05	0	30186595.99	30186595.99	30186595.99
43	82	5.54	0.18	57.05	89.71	28.12	0.06	0.06	0.04	30186595.99	30186595.99	30186595.99
43	83	5.56	0.18	57.05	89.79	28.15	0.01	0.08	0.03	30186595.99	30186595.99	30186595.99
43	84	5.59	0.18	57.06	89.84	28.47	0	0.05	0.32	30186595.99	30186595.99	30186595.99
43	85	5.61	0.18	57.07	89.89	28.55	0.01	0.06	0.07	30186595.99	30186595.99	30186595.99
43	86	5.64	0.18	57.08	89.92	28.56	0.01	0.02	0.01	30186595.99	30186595.99	30186595.99
43	87	5.65	0.18	57.08	89.93	28.56	0	0.01	0	30186595.99	30186595.99	30186595.99
43	88	5.68	0.18	57.08	89.93	28.59	0	0.01	0.04	30186595.99	30186595.99	30186595.99
43	89	5.69	0.18	57.08	89.96	28.59	0	0.02	0	30186595.99	30186595.99	30186595.99
43	90	5.73	0.17	57.09	89.96	28.99	0.01	0.01	0.39	30186595.99	30186595.99	30186595.99
43	91	5.74	0.17	57.1	89.98	29.03	0.01	0.01	0.04	30186595.99	30186595.99	30186595.99
43	92	5.77	0.17	57.1	89.98	29.19	0	0	0.16	30186595.99	30186595.99	30186595.99
43	93	5.78	0.17	57.1	89.99	29.19	0	0.01	0	30186595.99	30186595.99	30186595.99
43	94	5.79	0.17	57.1	89.99	29.35	0	0	0.16	30186595.99	30186595.99	30186595.99
43	95	5.81	0.17	57.13	90.13	29.35	0.03	0.15	0	30186595.99	30186595.99	30186595.99
43	96	5.82	0.17	57.13	90.13	30.02	0	0	0.66	30186595.99	30186595.99	30186595.99
43	97	5.82	0.17	57.13	90.15	30.04	0	0.01	0.02	30186595.99	30186595.99	30186595.99
43	98	5.88	0.17	57.13	90.15	31.51	0	0	1.47	30186595.99	30186595.99	30186595.99
43	99	5.89	0.17	57.13	90.15	31.52	0	0	0.01	30186595.99	30186595.99	30186595.99
43	100	5.9	0.17	57.14	90.17	31.56	0.01	0.02	0.04	30186595.99	30186595.99	30186595.99
43	101	5.9	0.17	57.14	90.17	31.65	0	0	0.09	30186595.99	30186595.99	30186595.99
43	102	5.91	0.17	57.14	90.17	31.79	0	0	0.14	30186595.99	30186595.99	30186595.99
43	103	5.94	0.17	57.14	90.18	31.8	0	0	0	30186595.99	30186595.99	30186595.99
43	104	5.95	0.17	57.14	90.18	31.98	0	0	0.19	30186595.99	30186595.99	30186595.99
43	105	5.96	0.17	57.15	90.21	34.21	0	0.02	2.23	30186595.99	30186595.99	30186595.99
43	106	5.99	0.17	57.15	90.21	34.21	0	0.01	0	30186595.99	30186595.99	30186595.99
43	107	6.01	0.17	57.15	90.21	34.46	0	0	0.25	30186595.99	30186595.99	30186595.99
43	108	6.03	0.17	57.15	90.22	34.64	0	0.01	0.17	30186595.99	30186595.99	30186595.99
43	109	6.04	0.17	57.15	90.23	34.64	0	0	0.01	30186595.99	30186595.99	30186595.99
43	110	6.06	0.17	57.15	90.23	34.7	0	0	0.06	30186595.99	30186595.99	30186595.99
43	111	6.13	0.16	57.15	90.24	34.89	0	0.01	0.19	30186595.99	30186595.99	30186595.99
43	112	6.16	0.16	57.15	90.24	34.89	0	0	0	30186595.99	30186595.99	30186595.99
43	113	6.21	0.16	57.15	90.24	36.81	0	0	1.92	30186595.99	30186595.99	30186595.99
43	114	6.24	0.16	57.15	90.25	36.82	0	0	0	30186595.99	30186595.99	30186595.99
43	115	6.26	0.16	57.15	90.25	36.82	0	0	0	30186595.99	30186595.99	30186595.99
43	116	6.27	0.16	57.16	90.25	36.97	0	0	0.15	30186595.99	30186595.99	30186595.99
43	117	6.3	0.16	57.16	90.25	37.23	0	0	0.26	30186595.99	30186595.99	30186595.99
43	118	6.31	0.16	57.16	90.25	37.26	0	0	0.02	30186595.99	30186595.99	30186595.99
43	119	6.32	0.16	57.2	90.25	37.26	0.04	0	0	30186595.99	30186595.99	30186595.99
43	120	6.32	0.16	57.25	90.26	37.27	0.05	0	0.01	30186595.99	30186595.99	30186595.99
43	121	6.34	0.16	57.25	90.26	37.28	0	0	0.01	30186595.99	30186595.99	30186595.99
43	122	6.37	0.16	57.25	90.26	37.28	0	0	0.01	30186595.99	30186595.99	30186595.99
43	123	6.4	0.16	57.25	90.26	37.3	0	0	0.01	30186595.99	30186595.99	30186595.99
43	124	6.4	0.16	57.25	90.26	37.3	0	0	0	30186595.99	30186595.99	30186595.99
43	125	6.42	0.16	57.26	90.27	37.83	0	0.01	0.53	30186595.99	30186595.99	30186595.99
43	126	6.43	0.16	57.26	90.27	37.84	0	0	0	30186595.99	30186595.99	30186595.99
43	127	6.44	0.16	57.26	90.28	38.83	0	0.01	1	30186595.99	30186595.99	30186595.99
43	128	6.48	0.15	57.26	90.3	39.5	0	0.02	0.67	30186595.99	30186595.99	30186595.99

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43	129	6.5	0.15	57.26	90.3	39.5	0	0	0	30186595.99	30186595.99	30186595.99
43	130	6.51	0.15	57.27	90.3	39.5	0	0	0	30186595.99	30186595.99	30186595.99
43	131	6.54	0.15	57.27	90.31	39.85	0	0.01	0.35	30186595.99	30186595.99	30186595.99
43	132	6.55	0.15	57.27	90.31	39.88	0	0	0.03	30186595.99	30186595.99	30186595.99
43	133	6.57	0.15	57.27	90.33	40.69	0	0.01	0.81	30186595.99	30186595.99	30186595.99
43	134	6.57	0.15	57.27	90.33	40.69	0	0	0	30186595.99	30186595.99	30186595.99
43	135	6.58	0.15	57.27	90.33	41.02	0	0	0.33	30186595.99	30186595.99	30186595.99
43	136	6.59	0.15	57.27	90.33	42.63	0	0	1.61	30186595.99	30186595.99	30186595.99
43	137	6.61	0.15	57.27	90.33	43.15	0	0	0.53	30186595.99	30186595.99	30186595.99
43	138	6.65	0.15	57.27	90.33	43.22	0	0	0.07	30186595.99	30186595.99	30186595.99
43	139	6.66	0.15	57.27	90.33	43.33	0	0	0.11	30186595.99	30186595.99	30186595.99
43	140	6.67	0.15	57.28	90.33	43.55	0.01	0	0.22	30186595.99	30186595.99	30186595.99
43	141	6.68	0.15	57.28	90.33	43.55	0	0	0	30186595.99	30186595.99	30186595.99
43	142	6.71	0.15	57.28	90.33	43.57	0	0	0.01	30186595.99	30186595.99	30186595.99
43	143	6.72	0.15	57.47	90.33	43.57	0.2	0	0	30186595.99	30186595.99	30186595.99
43	144	6.74	0.15	57.47	90.33	43.57	0	0	0	30186595.99	30186595.99	30186595.99
43	145	6.75	0.15	57.47	90.33	43.57	0	0	0	30186595.99	30186595.99	30186595.99
43	146	6.79	0.15	57.47	90.33	43.82	0	0	0.25	30186595.99	30186595.99	30186595.99
43	147	6.79	0.15	57.47	90.33	43.82	0	0	0	30186595.99	30186595.99	30186595.99
43	148	6.8	0.15	57.48	90.33	44.5	0.01	0	0.67	30186595.99	30186595.99	30186595.99
43	149	6.82	0.15	57.48	90.33	44.51	0	0	0.01	30186595.99	30186595.99	30186595.99
43	150	6.82	0.15	57.49	90.34	44.86	0.01	0	0.36	30186595.99	30186595.99	30186595.99
43	151	6.85	0.15	57.49	90.35	45	0	0.01	0.14	30186595.99	30186595.99	30186595.99
43	152	6.87	0.15	57.5	90.35	45.32	0	0.01	0.32	30186595.99	30186595.99	30186595.99
43	153	6.87	0.15	57.57	90.35	45.34	0.07	0	0.02	30186595.99	30186595.99	30186595.99
43	154	6.89	0.15	57.57	90.36	45.37	0	0	0.03	30186595.99	30186595.99	30186595.99
43	155	6.91	0.14	57.57	90.36	45.42	0	0	0.05	30186595.99	30186595.99	30186595.99
43	156	6.94	0.14	57.58	90.38	45.42	0	0.02	0	30186595.99	30186595.99	30186595.99
43	157	6.95	0.14	57.59	90.47	45.54	0.02	0.09	0.12	30186595.99	30186595.99	30186595.99
43	158	6.96	0.14	57.61	90.54	45.55	0.01	0.06	0.01	30186595.99	30186595.99	30186595.99
43	159	6.98	0.14	57.62	90.55	45.89	0.01	0.02	0.34	30186595.99	30186595.99	30186595.99
43	160	7	0.14	57.64	90.62	46.08	0.03	0.06	0.19	30186595.99	30186595.99	30186595.99
43	161	7.01	0.14	57.64	90.62	46.09	0	0	0.01	30186595.99	30186595.99	30186595.99
43	162	7.03	0.14	57.65	90.62	46.12	0	0	0.03	30186595.99	30186595.99	30186595.99
43	163	7.06	0.14	57.65	90.62	46.13	0	0	0.01	30186595.99	30186595.99	30186595.99
43	164	7.06	0.14	57.67	90.69	46.62	0.02	0.07	0.49	30186595.99	30186595.99	30186595.99
43	165	7.08	0.14	57.67	90.7	46.68	0	0	0.06	30186595.99	30186595.99	30186595.99
43	166	7.12	0.14	57.67	90.7	46.96	0	0	0.28	30186595.99	30186595.99	30186595.99
43	167	7.15	0.14	57.68	90.7	47.01	0.01	0	0.05	30186595.99	30186595.99	30186595.99
43	168	7.16	0.14	57.68	90.7	47.06	0	0	0.05	30186595.99	30186595.99	30186595.99
43	169	7.19	0.14	57.68	90.7	47.9	0	0	0.84	30186595.99	30186595.99	30186595.99
43	170	7.24	0.14	57.68	90.71	47.91	0	0.01	0.01	30186595.99	30186595.99	30186595.99
43	171	7.26	0.14	57.68	90.71	47.93	0	0	0.03	30186595.99	30186595.99	30186595.99
43	172	7.28	0.14	57.73	90.75	47.97	0.05	0.04	0.03	30186595.99	30186595.99	30186595.99
43	173	7.29	0.14	57.75	90.76	47.97	0.01	0.02	0	30186595.99	30186595.99	30186595.99
43	174	7.33	0.14	57.75	90.77	48.38	0	0.01	0.41	30186595.99	30186595.99	30186595.99
43	175	7.33	0.14	57.75	90.77	48.42	0	0	0.04	30186595.99	30186595.99	30186595.99
43	176	7.35	0.14	57.75	90.77	48.42	0	0	0	30186595.99	30186595.99	30186595.99
43	177	7.36	0.14	57.75	90.77	48.54	0	0	0.12	30186595.99	30186595.99	30186595.99
43	178	7.41	0.13	57.75	90.78	48.8	0	0	0.26	30186595.99	30186595.99	30186595.99
43	179	7.44	0.13	57.75	90.78	48.99	0	0	0.18	30186595.99	30186595.99	30186595.99
43	180	7.45	0.13	57.75	90.79	48.99	0	0.02	0	30186595.99	30186595.99	30186595.99
43	181	7.49	0.13	57.75	90.79	49.07	0	0	0.08	30186595.99	30186595.99	30186595.99
43	182	7.5	0.13	57.75	90.79	49.08	0	0	0	30186595.99	30186595.99	30186595.99
43	183	7.52	0.13	57.75	90.79	49.71	0	0	0.63	30186595.99	30186595.99	30186595.99
43	184	7.53	0.13	57.75	90.8	49.75	0	0	0.04	30186595.99	30186595.99	30186595.99
43	185	7.56	0.13	57.75	90.8	49.84	0	0	0.09	30186595.99	30186595.99	30186595.99
43	186	7.59	0.13	57.76	90.8	50.01	0	0	0.18	30186595.99	30186595.99	30186595.99
43	187	7.62	0.13	57.76	90.8	50.04	0	0	0.02	30186595.99	30186595.99	30186595.99
43	188	7.64	0.13	57.76	90.8	50.1	0	0	0.07	30186595.99	30186595.99	30186595.99
43	189	7.65	0.13	57.76	90.81	50.32	0	0.02	0.22	30186595.99	30186595.99	30186595.99
43	190	7.66	0.13	57.76	90.83	50.32	0	0.01	0	30186595.99	30186595.99	30186595.99
43	191	7.74	0.13	57.77	90.83	50.33	0	0	0.01	30186595.99	30186595.99	30186595.99
43	192	7.75	0.13	57.77	90.84	50.49	0.01	0.01	0.15	30186595.99	30186595.99	30186595.99
43	193	7.76	0.13	57.77	90.88	50.82	0	0.04	0.34	30186595.99	30186595.99	30186595.99
43	194	7.79	0.13	57.79	90.96	51.18	0.02	0.08	0.36	30186595.99	30186595.99	30186595.99

TN_CORPO 3_MODOS DE VIBRAÇÃO

43	195	7.82	0.13	58.28	91.65	51.21	0.49	0.69	0.03	30186595.99	30186595.99	30186595.99
43	196	7.83	0.13	58.35	91.85	51.52	0.06	0.19	0.31	30186595.99	30186595.99	30186595.99
43	197	7.85	0.13	58.35	91.87	51.59	0	0.02	0.07	30186595.99	30186595.99	30186595.99
43	198	7.86	0.13	58.35	91.87	51.6	0	0	0.01	30186595.99	30186595.99	30186595.99
43	199	7.91	0.13	58.39	91.98	52.28	0.04	0.11	0.68	30186595.99	30186595.99	30186595.99
43	200	7.93	0.13	58.39	91.98	52.55	0	0	0.27	30186595.99	30186595.99	30186595.99
43	201	7.95	0.13	58.39	92	52.87	0	0.02	0.32	30186595.99	30186595.99	30186595.99
43	202	7.96	0.13	58.4	92	53.32	0.01	0	0.45	30186595.99	30186595.99	30186595.99
43	203	7.99	0.13	58.41	92	53.32	0.01	0	0	30186595.99	30186595.99	30186595.99
43	204	8	0.12	58.41	92.01	53.36	0	0.01	0.05	30186595.99	30186595.99	30186595.99
43	205	8.01	0.12	58.41	92.01	53.36	0	0	0	30186595.99	30186595.99	30186595.99
43	206	8.02	0.12	58.42	92.02	53.37	0.01	0.01	0	30186595.99	30186595.99	30186595.99
43	207	8.03	0.12	58.43	92.06	54.24	0.01	0.04	0.87	30186595.99	30186595.99	30186595.99
43	208	8.06	0.12	58.43	92.06	54.73	0	0	0.5	30186595.99	30186595.99	30186595.99
43	209	8.08	0.12	58.43	92.06	54.74	0	0	0	30186595.99	30186595.99	30186595.99
43	210	8.09	0.12	58.44	92.06	55.98	0	0	1.24	30186595.99	30186595.99	30186595.99
43	211	8.11	0.12	58.44	92.08	55.98	0	0.01	0	30186595.99	30186595.99	30186595.99
43	212	8.15	0.12	58.44	92.08	56.26	0	0.01	0.28	30186595.99	30186595.99	30186595.99
43	213	8.16	0.12	58.44	92.08	56.26	0	0	0	30186595.99	30186595.99	30186595.99
43	214	8.2	0.12	58.44	92.08	56.35	0	0	0.09	30186595.99	30186595.99	30186595.99
43	215	8.21	0.12	58.44	92.08	56.42	0	0	0.07	30186595.99	30186595.99	30186595.99
43	216	8.22	0.12	58.44	92.08	56.48	0	0	0.07	30186595.99	30186595.99	30186595.99
43	217	8.29	0.12	58.45	92.09	56.49	0	0.01	0.01	30186595.99	30186595.99	30186595.99
43	218	8.3	0.12	58.45	92.1	56.49	0	0	0	30186595.99	30186595.99	30186595.99
43	219	8.33	0.12	58.45	92.1	56.55	0	0	0.06	30186595.99	30186595.99	30186595.99
43	220	8.35	0.12	58.45	92.1	56.94	0	0	0.39	30186595.99	30186595.99	30186595.99
43	221	8.42	0.12	58.45	92.1	56.94	0	0	0	30186595.99	30186595.99	30186595.99
43	222	8.44	0.12	58.45	92.1	56.94	0	0	0	30186595.99	30186595.99	30186595.99
43	223	8.48	0.12	58.48	92.1	57	0.02	0	0.07	30186595.99	30186595.99	30186595.99
43	224	8.49	0.12	58.59	92.11	57.58	0.11	0.01	0.58	30186595.99	30186595.99	30186595.99
43	225	8.51	0.12	58.8	92.11	57.72	0.22	0	0.14	30186595.99	30186595.99	30186595.99
43	226	8.53	0.12	59.29	92.11	57.92	0.48	0	0.2	30186595.99	30186595.99	30186595.99
43	227	8.54	0.12	59.78	92.12	57.93	0.49	0.01	0.02	30186595.99	30186595.99	30186595.99
43	228	8.54	0.12	59.94	92.13	57.94	0.16	0.01	0.01	30186595.99	30186595.99	30186595.99
43	229	8.56	0.12	60.56	92.13	58.12	0.62	0	0.18	30186595.99	30186595.99	30186595.99
43	230	8.57	0.12	60.6	92.13	58.18	0.04	0	0.06	30186595.99	30186595.99	30186595.99
43	231	8.63	0.12	62.25	92.15	58.73	1.65	0.03	0.55	30186595.99	30186595.99	30186595.99
43	232	8.66	0.12	64.33	92.18	58.74	2.08	0.02	0.01	30186595.99	30186595.99	30186595.99
43	233	8.69	0.12	64.39	92.18	58.85	0.05	0	0.11	30186595.99	30186595.99	30186595.99
43	234	8.7	0.11	64.41	92.18	58.87	0.02	0	0.01	30186595.99	30186595.99	30186595.99
43	235	8.75	0.11	64.43	92.18	58.95	0.03	0	0.08	30186595.99	30186595.99	30186595.99
43	236	8.79	0.11	64.44	92.18	58.97	0	0	0.02	30186595.99	30186595.99	30186595.99
43	237	8.81	0.11	64.44	92.18	59.02	0.01	0	0.05	30186595.99	30186595.99	30186595.99
43	238	8.83	0.11	64.47	92.18	60.12	0.03	0	1.1	30186595.99	30186595.99	30186595.99
43	239	8.84	0.11	64.47	92.18	60.18	0	0	0.06	30186595.99	30186595.99	30186595.99
43	240	8.84	0.11	64.47	92.18	60.18	0	0	0	30186595.99	30186595.99	30186595.99
43	241	8.9	0.11	64.47	92.18	60.3	0	0	0.12	30186595.99	30186595.99	30186595.99
43	242	8.92	0.11	64.51	92.19	60.63	0.03	0	0.34	30186595.99	30186595.99	30186595.99
43	243	8.93	0.11	64.51	92.19	60.66	0	0	0.03	30186595.99	30186595.99	30186595.99
43	244	8.93	0.11	64.51	92.19	60.72	0	0	0.05	30186595.99	30186595.99	30186595.99
43	245	8.95	0.11	64.56	92.19	60.97	0.05	0	0.25	30186595.99	30186595.99	30186595.99
43	246	9	0.11	64.56	92.19	60.97	0	0	0	30186595.99	30186595.99	30186595.99
43	247	9.01	0.11	64.6	92.19	60.98	0.04	0	0.01	30186595.99	30186595.99	30186595.99
43	248	9.04	0.11	64.71	92.2	61.02	0.11	0.01	0.04	30186595.99	30186595.99	30186595.99
43	249	9.05	0.11	64.77	92.2	61.03	0.06	0	0.01	30186595.99	30186595.99	30186595.99
43	250	9.07	0.11	64.82	92.2	61.16	0.05	0	0.13	30186595.99	30186595.99	30186595.99

9.3 VERIFICAÇÃO ESTRUTURAL DE LAJES DE PISO E DIMENSIONAMENTO DE ESCADAS EM BETÃO ARMADO

TN_CORPO 3_VERIFICAÇÃO ARMADURA DAS LAJES

Betão	C30/37			Aço	A500 NR
f_{ck}	f_{cd}	f_{ctm}	c_{nom}	f_{yk}	f_{yd}
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)
30.0	20.0	2.9	3.00	500	435

Direção Circunferencial - Direção XX																		
Dados				Geometria				Armaduras				Momento Resistente		Momento Atuentes		Verificação		
Parede / Zona			CASO	A _{s,of,Total} (cm²/m)	b (m)	h (m)	d (m)	Armadura base	A _{s,of} (cm²/m)	Reforço	A _{s,of,Reforço} (cm²/m)	A _{s,of,Total} (cm²/m)	ρ (%)	ω	μ	M _{Rd,XX} (kNm/m)	M _{Ed,XX} + M _{Ed,XY} (kNm/m)	M _{Ed,XX} ≤ M _{Rd,XX} (cm²/m)
PISO 0	al 16 al 17 e al 23 al 24	al 16 al 17 (vão)	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	Ø10/0.30	2.62	10.16	0.64	0.140	0.130	64.8	33.4	Verifica
		al 23 al 24 (vão)	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	Ø10/0.30	2.62	10.16	0.64	0.140	0.130	64.8	42.1	Verifica
		al A al C	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	Ø10/0.20	3.93	11.47	0.73	0.158	0.145	72.4	37.0	Verifica
		al D	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	Ø10/0.20	3.93	11.47	0.73	0.158	0.145	72.4	45.0	Verifica
		al D al E	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	Ø10/0.30	2.62	10.16	0.64	0.140	0.130	64.8	19.6	Verifica
	al 17; al 18; al 19; al 21; al 22; al 23	al A al B	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	28.0	Verifica
			156	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø12/0.20	5.65	9.58	0.61	0.132	0.123	61.4	-27.5	Verifica
		al B al C	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	31.9	Verifica
			156	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø12/0.20	5.65	9.58	0.61	0.132	0.123	61.4	-12.0	Verifica
		al C al D	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	28.0	Verifica
			156	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø12/0.20	5.65	9.58	0.61	0.132	0.123	61.4	-15.0	Verifica
		apoio escada caracol	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	68.0	Reforçar
		al D al E	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	28.0	Verifica
			156	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-12.0	Verifica
		CAPITEIS	104	INFERIOR	1.00	0.40	0.358	Ø12/0.15	7.54	-	0.00	7.54	0.21	0.046	0.045	114.6	80.0	Verifica
		al A	156	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø16/0.20	10.05	13.98	0.88	0.192	0.173	86.5	-70.0	Verifica
		CAPITEL al B	156	SUPERIOR	1.00	0.40	0.358	Ø12/0.20	5.65	Ø16/0.20	10.05	15.70	0.44	0.095	0.091	232.4	-70.2	Verifica
		CAPITEL al C	156	SUPERIOR	1.00	0.40	0.358	Ø12/0.20	5.65	Ø16/0.20	10.05	15.70	0.44	0.095	0.091	232.4	-170.0	Verifica
		CAPITEL al D	156	SUPERIOR	1.00	0.40	0.358	Ø12/0.20	5.65	Ø16/0.20	10.05	15.70	0.44	0.095	0.091	232.4	-200.0	Verifica
		al E	156	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø12/0.20	5.65	9.58	0.61	0.132	0.123	61.4	-160.0	Reforçar

Direção Radial - Direção YY																		
Dados				Geometria			Armaduras					Momento Resistente			Momento Atuentes	Verificação		
LAJE / ZONA		CASO	Armadura	b (m)	h (m)	d (m)	Armadura base	A _{s,at} (cm²/m)	Reforço	A _{s,at,Reforço} (cm²/m)	A _{s,at>Total} (cm²/m)	ρ (%)	ω	μ	M _{Res,YY} (kNm/m)	M _{Ed,YY} + M _{Ed,XY} (kNm/m)	M _{Ed,YY} ≤ M _{Res,YY} (kNm/m)	
PISO 0	al 16 (BANDA) e al 24 (V1.24)	al A al B	160	INFERIOR	1.20	0.40	0.352	8Ø20		25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	160.0
		al B al C	160	INFERIOR	1.20	0.40	0.352	8Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	155.0	Verifica
		al A al D	160	INFERIOR	1.20	0.40	0.352	8Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	170.0	Verifica
		al D al E	160	INFERIOR	1.20	0.40	0.352	8Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	120.0	Verifica
		al A	160	SUPERIOR	1.20	0.40	0.352	8Ø20	25.13	-	0.00	25.13	0.71	0.155	0.143	353.9	-250.0	Verifica
		al B	160	SUPERIOR	1.20	0.40	0.352	8Ø20	25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	-350.0	Verifica
		al C	160	SUPERIOR	1.20	0.40	0.352	8Ø20	25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	-350.0	Verifica
		al D	160	SUPERIOR	1.20	0.40	0.352	8Ø20	25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	-150.0	Verifica
		al E	160	SUPERIOR	1.20	0.40	0.352	8Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	70.0	Verifica
		al A al B	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	Ø12/0.30	3.77	11.31	0.72	0.156	0.143	71.5	70.0	Verifica
	al 16 a al 24 (vão)	al B al C	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	24.8	Verifica
		al C al D	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	35.3	Verifica
		apoio escada caracol	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	49.0	Verifica
		al D al E	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	22.0	Verifica
		al A	160	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-18.0	Verifica
		al B	160	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø16/0.20	10.05	13.98	0.88	0.192	0.173	86.5	-20.0	Verifica
		al C	160	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø12/0.20	5.65	9.58	0.61	0.132	0.123	61.4	-19.0	Verifica
		al D	160	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø12/0.20	5.65	9.58	0.61	0.132	0.123	61.4	-19.0	Verifica
		al E	160	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-18.0	Verifica
		al A al B	104	INFERIOR	1.00	0.20	0.158	Ø16/0.10	20.11	-	0.00	20.11	1.27	0.277	0.237	118.5	70.0	Verifica
	al 17; al 18; al 19; al 21; al 22; al 23	al B al C	160	SUPERIOR	1.00	0.20	0.158	Ø16/0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		al B al C	104	INFERIOR	1.00	0.20	0.158	Ø12/0.10	11.31	-	0.00	11.31	0.72	0.156	0.143	71.5	25.0	Verifica
		al B al C	160	SUPERIOR	1.00	0.20	0.158	Ø16/0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		al C al D	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	25.0	Verifica
		al C al D	160	SUPERIOR	1.00	0.20	0.158	Ø16/0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		al D al E	104	INFERIOR	1.00	0.20	0.158	Ø12/0.10	11.31	-	0.00	11.31	0.72	0.156	0.143	71.5	25.0	Verifica
		al D al E	160	SUPERIOR	1.00	0.20	0.158	Ø16/0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		CAPITEIS	104	INFERIOR	1.00	0.40	0.358	Ø12/0.15	7.54	-	0.00	7.54	0.21	0.046	0.045	114.6	70.0	Verifica
		CAP al A	104	INFERIOR	1.00	0.20	0.158	Ø16/0.10	20.11	-	0.00	20.11	1.27	0.277	0.237	118.5	100.0	Verifica
		al A	160	SUPERIOR	1.00	0.40	0.358	Ø12/0.20	5.65	Ø16/0.20	10.05	15.70	0.44	0.095	0.091	232.4	-210.0	Verifica
	al 23 al 24 al 24	CAPITEL al B	160	SUPERIOR	1.00	0.40	0.358	Ø12/0.20	5.65	Ø16/0.20	10.05	15.70	0.44	0.095	0.091	232.4	-210.0	Verifica
		CAPITEL al C	160	SUPERIOR	1.00	0.40	0.358	Ø12/0.20	5.65	Ø16/0.20	10.05	15.70	0.44	0.095	0.091	232.4	-210.0	Verifica
		CAPITEL al D	160	SUPERIOR	1.00	0.40	0.358	Ø12/0.20	5.65	Ø16/0.20	10.05	15.70	0.44	0.095	0.091	232.4	-210.0	Verifica
		al E	160	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-25.0	Verifica
		al A al B	104	INFERIOR	1.00	0.40	0.358	Ø12/0.15	7.54	-	0.00	7.54	0.21	0.046	0.045	114.6	85.0	Verifica
		al A al E	104	INFERIOR	1.20	0.40	0.352	8Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	180.0	Verifica

Betão	C30/37				Aço	A500 NR
f_{ck}	f_{cd}	f_{ctm}	c_{nom}		f_{yk}	f_{ed}
(MPa)	(MPa)	(MPa)	(cm)		(MPa)	(MPa)
30.0	20.0	2.9	3.00		500	435

Direção Circunferencial - Direção XX																		
Dados				Geometria			Armaduras							Momento Resistente			Momento Atuantes	Verificação
Parede / Zona		CASO	A _{s,ef,Total} (cm ² /m)	b (m)	h (m)	d (m)	Armadura base	A _{s,ef} (cm ² /m)	Reforço	A _{s,ef,Reforço} (cm ² /m)	A _{s,ef,Total} (cm ² /m)	ρ (%)	ω	μ	M _{Rd,XX} (kNm/m)	M _{Ed,XX} + M _{Ed,XY}	M _{Ed,XX} ≤ M _{Rd,XX}	
PISO 1	al 16 al 17 e al 23 al 24	al 8 al 9 (vão)	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	Ø10//0.30	2.62	10.16	0.64	0.140	0.130	64.8	35.0	Verifica
		al 15 al 16 (vão)	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	Ø10//0.30	2.62	10.16	0.64	0.140	0.130	64.8	27.7	Verifica
		al A al C	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	Ø10//0.20	3.93	11.47	0.73	0.158	0.145	72.4	20.7	Verifica
		al D	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	Ø10//0.20	3.93	11.47	0.73	0.158	0.145	72.4	45.0	Verifica
		al D al E	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	Ø10//0.30	2.62	10.16	0.64	0.140	0.130	64.8	17.0	Verifica
			104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	36.5	Verifica
		al A al B	156	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø12//0.20	5.65	9.58	0.61	0.132	0.123	61.4	-27.7	Verifica
			104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	-25.3	Verifica
		al B al C	156	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø12//0.20	5.65	9.58	0.61	0.132	0.123	61.4	-12.3	Verifica
			104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	25.3	Verifica
	al 17: al 18; al 19; al 21; al 22; al 23	al C al D	156	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø12//0.20	5.65	9.58	0.61	0.132	0.123	61.4	-15.0	Verifica
		apoio escada caracol	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	90.0	Reforçar
			104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	-16.3	Verifica
		al D al E	156	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-10.0	Verifica
		CAPITEIS	104	INFERIOR	1.00	0.40	0.358	Ø12//0.15	7.54	-	0.00	7.54	0.21	0.046	0.045	114.6	80.0	Verifica
		al A'	156	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø16//0.20	10.05	13.98	0.88	0.192	0.173	86.5	-70.2	Verifica
		CAPITEL al B	156	SUPERIOR	1.00	0.40	0.358	Ø12//0.20	5.65	Ø16//0.20	10.05	15.70	0.44	0.095	0.091	232.4	-170.0	Verifica
		CAPITEL al C	156	SUPERIOR	1.00	0.40	0.358	Ø12//0.20	5.65	Ø16//0.20	10.05	15.70	0.44	0.095	0.091	232.4	-200.0	Verifica
		CAPITEL al D	156	SUPERIOR	1.00	0.40	0.358	Ø12//0.20	5.65	Ø16//0.20	10.05	15.70	0.44	0.095	0.091	232.4	-160.0	Verifica
		al E	156	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø12//0.20	5.65	9.58	0.61	0.132	0.123	61.4	-50.0	Verifica

Direção Radial - Direção YY																		
Dados				Geometria			Armaduras						Momento Resistente			Momento Atuantes	Verificação	
LAJE / ZONA		CASO	Armadura	b (m)	h (m)	d (m)	Armadura base	A _{s,ef} (cm²/m)	Reforço	A _{s,ef,Reforço} (cm²/m)	A _{s,ef,Total} (cm²/m)	ρ (%)	ω	μ	M _{Rd,YY} (kNm/m)	M _{Ed,YY} + M _{Ed,XY} (kNm/m)	M _{Ed,YY} ≤ M _{Rd,YY} (kNm/m)	
PISO 1	al 16 (BANDA) e al 24 (V1.24)	al A al B	160	INFERIOR	1.20	0.40	0.352	Ø20	25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	155.0	Verifica
		al B al C	160	INFERIOR	1.20	0.40	0.352	Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	155.0	Verifica
		al C al D	160	INFERIOR	1.20	0.40	0.352	Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	120.0	Verifica
		al D al E	160	INFERIOR	1.20	0.40	0.352	Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	120.0	Verifica
		al A	160	SUPERIOR	1.20	0.40	0.352	Ø20	25.13	-	0.00	25.13	0.71	0.155	0.143	353.9	-250.0	Verifica
		al B	160	SUPERIOR	1.20	0.40	0.352	Ø20	25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	-350.0	Verifica
		al C	160	SUPERIOR	1.20	0.40	0.352	Ø20	25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	-350.0	Verifica
		al D	160	SUPERIOR	1.20	0.40	0.352	Ø20	25.13	4Ø20	12.57	37.70	1.07	0.194	0.175	519.4	-250.0	Verifica
		al E	160	SUPERIOR	1.20	0.40	0.352	Ø20	25.13	-	0.00	25.13	0.71	0.129	0.121	359.0	-70.0	Verifica
		al A al B	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	Ø12//0.30	3.77	11.31	0.72	0.156	0.143	71.5	37.0	Verifica
	al 16 a al 24 (vão)	al B al E	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	22.0	Verifica
		al C al D	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	Ø12//0.20	5.65	13.19	0.83	0.181	0.165	82.2	22.0	Verifica
		apoio escada caracol	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	70.0	Reforçar
		al D al E	104	INFERIOR	1.00	0.20	0.158	Ø12//0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	22.0	Verifica
		al A	160	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-18.0	Verifica
		al B	160	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø16//0.20	10.05	13.98	0.88	0.192	0.173	86.5	-20.0	Verifica
		al C	160	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø12//0.20	5.65	9.58	0.61	0.132	0.123	61.4	-19.0	Verifica
		al D	160	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	Ø12//0.20	5.65	9.58	0.61	0.132	0.123	61.4	-19.0	Verifica
		al E	160	SUPERIOR	1.00	0.20	0.158	Ø10//0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-18.0	Verifica
		al A al B	104	INFERIOR	1.00	0.20	0.158	Ø16//0.10	20.11	-	0.00	20.11	1.27	0.277	0.237	118.5	70.0	Verifica
	al 17: al 18; al 19; al 21; al 22; al 23		160	SUPERIOR	1.00	0.20	0.158	Ø16//0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		al B al C	104	INFERIOR	1.00	0.20	0.158	Ø12//0.10	11.31	-	0.00	11.31	0.72	0.156	0.143	71.5	25.0	Verifica
			160	SUPERIOR	1.00	0.20	0.158	Ø16//0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		al C al D	104	INFERIOR	1.00	0.20	0.158	Ø12//0.10	11.31	-	0.00	11.31	0.72	0.156	0.143	71.5	25.0	Verifica
			160	SUPERIOR	1.00	0.20	0.158	Ø16//0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		al D al E	104	INFERIOR	1.00	0.20	0.158	Ø12//0.10	11.31	-	0.00	11.31	0.72	0.156	0.143	71.5	25.0	Verifica
			160	SUPERIOR	1.00	0.20	0.158	Ø16//0.20	10.05	-	0.00	10.05	0.64	0.138	0.128	64.1	-22.0	Verifica
		CAPITEIS	104	INFERIOR	1.00	0.40	0.358	Ø12//0.15	7.54	-	0.00	7.54	0.21	0.046	0.045	114.6	70.0	Verifica
		CAP al A	105	INFERIOR	1.00	0.40	0.358	Ø12//0.15	7.54	-	0.00	7.54	0.21	0.046	0.045	114.6	71.0	Verifica
			160	INFERIOR	1.00	0.20	0.158	Ø16//0.10	20.11	-	0.00	20.11	1.27	0.277	0.237	233.1	186.0	Verifica
		CAPITEL al B	160	SUPERIOR	1.00	0.40	0.358	Ø12//0.20	5.65	Ø16//0.20	10.05	15.70	0.44	0.095	0.091	232.4	-185.0	Verifica
		CAPITEL al C	160	SUPERIOR	1.00	0.40	0.358	Ø12//0.20	5.65	Ø16//0.20	10.05	15.70	0.44	0.095	0.091	232.4	-180.0	Verifica
		CAPITEL al D	160	SUPERIOR	1.00	0.40	0.358	Ø12//0.20	5.65	Ø16//0.20	10.05	15.70	0.44	0.095	0.091	232.4	-180.0	Verifica
		al E	160	SUPERIOR	1.00	0.20	0.158	Ø12//0.20	5.65	-	0.00	5.65	0.36	0.078	0.075	37.3	-25.0	Verifica

TN_CORPO 3_VERIFICAÇÃO ARMADURAS DAS LAJES

Betão		C30/37		Aço	A500 NR
f_{ck}	f_{cd}	f_{ctm}	C_{nom}	f_{yk}	f_{yd}
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)
30.0	20.0	2.9	3.00	500	435

Direção Circunferencial - Direção XX																		
Dados				Geometria			Armaduras					Momento Resistente			Momento Atuentes		Verificação	
Parede / Zona		CASO	$A_{s,atTotal}$ (cm²/m)	b (m)	h (m)	d (m)	Armadura base	$A_{s,at}$ (cm²/m)	Reforço	$A_{s,atReforço}$ (cm²/m)	$A_{s,atTotal}$ (cm²/m)	ρ (%)	ω	μ	$M_{Rd,XX}$ (kNm/m)	$M_{Ed,XX} + M_{Ed,XY} $ (kNm/m)	$M_{Ed,YY} \leq M_{Rd,YY}$ (cm²/m)	
PISO 2	al 16 al 17; al 23 al 24	vão	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	Ø10/0.15	5.24	12.78	0.81	0.176	0.160	79.9	32.0	Verifica
		apoio viga bordo	105-175	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-10.0	Verifica
	al 18 al 19 (escada caracol)	apoio escada na laje	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	45.0	Verifica
		apoio escada na laje	105-175	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	-	0.00	3.93	0.25	0.054	0.053	26.2	-59.0	Reforçar
	al 17 a al 23	vão	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	28.2	Verifica
		apoio viga V2.17 a V2.23	105-175	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø12/0.10	11.31	15.24	0.96	0.210	0.187	93.4	-56.0	Verifica
		apoio viga radial	105-175	SUPERIOR	1.00	0.20	0.158	Ø12/0.20	5.65	Ø10/0.20	3.93	9.58	0.61	0.132	0.123	61.4	-58.0	Verifica

Direção Radial - Direção YY																		
Designação			CASO	Armadura	Geometria			Armadura base	Armaduras				Momento Resistente			Momento Atuentes	Verificação	
LAJE / ZONA		b (m)			h (m)	d (m)	$A_{s,ef}$ (cm ² /m)		Reforço	$A_{s,ef,Reforço}$ (cm ² /m)	$A_{s,ef,Total}$ (cm ² /m)	ρ (%)	ω	μ	$M_{Rd,YY}$ (kNm/m)			
PISO 2	al 16 a al 24	vão	104	INFERIOR	1,00	0,20	0,158	Ø10/0,10	-	0,00	7,85	0,50	0,108	0,102	50,9	41,0	Verifica	
		vão (escada caracol)	104	INFERIOR	1,00	0,20	0,158	Ø10/0,10	-	0,00	7,85	0,50	0,108	0,102	50,9	77,0	Reforçar	
		apoio viga circunferencial	104	SUPERIOR	1,00	0,20	0,158	Ø10/0,25	3,14	Ø12/0,25	4,52	7,66	0,48	0,105	0,100	49,8	-47,7	Verifica
		apoio viga circunferencial	104	SUPERIOR	1,00	0,20	0,158	Ø10/0,25	3,14	Ø16/0,25	8,04	11,18	0,71	0,154	0,142	70,7	-62,6	Verifica
		apoio (escada caracol)	104	SUPERIOR	1,00	0,20	0,158	Ø10/0,25	3,14	-	0,00	3,14	0,20	0,043	0,042	21,1	-50,0	Reforçar

Direção Circunferencial - Direção XX																		
Designação				Geometria				Armaduras					Momento Resistente		Momento Atuentes		Verificação	
Parede / Zona		CASO	A _{s,atTotal} (cm ² /m)	b (m)	h (m)	d (m)	Armadura base	A _{s,at} (cm ² /m)	Reforço	A _{s,atReforço} (cm ² /m)	A _{s,atTotal} (cm ² /m)	ρ (%)	ω	μ	M _{Rd,XX} (kNm/m)	M _{Ed,XX} + M _{Ed,XY} (kNm/m)	M _{Ed,YY} ≤ M _{Rd,YY} (cm ² /m)	
PISO 5	al 16 al 17; al 23 al 24	vão	104	INFERIOR	1.00	0.19	0.149	Ø10/0.15	5.24	Ø8/0.15	3.35	8.59	0.58	0.125	0.117	52.1	34.2	Verifica
		apoio viga V5.16b	104	SUPERIOR	1.00	0.19	0.149	Ø10/0.20	3.93	-	0.00	3.93	0.26	0.057	0.056	24.7	-19.0	Verifica
		apoio viga V5.17 e V5.23	104	SUPERIOR	1.00	0.19	0.149	Ø10/0.25	3.14	Ø12/0.125	9.05	12.19	0.82	0.178	0.162	71.8	-50.1	Verifica
	al 17 e al 23	al A al D, vão	104	INFERIOR	1.00	0.19	0.149	Ø10/0.15	5.24	-	0.00	5.24	0.35	0.076	0.073	32.6	23.9	Verifica
		apoio viga V5.18, V5.19,V5.20 e V5.22	104	SUPERIOR	1.00	0.19	0.149	Ø10/0.25	3.14	Ø12/0.25	4.52	7.66	0.51	0.112	0.105	46.8	-51.1	Reforçar
		al D al E, vão	104	INFERIOR	1.00	0.19	0.149	Ø10/0.15	5.24	-	0.00	5.24	0.35	0.076	0.073	32.6	14.0	Verifica
		al D al E, apoio viga radial	104	SUPERIOR	1.00	0.19	0.149	Ø10/0.25	3.14	Ø10/0.25	3.14	6.28	0.42	0.092	0.087	38.8	-32.4	Verifica

Direção Radial - Direção YY																		
Designação				Geometria			Armaduras						Momento Resistente			Momento Atuentes		Verificação
LAJE / ZONA		CASO	Armadura	b (m)	h (m)	d (m)	Armadura base	A _{s,ef} (cm ² /m)	Reforço	A _{s,ef,Reforço} (cm ² /m)	A _{s,ef>Total} (cm ² /m)	ρ (%)	ω	μ	M _{Rd,YY} (kNm/m)	M _{Ed,YY} + M _{Ed,XY} (kNm/m)	M _{Ed,YY} ≤ M _{Rd,YY} (kNm/m)	
PISO 5	al 16 al 17; al 23 al 24	vão	104	INFERIOR	1.00	0.19	0.149	Ø10/0.15	5.24	-	0.00	5.24	0.35	0.076	0.073	32.6	25.1	Verifica
		apoio viga circunferencial (al B)	104	SUPERIOR	1.00	0.19	0.149	Ø10/0.25	3.14	Ø12/0.25	4.52	7.66	0.51	0.112	0.105	46.8	-40.8	Verifica
	al 17 e al 23	apoio viga circunferencial (al C)	104	SUPERIOR	1.00	0.19	0.149	Ø10/0.25	3.14	Ø12/0.25	4.52	7.66	0.51	0.112	0.105	46.8	-45.6	Verifica
		apoio viga circunferencial (al D)	104	SUPERIOR	1.00	0.19	0.149	Ø10/0.25	3.14	Ø12/0.25	4.52	7.66	0.51	0.112	0.105	46.8	-33.7	Verifica

Direção Circunferencial - Direção XX																		
Designação			Armaduras Transversais - ULS															
Parede / Zona		CASO	$A_{s,atTotal}$	b	h	d	Armadura base	$A_{s,at}$	Reforço	$A_{s,atReforço}$	$A_{s,atTotal}$	ρ	ω	μ	$M_{Rd,XX}$	$M_{Ed,XX} + M_{Ed,XY} $	$M_{Ed,YY} \leq M_{Rd,YY}$	Verificação
			(cm ² /m)	(m)	(m)	(m)		(cm ² /m)		(cm ² /m)	(%)	(kNm/m)			(kNm/m)	(cm ² /m)		
PISO 6	al 16 e al 24	al A al B, vão	104	INFERIOR	1.00	0.20	0.159	Ø10/0.15	5.24	-	0.00	5.24	0.33	0.072	0.069	34.9	21.6	Verifica
		apoio viga V6.9, V6.15	104	SUPERIOR	1.00	0.20	0.159	Ø16/0.20	10.05	Ø12/0.25	4.52	14.57	0.92	0.199	0.179	90.4	-23.3	Verifica
		apoio viga V6.10 V6.14	104	SUPERIOR	1.00	0.20	0.159	Ø12/0.20	5.65	Ø10/0.20	3.93	9.58	0.60	0.131	0.122	61.8	-27.5	Verifica

Direção Radial - Direção YY																		
Designação					Geometria			Armaduras Radiais - ULS					Momento Resistente			Momento Atuentes	Verificação	
LAJE / ZONA			CASO	Armadura	b (m)	h (m)	d (m)	Armadura base	A _{s,at} (cm ² /m)	Reforço	A _{s,at} Reforço (cm ² /m)	A _{s,at} Total (cm ² /m)	ρ (%)	ω	μ	M _{Rd,YY} (kNm/m)	M _{Ed,YY} + M _{Ed,XY} (kNm/m)	M _{Ed,YY} ≤ M _{Rd,YY} (kNm/m)
PISO 6	al 8 al 9; al 15 al 16	vão	104	INFERIOR	1.00	0.20	0.158	Ø12/0.15	7.54	-	0.00	7.54	0.48	0.104	0.098	49.0	21.8	Verifica
	al 9 e al 15	al A, apoio viga circunferencial	104	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø8/0.20	2.51	6.44	0.41	0.089	0.085	42.2	-14.5	Verifica
		al B, apoio viga circunferencial	104	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø10/0.20	3.93	7.86	0.50	0.108	0.102	51.0	-21.9	Verifica

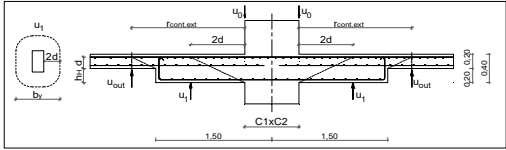
Direção Circunferencial - Direção XX																		
Designação				Geometria				Armaduras Transversais - ULS					Momento Resistente			Momento Atuales	Verificação	
Parede / Zona		CASO	$A_{s,at,Total}$	b	h	d	Armadura base	$A_{s,at}$	Reforço	$A_{s,at,Reforço}$	$A_{s,at,Total}$	ρ	ω	μ	$M_{Rd,XX}$	$M_{Ed,XX} + M_{Ed,XY} $	$M_{Ed,YY} \leq M_{Rd,YY}$	
			(cm ² /m)	(m)	(m)	(m)		(cm ² /m)		Reforço	(cm ² /m)	(cm ² /m)						(%)
PISO 7	al 9 e al 15	al A al B, vão	104	INFERIOR	1.00	0.20	0.158	Ø10/0.15	5.24	-	0.00	5.24	0.33	0.072	0.069	34.7	14.3	Verifica
		apoio viga V6.9 V6.15	104	SUPERIOR	1.00	0.20	0.158	Ø12/0.20	5.65	Ø10/0.20	3.93	9.58	0.61	0.132	0.123	61.4	-36.5	Verifica

Direção Radial - Direção YY																		
Designação				Geometria			Armaduras Radiais - ULS						Momento Resistente			Momento Atuentes	Verificação	
LAJE / ZONA			CASO	Armadura	b (m)	h (m)	d (m)	Armadura base	A _{s,at} (cm²/m)	Reforço	A _{s,at} Reforço (cm²/m)	A _{s,at} Total (cm²/m)	ρ (%)	ω	μ	M _{Rd,YY} (kNm/m)	M _{Ed,YY} + M _{Ed,XY} (kNm/m)	M _{Ed,YY} ≤ M _{Rd,YY}
PISO 7	al 8 al 9; al 15 al 16	vão	104	INFERIOR	1.00	0.20	0.158	Ø10/0.15	5.24	-	0.00	5.24	0.33	0.072	0.069	34.7	15.5	Verifica
	al 9 e al 15	al A, apoio viga circunferencial	104	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø8/0.20	2.51	6.44	0.41	0.089	0.085	42.2	-13.1	Verifica
		al B, apoio viga circunferencial	104	SUPERIOR	1.00	0.20	0.158	Ø10/0.20	3.93	Ø10/0.20	7.86	7.86	0.50	0.108	0.102	51.0	-16.5	Verifica

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

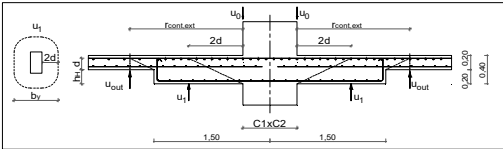


PISO	Pilar	Geometria						Esforços e excentricidades							Verificação no perímetro do pilar				Verificação no primeiro perímetro de controle			A _{s,x} (cm ²)	A _{s,y} (cm ²)	ρ	V _{Rd,c} (MPa)	Obs	
		C1	C2	h _{total}	d _{eff,H}	b _y	b _z	CASO	V _{Ed} (kN)	M _{Ed,y} (kNm)	M _{Ed,z} (kNm)	e _y (m)	e _z (m)	β	u ₀ (m)	V _{Ed,u0} (MPa)	V _{Rd,max} (MPa)	Obs V _{Ed,u0} <V _{Rd,max}	u ₁ (m)	V _{Ed,u1} (MPa)	k						
		(m)	(m)	(m)	(m)	(m)	(m)																				
PISO 1	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	908.7	-8.4	-105.0	0.12	0.01	1.09	3.400	0.820	5.280	OK	7.848	0.355	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	908.0	-9.8	-104.7	0.12	0.01	1.09	3.400	0.820	5.280	OK	7.848	0.355	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	908.3	-8.3	-105.1	0.12	0.01	1.09	3.400	0.820	5.280	OK	7.848	0.355	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	909.1	-2.5	-101.7	0.11	0.00	1.08	3.400	0.818	5.280	OK	7.848	0.354	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	909.6	10.8	-110.1	0.12	0.01	1.09	3.400	0.824	5.280	OK	7.848	0.357	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	909.5	-26.8	-101.2	0.11	0.03	1.09	3.400	0.821	5.280	OK	7.848	0.356	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	907.7	-9.7	-104.7	0.12	0.01	1.09	3.400	0.819	5.280	OK	7.848	0.355	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	908.4	-3.9	-101.3	0.11	0.00	1.08	3.400	0.818	5.280	OK	7.848	0.354	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	908.9	9.5	-109.7	0.12	0.01	1.09	3.400	0.823	5.280	OK	7.848	0.357	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	908.7	-28.1	-100.9	0.11	0.03	1.09	3.400	0.821	5.280	OK	7.848	0.355	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	462.0	1.8	-51.7	0.11	0.00	1.08	3.400	0.416	5.280	OK	7.848	0.180	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	660.6	-7.8	-75.7	0.11	0.01	1.09	3.400	0.596	5.280	OK	7.848	0.258	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	461.7	1.8	-51.8	0.11	0.00	1.08	3.400	0.416	5.280	OK	7.848	0.180	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	462.4	7.7	-48.3	0.10	0.02	1.08	3.400	0.415	5.280	OK	7.848	0.180	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	463.0	21.1	-56.8	0.12	0.05	1.10	3.400	0.423	5.280	OK	7.848	0.183	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	462.8	-16.7	-47.9	0.10	0.04	1.08	3.400	0.416	5.280	OK	7.848	0.180	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	660.3	-7.7	-75.9	0.11	0.01	1.09	3.400	0.596	5.280	OK	7.848	0.258	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	660.9	-1.9	-72.4	0.11	0.00	1.08	3.400	0.594	5.280	OK	7.848	0.257	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	661.4	11.5	-80.8	0.12	0.02	1.09	3.400	0.600	5.280	OK	7.848	0.260	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	661.4	-26.1	-71.9	0.11	0.04	1.09	3.400	0.598	5.280	OK	7.848	0.259	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	624.7	5.0	-70.7	0.11	0.01	1.08	3.400	0.563	5.280	OK	7.848	0.244	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	823.3	-4.5	-94.8	0.12	0.01	1.09	3.400	0.743	5.280	OK	7.848	0.322	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	624.0	3.6	-70.3	0.11	0.01	1.08	3.400	0.562	5.280	OK	7.848	0.243	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	624.3	5.0	-70.8	0.11	0.01	1.08	3.400	0.563	5.280	OK	7.848	0.244	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	625.0	10.9	-67.3	0.11	0.02	1.08	3.400	0.562	5.280	OK	7.848	0.243	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	625.5	24.3	-75.7	0.12	0.04	1.10	3.400	0.570	5.280	OK	7.848	0.247	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	625.5	-13.5	-66.9	0.11	0.02	1.08	3.400	0.562	5.280	OK	7.848	0.244	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	822.6	-5.9	-94.4	0.11	0.01	1.09	3.400	0.742	5.280	OK	7.848	0.321	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	822.9	-4.5	-94.9	0.12	0.01	1.09	3.400	0.743	5.280	OK	7.848	0.322	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	823.6	1.4	-91.4	0.11	0.00	1.08	3.400	0.741	5.280	OK	7.848	0.321	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	824.1	14.8	-99.8	0.12	0.02	1.09	3.400	0.747	5.280	OK	7.848	0.324	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	824.0	-22.9	-90.9	0.11	0.03	1.09	3.400	0.743	5.280	OK	7.848	0.322	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	822.3	-5.8	-94.6	0.12	0.01	1.09	3.400	0.742	5.280	OK	7.848	0.321	1.75	15.70	20.11	0.0050	0.519	OK	OK
	P1 (al 17 al B)	0.70	1.00	0.4																							

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

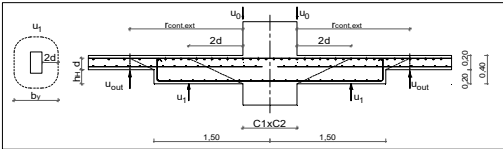


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	927.7	-56.4	-120.5	0.13	0.06	1.11	3.400	0.855	5.280	OK	7.848	0.371	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	927.5	-56.5	-120	0.13	0.06	1.11	3.400	0.855	5.280	OK	7.848	0.370	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	927.8	-56.2	-120.6	0.13	0.06	1.11	3.400	0.855	5.280	OK	7.848	0.371	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	928.5	-51.1	-117.8	0.13	0.06	1.11	3.400	0.853	5.280	OK	7.848	0.369	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	927.7	-37.3	-125.7	0.14	0.04	1.11	3.400	0.853	5.280	OK	7.848	0.369	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	927.9	-75.5	-116.8	0.13	0.08	1.12	3.400	0.861	5.280	OK	7.848	0.373	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	927.7	-56.3	-120.1	0.13	0.06	1.11	3.400	0.855	5.280	OK	7.848	0.370	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	928.4	-51.2	-117.3	0.13	0.06	1.11	3.400	0.852	5.280	OK	7.848	0.369	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	927.5	-37.4	-125.3	0.14	0.04	1.11	3.400	0.853	5.280	OK	7.848	0.369	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	927.8	-75.6	-116.3	0.13	0.08	1.12	3.400	0.861	5.280	OK	7.848	0.373	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	462.3	-29	-58.6	0.13	0.06	1.11	3.400	0.426	5.280	OK	7.848	0.184	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	674.7	-41.5	-86.9	0.13	0.06	1.11	3.400	0.622	5.280	OK	7.848	0.269	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	462.4	-28.8	-58.7	0.13	0.06	1.11	3.400	0.426	5.280	OK	7.848	0.184	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	463.2	-23.7	-55.9	0.12	0.05	1.10	3.400	0.423	5.280	OK	7.848	0.183	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	462.3	-9.9	-63.8	0.14	0.02	1.10	3.400	0.424	5.280	OK	7.848	0.184	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	462.6	-48.1	-54.9	0.12	0.10	1.13	3.400	0.432	5.280	OK	7.848	0.187	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	674.8	-41.3	-87	0.13	0.06	1.11	3.400	0.622	5.280	OK	7.848	0.269	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	675.5	-36.1	-84.2	0.12	0.05	1.10	3.400	0.619	5.280	OK	7.848	0.268	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	674.7	-22.3	-92.1	0.14	0.03	1.11	3.400	0.620	5.280	OK	7.848	0.268	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	674.9	-60.7	-83.2	0.12	0.09	1.12	3.400	0.628	5.280	OK	7.848	0.272	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	624.2	-38.6	-80.4	0.13	0.06	1.11	3.400	0.575	5.280	OK	7.848	0.249	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	836.5	-51	-108.7	0.13	0.06	1.11	3.400	0.771	5.280	OK	7.848	0.334	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	624	-38.7	-79.9	0.13	0.06	1.11	3.400	0.575	5.280	OK	7.848	0.249	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	624.2	-38.4	-80.4	0.13	0.06	1.11	3.400	0.575	5.280	OK	7.848	0.249	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	625	-33.2	-77.6	0.12	0.05	1.10	3.400	0.573	5.280	OK	7.848	0.248	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	624.1	-19.4	-85.6	0.14	0.03	1.11	3.400	0.573	5.280	OK	7.848	0.248	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	624.4	-57.7	-76.6	0.12	0.09	1.12	3.400	0.581	5.280	OK	7.848	0.252	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	836.3	-51.1	-108.2	0.13	0.06	1.11	3.400	0.771	5.280	OK	7.848	0.334	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	836.5	-50.8	-108.7	0.13	0.06	1.11	3.400	0.771	5.280	OK	7.848	0.334	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	837.4	-45.7	-105.9	0.13	0.05	1.11	3.400	0.769	5.280	OK	7.848	0.333	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	836.4	-31.9	-113.9	0.14	0.04	1.11	3.400	0.769	5.280	OK	7.848	0.333	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	836.8	-70.2	-104.9	0.13	0.08	1.12	3.400	0.777	5.280	OK	7.848	0.337	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al C)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	836.4	-50.9	-108.2	0.13	0.06	1.11	3.400	0.771	5.280	OK	7.848	0.334	15.50	15					

TN_CORPO 3_PISO 1_Estado Limite Último de Punçãoamento_Pilares Interiores

Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

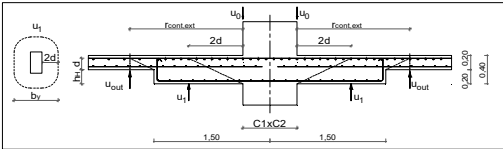


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	882.1	164.1	-83.6	0.09	0.19	1.17	3.400	0.860	5.280	OK	7.848	0.373	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	881.2	165.8	-83.3	0.09	0.19	1.17	3.400	0.860	5.280	OK	7.848	0.373	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	882.1	164.1	-83.7	0.09	0.19	1.17	3.400	0.860	5.280	OK	7.848	0.373	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	882.3	168.1	-81.7	0.09	0.19	1.18	3.400	0.862	5.280	OK	7.848	0.373	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	882	182.3	-89.8	0.10	0.21	1.19	3.400	0.873	5.280	OK	7.848	0.378	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	883	145.1	-79.9	0.09	0.16	1.16	3.400	0.847	5.280	OK	7.848	0.367	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	881.2	165.8	-83.3	0.09	0.19	1.17	3.400	0.860	5.280	OK	7.848	0.373	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	881.6	169.8	-81.4	0.09	0.19	1.18	3.400	0.863	5.280	OK	7.848	0.374	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	881.3	184.1	-89.4	0.10	0.21	1.19	3.400	0.874	5.280	OK	7.848	0.378	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	882.3	146.8	-79.6	0.09	0.17	1.16	3.400	0.848	5.280	OK	7.848	0.367	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	437.9	81.9	-39.6	0.09	0.19	1.17	3.400	0.427	5.280	OK	7.848	0.185	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	640.5	121.4	-60	0.09	0.19	1.18	3.400	0.626	5.280	OK	7.848	0.271	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	437.8	81.9	-39.6	0.09	0.19	1.17	3.400	0.427	5.280	OK	7.848	0.185	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	438.2	86	-37.7	0.09	0.20	1.18	3.400	0.429	5.280	OK	7.848	0.186	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	437.8	100.2	-45.7	0.10	0.23	1.21	3.400	0.440	5.280	OK	7.848	0.191	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	438.9	63	-35.9	0.08	0.14	1.14	3.400	0.414	5.280	OK	7.848	0.180	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	640.5	121.4	-60	0.09	0.19	1.18	3.400	0.626	5.280	OK	7.848	0.271	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	640.7	125.4	-58.1	0.09	0.20	1.18	3.400	0.628	5.280	OK	7.848	0.272	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	640.4	139.7	-66.2	0.10	0.22	1.20	3.400	0.639	5.280	OK	7.848	0.277	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	641.4	102.4	-56.3	0.09	0.16	1.15	3.400	0.613	5.280	OK	7.848	0.266	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	592.4	108.1	-54.6	0.09	0.18	1.17	3.400	0.576	5.280	OK	7.848	0.249	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	795	147.5	-75	0.09	0.19	1.17	3.400	0.775	5.280	OK	7.848	0.336	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	591.6	109.8	-54.2	0.09	0.19	1.17	3.400	0.576	5.280	OK	7.848	0.250	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	592.4	108.1	-54.6	0.09	0.18	1.17	3.400	0.576	5.280	OK	7.848	0.249	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	592.6	112.1	-52.6	0.09	0.19	1.17	3.400	0.578	5.280	OK	7.848	0.250	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	592.3	126.4	-60.7	0.10	0.21	1.20	3.400	0.589	5.280	OK	7.848	0.255	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	593.4	89.1	-50.8	0.09	0.15	1.14	3.400	0.563	5.280	OK	7.848	0.244	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	794.2	149.4	-74.7	0.09	0.19	1.17	3.400	0.775	5.280	OK	7.848	0.336	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	794.9	147.5	-75	0.09	0.19	1.17	3.400	0.775	5.280	OK	7.848	0.336	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	795.3	151.6	-73.1	0.09	0.19	1.18	3.400	0.777	5.280	OK	7.848	0.337	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	795	165.8	-81.1	0.10	0.21	1.19	3.400	0.788	5.280	OK	7.848	0.341	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	796	128.6	-71.3	0.09	0.16	1.15	3.400	0.762	5.280	OK	7.848	0.330	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 18 al D)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	794.2	149.3	-74.6	0.09	0.19	1.17	3.400	0.775	5.280	OK	7.848	0.336	15.50						

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

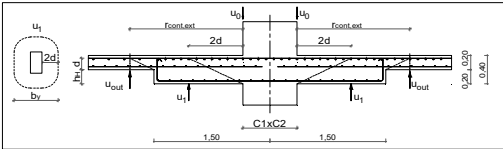


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρ _l	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	667.5	-109.3	3.5	0.01	0.16	1.14	3.400	0.632	5.280	OK	7.848	0.274	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	667.2	-110.6	3.3	0.00	0.17	1.14	3.400	0.633	5.280	OK	7.848	0.274	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	668.0	-108.6	3.3	0.00	0.16	1.14	3.400	0.632	5.280	OK	7.848	0.274	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	667.4	-104.8	7.9	0.01	0.16	1.13	3.400	0.629	5.280	OK	7.848	0.272	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	668.0	-88.6	-0.2	0.00	0.13	1.11	3.400	0.618	5.280	OK	7.848	0.268	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	663.3	-134.1	7.0	0.01	0.20	1.17	3.400	0.646	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	667.8	-110.0	3.1	0.00	0.16	1.14	3.400	0.633	5.280	OK	7.848	0.274	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	667.1	-106.2	7.6	0.01	0.16	1.14	3.400	0.629	5.280	OK	7.848	0.273	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	667.8	-90.0	-0.4	0.00	0.13	1.11	3.400	0.618	5.280	OK	7.848	0.268	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	663.1	-135.5	6.8	0.01	0.20	1.17	3.400	0.647	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	341.0	-42.0	1.5	0.00	0.12	1.10	3.400	0.313	5.280	OK	7.848	0.136	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	485.5	-80.4	2.4	0.00	0.17	1.14	3.400	0.460	5.280	OK	7.848	0.199	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	341.5	-41.4	1.2	0.00	0.12	1.10	3.400	0.313	5.280	OK	7.848	0.136	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	341.0	-37.5	5.7	0.02	0.11	1.09	3.400	0.310	5.280	OK	7.848	0.134	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	341.6	-21.3	-2.3	0.01	0.06	1.05	3.400	0.299	5.280	OK	7.848	0.130	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	336.8	-66.8	4.9	0.01	0.20	1.17	3.400	0.327	5.280	OK	7.848	0.142	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	486.1	-79.8	2.1	0.00	0.16	1.14	3.400	0.460	5.280	OK	7.848	0.199	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	485.4	-75.9	6.7	0.01	0.16	1.13	3.400	0.457	5.280	OK	7.848	0.198	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	486.1	-59.7	-1.3	0.00	0.12	1.10	3.400	0.446	5.280	OK	7.848	0.193	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	481.4	-105.2	5.8	0.01	0.22	1.19	3.400	0.474	5.280	OK	7.848	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	462.0	-53.4	1.9	0.00	0.12	1.10	3.400	0.422	5.280	OK	7.848	0.183	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	606.4	-91.8	2.8	0.00	0.15	1.13	3.400	0.569	5.280	OK	7.848	0.246	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	461.7	-54.6	1.6	0.00	0.12	1.10	3.400	0.422	5.280	OK	7.848	0.183	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	462.5	-52.7	1.5	0.00	0.11	1.10	3.400	0.422	5.280	OK	7.848	0.183	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	462.0	-48.9	6.1	0.01	0.11	1.09	3.400	0.419	5.280	OK	7.848	0.181	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	462.6	-32.7	-1.9	0.00	0.07	1.06	3.400	0.407	5.280	OK	7.848	0.177	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	457.8	-78.2	5.3	0.01	0.17	1.15	3.400	0.436	5.280	OK	7.848	0.189	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	606.2	-93.2	2.5	0.00	0.15	1.13	3.400	0.570	5.280	OK	7.848	0.247	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	607.0	-91.1	2.5	0.00	0.15	1.13	3.400	0.569	5.280	OK	7.848	0.246	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	606.4	-87.3	7.0	0.01	0.14	1.12	3.400	0.566	5.280	OK	7.848	0.245	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	607.0	-71.2	-1.0	0.00	0.12	1.10	3.400	0.555	5.280	OK	7.848	0.240	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	602.2	-116.6	6.2	0.01	0.19	1.16	3.400	0.583	5.280	OK	7.848	0.252	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al B)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	606.7	-92.5	2.2	0.00	0.15	1.13	3.400	0.569	5.280	OK	7.848	0.247	15.70	15.70	0.0044	1.75	0.498	OK	

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

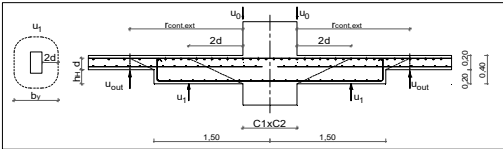


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)		(mm)	(mm)	(mm)		(kN)	(kNm)	(kNm)	(mm)	(mm)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	104 (C)	886.4	-42.7	1.4	0.00	0.05	1.04	4.100	0.636	5.280	OK	8.548	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	105 (C)	886.4	-42.8	1.3	0.00	0.05	1.04	4.100	0.636	5.280	OK	8.548	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	106 (C)	886.4	-42.7	1.4	0.00	0.05	1.04	4.100	0.636	5.280	OK	8.548	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	107 (C)	886.0	-38.5	4.4	0.00	0.04	1.04	4.100	0.633	5.280	OK	8.548	0.304	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	108 (C)	886.4	-24.1	-2.2	0.00	0.03	1.02	4.100	0.625	5.280	OK	8.548	0.300	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	109 (C)	886.1	-61.3	4.2	0.00	0.07	1.06	4.100	0.646	5.280	OK	8.548	0.310	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	110 (C)	886.4	-42.8	1.3	0.00	0.05	1.04	4.100	0.636	5.280	OK	8.548	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	111 (C)	886.1	-38.6	4.3	0.00	0.04	1.04	4.100	0.633	5.280	OK	8.548	0.304	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	112 (C)	886.4	-24.1	-2.3	0.00	0.03	1.02	4.100	0.625	5.280	OK	8.548	0.300	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	113 (C)	886.2	-61.3	4.1	0.00	0.07	1.06	4.100	0.647	5.280	OK	8.548	0.310	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	114 (C)	443.6	-21.3	0.5	0.00	0.05	1.04	4.100	0.318	5.280	OK	8.548	0.153	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	115 (C)	645.0	-31.4	1.0	0.00	0.05	1.04	4.100	0.463	5.280	OK	8.548	0.222	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	116 (C)	443.6	-21.3	0.4	0.00	0.05	1.04	4.100	0.318	5.280	OK	8.548	0.153	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	117 (C)	443.2	-17.2	3.4	0.01	0.04	1.03	4.100	0.316	5.280	OK	8.548	0.151	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	118 (C)	443.6	-2.7	-3.1	0.01	0.01	1.01	4.100	0.308	5.280	OK	8.548	0.148	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	119 (C)	443.3	-39.9	3.2	0.01	0.09	1.08	4.100	0.329	5.280	OK	8.548	0.158	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	120 (C)	645.0	-31.4	1.0	0.00	0.05	1.04	4.100	0.463	5.280	OK	8.548	0.222	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	121 (C)	644.6	-27.2	4.0	0.01	0.04	1.04	4.100	0.460	5.280	OK	8.548	0.221	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	122 (C)	645.0	-12.7	-2.6	0.00	0.02	1.02	4.100	0.452	5.280	OK	8.548	0.217	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	123 (C)	644.8	-49.9	3.8	0.01	0.08	1.07	4.100	0.474	5.280	OK	8.548	0.227	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	124 (C)	598.7	-28.4	0.3	0.00	0.05	1.04	4.100	0.429	5.280	OK	8.548	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	125 (C)	800.2	-38.5	0.9	0.00	0.05	1.04	4.100	0.574	5.280	OK	8.548	0.275	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	126 (C)	598.8	-28.5	0.2	0.00	0.05	1.04	4.100	0.429	5.280	OK	8.548	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	127 (C)	598.7	-28.5	0.2	0.00	0.05	1.04	4.100	0.429	5.280	OK	8.548	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	128 (C)	598.3	-24.3	3.2	0.01	0.04	1.03	4.100	0.427	5.280	OK	8.548	0.205	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	129 (C)	598.7	-9.8	-3.3	0.01	0.02	1.01	4.100	0.418	5.280	OK	8.548	0.201	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	130 (C)	598.5	-47.0	3.1	0.01	0.08	1.07	4.100	0.440	5.280	OK	8.548	0.211	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	131 (C)	800.2	-38.5	0.8	0.00	0.05	1.04	4.100	0.574	5.280	OK	8.548	0.275	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	132 (C)	800.2	-38.5	0.8	0.00	0.05	1.04	4.100	0.574	5.280	OK	8.548	0.275	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	133 (C)	799.8	-34.3	3.8	0.00	0.04	1.04	4.100	0.571	5.280	OK	8.548	0.274	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	134 (C)	800.2	-19.8	-2.7	0.00	0.02	1.02	4.100	0.563	5.280	OK	8.548	0.270	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	135 (C)	799.9	-57.0	3.7	0.00	0.07	1.06	4.100	0.585	5.280	OK	8.548	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35	0.40	0.354	2.12	2.77	136 (C)	800.2	-38.5	0.7	0.00	0.05	1.04	4.100	0.574	5.280	OK	8.548	0.275	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 19 al C)	0.70	1.35																								

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

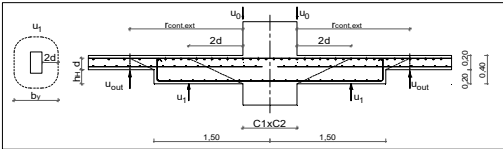


PISO	Pilar	Geometria						Esforços e excentricidades							Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo								
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρ _l	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(mm)	(mm)		(kN)	(kNm)	(kNm)	(mm)	(mm)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	780.6	120.9	23.1	0.03	0.15	1.13	3.400	0.735	5.280	OK	7.848	0.318	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	780.0	122.9	23.0	0.03	0.16	1.14	3.400	0.736	5.280	OK	7.848	0.319	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	780.6	120.9	23.1	0.03	0.15	1.13	3.400	0.735	5.280	OK	7.848	0.318	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	780.3	125.9	26.1	0.03	0.16	1.14	3.400	0.739	5.280	OK	7.848	0.320	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	780.0	142.1	18.3	0.02	0.18	1.16	3.400	0.749	5.280	OK	7.848	0.325	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	780.4	100.9	25.5	0.03	0.13	1.11	3.400	0.721	5.280	OK	7.848	0.313	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	780.1	122.7	22.9	0.03	0.16	1.14	3.400	0.736	5.280	OK	7.848	0.319	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	779.7	127.9	25.9	0.03	0.16	1.14	3.400	0.740	5.280	OK	7.848	0.320	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	779.5	144.0	18.2	0.02	0.18	1.16	3.400	0.750	5.280	OK	7.848	0.325	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	779.8	102.8	25.4	0.03	0.13	1.11	3.400	0.722	5.280	OK	7.848	0.313	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	391.6	52.2	10.9	0.03	0.13	1.12	3.400	0.363	5.280	OK	7.848	0.157	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	567.2	89.2	16.8	0.03	0.16	1.14	3.400	0.535	5.280	OK	7.848	0.232	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	391.6	52.0	10.8	0.03	0.13	1.11	3.400	0.363	5.280	OK	7.848	0.157	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	391.3	57.2	13.8	0.04	0.15	1.13	3.400	0.366	5.280	OK	7.848	0.159	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	391.0	73.3	6.1	0.02	0.19	1.16	3.400	0.377	5.280	OK	7.848	0.163	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	391.5	32.1	13.3	0.03	0.08	1.07	3.400	0.349	5.280	OK	7.848	0.151	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	567.1	89.2	16.8	0.03	0.16	1.14	3.400	0.535	5.280	OK	7.848	0.232	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	566.9	94.2	19.8	0.03	0.17	1.14	3.400	0.539	5.280	OK	7.848	0.233	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	566.6	110.5	12.1	0.02	0.20	1.17	3.400	0.549	5.280	OK	7.848	0.238	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	566.9	69.2	19.3	0.03	0.12	1.11	3.400	0.521	5.280	OK	7.848	0.226	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	530.0	67.6	14.3	0.03	0.13	1.11	3.400	0.489	5.280	OK	7.848	0.212	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	705.6	104.6	20.3	0.03	0.15	1.13	3.400	0.661	5.280	OK	7.848	0.286	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	529.4	69.5	14.2	0.03	0.13	1.11	3.400	0.490	5.280	OK	7.848	0.212	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	530.0	67.5	14.3	0.03	0.13	1.11	3.400	0.489	5.280	OK	7.848	0.212	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	529.8	72.6	17.3	0.03	0.14	1.12	3.400	0.493	5.280	OK	7.848	0.213	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	529.5	88.8	9.6	0.02	0.17	1.14	3.400	0.503	5.280	OK	7.848	0.218	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	529.9	47.6	16.8	0.03	0.09	1.08	3.400	0.475	5.280	OK	7.848	0.206	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	705.0	106.6	20.2	0.03	0.15	1.13	3.400	0.662	5.280	OK	7.848	0.287	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	705.6	104.6	20.3	0.03	0.15	1.13	3.400	0.661	5.280	OK	7.848	0.286	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	705.3	109.6	23.3	0.03	0.16	1.13	3.400	0.665	5.280	OK	7.848	0.288	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	705.0	125.9	15.5	0.02	0.18	1.15	3.400	0.675	5.280	OK	7.848	0.293	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	705.3	84.6	22.7	0.03	0.12	1.10	3.400	0.647	5.280	OK	7.848	0.280	15.50	15.50	0.0044	1.75	0.496	OK	OK
	P9 (al 19 al D)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	705.0	106.5	20.3	0.03	0.15	1.13	3.400	0.662	5.280	OK	7.848	0.287	15.50	15.50</					

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

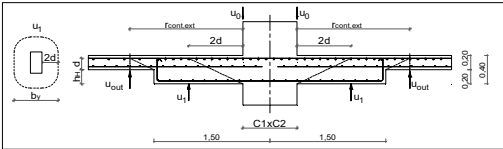


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρ _l	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	678.0	-126.7	25.2	0.04	0.19	1.16	3.400	0.654	5.280	OK	7.848	0.283	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	677.5	-128.0	25.2	0.04	0.19	1.16	3.400	0.655	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	678.5	-126.1	25.5	0.04	0.19	1.16	3.400	0.654	5.280	OK	7.848	0.283	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	678.4	-122.9	30.0	0.04	0.18	1.16	3.400	0.652	5.280	OK	7.848	0.283	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	680.4	-104.8	22.9	0.03	0.15	1.13	3.400	0.641	5.280	OK	7.848	0.278	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	673.4	-152.4	24.9	0.04	0.23	1.19	3.400	0.668	5.280	OK	7.848	0.290	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	678.0	-127.5	25.4	0.04	0.19	1.16	3.400	0.655	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	677.9	-124.2	30.0	0.04	0.18	1.16	3.400	0.653	5.280	OK	7.848	0.283	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	679.9	-106.1	22.9	0.03	0.16	1.14	3.400	0.641	5.280	OK	7.848	0.278	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	672.8	-153.8	24.9	0.04	0.23	1.20	3.400	0.669	5.280	OK	7.848	0.290	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	347.3	-49.1	14.3	0.04	0.14	1.12	3.400	0.324	5.280	OK	7.848	0.141	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	492.9	-92.8	18.2	0.04	0.19	1.16	3.400	0.476	5.280	OK	7.848	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	347.7	-48.5	14.5	0.04	0.14	1.12	3.400	0.324	5.280	OK	7.848	0.140	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	347.6	-45.1	19.1	0.05	0.13	1.12	3.400	0.323	5.280	OK	7.848	0.140	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	349.6	-27.1	12.0	0.03	0.08	1.07	3.400	0.311	5.280	OK	7.848	0.135	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	342.6	-74.7	14.1	0.04	0.22	1.19	3.400	0.338	5.280	OK	7.848	0.146	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	493.4	-92.2	18.5	0.04	0.19	1.16	3.400	0.476	5.280	OK	7.848	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	493.3	-89.0	23.0	0.05	0.18	1.16	3.400	0.474	5.280	OK	7.848	0.205	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	495.3	-70.9	15.9	0.03	0.14	1.12	3.400	0.463	5.280	OK	7.848	0.200	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	488.3	-118.5	18.0	0.04	0.24	1.21	3.400	0.490	5.280	OK	7.848	0.212	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	470.5	-63.4	19.8	0.04	0.13	1.12	3.400	0.437	5.280	OK	7.848	0.189	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	616.1	-107.1	23.7	0.04	0.17	1.15	3.400	0.589	5.280	OK	7.848	0.255	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	469.9	-64.7	19.7	0.04	0.14	1.12	3.400	0.438	5.280	OK	7.848	0.190	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	470.9	-62.8	20.0	0.04	0.13	1.12	3.400	0.437	5.280	OK	7.848	0.189	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	470.8	-59.4	24.5	0.05	0.13	1.11	3.400	0.436	5.280	OK	7.848	0.189	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	472.8	-41.4	17.4	0.04	0.09	1.08	3.400	0.424	5.280	OK	7.848	0.184	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	465.8	-89.0	19.5	0.04	0.19	1.17	3.400	0.451	5.280	OK	7.848	0.195	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	615.6	-108.4	23.7	0.04	0.18	1.15	3.400	0.589	5.280	OK	7.848	0.255	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	616.6	-106.5	23.9	0.04	0.17	1.15	3.400	0.589	5.280	OK	7.848	0.255	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	616.5	-103.3	28.5	0.05	0.17	1.15	3.400	0.587	5.280	OK	7.848	0.254	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	618.5	-85.2	21.4	0.03	0.14	1.12	3.400	0.576	5.280	OK	7.848	0.249	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	611.5	-132.8	23.4	0.04	0.22	1.19	3.400	0.603	5.280	OK	7.848	0.261	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	616.1	-107.9	23.9	0.04	0.18	1.15	3.400	0.590	5.280	OK	7.848	0.255	15.70	15.70	0.0044	1.75	0		

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

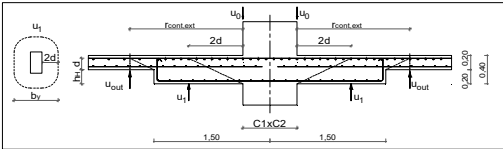


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b (m)	h (m)	h _{laje}	deff (m)	by (m)	bz (m)	CASO	V _{Ed} (kN)	M _{Ed,y} (kNm)	M _{Ed,z} (kNm)	ey (m)	ez (m)	β	u ₀ (m)	V _{Ed,u0} (MPa)	V _{Rd,max} (MPa)	Obs V _{Ed,u0} <V _{Rd,max}	u ₁ (m)	V _{Ed,u1} (MPa)	A _{s,x} (cm2)	A _{s,y} (cm2)	pl	k	V _{Rd,c} (MPa)	Obs V _{Ed,u1} <V _{Rd,c} V _{Ed,u1} <2V _{Rd,c}	
PISO 1	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	887.4	-38.7	11.0	0.01	0.04	1.04	3.400	0.765	5.280	OK	7.848	0.332	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	887.3	-38.7	11.0	0.01	0.04	1.04	3.400	0.765	5.280	OK	7.848	0.332	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	887.3	-38.7	11.0	0.01	0.04	1.04	3.400	0.765	5.280	OK	7.848	0.332	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	887.5	-35.0	13.6	0.02	0.04	1.04	3.400	0.764	5.280	OK	7.848	0.331	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	887.5	-19.3	8.6	0.01	0.02	1.02	3.400	0.752	5.280	OK	7.848	0.326	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	887.5	-58.4	11.4	0.01	0.07	1.06	3.400	0.779	5.280	OK	7.848	0.338	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	887.3	-38.7	11.1	0.01	0.04	1.04	3.400	0.765	5.280	OK	7.848	0.332	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	887.4	-35.1	13.6	0.02	0.04	1.04	3.400	0.763	5.280	OK	7.848	0.331	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	887.5	-19.3	8.6	0.01	0.02	1.02	3.400	0.752	5.280	OK	7.848	0.326	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	887.4	-58.4	11.4	0.01	0.07	1.06	3.400	0.779	5.280	OK	7.848	0.338	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	443.6	-19.3	5.7	0.01	0.04	1.04	3.400	0.383	5.280	OK	7.848	0.166	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	645.6	-28.4	8.1	0.01	0.04	1.04	3.400	0.557	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	443.6	-19.3	5.7	0.01	0.04	1.04	3.400	0.383	5.280	OK	7.848	0.166	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	443.7	-15.7	8.2	0.02	0.04	1.03	3.400	0.381	5.280	OK	7.848	0.165	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	443.8	0.1	3.3	0.01	0.00	1.01	3.400	0.371	5.280	OK	7.848	0.161	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	443.8	-39.0	6.0	0.01	0.09	1.08	3.400	0.397	5.280	OK	7.848	0.172	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	645.6	-28.4	8.1	0.01	0.04	1.04	3.400	0.557	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	645.7	-24.8	10.6	0.02	0.04	1.03	3.400	0.555	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	645.8	-9.0	5.7	0.01	0.01	1.01	3.400	0.544	5.280	OK	7.848	0.236	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	645.7	-48.1	8.4	0.01	0.07	1.06	3.400	0.571	5.280	OK	7.848	0.247	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	598.8	-25.7	7.7	0.01	0.04	1.04	3.400	0.516	5.280	OK	7.848	0.224	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	800.7	-34.8	10.1	0.01	0.04	1.04	3.400	0.691	5.280	OK	7.848	0.299	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	598.7	-25.8	7.7	0.01	0.04	1.04	3.400	0.516	5.280	OK	7.848	0.224	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	598.7	-25.8	7.7	0.01	0.04	1.04	3.400	0.516	5.280	OK	7.848	0.224	15.70	15.70	0.0044	1.75	0.498	OK	Obs
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	598.9	-22.1	10.2	0.02	0.04	1.03	3.400	0.514	5.280	OK	7.848	0.223	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	598.9	-6.4	5.3	0.01	0.01	1.01	3.400	0.503	5.280	OK	7.848	0.218	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	598.9	-45.5	8.1	0.01	0.08	1.07	3.400	0.530	5.280	OK	7.848	0.230	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	800.7	-34.9	10.1	0.01	0.04	1.04	3.400	0.691	5.280	OK	7.848	0.299	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	800.7	-34.8	10.1	0.01	0.04	1.04	3.400	0.691	5.280	OK	7.848	0.299	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	800.8	-31.2	12.6	0.02	0.04	1.04	3.400	0.689	5.280	OK	7.848	0.298	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	800.9	-15.5	7.7	0.01	0.02	1.02	3.400	0.677	5.280	OK	7.848	0.293	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	800.9	-54.6	10.5	0.01	0.07	1.06	3.400	0.705	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	800.6	-34.9	10.1	0.01	0.04	1.04	3.400	0.691	5.280	OK	7.848	0.299	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354																						

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

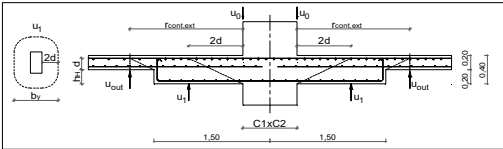


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	790.1	124.1	19.3	0.02	0.16	1.13	3.400	0.745	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	789.4	126.1	19.2	0.02	0.16	1.14	3.400	0.746	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	790.1	124.1	19.3	0.02	0.16	1.13	3.400	0.745	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	789.8	128.4	22.4	0.03	0.16	1.14	3.400	0.748	5.280	OK	7.848	0.324	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	789.4	145.6	16.0	0.02	0.18	1.16	3.400	0.759	5.280	OK	7.848	0.329	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	790.2	103.4	19.0	0.02	0.13	1.11	3.400	0.731	5.280	OK	7.848	0.316	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	789.5	126.0	19.3	0.02	0.16	1.14	3.400	0.746	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	789.2	130.3	22.3	0.03	0.17	1.14	3.400	0.749	5.280	OK	7.848	0.324	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	788.8	147.5	16.0	0.02	0.19	1.16	3.400	0.760	5.280	OK	7.848	0.329	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	789.5	105.2	19.0	0.02	0.13	1.11	3.400	0.731	5.280	OK	7.848	0.317	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	397.1	52.3	10.4	0.03	0.13	1.11	3.400	0.367	5.280	OK	7.848	0.159	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	574.0	91.4	13.9	0.02	0.16	1.14	3.400	0.542	5.280	OK	7.848	0.235	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	397.1	52.2	10.5	0.03	0.13	1.11	3.400	0.367	5.280	OK	7.848	0.159	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	396.9	56.5	13.5	0.03	0.14	1.12	3.400	0.371	5.280	OK	7.848	0.161	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	396.5	73.7	7.1	0.02	0.19	1.16	3.400	0.382	5.280	OK	7.848	0.165	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	397.2	31.4	10.1	0.03	0.08	1.07	3.400	0.353	5.280	OK	7.848	0.153	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	574.0	91.4	13.9	0.02	0.16	1.14	3.400	0.542	5.280	OK	7.848	0.235	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	573.8	95.6	17.0	0.03	0.17	1.14	3.400	0.545	5.280	OK	7.848	0.236	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	573.4	112.8	10.6	0.02	0.20	1.17	3.400	0.556	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	574.2	70.6	13.6	0.02	0.12	1.11	3.400	0.528	5.280	OK	7.848	0.229	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	537.4	68.0	14.3	0.03	0.13	1.11	3.400	0.495	5.280	OK	7.848	0.215	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	714.4	107.1	17.9	0.03	0.15	1.13	3.400	0.670	5.280	OK	7.848	0.290	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	536.8	69.8	14.2	0.03	0.13	1.11	3.400	0.496	5.280	OK	7.848	0.215	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	537.4	67.9	14.3	0.03	0.13	1.11	3.400	0.495	5.280	OK	7.848	0.215	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	537.2	72.2	17.4	0.03	0.13	1.12	3.400	0.498	5.280	OK	7.848	0.216	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	536.7	89.3	11.0	0.02	0.17	1.14	3.400	0.509	5.280	OK	7.848	0.221	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	537.5	47.1	14.0	0.03	0.09	1.08	3.400	0.481	5.280	OK	7.848	0.208	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	713.7	109.0	17.8	0.02	0.15	1.13	3.400	0.671	5.280	OK	7.848	0.291	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	714.4	107.1	17.9	0.03	0.15	1.13	3.400	0.670	5.280	OK	7.848	0.290	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	714.2	111.3	20.9	0.03	0.16	1.13	3.400	0.673	5.280	OK	7.848	0.292	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	713.7	128.4	14.6	0.02	0.18	1.15	3.400	0.684	5.280	OK	7.848	0.296	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	714.5	86.2	17.6	0.02	0.12	1.10	3.400	0.656	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	713.7	108.9	17.9	0.03	0.15	1.13	3.400	0.671	5.280	OK	7.848	0.291	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	137 (C)	713.6	113.3	20.9	0.03	0.16	1.14	3.400	0.674	5.280	OK	7.848	0.292	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12																					

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

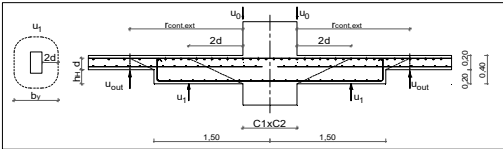


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	104 (C)	520.3	-106.9	-16.1	0.03	0.21	1.18	4.200	0.411	5.280	OK	8.648	0.200	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	105 (C)	520.2	-108.7	-16.3	0.03	0.21	1.18	4.200	0.412	5.280	OK	8.648	0.200	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	106 (C)	520.5	-107.2	-16.2	0.03	0.21	1.18	4.200	0.412	5.280	OK	8.648	0.200	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	107 (C)	520.1	-103.9	-10.1	0.02	0.20	1.17	4.200	0.409	5.280	OK	8.648	0.199	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	108 (C)	518.9	-84.1	-15.7	0.03	0.16	1.14	4.200	0.398	5.280	OK	8.648	0.193	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	109 (C)	520.4	-129.0	-17.6	0.03	0.25	1.21	4.200	0.424	5.280	OK	8.648	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	110 (C)	520.5	-109.1	-16.3	0.03	0.21	1.18	4.200	0.413	5.280	OK	8.648	0.201	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	111 (C)	520.1	-105.7	-10.2	0.02	0.20	1.17	4.200	0.410	5.280	OK	8.648	0.199	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	112 (C)	518.8	-86.0	-15.9	0.03	0.17	1.14	4.200	0.399	5.280	OK	8.648	0.194	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	113 (C)	520.4	-130.8	-17.7	0.03	0.25	1.21	4.200	0.425	5.280	OK	8.648	0.207	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	114 (C)	279.3	-40.9	-6.4	0.02	0.15	1.13	4.200	0.211	5.280	OK	8.648	0.103	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	115 (C)	379.8	-77.8	-11.7	0.03	0.20	1.18	4.200	0.300	5.280	OK	8.648	0.146	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	116 (C)	279.4	-41.2	-6.4	0.02	0.15	1.13	4.200	0.212	5.280	OK	8.648	0.103	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	117 (C)	279.1	-37.9	-0.3	0.00	0.14	1.12	4.200	0.209	5.280	OK	8.648	0.102	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	118 (C)	277.8	-18.1	-5.9	0.02	0.07	1.06	4.200	0.198	5.280	OK	8.648	0.096	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	119 (C)	279.3	-63.0	-7.7	0.03	0.23	1.19	4.200	0.224	5.280	OK	8.648	0.109	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	120 (C)	379.9	-78.2	-11.7	0.03	0.21	1.18	4.200	0.301	5.280	OK	8.648	0.146	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	121 (C)	379.6	-74.9	-5.6	0.01	0.20	1.17	4.200	0.298	5.280	OK	8.648	0.145	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	122 (C)	378.3	-55.1	-11.3	0.03	0.15	1.13	4.200	0.286	5.280	OK	8.648	0.139	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	123 (C)	379.8	-100.0	-13.1	0.03	0.26	1.23	4.200	0.313	5.280	OK	8.648	0.152	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	124 (C)	377.0	-54.4	-8.7	0.02	0.14	1.12	4.200	0.285	5.280	OK	8.648	0.138	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	125 (C)	477.5	-91.4	-14.1	0.03	0.19	1.16	4.200	0.374	5.280	OK	8.648	0.182	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	126 (C)	377.0	-56.2	-8.8	0.02	0.15	1.13	4.200	0.286	5.280	OK	8.648	0.139	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	127 (C)	377.1	-54.7	-8.7	0.02	0.15	1.12	4.200	0.285	5.280	OK	8.648	0.138	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	128 (C)	376.8	-51.4	-2.6	0.01	0.14	1.12	4.200	0.283	5.280	OK	8.648	0.137	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	129 (C)	375.6	-31.7	-8.3	0.02	0.08	1.07	4.200	0.271	5.280	OK	8.648	0.132	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	130 (C)	377.1	-76.5	-10.1	0.03	0.20	1.17	4.200	0.298	5.280	OK	8.648	0.145	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	131 (C)	477.5	-93.2	-14.1	0.03	0.20	1.17	4.200	0.375	5.280	OK	8.648	0.182	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	132 (C)	477.7	-91.7	-14.1	0.03	0.19	1.16	4.200	0.374	5.280	OK	8.648	0.182	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	133 (C)	477.3	-88.4	-8.0	0.02	0.19	1.16	4.200	0.372	5.280	OK	8.648	0.181	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	134 (C)	476.1	-68.7	-13.6	0.03	0.14	1.12	4.200	0.360	5.280	OK	8.648	0.175	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	135 (C)	477.6	-113.5	-15.4	0.03	0.24	1.20	4.200	0.387	5.280	OK	8.648	0.188	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40	0.40	0.354	2.12	2.82	136 (C)	477.6	-93.6	-14.1	0.03	0.20	1.17	4.200	0.375	5.280	OK	8.648	0.182	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 21 al A')	0.70	1.40																								

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

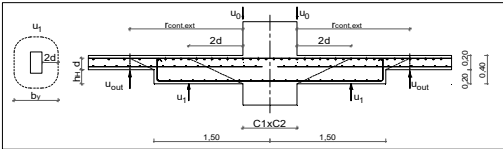


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρ _l	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	592.9	-155.4	-32.0	0.05	0.26	1.23	3.400	0.604	5.280	OK	7.848	0.262	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	592.6	-156.6	-32.0	0.05	0.26	1.23	3.400	0.605	5.280	OK	7.848	0.262	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	592.5	-155.3	-32.0	0.05	0.26	1.23	3.400	0.604	5.280	OK	7.848	0.262	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	592.7	-152.1	-27.2	0.05	0.26	1.22	3.400	0.601	5.280	OK	7.848	0.260	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	595.2	-132.9	-32.5	0.05	0.22	1.19	3.400	0.591	5.280	OK	7.848	0.256	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	592.4	-179.3	-33.2	0.06	0.30	1.26	3.400	0.621	5.280	OK	7.848	0.269	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	592.1	-156.5	-32.1	0.05	0.26	1.23	3.400	0.604	5.280	OK	7.848	0.262	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	592.4	-153.3	-27.3	0.05	0.26	1.22	3.400	0.602	5.280	OK	7.848	0.261	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	594.8	-134.0	-32.6	0.05	0.23	1.20	3.400	0.591	5.280	OK	7.848	0.256	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	592.1	-180.5	-33.3	0.06	0.30	1.26	3.400	0.621	5.280	OK	7.848	0.269	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	299.4	-68.3	-15.4	0.05	0.23	1.20	3.400	0.298	5.280	OK	7.848	0.129	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	431.5	-113.8	-23.4	0.05	0.26	1.23	3.400	0.440	5.280	OK	7.848	0.191	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	299.0	-68.2	-15.6	0.05	0.23	1.20	3.400	0.298	5.280	OK	7.848	0.129	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	299.3	-65.0	-10.7	0.04	0.22	1.19	3.400	0.295	5.280	OK	7.848	0.128	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	301.7	-45.6	-16.0	0.05	0.15	1.13	3.400	0.284	5.280	OK	7.848	0.123	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	299.0	-92.2	-16.8	0.06	0.31	1.27	3.400	0.314	5.280	OK	7.848	0.136	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	431.0	-113.7	-23.4	0.05	0.26	1.23	3.400	0.440	5.280	OK	7.848	0.190	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	431.4	-110.4	-18.6	0.04	0.26	1.22	3.400	0.437	5.280	OK	7.848	0.189	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	433.8	-91.1	-23.9	0.06	0.21	1.18	3.400	0.426	5.280	OK	7.848	0.185	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	431.1	-137.6	-24.6	0.06	0.32	1.27	3.400	0.457	5.280	OK	7.848	0.198	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	403.8	-90.5	-20.7	0.05	0.22	1.19	3.400	0.401	5.280	OK	7.848	0.174	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	535.8	-136.0	-28.6	0.05	0.25	1.22	3.400	0.543	5.280	OK	7.848	0.235	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	403.4	-91.7	-20.8	0.05	0.23	1.20	3.400	0.401	5.280	OK	7.848	0.174	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	403.3	-90.4	-20.8	0.05	0.22	1.19	3.400	0.400	5.280	OK	7.848	0.173	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	403.7	-87.2	-16.0	0.04	0.22	1.19	3.400	0.398	5.280	OK	7.848	0.172	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	406.0	-67.9	-21.3	0.05	0.17	1.15	3.400	0.387	5.280	OK	7.848	0.168	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	403.2	-114.3	-22.0	0.05	0.28	1.24	3.400	0.417	5.280	OK	7.848	0.181	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	535.5	-137.1	-28.7	0.05	0.26	1.22	3.400	0.543	5.280	OK	7.848	0.235	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	535.4	-135.9	-28.7	0.05	0.25	1.22	3.400	0.543	5.280	OK	7.848	0.235	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	535.8	-132.7	-23.8	0.04	0.25	1.21	3.400	0.540	5.280	OK	7.848	0.234	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	538.1	-113.3	-29.1	0.05	0.21	1.18	3.400	0.529	5.280	OK	7.848	0.229	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	535.3	-159.7	-29.9	0.06	0.30	1.26	3.400	0.559	5.280	OK	7.848	0.242	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al B)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	535.1	-137.0	-28.8	0.05	0.26	1.22	3.400	0.543	5.280	OK	7.848	0.235	15.70	15.70	0.0044	1.			

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

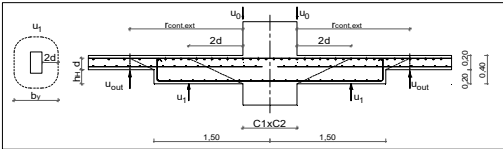


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	906.1	-36.7	-0.6	0.00	0.04	1.03	3.400	0.779	5.280	OK	7.848	0.337	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	906.0	-36.7	-0.7	0.00	0.04	1.03	3.400	0.779	5.280	OK	7.848	0.337	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	906.3	-36.6	-0.6	0.00	0.04	1.03	3.400	0.779	5.280	OK	7.848	0.337	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	906.4	-33.7	2.5	0.00	0.04	1.03	3.400	0.777	5.280	OK	7.848	0.337	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	906.0	-17.0	-0.9	0.00	0.02	1.02	3.400	0.765	5.280	OK	7.848	0.331	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	905.4	-57.5	-2.3	0.00	0.06	1.05	3.400	0.793	5.280	OK	7.848	0.343	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	906.1	-36.6	-0.7	0.00	0.04	1.03	3.400	0.779	5.280	OK	7.848	0.337	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	906.3	-33.7	2.4	0.00	0.04	1.03	3.400	0.777	5.280	OK	7.848	0.337	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	905.9	-17.0	-0.9	0.00	0.02	1.02	3.400	0.765	5.280	OK	7.848	0.331	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	905.3	-57.5	-2.4	0.00	0.06	1.05	3.400	0.793	5.280	OK	7.848	0.343	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	454.1	-18.2	-0.8	0.00	0.04	1.03	3.400	0.390	5.280	OK	7.848	0.169	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	659.1	-27.0	-0.6	0.00	0.04	1.03	3.400	0.567	5.280	OK	7.848	0.245	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	454.3	-18.1	-0.8	0.00	0.04	1.03	3.400	0.390	5.280	OK	7.848	0.169	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	454.4	-15.2	2.3	0.01	0.03	1.03	3.400	0.388	5.280	OK	7.848	0.168	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	454.0	1.5	-1.1	0.00	0.00	1.00	3.400	0.378	5.280	OK	7.848	0.164	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	453.5	-39.0	-2.5	0.01	0.09	1.07	3.400	0.404	5.280	OK	7.848	0.175	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	659.2	-26.9	-0.6	0.00	0.04	1.03	3.400	0.567	5.280	OK	7.848	0.245	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	659.3	-24.0	2.5	0.00	0.04	1.03	3.400	0.565	5.280	OK	7.848	0.245	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	659.0	-7.3	-0.8	0.00	0.01	1.01	3.400	0.553	5.280	OK	7.848	0.239	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	658.4	-47.8	-2.3	0.00	0.07	1.06	3.400	0.581	5.280	OK	7.848	0.252	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	613.5	-24.2	-1.0	0.00	0.04	1.03	3.400	0.527	5.280	OK	7.848	0.228	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	818.5	-32.9	-0.7	0.00	0.04	1.03	3.400	0.703	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	613.4	-24.2	-1.0	0.00	0.04	1.03	3.400	0.527	5.280	OK	7.848	0.228	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	613.6	-24.0	-1.0	0.00	0.04	1.03	3.400	0.527	5.280	OK	7.848	0.228	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	613.8	-21.1	2.1	0.00	0.03	1.03	3.400	0.525	5.280	OK	7.848	0.227	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	613.4	-4.4	-1.2	0.00	0.01	1.01	3.400	0.513	5.280	OK	7.848	0.222	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	612.8	-44.9	-2.7	0.00	0.07	1.06	3.400	0.541	5.280	OK	7.848	0.234	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	818.4	-33.0	-0.8	0.00	0.04	1.03	3.400	0.703	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	818.6	-32.8	-0.8	0.00	0.04	1.03	3.400	0.703	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	818.7	-29.9	2.4	0.00	0.04	1.03	3.400	0.701	5.280	OK	7.848	0.304	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	818.3	-13.2	-1.0	0.00	0.02	1.01	3.400	0.689	5.280	OK	7.848	0.299	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	817.8	-53.7	-2.4	0.00	0.07	1.06	3.400	0.717	5.280	OK	7.848	0.311	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al C)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	818.5	-32.8	-0.8	0.00	0.04	1.03	3.400	0.703	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK</

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

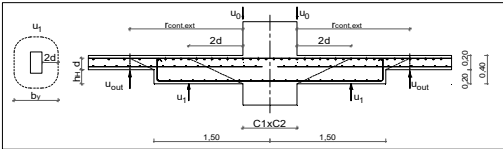


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρ _l	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	752.6	133.6	-8.0	0.01	0.18	1.15	3.400	0.720	5.280	OK	7.848	0.312	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	752.2	135.5	-8.0	0.01	0.18	1.15	3.400	0.721	5.280	OK	7.848	0.312	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	752.5	133.6	-8.0	0.01	0.18	1.15	3.400	0.720	5.280	OK	7.848	0.312	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	752.5	136.6	-4.7	0.01	0.18	1.15	3.400	0.722	5.280	OK	7.848	0.313	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	753.5	154.2	-8.0	0.01	0.20	1.17	3.400	0.735	5.280	OK	7.848	0.318	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	752.8	112.2	-11.0	0.01	0.15	1.13	3.400	0.705	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	752.0	135.5	-8.1	0.01	0.18	1.15	3.400	0.721	5.280	OK	7.848	0.312	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	752.1	138.5	-4.6	0.01	0.18	1.16	3.400	0.723	5.280	OK	7.848	0.313	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	753.0	156.1	-8.0	0.01	0.21	1.18	3.400	0.736	5.280	OK	7.848	0.319	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	752.3	113.9	-11.1	0.01	0.15	1.13	3.400	0.706	5.280	OK	7.848	0.306	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	374.6	60.6	-4.5	0.01	0.16	1.14	3.400	0.354	5.280	OK	7.848	0.153	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	547.0	98.4	-6.0	0.01	0.18	1.15	3.400	0.524	5.280	OK	7.848	0.227	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	374.5	60.6	-4.6	0.01	0.16	1.14	3.400	0.354	5.280	OK	7.848	0.153	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	374.5	63.7	-1.2	0.00	0.17	1.14	3.400	0.356	5.280	OK	7.848	0.154	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	375.4	81.3	-4.5	0.01	0.22	1.18	3.400	0.369	5.280	OK	7.848	0.160	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	374.8	39.1	-7.6	0.02	0.10	1.09	3.400	0.339	5.280	OK	7.848	0.147	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	546.9	98.4	-6.0	0.01	0.18	1.15	3.400	0.524	5.280	OK	7.848	0.227	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	546.9	101.4	-2.5	0.00	0.19	1.16	3.400	0.526	5.280	OK	7.848	0.228	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	547.8	119.0	-5.9	0.01	0.22	1.18	3.400	0.539	5.280	OK	7.848	0.234	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	547.1	77.0	-9.0	0.02	0.14	1.12	3.400	0.509	5.280	OK	7.848	0.221	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	506.1	79.6	-6.1	0.01	0.16	1.13	3.400	0.477	5.280	OK	7.848	0.207	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	678.4	117.3	-7.4	0.01	0.17	1.15	3.400	0.647	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	505.6	81.4	-6.0	0.01	0.16	1.14	3.400	0.478	5.280	OK	7.848	0.207	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	506.0	79.6	-6.0	0.01	0.16	1.13	3.400	0.477	5.280	OK	7.848	0.207	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	506.0	82.6	-2.6	0.01	0.16	1.14	3.400	0.479	5.280	OK	7.848	0.207	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	506.9	100.2	-6.1	0.01	0.20	1.17	3.400	0.492	5.280	OK	7.848	0.213	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	506.3	58.2	-9.0	0.02	0.11	1.10	3.400	0.462	5.280	OK	7.848	0.200	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	678.0	119.2	-7.4	0.01	0.18	1.15	3.400	0.648	5.280	OK	7.848	0.281	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	678.4	117.3	-7.4	0.01	0.17	1.15	3.400	0.647	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	678.4	120.4	-4.1	0.01	0.18	1.15	3.400	0.649	5.280	OK	7.848	0.281	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	679.3	137.9	-7.4	0.01	0.20	1.17	3.400	0.662	5.280	OK	7.848	0.287	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	678.6	95.9	-10.4	0.02	0.14	1.12	3.400	0.632	5.280	OK	7.848	0.274	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 21 al D)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	677.9	119.2	-7.5	0.01	0.18	1.15	3.400	0.648	5.280	OK	7.848	0.281	15.70	15.70	0.				

TN_CORPO 3_PISO 1_Estado Limite Último de Punçãoamento_Pilares Interiores

Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	c _{nom}	f _{yk}	f _{yd}
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

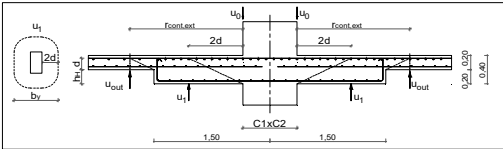


PISO	Pilar	Geometria						Esforços e excentricidades							Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo								
		b (m)	h (m)	h _{nje}	deff (m)	by (m)	bz (m)	CASO	V _{Ed} (kN)	M _{Ed,y} (kNm)	M _{Ed,z} (kNm)	ey (m)	ez (m)	β	u ₀ (m)	V _{Ed,u0} (MPa)	V _{Rd,max} (MPa)	Obs V _{Ed,u0} <V _{Rd,max}	u ₁ (m)	V _{Ed,u1} (MPa)	A _{s,x} (cm2)	A _{s,y} (cm2)	pl	k	V _{Rd,c} (MPa)	Obs V _{Ed,u1} <V _{Rd,c} V _{Ed,u1} <2V _{Rd,c}	
PISO 1	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	682.1	120.0	45.8	0.07	0.18	1.16	3.400	0.656	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	681.7	121.2	45.6	0.07	0.18	1.16	3.400	0.657	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	682.5	119.4	46.1	0.07	0.17	1.16	3.400	0.656	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	683.1	117.0	40.8	0.06	0.17	1.15	3.400	0.654	5.280	OK	7.848	0.283	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	685.4	96.7	44.5	0.06	0.14	1.13	3.400	0.643	5.280	OK	7.848	0.279	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	677.0	146.6	48.2	0.07	0.22	1.19	3.400	0.670	5.280	OK	7.848	0.290	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	682.2	120.6	45.9	0.07	0.18	1.16	3.400	0.657	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	682.7	118.2	40.6	0.06	0.17	1.15	3.400	0.654	5.280	OK	7.848	0.284	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	685.1	97.9	44.3	0.06	0.14	1.13	3.400	0.644	5.280	OK	7.848	0.279	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	676.7	147.8	47.9	0.07	0.22	1.19	3.400	0.671	5.280	OK	7.848	0.291	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	348.7	56.2	20.4	0.06	0.16	1.14	3.400	0.331	5.280	OK	7.848	0.144	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	495.9	89.3	32.7	0.07	0.18	1.16	3.400	0.478	5.280	OK	7.848	0.207	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	349.2	55.7	20.6	0.06	0.16	1.14	3.400	0.332	5.280	OK	7.848	0.144	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	349.8	53.2	15.4	0.04	0.15	1.13	3.400	0.329	5.280	OK	7.848	0.143	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	352.1	32.9	19.1	0.05	0.09	1.09	3.400	0.319	5.280	OK	7.848	0.138	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	343.7	82.9	22.7	0.07	0.24	1.21	3.400	0.346	5.280	OK	7.848	0.150	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	496.3	88.7	33.0	0.07	0.18	1.16	3.400	0.478	5.280	OK	7.848	0.207	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	496.9	86.2	27.8	0.06	0.17	1.15	3.400	0.476	5.280	OK	7.848	0.206	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	499.2	66.0	31.4	0.06	0.13	1.12	3.400	0.465	5.280	OK	7.848	0.202	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	490.8	115.9	35.1	0.07	0.24	1.21	3.400	0.493	5.280	OK	7.848	0.213	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	472.3	72.4	28.3	0.06	0.15	1.14	3.400	0.446	5.280	OK	7.848	0.193	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	619.4	105.5	40.7	0.07	0.17	1.15	3.400	0.593	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	471.9	73.6	28.1	0.06	0.16	1.14	3.400	0.447	5.280	OK	7.848	0.194	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	472.7	71.9	28.6	0.06	0.15	1.14	3.400	0.447	5.280	OK	7.848	0.193	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	473.3	69.3	23.4	0.05	0.15	1.13	3.400	0.444	5.280	OK	7.848	0.192	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	475.6	49.1	27.0	0.06	0.10	1.10	3.400	0.434	5.280	OK	7.848	0.188	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	467.2	99.1	30.7	0.07	0.21	1.19	3.400	0.461	5.280	OK	7.848	0.200	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	619.1	106.7	40.5	0.07	0.17	1.15	3.400	0.594	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	619.9	104.9	41.0	0.07	0.17	1.15	3.400	0.593	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	620.4	102.3	35.8	0.06	0.16	1.15	3.400	0.591	5.280	OK	7.848	0.256	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	622.7	82.2	39.4	0.06	0.13	1.12	3.400	0.580	5.280	OK	7.848	0.251	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	614.2	132.1	43.1	0.07	0.22	1.19	3.400	0.607	5.280	OK	7.848	0.263	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	619.4	106.1	40.8	0.07	0.17	1.15	3.400	0.594	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	137 (C)	620.0	103.5	35.5	0.06	0.17	1.15	3.400	0.592	5.280	OK	7.848	0.256	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	138 (C)	622.4	83.4	39.2	0.06	0.13	1.12	3.400	0.581	5.280	OK	7.848	0.252	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	139 (C)	613.9	133.3	42.9	0.07	0.22	1.19	3.400	0.608	5.280	OK	7.848	0.263	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	140 (C)	472.7	71.9	28.7	0.06	0.15	1.14	3.400	0.447	5.280	OK	7.848	0.193	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	141 (C)	619.9	104.9	41.0	0.07	0.17	1.15	3.400	0.593	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	142 (C)	472.3	73.1	28.4	0.06	0.15	1.14	3.400	0.447	5.280	OK	7.848	0.194	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	143 (C)	619.4	106.2	40.9	0.07	0.17	1.15	3.400	0.594	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	144 (C)	473.6	67.7	19.9	0.04	0.14	1.13	3.400	0.443	5.280	OK	7.848	0.192	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	145 (C)	620.7	100.7	32.2	0.05	0.16	1.14	3.400	0.590	5.280	OK	7.848	0.255	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	146 (C)	473.3	68.9	19.7	0.04	0.15	1.13	3.400	0.443	5.280	OK	7.848	0.192	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	147 (C)	620.3	101.9	32.1	0.05	0.16	1.14	3.400	0.590	5.280	OK	7.848	0.256	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	148 (C)	477.6	33.9	25.9	0.05	0.07	1.07	3.400	0.426	5.280	OK	7.848	0.184	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	149 (C)	624.7	67.0	38.3	0.06	0.11	1.10	3.400	0.572	5.280	OK	7.848	0.248	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al B)	0.70	1.00	0.40	0.354	2.12	2.42	150 (C)	477.1	35.1																	

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

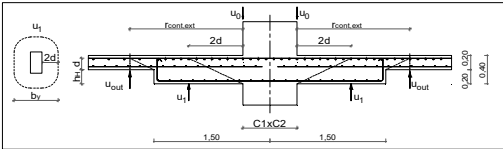


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,Y}	M _{Ed,Z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)		(mm)	(mm)	(mm)		(kN)	(kNm)	(kNm)	(mm)	(mm)		(mm)	(MPa)	(MPa)		(mm)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	820.4	46.5	20.5	0.02	0.06	1.05	3.400	0.717	5.280	OK	7.848	0.311	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	820.5	46.5	20.4	0.02	0.06	1.05	3.400	0.717	5.280	OK	7.848	0.311	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	820.3	46.6	20.6	0.03	0.06	1.05	3.400	0.717	5.280	OK	7.848	0.311	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	820.4	44.5	16.3	0.02	0.05	1.05	3.400	0.715	5.280	OK	7.848	0.310	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	820.7	25.8	18.6	0.02	0.03	1.03	3.400	0.703	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	820.2	68.4	24.9	0.03	0.08	1.07	3.400	0.732	5.280	OK	7.848	0.317	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	820.4	46.7	20.5	0.02	0.06	1.05	3.400	0.717	5.280	OK	7.848	0.311	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	820.5	44.5	16.3	0.02	0.05	1.05	3.400	0.715	5.280	OK	7.848	0.310	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	820.8	25.9	18.4	0.02	0.03	1.03	3.400	0.704	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	820.3	68.5	24.8	0.03	0.08	1.07	3.400	0.732	5.280	OK	7.848	0.317	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	411.4	23.3	7.8	0.02	0.06	1.05	3.400	0.359	5.280	OK	7.848	0.156	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	597.2	34.3	14.4	0.02	0.06	1.05	3.400	0.522	5.280	OK	7.848	0.226	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	411.4	23.4	7.8	0.02	0.06	1.05	3.400	0.359	5.280	OK	7.848	0.156	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	411.5	21.3	3.6	0.01	0.05	1.04	3.400	0.357	5.280	OK	7.848	0.155	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	411.8	2.6	5.9	0.01	0.01	1.01	3.400	0.346	5.280	OK	7.848	0.150	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	411.3	45.2	12.1	0.03	0.11	1.10	3.400	0.375	5.280	OK	7.848	0.162	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	597.1	34.3	14.5	0.02	0.06	1.05	3.400	0.522	5.280	OK	7.848	0.226	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	597.2	32.2	10.2	0.02	0.05	1.05	3.400	0.520	5.280	OK	7.848	0.225	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	597.4	13.5	12.5	0.02	0.02	1.02	3.400	0.509	5.280	OK	7.848	0.220	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	597.0	56.1	18.8	0.03	0.09	1.08	3.400	0.537	5.280	OK	7.848	0.233	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	555.0	30.9	11.1	0.02	0.06	1.05	3.400	0.484	5.280	OK	7.848	0.210	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	740.7	41.8	17.7	0.02	0.06	1.05	3.400	0.647	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	555.1	31.0	11.0	0.02	0.06	1.05	3.400	0.484	5.280	OK	7.848	0.210	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	554.9	31.0	11.2	0.02	0.06	1.05	3.400	0.484	5.280	OK	7.848	0.210	15.70	15.70	0.0044	1.75	0.498	OK	Obs
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	555.0	28.8	6.9	0.01	0.05	1.05	3.400	0.482	5.280	OK	7.848	0.209	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	555.3	10.3	9.2	0.02	0.02	1.02	3.400	0.471	5.280	OK	7.848	0.204	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	554.9	52.8	15.5	0.03	0.10	1.08	3.400	0.500	5.280	OK	7.848	0.216	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	740.8	41.9	17.7	0.02	0.06	1.05	3.400	0.647	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	740.7	41.9	17.8	0.02	0.06	1.05	3.400	0.647	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	740.7	39.7	13.6	0.02	0.05	1.05	3.400	0.645	5.280	OK	7.848	0.279	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	741.0	21.2	15.8	0.02	0.03	1.03	3.400	0.634	5.280	OK	7.848	0.274	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	740.5	63.8	22.1	0.03	0.09	1.08	3.400	0.662	5.280	OK	7.848	0.287	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al C)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	740.8	42.0	17.7	0.02	0.06	1.05	3.400	0.647	5.280	OK	7.848	0.280	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al																										

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

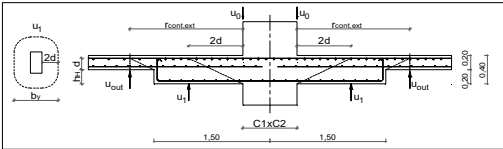


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{aje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	816.4	-123.0	29.1	0.04	0.15	1.13	3.400	0.767	5.280	OK	7.848	0.332	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	815.6	-124.9	28.9	0.04	0.15	1.13	3.400	0.768	5.280	OK	7.848	0.333	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	816.4	-123.0	29.1	0.04	0.15	1.13	3.400	0.767	5.280	OK	7.848	0.332	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	816.3	-125.2	25.2	0.03	0.15	1.13	3.400	0.768	5.280	OK	7.848	0.333	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	815.0	-144.6	26.1	0.03	0.18	1.15	3.400	0.781	5.280	OK	7.848	0.338	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	817.2	-100.8	34.9	0.04	0.12	1.11	3.400	0.753	5.280	OK	7.848	0.326	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	815.7	-124.9	28.9	0.04	0.15	1.13	3.400	0.768	5.280	OK	7.848	0.333	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	815.5	-127.1	25.0	0.03	0.16	1.13	3.400	0.769	5.280	OK	7.848	0.333	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	814.2	-146.4	26.0	0.03	0.18	1.15	3.400	0.781	5.280	OK	7.848	0.338	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	816.4	-102.5	34.7	0.04	0.13	1.11	3.400	0.754	5.280	OK	7.848	0.327	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	408.6	-59.8	16.9	0.04	0.15	1.13	3.400	0.383	5.280	OK	7.848	0.166	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	592.9	-91.5	21.1	0.04	0.15	1.13	3.400	0.559	5.280	OK	7.848	0.242	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	408.6	-59.8	16.9	0.04	0.15	1.13	3.400	0.383	5.280	OK	7.848	0.166	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	408.5	-62.0	13.0	0.03	0.15	1.13	3.400	0.384	5.280	OK	7.848	0.166	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	407.2	-81.4	14.0	0.03	0.20	1.17	3.400	0.396	5.280	OK	7.848	0.172	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	409.4	-37.6	22.7	0.06	0.09	1.09	3.400	0.370	5.280	OK	7.848	0.160	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	593.0	-91.4	21.1	0.04	0.15	1.13	3.400	0.559	5.280	OK	7.848	0.242	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	592.8	-93.7	17.3	0.03	0.16	1.14	3.400	0.560	5.280	OK	7.848	0.242	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	591.5	-113.0	18.2	0.03	0.19	1.16	3.400	0.572	5.280	OK	7.848	0.248	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	593.7	-69.2	26.9	0.05	0.12	1.10	3.400	0.545	5.280	OK	7.848	0.236	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	553.2	-77.7	23.0	0.04	0.14	1.12	3.400	0.516	5.280	OK	7.848	0.224	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	737.5	-109.3	27.3	0.04	0.15	1.13	3.400	0.692	5.280	OK	7.848	0.300	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	552.4	-79.5	22.9	0.04	0.14	1.13	3.400	0.517	5.280	OK	7.848	0.224	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	553.1	-77.6	23.0	0.04	0.14	1.12	3.400	0.516	5.280	OK	7.848	0.224	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	553.1	-79.9	19.2	0.03	0.14	1.13	3.400	0.517	5.280	OK	7.848	0.224	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	551.7	-99.2	20.1	0.04	0.18	1.16	3.400	0.530	5.280	OK	7.848	0.229	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	554.0	-55.4	28.9	0.05	0.10	1.09	3.400	0.503	5.280	OK	7.848	0.218	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	736.8	-111.2	27.1	0.04	0.15	1.13	3.400	0.693	5.280	OK	7.848	0.300	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	737.5	-109.3	27.3	0.04	0.15	1.13	3.400	0.692	5.280	OK	7.848	0.300	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	737.4	-111.5	23.5	0.03	0.15	1.13	3.400	0.693	5.280	OK	7.848	0.300	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	736.1	-130.9	24.4	0.03	0.18	1.15	3.400	0.705	5.280	OK	7.848	0.306	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	738.3	-87.0	33.2	0.04	0.12	1.11	3.400	0.678	5.280	OK	7.848	0.294	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 22 al D)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	736.8	-111.1	27.1	0.04	0.15	1.13	3.400	0.692	5.280	OK	7.848	0.300							

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

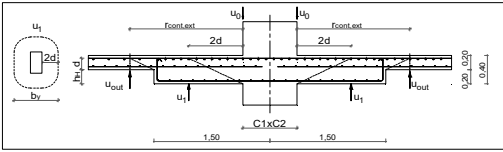


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	pl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(mm)	(mm)		(kN)	(kNm)	(kNm)	(mm)	(mm)		(mm)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(mm)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	818.0	83.1	-149.5	0.18	0.10	1.16	3.400	0.789	5.280	OK	7.848	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	816.8	84.7	-148.9	0.18	0.10	1.16	3.400	0.789	5.280	OK	7.848	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	819.2	82.1	-150.2	0.18	0.10	1.16	3.400	0.790	5.280	OK	7.848	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	819.6	80.5	-155.6	0.19	0.10	1.16	3.400	0.793	5.280	OK	7.848	0.343	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	822.6	59.5	-155.0	0.19	0.07	1.15	3.400	0.788	5.280	OK	7.848	0.341	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	808.9	112.4	-139.0	0.17	0.14	1.17	3.400	0.789	5.280	OK	7.848	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	818.0	83.7	-149.6	0.18	0.10	1.16	3.400	0.790	5.280	OK	7.848	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	818.4	82.1	-155.1	0.19	0.10	1.16	3.400	0.792	5.280	OK	7.848	0.343	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	821.4	61.0	-154.4	0.19	0.07	1.15	3.400	0.787	5.280	OK	7.848	0.341	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	807.7	113.8	-138.5	0.17	0.14	1.18	3.400	0.789	5.280	OK	7.848	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	384.1	56.8	-45.7	0.12	0.15	1.15	3.400	0.368	5.280	OK	7.848	0.160	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	590.3	65.0	-105.0	0.18	0.11	1.16	3.400	0.570	5.280	OK	7.848	0.247	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	385.3	55.7	-46.4	0.12	0.14	1.15	3.400	0.369	5.280	OK	7.848	0.160	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	385.7	54.2	-51.8	0.13	0.14	1.16	3.400	0.370	5.280	OK	7.848	0.160	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	388.6	33.1	-51.2	0.13	0.09	1.12	3.400	0.362	5.280	OK	7.848	0.157	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	375.0	86.0	-35.2	0.09	0.23	1.21	3.400	0.376	5.280	OK	7.848	0.163	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	591.5	64.0	-105.7	0.18	0.11	1.16	3.400	0.571	5.280	OK	7.848	0.247	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	591.9	62.5	-111.2	0.19	0.11	1.17	3.400	0.574	5.280	OK	7.848	0.248	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	594.9	41.4	-110.5	0.19	0.07	1.15	3.400	0.569	5.280	OK	7.848	0.246	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	581.2	94.3	-94.6	0.16	0.16	1.18	3.400	0.572	5.280	OK	7.848	0.248	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	524.2	70.4	-65.2	0.12	0.13	1.15	3.400	0.500	5.280	OK	7.848	0.216	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	730.5	78.7	-124.6	0.17	0.11	1.16	3.400	0.702	5.280	OK	7.848	0.304	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	523.0	72.0	-64.6	0.12	0.14	1.15	3.400	0.499	5.280	OK	7.848	0.216	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	525.4	69.4	-65.9	0.13	0.13	1.15	3.400	0.500	5.280	OK	7.848	0.217	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	525.8	67.9	-71.2	0.14	0.13	1.15	3.400	0.502	5.280	OK	7.848	0.217	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	528.8	46.8	-70.7	0.13	0.09	1.12	3.400	0.494	5.280	OK	7.848	0.214	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	515.1	99.7	-54.7	0.11	0.19	1.18	3.400	0.506	5.280	OK	7.848	0.219	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	729.3	80.3	-124.1	0.17	0.11	1.16	3.400	0.701	5.280	OK	7.848	0.304	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	731.6	77.7	-125.3	0.17	0.11	1.16	3.400	0.703	5.280	OK	7.848	0.304	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	732.2	76.2	-130.7	0.18	0.10	1.16	3.400	0.706	5.280	OK	7.848	0.306	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	735.0	55.1	-130.1	0.18	0.07	1.15	3.400	0.700	5.280	OK	7.848	0.303	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	721.4	108.0	-114.1	0.16	0.15	1.17	3.400	0.703	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	730.4	79.3	-124.7	0.17	0.11	1.16	3.400	0.702	5.280	OK	7.848	0.304	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.354	2.12	2.42	137 (C)	730.9	77.7	-130.1	0.18	0.11	1.16	3.400	0.705	5.280	OK	7.848	0.305	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al B)	0.70	1.00	0.40	0.35																						

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	c _{nom}	f _{yk}	f _{yd}
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

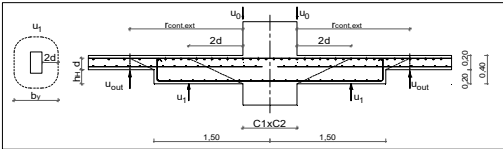


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b (m)	h (m)	h _{laje} (m)	deff (m)	by (m)	bz (m)	CASO	V _{Ed} (kN)	M _{Ed,y} (kNm)	M _{Ed,z} (kNm)	ey (m)	ez (m)	β	U ₀ (m)	V _{Ed,u0} (MPa)	V _{Rd,max} (MPa)	Obs V _{Ed,u0} <V _{Rd,max}	u ₁ (m)	V _{Ed,u1} (MPa)	A _{s,x} (cm2)	A _{s,y} (cm2)	pl	k	V _{Rd,c} (MPa)	Obs V _{Ed,u1} <V _{Rd,c} V _{Ed,u1} <2V _{Rd,c}	
PISO 1	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	913.1	43.9	-97.1	0.11	0.05	1.09	3.400	0.826	5.280	OK	7.848	0.358	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	913.1	44.0	-96.7	0.11	0.05	1.09	3.400	0.826	5.280	OK	7.848	0.358	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	913.1	44.0	-97.1	0.11	0.05	1.09	3.400	0.826	5.280	OK	7.848	0.358	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	913.1	42.8	-101.7	0.11	0.05	1.09	3.400	0.828	5.280	OK	7.848	0.359	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	913.5	23.4	-101.5	0.11	0.03	1.09	3.400	0.824	5.280	OK	7.848	0.357	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	913.1	66.0	-89.6	0.10	0.07	1.10	3.400	0.831	5.280	OK	7.848	0.360	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	913.0	44.0	-96.8	0.11	0.05	1.09	3.400	0.826	5.280	OK	7.848	0.358	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	912.9	42.8	-101.4	0.11	0.05	1.09	3.400	0.828	5.280	OK	7.848	0.359	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	913.4	23.4	-101.1	0.11	0.03	1.09	3.400	0.824	5.280	OK	7.848	0.357	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	913.0	66.1	-89.2	0.10	0.07	1.10	3.400	0.831	5.280	OK	7.848	0.360	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	456.8	20.8	-47.4	0.10	0.05	1.09	3.400	0.412	5.280	OK	7.848	0.179	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	664.2	32.2	-69.9	0.11	0.05	1.09	3.400	0.601	5.280	OK	7.848	0.260	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	456.8	20.9	-47.4	0.10	0.05	1.09	3.400	0.412	5.280	OK	7.848	0.179	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	456.7	19.7	-52.0	0.11	0.04	1.09	3.400	0.415	5.280	OK	7.848	0.180	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	457.2	0.3	-51.7	0.11	0.00	1.08	3.400	0.412	5.280	OK	7.848	0.178	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	456.7	42.9	-39.8	0.09	0.09	1.10	3.400	0.419	5.280	OK	7.848	0.181	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	664.2	32.3	-70.0	0.11	0.05	1.09	3.400	0.601	5.280	OK	7.848	0.260	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	664.1	31.0	-74.6	0.11	0.05	1.09	3.400	0.603	5.280	OK	7.848	0.261	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	664.5	11.7	-74.3	0.11	0.02	1.08	3.400	0.599	5.280	OK	7.848	0.259	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	664.2	54.3	-62.3	0.09	0.08	1.10	3.400	0.606	5.280	OK	7.848	0.263	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	616.7	27.7	-64.9	0.11	0.04	1.09	3.400	0.557	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	824.2	39.1	-87.5	0.11	0.05	1.09	3.400	0.746	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	616.7	27.7	-64.6	0.10	0.04	1.09	3.400	0.557	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	616.7	27.7	-64.9	0.11	0.04	1.09	3.400	0.557	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	616.7	26.5	-69.5	0.11	0.04	1.09	3.400	0.559	5.280	OK	7.848	0.242	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	617.1	7.1	-69.3	0.11	0.01	1.08	3.400	0.556	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	616.7	49.8	-57.4	0.09	0.08	1.10	3.400	0.562	5.280	OK	7.848	0.244	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	824.2	39.1	-87.1	0.11	0.05	1.09	3.400	0.745	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	824.1	39.1	-87.5	0.11	0.05	1.09	3.400	0.746	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	824.1	38.0	-92.1	0.11	0.05	1.09	3.400	0.748	5.280	OK	7.848	0.324	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	824.5	18.5	-91.8	0.11	0.02	1.09	3.400	0.743	5.280	OK	7.848	0.322	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	824.1	61.2	-79.9	0.10	0.07	1.10	3.400	0.750	5.280	OK	7.848	0.325	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	824.1	39.2	-87.1	0.11	0.05	1.09	3.400	0.745	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	137 (C)	824.0	38.0	-91.7	0.11	0.05	1.09	3.400	0.747	5.280	OK	7.848	0.324	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	138 (C)	824.5	18.6	-91.5	0.11	0.02	1.08	3.400	0.743	5.280	OK	7.848	0.322	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	139 (C)	824.1	61.2	-79.6	0.10	0.07	1.10	3.400	0.750	5.280	OK	7.848	0.325	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	140 (C)	616.7	27.8	-64.9	0.11	0.05	1.09	3.400	0.557	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	141 (C)	824.2	39.1	-87.5	0.11	0.05	1.09	3.400	0.746	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	142 (C)	616.7	27.9	-64.6	0.10	0.05	1.09	3.400	0.557	5.280	OK	7.848	0.241	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	143 (C)	824.1	39.2	-87.1	0.11	0.05	1.09	3.400	0.745	5.280	OK	7.848	0.323	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	144 (C)	616.6	25.7	-72.5	0.12	0.04	1.09	3.400	0.561	5.280	OK	7.848	0.243	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	145 (C)	824.1	37.1	-95.1	0.12	0.05	1.09	3.400	0.749	5.280	OK	7.848	0.325	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	146 (C)	616.5	25.8	-72.2	0.12	0.04	1.09	3.400	0.560	5.280	OK	7.848	0.243	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	147 (C)	824.0	37.1	-94.8	0.12	0.05	1.09	3.400	0.749	5.280	OK	7.848	0.324	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	148 (C)	617.4	-6.6	-72.2	0.12	0.01	1.09	3.400	0.558	5.280	OK	7.848	0.242	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	149 (C)	824.9	4.8	-94.7	0.11	0.01	1.09	3.400	0.744	5.280	OK	7.848	0.322	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al C)	0.70	1.00	0.40	0.354	2.12	2.42	150 (C)	617.3	-6.5	-71.8	0.12	0														

TN_CORPO 3_PISO 1_Estado Limite Último de Punçoamento_Pilares Interiores

Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	Cnom	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

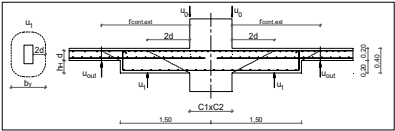


PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo									
		b	h	h _{laje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρ _l	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(mm)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
PISO 1	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	104 (C)	855.8	-137.5	-62.6	0.07	0.16	1.15	3.400	0.816	5.280	OK	7.848	0.353	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	105 (C)	854.8	-139.5	-62.3	0.07	0.16	1.15	3.400	0.816	5.280	OK	7.848	0.354	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	106 (C)	855.8	-137.6	-62.6	0.07	0.16	1.15	3.400	0.816	5.280	OK	7.848	0.353	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	107 (C)	855.7	-139.0	-66.7	0.08	0.16	1.15	3.400	0.818	5.280	OK	7.848	0.354	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	108 (C)	854.4	-159.8	-67.0	0.08	0.19	1.17	3.400	0.830	5.280	OK	7.848	0.360	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	109 (C)	857.1	-113.9	-54.7	0.06	0.13	1.12	3.400	0.799	5.280	OK	7.848	0.346	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	110 (C)	854.8	-139.5	-62.4	0.07	0.16	1.15	3.400	0.816	5.280	OK	7.848	0.354	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	111 (C)	854.7	-141.0	-66.4	0.08	0.16	1.15	3.400	0.818	5.280	OK	7.848	0.354	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	112 (C)	853.5	-161.7	-66.7	0.08	0.19	1.17	3.400	0.831	5.280	OK	7.848	0.360	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	113 (C)	856.1	-115.9	-54.4	0.06	0.14	1.12	3.400	0.800	5.280	OK	7.848	0.346	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	114 (C)	427.5	-68.8	-31.4	0.07	0.16	1.15	3.400	0.408	5.280	OK	7.848	0.177	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	115 (C)	621.3	-102.3	-45.0	0.07	0.16	1.15	3.400	0.594	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	116 (C)	427.5	-68.7	-31.4	0.07	0.16	1.15	3.400	0.407	5.280	OK	7.848	0.177	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	117 (C)	427.4	-70.2	-35.4	0.08	0.16	1.15	3.400	0.409	5.280	OK	7.848	0.177	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	118 (C)	426.1	-90.9	-35.8	0.08	0.21	1.19	3.400	0.422	5.280	OK	7.848	0.183	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	119 (C)	428.7	-45.2	-23.4	0.05	0.11	1.10	3.400	0.391	5.280	OK	7.848	0.169	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	120 (C)	621.3	-102.4	-45.0	0.07	0.16	1.15	3.400	0.594	5.280	OK	7.848	0.257	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	121 (C)	621.3	-103.8	-49.1	0.08	0.17	1.15	3.400	0.596	5.280	OK	7.848	0.258	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	122 (C)	619.9	-124.6	-49.4	0.08	0.20	1.18	3.400	0.608	5.280	OK	7.848	0.264	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	123 (C)	622.6	-78.8	-37.1	0.06	0.13	1.12	3.400	0.578	5.280	OK	7.848	0.250	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	124 (C)	579.0	-89.4	-43.2	0.07	0.15	1.14	3.400	0.550	5.280	OK	7.848	0.238	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	125 (C)	772.7	-123.0	-56.9	0.07	0.16	1.15	3.400	0.736	5.280	OK	7.848	0.319	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	126 (C)	578.0	-91.4	-42.9	0.07	0.16	1.15	3.400	0.550	5.280	OK	7.848	0.238	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	127 (C)	578.9	-89.4	-43.2	0.07	0.15	1.14	3.400	0.550	5.280	OK	7.848	0.238	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	128 (C)	578.8	-90.9	-47.2	0.08	0.16	1.15	3.400	0.551	5.280	OK	7.848	0.239	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	129 (C)	577.6	-111.6	-47.5	0.08	0.19	1.18	3.400	0.564	5.280	OK	7.848	0.244	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	130 (C)	580.1	-65.9	-35.2	0.06	0.11	1.11	3.400	0.533	5.280	OK	7.848	0.231	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	131 (C)	771.8	-125.0	-56.5	0.07	0.16	1.15	3.400	0.736	5.280	OK	7.848	0.319	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	132 (C)	772.8	-123.1	-56.9	0.07	0.16	1.15	3.400	0.736	5.280	OK	7.848	0.319	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	133 (C)	772.7	-124.5	-60.9	0.08	0.16	1.15	3.400	0.738	5.280	OK	7.848	0.320	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	134 (C)	771.4	-145.3	-61.2	0.08	0.19	1.17	3.400	0.750	5.280	OK	7.848	0.325	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	135 (C)	774.0	-99.4	-48.9	0.06	0.13	1.12	3.400	0.720	5.280	OK	7.848	0.312	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P9 (al 23 al D)	0.70	1.00	0.40	0.354	2.12	2.42	136 (C)	771.8	-125.0	-56.5	0.07	0.16	1.15	3.400	0.736	5.280	OK	7.848	0.319	15.70	15.70	0.0044	1.75			

TN_CORPO 3_PISO 1_Estado Limite Último de Punçoamento_Pilares de Bordo

Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	C _{nom}	f _{yk}	f _{yd}
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3



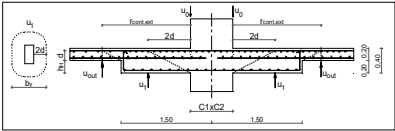
C1/(2C2)	≤0.5	1	2	≥3
k	0.45	0.6	0.7	0.8

PISO	Pilar	Geometria						Esforços e excentricidades										Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo										
		C2	C1	h _{aje}	deff	by	bz	CASO	V _{Ed}	M _{EdY}	M _{EdZ}	ey	ez	u ₁	u ₁ *	k	e _{par}	Paralelo ao bordo		u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(m)		W1	β	(m)		(MPa)	(MPa)		V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)	(cm2)			(cm2)	(MPa)	V _{Ed,u1} < V _{Rd,c}
PISO 1	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	104 (C)	494.3	-90.3	-29.4	0.06	0.18	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.742	5.280	OK	8.648	0.361	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	105 (C)	494.5	-92.3	-29.4	0.06	0.19	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.743	5.280	OK	8.648	0.361	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	106 (C)	493.3	-90.5	-29.3	0.06	0.18	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.741	5.280	OK	8.648	0.360	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	107 (C)	496.7	-83.9	-25.1	0.05	0.17	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.743	5.280	OK	8.648	0.361	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	108 (C)	497.7	-66.8	-34.8	0.07	0.13	8.648	3.99	0.60	0.07	4.87	2.24	4.200	0.751	5.280	OK	8.648	0.365	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	109 (C)	498.8	-111.5	-25.7	0.05	0.22	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.746	5.280	OK	8.648	0.362	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	110 (C)	493.5	-92.4	-29.4	0.06	0.19	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.741	5.280	OK	8.648	0.360	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	111 (C)	496.9	-86.0	-25.2	0.05	0.17	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.743	5.280	OK	8.648	0.361	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	112 (C)	497.8	-68.7	-34.9	0.07	0.14	8.648	3.99	0.60	0.07	4.87	2.24	4.200	0.751	5.280	OK	8.648	0.365	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	113 (C)	499.0	-113.5	-25.8	0.05	0.23	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.747	5.280	OK	8.648	0.363	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	114 (C)	261.5	-29.6	-14.3	0.05	0.11	8.648	3.99	0.60	0.05	4.87	2.23	4.200	0.392	5.280	OK	8.648	0.190	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	115 (C)	361.7	-65.8	-21.5	0.06	0.18	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.543	5.280	OK	8.648	0.264	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	116 (C)	260.5	-29.8	-14.1	0.05	0.11	8.648	3.99	0.60	0.05	4.87	2.23	4.200	0.390	5.280	OK	8.648	0.190	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	117 (C)	263.9	-23.2	-10.0	0.04	0.09	8.648	3.99	0.60	0.04	4.87	2.21	4.200	0.392	5.280	OK	8.648	0.190	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	118 (C)	264.9	-6.0	-19.7	0.07	0.02	8.648	3.99	0.60	0.07	4.87	2.25	4.200	0.401	5.280	OK	8.648	0.195	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	119 (C)	266.0	-50.8	-10.6	0.04	0.19	8.648	3.99	0.60	0.04	4.87	2.21	4.200	0.396	5.280	OK	8.648	0.192	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	120 (C)	360.8	-65.9	-21.4	0.06	0.18	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.542	5.280	OK	8.648	0.263	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	121 (C)	364.2	-59.4	-17.2	0.05	0.16	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.544	5.280	OK	8.648	0.264	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	122 (C)	365.1	-42.2	-26.9	0.07	0.12	8.648	3.99	0.60	0.07	4.87	2.25	4.200	0.552	5.280	OK	8.648	0.268	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	123 (C)	366.2	-87.0	-17.8	0.05	0.24	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.547	5.280	OK	8.648	0.266	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	124 (C)	349.0	-39.4	-18.9	0.05	0.11	8.648	3.99	0.60	0.05	4.87	2.23	4.200	0.523	5.280	OK	8.648	0.254	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	125 (C)	449.3	-75.6	-26.1	0.06	0.17	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.674	5.280	OK	8.648	0.327	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	126 (C)	349.2	-41.3	-19.0	0.05	0.12	8.648	3.99	0.60	0.05	4.87	2.23	4.200	0.523	5.280	OK	8.648	0.254	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	127 (C)	348.1	-39.6	-18.8	0.05	0.11	8.648	3.99	0.60	0.05	4.87	2.23	4.200	0.521	5.280	OK	8.648	0.253	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	128 (C)	351.5	-33.0	-14.6	0.04	0.09	8.648	3.99	0.60	0.04	4.87	2.21	4.200	0.523	5.280	OK	8.648	0.254	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	129 (C)	352.4	-15.8	-24.3	0.07	0.04	8.648	3.99	0.60	0.07	4.87	2.24	4.200	0.532	5.280	OK	8.648	0.258	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	130 (C)	353.6	-60.6	-15.2	0.04	0.17	8.648	3.99	0.60	0.04	4.87	2.22	4.200	0.527	5.280	OK	8.648	0.256	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	131 (C)	449.5	-77.5	-26.2	0.06	0.17	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.675	5.280	OK	8.648	0.328	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	132 (C)	448.3	-75.7	-26.0	0.06	0.17	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.673	5.280	OK	8.648	0.327	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 10 al A)	0.70	1.40	0.40	0.354	2.12	2.82	133 (C)	451.7	-69.2	-21.8	0.05	0.15	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.675	5.280	OK	8.648	0.328	15.70	15.70	0.0044	1.75			

TN_CORPO 3_PISO 1_Estado Limite Último de Punçãoamento_Pilares de Bordo

Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	c _{nom}	f _{yk}	f _{yd}
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3



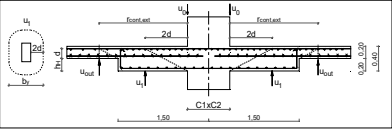
C1/(2°C2)	≤0.5	1	2	≥3
k	0.45	0.6	0.7	0.8

PISO	Pilar	Geometria						Esforços e excentricidades										Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo											
		C2	C1	h _{aje}	d _{eff}	b _y	b _z	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	e _y	e _z	u _x	u _y *	k	e _{par}	Paralelo ao bordo		u ₂	V _{Ed,ult}	V _{Ed,max}	Obs	V _{Ed,ult} < V _{Rd,max}	u ₁	V _{Ed,ult}	A _{s,x}	A _{s,y}	ρl	k	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m)	(m)	(m)	(m)		(m)	(m)	(m)		(m)	(MPa)				(MPa)	(m)	(MPa)			(cm2)	(cm2)	(MPa)
PISO 1	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	104 (C)	476.0	-54.0	-4.1	0.01	0.11	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.698	5.280	OK		8.648	0.339	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	105 (C)	476.4	-55.8	-4.2	0.01	0.12	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.698	5.280	OK		8.648	0.339	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	106 (C)	475.3	-53.9	-4.3	0.01	0.11	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.697	5.280	OK		8.648	0.338	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	107 (C)	476.3	-49.5	1.6	0.00	0.10	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.696	5.280	OK		8.648	0.338	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	108 (C)	475.1	-32.9	-5.9	0.01	0.07	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.698	5.280	OK		8.648	0.339	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	109 (C)	481.3	-75.3	-2.3	0.00	0.16	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.704	5.280	OK		8.648	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	110 (C)	475.7	-55.7	-4.4	0.01	0.12	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.697	5.280	OK		8.648	0.339	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	111 (C)	476.8	-51.4	1.6	0.00	0.11	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.697	5.280	OK		8.648	0.338	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	112 (C)	475.4	-34.7	-6.0	0.01	0.07	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.698	5.280	OK		8.648	0.339	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	113 (C)	481.6	-77.0	-2.3	0.00	0.16	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.704	5.280	OK		8.648	0.342	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	114 (C)	250.6	-9.6	-1.4	0.01	0.04	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.367	5.280	OK		8.648	0.178	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	115 (C)	348.0	-39.2	-3.0	0.01	0.11	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.510	5.280	OK		8.648	0.248	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	116 (C)	250.0	-9.5	-1.6	0.01	0.04	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.366	5.280	OK		8.648	0.178	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	117 (C)	251.0	-5.1	4.4	0.02	0.02	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.369	5.280	OK		8.648	0.179	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	118 (C)	249.6	11.5	-3.2	0.01	0.05	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.367	5.280	OK		8.648	0.178	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	119 (C)	255.9	-30.9	0.4	0.00	0.12	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.374	5.280	OK		8.648	0.181	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	120 (C)	347.4	-39.1	-3.1	0.01	0.11	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.509	5.280	OK		8.648	0.247	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	121 (C)	348.4	-34.7	2.9	0.01	0.10	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.510	5.280	OK		8.648	0.248	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	122 (C)	347.0	-18.1	-4.7	0.01	0.05	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.510	5.280	OK		8.648	0.248	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	123 (C)	353.3	-60.5	-1.0	0.00	0.17	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.516	5.280	OK		8.648	0.251	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	124 (C)	335.8	-11.9	-2.4	0.01	0.04	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.492	5.280	OK		8.648	0.239	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	125 (C)	433.2	-41.5	-3.8	0.01	0.10	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.635	5.280	OK		8.648	0.308	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	126 (C)	336.1	-13.7	-2.4	0.01	0.04	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.492	5.280	OK		8.648	0.239	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	127 (C)	335.0	-11.8	-2.5	0.01	0.04	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.491	5.280	OK		8.648	0.238	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	128 (C)	336.1	-7.4	3.5	0.01	0.02	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.493	5.280	OK		8.648	0.239	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	129 (C)	334.7	9.2	-4.1	0.01	0.03	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.491	5.280	OK		8.648	0.239	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	130 (C)	341.0	-33.2	-0.5	0.00	0.10	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.498	5.280	OK		8.648	0.242	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	131 (C)	433.5	-43.3	-3.9	0.01	0.10	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.635	5.280	OK		8.648	0.309	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	132 (C)	432.4	-41.4	-4.0	0.01	0.10	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.634	5.280	OK		8.648	0.308	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 11 al A)	0.70	1.40	0.40	0.354	2.12	2.82	133 (C)	433.5	-37.0	2.0	0.																					

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	C _{nom}	f _{yk}	f _{yd}
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3



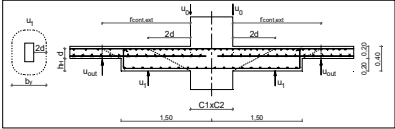
C1/(2C2)	≤0.5	1	2	≥3
k	0.45	0.6	0.7	0.8

PISO	Pilar	Geometria						Esforços e excentricidades												Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo								
		b	h	h _{aje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	u _x	u _y *	k	e _{par}	Paralelo ao bordo		u ₂	V _{Ed,u1}	V _{Ed,max}	Obs	u ₁	V _{Ed,u1}	A _{s,x}	A _{s,y}	ρl	k	V _{Red,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(m)		(m)	W1	β	(m)	(MPa)	(MPa)	V _{Ed,u1} < V _{Red,max}	(m)	(MPa)	(cm2)	(cm2)			(MPa)	V _{Ed,u1} < V _{Red,c}	V _{Ed,u1} < V _{Red,c}
PISO 1	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	104 (C)	400.1	69.8	-9.2	0.02	0.17	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.590	5.280	OK	8.648	0.287	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	105 (C)	400.5	71.5	-9.3	0.02	0.18	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.591	5.280	OK	8.648	0.287	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	106 (C)	399.2	69.8	-9.3	0.02	0.17	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.589	5.280	OK	8.648	0.286	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	107 (C)	399.0	67.5	-14.9	0.04	0.17	8.648	3.99	0.60	0.04	4.87	2.21	4.200	0.593	5.280	OK	8.648	0.288	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	108 (C)	398.0	48.5	-12.1	0.03	0.12	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.589	5.280	OK	8.648	0.286	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	109 (C)	405.4	92.1	-4.7	0.01	0.23	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.595	5.280	OK	8.648	0.289	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	110 (C)	399.7	71.5	-9.3	0.02	0.18	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.590	5.280	OK	8.648	0.286	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	111 (C)	399.5	69.2	-15.0	0.04	0.17	8.648	3.99	0.60	0.04	4.87	2.21	4.200	0.594	5.280	OK	8.648	0.288	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	112 (C)	398.4	50.2	-12.2	0.03	0.13	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.590	5.280	OK	8.648	0.287	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	113 (C)	405.8	93.8	-4.7	0.01	0.23	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.596	5.280	OK	8.648	0.289	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	114 (C)	218.8	29.4	-11.3	0.05	0.13	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.327	5.280	OK	8.648	0.159	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	115 (C)	293.7	52.2	-7.4	0.03	0.18	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.434	5.280	OK	8.648	0.211	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	116 (C)	218.0	29.4	-11.3	0.05	0.13	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.326	5.280	OK	8.648	0.158	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	117 (C)	217.7	27.1	-17.0	0.08	0.12	8.648	3.99	0.60	0.08	4.87	2.25	4.200	0.330	5.280	OK	8.648	0.160	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	118 (C)	216.7	8.1	-14.2	0.07	0.04	8.648	3.99	0.60	0.07	4.87	2.24	4.200	0.326	5.280	OK	8.648	0.159	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	119 (C)	224.2	51.8	-6.7	0.03	0.23	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.332	5.280	OK	8.648	0.161	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	120 (C)	292.8	52.2	-7.4	0.03	0.18	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.433	5.280	OK	8.648	0.210	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	121 (C)	292.7	49.9	-13.0	0.04	0.17	8.648	3.99	0.60	0.04	4.87	2.22	4.200	0.436	5.280	OK	8.648	0.212	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	122 (C)	291.6	30.9	-10.2	0.03	0.11	8.648	3.99	0.60	0.03	4.87	2.21	4.200	0.433	5.280	OK	8.648	0.210	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	123 (C)	299.0	74.5	-2.8	0.01	0.25	8.648	3.99	0.60	0.01	4.87	2.18	4.200	0.438	5.280	OK	8.648	0.213	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	124 (C)	292.5	37.4	-15.1	0.05	0.13	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.438	5.280	OK	8.648	0.213	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	125 (C)	367.3	60.2	-11.0	0.03	0.16	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.544	5.280	OK	8.648	0.264	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	126 (C)	293.0	39.0	-15.1	0.05	0.13	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.438	5.280	OK	8.648	0.213	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	127 (C)	291.6	37.4	-15.1	0.05	0.13	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.436	5.280	OK	8.648	0.212	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	128 (C)	291.4	35.1	-20.7	0.07	0.12	8.648	3.99	0.60	0.07	4.87	2.25	4.200	0.440	5.280	OK	8.648	0.214	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	129 (C)	290.4	16.2	-17.8	0.06	0.06	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.437	5.280	OK	8.648	0.212	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	130 (C)	297.8	59.7	-10.5	0.04	0.20	8.648	3.99	0.60	0.04	4.87	2.21	4.200	0.442	5.280	OK	8.648	0.215	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	131 (C)	367.8	61.8	-11.1	0.03	0.17	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.545	5.280	OK	8.648	0.265	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	132 (C)	366.5	60.2	-11.1	0.03	0.16	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.543	5.280	OK	8.648	0.264	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 14 al A)	0.70	1.40	0.40	0.354	2.12	2.82	133 (C)	366.2	57.9	-16.7	0.05	0.16	8.648	3.99	0.6																

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fcd	fctm	C _{nom}	f _{yk}	f _{yd}
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

Capitel	
L1	L2
(m)	(m)
3	3

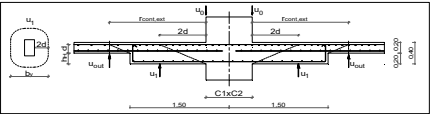


C1/(2°C2)	≤0.5	1	2	≥3
k	0.45	0.6	0.7	0.8

PISO	Pilar	Geometria						Esforços e excentricidades										Verificação no perímetro do pilar				Verificação no primeiro perímetro de controlo										
		b	h	h _{aje}	deff	by	bz	CASO	V _{Ed}	M _{Ed,Y}	M _{Ed,Z}	ey	ez	u _x	u _y *	k	e _{par}	Paralelo ao bordo		u ₂	V _{Ed,u2}	V _{Ed,max}	Obs	u ₁	V _{Ed,u1}	A _{s,X}	A _{s,Y}	ρl	k	V _{Ed,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(m)		W1	β	(m)	(MPa)	(MPa)	V _{Ed,u2} < V _{Ed,max}	(m)	(MPa)	(cm2)	(cm2)	(MPa)			V _{Ed,u1} < V _{Ed,c}	V _{Ed,u1} < 2V _{Ed,c}	
PISO 1	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	104 (C)	476.7	127.9	-29.2	0.06	0.27	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.717	5.280	OK	8.648	0.348	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	105 (C)	476.8	129.6	-29.0	0.06	0.27	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.717	5.280	OK	8.648	0.348	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	106 (C)	476.6	128.3	-29.5	0.06	0.27	8.648	3.99	0.60	0.06	4.87	2.24	4.200	0.717	5.280	OK	8.648	0.348	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	107 (C)	475.7	127.1	-34.1	0.07	0.27	8.648	3.99	0.60	0.07	4.87	2.25	4.200	0.719	5.280	OK	8.648	0.349	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	108 (C)	474.2	106.5	-33.3	0.07	0.22	8.648	3.99	0.60	0.07	4.87	2.24	4.200	0.716	5.280	OK	8.648	0.348	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	109 (C)	480.6	149.6	-22.9	0.05	0.31	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.718	5.280	OK	8.648	0.349	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	110 (C)	476.5	130.0	-29.4	0.06	0.27	8.648	3.99	0.60	0.06	4.87	2.24	4.200	0.716	5.280	OK	8.648	0.348	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	111 (C)	475.7	128.8	-33.9	0.07	0.27	8.648	3.99	0.60	0.07	4.87	2.25	4.200	0.718	5.280	OK	8.648	0.349	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	112 (C)	474.1	108.1	-33.2	0.07	0.23	8.648	3.99	0.60	0.07	4.87	2.24	4.200	0.716	5.280	OK	8.648	0.348	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	113 (C)	480.6	151.3	-22.7	0.05	0.31	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.718	5.280	OK	8.648	0.348	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	114 (C)	229.3	53.1	-0.1	0.00	0.23	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.335	5.280	OK	8.648	0.163	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	115 (C)	346.2	93.9	-19.8	0.06	0.27	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.519	5.280	OK	8.648	0.252	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	116 (C)	229.1	53.5	-0.3	0.00	0.23	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.335	5.280	OK	8.648	0.162	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	117 (C)	228.2	52.2	-5.0	0.02	0.23	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.337	5.280	OK	8.648	0.163	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	118 (C)	226.7	31.6	-4.3	0.02	0.14	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.334	5.280	OK	8.648	0.162	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	119 (C)	233.1	74.7	6.2	0.03	0.32	8.648	3.99	0.60	0.03	4.87	2.20	4.200	0.345	5.280	OK	8.648	0.167	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	120 (C)	346.0	94.3	-20.1	0.06	0.27	8.648	3.99	0.60	0.06	4.87	2.23	4.200	0.519	5.280	OK	8.648	0.252	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	121 (C)	345.1	93.0	-24.7	0.07	0.27	8.648	3.99	0.60	0.07	4.87	2.25	4.200	0.521	5.280	OK	8.648	0.253	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	122 (C)	343.6	72.4	-24.0	0.07	0.21	8.648	3.99	0.60	0.07	4.87	2.24	4.200	0.519	5.280	OK	8.648	0.252	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	123 (C)	350.1	115.5	-13.4	0.04	0.33	8.648	3.99	0.60	0.04	4.87	2.21	4.200	0.520	5.280	OK	8.648	0.253	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	124 (C)	309.6	69.9	-1.3	0.00	0.23	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.453	5.280	OK	8.648	0.220	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	125 (C)	426.6	110.7	-20.9	0.05	0.26	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.637	5.280	OK	8.648	0.310	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	126 (C)	309.5	71.6	-1.0	0.00	0.23	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.452	5.280	OK	8.648	0.220	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	127 (C)	309.4	70.3	-1.5	0.00	0.23	8.648	3.99	0.60	0.00	4.87	2.17	4.200	0.453	5.280	OK	8.648	0.220	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	128 (C)	308.5	69.0	-6.2	0.02	0.22	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.455	5.280	OK	8.648	0.221	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	129 (C)	306.9	48.4	-5.4	0.02	0.16	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.452	5.280	OK	8.648	0.219	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	130 (C)	313.5	91.6	5.1	0.02	0.29	8.648	3.99	0.60	0.02	4.87	2.19	4.200	0.461	5.280	OK	8.648	0.224	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	131 (C)	426.5	112.4	-20.8	0.05	0.26	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.637	5.280	OK	8.648	0.309	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	132 (C)	426.3	111.1	-21.3	0.05	0.26	8.648	3.99	0.60	0.05	4.87	2.22	4.200	0.637	5.280	OK	8.648	0.310	15.70	15.70	0.0044	1.75	0.498	OK	OK
	P7 (al 15 al A)	0.70	1.40	0.40	0.354	2.12	2.82	133 (C)	425.5	109.9	-25.9	0.06	0.26																			

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Betão (C 30/37)				Aço (S500 NR SD)	
fck	fed	fctm	C _{nomi}	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435

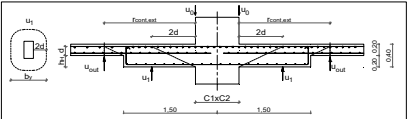


CHAPA DE APOIO PILARES METÁLIOS 220X220 mm²

PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controle							Obs		
		C1	C2	h _{total}	d _{eff,H}	by	bz	CASO	V _{Ed}	M _{Ed,Y}	M _{Ed,Z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	k	A _{s,x}	A _{s,y}	ρl	V _{Rd,c}	Obs	
		(m)	(m)	(m)	(m)	(m)	(m)		(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} <V _{Rd,max}	(m)	(MPa)	(cm2)	(cm2)	V _{Ed,u1} <V _{Rd,c}		V _{Ed,u1} <2V _{Rd,c}		
PISO 0 (ESCADA E11 - PILARES DE APOIO NA LAJE DE 20 cm)	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	104 (C)	59.2	-3.2	-6.0	0.10	0.05	1.24	0.880	0.529	5.280	OK	2.865	0.162	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	105 (C)	58.9	-3.1	-5.9	0.10	0.05	1.24	0.880	0.525	5.280	OK	2.865	0.161	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	106 (C)	59.2	-3.2	-6.0	0.10	0.05	1.24	0.880	0.529	5.280	OK	2.865	0.162	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	107 (C)	59.2	-3.2	-6.0	0.10	0.05	1.24	0.880	0.529	5.280	OK	2.865	0.162	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	108 (C)	55.1	-3.0	-5.9	0.11	0.05	1.25	0.880	0.497	5.280	OK	2.865	0.153	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	109 (C)	53.5	-2.2	-5.7	0.11	0.04	1.24	0.880	0.478	5.280	OK	2.865	0.147	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	110 (C)	58.9	-3.1	-5.9	0.10	0.05	1.24	0.880	0.525	5.280	OK	2.865	0.161	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	111 (C)	58.9	-3.1	-5.9	0.10	0.05	1.24	0.880	0.525	5.280	OK	2.865	0.161	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	112 (C)	54.8	-2.9	-5.8	0.11	0.05	1.25	0.880	0.493	5.280	OK	2.865	0.151	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	113 (C)	53.2	-2.1	-5.6	0.11	0.04	1.24	0.880	0.474	5.280	OK	2.865	0.145	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	114 (C)	16.0	-1.5	-2.2	0.14	0.09	1.35	0.880	0.156	5.280	OK	2.865	0.048	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	115 (C)	40.3	-2.2	-4.2	0.10	0.05	1.25	0.880	0.362	5.280	OK	2.865	0.111	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	116 (C)	16.0	-1.5	-2.2	0.14	0.09	1.35	0.880	0.156	5.280	OK	2.865	0.048	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	117 (C)	16.0	-1.5	-2.2	0.14	0.09	1.35	0.880	0.156	5.280	OK	2.865	0.048	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	118 (C)	12.0	-1.2	-2.1	0.18	0.10	1.43	0.880	0.123	5.280	OK	2.865	0.038	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	119 (C)	10.3	-0.4	-1.8	0.17	0.04	1.38	0.880	0.102	5.280	OK	2.865	0.031	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	120 (C)	40.3	-2.2	-4.2	0.10	0.05	1.25	0.880	0.362	5.280	OK	2.865	0.111	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	121 (C)	40.3	-2.2	-4.2	0.10	0.05	1.25	0.880	0.362	5.280	OK	2.865	0.111	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	122 (C)	36.3	-1.9	-4.1	0.11	0.05	1.26	0.880	0.330	5.280	OK	2.865	0.101	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	123 (C)	34.6	-1.1	-3.9	0.11	0.03	1.25	0.880	0.310	5.280	OK	2.865	0.095	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	124 (C)	26.8	-2.4	-3.1	0.12	0.09	1.31	0.880	0.252	5.280	OK	2.865	0.077	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	125 (C)	51.1	-3.1	-5.2	0.10	0.06	1.25	0.880	0.460	5.280	OK	2.865	0.141	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	126 (C)	26.5	-2.3	-3.1	0.12	0.09	1.31	0.880	0.249	5.280	OK	2.865	0.077	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	127 (C)	26.8	-2.4	-3.1	0.12	0.09	1.31	0.880	0.252	5.280	OK	2.865	0.077	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	128 (C)	26.8	-2.4	-3.1	0.12	0.09	1.31	0.880	0.252	5.280	OK	2.865	0.077	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	129 (C)	22.7	-2.1	-3.0	0.13	0.09	1.34	0.880	0.219	5.280	OK	2.865	0.067	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	130 (C)	21.1	-1.4	-2.8	0.13	0.07	1.31	0.880	0.199	5.280	OK	2.865	0.061	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	131 (C)	50.8	-3.0	-5.1	0.10	0.06	1.25	0.880	0.455	5.280	OK	2.865	0.140	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	132 (C)	51.1	-3.1	-5.2	0.10	0.06	1.25	0.880	0.460	5.280	OK	2.865	0.141	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	133 (C)	51.1	-3.1	-5.2	0.10	0.06	1.25	0.880	0.460	5.280	OK	2.865	0.141	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	134 (C)	47.0	-2.8	-5.1	0.11	0.06	1.26	0.880	0.426	5.280	OK	2.865	0.131	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	135 (C)	45.4	-2.1	-4.8	0.11	0.05	1.24	0.880	0.406	5.280	OK	2.865	0.125	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	136 (C)	50.8	-3.0	-5.1	0.10	0.06	1.25	0.880	0.455	5.280	OK	2.865	0.140	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	137 (C)	50.8	-3.0	-5.1	0.10	0.06	1.25	0.880	0.455	5.280	OK	2.865	0.140	2.00	10.16	11.31	0.0068	0.655	OK	OK
	PM (E12)	0.22	0.22	0.20	0.158	0.85	0.85	138 (C)	46.7	-2.7	-5.0																

TN_CORPO 3_PISO 0_Estado Limite Último de Punçãoamento_ESCADAS E11

Betão (C 30/37)				Aço (S500 NR SD)	
fck	ftcd	fctm	C _{nom}	fyk	fyd
(MPa)	(MPa)	(MPa)	cm	(MPa)	(MPa)
30	20.0	2.9	3.0	500	435



CHAPA DE APOIO PILARES METÁLIOS 220X220 mm²

PISO	Pilar	Geometria						Esforços e excentricidades						Verificação no perímetro do pilar				Verificação no primeiro perímetro de controle					pl	V _{Rd,c}	Obs		
		C1	C2	h _{total}	d _{eff,H}	by	bz	CASO	V _{Ed}	M _{Ed,y}	M _{Ed,z}	ey	ez	β	u ₀	V _{Ed,u0}	V _{Rd,max}	Obs	u ₁	V _{Ed,u1}	k	A _{s,x}			A _{s,y}	V _{Ed,u1} < V _{Rd,c}	V _{Ed,u1} < 2V _{Rd,c}
		(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)		(m)	(MPa)	(MPa)	V _{Ed,u0} < V _{Rd,max}	(m)	(MPa)		(cm2)	(cm2)					
PISO 0 (ESCADA E11 - PILARES DE APOIO NO CAPITEL e=40 cm)	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	104 (C)	83.4	16.9	-0.4	0.00	0.20	1.22	0.880	0.323	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	105 (C)	83.7	16.9	-0.4	0.00	0.20	1.22	0.880	0.324	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	106 (C)	83.4	16.9	-0.4	0.00	0.20	1.22	0.880	0.323	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	107 (C)	83.4	16.9	-0.4	0.00	0.20	1.22	0.880	0.323	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	108 (C)	80.1	16.7	-0.4	0.00	0.21	1.23	0.880	0.312	5.280	OK	5.379	0.051	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	109 (C)	83.3	16.9	-0.2	0.00	0.20	1.22	0.880	0.323	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	110 (C)	83.7	16.9	-0.4	0.00	0.20	1.22	0.880	0.324	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	111 (C)	83.7	16.9	-0.4	0.00	0.20	1.22	0.880	0.324	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	112 (C)	80.4	16.7	-0.3	0.00	0.21	1.23	0.880	0.313	5.280	OK	5.379	0.051	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	113 (C)	83.6	17.0	-0.2	0.00	0.20	1.22	0.880	0.324	5.280	OK	5.379	0.053	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	114 (C)	40.5	6.1	-0.3	0.01	0.15	1.16	0.880	0.150	5.280	OK	5.379	0.024	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	115 (C)	60.4	12.1	-0.2	0.00	0.20	1.22	0.880	0.234	5.280	OK	5.379	0.038	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	116 (C)	40.5	6.1	-0.3	0.01	0.15	1.16	0.880	0.150	5.280	OK	5.379	0.024	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	117 (C)	40.5	6.1	-0.3	0.01	0.15	1.16	0.880	0.150	5.280	OK	5.379	0.024	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	118 (C)	37.2	5.9	-0.3	0.01	0.16	1.17	0.880	0.139	5.280	OK	5.379	0.023	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	119 (C)	40.3	6.2	-0.1	0.00	0.15	1.17	0.880	0.149	5.280	OK	5.379	0.024	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	120 (C)	60.4	12.1	-0.2	0.00	0.20	1.22	0.880	0.234	5.280	OK	5.379	0.038	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	121 (C)	60.4	12.1	-0.2	0.00	0.20	1.22	0.880	0.234	5.280	OK	5.379	0.038	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	122 (C)	57.0	12.0	-0.2	0.00	0.21	1.23	0.880	0.222	5.280	OK	5.379	0.036	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	123 (C)	60.2	12.2	-0.1	0.00	0.20	1.22	0.880	0.233	5.280	OK	5.379	0.038	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	124 (C)	57.3	8.4	-0.4	0.01	0.15	1.16	0.880	0.211	5.280	OK	5.379	0.035	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	125 (C)	77.2	14.4	-0.4	0.01	0.19	1.20	0.880	0.295	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	126 (C)	57.6	8.4	-0.4	0.01	0.15	1.16	0.880	0.212	5.280	OK	5.379	0.035	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	127 (C)	57.3	8.4	-0.4	0.01	0.15	1.16	0.880	0.211	5.280	OK	5.379	0.035	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	128 (C)	57.3	8.4	-0.4	0.01	0.15	1.16	0.880	0.211	5.280	OK	5.379	0.035	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	129 (C)	53.9	8.2	-0.4	0.01	0.15	1.17	0.880	0.199	5.280	OK	5.379	0.033	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	130 (C)	57.1	8.5	-0.3	0.01	0.15	1.16	0.880	0.211	5.280	OK	5.379	0.034	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	131 (C)	77.5	14.4	-0.4	0.01	0.19	1.20	0.880	0.296	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	132 (C)	77.2	14.4	-0.4	0.01	0.19	1.20	0.880	0.295	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	133 (C)	77.2	14.4	-0.4	0.01	0.19	1.20	0.880	0.295	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	134 (C)	73.8	14.2	-0.4	0.01	0.19	1.21	0.880	0.283	5.280	OK	5.379	0.046	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	135 (C)	77.0	14.5	-0.3	0.00	0.19	1.21	0.880	0.295	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	136 (C)	77.5	14.4	-0.4	0.01	0.19	1.20	0.880	0.296	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	137 (C)	77.5	14.4	-0.4	0.01	0.19	1.20	0.880	0.296	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	138 (C)	74.1	14.2	-0.4	0.01	0.19	1.21	0.880	0.284	5.280	OK	5.379	0.047	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.65	1.65	139 (C)	77.3	14.5	-0.2	0.00	0.19	1.20	0.880	0.296	5.280	OK	5.379	0.048	1.75	7.54	7.54	0.0021	0.388	OK	OK
	PM (E12)	0.22	0.22	0.40	0.358	1.6																					

Betão	C30/37		Aço	A500 NR	
fck	fc'd	fc'lm	fyk	fy'd	σs
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30.0	20.0	2.9	500	435	240

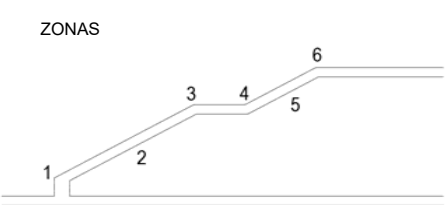
ARMADURAS LONGITUDINAIS - Direção XX																									
DADOS			GEOMETRIA			Esforços Atuantes						Armaduras Mínimas				Armaduras - ELU				As,ef - Armadura Base + Armadura de Reforço					
Laje / Zona	CASO	Face	b	h	d	$M_{Ed,XX} + M_{Ed,XY} - ELU$ (kNm/m)	$N_{Ed,X} + N_{Ed,Y} - ELU$ (kN/m)	N_{Ed} (kN/m)	$A_{s,min}$ (cm²/m)	$A_{s,min}$ (cm²/m)	μ	ω	$A_{s,F}$ (cm²/m)	$A_{s,N/Face}$ (cm²/m)	$A_{s,Total}$ (cm²/m)	Armadura base Ø10/0.15	As,ef (cm²/m)	Reforço	$A_{s,ef,Reforço}$ (cm²/m)	$A_{s,ef,Total}$ (cm²/m)	ρ (%)				
			(m)	(m)	(m)																				
ESCADA 8	LANÇO INICIAL	ELU	As,sup	1.00	0.20	0.138	-15.0	150.0	580.0	2.08	24.17	0.039	0.040	2.55	1.73	4.28	Ø10/0.15	5.24	-	0.00	5.24	0.26			
		ELU	As,inf	1.00	0.20	0.138	10.0	250.0	580.0	2.08	24.17	0.026	0.027	2.08	2.88	4.96	Ø10/0.15	5.24	-	0.00	5.24	0.26			
		ELU	As,sup	1.00	0.20	0.138	-20.0	150.0	580.0	2.08	24.17	0.053	0.054	3.43	1.73	5.15	Ø10/0.15	5.24	-	0.00	5.24	0.26			
	PATAMAR	ELU	As,sup	1.00	0.20	0.138	-20.0	150.0	580.0	2.08	24.17	0.053	0.054	3.43	1.73	5.15	-	0.00	Ø16/0.30	6.70	6.70	0.34			
		ELU	As,inf	1.00	0.20	0.138	10.0	100.0	580.0	2.08	24.17	0.026	0.027	2.08	1.15	3.23	Ø10/0.15	5.24	-	0.00	5.24	0.26			
		ELU	As,sup	1.00	0.20	0.138	-20.0	250.0	580.0	2.08	24.17	0.053	0.054	3.43	2.88	6.30	-	0.00	Ø16/0.30	6.70	6.70	0.34			
	LANÇO FINAL	ELU	As,sup	1.00	0.20	0.138	-20.0	250.0	580.0	2.08	24.17	0.053	0.054	3.43	2.88	6.30	Ø10/0.15	5.24	Ø10/0.15	5.24	10.48	0.52			
		ELU	As,inf	1.00	0.20	0.138	10.0	100.0	580.0	2.08	24.17	0.026	0.027	2.08	1.15	3.23	Ø10/0.15	5.24	-	0.00	5.24	0.26			
		ELU	As,sup	1.00	0.20	0.138	-12.0	100.0	580.0	2.08	24.17	0.032	0.032	2.08	1.15	3.23	Ø10/0.15	5.24	-	0.00	5.24	0.26			
	PAREDE LONGITUDINAL	ELU	face ext	1.00	0.25	0.188	-35.0	600.0	725.0	2.84	30.21	0.050	0.051	4.39	6.90	11.29	-	0.00	Ø16/0.15	13.40	13.40	0.54			
		ELU	face int	1.00	0.25	0.188	-20.7	600.0	725.0	2.84	30.21	0.029	0.030	2.84	6.90	9.74	-	0.00	Ø16/0.15	13.40	13.40	0.54			
		ELU	face ext	1.00	0.25	0.188	-30.0	250.0	725.0	2.84	30.21	0.042	0.043	3.75	2.88	6.63	Ø12/0.15	7.54	-	0.00	7.54	0.30			
		ELU	face int	1.00	0.25	0.188	-18.0	250.0	725.0	2.84	30.21	0.025	0.026	2.84	2.88	5.71	Ø12/0.15	7.54	-	0.00	7.54	0.30			
	PAREDE TRANSVERSAL	ELU	face ext	1.00	0.25	0.188	-30.0	200.0	725.0	2.84	30.21	0.042	0.043	3.75	2.30	6.05	-	0.00	Ø16/0.20	10.05	10.05	0.40			
		ELU	face int	1.00	0.25	0.188	14.9	200.0	725.0	2.84	30.21	0.021	0.021	2.84	2.30	5.14	-	0.00	Ø16/0.20	10.05	10.05	0.40			
		ELU	face ext	1.00	0.25	0.188	-30.0	50.0	725.0		30.21	0.042	0.043	3.75	0.58	4.33	Ø12/0.15	7.54		0.00	7.54	0.30			
	ELU	face int	1.00	0.25	0.188	14.9	50.0	725.0	2.84	30.21	0.021	0.021	2.84	0.58	3.41	Ø12/0.15	7.54		0.00	7.54	0.30				

ARMADURAS LONGITUDINAIS - Direção YY																						
DADOS			GEOMETRIA			Esforços Atuantes			Armaduras Mínimas		Armaduras - ELU				As,ef - Armadura Base + Armadura de Reforço							
Laje / Zona	CASO	Face	b	h	d	$M_{Ed,YY} + M_{Ed,XY} $ - ELU (kNm/m)	$N_{YY} + N_{XY} $ - ELU (kN/m)	N_U (kN/m)	$A_{s,min}$ (cm²/m)	$A_{s,min}$ (cm²/m)	μ	ω	$A_{s,F}$ (cm²/m)	$A_{s,N}$ (cm²/m)	$A_{s,Total}$ (cm²/m)	Armadura base Ø10/0.15	$A_{s,ef}$ (cm²/m)	Reforço Ø12/0.30	$A_{s,ef,Reforço}$ (cm²/m)	$A_{s,ef,Total}$ (cm²/m)	ρ (%)	
			(m)	(m)	(m)																	
ESCADA 8	LANÇO INICIAL	ELU	As,sup	1.00	0.20	0.138	-14.0	250.0	580.0	2.08	24.17	0.037	0.037	2.38	2.88	5.25	Ø10/0.15	5.24	Ø12/0.30	3.77	9.01	0.45
		ELU	As,inf	1.00	0.20	0.138	10.0	250.0	580.0	2.08	24.17	0.026	0.027	2.08	2.88	4.96	Ø10/0.15	5.24	-	0.00	5.24	0.26
		ELU	As,sup	1.00	0.20	0.138	-15.0	100.0	580.0	2.08	24.17	0.039	0.040	2.55	1.15	3.70	Ø10/0.15	5.24	-	0.00	5.24	0.26
	PATAMAR	ELU	As,sup	1.00	0.20	0.138	-15.0	100.0	580.0	2.08	24.17	0.039	0.040	2.55	1.15	3.70	Ø10/0.15	5.24	-	0.00	5.24	0.26
		ELU	As,inf	1.00	0.20	0.138	10.0	100.0	580.0	2.08	24.17	0.026	0.027	2.08	1.15	3.23	Ø10/0.15	5.24	-	0.00	5.24	0.26
		ELU	As,sup	1.00	0.20	0.138	-20.0	100.0	580.0	2.08	24.17	0.053	0.054	3.43	1.15	4.58	Ø10/0.15	5.24	-	0.00	5.24	0.26
	LANÇO FINAL	ELU	As,sup	1.00	0.20	0.138	-20.0	100.0	580.0	2.08	24.17	0.053	0.054	3.43	1.15	4.58	Ø10/0.15	5.24	-	0.00	5.24	0.26
		ELU	As,inf	1.00	0.20	0.138	10.0	100.0	580.0	2.08	24.17	0.026	0.027	2.08	1.15	3.23	Ø10/0.15	5.24	-	0.00	5.24	0.26
		ELU	As,sup	1.00	0.20	0.138	-12.0	100.0	580.0	2.08	24.17	0.032	0.032	2.08	1.15	3.23	Ø10/0.15	5.24	-	0.00	5.24	0.26
	PAREDE LONGITUDINAL	ELU	face ext	1.00	0.25	0.188	-50.0	100.0	725.0	2.84	30.21	0.071	0.073	6.35	1.15	7.50	Ø12/0.15	7.54	-	0.00	7.54	0.30
		ELU	face int	1.00	0.25	0.188	11.5	100.0	725.0	2.84	30.21	0.016	0.016	2.84	1.15	3.99	Ø10/0.15	5.24	-	0.00	5.24	0.21
		ELU	face ext	1.00	0.25	0.188	-17.0	100.0	725.0	2.84	30.21	0.024	0.024	2.84	1.15	3.99	Ø10/0.15	5.24	-	0.00	5.24	0.21
		ELU	face int	1.00	0.25	0.188	11.5	100.0	725.0	2.84	30.21	0.016	0.016	2.84	1.15	3.99	Ø10/0.15	5.24	-	0.00	5.24	0.21
	PAREDE TRANSVERSAL	ELU	face ext	1.00	0.25	0.188	-20.0	80.0	725.0	2.84	30.21	0.028	0.029	2.84	0.92	3.76	Ø10/0.15	5.24		0.00	5.24	0.21
		ELU	face int	1.00	0.25	0.188	5.0	80.0	725.0	2.84	30.21	0.007	0.007	2.84	0.92	3.76	Ø10/0.15	5.24		0.00	5.24	0.21
		ELU	face ext	1.00	0.25	0.188	0.0	80.0	725.0	2.84	30.21	0.000	0.000	2.84	0.92	3.76	Ø10/0.15	5.24		0.00	5.24	0.21
		ELU	face int	1.00	0.25	0.188	5.0	80.0	725.0	2.84	30.21	0.007	0.007	2.84	0.92	3.76	Ø10/0.15	5.24		0.00	5.24	0.21

ARMADURAS de LIGAÇÃO ÀS PAREDES EXISTENTES E A CONSTRUIR											
DADOS			GEOMETRIA			Esforços Atuantes		Armadura		Esforço Resistente	
Laje / Zona		Elemento	CASO	b	h	d	$V_{Ed,XX}$	Armadura		V_{Rd}	Obs.
				(m)	(m)	(m)		Varão	As (cm2)	Av (cm2)	
E8	LAJE COBERTURA	Apoio Parede Moldada	ELU	1.00	0.20	0.138	15.0	Ø12/0.60	1.89	1.20	27.5
		Apoio Parede Interior	ELU	1.00	0.20	0.138	17.8	Ø12/0.50	1.89	1.20	27.5
	PATAMAR	PAR Transversal	ELU	1.00	0.20	0.138	25.0	Ø16/0.40	5.03	3.20	73.1
		PAR Longitudinal	ELU	1.00	0.20	0.138	45.0	Ø16/0.40	5.03	3.20	73.1

DIMENSIONAMENTO DE LAJE DE ESCADAS

Betão			C30/37		Aço	A500 NR	
fck	fcd	fctm	(MPa)	(MPa)		fyk	fyd
(MPa)	(MPa)	(MPa)				(MPa)	(MPa)
30.0	20.0	2.9				500	435



Armaduras Verticais - Direção YY																										
Dados				Geometria			Esforços Atuantes				Esforços Resistentes Fend.		Armaduras - ULS					Armaduras Totais								
Parede / Zona			CASO		b	h	d	M _{Ed,YY} + M _{Ed,XY} - ELU	N _{YY} + N _{xy} - ELU	N _{YY,Ação} (Temp/Retr)	M _{QP}	M _{cr}	N _{cr}	μ	ω	A _{S,v,F}	A _{S,v,Nyy}	A _{S,v,Total}	A _{S,v,Total}	A _{S,v,min}	A _{S,min,fend}	Armadura base	A _{S,v,ef}	Reforço	A _{S,v,ef,Reforço}	A _{S,v,ef,Total}
					(m)	(m)	(m)	(kNm/m)	(kN/m)	(kN/m)	(kNm/m)	(kNm/m)	(kN/m)			(cm²/m)	(cm²/m)	(cm²/m)	(cm²/m)	(cm²/m)	(cm²/m)		(cm²/m)		(cm²/m)	
Escadas Caracol Piso 0 a 2																										
Escadas Caracol Piso 0 a 2	Apoio	Zona 1	109		1.00	0.20	0.165	-40.0	350.0		-29.0	19.3	580.0	0.073	0.076	5.80	4.03	9.82	9.82	4.00	3.14	Ø16//0.15	13.40		0.00	13.40
	Vão	Zona 2	159		1.00	0.20	0.165	26.0	235.0		17.0	19.3	580.0	0.048	0.049	3.72	2.70	6.42	6.42	4.00	3.14	Ø16//0.15	13.40		0.00	13.40
	Patamar início	Zona 3	156		1.00	0.20	0.165	-30.0	350.0		-7.0	19.3	580.0	0.055	0.057	4.30	4.03	8.33	8.33	4.00	3.14	Ø16//0.15	13.40		0.00	13.40
	Patamar fim	Zona 4	109		1.00	0.20	0.165	-45.0	560.0		-30.0	19.3	580.0	0.083	0.086	6.56	6.44	13.00	13.00	4.00	3.14	Ø16//0.15	13.40		0.00	13.40
	Vão	Zona 5	113		1.00	0.20	0.165	37.0	500.0		25.0	19.3	580.0	0.068	0.070	5.35	5.75	11.10	11.10	4.00	3.14	Ø16//0.15	13.40		0.00	13.40
	Apoio	Zona 6	160		1.00	0.20	0.165	-50.0	900.0		-33.0	19.3	580.0	0.092	0.096	7.32	10.35	17.67	17.67	4.00	3.14	Ø16//0.15	13.40	Ø10//0.15	5.24	18.64

Armaduras Horizontais - Direção XX																										
Dados				Geometria			Esforços						ULS				Armadura									
Parede / Zona		CASO	A _{s,v,ef,Total}	b	h	d	M _{Ed,XX} + M _{Ed,XY}	N _{xx} + N _{xy}	N _{XX,Ação} (Temp/Retr)	M _{QP}	M _{cr}	N _{cr}	μ	ω	A _{s,h,F}	A _{s,h,Nxx}	A _{s,h,Total}	A _{s,h,Total}	A _{s,h,min}	A _{s,min,fend}	Armadura base	A _{s,h,ef}	Reforço	A _{s,h,ef,Reforço}	A _{s,h,ef,Total}	
			(cm²/m)	(m)	(m)	(m)	(kNm/m)	(kN/m)	(kN/m)	(kNm/m)	(kN/m)	(cm²/m)			(cm²/m)	(cm²/m)	(cm²/m)	(cm²/m)	(cm²/m)	(cm²/m)		(cm²/m)				
Escadas Caracol Piso 0 a 2																										
Escadas Caracol Piso 0 a 2	Apoio	Zona 1	156	13.40	1.00	0.20	0.165	-26.0	250.0		-15.0	19.3	580.0	0.048	0.049	3.72	2.88	6.59	6.59	3.35	3.14	Ø12//0.15	7.54		0.00	7.54
	Vão	Zona 2	109	13.40	1.00	0.20	0.165	20.0	170.0		12.0	19.3	580.0	0.037	0.037	2.84	1.96	4.80	4.80	3.35	3.14	Ø12//0.15	7.54		0.00	7.54
	Patamar sup início	Zona 3	109	13.40	1.00	0.20	0.165	-10.0	180.0		-5.0	19.3	580.0	0.018	0.019	1.41	2.07	3.48	3.48	3.35	3.14	Ø12//0.15	7.54		0.00	7.54
	Patamar sup fim	Zona 4	104	13.40	1.00	0.20	0.165	-35.0	180.0		-20.0	19.3	580.0	0.064	0.066	5.05	2.07	7.12	7.12	3.35	3.14	Ø12//0.15	7.54		0.00	7.54
	Vão	Zona 5	104	13.40	1.00	0.20	0.165	35.0	330.0		24.0	19.3	580.0	0.064	0.066	5.05	3.80	8.84	8.84	3.35	3.14	Ø12//0.10	11.31		0.00	11.31
	Apoio	Zona 6	104	13.40	1.00	0.20	0.165	-40.0	250.0		-25.0	19.3	580.0	0.073	0.076	5.80	2.88	8.67	8.67	3.35	3.14	Ø12//0.10	11.31		0.00	11.31

E.L.U. Esforço Transverso											
Zona		Caso	V _{Ed}	b	h	d	k	Asl	ρ _L	V _{Rd,c}	Verificação
			(kN/m)	(m)	(m)	(m)		(cm²/m)		(kN/m)	
Topo Norte - Escada Caracol											
Escadas Caracol Piso 0 a 2	XX	159	150.00	1.00	0.20	0.165	2.00	10.48	0.006	105.77	Calcular armadura especifica de esforço transverso
	YY Zona 1	108	350.00	1.00	0.40	0.365	1.74	15.08	0.004	176.40	Calcular armadura especifica de esforço transverso
	YY Zona 5	108	220.00	1.00	0.20	0.165	2.00	15.08	0.009	119.41	Calcular armadura especifica de esforço transverso

Betão			θ	Aço	
fck	fcd	fctm	cotg q	fyk	fyd
(MPa)	(MPa)	(MPa)	(°)	(MPa)	(MPa)
30	20.0	2.9	30	500	435

Armaduras Transversais da Laje Escadas Caracol																	
Viga	Zona	b	h	d	V _{Ed}			A _{sw,min}	A _{sw}	Ramos	A _{sw}	Ø	Afastam.	A _{sw,ef}	V _{Rd,s}	V _{Rd,max}	Verif
		(m)	(m)	(m)	(kN)			(cm²/m)	(cm²/m)		(cm²/m)	(mm)	(m)	(cm²/m)	(kN)	(kN)	
Escadas Caracol Piso 0 a 2	XX	1.00	0.20	0.165	150.0			8.76	8.76	6	1.46	8	af. 0.20	2.51	168.4	679.0	
	YY Zona 1	1.00	0.40	0.365	350.0			8.76	8.76	6	1.46	8	af. 0.20	2.51	372.6	1502.1	
	YY Zona 5	1.00	0.20	0.165	220.0			8.76	8.76	6	1.46	8	af. 0.20	2.51	168.4	679.0	

Resistência ao Corte na ligação Betão novo - Betão existente					
V _{Ed}	f _{yd}	Armadura base	A _{s,ef}	V _{pl,Rd}	Verificação
(kN/m)	(MPa)		(cm²/m)	(kN/m)	
150	275	Ø20//0.20	15.71	158.79	Verifica

Comentários do projectista:
1 Dados de Cálculo


Tipo e dimensão da ancoragem: HIT-HY 170 + AM (8.8) M16

Return period (service life in years): 50

Folga preenchida com Conjunto Sísmico M Hilti16 mm

Prof. efectiva de ancoragem: $h_{ef,act} = 140 \text{ mm}$ ($h_{ef,limit} = - \text{mm}$)

Material: 8.8

Homologação N.º: ETA-19/0465

Publicados I Válidos: 28/08/2019 | -

Verificação: Parecer de engenharia SOFA BOND após ensaios ETAG BOND

Afastamento da chapa: $e_b = 0 \text{ mm}$ (sem afastamento da chapa); $t = 1 \text{ mm}$

Chapa de fixação: $l_x \times l_y \times t = 1\,300 \text{ mm} \times 250 \text{ mm} \times 1 \text{ mm}$; (Espessura da chapa recomendada: não calculado)

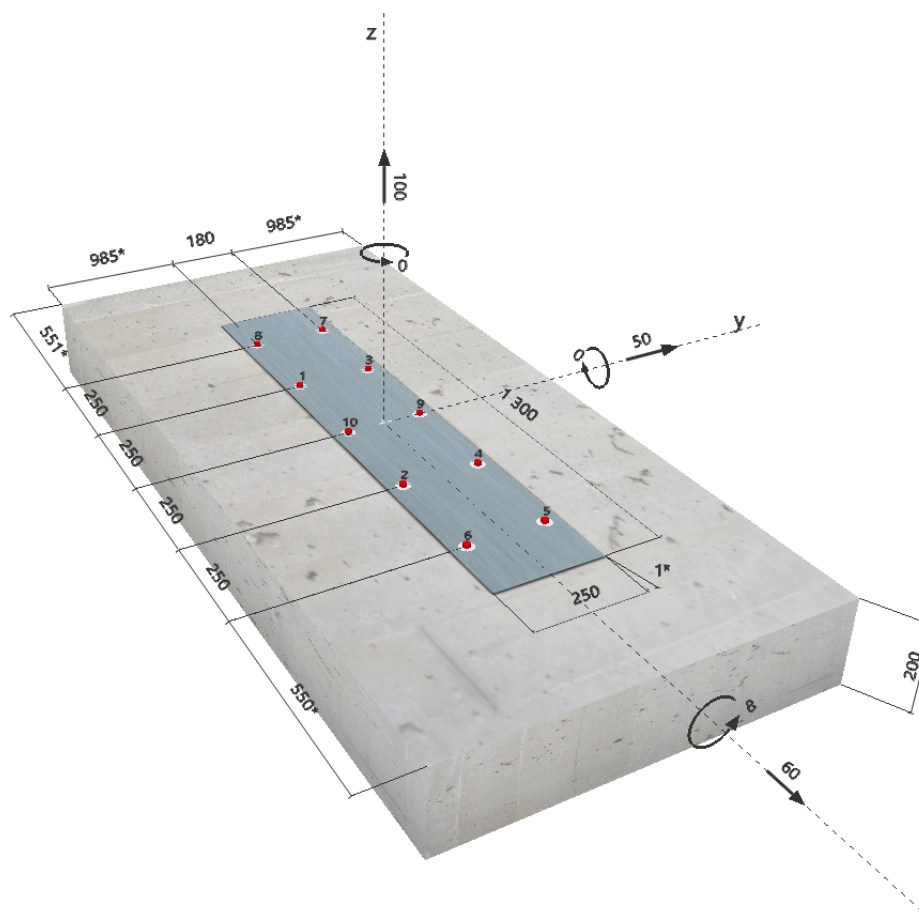
Perfil: sem perfil

Material Base: Betão não fendilhado betão , C30/37, $f_{c,cube} = 37,00 \text{ N/mm}^2$; $h = 200 \text{ mm}$, Temp. curto/longo: 0/0 °C

Instalação: furo limpo automaticamente, Condições de instalação: seco

Armadura: Sem armadura ou com armadura com espaçamento $\geq 150 \text{ mm}$ (qq $\emptyset$) or $\geq 100 \text{ mm}$ ($\emptyset \leq 10 \text{ mm}$) com armadura longitudinal de bordo $d \geq 12$

^R - o utilizador é responsável por garantir uma placa base rígida para a espessura introduzida com soluções apropriadas (reforços, etc.)

Geometria [mm] & Carga [kN, kNm]


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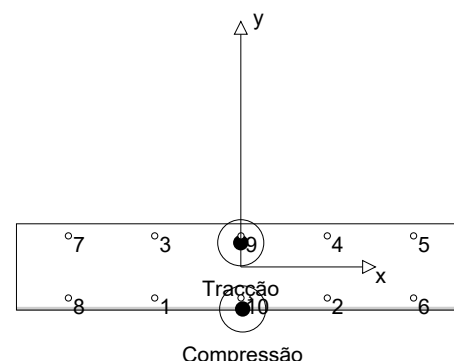
2 Combinação de Carga/Resultantes

Combinação de Carga: Cargas majoradas

Reacções nas ancoragens [kN]

Tracção: (+Tracção;-Compressão)

Ancoragem	Tracção	Carga de corte	Corte em x	Corte em y
1	2,324	7,812	5,998	5,005
2	2,315	7,806	5,998	4,995
3	18,712	7,815	6,002	5,005
4	18,703	7,809	6,002	4,995
5	18,698	7,806	6,002	4,991
6	2,310	7,803	5,998	4,991
7	18,716	7,818	6,002	5,009
8	2,328	7,815	5,998	5,009
9	18,707	7,812	6,002	5,000
10	2,319	7,809	5,998	5,000



Extensão máxima à compressão da alvenaria: 0,03 [‰]
Resistência máxima à compressão da alvenaria: 0,84 [N/mm²]
Tracção resultante em (x/y)=(0/70): 105,133 [kN]
Compressão resultante em (x/y)=(5/-122): 5,133 [kN]

As forças de ancoragem baseiam-se numa suposição da placa base rígida!

3 Análise à Tracção (EOTA TR 029, Secção 5.2.2)

	Carga [kN]	Capacidade [kN]	Utilização β_N [%]	Estado
Rotura do aço*	18,716	83,733	23	OK
Rotura combinada por arranque (pull-out) - cone de betão**	105,133	233,225	46	OK
Rotura por cone de betão**	105,133	245,389	43	OK
Rotura por fendilhação (splitting)**	105,133	215,225	49	OK

* ancoragem mais solicitada **grupo de ancoragens (ancoragens sob tracção)

3.1 Rotura do aço

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
125,600	1,500	83,733	18,716

3.2 Rotura combinada por arranque (pull-out) - cone de betão

$A_{p,N}$ [mm ²]	$A_{p,N}^0$ [mm ²]	$\tau_{Rk,ucr,25}$ [N/mm ²]	$s_{cr,Np}$ [mm]	$c_{cr,Np}$ [mm]	c_{min} [mm]
752 548	136 533	10,00	370	185	550
ψ_c	$\tau_{Rk,ucr}$ [N/mm ²]	k	$\psi_{g,Np}^0$	$\psi_{g,Np}$	
1,040	10,40	3,200	1,834	1,198	
$e_{c1,N}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,N}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$
0	0,999	70	0,725	1,000	1,000
$N_{Rk,p}^0$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]	
73,185	349,837	1,500	233,225	105,133	

Group anchor ID
1-10

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3.3 Rotura por cone de betão

$A_{c,N}$ [mm ²]	$A_{c,N}^0$ [mm ²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]		
852 000	176 400	210	420		
$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0	0,999	70	0,750	1,000	1,000
k_1	$N_{Rk,c}^0$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]	
10,100	101,769	1,500	245,389	105,133	
Group anchor ID					
1-10					

3.4 Rotura por fendilhação (splitting)

$A_{c,N}$ [mm ²]	$A_{c,N}^0$ [mm ²]	$c_{cr,sp}$ [mm]	$s_{cr,sp}$ [mm]	$\psi_{h,sp}$		
1 172 864	322 624	284	568	1,089		
$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	k_1
0	0,999	70	0,802	1,000	1,000	10,100
$N_{Rk,c}^0$ [kN]	$\gamma_{M,sp}$	$N_{Rd,sp}$ [kN]	N_{Sd} [kN]			
101,769	1,500	215,225	105,133			
Group anchor ID						
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4 Análise ao Corte (EOTA TR 029, Secção 5.2.3)

	Carga [kN]	Capacidade [kN]	Utilização β_v [%]	Estado
Rotura do aço (sem braço de binário)*	7,818	50,240	16	OK
Cedência do aço (com braço de binário)*	N/A	N/A	N/A	N/A
Rotura por efeito de alavanca (pryout)**	78,102	642,729	13	OK
Rotura do bordo de betão na direcção $x+$ **	60,825	101,671	60	OK

* ancoragem mais solicitada **grupo de ancoragens (ancoragens relevantes)

4.1 Rotura do aço (sem braço de binário)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
62,800	1,250	50,240	7,818

4.2 Rotura por efeito de alavanca (aderência)

$A_{p,N}$ [mm ²]	$A_{p,N}^0$ [mm ²]	$\tau_{Rk,ucr,25}$ [N/mm ²]	$c_{cr,Np}$ [mm]	$s_{cr,Np}$ [mm]	c_{min} [mm]
752 548	136 533	10,00	185	370	550
ψ_c	$\tau_{Rk,ucr}$ [N/mm ²]	k_4	k-factor	$\psi_{g,Np}^0$	$\psi_{g,Np}$
1,040	10,40	3,200	2,000	1,834	1,198
$e_{c1,V}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,V}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$
0	0,999	0	0,999	1,000	1,000
$N_{Rk,p}^0$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]	
73,185	490,483	1,500	642,729	78,102	
Group anchor ID					
1-10					

4.3 Rotura do bordo de betão na direcção $x+$

l_f [mm]	d_{nom} [mm]	k_1	α	β	
140	16,0	2,400	0,050	0,049	
c_1 [mm]	$A_{c,V}$ [mm ²]	$A_{c,V}^0$ [mm ²]			
550	365 700	1 358 776			
$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1,000	2,030	1,012	0	1,000	1,000
$V_{Rk,c}^0$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]		
275,958	1,500	101,671	60,825		

5 Combinação de Cargas de Tracção e Corte (EOTA TR 029, Secção 5.2.4)

Cedência do aço

β_N	β_V	α	Utilização $\beta_{N,V}$ [%]	Estado
0,488	0,598	1,500	81	OK

$$\beta_N^\alpha + \beta_V^\alpha \leq 1,0$$

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6 Deslocamento (ancoragem mais solicitada)

Carregamento a curto prazo:

$$\begin{aligned} N_{Sk} &= 13,851 \text{ [kN]} & \delta_N &= 0,157 \text{ [mm]} \\ V_{Sk} &= 22,528 \text{ [kN]} & \delta_V &= 0,901 \text{ [mm]} \\ & & \delta_{NV} &= 0,915 \text{ [mm]} \end{aligned}$$

Carregamento a longo prazo:

$$\begin{aligned} N_{Sk} &= 13,851 \text{ [kN]} & \delta_N &= 0,157 \text{ [mm]} \\ V_{Sk} &= 22,528 \text{ [kN]} & \delta_V &= 1,352 \text{ [mm]} \\ & & \delta_{NV} &= 1,361 \text{ [mm]} \end{aligned}$$

Comentários: Os deslocamentos à tracção são válidos para metade do torque de aperto requerido para o Betão não fendilhado betão! Os deslocamentos ao corte são válidos sem atrito entre o betão e chapa de fixação! A folga do furo no material base e na chapa não é considerada neste cálculo!

Os deslocamentos aceitáveis para as ancoragens dependem da natureza da estrutura a fixar e devem ser definidos pelo projectista!

7 Avisos

- Os métodos de cálculo de ancoragens no PROFIS requerem chapas de fixação rígidas de acordo com as normas em vigor (ETAG 001 / Anexo C, EOTA TR029, etc.). Isto significa que a re-distribuição de carga nas ancoragens devido a deformações elásticas da chapa de fixação não são consideradas - a chapa de fixação é assumida como suficientemente rígida, para não ser deformada quando sujeita à carga de projecto. O PROFIS Anchor calcula a espessura mínima da chapa de fixação necessária com FEM para limitar a tensão da chapa de fixação com base nas suposições explicadas acima. A prova de que a suposição da chapa de fixação rígida é válida não é realizada por PROFIS Anchor. Os dados inseridos e resultados devem ser verificados para concordância com as condições existentes e para a plausibilidade!
- A verificação da transferência de cargas para o material base deve ser efectuada de acordo com EOTA TR 029 Secção 7!
- O cálculo somente é válido se o diâmetro do furo não for superior ao valor dado na Tabela 4.1 da EOTA 001 TR029! Para diâmetros superiores do furo, ver Capítulo 1.1 da EOTA TR029!
- As resistências das ancoragens utilizadas neste cálculo são APENAS válidas se o conjunto Sísmico for instalado na obra conforme as instruções de utilização quando a anilha Sísmica foi seleccionada.
- A lista suplementar neste relatório é apenas para informação do utilizador. Em qualquer caso, as instruções para utilização disponibilizadas com o produto têm de ser cumpridas para garantir a correta instalação.
- A tensão de aderência característica depende das temperaturas a curto e longo prazo.
- O método SOFA assume a não existência de folga na chapa a fixar, entre as ancoragens e a chapa de fixação. Para o conseguir deve preencher a folga com resina química de suficiente resistência à compressão (ex., por utilização do conjunto de preenchimento/sísmico HILTI) ou por outro meio adequado.
- É da responsabilidade do utilizador verificar a conformidade com as normas actuais (ex: EC3)
- A verificação dos ELS não é efectuada pelo SOFA e dever ser efectuada pelo utilizador!
- The characteristic bond resistances depend on the return period (service life in years): 50

O cálculo da fixação cumpre o regulamento em vigor!

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8 Pormenores da Instalação

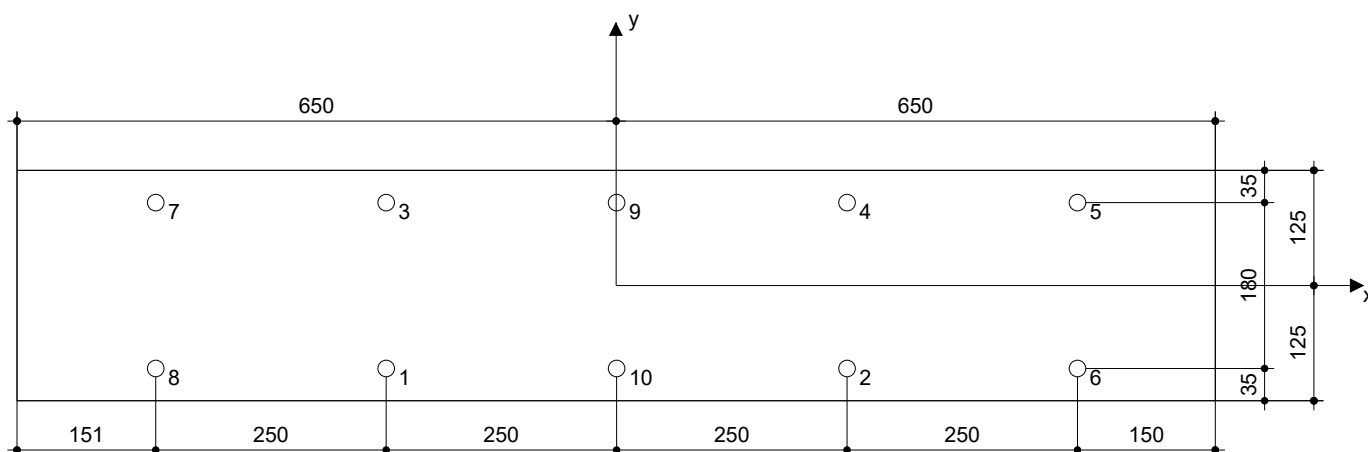
Chapa de fixação, aço: -
Perfil: sem perfil
Diâmetro do furo na chapa: $d_f = 18 \text{ mm}$
Espessura da chapa (introduzir): 1 mm
Espessura da chapa recomendada: não calculado
Sistema de perfuração: SafeSet - limpeza automática
Limpeza: Executada automaticamente durante a perfuração

Tipo e dimensão da ancoragem: HIT-HY 170 + AM (8.8) M16
Torque de aperto: 0,080 kNm
Diâmetro do furo no material base: 18 mm
Profundidade do furo : 140 mm
Espessura mínima do material base: 176 mm

Folga preenchida com Conjunto Sísmico M Hilti 16 mm
http://download.hilti.biz/data/techlib/help/IFU_Seismic-Filling-Set.pdf

8.1 Acessórios recomendados

Perfuração	Limpeza	Configuração
- Martelo perfurador - Broca de dimensão adequada para limpeza automática (TE-CD / TE-YD) - Aspirador	Não são necessários acessórios	- Dispensador incluindo cassete e misturador - Conjunto de preenchimento sísmico Hilti - Chave dinamométrica



Coordenadas das ancoragens [mm]

Ancoragem	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}
1	-250	-90	801	1 300	985	1 165
2	251	-90	1 301	800	985	1 165
3	-250	90	801	1 300	1 165	985
4	251	90	1 301	800	1 165	985
5	501	90	1 551	550	1 165	985
6	501	-90	1 551	550	985	1 165
7	-500	90	551	1 550	1 165	985
8	-500	-90	551	1 550	985	1 165
9	1	90	1 051	1 050	1 165	985
10	1	-90	1 051	1 050	985	1 165

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9 Observações; Cooperação

- Todas as informações e todos os dados contidos no Programa só dizem respeito à utilização dos produtos da Hilti e baseiam-se em princípios, fórmulas e regulamentações de segurança em conformidade com avisos técnicos da Hilti e instruções de funcionamento, montagem, ligação, etc., que o utilizador deve seguir à risca. Todos os números aí apresentados são médias; em consequência, testes de utilização específicos devem ser conduzidos antes da utilização do produto da Hilti aplicável. Os resultados dos cálculos executados por intermédio do Programa assentam essencialmente nos dados que aí inseriu. Em consequência, é o único responsável pela ausência de erros, exaustividade e pertinência dos dados inseridos ao seu cuidado. Além disso, é o único responsável pela verificação dos resultados do cálculo e da sua validação por um perito, particularmente no que diz respeito ao cumprimento de normas e permissões aplicáveis antes da sua utilização para o seu sítio em particular. O programa só serve para ajudar a interpretar as normas e as permissões sem nenhuma garantia respeitante à ausência de erros, à exactidão e à pertinência dos resultados ou a sua adaptação a uma aplicação específica.
- Deverá tomar todas as medidas necessárias e razoáveis para impedir ou limitar os danos causados pelo Programa. Mais particularmente, deverá adoptar disposições próprias para efectuar regularmente cópias de segurança dos programas e dos dados e, se aplicável, executar as actualizações regularmente fornecidas pela Hilti. Se não utilizar a funcionalidade AutoUpdate do Programa, deve certificar-se de que utiliza em cada caso a versão actual e actualizada do Programa, executando as actualizações manualmente através do Sítio Web da Hilti. A Hilti não assumirá qualquer responsabilidade por nenhuma consequência, como por exemplo, a necessidade de recuperar requisitos ou programas perdidos ou danificados, que derivem de uma falta culpável da sua parte quanto às suas obrigações.

9.4 VERIFICAÇÃO ESTRUTURAL DE VIGAS DE BETÃO ARMADO

TN_CORPO 3 - VERIFICAÇÃO DA SEGURANÇA DE VIGAS DE BETÃO ARMADO

Betão (C 30/37)				Aço (A500 NR)		Parâmetros	
fck	fcđ	fcđm	c _{nom}	f _{yk}	f _{yd}	Ø	colØ
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)	(")	
30	20.0	2.9	3.0	500	435	30	1.73

TN_CORPO 3 - Verificação do Estado Limite Último de Flexão das Vigas de Betão Armado do Piso 1																				TN_CORPO 3 - Verificação do Estado Limite Último de Esforço Transverso das Vigas de Betão Armado do Piso 1											
alinhamento	Viga	Vãos	Tramo	i (m)	SECÇÃO		b (m)	h (m)	d (m)	Armadura			Verificação										↓ (mm)	A _{ser} (cm²/m)	Ramos	A _{ser} (cm²/m)	V _{ser} (kN)	V _{sd} (kN)	CASO	OBS.	
					Varões	A _s (cm²)				ρ (%)	u	k	x (m)	x/d	Redistribuição (10%)	μ	M _{ser} (kNm)	M _{cd} (kNm)	CASO	OBS.											
A	V1.A3	1	1	6.12	Apóio.asp	D-D'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	-209.2	156	Verifica	Ø8/0.20	2.51	2	5.02	920.0	255.2	201.0	156	Verifica
					vão	D-D'	0.30	0.80	0.745	4Ø20+1Ø20	18.85	0.84	0.183	0.226	0.169	0.226	Sim	0.166	553.3	216.7	156	Verifica	Ø8/0.20	2.51	2	5.02	920.2	253.6	208.0	156	Verifica
					Apóio.asp	D-D'	0.30	0.80	0.744	4Ø20+1Ø20	25.91	1.16	0.252	0.312	0.232	0.312	Sim	0.220	729.4	135.0	159	Verifica	Ø8/0.20	2.51	2	5.02	918.6	253.1	100.0	159	Verifica
		3			vão	E-E'	0.30	0.80	0.749	4Ø25	19.63	0.87	0.190	0.234	0.176	0.234	Sim	0.171	577.3	140.0	159	Verifica	Ø8/0.20	3.93	2	7.86	925.3	399.3	106.0	159	Verifica
					Apóio.asp	C-C'	0.30	0.80	0.745	4Ø20+1Ø20	18.85	0.84	0.183	0.226	0.169	0.226	Sim	0.166	553.3	-390.0	156	Verifica	Ø8/0.20	2.51	2	5.02	920.2	253.6	157.4	107	Verifica
					vão	B-B'	0.30	0.80	0.744	2Ø20+3Ø16+1Ø20	16.59	0.74	0.161	0.199	0.148	0.199	Sim	0.148	492.4	130.0	159	Verifica	Ø8/0.20	2.51	2	5.02	919.1	253.3	90.0	159	Verifica
E	V1.E4	4			vão	A-A'	0.30	0.80	0.753	2Ø20+1Ø20	10.30	0.46	0.099	0.122	0.092	0.122	Sim	0.094	319.9	130.0	156	Verifica	Ø8/0.20	2.51	2	5.02	929.4	256.1	60.0	156	Verifica
					Apóio.asp	C-C'	0.30	0.80	0.745	4Ø20+1Ø20	18.85	0.84	0.183	0.226	0.169	0.226	Sim	0.166	553.3	-363.3	159	Verifica	Ø8/0.20	2.51	2	5.02	920.2	253.6	147.9	159	Verifica
					vão	B-B'	0.30	0.80	0.742	4Ø25+1Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	-291.8	156	Verifica	Ø8/0.20	7.85	2	15.70	916.1	789.6	149.0	156	Verifica
		24	V1.24a	4	Apóio.asp	A-A'	0.30	0.80	0.742	4Ø25+1Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	-276.8	156	Verifica	Ø8/0.20	3.93	2	7.86	916.1	395.3	124.1	156	Verifica
					vão	B-B'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	133.0	160	Verifica	Ø8/0.20	3.93	2	7.86	926.0	399.6	61.0	156	Verifica

Betão (C 30/37)				Aço (A500 NR)		Parâmetros	
fck	fcđ	fcđm	c _{nom}	f _{yk}	f _{yd}	Ø	colØ
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)	(")	
30	20.0	2.9	3.0	500	435	30	1.73

TN_CORPO 3 - Verificação do Estado Limite Último de Flexão das Vigas de Betão Armado do Piso 6 e Piso 7																				TN_CORPO 3 - Verificação do Estado Limite Último de Esforço Transverso das Vigas de Betão Armado do Piso 6,7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
alinhamento	Viga	Vãos	Tramo	i (m)	SECCÃO		b (m)	h (m)	d (m)	Armadura			Verificação							↓ (mm)	Ramos	V _{ser} (cm ² /m)	V _{ser} (kN)	V _{cd} (kN)	CASO	OBS.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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TN_CORPO 3 - VERIFICAÇÃO DA SEGURANÇA DE VIGAS DE BETÃO ARMADO

Betão (C 30/37)				Aço (A500 NR)		Parâmetros	
f _{ck}	f _{cd}	f _{ctm}	c _{min}	f _{yk}	f _{yd}	Ø	colØ
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)	(°)	
30	20.0	2.9	3.0	500	435	30	1.73

TN_CORPO 3 - Verificação do Estado Limite Último de Flexão das Vigas de Betão Armado do Piso 2																				TN_CORPO 3 - Verificação do Estado Limite Último de Esforço Transverso das Vigas de Betão Armado do Piso 2													
Alinhamento	Viga	Vãos	Tramo	i	SECÇÃO	b	h	d	Armadura			Verificação										Ø	A _{s,ef}	Ramos	A _{s,ef}	V _{Ed}	V _{Ed}	V _{Ed}	CASO	OBS.			
				(m)		(m)	(m)	Varões	A _s (cm ²)	ρ (%)	u	k	x (m)	x/d	Redistribuição (10%)	μ	M _{Ed} (kNm)	M _{Ed} (kNm)	CASO	OBS	(mm)	(cm ² /m)	(kN)		(kN)	(kN)							
A	V2.A3	4	1	6.35	Apoio.sus	J-J'	0.30	0.80	0.742	3Ø25+2Ø20+2Ø20	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-256.7	156	Verifica	Ø18/0.20	3.93	2	7.86	916.0	395.2	154.9	159	Verifica		
			2	6.38	Vão	K-K'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	106.6	159	Verifica	Ø18/0.20	3.93	2	7.86	926.0	399.6	123.8	156	Verifica		
	V2.A7	1	1	5.90	Apoio.sus	J-J'	0.30	0.80	0.742	3Ø25+2Ø20+2Ø20	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-405.9	160	Verifica	Ø18/0.20	3.93	2	7.86	916.0	395.2	292.3	156	Verifica		
			1	5.80	Vão	K-K'	0.30	0.80	0.748	4Ø20	16.10	0.72	0.156	0.193	0.144	0.193	Sim	0.143	482.0	289.8	159	Verifica	Ø18/0.20	3.93	2	7.86	924.1	398.7	168.0	159	Verifica		
B	V2.B2	7	1	7.04	Apoio.sus	J-J'	0.30	0.80	0.742	3Ø25+2Ø20+2Ø20	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-487.5	156	Verifica	Ø18/0.20	3.93	2	7.86	916.0	395.2	197.1	159	Verifica		
			2	7.10	Vão	K-K'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	255.1	159	Verifica	Ø18/0.20	3.93	2	7.86	926.0	399.6	241.9	159	Verifica		
			4	6.56	Apoio.sus	M-M'	0.50	0.80	0.745	6Ø20+2Ø20	25.13	0.67	0.147	0.181	0.135	0.181	Sim	0.136	782.7	-487.5	156	Verifica	Ø18/0.10	7.85	4	31.40	1533.0	1533.0	320.1	160	Verifica		
			1	7.76	Apoio. sus	H-H'	0.30	0.80	0.742	4Ø25+2Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	-351.7	156	Verifica	Ø18/0.15	5.24	2	10.48	916.1	927.1	254.0	104	Verifica		
C	V2.C2	7	2	7.83	vao	I-I'	0.30	0.80	0.747	2Ø25+2Ø20	15.70	0.70	0.152	0.188	0.141	0.188	Sim	0.140	470.1	111.8	159	Verifica	Ø18/0.15	5.24	2	10.48	922.6	930.7	236.0	105	Verifica		
			4	7.54	Apoio.sus	F-F'	0.50	0.80	0.749	4Ø25+2Ø20	29.45	0.79	0.171	0.211	0.158	0.211	Sim	0.156	874.8	-427.3	104	Verifica	Ø18/0.15	5.24	4	20.96	1541.2	1064.0	326.2	156	Verifica		
			7	7.48	Apoio.sus	G-G'	0.30	0.80	0.742	4Ø25+2Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	-278.8	113	Verifica	Ø18/0.15	5.24	2	10.48	916.1	927.1	292.1	113	Verifica		
			1	8.48	Apoio.sus	N-N'	0.40	0.80	0.742	4Ø25+2Ø20	25.91	0.87	0.190	0.234	0.174	0.234	Sim	0.171	754.4	-378.0	156	Verifica	Ø18/0.15	5.24	2	10.48	1221.5	927.1	251.4	104	Verifica		
D	V2.D2	7	2	8.56	Vão	E-E'	0.40	0.80	0.747	4Ø25	19.63	0.66	0.143	0.176	0.132	0.176	Sim	0.132	591.2	119.7	159	Verifica	Ø18/0.15	5.24	2	10.48	1230.4	930.9	252.7	156	Verifica		
			4	8.49	Apoio.sus	O-O'	0.50	0.80	0.743	6Ø25+2Ø20+2Ø20	40.64	1.09	0.238	0.294	0.218	0.294	Sim	0.209	1192.4	-460.2	156	Verifica	Ø18/0.15	5.24	2	10.48	1628.9	927.8	288.5	113	Verifica		
			7	8.43	Apoio.sus	N-N'	0.40	0.80	0.743	4Ø25+2Ø20	25.91	0.87	0.190	0.234	0.174	0.234	Sim	0.171	755.4	-325.0	156	Verifica	Ø18/0.15	5.24	2	10.48	1223.0	927.7	287.5	113	Verifica		
			1	8.95	Vão	A-A'	0.30	0.80	0.743	2Ø20+2Ø20	10.30	0.46	0.100	0.124	0.092	0.124	Sim	0.095	315.5	245.3	159	Verifica	Ø18/0.15	3.35	2	6.70	917.3	937.4	191.0	156	Verifica		
E	V2.E3B	2	2	9.00	Apoio.sus	B-B'	0.30	0.80	0.743	4Ø20+2Ø20	18.85	0.85	0.184	0.227	0.169	0.227	Sim	0.166	551.7	-436.7	156	Verifica	Ø18/0.15	3.35	2	6.70	917.8	937.6	105.0	156	Verifica		
			1	5.73	Apoio.sus	B-B'	0.30	0.80	0.743	4Ø20+2Ø20	18.85	0.85	0.184	0.227	0.169	0.227	Sim	0.166	551.7	-436.7	156	Verifica	Ø18/0.15	3.35	2	6.70	917.8	937.6	76.6	113	Verifica		
			V2.E4	3	1	9.18	Apoio.sus	C-C'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	-322.7	156	Verifica	Ø18/0.15	3.35	2	6.70	926.0	940.6	166.7	159	Verifica
					1	9.18	Apoio.sus	B-B'	0.30	0.80	0.745	4Ø20+2Ø20	16.85	0.84	0.183	0.226	0.169	0.226	Sim	0.166	553.3	-283.6	156	Verifica	Ø18/0.15	3.35	2	6.70	920.2	938.5	154.5	159	Verifica
2	9.21	Vão			A-A'	0.30	0.80	0.743	2Ø20+2Ø20	10.30	0.46	0.100	0.124	0.092	0.124	Sim	0.095	315.5	159.2	159	Verifica	Ø18/0.15	3.35	2	6.70	917.3	937.4	149.1	156	Verifica			
2	9.21	Apoio.sus			B-B'	0.30	0.80	0.745	4Ø20+2Ø20	16.85	0.84	0.183	0.226	0.169	0.226	Sim	0.166	553.3	-289.9	156	Verifica	Ø18/0.15	3.35	2	6.70	920.2	938.5	151.4	159	Verifica			
1	5.62	Apoio.sus			A-A'	0.30	0.80	0.742	4Ø25+2Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	-421.9	160	Verifica	Ø18/0.20	3.93	2	7.86	916.1	955.9	152.2	163	Verifica			
2	7.14	Vão			B-B'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	245.4	163	Verifica	Ø18/0.10	7.85	2	15.70	925.0	758.1	126.5	160	Verifica			
16	V2.16B	4	2	7.02	Apoio.sus	C-C'	0.30	0.80	0.742	3Ø25+2Ø20+2Ø20	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-386.1	160	Verifica	Ø18/0.20	3.93	2	7.86	916.0	395.2	164.2	163	Verifica		
			1	5.07	Apoio.sus	C-C'	0.30	0.80	0.748	3Ø25	14.73	0.66	0.143	0.176	0.132	0.176	Sim	0.132	443.6	-26.7	104	Verifica	Ø18/0.10	7.85	2	15.70	922.9	795.4	59.7	160	Verifica		
17	V2.17a	1	1	5.07	Vão	C-C'	0.30	0.80	0.742	4Ø25+2Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	46.1	163	Verifica	Ø18/0.20	3.93	2	7.86	916.1	395.3	55.1	163	Verifica		
			2	7.75	Apoio.sus	A-A'	0.30	0.80	0.747	4Ø25	19.63	0.88	0.190	0.235	0.176	0.235	Sim	0.172	575.6	-513.0	160	Verifica	Ø18/0.10	3.93	2	7.86	922.8	398.2	359.0	160	Verifica		
			3	7.75	Vão	B-B'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	222.1	163	Verifica	Ø18/0.10	7.85	2	15.70	926.0	795.1	244.3	163	Verifica		
18	V2.18	4	2	5.53	Apoio.sus	A-A'	0.30	0.80	0.742	4Ø25+2Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	-476.8	160	Verifica	Ø18/0.20	3.93	2	7.86	916.1	395.3	353.9	160	Verifica		
			4	7.75	Vão	B-B'	0.30	0.80	0.747	4Ø25	19.63	0.88	0.190	0.235	0.176	0.235	Sim	0.172	575.6	307.5	163	Verifica	Ø18/0.20	3.93	2	7.86	922.8	398.2	321.1	163	Verifica		
19	V2.19	4	2	5.53	Apoio.sus	A-A'	0.30	0.80	0.742	4Ø25+2Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	-435.1	160	Verifica	Ø18/0.20	3.93	2	7.86	916.1	395.3	327.3	160	Verifica		
			3	7.75	Vão	B-B'	0.30	0.80	0.747	4Ø25	19.63	0.88	0.190	0.235	0.176	0.235	Sim	0.172	575.6	256.3	163	Verifica	Ø18/0.20	3.93	2	7.86	922.8	398.2	296.7	163	Verifica		
20	V2.20	1	1	5.07	Apoio.sus	C-C'	0.30	0.80	0.748	3Ø25	14.73	0.66	0.143	0.176	0.132	0.176	Sim	0.132	443.6	-50.0	109	Verifica	Ø18/0.10	7.85	2	15.70	922.9	795.4	47.5	139	Verifica		
			1	5.07	Vão	C-C'	0.30	0.80	0.742	4Ø25+2Ø20	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	31.9	109	Verifica	Ø18/0.20	3.93	2	7.86	916.1	395.3	84.0	113	Verifica		
24	V2.24a	3	1	8.05	Apoio.sus	C-C'	0.30	0.80	0.742	3Ø25+2Ø20+2Ø20	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-242.9	156	Verifica	Ø18/0.20	3.93	2	7.86	916.0	395.2	124.8	156	Verifica		
			2	7.75	Apoio.sus	A-A'	0.30	0.80	0.742	3Ø25+2Ø20+2Ø20	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-386.3	156	Verifica	Ø18/0.20	3.93	2	7.86	916.0	395.2	157.2	159	Verifica		
			3	7.75	Vão	B-B'	0.30	0.80	0.750	4Ø20	12.57	0.56	0.121	0.150	0.112	0.150	Sim	0.114	384.3	141.1	159	Verifica	Ø18/0.20	3.93	2	7.86	926.0	399.6	128.8	156	Verifica		
			3	7.84	Apoio.sus	C-C'	0.30	0.80	0.742	3Ø25+2Ø20+2Ø20	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-296.3	156	Verifica	Ø18/0.20	3.93	2	7.86	916.0	395.2	159	Verifica			

TN_CORPO 3 - VERIFICAÇÃO DA SEGURANÇA DE VIGAS DE BETÃO ARMADO

Betão (C 30/37)				Aço (A500 NR)		Parâmetros		Armaduras			
fck	fcd	fctm	c _{nom}	f _{yk}	f _{yd}	θ	cotθ	Øl		Øw	
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)	(°)		(cm)	(cm)	(cm)	(cm)
30	20.0	2.9	3.0	500	435	30	1.73	2.0	2.5	0.8	1.0

TN_CORPO 3 - Verificação do Estado Limite Último de Flexão + Torção das Vigas de Betão Armado do Piso 4																																	
Dados																Flexão										Torção				Torção + Flexão			
Alinhamento	Viga	Vãos	Tramo	I	SECÇÃO		b	h	d	A	u	t _{ef}	b _k	h _k	A _k	u _k	M _{Ed,y}	CASO	μ	ω	A _{s,min}	A _{s,cal}	A _{s,inf}		A _{s,sup}		M _{Ed,s}	A _{s,cal}	Varões	A _{s,lat}	A _{s,tot}	A _{s,lat}	OBS.
				(m)			(m)	(m)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm ²)	(cm)	(cm ²)					(cm ²)	(cm ²)	(cm ²)	(cm ²)	(kNm)	(cm2)				(cm ²)			
A	V4.A3	1	1	6.12	Apoio,sup	E-E'	0.30	0.80	0.740	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	-352.0	156	0.107	0.114	3.77	10.09	4Ø25	19.63	2Ø25+2Ø20+(2Ø20)	22.39	29.7	3.95	3Ø16//0.20/face	12.06	14.04	34.45	Verifica
A'	V4.A6	7	2	6.52	Apoio,sup	F-F'	0.30	0.80	0.740	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	-484.6	156	0.147	0.160	3.77	14.24	4Ø25+(2Ø20)	25.91	4Ø25+(2Ø20)	25.91	35.50	4.73	3Ø16//0.20/face	12.06	18.97	37.97	Verifica
E	V4.E6	4	1	8.97	Apoio,sup	D-D'	0.40	0.80	0.740	3200.0	240.0	13.33	26.7	66.7	1777.8	93.3	-596.6	156	0.136	0.147	5.02	17.40	8Ø25	39.27	7Ø25	34.36	67.70	7.08	3Ø16//0.20/face	12.06	24.48	46.42	Verifica
16	V4.16b	4	1	5.67	Apoio,sup	C-C'	0.30	0.80	0.740	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	-480.6	160	0.146	0.159	3.77	14.11	4Ø25	19.63	4Ø25+(2Ø25)	29.45	27.7	3.69	3Ø16//0.20/face	12.06	17.80	41.51	Verifica
17	V4.17	1	1	6.12	Apoio,sup	D-D'	0.30	0.80	0.740	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	-410.5	160	0.125	0.134	3.77	11.89	4Ø20+(2Ø20)		4Ø20+(2Ø20)	18.85	39.6	5.27	3Ø16//0.20/face	12.06	17.16	30.91	Verifica
24a	V4.24a	5	1	6.12	Apoio,sup	D-D'	0.30	0.80	0.740	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	-252.4	155	0.077	0.080	3.77	7.11	4Ø20	12.57	2Ø25+2Ø20+(2Ø20)	22.39	26.3	3.50	3Ø16//0.20/face	12.06	10.61	34.45	Verifica

Betão (C 30/37)				Aço (A500 NR)		Parâmetros		Armaduras			
fck	fcd	fctm	c _{nom}	f _{yk}	f _{yd}	θ	cotθ	Øl		Øw	
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)	(°)		(cm)	(cm)	(cm)	(cm)
30	20.0	2.9	3.0	500	435	30	1.73	2.0	2.5	0.8	1.0

TN_CORPO 3 - Verificação do Estado Limite Último de Esforço Transverso das Vigas de Betão Armado do Piso 4																													
Alinhamento	Viga	Vãos	Tramo	I	SECÇÃO	b	h	d	A	u	t _{ef}	b _k	h _k	A _k	u _k	V _{Ed}	T _{Ed}	Q	A _{sw,min}	Asw	Ramos	Asw	φ	A _{sw,xf}	V _{Rd,s}	V _{Rd,max}	T _{Rd,max}	Verif	
				(m)		(m)	(m)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm ²)	(cm)	(kN)	(kNm)	(kN)	(cm ² /m)	(cm ² /m)	(cm ² /m)	(mm)	(cm ² /m)	(kN)	(kN)	(kN)	conjunta			
A	V4.A3	1	1	6.12	Apoio,sup	E-E'	0.30	0.80	0.74	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	145.0	20.0	124.9	2.63	2.49	2	2.49	ø8/0.20	2.51	251.8	913.6	131.6	Verifica
A'	V4.A6	7	2	6.52	Apoio,sup	F-F'	0.30	0.80	0.74	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	253.0	23.1	187.0	2.63	3.73	2	3.73	ø10/0.20	3.93	394.2	913.6	131.6	Verifica
E	V4.E6	4	1	8.97	Apoio,sup	D-D'	0.40	0.80	0.74	3200.0	240.0	13.33	26.7	66.7	1777.8	93.3	226.7	67.7	240.3	3.51	4.79	2	4.79	ø10/0.10	7.85	787.4	1218.1	216.8	Verifica
16	V4.16b	4	1	5.67	Apoio,sup	C-C'	0.30	0.80	0.74	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	204.4	27.7	174.7	2.63	3.48	2	3.48	ø10/0.10	7.85	787.4	913.6	131.6	Verifica
17	V4.17	1	1	6.12	Apoio,sup	D-D'	0.30	0.80	0.74	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	220.9	19.3	161.0	2.63	3.21	2	3.21	ø10/0.20	3.93	394.2	913.6	131.6	Verifica
24a	V4.24a	5	1	6.12	Apoio,sup	D-D'	0.30	0.80	0.74	2400.0	220.0	10.91	19.1	69.1	1319.0	88.2	163.9	26.3	150.8	2.63	3.01	2	3.01	ø10/0.20	3.93	394.2	913.6	131.6	Verifica

TN_CORPO 3 - VERIFICAÇÃO DA SEGURANÇA DE VIGAS DE BETÃO ARMADO

Betão (C 30/37)				Aço (A500 NR)		Parâmetros	
f _{ck}	f _{cd}	f _{ctm}	c _{min}	f _{yk}	f _{yd}	θ	cotθ
(MPa)	(MPa)	(MPa)	(cm)	(MPa)	(MPa)	(°)	
30	20.0	2.9	3.0	500	435	30	1.73

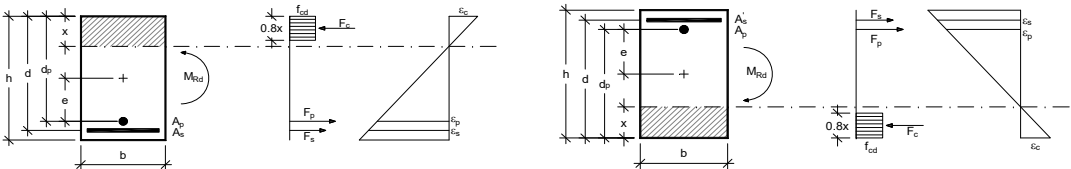
TN_CORPO 3 - Verificação do Estado Limite Último de Flexão das Vigas de Betão Armado do Piso 5																	TN_CORPO 3 - Verificação do Estado Limite Último de Esforço Transverso das Vigas de Betão Armado do Piso 5																	
alimentação	Viga	Vãos	Tramo	l (m)	SECÇÃO		Armadura										Verificação										Ø	A _{s,cal} (cm²/m)	Ramos	A _{s,cal} (cm²/m)	V _{des} (kN)	V _{des} (kN)	CASO	OBS.
					b (m)	h (m)	d (m)	Varões	A _s (cm²)	ρ (%)	ω	k	x (m)	x/d	Redistribuição (10%)	μ	M _{ed,1} (kNm)	M _{ed,2} (kNm)																
A	V5A.6	1	1	6.70	Sup	A-A'	0.30	0.80	0.750	2Ø20	6.28	0.28	0.061	0.075	0.056	0.075	Sim	0.059	198.4	-47.5	156	Verifica	Ø10/0.20	3.93	2	7.86	926.0	399.5	125.2	156	Verifica			
			1	6.70	Inf	A-A'	0.30	0.80	0.747	4Ø25	19.63	0.88	0.190	0.235	0.176	0.235	Sim	0.172	575.6	96.2	169	Verifica	Ø10/0.20	3.93	2	7.86	922.8	398.2	83.2	169	Verifica			
	V5A.7	1	1	6.28	Sup	A-A'	0.30	0.80	0.750	2Ø20	6.28	0.28	0.061	0.075	0.056	0.075	Sim	0.059	198.4	-185.4	156	Verifica	Ø10/0.20	3.93	2	7.86	926.0	399.5	133.8	159	Verifica			
			1	6.28	Inf	A-A'	0.30	0.80	0.747	4Ø25	19.63	0.88	0.190	0.235	0.176	0.235	Sim	0.172	575.6	163.5	156	Verifica	Ø10/0.20	3.93	2	7.86	922.8	398.2	86.3	107	Verifica			
	V5A.3	6	1	6.54	Apico,sup	D-D'	0.30	0.80	0.742	2Ø25+2Ø20+(2Ø20)	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-214.6	156	Verifica	Ø10/0.20	3.93	2	7.86	916.0	395.2	167.0	156	Verifica			
			2	6.57	Vão	E-E'	0.30	0.80	0.748	2Ø25+2Ø20	16.10	0.72	0.156	0.193	0.144	0.193	Sim	0.143	482.0	85.0	169	Verifica	Ø10/0.20	3.93	2	7.86	924.1	398.7	22.9	169	Verifica			
			4	5.83	Apico,sup	D-D'	0.30	0.80	0.742	2Ø25+2Ø20+(2Ø20)	22.39	1.01	0.219	0.270	0.200	0.270	Sim	0.194	641.1	-316.9	160	Verifica	Ø10/0.20	3.93	2	7.86	916.0	395.2	228.0	160	Verifica			
			1	7.12	Apico,sup	F-F'	0.30	0.80	0.739	4Ø25+(2Ø25)	29.45	1.33	0.289	0.357	0.264	0.357	Sim	0.246	806.0	-213.5	156	Verifica	Ø10/0.15	5.24	2	10.48	912.6	525.0	189.0	156	Verifica			
B	V5B.2	7	2	7.10	Vão	G-G'	0.30	0.80	0.748	2Ø25+2Ø20	16.10	0.72	0.156	0.193	0.144	0.193	Sim	0.143	482.0	106.3	156	Verifica	Ø10/0.15	5.24	2	10.48	924.1	531.6	50.0	156	Verifica			
			5	6.78	Apico,sup	J-J'	0.50	0.80	0.742	4Ø25+(2Ø20)	25.91	0.70	0.152	0.187	0.139	0.187	Sim	0.140	770.7	-165.0	112	Verifica	Ø10/0.15	5.24	2	10.48	1526.8	527.1	157.9	105	Verifica			
	V5B.4-V5B.5	1	1	7.52	Sup	A-A'	0.30	0.80	0.750	2Ø20	6.28	0.28	0.061	0.075	0.056	0.075	Sim	0.059	198.4	-152.5	113	Verifica	Ø10/0.20	3.93	2	7.86	926.0	399.5	148.0	113	Verifica			
			1	7.52	Inf	A-A'	0.30	0.80	0.747	4Ø25	19.63	0.88	0.190	0.235	0.176	0.235	Sim	0.172	575.6	79.0	113	Verifica	Ø10/0.20	3.93	2	7.86	922.8	398.2	83.1	113	Verifica			
C	V5.C.2	7	1	7.87	Apico,sup	H-H'	0.30	0.80	0.739	4Ø25+(2Ø25)	29.45	1.33	0.289	0.357	0.264	0.357	Sim	0.246	806.0	-287.6	156	Verifica	Ø10/0.10	7.85	2	15.70	912.6	786.5	237.6	104	Verifica			
			2	7.83	Vão	I-I'	0.30	0.80	0.742	4Ø25+(2Ø20)	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	187.2	104	Verifica	Ø10/0.10	7.85	2	15.70	916.1	789.6	237.6	104	Verifica			
	V5.C.4-V5.C.5	1	1	7.89	Sup	A-A'	0.30	0.80	0.750	2Ø20	6.28	0.28	0.061	0.075	0.056	0.075	Sim	0.059	198.4	-152.5	113	Verifica	Ø10/0.20	3.93	2	7.86	926.0	399.5	148.0	113	Verifica			
			1	7.89	Inf	A-A'	0.30	0.80	0.747	4Ø25	19.63	0.88	0.190	0.235	0.176	0.235	Sim	0.172	575.6	79.0	113	Verifica	Ø10/0.20	3.93	2	7.86	922.8	398.2	83.1	113	Verifica			
D	V2.D.2	7	1	8.62	Apico,sup	H-H'	0.30	0.80	0.739	4Ø25+(2Ø25)	29.45	1.33	0.289	0.357	0.264	0.357	Sim	0.246	806.0	-309.1	104	Verifica	Ø10/0.10	7.85	2	15.70	912.6	786.5	272.4	104	Verifica			
			2	8.56	Vão	I-I'	0.30	0.80	0.742	4Ø25+(2Ø20)	25.91	1.16	0.253	0.312	0.232	0.312	Sim	0.220	727.2	120.2	112	Verifica	Ø10/0.10	7.85	2	15.70	916.1	789.6	218.3	104	Verifica			
E	V5.E.3	4	1	9.18	Apico,sup	K-K'	0.30	0.80	0.745	4Ø25+(2Ø20)	18.85	0.84	0.183	0.226	0.169	0.226	Sim	0.166	553.3	-327.1	156	Verifica	Ø10/0.20	3.93	2	7.86	920.2	397.1	146.7	156	Verifica			
			1	9.18	Vão	L-L'	0.30	0.80	0.753	2Ø20+2Ø16	10.30	0.46	0.099	0.122	0.092	0.122	Sim	0.094	319.9	189.2	169	Verifica	Ø10/0.20	3.93	2	7.86	929.4	401.0	141.0	169	Verifica			
			3	9.00	Apico,sup	K-K'	0.30	0.80	0.752	4Ø25+(2Ø20)	18.85	0.84	0.182	0.224	0.169	0.224	Sim	0.165	558.9	-253.0	156	Verifica	Ø10/0.20	3.93	2	7.86	926.6	400.7	150.8	156	Verifica			
	V5.E.4	3	1	9.18	Vão	J-J'	0.30	0.80	0.753	2Ø20+2Ø16	10.30	0.46	0.099	0.122	0.092	0.122	Sim	0.094	319.9	128.4	169	Verifica	Ø10/0.20	3.93	2	7.86	929.4	401.0	126.0	169	Verifica			
			1	9.18	Apico,sup	K-K'	0.30	0.80	0.745	4Ø25+(2Ø20)	18.85	0.84	0.183	0.226	0.169	0.226	Sim	0.166	553.3	-217.8	156	Verifica	Ø10/0.20	3.93	2	7.86	920.2	397.1	125.4	159	Verifica			
			2	9.21	Vão	L-L'	0.30	0.80	0.753	2Ø20+2Ø16	10.30	0.46	0.099	0.122	0.092	0.122	Sim	0.094	319.9	109.9	169	Verifica	Ø10/0.20	3.93	2	7.86	929.4	401.0	112.7	156	Verifica			
	V5.16b	4	1	8.05	Apico,sup	C-C'	0.30	1.00	0.942	2Ø25+2Ø20+(2Ø20)	22.39	0.79	0.172	0.213	0.200	0.213	Sim	0.157	835.7	-447.1	160	Verifica	Ø10/0.20	3.93	2	7.86	1162.9	501.8	432.9	160	Verifica			
			3	7.75	Apico,sup	C-C'	0.30	1.00	0.942	2Ø25+2Ø20+(2Ø20)	22.39	0.79	0.172	0.213	0.200	0.213	Sim	0.157	835.7	-356.0	160	Verifica	Ø10/0.20	3.93	2	7.86	1162.9	501.8	154.4	160	Verifica			
4			6.07	Vão	G-G'	0.30	1.00	0.946	4Ø20+(2Ø16)	16.59	0.58	0.127	0.157	0.148	0.157	Sim	0.119	637.5	235.8	163	Verifica	Ø10/0.20	3.93	2	7.86	1167.5	503.8	212.1	113	Verifica				
V5.9	4	2	7.75	Apico,sup	A-A'	0.30	1.00	0.942	4Ø25+(2Ø20)	25.91	0.92	0.199	0.246	0.232	0.246	Sim	0.179	952.5	-386.1	160	Verifica	Ø10/0.20	3.93	2	7.86	1163.0	501.8	193.2	160	Verifica				
		3	7.14	Vão	B-B'	0.30	1.00	0.947	4Ø25	19.63	0.69	0.150	0.185	0.176	0.185	Sim	0.139	746.2	106.4	163	Verifica	Ø10/0.20	3.93	2	7.86	1169.8	504.7	101.9	163	Verifica				
		1	8.05	Apico,sup	C-C'	0.30	1.00	0.942	2Ø25+2Ø20+(2Ø20)	22.39	0.79	0.172	0.213	0.200	0.213	Sim	0.157	835.7	-299.3	156	Verifica	Ø10/0.10	7.85	2	15.70	1162.9	1002.3	154.7	156	Verifica				
V5.24a	4	2	7.75	Apico,sup	A-A'	0.30	1.00	0.942	2Ø25+2Ø20+(2Ø20)	22.39	0.79	0.172	0.213	0.200	0.213	Sim	0.157	835.7	-299.3	156	Verifica	Ø10/0.20	3.93	2	7.86	1162.9	501.8	156.8	156	Verifica				
		3	7.75	Vão	B-B'	0.30	1.00	0.950	4Ø20	12.57	0.44	0.096	0.118	0.112	0.118	Sim	0.091	493.6	159.1	159	Verifica	Ø10/0.20	3.93	2	7.86	1172.9	506.1	79.3	159	Verifica				
		4	5.07	Vão	G-G'	0.30	1.00	0.946	4Ø20+(2Ø16)	16.59	0.58	0.127	0.157	0.148	0.157	Sim	0.119	637.5	166.2	159	Verifica	Ø10/0.20	3.93	2	7.86	1167.5	503.8	77.4	159	Verifica				

9.5 VERIFICAÇÃO ESTRUTURAL DE VIGAS DE BETÃO PRÉ-ESFORÇADO

Verificação de Vigas Pré-Esforçadas - CORPO 3

Materiais

Betão	C30/37	
Aço (armaduras ordinárias)	A500 NR	
Aço (Pré-Esforço)	f _{p0.1k} 1670	[Mpa]
E _p	195	[Gpa]
Es	200	[Gpa]



Verificação E.L.U. Flexão

Viga	b	h	e	d	dp	z	zp	As	Ap	P∞	σ _{pd}	M _{Ed}	M _{QP}	M _{Freq}	M _{Caract}	σ _s (QP)	σ _s (Freq)	σ _s (Caract)	σ _i (QP)	σ _i (Freq)	σ _i (Caract)	Limitação Tensão Betão	Limitação Tensão Aço	Estado Limite Descompressão	Existência de Trações	fctm [Mpa]	Estado Limite Formação Fendas
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[cm²]	[cm²]	[kN]	[MPa]	[kN.m]	[kN.m]	[kN.m]	[kN.m]	[Mpa]	[Mpa]	[Mpa]	[Mpa]	[Mpa]	[Mpa]						
V70x110 Piso 2 - Alinhamentos 22 e 23_Corpo 3 - Meio Vão	0.70	1.10	0.43	1.04	0.98	0.93	0.88	29.45	33.60	3500.00	1041.67	3032.00	1727.00	1844.00	2157.00	-6.1	-6.9	-9.2	-3.0	-2.1	0.1	OK	OK	OK	Trações	2.9	OK
V70x110 Piso 2 - Alinhamentos 22, 23_Corpo 3 - Apoio	0.70	1.10	0.40	1.05	0.95	0.94	0.86	22.39	33.60	3500.00	1041.67	2269.00															
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Meio vão	0.70	1.10	0.40	1.04	0.95	0.93	0.86	29.45	33.60	3500.00	1041.67	2531.00	1645.00	1698.00	1849.00	-6.3	-6.7	-7.7	-2.8	-2.4	-1.4	OK	-	OK	-	2.9	OK
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Apoio	0.70	1.10	0.40	1.05	0.95	0.94	0.86	22.39	33.60	3500.00	1041.67	2256.00															
V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Meio Vão	0.60	1.30	0.53	1.24	1.18	1.11	1.06	29.45	28.00	3000.00	1071.43	580.00	330.00	280.00	335.00	3.6	3.9	3.6	-11.3	-11.6	-11.3	-	-	KO - Trações	Trações	2.9	Abertura de fenda deverá ser inferior a 0.2 mm
V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Apoio	0.60	1.30	0.53	1.25	1.18	1.12	1.06	22.39	28.00	3000.00	1071.43	2320.00															
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Meio Vão	0.60	2.50	1.10	2.44	2.35	2.19	2.12	44.18	61.60	6500.00	1055.19	13485.00	9053.00	9313.00	9963.00	-7.4	-7.8	-8.8	-1.3	-0.9	0.2	OK	OK	OK	Trações	2.9	OK
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Apoio	0.60	2.50	0.25	2.45	1.50	2.20	1.35	19.63	61.60	6500.00	1055.19	2450.00															

Viga	F _c	F _p	F _s	x	M _{Rd}	Verificação	Extensões [‰]						Verificação	Observações	
	[kN]	[kN]	[kN]	[m]	[kN.m]		ε _c	ε _{p0}	Δε _p	ε _p	ε _s	ε _{ud}			
V70x110 Piso 2 - Alinhamentos 22 e 23_Corpo 3 - Meio Vão	11200.x	4879.3	1280.4	0.55	4751.9	Verifica	3.5	5.3	2.7	8.1	9.1	22.5	Verifica	Aço pré-esforço está na cedência	e Aço armaduras ordinárias está na cedência
V70x110 Piso 2 - Alinhamentos 22, 23_Corpo 3 - Apoio	11200.x	4879.3	973.5	0.52	4431.7	Verifica	3.5	5.3	2.9	8.2	10.1	22.5	Verifica	Aço pré-esforço está na cedência	e Aço armaduras ordinárias está na cedência
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Meio vão	11200.x	4879.3	1280.4	0.55	4605.5	Verifica	3.5	5.3	2.5	7.9	9.6	22.5	Verifica	Aço pré-esforço está na cedência	e Aço armaduras ordinárias está na cedência
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Apoio	11200.x	4879.3	973.5	0.52	4431.7	Verifica	3.5	5.3	2.9	8.2	10.1	22.5	Verifica	Aço pré-esforço está na cedência	e Aço armaduras ordinárias está na cedência
V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Meio Vão	9600.x	4066.1	1280.4	0.56	5188.3	Verifica	3.5	5.5	3.9	9.4	10.2	22.5	Verifica	Aço pré-esforço está na cedência	e Aço armaduras ordinárias está na cedência
V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Apoio	9600.x	4066.1	973.5	0.52	4954.2	Verifica	3.5	5.5	4.4	9.9	10.9	22.5	Verifica	Aço pré-esforço está na cedência	e Aço armaduras ordinárias está na cedência
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Meio Vão	9600.x	8945.4	1920.9	1.13	20779.2	Verifica	3.5	5.4	3.8	9.2	9.8	22.5	Verifica	Aço pré-esforço está na cedência	e Aço armaduras ordinárias está na cedência
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Apoio	9600.x	8945.4	853.5	1.02	11506.2	Verifica	3.5	5.4	1.6	7.1	21.0	22.5	Verifica	Aço pré-esforço não está na cedência	e Aço armaduras ordinárias está na cedência

Verificação E.L.U. Esforço Transverso

Viga	Ø _{bainhas metálicas injetadas} [mm]	Nº de bainhas	Asw/s [cm²/m]	V _{Ed,eff} [kN]	cotg θ	V _{Rd,s} [kN]	bw/8 [m]	bw [m]	Asw/s _{min} [cm²/m]	σ _{cp} [MPa]	α _{cw}	V _{Rd,máx} [kN]	Verificação	Ws [m³]	Wi [m³]	Ac [m²]	MEd/Ws [kN/m²]	MEd/Wi [kN/m²]	P _{∞,e} /Ws [kN/m²]	P _{∞,e} /Wi [kN/m²]	P _∞ /Λ [kN/m²]	σ _s [MPa]	σ _i [MPa]	Z.cotg θ [m]
V70x110 Piso 2 - Alinhamentos 22 e 23_Corpo 3 - Meio Vão	85	2	8.59	245.00	2.00	695.79	0.09	0.70	6.13	4.55	1.23	3380.23	Verifica	0.14	0.14	0.77	21478.16	21478.16	10661.16	10661.16	4545.45	-15.36	6.27	1.86
V70x110 Piso 2 - Alinhamentos 22, 23_Corpo 3 - Apoio	85	2	8.59	400.00	2.00	704.19	0.09	0.70	6.13	4.55	1.23	3421.05	Verifica	0.14	0.14	0.77	16073.20	16073.20	9917.36	9917.36	4545.45	-10.70	1.61	1.89
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Meio vão	85	2	8.59	315.00	2.00	695.79	0.09	0.70	6.13	4.55	1.23	3380.23	Verifica	0.14	0.14	0.77	17929.16	17929.16	9917.36	9917.36	4545.45	-12.56	3.47	1.86
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Apoio	85	2	8.59	550.00	2.00	704.19	0.09	0.70	6.13	4.55	1.23	3421.05	Verifica	0.14	0.14	0.77	15981.11	15981.11	9917.36	9917.36	4545.45	-10.61	1.52	1.89

V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Meio Vão	85	2	8.59	130.00	2.00	830.24	0.08	0.52	4.51	3.85	1.19	2882.90	Verifica	0.17	0.17	0.78	3431.95	3431.95	9408.28	9408.28	3846.15	2.13	-9.82	2.22
V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Apoio	85	2	8.59	520.00	2.00	838.65	0.08	0.52	4.51	3.85	1.19	2912.07	Verifica	0.17	0.17	0.78	13727.81	13727.81	9408.28	9408.28	3846.15	-8.17	0.47	2.25
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Meio Vão	100	2	7.86	895.00	2.00	1497.84	0.08	0.50	4.38	4.33	1.22	5631.28	Verifica	0.63	0.63	1.50	21576.00	21576.00	11440.00	11440.00	4333.33	-14.47	5.80	4.38
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Apoio	100	2	7.86	1150.00	2.00	1505.53	0.08	0.50	4.38	4.33	1.22	5660.19	Verifica	0.63	0.63	1.50	3920.00	3920.00	2600.00	2600.00	4333.33	-5.65	-3.01	4.41

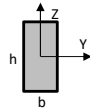
Armadura longitudinal INFERIOR nos apoios para equilibrar o esforço transverso

Viga / apoio	Asl,exist [cm²]	As,req [cm²]	Verificação
V70x110 Piso 2 - Alinhamentos 22 e 23_Corpo 3 - Meio Vão			
V70x110 Piso 2 - Alinhamentos 22, 23_Corpo 3 - Apoio	29.45	9.20	Asl,exist suficiente
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Meio vão			
V70x110 Piso 2 - Alinhamento 21_Corpo 3 - Apoio	29.45	12.65	Asl,exist suficiente
V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Meio Vão			
V60x130 Piso 5 - Alinhamento 21 - Corpo 3 - Apoio	29.45	11.96	Asl,exist suficiente
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Meio Vão			
V60x250 Piso 5 - Alinhamentos 18, 19, 22, 23 - Corpo 3 - Apoio	44.18	26.45	Asl,exist suficiente

9.6 VERIFICAÇÃO ESTRUTURAL DE PILARES DE BETÃO ARMADO

Efeitos de 2ª Ordem

TOPO NORTE - CORPO 3 (Corpos Centrais)



Betão: C30/37
Aço: A500 NR

Efeitos globais de segunda ordem em edifícios

Pilares / Paredes	Dimensões			Baricêntricos							FV,Ed [kN]	k ₁	n _s	E _{cd} [GPa]	L [m]	Direção Y	Direção Z	Verificação
	b [m]	h [m]	Ø [m]	θ [graus]	I _y [m ⁴]	I _z [m ⁴]	I _{yz} [m ⁴]	Cos (2θ)	Sen (2θ)	I _{y'} [m ⁴]	I _{z'} [m ⁴]					$k_1 \cdot \frac{n_s}{n_s+1,6} \cdot \frac{\sum E_{cd} I_{cz}}{L^2}$ [kN]	$k_1 \cdot \frac{n_s}{n_s+1,6} \cdot \frac{\sum E_{cd} I_{cy}}{L^2}$ [kN]	
P11	0.45	1.30		11.59	8.24E-02	9.87E-03	0.00	0.9193	0.3936	7.95E-02	1.28E-02							
P11	0.45	1.30		56.15	8.24E-02	9.87E-03	0.00	-0.3795	0.9252	3.24E-02	5.99E-02							
P11	0.45	1.30		56.15	8.24E-02	9.87E-03	1.00	-0.3795	0.9252	-8.93E-01	9.85E-01							
P10	0.70	1.00		34.93	5.83E-02	2.86E-02	0.00	0.3443	0.9389	4.86E-02	3.83E-02							
P10	0.70	1.00		42.02	5.83E-02	2.86E-02	0.00	0.1038	0.9946	4.50E-02	4.19E-02							
P10	0.70	1.00		49.10	5.83E-02	2.86E-02	0.00	-0.1426	0.9898	4.13E-02	4.56E-02							
P9	0.70	1.00		16.92	5.83E-02	2.86E-02	0.00	0.8306	0.5569	5.58E-02	3.11E-02							
P9	0.70	1.00		16.92	5.83E-02	2.86E-02	0.00	0.8306	0.5569	5.58E-02	3.11E-02							
P9	0.70	1.00		16.92	5.83E-02	2.86E-02	0.00	0.8306	0.5569	5.58E-02	3.11E-02							
P9	0.70	1.00		22.28	5.83E-02	2.86E-02	0.00	0.7125	0.7017	5.41E-02	3.29E-02							
P9	0.70	1.00		22.28	5.83E-02	2.86E-02	0.00	0.7125	0.7017	5.41E-02	3.29E-02							
P9	0.70	1.00		22.28	5.83E-02	2.86E-02	0.00	0.7125	0.7017	5.41E-02	3.29E-02							
P9	0.70	1.00		27.84	5.83E-02	2.86E-02	0.00	0.5638	0.8259	5.18E-02	3.51E-02							
P9	0.70	1.00		27.84	5.83E-02	2.86E-02	0.00	0.5638	0.8259	5.18E-02	3.51E-02							
P9	0.70	1.00		27.84	5.83E-02	2.86E-02	0.00	0.5638	0.8259	5.18E-02	3.51E-02							
P9	0.70	1.00		34.93	5.83E-02	2.86E-02	0.00	0.3443	0.9389	4.86E-02	3.83E-02							
P9	0.70	1.00		34.93	5.83E-02	2.86E-02	0.00	0.3443	0.9389	4.86E-02	3.83E-02							
P9	0.70	1.00		34.93	5.83E-02	2.86E-02	0.00	0.3443	0.9389	4.86E-02	3.83E-02							
P9	0.70	1.00		42.02	5.83E-02	2.86E-02	0.00	0.1038	0.9946	4.50E-02	4.19E-02							
P9	0.70	1.00		42.02	5.83E-02	2.86E-02	0.00	0.1038	0.9946	4.50E-02	4.19E-02							
P9	0.70	1.00		42.02	5.83E-02	2.86E-02	0.00	0.1038	0.9946	4.50E-02	4.19E-02							
P9	0.70	1.00		49.10	5.83E-02	2.86E-02	0.00	-0.1426	0.9898	4.13E-02	4.56E-02							
P9	0.70	1.00		49.10	5.83E-02	2.86E-02	0.00	-0.1426	0.9898	4.13E-02	4.56E-02							
P9	0.70	1.00		49.10	5.83E-02	2.86E-02	0.00	-0.1426	0.9898	4.13E-02	4.56E-02							
P14	0.45	1.70		56.15	1.84E-01	1.29E-02	0.00	-0.3795	0.9252	6.61E-02	1.31E-01							
P14	0.45	1.70		56.15	1.84E-01	1.29E-02	0.00	-0.3795	0.9252	6.61E-02	1.31E-01							
P14	0.45	1.70		56.15	1.84E-01	1.29E-02	0.00	-0.3795	0.9252	6.61E-02	1.31E-01							
P8	0.70	1.30		16.92	1.28E-01	3.72E-02	0.00	0.8306	0.5569	1.20E-01	4.49E-02							
P7	0.70	1.40		22.28	1.60E-01	4.00E-02	0.00	0.7125	0.7017	1.43E-01	5.73E-02							
P7	0.70	1.40		27.84	1.60E-01	4.00E-02	0.00	0.5638	0.8259	1.34E-01	6.62E-02							
P7	0.70	1.40		34.93	1.60E-01	4.00E-02	0.00	0.3443	0.9389	1.21E-01	7.94E-02							
P7	0.70	1.40		42.02	1.60E-01	4.00E-02	0.00	0.1038	0.9946	1.06E-01	9.38E-02							
P7	0.70	1.40		49.10	1.60E-01	4.00E-02	0.00	-0.1426	0.9898	9.15E-02	1.09E-01							
P10B			1.00		4.91E-02	4.91E-02	0.00			4.91E-02	4.91E-02							
P10B			1.00		4.91E-02	4.91E-02	0.00			4.91E-02	4.91E-02							
P10B			1.00		4.91E-02	4.91E-02	0.00			4.91E-02	4.91E-02							
P13B			1.00		2.45E-02	2.45E-02	0.00			2.45E-02	2.45E-02							
P12	0.45	1.00		11.59	3.75E-02	7.59E-03	0.00	0.9193	0.3936	3.63E-02	8.80E-03							
P12	0.45	1.00		11.59	3.75E-02	7.59E-03	0.00	0.9193	0.3936	3.63E-02	8.80E-03							
P12	0.45	1.00		11.59	3.75E-02	7.59E-03	0.00	0.9193	0.3936	3.63E-02	8.80E-03							
					0.00E+00	0.00E+00	0.00			0.00E+00	0.00E+00							
					3.24E+00	1.10E+00		Σ =		1.44E+00	2.90E+00							

Esbelteza para elementos isolados

Elementos	Secção			A [m²]	As [cm²]	N [kN]	()	U	lo,y [m]	lo,z [m]	Φ _{ef}	Esbelteza			Verificação
	b [m]	h [m]	L [m]									λ _y	λ _z	λ _{lim}	
P11 45x130 (-3a2)	0.45	1.30	3.80	0.59	125.27	3130.4	0.4655	0.2676	3.8	3.8	0.7	29.3	10.1	47.1	Ignorar efeitos 2ª ordem
P11 45x100 (2a5)	0.45	1.00	5.50	0.45	106.42	743.8	0.5141	0.0826	5.5	5.5	0.7	42.3	19.1	86.9	Ignorar efeitos 2ª ordem
P14 45x170 (-3a2)	0.45	1.70	3.80	0.77	161.01	3479.0	0.4575	0.2274	3.8	3.8	0.7	29.3	7.7	50.9	Ignorar efeitos 2ª ordem
P14 45x135 (2a5)	0.45	1.35	5.50	0.61	125.27	1224.0	0.4483	0.1007	5.5	5.5	0.7	42.3	14.1	76.1	Ignorar efeitos 2ª ordem
P10 70x130 (-3a0)	0.70	1.30	3.00	0.91	147.65	4053.0	0.3527	0.2227	3.0	3.0	0.7	14.8	8.0	48.6	Ignorar efeitos 2ª ordem
P10 70x100 (0a5)	0.70	1.00	3.80	0.70	122.52	3659.0	0.3805	0.2614	3.8	3.8	0.7	18.8	13.2	45.5	Ignorar efeitos 2ª ordem
P9 70x100 (-3a2)	0.70	1.00	3.80	0.70	122.52	6946.0	0.3805	0.4961	3.8	3.8	0.7	18.8	13.2	33.1	Ignorar efeitos 2ª ordem
P9 70x100 (2a4)	0.70	1.00	5.50	0.70	122.52	2171.0	0.3805	0.1551	5.5	5.5	0.7	27.2	19.1	59.1	Ignorar efeitos 2ª ordem
P8 70x130 (-3a2)	0.70	1.30	3.80	0.91	141.37	1954.0	0.3377	0.1074	3.8	3.8	0.7	18.8	10.1	69.3	Ignorar efeitos 2ª ordem
P8 70x100 (2a5)	0.70	1.00	5.50	0.70	122.52	1898.0	0.3805	0.1356	5.5	5.5	0.7	27.2	19.1	63.2	Ignorar efeitos 2ª ordem
P7 70x140 (-3a2)	0.70	1.40	3.80	0.98	147.65	5776.0	0.3275	0.2947	3.8	3.8	0.7	18.8	9.4	41.6	Ignorar efeitos 2ª ordem
P7 70x140 (2a5)	0.70	1.40	5.50	0.98	147.65	4000.0	0.3275	0.2041	5.5	5.5	0.7	27.2	13.6	50.0	Ignorar efeitos 2ª ordem
P12 45x100 (-3a2)	0.45	1.00	3.80	0.45	106.42	3245.0	0.5141	0.3606	3.8	3.8	0.7	29.3	13.2	41.6	Ignorar efeitos 2ª ordem
P12 45x100 (2a5)	0.45	1.00	5.50	0.45	106.42	985.0	0.5141	0.1094	5.5	5.5	0.7	42.3	19.1	75.5	Ignorar efeitos 2ª ordem
P10B Ø100 (0a2)	Ø =	1.00	3.80	0.79	117.81	3900.0	0.3261	0.2483	3.8	3.8	0.7	15.2	15.2	45.3	Ignorar efeitos 2ª ordem
P10B Ø100 (2a5)	Ø =	1.00	5.50	0.79	117.81	3192.0	0.3261	0.2032	5.5	5.5	0.7	22.0	22.0	50.0	Ignorar efeitos 2ª ordem

Verificação Pilares



TOPO NORTE - CORPO 3 (Corpos Centrais)

Betão: C30/37
Aço: A500 NR

ESFORÇOS DE DIMENSIONAMENTO E ARMADURA EXISTENTE

Elementos	Secção										Esbelteza		Considerar efeitos 2ª Ordem?	e _{2,y}		e _{2,z}	M _{2,y}	M _{2,z}	M _{Ed,y} [*]	M _{Ed,z} [*]	NºVarões	As,off Ø	[cm²]	ρ	(t)			
	b	h	L	A _c	I _{0,y}	I _{0,z}	N _{Ed}	M _{Ed,y}	M _{Ed,z}	e _{1,y}	e _{1,z}	e ₀		M _{Ed,y}	M _{Ed,z}													
	[m]	[m]	[m]	[m²]	[m]	[m]	[kN]	[kN.m]	[kN.m]	[m]	[m]	[m]		[kN.m]	[kN.m]													
P11 45x130 (-3a2)	0.45	1.30	3.80	0.59	3.8	3.8	-1048.07	-286.96	144.66	0.010	0.010	0.000	296.92	154.62	29.3	10.1	81.5	Sim	0.0099	0.0037	10.38	3.86	307.30	158.47	14025 + 18020	125.27	2.1%	0.4655
P11 45x100 (2a5)	0.45	1.00	5.50	0.45	5.5	5.5	-576.65	-579.35	163.38	0.012	0.012	0.000	586.11	170.14	42.3	19.1	98.7	Sim	0.0152	0.0075	8.74	4.30	594.85	174.45	14025 + 12020	106.42	2.4%	0.5141
P14 45x170 (-3a2)	0.45	1.70	3.80	0.77	3.8	3.8	-2911.03	814.81	-2.29	0.010	0.010	0.000	842.46	29.94	29.3	7.7	55.7	Sim	0.0130	0.0037	37.70	10.81	880.17	40.75	20025 + 20020	161.01	2.1%	0.4575
P14 45x135 (2a5)	0.45	1.35	5.50	0.61	5.5	5.5	-236.95	597.30	-210.05	0.012	0.012	0.000	600.08	212.83	42.3	14.1	173.0	Sim	0.0205	0.0076	4.85	1.80	604.93	214.63	14025 + 18020	125.27	2.1%	0.4483
P10 70x130 (-3a0)	0.70	1.30	3.00	0.91	3.0	3.0	-638.41	337.89	-791.72	0.008	0.008	0.000	342.68	796.51	14.8	8.0	122.3	Sim	0.0065	0.0036	4.16	2.30	346.84	798.80	16025 + 22020	147.65	1.6%	0.3527
P10 70x100 (0a5)	0.70	1.00	3.80	0.70	3.8	3.8	-769.12	-974.98	363.19	0.010	0.010	0.000	982.29	370.50	18.8	13.2	99.3	Sim	0.0079	0.0057	6.10	4.36	988.38	374.85	16025 + 14020	122.52	1.8%	0.3805
P9 70x100 (-3a2)	0.70	1.00	3.80	0.70	3.8	3.8	-5900.25	596.86	1.45	0.010	0.010	0.000	652.91	57.50	18.8	13.2	35.9	Sim	0.0078	0.0055	45.73	32.68	698.65	90.18	16025 + 14020	122.52	1.8%	0.3805
P8 70x130 (-3a2)	0.70	1.30	3.80	0.91	3.8	3.8	-2621.23	-830.99	425.63	0.010	0.010	0.000	855.89	450.53	18.8	10.1	59.8	Sim	0.0103	0.0057	27.00	15.01	882.90	465.54	16025 + 20020	141.37	1.6%	0.3377
P8 70x100 (2a5)	0.70	1.00	5.50	0.70	5.5	5.5	-1032.26	-930.67	211.24	0.012	0.012	0.000	942.77	223.34	27.2	19.1	85.7	Sim	0.0161	0.0116	16.60	11.98	959.38	235.33	16025 + 14020	122.52	1.8%	0.3805
P7 70x140 (-3a2)	0.70	1.40	3.80	0.98	3.8	3.8	-1994.51	2532.26	-498.47	0.010	0.010	0.000	2551.21	517.42	18.8	9.4	70.8	Sim	0.0111	0.0057	22.13	11.45	2573.34	528.87	16025 + 22020	147.65	1.5%	0.3275
P12 45x100 (-3a2)	0.45	1.00	3.80	0.45	3.8	3.8	-341.52	-544.21	204.53	0.010	0.010	0.000	547.45	207.77	29.3	13.2	128.3	Sim	0.0076	0.0036	2.60	1.24	550.06	209.02	14025 + 12020	106.42	2.4%	0.5141
P10B Ø100 (0a5)	Ø =	1.00	3.80	0.79	3.8	3.8	-1786.33	-1118.83	630.98	0.010	0.010	0.000	1135.80	647.95	15.2	15.2	66.9	Sim	0.0080	0.0080	14.34	14.34	1150.14	662.29	24025	117.81	1.5%	0.3261
P20 40x40	0.40	0.40	3.80	0.13	3.8	3.8	-531.83	-237.43	103.21	0.010	0.010	0.000	242.48	108.26	38.0	38.0	57.9	Sim	0.0029	0.0029	1.57	1.57	244.05	109.83	12020	37.70	3.0%	0.6522

ARMADURA REQUERIDA

Elementos	Secção			A_c [m²]	N_{Ed} [kN]	$M_{Ed,y}^*$ [kN.m]	$M_{Ed,z}^*$ [kN.m]	μ_y	μ_z	ψ	ϕ	$A_{s,Totat,req}$ [cm²]	$A_{s,min}$ [cm²]	$A_{s,max}$ [cm²]	$A_{s,exist}$ [cm²]	ρ_{exist}	N_{Rd} [kN]	$M_{Rd,y}$ [kN.m]	$M_{Rd,z}$ [kN.m]	F.S.	Verificação
	b [m]	h [m]	L [m]																		
P11 45x130 (-3a2)	0.45	1.30	3.80	0.59	-1048.07	-307.30	158.47	0.0202	0.0301	0.0896	0.2700	72.66	2.41	234.00	125.27	2.1%	-5827.60	-1708.72	881.07	5.56	Verifica
P11 45x100 (2a5)	0.45	1.00	5.50	0.45	-576.65	-594.85	174.45	0.0661	0.0431	0.0641	0.2900	60.03	1.33	180.00	106.42	2.4%	-1562.00	-1611.30	472.54	2.71	Verifica
P14 45x170 (-3a2)	0.45	1.70	3.80	0.77	-2911.03	880.17	-40.75	0.0338	0.0059	0.1903	0.2400	84.46	6.70	306.00	161.01	2.1%	-12689.32	3638.71	-177.62	4.36	Verifica
P14 45x135 (2a5)	0.45	1.35	5.50	0.61	-236.95	604.93	-214.63	0.0369	0.0393	0.0195	0.2500	69.86	0.54	243.00	125.27	2.1%	-807.31	2061.04	-731.27	3.41	Verifica
P10 70x130 (-3a0)	0.70	1.30	3.00	0.91	-638.41	346.84	-798.80	0.0147	0.0627	0.0351	0.2700	113.02	1.47	364.00	147.65	1.6%	-1723.20	936.38	-2156.03	2.70	Verifica
P10 70x100 (0a5)	0.70	1.00	3.80	0.70	-769.12	-988.38	374.85	0.0706	0.0383	0.0549	0.2600	83.72	1.77	280.00	122.52	1.8%	-1722.81	-2214.01	839.53	2.24	Verifica
P9 70x100 (-3a2)	0.70	1.00	3.80	0.70	-5900.25	596.86	90.18	0.0499	0.0092	0.4214	0.2000	64.40	13.57	280.00	122.52	1.8%	-12874.52	1524.48	196.70	2.18	Verifica
P8 70x130 (-3a2)	0.70	1.30	3.80	0.91	-2621.23	-882.90	465.54	0.0373	0.0365	0.1440	0.2400	100.46	6.03	364.00	141.37	1.6%	-8709.19	-2933.49	1546.78	3.32	Verifica
P8 70x100 (2a5)	0.70	1.00	5.50	0.70	-1032.26	-959.38	235.33	0.0685	0.0240	0.0737	0.2900	93.38	2.37	280.00	122.52	1.8%	-2759.27	-2564.52	628.85	2.67	Verifica
P7 70x140 (-3a2)	0.70	1.40	3.80	0.98	-1994.51	2573.34	-528.87	0.0938	0.0385	0.1018	0.2700	121.72	4.59	392.00	147.65	1.5%	-3357.64	4332.15	-899.96	1.68	Verifica
P12 45x100 (-3a2)	0.45	1.00	3.80	0.45	-341.52	-550.06	209.02	0.0611	0.0516	0.0379	0.2400	49.68	0.79	180.00	106.42	2.4%	-877.14	-1412.74	536.84	2.57	Verifica
P10B Ø100 (0a5)	Ø =	1.00	3.80	0.79	-1786.33	-1150.14	662.29	0.0732	0.0422	0.1137	0.2300	83.10	4.11	314.16	117.81	1.5%	-3436.23	-2212.44	1274.00	1.92	Verifica
P20 40x40	0.40	0.40	3.80	0.13	-531.83	-244.05	109.83	0.1907	0.0858	0.2116	0.5000	28.90	1.22	50.27	37.70	3.0%	-540.83	-244.05	109.83	1.02	Verifica

As Transversal

Elementos	Vy [kN]	Vz [kN]	CRd,c	Ky	Kz	ρl	σcp [MPa]	α	θ	Asw,min,y [cm²/m]	Asw,min,z [cm²/m]	Cintas existentes										Asw/s,y [kN]	Asw/s,z [kN]	VRd,c,y [kN]	VRd,c,z [kN]	VRd,s,y [kN]								
												Ramos,y					Ramos,z																	
P11 45x130 (-3a2)	167	219	0.12	1.70	1.41	2.4%	0.0	90	30	10.18	3.53	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	446.3	370.4	1513.18
P11 45x100 (2a5)	191	254	0.12	1.70	1.47	2.6%	0.0	90	30	7.83	3.53	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	354.8	306.6	1163.99
P14 45x170 (-3a2)	124	325	0.12	1.70	1.36	2.3%	0.0	90	30	13.32	3.53	2	Ø10	afast.	0.150 m	+	4	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	23.88	17.17	580.2	464.0	2750.98
P14 45x135 (2a5)	47	156	0.12	1.70	1.41	2.3%	0.0	90	30	10.58	3.53	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	457.6	377.8	1571.38
P10 70x130 (-3a0)	862	406	0.12	1.56	1.41	1.8%	0.0	90	30	10.18	5.48	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	581.1	525.3	1513.18
P10 70x100 (0a5)	228	243	0.12	1.56	1.47	1.9%	0.0	90	30	7.83	5.48	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	458.4	431.4	1163.99
P9 70x100 (-3a2)	199	270	0.12	1.56	1.47	1.9%	0.0	90	30	7.83	5.48	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	458.4	431.4	1163.99
P8 70x130 (-3a2)	607	444	0.12	1.56	1.41	1.7%	0.0	90	30	10.18	5.48	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	572.7	517.8	1513.18
P8 70x100 (2a5)	125	225	0.12	1.56	1.47	1.9%	0.0	90	30	7.83	5.48	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	458.4	431.4	1163.99
P7 70x140 (-3a2)	207	508	0.12	1.56	1.40	1.7%	0.0	90	30	10.97	5.48	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	610.5	546.1	1629.58
P12 45x100 (-3a2)	126	194	0.12	1.70	1.47	2.6%	0.0	90	30	7.83	3.53	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	2	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	17.17	17.17	354.8	306.6	1163.99
P10B Ø100 (0a5)	335	294	0.12	1.47	1.47	1.3%	0.0	90	30	7.83	7.83	1	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	1	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	11.94	13.82	540.1	540.1	809.11
P20 40x40	105	123	0.12	1.75	1.75	2.6%	0.0	90	30	3.13	3.13	0	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	0	Ø10	afast.	0.150 m	+	2	Ø8	afast.	0.150 m	6.70	10.47	129.2	129.2	181.70

CORPO 3

Betão	C30/37		Es	200	Gpa
Aço	A500 NR		cs	2.00E-03	
Rec.	3.0	cm			

Pilar			b (m)	h (m)	qt.	Armadura					ρ	N _{Ed} (kN)	Espess. a sacrif (mm)				a (mm)	Temp. das armaduras (° C)				Fator de redução				fs,θ _{R30}	fs,θ _{R60}	fs,θ _{R90}	fs,θ _{R120}	N _{Rd,fi} (R30)	N _{Rd,fi} (R60)	N _{Rd,fi} (R90)	N _{Rd,fi} (R120)	OBSERVAÇÃO
						Ø (mm)	+	qt.	Ø (mm)	(cm²)			R30	R60	R90	R120		θ _{R30}	θ _{R60}	θ _{R90}	θ _{R120}	k (R30)	k (R60)	k (R90)	k (R120)	(Mpa)	(Mpa)	(Mpa)	(Mpa)	(kN)	(kN)	(kN)	(kN)	
P1	Alinhamento B e D	Pisos 6 a 8	0.70	1.00	12	25	+	18	20	115.45	1.65%	1143	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	21679.7	20859.7	18955.4	16067.1	Verifica
P1	Alinhamento B e D	Pisos 3 a 6	0.70	1.35	16	25	+	20	20	141.37	1.50%	3311	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	28756.6	27761.6	25434.3	21897.8	Verifica
P1	Alinhamento B e D	Pisos 0 a 3	0.70	1.70	22	25	+	22	20	177.11	1.49%	5205	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	36260.3	35090.3	32246.2	27882.1	Verifica
P1	Alinhamento B e D	Pisos -3 a 0	0.70	1.70	22	25	+	22	20	177.11	1.49%	5205	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	36260.3	35090.3	32246.2	27882.1	Verifica
P1	Alinhamento C	Pisos 6 a 8	0.70	1.00	12	25	+	18	20	115.45	1.65%	1143	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	21679.7	20859.7	18955.4	16067.1	Verifica
P1	Alinhamento C	Pisos 3 a 6	0.70	1.35	16	25	+	20	20	141.37	1.50%	3311	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	28756.6	27761.6	25434.3	21897.8	Verifica
P1	Alinhamento C	Pisos 0 a 3	0.70	1.70	22	25	+	22	20	177.11	1.49%	5205	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	36260.3	35090.3	32246.2	27882.1	Verifica
P1	Alinhamento C	Pisos -3 a 0	0.70	1.70	22	25	+	22	20	177.11	1.49%	5205	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	36260.3	35090.3	32246.2	27882.1	Verifica
P2	Alinhamento A	Pisos 6 a 8	0.70	0.60	12	25	+	10	20	90.32	2.15%	614	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	13787.0	13167.0	11703.1	9473.7	Verifica
P2	Alinhamento A	Pisos 3 a 6	0.70	0.80	12	25	+	14	20	102.89	1.84%	1794	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	17733.4	17013.4	15329.2	12770.4	Verifica
P2	Alinhamento A	Pisos 0 a 3	0.70	1.30	16	25	+	20	20	141.37	1.55%	3102	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	27906.6	26936.6	24634.3	21122.8	Verifica
P2	Alinhamento A	Pisos -3 a 0	0.70	1.30	16	25	+	20	20	141.37	1.55%	2674	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	27906.6	26936.6	24634.3	21122.8	Verifica
P2	Alinhamento E - Alinhamento B e D	Pisos 6 a 8	0.70	0.60	12	25	+	10	20	90.32	2.15%	614	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	13787.0	13167.0	11703.1	9473.7	Verifica
P2	Alinhamento E - Alinhamento B e D	Pisos 3 a 6	0.70	0.80	12	25	+	14	20	102.89	1.84%	1794	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	17733.4	17013.4	15329.2	12770.4	Verifica
P2	Alinhamento E - Alinhamento B e D	Pisos 0 a 3	0.70	1.30	16	25	+	20	20	141.37	1.55%	3102	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	27906.6	26936.6	24634.3	21122.8	Verifica
P2	Alinhamento E - Alinhamento B e D	Pisos -3 a 0	0.70	1.30	16	25	+	20	20	141.37	1.55%	2674	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	27906.6	26936.6	24634.3	21122.8	Verifica
P2	Alinhamento E - Alinhamento B e D	Pisos 6 a 8	0.70	0.60	12	25	+	10	20	90.32	2.15%	614	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	13787.0	13167.0	11703.1	9473.7	Verifica
P2	Alinhamento E - Alinhamento B e D	Pisos 3 a 6	0.70	0.80	12	25	+	14	20	102.89	1.84%	1794	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	17733.4	17013.4	15329.2	12770.4	Verifica
P3		Pisos 6 a 8	0.45	1.00	10	25	+	16	20	99.35	2.21%	560	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	14854.7	14159.7	12534.4	10065.1	Verifica
P3		Pisos 3 a 6	0.45	1.35	14	25	+	18	20	125.27	2.06%	1570	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	19744.1	18874.1	16825.8	13708.3	Verifica
P3		Pisos 0 a 3	0.45	1.70	20	25	+	20	20	161.01	2.10%	2627	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	25060.3	24015.3	21450.2	17505.1	Verifica
P3		Pisos -3 a 0	0.45	1.70	20	25	+	20	20	161.01	2.10%	3617	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	25060.3	24015.3	21450.2	17505.1	Verifica
P4		Pisos 6 a 8	0.45	0.60	10	25	+	8	20	74.22	2.75%	330	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	9462.0	8967.0	7782.0	5971.7	Verifica
P4		Pisos 3 a 6	0.45	0.80	10	25	+	12	20	86.79	2.41%	955	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	12158.3	11563.3	10158.2	8018.4	Verifica
P4		Pisos 0 a 3	0.45	1.30	14	25	+	18	20	125.27	2.14%	1652	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	19206.6	18361.6	16338.3	13245.8	Verifica
P4		Pisos -3 a 0	0.45	1.30	14	25	+	18	20	125.27	2.14%	1486	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	19206.6	18361.6	16338.3	13245.8	Verifica
P5		Pisos 6 a 8	0.45	1.00	10	25	+	16	20	99.35	2.21%	470	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	14854.7	14159.7	12534.4	10065.1	Verifica
P5		Pisos 3 a 6	0.45	1.35	14	25	+	18	20	125.27	2.06%	1330	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	19744.1	18874.1	16825.8	13708.3	Verifica
P5		Pisos 0 a 3	0.45	1.70	20	25	+	20	20	161.01	2.10%	2238	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	25060.3	24015.3	21450.2	17505.1	Verifica
P5		Pisos -3 a 0	0.45	1.70	20	25	+	20	20	161.01	2.10%	1856	10	20	30	40	50	180	400	500	650	1.00	1.00	0.78	0.36	500	500	390	180	25060.3	24015.3	21450.2	17505.1	Verifica

9.7 VERIFICAÇÃO ESTRUTURAL DE FUNDAÇÕES

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 16 - Verificação da Rotura do sol de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	Q _{seg}	Hmin	ex	ey	B´	L´	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)		
P12	al B al 16a-16b	S6	177 (C)	0.90	1.00	3 959.6			4.00	4.00	1.30	716.3	4 675.9	400	1.02	0.000	0.000	3.42	3.42	Verifica	292.2	1.37	Verifica
P12	al B al 16a-16b	S6	178 (C)	0.90	1.00	4 069.8			4.00	4.00	1.30	716.3	4 786.1	400	1.03	0.000	0.000	3.46	3.46	Verifica	299.1	1.34	Verifica
P12	al B al 16a-16b	S6	179 (C)	0.90	1.00	3 968.6			4.00	4.00	1.30	716.3	4 684.9	400	1.02	0.000	0.000	3.42	3.42	Verifica	292.8	1.37	Verifica
P12	al B al 16a-16b	S6	180 (C)	0.90	1.00	3 964.4			4.00	4.00	1.30	716.3	4 680.7	400	1.02	0.000	0.000	3.42	3.42	Verifica	292.5	1.37	Verifica
P12	al B al 16a-16b	S6	181 (C)	0.90	1.00	3 955.7			4.00	4.00	1.30	716.3	4 672.0	400	1.01	0.000	0.000	3.42	3.42	Verifica	292.0	1.37	Verifica
P12	al B al 16a-16b	S6	182 (C)	0.90	1.00	3 915.3			4.00	4.00	1.30	716.3	4 631.6	400	1.01	0.000	0.000	3.40	3.40	Verifica	289.5	1.38	Verifica
P12	al B al 16a-16b	S6	183 (C)	0.90	1.00	4 078.8			4.00	4.00	1.30	716.3	4 795.1	400	1.03	0.000	0.000	3.46	3.46	Verifica	299.7	1.33	Verifica
P12	al B al 16a-16b	S6	184 (C)	0.90	1.00	4 074.6			4.00	4.00	1.30	716.3	4 790.9	400	1.03	0.000	0.000	3.46	3.46	Verifica	299.4	1.34	Verifica
P12	al B al 16a-16b	S6	185 (C)	0.90	1.00	4 065.9			4.00	4.00	1.30	716.3	4 782.2	400	1.03	0.000	0.000	3.46	3.46	Verifica	298.9	1.34	Verifica
P12	al B al 16a-16b	S6	186 (C)	0.90	1.00	4 025.5			4.00	4.00	1.30	716.3	4 741.8	400	1.02	0.000	0.000	3.44	3.44	Verifica	296.4	1.35	Verifica
P12	al B al 16a-16b	S6	187 (C)	0.90	1.00	3 298.2			4.00	4.00	1.30	716.3	4 014.5	400	0.94	0.000	0.000	3.17	3.17	Verifica	250.9	1.59	Verifica
P12	al B al 16a-16b	S6	188 (C)	0.90	1.00	3 871.3			4.00	4.00	1.30	716.3	4 587.6	400	1.01	0.000	0.000	3.39	3.39	Verifica	286.7	1.40	Verifica
P12	al B al 16a-16b	S6	189 (C)	0.90	1.00	3 307.2			4.00	4.00	1.30	716.3	4 023.5	400	0.94	0.000	0.000	3.17	3.17	Verifica	251.5	1.59	Verifica
P12	al B al 16a-16b	S6	190 (C)	0.90	1.00	3 303.0			4.00	4.00	1.30	716.3	4 019.3	400	0.94	0.000	0.000	3.17	3.17	Verifica	251.2	1.59	Verifica
P12	al B al 16a-16b	S6	191 (C)	0.90	1.00	3 294.4			4.00	4.00	1.30	716.3	4 010.7	400	0.94	0.000	0.000	3.17	3.17	Verifica	250.7	1.60	Verifica
P12	al B al 16a-16b	S6	192 (C)	0.90	1.00	3 254.0			4.00	4.00	1.30	716.3	3 970.3	400	0.94	0.000	0.000	3.15	3.15	Verifica	248.1	1.61	Verifica
P12	al B al 16a-16b	S6	193 (C)	0.90	1.00	3 880.3			4.00	4.00	1.30	716.3	4 596.6	400	1.01	0.000	0.000	3.39	3.39	Verifica	287.3	1.39	Verifica
P12	al B al 16a-16b	S6	194 (C)	0.90	1.00	3 876.1			4.00	4.00	1.30	716.3	4 592.4	400	1.01	0.000	0.000	3.39	3.39	Verifica	287.0	1.39	Verifica
P12	al B al 16a-16b	S6	195 (C)	0.90	1.00	3 867.6			4.00	4.00	1.30	716.3	4 583.9	400	1.01	0.000	0.000	3.39	3.39	Verifica	286.5	1.40	Verifica
P12	al B al 16a-16b	S6	196 (C)	0.90	1.00	3 827.1			4.00	4.00	1.30	716.3	4 543.4	400	1.00	0.000	0.000	3.37	3.37	Verifica	284.0	1.41	Verifica
P12	al B al 16a-16b	S6	197 (C)	0.90	1.00	3 179.0			4.00	4.00	1.30	716.3	3 895.3	400	0.93	0.000	0.000	3.12	3.12	Verifica	243.5	1.64	Verifica
P12	al B al 16a-16b	S6	198 (C)	0.90	1.00	3 752.1			4.00	4.00	1.30	716.3	4 468.4	400	0.99	0.000	0.000	3.34	3.34	Verifica	279.3	1.43	Verifica
P12	al B al 16a-16b	S6	199 (C)	0.90	1.00	3 289.1			4.00	4.00	1.30	716.3	4 005.4	400	0.94	0.000	0.000	3.16	3.16	Verifica	250.3	1.60	Verifica
P12	al B al 16a-16b	S6	200 (C)	0.90	1.00	3 188.0			4.00	4.00	1.30	716.3	3 904.3	400	0.93	0.000	0.000	3.12	3.12	Verifica	244.0	1.64	Verifica
P12	al B al 16a-16b	S6	201 (C)	0.90	1.00	3 183.8			4.00	4.00	1.30	716.3	3 900.1	400	0.93	0.000	0.000	3.12	3.12	Verifica	243.8	1.64	Verifica
P12	al B al 16a-16b	S6	202 (C)	0.90	1.00	3 175.2			4.00	4.00	1.30	716.3	3 891.5	400	0.93	0.000	0.000	3.12	3.12	Verifica	243.2	1.64	Verifica
P12	al B al 16a-16b	S6	203 (C)	0.90	1.00	3 134.8			4.00	4.00	1.30	716.3	3 851.1	400	0.92	0.000	0.000	3.10	3.10	Verifica	240.7	1.66	Verifica
P12	al B al 16a-16b	S6	204 (C)	0.90	1.00	3 862.3			4.00	4.00	1.30	716.3	4 578.6	400	1.00	0.000	0.000	3.38	3.38	Verifica	286.2	1.40	Verifica
P12	al B al 16a-16b	S6	205 (C)	0.90	1.00	3 761.1			4.00	4.00	1.30	716.3	4 477.4	400	0.99	0.000	0.000	3.35	3.35	Verifica	279.8	1.43	Verifica
P12	al B al 16a-16b	S6	206 (C)	0.90	1.00	3 757.0			4.00	4.00	1.30	716.3	4 473.3	400	0.99	0.000	0.000	3.34	3.34	Verifica	279.6	1.43	Verifica
P12	al B al 16a-16b	S6	207 (C)	0.90	1.00	3 748.3			4.00	4.00	1.30	716.3	4 464.6	400	0.99	0.000	0.000	3.34	3.34	Verifica	279.0	1.43	Verifica
P12	al B al 16a-16b	S6	208 (C)	0.90	1.00	3 707.9			4.00	4.00	1.30	716.3	4 424.2	400	0.99	0.000	0.000	3.33	3.33	Verifica	276.5	1.45	Verifica
P12	al B al 16a-16b	S6	209 (C)	0.90	1.00	3 298.1			4.00	4.00	1.30	716.3	4 014.4	400	0.94	0.000	0.000	3.17	3.17	Verifica	250.9	1.59	Verifica
P12	al B al 16a-16b	S6	210 (C)	0.90	1.00	3 293.9			4.00	4.00	1.30	716.3	4 010.2	400	0.94	0.000	0.000	3.17	3.17	Verifica	250.6	1.60	Verifica
P12	al B al 16a-16b	S6	211 (C)	0.90	1.00	3 285.4			4.00	4.00	1.30	716.3	4 001.7	400	0.94	0.000	0.000	3.16	3.16	Verifica	250.1	1.60	Verifica
P12	al B al 16a-16b	S6	212 (C)	0.90	1.00	3 244.9			4.00	4.00	1.30	716.3	3 961.2	400	0.93	0.000	0.000	3.15	3.15	Verifica	247.6	1.62	Verifica
P12	al B al 16a-16b	S6	213 (C)	0.90	1.00	3 871.3			4.00	4.00	1.30	716.3	4 587.6	400	1.01	0.000	0.000	3.39	3.39	Verifica	286.7	1.40	Verifica
P12																							

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcđ	fctm	fyk	fyđ
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 16 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	As,cal/s	Ø	As,ef/s	FS	(kN)	(cm2)	As/s	Ø	As,ef/s		FS	
P12	al B al 16a-16b	S6	105 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5637.9	967.0	6604.9	0.000	0.000	2132.8	49.06	12.91	Ø20//0.15	20.93	1.62	2064.0	47.47	12.17	Ø20//0.15	20.93	1.72	Verifica
P12	al B al 16a-16b	S6	106 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5486.1	967.0	6453.1	0.000	0.000	2083.8	47.93	12.61	Ø20//0.15	20.93	1.66	2016.6	46.38	11.89	Ø20//0.15	20.93	1.76	Verifica
P12	al B al 16a-16b	S6	107 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5479.8	967.0	6446.8	0.000	0.000	2081.8	47.88	12.60	Ø20//0.15	20.93	1.66	2014.6	46.34	11.88	Ø20//0.15	20.93	1.76	Verifica
P12	al B al 16a-16b	S6	108 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5466.9	967.0	6433.9	0.000	0.000	2077.6	47.79	12.58	Ø20//0.15	20.93	1.66	2010.6	46.24	11.86	Ø20//0.15	20.93	1.77	Verifica
P12	al B al 16a-16b	S6	109 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5406.2	967.0	6373.2	0.000	0.000	2058.0	47.33	12.46	Ø20//0.15	20.93	1.68	1991.6	45.81	11.75	Ø20//0.15	20.93	1.78	Verifica
P12	al B al 16a-16b	S6	110 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5651.3	967.0	6618.3	0.000	0.000	2137.2	49.15	12.94	Ø20//0.15	20.93	1.62	2068.2	47.57	12.20	Ø20//0.15	20.93	1.72	Verifica
P12	al B al 16a-16b	S6	111 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5645.1	967.0	6612.1	0.000	0.000	2135.2	49.11	12.92	Ø20//0.15	20.93	1.62	2066.3	47.52	12.19	Ø20//0.15	20.93	1.72	Verifica
P12	al B al 16a-16b	S6	112 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5632.1	967.0	6599.1	0.000	0.000	2131.0	49.01	12.90	Ø20//0.15	20.93	1.62	2062.2	47.43	12.16	Ø20//0.15	20.93	1.72	Verifica
P12	al B al 16a-16b	S6	113 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5571.4	967.0	6538.4	0.000	0.000	2111.4	48.56	12.78	Ø20//0.15	20.93	1.64	2043.3	46.99	12.05	Ø20//0.15	20.93	1.74	Verifica
P12	al B al 16a-16b	S6	114 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3376.9	967.0	4343.9	0.000	0.000	1402.7	32.26	8.49	Ø20//0.15	20.93	2.47	1357.5	31.22	8.01	Ø20//0.15	20.93	2.61	Verifica
P12	al B al 16a-16b	S6	115 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4236.6	967.0	5203.6	0.000	0.000	1680.3	38.65	10.17	Ø20//0.15	20.93	2.06	1626.1	37.40	9.59	Ø20//0.15	20.93	2.18	Verifica
P12	al B al 16a-16b	S6	116 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3390.4	967.0	4357.4	0.000	0.000	1407.1	32.36	8.52	Ø20//0.15	20.93	2.46	1361.7	31.32	8.03	Ø20//0.15	20.93	2.61	Verifica
P12	al B al 16a-16b	S6	117 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3384.1	967.0	4351.1	0.000	0.000	1405.0	32.32	8.50	Ø20//0.15	20.93	2.46	1359.7	31.27	8.02	Ø20//0.15	20.93	2.61	Verifica
P12	al B al 16a-16b	S6	118 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3371.2	967.0	4338.2	0.000	0.000	1400.9	32.22	8.48	Ø20//0.15	20.93	2.47	1355.7	31.18	8.00	Ø20//0.15	20.93	2.62	Verifica
P12	al B al 16a-16b	S6	119 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3310.5	967.0	4277.5	0.000	0.000	1381.3	31.77	8.36	Ø20//0.15	20.93	2.50	1336.7	30.74	7.88	Ø20//0.15	20.93	2.66	Verifica
P12	al B al 16a-16b	S6	120 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4250.0	967.0	5217.0	0.000	0.000	1684.7	38.75	10.20	Ø20//0.15	20.93	2.05	1630.3	37.50	9.61	Ø20//0.15	20.93	2.18	Verifica
P12	al B al 16a-16b	S6	121 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4243.8	967.0	5210.8	0.000	0.000	1682.7	38.70	10.18	Ø20//0.15	20.93	2.06	1628.4	37.45	9.60	Ø20//0.15	20.93	2.18	Verifica
P12	al B al 16a-16b	S6	122 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4230.9	967.0	5197.9	0.000	0.000	1678.5	38.61	10.16	Ø20//0.15	20.93	2.06	1624.3	37.36	9.58	Ø20//0.15	20.93	2.18	Verifica
P12	al B al 16a-16b	S6	123 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4170.2	967.0	5137.2	0.000	0.000	1658.9	38.15	10.04	Ø20//0.15	20.93	2.08	1605.4	36.92	9.47	Ø20//0.15	20.93	2.21	Verifica
P12	al B al 16a-16b	S6	124 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4301.7	967.0	5268.7	0.000	0.000	1701.4	39.13	10.30	Ø20//0.15	20.93	2.03	1646.5	37.87	9.71	Ø20//0.15	20.93	2.16	Verifica
P12	al B al 16a-16b	S6	125 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5161.4	967.0	6128.4	0.000	0.000	1979.0	45.52	11.98	Ø20//0.15	20.93	1.75	1915.1	44.05	11.29	Ø20//0.15	20.93	1.85	Verifica
P12	al B al 16a-16b	S6	126 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4466.9	967.0	5433.9	0.000	0.000	1754.7	40.36	10.62	Ø20//0.15	20.93	1.97	1698.1	39.06	10.01	Ø20//0.15	20.93	2.09	Verifica
P12	al B al 16a-16b	S6	127 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4315.1	967.0	5282.1	0.000	0.000	1705.7	39.23	10.32	Ø20//0.15	20.93	2.03	1650.7	37.97	9.73	Ø20//0.15	20.93	2.15	Verifica
P12	al B al 16a-16b	S6	128 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4308.9	967.0	5275.9	0.000	0.000	1703.7	39.18	10.31	Ø20//0.15	20.93	2.03	1648.7	37.92	9.72	Ø20//0.15	20.93	2.15	Verifica
P12	al B al 16a-16b	S6	129 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4296.0	967.0	5263.0	0.000	0.000	1699.5	39.09	10.29	Ø20//0.15	20.93	2.03	1644.7	37.83	9.70	Ø20//0.15	20.93	2.16	Verifica
P12	al B al 16a-16b	S6	130 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4235.3	967.0	5202.3	0.000	0.000	1679.9	38.64	10.17	Ø20//0.15	20.93	2.06	1625.7	37.39	9.59	Ø20//0.15	20.93	2.18	Verifica
P12	al B al 16a-16b	S6	131 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5326.6	967.0	6293.6	0.000	0.000	2032.3	46.74	12.30	Ø20//0.15	20.93	1.70	1966.8	45.24	11.60	Ø20//0.15	20.93	1.80	Verifica
P12	al B al 16a-16b	S6	132 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5174.8	967.0	6141.8	0.000	0.000	1983.3	45.62	12.00	Ø20//0.15	20.93	1.74	1919.3	44.14	11.32	Ø20//0.15	20.93	1.85	Verifica
P12	al B al 16a-16b	S6	133 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5168.6	967.0	6135.6	0.000	0.000	1981.3	45.57	11.99	Ø20//0.15	20.93	1.75	1917.4	44.10	11.31	Ø20//0.15	20.93	1.85	Verifica
P12	al B al 16a-16b	S6	134 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5155.7	967.0	6122.7	0.000	0.000	1977.1	45.47	11.97	Ø20//0.15	20.93	1.75	1913.3	44.01	11.28	Ø20//0.15	20.93	1.85	Verifica
P12	al B al 16a-16b	S6	135 (C)	0.90	1.00																						

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 16 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	Q _{seg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m ²)	(kN)	(kNm)	(kNm)	(kN)		(m)		(m)	(kN/m ²)		(cm2/m)		
P12	al B al 16a-16b	S6	105 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	413	6 604.9			1590.5	0.000	0.000	1.00	552.0	1.41	20.93	20.93	0.002	1173.5	2.1	Verifica
P12	al B al 16a-16b	S6	106 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	403	6 453.1			1549.6	0.000	0.000	1.00	539.8	1.41	20.93	20.93	0.002	1173.5	2.2	Verifica
P12	al B al 16a-16b	S6	107 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	403	6 446.8			1547.9	0.000	0.000	1.00	539.3	1.41	20.93	20.93	0.002	1173.5	2.2	Verifica
P12	al B al 16a-16b	S6	108 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	402	6 433.9			1544.4	0.000	0.000	1.00	538.3	1.41	20.93	20.93	0.002	1173.5	2.2	Verifica
P12	al B al 16a-16b	S6	109 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	398	6 373.2			1528.0	0.000	0.000	1.00	533.4	1.41	20.93	20.93	0.002	1173.5	2.2	Verifica
P12	al B al 16a-16b	S6	110 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	414	6 618.3			1594.1	0.000	0.000	1.00	553.1	1.41	20.93	20.93	0.002	1173.5	2.1	Verifica
P12	al B al 16a-16b	S6	111 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	413	6 612.1			1592.4	0.000	0.000	1.00	552.6	1.41	20.93	20.93	0.002	1173.5	2.1	Verifica
P12	al B al 16a-16b	S6	112 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	412	6 599.1			1588.9	0.000	0.000	1.00	551.5	1.41	20.93	20.93	0.002	1173.5	2.1	Verifica
P12	al B al 16a-16b	S6	113 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	409	6 538.4			1572.5	0.000	0.000	1.00	546.7	1.41	20.93	20.93	0.002	1173.5	2.1	Verifica
P12	al B al 16a-16b	S6	114 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	271	4 343.9			981.3	0.000	0.000	1.00	370.2	1.41	20.93	20.93	0.002	1173.5	3.2	Verifica
P12	al B al 16a-16b	S6	115 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	325	5 203.6			1212.9	0.000	0.000	1.00	439.3	1.41	20.93	20.93	0.002	1173.5	2.7	Verifica
P12	al B al 16a-16b	S6	116 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	272	4 357.4			984.9	0.000	0.000	1.00	371.3	1.41	20.93	20.93	0.002	1173.5	3.2	Verifica
P12	al B al 16a-16b	S6	117 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	272	4 351.1			983.2	0.000	0.000	1.00	370.8	1.41	20.93	20.93	0.002	1173.5	3.2	Verifica
P12	al B al 16a-16b	S6	118 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	271	4 338.2			979.7	0.000	0.000	1.00	369.7	1.41	20.93	20.93	0.002	1173.5	3.2	Verifica
P12	al B al 16a-16b	S6	119 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	267	4 277.5			963.4	0.000	0.000	1.00	364.8	1.41	20.93	20.93	0.002	1173.5	3.2	Verifica
P12	al B al 16a-16b	S6	120 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	326	5 217.0			1216.5	0.000	0.000	1.00	440.4	1.41	20.93	20.93	0.002	1173.5	2.7	Verifica
P12	al B al 16a-16b	S6	121 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	326	5 210.8			1214.8	0.000	0.000	1.00	439.9	1.41	20.93	20.93	0.002	1173.5	2.7	Verifica
P12	al B al 16a-16b	S6	122 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	325	5 197.9			1211.4	0.000	0.000	1.00	438.9	1.41	20.93	20.93	0.002	1173.5	2.7	Verifica
P12	al B al 16a-16b	S6	123 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	321	5 137.2			1195.0	0.000	0.000	1.00	434.0	1.41	20.93	20.93	0.002	1173.5	2.7	Verifica
P12	al B al 16a-16b	S6	124 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	329	5 268.7			1230.4	0.000	0.000	1.00	444.6	1.41	20.93	20.93	0.002	1173.5	2.6	Verifica
P12	al B al 16a-16b	S6	125 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	383	6 128.4			1462.1	0.000	0.000	1.00	513.7	1.41	20.93	20.93	0.002	1173.5	2.3	Verifica
P12	al B al 16a-16b	S6	126 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	340	5 433.9			1274.9	0.000	0.000	1.00	457.8	1.41	20.93	20.93	0.002	1173.5	2.6	Verifica
P12	al B al 16a-16b	S6	127 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	330	5 282.1			1234.0	0.000	0.000	1.00	445.6	1.41	20.93	20.93	0.002	1173.5	2.6	Verifica
P12	al B al 16a-16b	S6	128 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	330	5 275.9			1232.4	0.000	0.000	1.00	445.1	1.41	20.93	20.93	0.002	1173.5	2.6	Verifica
P12	al B al 16a-16b	S6	129 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	329	5 263.0			1228.9	0.000	0.000	1.00	444.1	1.41	20.93	20.93	0.002	1173.5	2.6	Verifica
P12	al B al 16a-16b	S6	130 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	325	5 202.3			1212.5	0.000	0.000	1.00	439.2	1.41	20.93	20.93	0.002	1173.5	2.7	Verifica
P12	al B al 16a-16b	S6	131 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	393	6 293.6			1506.6	0.000	0.000	1.00	527.0	1.41	20.93	20.93	0.002	1173.5	2.2	Verifica
P12	al B al 16a-16b	S6	132 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	384	6 141.8			1465.7	0.000	0.000	1.00	514.8	1.41	20.93	20.93	0.002	1173.5	2.3	Verifica
P12	al B al 16a-16b	S6	133 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	383	6 135.6			1464.0	0.000	0.000	1.00	514.3	1.41	20.93	20.93	0.002	1173.5	2.3	Verifica
P12	al B al 16a-16b	S6	134 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	383	6 122.7			1460.5	0.000	0.000	1.00	513.2	1.41	20.93	20.93	0.002	1173.5	2.3	Verifica
P12	al B al 16a-16b	S6	135 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	379	6 062.0			1444.2	0.000	0.000	1.00	508.4	1.41	20.93	20.93	0.002	1173.5	2.3	Verifica
P12	al B al 16a-16b	S6	136 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	394	6 307.1			1510.2	0.000	0.000	1.00	528.1	1.41	20.93	20.93	0.002	1173.5	2.2	Verifica
P12	al B al 16a-16b	S6	137 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	394															

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 16 - Verificação da Rotura do sol de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'	L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)		
P12	al C al 16a-16b	S6	177 (C)	0.90	1.00	4 497.7			4.00	4.00	1.30	716.3	5 214.0	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.9	1.23	Verifica
P12	al C al 16a-16b	S6	178 (C)	0.90	1.00	4 689.3			4.00	4.00	1.30	716.3	5 405.6	400	1.09	0.000	0.000	3.68	3.68	Verifica	337.9	1.18	Verifica
P12	al C al 16a-16b	S6	179 (C)	0.90	1.00	4 498.4			4.00	4.00	1.30	716.3	5 214.7	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.9	1.23	Verifica
P12	al C al 16a-16b	S6	180 (C)	0.90	1.00	4 496.3			4.00	4.00	1.30	716.3	5 212.6	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.8	1.23	Verifica
P12	al C al 16a-16b	S6	181 (C)	0.90	1.00	4 495.8			4.00	4.00	1.30	716.3	5 212.1	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.8	1.23	Verifica
P12	al C al 16a-16b	S6	182 (C)	0.90	1.00	4 498.9			4.00	4.00	1.30	716.3	5 215.2	400	1.07	0.000	0.000	3.61	3.61	Verifica	326.0	1.23	Verifica
P12	al C al 16a-16b	S6	183 (C)	0.90	1.00	4 690.0			4.00	4.00	1.30	716.3	5 406.3	400	1.09	0.000	0.000	3.68	3.68	Verifica	337.9	1.18	Verifica
P12	al C al 16a-16b	S6	184 (C)	0.90	1.00	4 687.9			4.00	4.00	1.30	716.3	5 404.2	400	1.09	0.000	0.000	3.68	3.68	Verifica	337.8	1.18	Verifica
P12	al C al 16a-16b	S6	185 (C)	0.90	1.00	4 687.4			4.00	4.00	1.30	716.3	5 403.7	400	1.09	0.000	0.000	3.68	3.68	Verifica	337.7	1.18	Verifica
P12	al C al 16a-16b	S6	186 (C)	0.90	1.00	4 690.5			4.00	4.00	1.30	716.3	5 406.8	400	1.09	0.000	0.000	3.68	3.68	Verifica	337.9	1.18	Verifica
P12	al C al 16a-16b	S6	187 (C)	0.90	1.00	3 857.1			4.00	4.00	1.30	716.3	4 573.4	400	1.00	0.000	0.000	3.38	3.38	Verifica	285.8	1.40	Verifica
P12	al C al 16a-16b	S6	188 (C)	0.90	1.00	4 497.0			4.00	4.00	1.30	716.3	5 213.3	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.8	1.23	Verifica
P12	al C al 16a-16b	S6	189 (C)	0.90	1.00	3 857.9			4.00	4.00	1.30	716.3	4 574.2	400	1.00	0.000	0.000	3.38	3.38	Verifica	285.9	1.40	Verifica
P12	al C al 16a-16b	S6	190 (C)	0.90	1.00	3 855.8			4.00	4.00	1.30	716.3	4 572.1	400	1.00	0.000	0.000	3.38	3.38	Verifica	285.8	1.40	Verifica
P12	al C al 16a-16b	S6	191 (C)	0.90	1.00	3 855.3			4.00	4.00	1.30	716.3	4 571.6	400	1.00	0.000	0.000	3.38	3.38	Verifica	285.7	1.40	Verifica
P12	al C al 16a-16b	S6	192 (C)	0.90	1.00	3 858.4			4.00	4.00	1.30	716.3	4 574.7	400	1.00	0.000	0.000	3.38	3.38	Verifica	285.9	1.40	Verifica
P12	al C al 16a-16b	S6	193 (C)	0.90	1.00	4 497.8			4.00	4.00	1.30	716.3	5 214.1	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.9	1.23	Verifica
P12	al C al 16a-16b	S6	194 (C)	0.90	1.00	4 495.7			4.00	4.00	1.30	716.3	5 212.0	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.8	1.23	Verifica
P12	al C al 16a-16b	S6	195 (C)	0.90	1.00	4 495.2			4.00	4.00	1.30	716.3	5 211.5	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.7	1.23	Verifica
P12	al C al 16a-16b	S6	196 (C)	0.90	1.00	4 498.4			4.00	4.00	1.30	716.3	5 214.7	400	1.07	0.000	0.000	3.61	3.61	Verifica	325.9	1.23	Verifica
P12	al C al 16a-16b	S6	197 (C)	0.90	1.00	3 585.1			4.00	4.00	1.30	716.3	4 301.4	400	0.97	0.000	0.000	3.28	3.28	Verifica	268.8	1.49	Verifica
P12	al C al 16a-16b	S6	198 (C)	0.90	1.00	4 225.1			4.00	4.00	1.30	716.3	4 941.4	400	1.04	0.000	0.000	3.51	3.51	Verifica	308.8	1.30	Verifica
P12	al C al 16a-16b	S6	199 (C)	0.90	1.00	3 776.7			4.00	4.00	1.30	716.3	4 493.0	400	1.00	0.000	0.000	3.35	3.35	Verifica	280.8	1.42	Verifica
P12	al C al 16a-16b	S6	200 (C)	0.90	1.00	3 585.8			4.00	4.00	1.30	716.3	4 302.1	400	0.97	0.000	0.000	3.28	3.28	Verifica	268.9	1.49	Verifica
P12	al C al 16a-16b	S6	201 (C)	0.90	1.00	3 583.8			4.00	4.00	1.30	716.3	4 300.1	400	0.97	0.000	0.000	3.28	3.28	Verifica	268.8	1.49	Verifica
P12	al C al 16a-16b	S6	202 (C)	0.90	1.00	3 583.3			4.00	4.00	1.30	716.3	4 299.6	400	0.97	0.000	0.000	3.28	3.28	Verifica	268.7	1.49	Verifica
P12	al C al 16a-16b	S6	203 (C)	0.90	1.00	3 586.4			4.00	4.00	1.30	716.3	4 302.7	400	0.97	0.000	0.000	3.28	3.28	Verifica	268.9	1.49	Verifica
P12	al C al 16a-16b	S6	204 (C)	0.90	1.00	4 416.7			4.00	4.00	1.30	716.3	5 133.0	400	1.06	0.000	0.000	3.58	3.58	Verifica	320.8	1.25	Verifica
P12	al C al 16a-16b	S6	205 (C)	0.90	1.00	4 225.8			4.00	4.00	1.30	716.3	4 942.1	400	1.04	0.000	0.000	3.52	3.52	Verifica	308.9	1.29	Verifica
P12	al C al 16a-16b	S6	206 (C)	0.90	1.00	4 223.8			4.00	4.00	1.30	716.3	4 940.1	400	1.04	0.000	0.000	3.51	3.51	Verifica	308.8	1.30	Verifica
P12	al C al 16a-16b	S6	207 (C)	0.90	1.00	4 223.3			4.00	4.00	1.30	716.3	4 939.6	400	1.04	0.000	0.000	3.51	3.51	Verifica	308.7	1.30	Verifica
P12	al C al 16a-16b	S6	208 (C)	0.90	1.00	4 226.3			4.00	4.00	1.30	716.3	4 942.6	400	1.04	0.000	0.000	3.52	3.52	Verifica	308.9	1.29	Verifica
P12	al C al 16a-16b	S6	209 (C)	0.90	1.00	3 777.4			4.00	4.00	1.30	716.3	4 493.7	400	1.00	0.000	0.000	3.35	3.35	Verifica	280.9	1.42	Verifica
P12	al C al 16a-16b	S6	210 (C)	0.90	1.00	3 775.3			4.00	4.00	1.30	716.3	4 491.6	400	1.00	0.000	0.000	3.35	3.35	Verifica	280.7	1.42	Verifica
P12	al C al 16a-16b	S6	211 (C)	0.90	1.00	3 774.8			4.00	4.00	1.30	716.3	4 491.1	400	1.00	0.000	0.000	3.35	3.35	Verifica	280.7	1.43	Verifica
P12	al C al 16a-16b	S6	212 (C)	0.90	1.00	3 778.0			4.00	4.00	1.30	716.3	4 494.3	400	1.00	0.000	0.000	3.35	3.35	Verifica	280.9	1.42	Verifica
P12	al C al 16a-16b	S6	213 (C)	0.90	1.00	4 417.4			4.00	4.00	1.30	716.3	5 133.7	400	1.06	0.000	0.000	3.58	3.58	Verifica	320.9	1.25	Verifica
P12																							

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 16 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	As,cal/s	Ø	As,ef/s	FS	(kN)	(cm2)	As/s	Ø		As,ef/s	FS
P12	al C al 16a-16b	S6	105 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6497.7	967.0	7464.7	0.000	0.000	2410.5	55.44	14.59	Ø20/0.15	20.93	1.43	2332.7	53.65	13.76	Ø20/0.15	20.93	1.52	Verifica
P12	al C al 16a-16b	S6	106 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6211.3	967.0	7178.3	0.000	0.000	2318.0	53.31	14.03	Ø20/0.15	20.93	1.49	2243.2	51.59	13.23	Ø20/0.15	20.93	1.58	Verifica
P12	al C al 16a-16b	S6	107 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6208.2	967.0	7175.2	0.000	0.000	2317.0	53.29	14.02	Ø20/0.15	20.93	1.49	2242.3	51.57	13.22	Ø20/0.15	20.93	1.58	Verifica
P12	al C al 16a-16b	S6	108 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6207.4	967.0	7174.4	0.000	0.000	2316.7	53.28	14.02	Ø20/0.15	20.93	1.49	2242.0	51.57	13.22	Ø20/0.15	20.93	1.58	Verifica
P12	al C al 16a-16b	S6	109 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6212.2	967.0	7179.2	0.000	0.000	2318.3	53.32	14.03	Ø20/0.15	20.93	1.49	2243.5	51.60	13.23	Ø20/0.15	20.93	1.58	Verifica
P12	al C al 16a-16b	S6	110 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6498.8	967.0	7465.8	0.000	0.000	2410.8	55.45	14.59	Ø20/0.15	20.93	1.43	2333.1	53.66	13.76	Ø20/0.15	20.93	1.52	Verifica
P12	al C al 16a-16b	S6	111 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6495.6	967.0	7462.6	0.000	0.000	2409.8	55.43	14.59	Ø20/0.15	20.93	1.43	2332.1	53.64	13.75	Ø20/0.15	20.93	1.52	Verifica
P12	al C al 16a-16b	S6	112 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6494.8	967.0	7461.8	0.000	0.000	2409.5	55.42	14.58	Ø20/0.15	20.93	1.44	2331.8	53.63	13.75	Ø20/0.15	20.93	1.52	Verifica
P12	al C al 16a-16b	S6	113 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6499.5	967.0	7466.5	0.000	0.000	2411.1	55.45	14.59	Ø20/0.15	20.93	1.43	2333.3	53.67	13.76	Ø20/0.15	20.93	1.52	Verifica
P12	al C al 16a-16b	S6	114 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3994.0	967.0	4961.0	0.000	0.000	1602.0	36.85	9.70	Ø20/0.15	20.93	2.16	1550.3	35.66	9.14	Ø20/0.15	20.93	2.29	Verifica
P12	al C al 16a-16b	S6	115 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4953.9	967.0	5920.9	0.000	0.000	1912.0	43.98	11.57	Ø20/0.15	20.93	1.81	1850.3	42.56	10.91	Ø20/0.15	20.93	1.92	Verifica
P12	al C al 16a-16b	S6	116 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3995.1	967.0	4962.1	0.000	0.000	1602.3	36.85	9.70	Ø20/0.15	20.93	2.16	1550.7	35.67	9.14	Ø20/0.15	20.93	2.29	Verifica
P12	al C al 16a-16b	S6	117 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3992.0	967.0	4959.0	0.000	0.000	1601.3	36.83	9.69	Ø20/0.15	20.93	2.16	1549.7	35.64	9.14	Ø20/0.15	20.93	2.29	Verifica
P12	al C al 16a-16b	S6	118 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3991.1	967.0	4958.1	0.000	0.000	1601.1	36.82	9.69	Ø20/0.15	20.93	2.16	1549.4	35.64	9.14	Ø20/0.15	20.93	2.29	Verifica
P12	al C al 16a-16b	S6	119 (C)	0.90	1.00	4.00	4.00	1.30	1.20	3995.9	967.0	4962.9	0.000	0.000	1602.6	36.86	9.70	Ø20/0.15	20.93	2.16	1550.9	35.67	9.15	Ø20/0.15	20.93	2.29	Verifica
P12	al C al 16a-16b	S6	120 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4955.0	967.0	5922.0	0.000	0.000	1912.3	43.98	11.57	Ø20/0.15	20.93	1.81	1850.6	42.56	10.91	Ø20/0.15	20.93	1.92	Verifica
P12	al C al 16a-16b	S6	121 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4951.9	967.0	5918.9	0.000	0.000	1911.3	43.96	11.57	Ø20/0.15	20.93	1.81	1849.7	42.54	10.91	Ø20/0.15	20.93	1.92	Verifica
P12	al C al 16a-16b	S6	122 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4951.0	967.0	5918.0	0.000	0.000	1911.0	43.95	11.57	Ø20/0.15	20.93	1.81	1849.4	42.54	10.91	Ø20/0.15	20.93	1.92	Verifica
P12	al C al 16a-16b	S6	123 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4955.8	967.0	5922.8	0.000	0.000	1912.6	43.99	11.58	Ø20/0.15	20.93	1.81	1850.9	42.57	10.92	Ø20/0.15	20.93	1.92	Verifica
P12	al C al 16a-16b	S6	124 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4841.5	967.0	5808.5	0.000	0.000	1875.7	43.14	11.35	Ø20/0.15	20.93	1.84	1815.2	41.75	10.70	Ø20/0.15	20.93	1.96	Verifica
P12	al C al 16a-16b	S6	125 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5801.4	967.0	6768.4	0.000	0.000	2185.6	50.27	13.23	Ø20/0.15	20.93	1.58	2115.1	48.65	12.47	Ø20/0.15	20.93	1.68	Verifica
P12	al C al 16a-16b	S6	126 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5128.8	967.0	6095.8	0.000	0.000	1968.4	45.27	11.91	Ø20/0.15	20.93	1.76	1904.9	43.81	11.23	Ø20/0.15	20.93	1.86	Verifica
P12	al C al 16a-16b	S6	127 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4842.6	967.0	5809.6	0.000	0.000	1876.0	43.15	11.35	Ø20/0.15	20.93	1.84	1815.5	41.76	10.71	Ø20/0.15	20.93	1.95	Verifica
P12	al C al 16a-16b	S6	128 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4839.5	967.0	5806.5	0.000	0.000	1875.0	43.13	11.35	Ø20/0.15	20.93	1.84	1814.5	41.73	10.70	Ø20/0.15	20.93	1.96	Verifica
P12	al C al 16a-16b	S6	129 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4838.7	967.0	5805.7	0.000	0.000	1874.8	43.12	11.35	Ø20/0.15	20.93	1.84	1814.3	41.73	10.70	Ø20/0.15	20.93	1.96	Verifica
P12	al C al 16a-16b	S6	130 (C)	0.90	1.00	4.00	4.00	1.30	1.20	4843.3	967.0	5810.3	0.000	0.000	1876.2	43.15	11.36	Ø20/0.15	20.93	1.84	1815.7	41.76	10.71	Ø20/0.15	20.93	1.95	Verifica
P12	al C al 16a-16b	S6	131 (C)	0.90	1.00	4.00	4.00	1.30	1.20	6088.8	967.0	7055.8	0.000	0.000	2278.4	52.40	13.79	Ø20/0.15	20.93	1.52	2204.9	50.71	13.00	Ø20/0.15	20.93	1.61	Verifica
P12	al C al 16a-16b	S6	132 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5802.5	967.0	6769.5	0.000	0.000	2186.0	50.28	13.23	Ø20/0.15	20.93	1.58	2115.5	48.66	12.48	Ø20/0.15	20.93	1.68	Verifica
P12	al C al 16a-16b	S6	133 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5799.4	967.0	6766.4	0.000	0.000	2185.0	50.25	13.22	Ø20/0.15	20.93	1.58	2114.5	48.63	12.47	Ø20/0.15	20.93	1.68	Verifica
P12	al C al 16a-16b	S6	134 (C)	0.90	1.00	4.00	4.00	1.30	1.20	5798.6	967.0	6765.6	0.000	0.000	2184.7	50.25	13.22	Ø20/0.15	20.93	1.58	2114.3	48.63	12.47	Ø20/0.15	20.93	1.6	

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 16 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b (m)	l (m)	Hproj (m)	d (m)	bx (m)	by (m)	u1 (m)	Ao (m2)	q _{seg} (kN/m²)	V _{Ed} (kN)	MX (kNm)	MY (kNm)	ΔV _{Ed,red} (kN)	ex (m)	ey (m)	β	V _{Ed} (kN/m²)	k	As,X (cm2/m)	As,Y (cm2/m)	ρl	V _{Rd} (kN/m²)	FS	Obs.
P12	al C al 16a-16b	S6	105 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	467	7 464.7			1822.1	0.000	0.000	1.00	621.2	1.41	20.93	20.93	0.0017	1173.5	1.9	Verifica
P12	al C al 16a-16b	S6	106 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	449	7 178.3			1744.9	0.000	0.000	1.00	598.1	1.41	20.93	20.93	0.0017	1173.5	2.0	Verifica
P12	al C al 16a-16b	S6	107 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	448	7 175.2			1744.1	0.000	0.000	1.00	597.9	1.41	20.93	20.93	0.0017	1173.5	2.0	Verifica
P12	al C al 16a-16b	S6	108 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	448	7 174.4			1743.9	0.000	0.000	1.00	597.8	1.41	20.93	20.93	0.0017	1173.5	2.0	Verifica
P12	al C al 16a-16b	S6	109 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	449	7 179.2			1745.2	0.000	0.000	1.00	598.2	1.41	20.93	20.93	0.0017	1173.5	2.0	Verifica
P12	al C al 16a-16b	S6	110 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	467	7 465.8			1822.4	0.000	0.000	1.00	621.3	1.41	20.93	20.93	0.0017	1173.5	1.9	Verifica
P12	al C al 16a-16b	S6	111 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	466	7 462.6			1821.5	0.000	0.000	1.00	621.0	1.41	20.93	20.93	0.0017	1173.5	1.9	Verifica
P12	al C al 16a-16b	S6	112 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	466	7 461.8			1821.3	0.000	0.000	1.00	620.9	1.41	20.93	20.93	0.0017	1173.5	1.9	Verifica
P12	al C al 16a-16b	S6	113 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	467	7 466.5			1822.6	0.000	0.000	1.00	621.3	1.41	20.93	20.93	0.0017	1173.5	1.9	Verifica
P12	al C al 16a-16b	S6	114 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	310	4 961.0			1147.5	0.000	0.000	1.00	419.8	1.41	20.93	20.93	0.0017	1173.5	2.8	Verifica
P12	al C al 16a-16b	S6	115 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	370	5 920.9			1406.2	0.000	0.000	1.00	497.0	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	116 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	310	4 962.1			1147.8	0.000	0.000	1.00	419.9	1.41	20.93	20.93	0.0017	1173.5	2.8	Verifica
P12	al C al 16a-16b	S6	117 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	310	4 959.0			1147.0	0.000	0.000	1.00	419.6	1.41	20.93	20.93	0.0017	1173.5	2.8	Verifica
P12	al C al 16a-16b	S6	118 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	310	4 958.1			1146.7	0.000	0.000	1.00	419.6	1.41	20.93	20.93	0.0017	1173.5	2.8	Verifica
P12	al C al 16a-16b	S6	119 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	310	4 962.9			1148.0	0.000	0.000	1.00	420.0	1.41	20.93	20.93	0.0017	1173.5	2.8	Verifica
P12	al C al 16a-16b	S6	120 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	370	5 922.0			1406.5	0.000	0.000	1.00	497.1	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	121 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	370	5 918.9			1405.6	0.000	0.000	1.00	496.8	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	122 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	370	5 918.0			1405.4	0.000	0.000	1.00	496.8	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	123 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	370	5 922.8			1406.7	0.000	0.000	1.00	497.2	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	124 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	363	5 808.5			1375.9	0.000	0.000	1.00	488.0	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	125 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	423	6 768.4			1634.5	0.000	0.000	1.00	565.2	1.41	20.93	20.93	0.0017	1173.5	2.1	Verifica
P12	al C al 16a-16b	S6	126 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	381	6 095.8			1453.3	0.000	0.000	1.00	511.1	1.41	20.93	20.93	0.0017	1173.5	2.3	Verifica
P12	al C al 16a-16b	S6	127 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	363	5 809.6			1376.2	0.000	0.000	1.00	488.1	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	128 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	363	5 806.5			1375.3	0.000	0.000	1.00	487.8	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	129 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	363	5 805.7			1375.1	0.000	0.000	1.00	487.7	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	130 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	363	5 810.3			1376.4	0.000	0.000	1.00	488.1	1.41	20.93	20.93	0.0017	1173.5	2.4	Verifica
P12	al C al 16a-16b	S6	131 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	441	7 055.8			1711.9	0.000	0.000	1.00	588.3	1.41	20.93	20.93	0.0017	1173.5	2.0	Verifica
P12	al C al 16a-16b	S6	132 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	423	6 769.5			1634.8	0.000	0.000	1.00	565.3	1.41	20.93	20.93	0.0017	1173.5	2.1	Verifica
P12	al C al 16a-16b	S6	133 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	423	6 766.4			1634.0	0.000	0.000	1.00	565.0	1.41	20.93	20.93	0.0017	1173.5	2.1	Verifica
P12	al C al 16a-16b	S6	134 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	423	6 765.6			1633.8	0.000	0.000	1.00	564.9	1.41	20.93	20.93	0.0017	1173.5	2.1	Verifica
P12	al C al 16a-16b	S6	135 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	423	6 770.3			1635.0	0.000	0.000	1.00	565.3	1.41	20.93	20.93	0.0017	1173.5	2.1	Verifica
P12	al C al 16a-16b	S6	136 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	441	7 056.9			1712.2	0.000	0.000	1.00	588.4	1.41	20.93	20.93	0.0017	1173.5	2.0	Verifica
P12	al C al 16a-16b	S6	137 (C)	0.90	1.00	1.30	1.20	2.10	2.20	7.570	4.31	441	7 053.8			1711.4	0.000	0.000	1.								

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 17 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P9	al B al 17	S6	177 (C)	0.70	1.00	4 019.8			4.00	4.00	1.30	718.9	4 738.7	400	1.02	0.000	0.000	3.44		0.00	Verifica	296.2	1.35	Verifica
P9	al B al 17	S6	178 (C)	0.70	1.00	4 176.7			4.00	4.00	1.30	718.9	4 895.6	400	1.04	0.000	0.000	3.50		0.00	Verifica	306.0	1.31	Verifica
P9	al B al 17	S6	179 (C)	0.70	1.00	4 019.8			4.00	4.00	1.30	718.9	4 738.7	400	1.02	0.000	0.000	3.44		0.00	Verifica	296.2	1.35	Verifica
P9	al B al 17	S6	180 (C)	0.70	1.00	4 019.8			4.00	4.00	1.30	718.9	4 738.7	400	1.02	0.000	0.000	3.44		0.00	Verifica	296.2	1.35	Verifica
P9	al B al 17	S6	181 (C)	0.70	1.00	3 995.9			4.00	4.00	1.30	718.9	4 714.8	400	1.02	0.000	0.000	3.43		0.00	Verifica	294.7	1.36	Verifica
P9	al B al 17	S6	182 (C)	0.70	1.00	3 975.1			4.00	4.00	1.30	718.9	4 694.0	400	1.02	0.000	0.000	3.43		0.00	Verifica	293.4	1.36	Verifica
P9	al B al 17	S6	183 (C)	0.70	1.00	4 176.7			4.00	4.00	1.30	718.9	4 895.6	400	1.04	0.000	0.000	3.50		0.00	Verifica	306.0	1.31	Verifica
P9	al B al 17	S6	184 (C)	0.70	1.00	4 176.7			4.00	4.00	1.30	718.9	4 895.6	400	1.04	0.000	0.000	3.50		0.00	Verifica	306.0	1.31	Verifica
P9	al B al 17	S6	185 (C)	0.70	1.00	4 152.7			4.00	4.00	1.30	718.9	4 871.6	400	1.04	0.000	0.000	3.49		0.00	Verifica	304.5	1.31	Verifica
P9	al B al 17	S6	186 (C)	0.70	1.00	4 132.0			4.00	4.00	1.30	718.9	4 850.9	400	1.03	0.000	0.000	3.48		0.00	Verifica	303.2	1.32	Verifica
P9	al B al 17	S6	187 (C)	0.70	1.00	3 416.1			4.00	4.00	1.30	718.9	4 135.0	400	0.95	0.000	0.000	3.22		0.00	Verifica	258.4	1.55	Verifica
P9	al B al 17	S6	188 (C)	0.70	1.00	3 995.6			4.00	4.00	1.30	718.9	4 714.5	400	1.02	0.000	0.000	3.43		0.00	Verifica	294.7	1.36	Verifica
P9	al B al 17	S6	189 (C)	0.70	1.00	3 416.1			4.00	4.00	1.30	718.9	4 135.0	400	0.95	0.000	0.000	3.22		0.00	Verifica	258.4	1.55	Verifica
P9	al B al 17	S6	190 (C)	0.70	1.00	3 416.1			4.00	4.00	1.30	718.9	4 135.0	400	0.95	0.000	0.000	3.22		0.00	Verifica	258.4	1.55	Verifica
P9	al B al 17	S6	191 (C)	0.70	1.00	3 392.1			4.00	4.00	1.30	718.9	4 111.0	400	0.95	0.000	0.000	3.21		0.00	Verifica	256.9	1.56	Verifica
P9	al B al 17	S6	192 (C)	0.70	1.00	3 371.3			4.00	4.00	1.30	718.9	4 090.2	400	0.95	0.000	0.000	3.20		0.00	Verifica	255.6	1.56	Verifica
P9	al B al 17	S6	193 (C)	0.70	1.00	3 995.6			4.00	4.00	1.30	718.9	4 714.5	400	1.02	0.000	0.000	3.43		0.00	Verifica	294.7	1.36	Verifica
P9	al B al 17	S6	194 (C)	0.70	1.00	3 995.6			4.00	4.00	1.30	718.9	4 714.5	400	1.02	0.000	0.000	3.43		0.00	Verifica	294.7	1.36	Verifica
P9	al B al 17	S6	195 (C)	0.70	1.00	3 971.6			4.00	4.00	1.30	718.9	4 690.5	400	1.02	0.000	0.000	3.42		0.00	Verifica	293.2	1.36	Verifica
P9	al B al 17	S6	196 (C)	0.70	1.00	3 950.8			4.00	4.00	1.30	718.9	4 669.7	400	1.01	0.000	0.000	3.42		0.00	Verifica	291.9	1.37	Verifica
P9	al B al 17	S6	197 (C)	0.70	1.00	3 229.6			4.00	4.00	1.30	718.9	3 948.5	400	0.93	0.000	0.000	3.14		0.00	Verifica	246.8	1.62	Verifica
P9	al B al 17	S6	198 (C)	0.70	1.00	3 809.1			4.00	4.00	1.30	718.9	4 528.0	400	1.00	0.000	0.000	3.36		0.00	Verifica	283.0	1.41	Verifica
P9	al B al 17	S6	199 (C)	0.70	1.00	3 386.5			4.00	4.00	1.30	718.9	4 105.4	400	0.95	0.000	0.000	3.20		0.00	Verifica	256.6	1.56	Verifica
P9	al B al 17	S6	200 (C)	0.70	1.00	3 229.6			4.00	4.00	1.30	718.9	3 948.5	400	0.93	0.000	0.000	3.14		0.00	Verifica	246.8	1.62	Verifica
P9	al B al 17	S6	201 (C)	0.70	1.00	3 229.6			4.00	4.00	1.30	718.9	3 948.5	400	0.93	0.000	0.000	3.14		0.00	Verifica	246.8	1.62	Verifica
P9	al B al 17	S6	202 (C)	0.70	1.00	3 205.6			4.00	4.00	1.30	718.9	3 924.5	400	0.93	0.000	0.000	3.13		0.00	Verifica	245.3	1.63	Verifica
P9	al B al 17	S6	203 (C)	0.70	1.00	3 184.9			4.00	4.00	1.30	718.9	3 903.8	400	0.93	0.000	0.000	3.12		0.00	Verifica	244.0	1.64	Verifica
P9	al B al 17	S6	204 (C)	0.70	1.00	3 966.0			4.00	4.00	1.30	718.9	4 684.9	400	1.02	0.000	0.000	3.42		0.00	Verifica	292.8	1.37	Verifica
P9	al B al 17	S6	205 (C)	0.70	1.00	3 809.1			4.00	4.00	1.30	718.9	4 528.0	400	1.00	0.000	0.000	3.36		0.00	Verifica	283.0	1.41	Verifica
P9	al B al 17	S6	206 (C)	0.70	1.00	3 809.1			4.00	4.00	1.30	718.9	4 528.0	400	1.00	0.000	0.000	3.36		0.00	Verifica	283.0	1.41	Verifica
P9	al B al 17	S6	207 (C)	0.70	1.00	3 785.1			4.00	4.00	1.30	718.9	4 504.0	400	1.00	0.000	0.000	3.36		0.00	Verifica	281.5	1.42	Verifica
P9	al B al 17	S6	208 (C)	0.70	1.00	3 764.4			4.00	4.00	1.30	718.9	4 483.3	400	0.99	0.000	0.000	3.35		0.00	Verifica	280.2	1.43	Verifica
P9	al B al 17	S6	209 (C)	0.70	1.00	3 386.5			4.00	4.00	1.30	718.9	4 105.4	400	0.95	0.000	0.000	3.20		0.00	Verifica	256.6	1.56	Verifica
P9	al B al 17	S6	210 (C)	0.70	1.00	3 386.5			4.00	4.00	1.30	718.9	4 105.4	400	0.95	0.000	0.000	3.20		0.00	Verifica	256.6	1.56	Verifica
P9	al B al 17	S6	211 (C)	0.70	1.00	3 362.5			4.00	4.00	1.30	718.9	4 081.4	400	0.95	0.000	0.000	3.19		0.00	Verifica	255.1	1.57	Verifica
P9	al B al 17	S6	212 (C)	0.70	1.00	3 341.7			4.00	4.00	1.30	718.9	4 060.6	400	0.95	0.000	0.000	3.19		0.00	Verifica	253.8	1.58	Verifica
P9	al B al 17	S6	213 (C)	0.70	1.00	3 966.0			4.00	4.00	1.30	718.9	4 684.9	400	1.02	0.000	0.000	3.42		0.00	Verifica	292.8	1.37	Verifica
P9	al B al 17	S6	214 (C)	0.70	1.00	3 966.0			4.00	4.00	1.30	718.9	4 684.9											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 17 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al B al 17	S6	105 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5793.7	970.5	6764.2	0.000	0.000	2325.2	53.48	14.07	Ø20/0.125	25.13	1.79	2113.8	48.62	12.47	Ø20/0.125	25.13	2.02	Verifica
P9	al B al 17	S6	106 (C)	0.70	1.00	4.00	4.00	1.30	1.20	2244.3	970.5	6528.9	0.000	0.000	2244.3	51.62	13.58	Ø20/0.125	25.13	1.85	2040.3	46.93	12.03	Ø20/0.125	25.13	2.09	Verifica
P9	al B al 17	S6	107 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5558.4	970.5	6528.9	0.000	0.000	2244.3	51.62	13.58	Ø20/0.125	25.13	1.85	2040.3	46.93	12.03	Ø20/0.125	25.13	2.09	Verifica
P9	al B al 17	S6	108 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5522.5	970.5	6493.0	0.000	0.000	2232.0	51.34	13.51	Ø20/0.125	25.13	1.86	2029.1	46.67	11.97	Ø20/0.125	25.13	2.10	Verifica
P9	al B al 17	S6	109 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5491.4	970.5	6461.9	0.000	0.000	2221.3	51.09	13.44	Ø20/0.125	25.13	1.87	2019.3	46.45	11.91	Ø20/0.125	25.13	2.11	Verifica
P9	al B al 17	S6	110 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5793.7	970.5	6764.2	0.000	0.000	2325.2	53.48	14.07	Ø20/0.125	25.13	1.79	2113.8	48.62	12.47	Ø20/0.125	25.13	2.02	Verifica
P9	al B al 17	S6	111 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5793.7	970.5	6764.2	0.000	0.000	2325.2	53.48	14.07	Ø20/0.125	25.13	1.79	2113.8	48.62	12.47	Ø20/0.125	25.13	2.02	Verifica
P9	al B al 17	S6	112 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5757.8	970.5	6728.3	0.000	0.000	2312.9	53.20	14.00	Ø20/0.125	25.13	1.80	2102.6	48.36	12.40	Ø20/0.125	25.13	2.03	Verifica
P9	al B al 17	S6	113 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5726.6	970.5	6697.1	0.000	0.000	2302.1	52.95	13.93	Ø20/0.125	25.13	1.80	2092.8	48.14	12.34	Ø20/0.125	25.13	2.04	Verifica
P9	al B al 17	S6	114 (C)	0.70	1.00	4.00	4.00	1.30	1.20	3528.1	970.5	4498.6	0.000	0.000	1546.4	35.57	9.36	Ø20/0.125	25.13	2.68	1405.8	32.33	8.29	Ø20/0.125	25.13	3.03	Verifica
P9	al B al 17	S6	115 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4397.3	970.5	5367.8	0.000	0.000	1845.2	42.44	11.17	Ø20/0.125	25.13	2.25	1677.4	38.58	9.89	Ø20/0.125	25.13	2.54	Verifica
P9	al B al 17	S6	116 (C)	0.70	1.00	4.00	4.00	1.30	1.20	3528.1	970.5	4498.6	0.000	0.000	1546.4	35.57	9.36	Ø20/0.125	25.13	2.68	1405.8	32.33	8.29	Ø20/0.125	25.13	3.03	Verifica
P9	al B al 17	S6	117 (C)	0.70	1.00	4.00	4.00	1.30	1.20	3528.1	970.5	4498.6	0.000	0.000	1546.4	35.57	9.36	Ø20/0.125	25.13	2.68	1405.8	32.33	8.29	Ø20/0.125	25.13	3.03	Verifica
P9	al B al 17	S6	118 (C)	0.70	1.00	4.00	4.00	1.30	1.20	3492.1	970.5	4462.6	0.000	0.000	1534.0	35.28	9.28	Ø20/0.125	25.13	2.71	1394.6	32.08	8.22	Ø20/0.125	25.13	3.06	Verifica
P9	al B al 17	S6	119 (C)	0.70	1.00	4.00	4.00	1.30	1.20	3461.0	970.5	4431.5	0.000	0.000	1523.3	35.04	9.22	Ø20/0.125	25.13	2.73	1384.8	31.85	8.17	Ø20/0.125	25.13	3.08	Verifica
P9	al B al 17	S6	120 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4397.3	970.5	5367.8	0.000	0.000	1845.2	42.44	11.17	Ø20/0.125	25.13	2.25	1677.4	38.58	9.89	Ø20/0.125	25.13	2.54	Verifica
P9	al B al 17	S6	121 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4397.3	970.5	5367.8	0.000	0.000	1845.2	42.44	11.17	Ø20/0.125	25.13	2.25	1677.4	38.58	9.89	Ø20/0.125	25.13	2.54	Verifica
P9	al B al 17	S6	122 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4361.4	970.5	5331.9	0.000	0.000	1832.8	42.16	11.09	Ø20/0.125	25.13	2.27	1666.2	38.32	9.83	Ø20/0.125	25.13	2.56	Verifica
P9	al B al 17	S6	123 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4330.3	970.5	5300.8	0.000	0.000	1822.2	41.91	11.03	Ø20/0.125	25.13	2.28	1656.5	38.10	9.77	Ø20/0.125	25.13	2.57	Verifica
P9	al B al 17	S6	124 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4373.1	970.5	5343.6	0.000	0.000	1836.9	42.25	11.12	Ø20/0.125	25.13	2.26	1669.9	38.41	9.85	Ø20/0.125	25.13	2.55	Verifica
P9	al B al 17	S6	125 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5242.3	970.5	6212.8	0.000	0.000	2135.7	49.12	12.93	Ø20/0.125	25.13	1.94	1941.5	44.65	11.45	Ø20/0.125	25.13	2.19	Verifica
P9	al B al 17	S6	126 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4608.4	970.5	5578.9	0.000	0.000	1917.8	44.11	11.61	Ø20/0.125	25.13	2.16	1743.4	40.10	10.28	Ø20/0.125	25.13	2.44	Verifica
P9	al B al 17	S6	127 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4373.1	970.5	5343.6	0.000	0.000	1836.9	42.25	11.12	Ø20/0.125	25.13	2.26	1669.9	38.41	9.85	Ø20/0.125	25.13	2.55	Verifica
P9	al B al 17	S6	128 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4373.1	970.5	5343.6	0.000	0.000	1836.9	42.25	11.12	Ø20/0.125	25.13	2.26	1669.9	38.41	9.85	Ø20/0.125	25.13	2.55	Verifica
P9	al B al 17	S6	129 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4337.1	970.5	5307.6	0.000	0.000	1824.5	41.96	11.04	Ø20/0.125	25.13	2.28	1658.6	38.15	9.78	Ø20/0.125	25.13	2.57	Verifica
P9	al B al 17	S6	130 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4306.0	970.5	5276.5	0.000	0.000	1813.8	41.72	10.98	Ø20/0.125	25.13	2.29	1648.9	37.92	9.72	Ø20/0.125	25.13	2.58	Verifica
P9	al B al 17	S6	131 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5477.6	970.5	6448.1	0.000	0.000	2216.5	50.98	13.42	Ø20/0.125	25.13	1.87	2015.0	46.35	11.88	Ø20/0.125	25.13	2.11	Verifica
P9	al B al 17	S6	132 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5242.3	970.5	6212.8	0.000	0.000	2135.7	49.12	12.93	Ø20/0.125	25.13	1.94	1941.5	44.65	11.45	Ø20/0.125	25.13	2.19	Verifica
P9	al B al 17	S6	133 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5242.3	970.5	6212.8	0.000	0.000	2135.7	49.12	12.93	Ø20/0.125	25.13	1.94	1941.5	44.65	11.45	Ø20/0.125	25.13	2.19	Verifica
P9	al B al 17	S6	134 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5206.4	970.5	6176.9	0.000	0.000	2123.3	48.84	12.85	Ø20/0.125	25.13	1.96	1930.3	44.40	11.38	Ø20/0.125	25.13	2.21	Verifica
P9	al B al 17	S6	135 (C)																								

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 17 - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{issg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m ²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(cm2/m)	(cm2/m)		(kN/m ²)		V _{Ed} ≤ V _{Rd}					
P9	al B al 17	S6	105 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	423	6 764.2			1466.7	0.000	0.000	1.00	615.7	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	106 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	408	6 528.9			1409.7	0.000	0.000	1.00	595.0	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	107 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	408	6 528.9			1409.7	0.000	0.000	1.00	595.0	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	108 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	406	6 493.0			1401.1	0.000	0.000	1.00	591.8	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	109 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	404	6 461.9			1393.5	0.000	0.000	1.00	589.1	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	110 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	423	6 764.2			1466.7	0.000	0.000	1.00	615.7	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	111 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	423	6 764.2			1466.7	0.000	0.000	1.00	615.7	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	112 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	421	6 728.3			1458.0	0.000	0.000	1.00	612.6	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	113 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	419	6 697.1			1450.4	0.000	0.000	1.00	609.8	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	114 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	281	4 498.6			918.5	0.000	0.000	1.00	416.1	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	115 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	335	5 367.8			1128.8	0.000	0.000	1.00	492.7	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	116 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	281	4 498.6			918.5	0.000	0.000	1.00	416.1	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	117 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	281	4 498.6			918.5	0.000	0.000	1.00	416.1	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	118 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	279	4 462.6			909.8	0.000	0.000	1.00	412.9	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	119 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	277	4 431.5			902.3	0.000	0.000	1.00	410.2	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	120 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	335	5 367.8			1128.8	0.000	0.000	1.00	492.7	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	121 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	335	5 367.8			1128.8	0.000	0.000	1.00	492.7	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	122 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	333	5 331.9			1120.1	0.000	0.000	1.00	489.5	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	123 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	331	5 300.8			1112.6	0.000	0.000	1.00	486.8	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	124 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	334	5 343.6			1123.0	0.000	0.000	1.00	490.6	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	125 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	388	6 212.8			1333.3	0.000	0.000	1.00	567.1	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	126 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	349	5 578.9			1179.9	0.000	0.000	1.00	511.3	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	127 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	334	5 343.6			1123.0	0.000	0.000	1.00	490.6	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	128 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	334	5 343.6			1123.0	0.000	0.000	1.00	490.6	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	129 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	332	5 307.6			1114.3	0.000	0.000	1.00	487.4	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	130 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	330	5 276.5			1106.7	0.000	0.000	1.00	484.6	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	131 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	403	6 448.1			1390.2	0.000	0.000	1.00	587.9	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	132 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	388	6 212.8			1333.3	0.000	0.000	1.00	567.1	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	133 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	388	6 212.8			1333.3	0.000	0.000	1.00	567.1	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	134 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	386	6 176.9			1324.6	0.000	0.000	1.00	564.0	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	135 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	384	6 145.7			1317.0	0.000	0.000	1.00	561.2	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	136 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	403	6 448.1			1390.2	0.000	0.000	1.00	587.9	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	137 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	403	6 448.1			1390.2	0.000	0.000	1.00	587.9	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9	al B al 17	S6	138 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	401	6 412.2			1381.5	0.000	0.000	1.00	584.7	1.41	Æ20//0.125	25.13	#VALOR!	#VALOR!	#VALOR!	#VALOR!
P9																											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 17 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P9	al C al 17	S6	177 (C)	0.70	1.00	4 631.9			4.00	4.00	1.30	688.3	5 151.9	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.0	1.24	Verifica
P9	al C al 17	S6	178 (C)	0.70	1.00	4 863.8			4.00	4.00	1.30	688.3	5 383.8	400	1.09	0.000	0.000	3.67		3.67	Verifica	336.5	1.19	Verifica
P9	al C al 17	S6	179 (C)	0.70	1.00	4 631.9			4.00	4.00	1.30	688.3	5 151.9	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.0	1.24	Verifica
P9	al C al 17	S6	180 (C)	0.70	1.00	4 631.9			4.00	4.00	1.30	688.3	5 151.9	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.0	1.24	Verifica
P9	al C al 17	S6	181 (C)	0.70	1.00	4 629.8			4.00	4.00	1.30	688.3	5 149.8	400	1.07	0.000	0.000	3.59		3.59	Verifica	321.9	1.24	Verifica
P9	al C al 17	S6	182 (C)	0.70	1.00	4 625.9			4.00	4.00	1.30	688.3	5 145.9	400	1.07	0.000	0.000	3.59		3.59	Verifica	321.6	1.24	Verifica
P9	al C al 17	S6	183 (C)	0.70	1.00	4 863.8			4.00	4.00	1.30	688.3	5 383.8	400	1.09	0.000	0.000	3.67		3.67	Verifica	336.5	1.19	Verifica
P9	al C al 17	S6	184 (C)	0.70	1.00	4 863.8			4.00	4.00	1.30	688.3	5 383.8	400	1.09	0.000	0.000	3.67		3.67	Verifica	336.5	1.19	Verifica
P9	al C al 17	S6	185 (C)	0.70	1.00	4 861.7			4.00	4.00	1.30	688.3	5 381.7	400	1.09	0.000	0.000	3.67		3.67	Verifica	336.4	1.19	Verifica
P9	al C al 17	S6	186 (C)	0.70	1.00	4 857.8			4.00	4.00	1.30	688.3	5 377.8	400	1.09	0.000	0.000	3.67		3.67	Verifica	336.1	1.19	Verifica
P9	al C al 17	S6	187 (C)	0.70	1.00	3 898.6			4.00	4.00	1.30	688.3	4 418.6	400	0.99	0.000	0.000	3.32		3.32	Verifica	276.2	1.45	Verifica
P9	al C al 17	S6	188 (C)	0.70	1.00	4 643.9			4.00	4.00	1.30	688.3	5 163.9	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.7	1.24	Verifica
P9	al C al 17	S6	189 (C)	0.70	1.00	3 898.6			4.00	4.00	1.30	688.3	4 418.6	400	0.99	0.000	0.000	3.32		3.32	Verifica	276.2	1.45	Verifica
P9	al C al 17	S6	190 (C)	0.70	1.00	3 898.6			4.00	4.00	1.30	688.3	4 418.6	400	0.99	0.000	0.000	3.32		3.32	Verifica	276.2	1.45	Verifica
P9	al C al 17	S6	191 (C)	0.70	1.00	3 896.5			4.00	4.00	1.30	688.3	4 416.5	400	0.99	0.000	0.000	3.32		3.32	Verifica	276.0	1.45	Verifica
P9	al C al 17	S6	192 (C)	0.70	1.00	3 892.6			4.00	4.00	1.30	688.3	4 412.6	400	0.99	0.000	0.000	3.32		3.32	Verifica	275.8	1.45	Verifica
P9	al C al 17	S6	193 (C)	0.70	1.00	4 643.9			4.00	4.00	1.30	688.3	5 163.9	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.7	1.24	Verifica
P9	al C al 17	S6	194 (C)	0.70	1.00	4 643.9			4.00	4.00	1.30	688.3	5 163.9	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.7	1.24	Verifica
P9	al C al 17	S6	195 (C)	0.70	1.00	4 641.7			4.00	4.00	1.30	688.3	5 161.7	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.6	1.24	Verifica
P9	al C al 17	S6	196 (C)	0.70	1.00	4 637.8			4.00	4.00	1.30	688.3	5 157.8	400	1.07	0.000	0.000	3.59		3.59	Verifica	322.4	1.24	Verifica
P9	al C al 17	S6	197 (C)	0.70	1.00	3 568.8			4.00	4.00	1.30	688.3	4 088.8	400	0.95	0.000	0.000	3.20		3.20	Verifica	255.6	1.57	Verifica
P9	al C al 17	S6	198 (C)	0.70	1.00	4 314.0			4.00	4.00	1.30	688.3	4 834.0	400	1.03	0.000	0.000	3.48		3.48	Verifica	302.1	1.32	Verifica
P9	al C al 17	S6	199 (C)	0.70	1.00	3 800.7			4.00	4.00	1.30	688.3	4 320.7	400	0.98	0.000	0.000	3.29		3.29	Verifica	270.0	1.48	Verifica
P9	al C al 17	S6	200 (C)	0.70	1.00	3 568.8			4.00	4.00	1.30	688.3	4 088.8	400	0.95	0.000	0.000	3.20		3.20	Verifica	255.6	1.57	Verifica
P9	al C al 17	S6	201 (C)	0.70	1.00	3 568.8			4.00	4.00	1.30	688.3	4 088.8	400	0.95	0.000	0.000	3.20		3.20	Verifica	255.6	1.57	Verifica
P9	al C al 17	S6	202 (C)	0.70	1.00	3 566.7			4.00	4.00	1.30	688.3	4 086.7	400	0.95	0.000	0.000	3.20		3.20	Verifica	255.4	1.57	Verifica
P9	al C al 17	S6	203 (C)	0.70	1.00	3 562.8			4.00	4.00	1.30	688.3	4 082.8	400	0.95	0.000	0.000	3.19		3.19	Verifica	255.2	1.57	Verifica
P9	al C al 17	S6	204 (C)	0.70	1.00	4 545.9			4.00	4.00	1.30	688.3	5 065.9	400	1.06	0.000	0.000	3.56		3.56	Verifica	316.6	1.26	Verifica
P9	al C al 17	S6	205 (C)	0.70	1.00	4 314.0			4.00	4.00	1.30	688.3	4 834.0	400	1.03	0.000	0.000	3.48		3.48	Verifica	302.1	1.32	Verifica
P9	al C al 17	S6	206 (C)	0.70	1.00	4 314.0			4.00	4.00	1.30	688.3	4 834.0	400	1.03	0.000	0.000	3.48		3.48	Verifica	302.1	1.32	Verifica
P9	al C al 17	S6	207 (C)	0.70	1.00	4 311.9			4.00	4.00	1.30	688.3	4 831.9	400	1.03	0.000	0.000	3.48		3.48	Verifica	302.0	1.32	Verifica
P9	al C al 17	S6	208 (C)	0.70	1.00	4 308.0			4.00	4.00	1.30	688.3	4 828.0	400	1.03	0.000	0.000	3.47		3.47	Verifica	301.8	1.33	Verifica
P9	al C al 17	S6	209 (C)	0.70	1.00	3 800.7			4.00	4.00	1.30	688.3	4 320.7	400	0.98	0.000	0.000	3.29		3.29	Verifica	270.0	1.48	Verifica
P9	al C al 17	S6	210 (C)	0.70	1.00	3 800.7			4.00	4.00	1.30	688.3	4 320.7	400	0.98	0.000	0.000	3.29		3.29	Verifica	270.0	1.48	Verifica
P9	al C al 17	S6	211 (C)	0.70	1.00	3 798.6			4.00	4.00	1.30	688.3	4 318.6	400	0.98	0.000	0.000	3.29		3.29	Verifica	269.9	1.48	Verifica
P9	al C al 17	S6	212 (C)	0.70	1.00	3 794.7			4.00	4.00	1.30	688.3	4 314.7	400	0.98	0.000	0.000	3.28		3.28	Verifica	269.7	1.48	Verifica
P9	al C al 17	S6	213 (C)	0.70	1.00	4 545.9			4.00	4.00	1.30	688.3	5 065.9	400	1.06	0.000	0.000	3.56		3.56	Verifica	316.6	1.26	Verifica
P9	al C al 17	S6	214 (C)	0.70	1.00	4 545.9			4.00	4.00	1.30	688.3	5 065.9											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 17 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al C al 17	S6	105 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6764.8	929.2	7694.0	0.000	0.000	2644.8	60.83	16.01	Ø20/0.125	25.13	1.57	2404.4	55.30	14.18	Ø20/0.125	25.13	1.77	Verifica
P9	al C al 17	S6	106 (C)	0.70	1.00	4.00	4.00	1.30	1.20	2525.3	929.2	7346.2	0.000	0.000	2525.3	58.08	15.28	Ø20/0.125	25.13	1.64	2295.7	52.80	13.54	Ø20/0.125	25.13	1.86	Verifica
P9	al C al 17	S6	107 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6417.0	929.2	7346.2	0.000	0.000	2525.3	58.08	15.28	Ø20/0.125	25.13	1.64	2295.7	52.80	13.54	Ø20/0.125	25.13	1.86	Verifica
P9	al C al 17	S6	108 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6413.8	929.2	7343.0	0.000	0.000	2524.2	58.06	15.28	Ø20/0.125	25.13	1.64	2294.7	52.78	13.53	Ø20/0.125	25.13	1.86	Verifica
P9	al C al 17	S6	109 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6407.9	929.2	7337.1	0.000	0.000	2522.1	58.01	15.27	Ø20/0.125	25.13	1.65	2292.8	52.74	13.52	Ø20/0.125	25.13	1.86	Verifica
P9	al C al 17	S6	110 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6764.8	929.2	7694.0	0.000	0.000	2644.8	60.83	16.01	Ø20/0.125	25.13	1.57	2404.4	55.30	14.18	Ø20/0.125	25.13	1.77	Verifica
P9	al C al 17	S6	111 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6764.8	929.2	7694.0	0.000	0.000	2644.8	60.83	16.01	Ø20/0.125	25.13	1.57	2404.4	55.30	14.18	Ø20/0.125	25.13	1.77	Verifica
P9	al C al 17	S6	112 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6761.6	929.2	7690.8	0.000	0.000	2643.7	60.81	16.00	Ø20/0.125	25.13	1.57	2403.4	55.28	14.17	Ø20/0.125	25.13	1.77	Verifica
P9	al C al 17	S6	113 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6755.7	929.2	7684.9	0.000	0.000	2641.7	60.76	15.99	Ø20/0.125	25.13	1.57	2401.5	55.24	14.16	Ø20/0.125	25.13	1.77	Verifica
P9	al C al 17	S6	114 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4064.3	929.2	4993.5	0.000	0.000	1716.5	39.48	10.39	Ø20/0.125	25.13	2.42	1560.5	35.89	9.20	Ø20/0.125	25.13	2.73	Verifica
P9	al C al 17	S6	115 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5182.1	929.2	6111.3	0.000	0.000	2100.8	48.32	12.72	Ø20/0.125	25.13	1.98	1909.8	43.93	11.26	Ø20/0.125	25.13	2.23	Verifica
P9	al C al 17	S6	116 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4064.3	929.2	4993.5	0.000	0.000	1716.5	39.48	10.39	Ø20/0.125	25.13	2.42	1560.5	35.89	9.20	Ø20/0.125	25.13	2.73	Verifica
P9	al C al 17	S6	117 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4064.3	929.2	4993.5	0.000	0.000	1716.5	39.48	10.39	Ø20/0.125	25.13	2.42	1560.5	35.89	9.20	Ø20/0.125	25.13	2.73	Verifica
P9	al C al 17	S6	118 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4061.1	929.2	4990.3	0.000	0.000	1715.4	39.45	10.38	Ø20/0.125	25.13	2.42	1559.5	35.87	9.20	Ø20/0.125	25.13	2.73	Verifica
P9	al C al 17	S6	119 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4055.2	929.2	4984.4	0.000	0.000	1713.4	39.41	10.37	Ø20/0.125	25.13	2.42	1557.6	35.83	9.19	Ø20/0.125	25.13	2.74	Verifica
P9	al C al 17	S6	120 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5182.1	929.2	6111.3	0.000	0.000	2100.8	48.32	12.72	Ø20/0.125	25.13	1.98	1909.8	43.93	11.26	Ø20/0.125	25.13	2.23	Verifica
P9	al C al 17	S6	121 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5182.1	929.2	6111.3	0.000	0.000	2100.8	48.32	12.72	Ø20/0.125	25.13	1.98	1909.8	43.93	11.26	Ø20/0.125	25.13	2.23	Verifica
P9	al C al 17	S6	122 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5178.9	929.2	6108.1	0.000	0.000	2099.7	48.29	12.71	Ø20/0.125	25.13	1.98	1908.8	43.90	11.26	Ø20/0.125	25.13	2.23	Verifica
P9	al C al 17	S6	123 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5173.0	929.2	6102.2	0.000	0.000	2097.6	48.25	12.70	Ø20/0.125	25.13	1.98	1906.9	43.86	11.25	Ø20/0.125	25.13	2.23	Verifica
P9	al C al 17	S6	124 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4822.3	929.2	5751.5	0.000	0.000	1977.1	45.47	11.97	Ø20/0.125	25.13	2.10	1797.3	41.34	10.60	Ø20/0.125	25.13	2.37	Verifica
P9	al C al 17	S6	125 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5940.1	929.2	6869.3	0.000	0.000	2361.3	54.31	14.29	Ø20/0.125	25.13	1.76	2146.7	49.37	12.66	Ø20/0.125	25.13	1.99	Verifica
P9	al C al 17	S6	126 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5170.1	929.2	6099.3	0.000	0.000	2096.6	48.22	12.69	Ø20/0.125	25.13	1.98	1906.0	43.84	11.24	Ø20/0.125	25.13	2.24	Verifica
P9	al C al 17	S6	127 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4822.3	929.2	5751.5	0.000	0.000	1977.1	45.47	11.97	Ø20/0.125	25.13	2.10	1797.3	41.34	10.60	Ø20/0.125	25.13	2.37	Verifica
P9	al C al 17	S6	128 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4822.3	929.2	5751.5	0.000	0.000	1977.1	45.47	11.97	Ø20/0.125	25.13	2.10	1797.3	41.34	10.60	Ø20/0.125	25.13	2.37	Verifica
P9	al C al 17	S6	129 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4819.1	929.2	5748.3	0.000	0.000	1976.0	45.45	11.96	Ø20/0.125	25.13	2.10	1796.3	41.32	10.59	Ø20/0.125	25.13	2.37	Verifica
P9	al C al 17	S6	130 (C)	0.70	1.00	4.00	4.00	1.30	1.20	4813.2	929.2	5742.4	0.000	0.000	1974.0	45.40	11.95	Ø20/0.125	25.13	2.10	1794.5	41.27	10.58	Ø20/0.125	25.13	2.37	Verifica
P9	al C al 17	S6	131 (C)	0.70	1.00	4.00	4.00	1.30	1.20	6287.9	929.2	7217.1	0.000	0.000	2480.9	57.06	15.02	Ø20/0.125	25.13	1.67	2255.3	51.87	13.30	Ø20/0.125	25.13	1.89	Verifica
P9	al C al 17	S6	132 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5940.1	929.2	6869.3	0.000	0.000	2361.3	54.31	14.29	Ø20/0.125	25.13	1.76	2146.7	49.37	12.66	Ø20/0.125	25.13	1.99	Verifica
P9	al C al 17	S6	133 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5940.1	929.2	6869.3	0.000	0.000	2361.3	54.31	14.29	Ø20/0.125	25.13	1.76	2146.7	49.37	12.66	Ø20/0.125	25.13	1.99	Verifica
P9	al C al 17	S6	134 (C)	0.70	1.00	4.00	4.00	1.30	1.20	5936.9	929.2	6866.1	0.000	0.000	2360.2	54.29	14.29	Ø20/0.125	25.13	1.76	2145.7	49.35	12.65	Ø20/0.125	25.13	1.99	Verifica
P9	al C al 17																										

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 17 - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{Ed}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m ²)	(kN)	(kNm)	(kNm)	(kN)		(m)		(m)	(kN/m ²)		(cm2/m)		(cm2/m)
P9	al C al 17	S6	105 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	481	7 694.0			1691.6	0.000	0.000	1.00	697.6	1.41	25.13	25.13	0.002	1247.3	1.8	Verifica
P9	al C al 17	S6	106 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	459	7 346.2			1607.5	0.000	0.000	1.00	667.0	1.41	25.13	25.13	0.002	1247.3	1.9	Verifica
P9	al C al 17	S6	107 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	459	7 346.2			1607.5	0.000	0.000	1.00	667.0	1.41	25.13	25.13	0.002	1247.3	1.9	Verifica
P9	al C al 17	S6	108 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	459	7 343.0			1606.7	0.000	0.000	1.00	666.7	1.41	25.13	25.13	0.002	1247.3	1.9	Verifica
P9	al C al 17	S6	109 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	459	7 337.1			1605.3	0.000	0.000	1.00	666.2	1.41	25.13	25.13	0.002	1247.3	1.9	Verifica
P9	al C al 17	S6	110 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	481	7 694.0			1691.6	0.000	0.000	1.00	697.6	1.41	25.13	25.13	0.002	1247.3	1.8	Verifica
P9	al C al 17	S6	111 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	481	7 694.0			1691.6	0.000	0.000	1.00	697.6	1.41	25.13	25.13	0.002	1247.3	1.8	Verifica
P9	al C al 17	S6	112 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	481	7 690.8			1690.8	0.000	0.000	1.00	697.4	1.41	25.13	25.13	0.002	1247.3	1.8	Verifica
P9	al C al 17	S6	113 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	480	7 684.9			1689.4	0.000	0.000	1.00	696.8	1.41	25.13	25.13	0.002	1247.3	1.8	Verifica
P9	al C al 17	S6	114 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	312	4 993.5			1038.3	0.000	0.000	1.00	459.7	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P9	al C al 17	S6	115 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	382	6 111.3			1308.7	0.000	0.000	1.00	558.2	1.41	25.13	25.13	0.002	1247.3	2.2	Verifica
P9	al C al 17	S6	116 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	312	4 993.5			1038.3	0.000	0.000	1.00	459.7	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P9	al C al 17	S6	117 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	312	4 993.5			1038.3	0.000	0.000	1.00	459.7	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P9	al C al 17	S6	118 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	312	4 990.3			1037.5	0.000	0.000	1.00	459.4	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P9	al C al 17	S6	119 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	312	4 984.4			1036.1	0.000	0.000	1.00	458.9	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P9	al C al 17	S6	120 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	382	6 111.3			1308.7	0.000	0.000	1.00	558.2	1.41	25.13	25.13	0.002	1247.3	2.2	Verifica
P9	al C al 17	S6	121 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	382	6 111.3			1308.7	0.000	0.000	1.00	558.2	1.41	25.13	25.13	0.002	1247.3	2.2	Verifica
P9	al C al 17	S6	122 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	382	6 108.1			1307.9	0.000	0.000	1.00	557.9	1.41	25.13	25.13	0.002	1247.3	2.2	Verifica
P9	al C al 17	S6	123 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	381	6 102.2			1306.5	0.000	0.000	1.00	557.4	1.41	25.13	25.13	0.002	1247.3	2.2	Verifica
P9	al C al 17	S6	124 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	359	5 751.5			1221.7	0.000	0.000	1.00	526.5	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al C al 17	S6	125 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	429	6 869.3			1492.1	0.000	0.000	1.00	625.0	1.41	25.13	25.13	0.002	1247.3	2.0	Verifica
P9	al C al 17	S6	126 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	381	6 099.3			1305.8	0.000	0.000	1.00	557.1	1.41	25.13	25.13	0.002	1247.3	2.2	Verifica
P9	al C al 17	S6	127 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	359	5 751.5			1221.7	0.000	0.000	1.00	526.5	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al C al 17	S6	128 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	359	5 751.5			1221.7	0.000	0.000	1.00	526.5	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al C al 17	S6	129 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	359	5 748.3			1220.9	0.000	0.000	1.00	526.2	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al C al 17	S6	130 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	359	5 742.4			1219.5	0.000	0.000	1.00	525.7	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al C al 17	S6	131 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	451	7 217.1			1576.2	0.000	0.000	1.00	655.6	1.41	25.13	25.13	0.002	1247.3	1.9	Verifica
P9	al C al 17	S6	132 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	429	6 869.3			1492.1	0.000	0.000	1.00	625.0	1.41	25.13	25.13	0.002	1247.3	2.0	Verifica
P9	al C al 17	S6	133 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	429	6 869.3			1492.1	0.000	0.000	1.00	625.0	1.41	25.13	25.13	0.002	1247.3	2.0	Verifica
P9	al C al 17	S6	134 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	429	6 866.1			1491.3	0.000	0.000	1.00	624.7	1.41	25.13	25.13	0.002	1247.3	2.0	Verifica
P9	al C al 17	S6	135 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	429	6 860.2			1489.9	0.000	0.000	1.00	624.2	1.41	25.13	25.13	0.002	1247.3	2.0	Verifica
P9	al C al 17	S6	136 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	451	7 217.1			1576.2	0.000	0.000	1.00	655.6	1.41	25.13	25.13	0.002	1247.3	1.9	Verifica
P9	al C al 17	S6	137 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.87	451	7 217.1			1576.2	0.000	0.000	1.00	655.6	1.41	25.13	25.13	0.002	1247.3	1.9	Verifica
P9	al C al 17	S6	138 (C)	0.70	1.00	1.30	1.20	1.90	2.20	7.170	3.																

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 18 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P7	al A' al 18	S6	177 (C)	0.70	1.40	4 122.8			4.00	4.00	1.30	715.3	4 642.8	400	1.01	0.000	0.000	3.41		3.41	Verifica	290.2	1.38	Verifica
P9	al A' al 18	S6	178 (C)	0.70	1.40	4 213.3			4.00	4.00	1.30	715.3	4 733.3	400	1.02	0.000	0.000	3.44		3.44	Verifica	295.8	1.35	Verifica
P9	al A' al 18	S6	179 (C)	0.70	1.40	4 122.8			4.00	4.00	1.30	715.3	4 642.8	400	1.01	0.000	0.000	3.41		3.41	Verifica	290.2	1.38	Verifica
P9	al A' al 18	S6	180 (C)	0.70	1.40	4 122.8			4.00	4.00	1.30	715.3	4 642.8	400	1.01	0.000	0.000	3.41		3.41	Verifica	290.2	1.38	Verifica
P9	al A' al 18	S6	181 (C)	0.70	1.40	4 083.6			4.00	4.00	1.30	715.3	4 603.6	400	1.01	0.000	0.000	3.39		3.39	Verifica	287.7	1.39	Verifica
P9	al A' al 18	S6	182 (C)	0.70	1.40	4 075.9			4.00	4.00	1.30	715.3	4 595.9	400	1.01	0.000	0.000	3.39		3.39	Verifica	287.2	1.39	Verifica
P9	al A' al 18	S6	183 (C)	0.70	1.40	4 213.3			4.00	4.00	1.30	715.3	4 733.3	400	1.02	0.000	0.000	3.44		3.44	Verifica	295.8	1.35	Verifica
P9	al A' al 18	S6	184 (C)	0.70	1.40	4 213.3			4.00	4.00	1.30	715.3	4 733.3	400	1.02	0.000	0.000	3.44		3.44	Verifica	295.8	1.35	Verifica
P9	al A' al 18	S6	185 (C)	0.70	1.40	4 174.1			4.00	4.00	1.30	715.3	4 694.1	400	1.02	0.000	0.000	3.43		3.43	Verifica	293.4	1.36	Verifica
P9	al A' al 18	S6	186 (C)	0.70	1.40	4 166.4			4.00	4.00	1.30	715.3	4 686.4	400	1.02	0.000	0.000	3.42		3.42	Verifica	292.9	1.37	Verifica
P9	al A' al 18	S6	187 (C)	0.70	1.40	3 505.5			4.00	4.00	1.30	715.3	4 025.5	400	0.94	0.000	0.000	3.17		3.17	Verifica	251.6	1.59	Verifica
P9	al A' al 18	S6	188 (C)	0.70	1.40	4 028.1			4.00	4.00	1.30	715.3	4 548.1	400	1.00	0.000	0.000	3.37		3.37	Verifica	284.3	1.41	Verifica
P9	al A' al 18	S6	189 (C)	0.70	1.40	3 505.5			4.00	4.00	1.30	715.3	4 025.5	400	0.94	0.000	0.000	3.17		3.17	Verifica	251.6	1.59	Verifica
P9	al A' al 18	S6	190 (C)	0.70	1.40	3 505.5			4.00	4.00	1.30	715.3	4 025.5	400	0.94	0.000	0.000	3.17		3.17	Verifica	251.6	1.59	Verifica
P9	al A' al 18	S6	191 (C)	0.70	1.40	3 466.3			4.00	4.00	1.30	715.3	3 986.3	400	0.94	0.000	0.000	3.16		3.16	Verifica	249.1	1.61	Verifica
P9	al A' al 18	S6	192 (C)	0.70	1.40	3 458.6			4.00	4.00	1.30	715.3	3 978.6	400	0.94	0.000	0.000	3.15		3.15	Verifica	248.7	1.61	Verifica
P9	al A' al 18	S6	193 (C)	0.70	1.40	4 028.1			4.00	4.00	1.30	715.3	4 548.1	400	1.00	0.000	0.000	3.37		3.37	Verifica	284.3	1.41	Verifica
P9	al A' al 18	S6	194 (C)	0.70	1.40	4 028.1			4.00	4.00	1.30	715.3	4 548.1	400	1.00	0.000	0.000	3.37		3.37	Verifica	284.3	1.41	Verifica
P9	al A' al 18	S6	195 (C)	0.70	1.40	3 988.9			4.00	4.00	1.30	715.3	4 508.9	400	1.00	0.000	0.000	3.36		3.36	Verifica	281.8	1.42	Verifica
P9	al A' al 18	S6	196 (C)	0.70	1.40	3 981.2			4.00	4.00	1.30	715.3	4 501.2	400	1.00	0.000	0.000	3.35		3.35	Verifica	281.3	1.42	Verifica
P9	al A' al 18	S6	197 (C)	0.70	1.40	3 392.5			4.00	4.00	1.30	715.3	3 912.5	400	0.93	0.000	0.000	3.13		3.13	Verifica	244.5	1.64	Verifica
P9	al A' al 18	S6	198 (C)	0.70	1.40	3 915.1			4.00	4.00	1.30	715.3	4 435.1	400	0.99	0.000	0.000	3.33		3.33	Verifica	277.2	1.44	Verifica
P9	al A' al 18	S6	199 (C)	0.70	1.40	3 483.0			4.00	4.00	1.30	715.3	4 003.0	400	0.94	0.000	0.000	3.16		3.16	Verifica	250.2	1.60	Verifica
P9	al A' al 18	S6	200 (C)	0.70	1.40	3 392.5			4.00	4.00	1.30	715.3	3 912.5	400	0.93	0.000	0.000	3.13		3.13	Verifica	244.5	1.64	Verifica
P9	al A' al 18	S6	201 (C)	0.70	1.40	3 392.5			4.00	4.00	1.30	715.3	3 912.5	400	0.93	0.000	0.000	3.13		3.13	Verifica	244.5	1.64	Verifica
P9	al A' al 18	S6	202 (C)	0.70	1.40	3 353.3			4.00	4.00	1.30	715.3	3 873.3	400	0.92	0.000	0.000	3.11		3.11	Verifica	242.1	1.65	Verifica
P9	al A' al 18	S6	203 (C)	0.70	1.40	3 345.6			4.00	4.00	1.30	715.3	3 865.6	400	0.92	0.000	0.000	3.11		3.11	Verifica	241.6	1.66	Verifica
P9	al A' al 18	S6	204 (C)	0.70	1.40	4 005.6			4.00	4.00	1.30	715.3	4 525.6	400	1.00	0.000	0.000	3.36		3.36	Verifica	282.9	1.41	Verifica
P9	al A' al 18	S6	205 (C)	0.70	1.40	3 915.1			4.00	4.00	1.30	715.3	4 435.1	400	0.99	0.000	0.000	3.33		3.33	Verifica	277.2	1.44	Verifica
P9	al A' al 18	S6	206 (C)	0.70	1.40	3 915.1			4.00	4.00	1.30	715.3	4 435.1	400	0.99	0.000	0.000	3.33		3.33	Verifica	277.2	1.44	Verifica
P9	al A' al 18	S6	207 (C)	0.70	1.40	3 875.9			4.00	4.00	1.30	715.3	4 395.9	400	0.98	0.000	0.000	3.32		3.32	Verifica	274.7	1.46	Verifica
P9	al A' al 18	S6	208 (C)	0.70	1.40	3 868.2			4.00	4.00	1.30	715.3	4 388.2	400	0.98	0.000	0.000	3.31		3.31	Verifica	274.3	1.46	Verifica
P9	al A' al 18	S6	209 (C)	0.70	1.40	3 483.0			4.00	4.00	1.30	715.3	4 003.0	400	0.94	0.000	0.000	3.16		3.16	Verifica	250.2	1.60	Verifica
P9	al A' al 18	S6	210 (C)	0.70	1.40	3 483.0			4.00	4.00	1.30	715.3	4 003.0	400	0.94	0.000	0.000	3.16		3.16	Verifica	250.2	1.60	Verifica
P9	al A' al 18	S6	211 (C)	0.70	1.40	3 443.8			4.00	4.00	1.30	715.3	3 963.8	400	0.93	0.000	0.000	3.15		3.15	Verifica	247.7	1.61	Verifica
P9	al A' al 18	S6	212 (C)	0.70	1.40	3 436.1			4.00	4.00	1.30	715.3	3 956.1	400	0.93	0.000	0.000	3.14		3.14	Verifica	247.3	1.62	Verifica
P9	al A' al 18	S6	213 (C)	0.70	1.40	4 005.6			4.00	4.00	1.30	715.3	4 525.6	400	1.00	0.000	0.000	3.36		3.36	Verifica	282.9	1.41	Verifica
P9	al A' al 18	S6	214 (C)	0.70	1.40	4 005.6			4.00	4.00	1.30	715.3	4 525.6	400	1.00	0.000	0.000	3.36						

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 10 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	
P7	al A´ al 18	S6	105 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5822.9	965.6	6788.5	0.000	0.000	2333.5	53.67	14.12	Ø20/0.125	25.13	1.78	1838.6	42.29	10.84	Ø20/0.125	25.13	2.32	Verifica
P9	al A´ al 18	S6	106 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2286.9	965.6	6652.8	0.000	0.000	2286.9	52.60	13.84	Ø20/0.125	25.13	1.82	1801.8	41.44	10.63	Ø20/0.125	25.13	2.36	Verifica
P9	al A´ al 18	S6	107 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5687.2	965.6	6652.8	0.000	0.000	2286.9	52.60	13.84	Ø20/0.125	25.13	1.82	1801.8	41.44	10.63	Ø20/0.125	25.13	2.36	Verifica
P9	al A´ al 18	S6	108 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5628.4	965.6	6594.0	0.000	0.000	2266.7	52.13	13.72	Ø20/0.125	25.13	1.83	1785.9	41.08	10.53	Ø20/0.125	25.13	2.39	Verifica
P9	al A´ al 18	S6	109 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5616.9	965.6	6582.5	0.000	0.000	2262.7	52.04	13.70	Ø20/0.125	25.13	1.83	1782.8	41.00	10.51	Ø20/0.125	25.13	2.39	Verifica
P9	al A´ al 18	S6	110 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5822.9	965.6	6788.5	0.000	0.000	2333.5	53.67	14.12	Ø20/0.125	25.13	1.78	1838.6	42.29	10.84	Ø20/0.125	25.13	2.32	Verifica
P9	al A´ al 18	S6	111 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5822.9	965.6	6788.5	0.000	0.000	2333.5	53.67	14.12	Ø20/0.125	25.13	1.78	1838.6	42.29	10.84	Ø20/0.125	25.13	2.32	Verifica
P9	al A´ al 18	S6	112 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5764.2	965.6	6729.8	0.000	0.000	2313.4	53.21	14.00	Ø20/0.125	25.13	1.79	1822.7	41.92	10.75	Ø20/0.125	25.13	2.34	Verifica
P9	al A´ al 18	S6	113 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5752.6	965.6	6718.2	0.000	0.000	2309.4	53.12	13.98	Ø20/0.125	25.13	1.80	1819.5	41.85	10.73	Ø20/0.125	25.13	2.34	Verifica
P9	al A´ al 18	S6	114 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3570.1	965.6	4535.7	0.000	0.000	1559.1	35.86	9.44	Ø20/0.125	25.13	2.66	1228.4	28.25	7.24	Ø20/0.125	25.13	3.47	Verifica
P9	al A´ al 18	S6	115 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4354.0	965.6	5319.6	0.000	0.000	1828.6	42.06	11.07	Ø20/0.125	25.13	2.27	1440.7	33.14	8.50	Ø20/0.125	25.13	2.96	Verifica
P9	al A´ al 18	S6	116 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3570.1	965.6	4535.7	0.000	0.000	1559.1	35.86	9.44	Ø20/0.125	25.13	2.66	1228.4	28.25	7.24	Ø20/0.125	25.13	3.47	Verifica
P9	al A´ al 18	S6	117 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3570.1	965.6	4535.7	0.000	0.000	1559.1	35.86	9.44	Ø20/0.125	25.13	2.66	1228.4	28.25	7.24	Ø20/0.125	25.13	3.47	Verifica
P9	al A´ al 18	S6	118 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3511.3	965.6	4476.9	0.000	0.000	1538.9	35.40	9.31	Ø20/0.125	25.13	2.70	1212.5	27.89	7.15	Ø20/0.125	25.13	3.51	Verifica
P9	al A´ al 18	S6	119 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3499.8	965.6	4465.4	0.000	0.000	1535.0	35.30	9.29	Ø20/0.125	25.13	2.70	1209.4	27.82	7.13	Ø20/0.125	25.13	3.52	Verifica
P9	al A´ al 18	S6	120 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4354.0	965.6	5319.6	0.000	0.000	1828.6	42.06	11.07	Ø20/0.125	25.13	2.27	1440.7	33.14	8.50	Ø20/0.125	25.13	2.96	Verifica
P9	al A´ al 18	S6	121 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4354.0	965.6	5319.6	0.000	0.000	1828.6	42.06	11.07	Ø20/0.125	25.13	2.27	1440.7	33.14	8.50	Ø20/0.125	25.13	2.96	Verifica
P9	al A´ al 18	S6	122 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4295.2	965.6	5260.8	0.000	0.000	1808.4	41.59	10.95	Ø20/0.125	25.13	2.30	1424.8	32.77	8.40	Ø20/0.125	25.13	2.99	Verifica
P9	al A´ al 18	S6	123 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4283.7	965.6	5249.3	0.000	0.000	1804.4	41.50	10.92	Ø20/0.125	25.13	2.30	1421.7	32.70	8.38	Ø20/0.125	25.13	3.00	Verifica
P9	al A´ al 18	S6	124 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4591.8	965.6	5557.4	0.000	0.000	1910.4	43.94	11.56	Ø20/0.125	25.13	2.17	1505.1	34.62	8.88	Ø20/0.125	25.13	2.83	Verifica
P9	al A´ al 18	S6	125 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5375.7	965.6	6341.3	0.000	0.000	2179.8	50.14	13.19	Ø20/0.125	25.13	1.90	1717.4	39.50	10.13	Ø20/0.125	25.13	2.48	Verifica
P9	al A´ al 18	S6	126 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4727.5	965.6	5693.1	0.000	0.000	1957.0	45.01	11.85	Ø20/0.125	25.13	2.12	1541.9	35.46	9.09	Ø20/0.125	25.13	2.76	Verifica
P9	al A´ al 18	S6	127 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4591.8	965.6	5557.4	0.000	0.000	1910.4	43.94	11.56	Ø20/0.125	25.13	2.17	1505.1	34.62	8.88	Ø20/0.125	25.13	2.83	Verifica
P9	al A´ al 18	S6	128 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4591.8	965.6	5557.4	0.000	0.000	1910.4	43.94	11.56	Ø20/0.125	25.13	2.17	1505.1	34.62	8.88	Ø20/0.125	25.13	2.83	Verifica
P9	al A´ al 18	S6	129 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4533.0	965.6	5498.6	0.000	0.000	1890.1	43.47	11.44	Ø20/0.125	25.13	2.20	1489.2	34.25	8.78	Ø20/0.125	25.13	2.86	Verifica
P9	al A´ al 18	S6	130 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4521.4	965.6	5487.0	0.000	0.000	1886.2	43.38	11.42	Ø20/0.125	25.13	2.20	1486.1	34.18	8.76	Ø20/0.125	25.13	2.87	Verifica
P9	al A´ al 18	S6	131 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5511.4	965.6	6477.0	0.000	0.000	2226.5	51.21	13.48	Ø20/0.125	25.13	1.86	1754.2	40.35	10.35	Ø20/0.125	25.13	2.43	Verifica
P9	al A´ al 18	S6	132 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5375.7	965.6	6341.3	0.000	0.000	2179.8	50.14	13.19	Ø20/0.125	25.13	1.90	1717.4	39.50	10.13	Ø20/0.125	25.13	2.48	Verifica
P9	al A´ al 18	S6	133 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5375.7	965.6	6341.3	0.000	0.000	2179.8	50.14	13.19	Ø20/0.125	25.13	1.90	1717.4	39.50	10.13	Ø20/0.125	25.13	2.48	Verifica
P9	al A´ al 18	S6	134 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5316.9	965.6	6282.5	0.000	0.000	2159.6	49.67	13.07	Ø20/0.125	25.13	1.92	1701.5	39.13	10.03	Ø20/0.125	25.13	2.50	Verifica
P9	al A´ al																										

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 10 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{seg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)		(m)		(m)	(kN/m²)		(cm2/m)		(cm2/m)
P7	al A´ al 18	S6	105 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	424	6 788.5			1761.7	0.000	0.000	1.00	525.6	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	106 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	416	6 652.8			1722.4	0.000	0.000	1.00	515.5	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	107 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	416	6 652.8			1722.4	0.000	0.000	1.00	515.5	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	108 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	412	6 594.0			1705.4	0.000	0.000	1.00	511.2	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	109 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	411	6 582.5			1702.0	0.000	0.000	1.00	510.3	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	110 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	424	6 788.5			1761.7	0.000	0.000	1.00	525.6	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	111 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	424	6 788.5			1761.7	0.000	0.000	1.00	525.6	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	112 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	421	6 729.8			1744.7	0.000	0.000	1.00	521.2	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	113 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	420	6 718.2			1741.3	0.000	0.000	1.00	520.4	1.41	25.13	25.13	0.002	1247.3	2.4	Verifica
P9	al A´ al 18	S6	114 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	283	4 535.7			1109.6	0.000	0.000	1.00	358.2	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P9	al A´ al 18	S6	115 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	332	5 319.6			1336.5	0.000	0.000	1.00	416.5	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P9	al A´ al 18	S6	116 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	283	4 535.7			1109.6	0.000	0.000	1.00	358.2	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P9	al A´ al 18	S6	117 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	283	4 535.7			1109.6	0.000	0.000	1.00	358.2	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P9	al A´ al 18	S6	118 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	280	4 476.9			1092.6	0.000	0.000	1.00	353.9	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P9	al A´ al 18	S6	119 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	279	4 465.4			1089.3	0.000	0.000	1.00	353.0	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P9	al A´ al 18	S6	120 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	332	5 319.6			1336.5	0.000	0.000	1.00	416.5	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P9	al A´ al 18	S6	121 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	332	5 319.6			1336.5	0.000	0.000	1.00	416.5	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P9	al A´ al 18	S6	122 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	329	5 260.8			1319.5	0.000	0.000	1.00	412.1	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P9	al A´ al 18	S6	123 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	328	5 249.3			1316.2	0.000	0.000	1.00	411.2	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P9	al A´ al 18	S6	124 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	347	5 557.4			1405.3	0.000	0.000	1.00	434.1	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P9	al A´ al 18	S6	125 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	396	6 341.3			1632.2	0.000	0.000	1.00	492.4	1.41	25.13	25.13	0.002	1247.3	2.5	Verifica
P9	al A´ al 18	S6	126 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	356	5 693.1			1444.6	0.000	0.000	1.00	444.2	1.41	25.13	25.13	0.002	1247.3	2.8	Verifica
P9	al A´ al 18	S6	127 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	347	5 557.4			1405.3	0.000	0.000	1.00	434.1	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P9	al A´ al 18	S6	128 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	347	5 557.4			1405.3	0.000	0.000	1.00	434.1	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P9	al A´ al 18	S6	129 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	344	5 498.6			1388.3	0.000	0.000	1.00	429.8	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P9	al A´ al 18	S6	130 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	343	5 487.0			1385.0	0.000	0.000	1.00	428.9	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P9	al A´ al 18	S6	131 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	405	6 477.0			1671.5	0.000	0.000	1.00	502.5	1.41	25.13	25.13	0.002	1247.3	2.5	Verifica
P9	al A´ al 18	S6	132 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	396	6 341.3			1632.2	0.000	0.000	1.00	492.4	1.41	25.13	25.13	0.002	1247.3	2.5	Verifica
P9	al A´ al 18	S6	133 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	396	6 341.3			1632.2	0.000	0.000	1.00	492.4	1.41	25.13	25.13	0.002	1247.3	2.5	Verifica
P9	al A´ al 18	S6	134 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	393	6 282.5			1615.2	0.000	0.000	1.00	488.0	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P9	al A´ al 18	S6	135 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	392	6 270.9			1611.8	0.000	0.000	1.00	487.2	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P9	al A´ al 18	S6	136 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	405	6 477.0			1671.5	0.000	0.000	1.00	502.5	1.41	25.13	25.13	0.002	1247.3	2.5	Verifica
P9	al A´ al 18	S6	137 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	405	6 477.0			1671.5	0.000	0.000	1.00	502.5	1.41	25.13	25.13	0.002	1247.3	2.5	Verifica
P9	al A´ al 18	S6	138 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.																	

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 18 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)				
P9	al B al 18	S7	177 (C)	0.70	1.00	3 231.8			3.50	3.50	1.10	487.0	3 718.8	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.6	1.32	Verifica
P9	al B al 18	S7	178 (C)	0.70	1.00	3 407.2			3.50	3.50	1.10	487.0	3 894.2	400	0.93	0.000	0.000	3.12		3.12	Verifica	317.9	1.26	Verifica
P9	al B al 18	S7	179 (C)	0.70	1.00	3 231.8			3.50	3.50	1.10	487.0	3 718.8	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.6	1.32	Verifica
P9	al B al 18	S7	180 (C)	0.70	1.00	3 231.8			3.50	3.50	1.10	487.0	3 718.8	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.6	1.32	Verifica
P9	al B al 18	S7	181 (C)	0.70	1.00	3 229.0			3.50	3.50	1.10	487.0	3 716.0	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.3	1.32	Verifica
P9	al B al 18	S7	182 (C)	0.70	1.00	3 217.9			3.50	3.50	1.10	487.0	3 704.9	400	0.90	0.000	0.000	3.04		3.04	Verifica	302.4	1.32	Verifica
P9	al B al 18	S7	183 (C)	0.70	1.00	3 407.2			3.50	3.50	1.10	487.0	3 894.2	400	0.93	0.000	0.000	3.12		3.12	Verifica	317.9	1.26	Verifica
P9	al B al 18	S7	184 (C)	0.70	1.00	3 407.2			3.50	3.50	1.10	487.0	3 894.2	400	0.93	0.000	0.000	3.12		3.12	Verifica	317.9	1.26	Verifica
P9	al B al 18	S7	185 (C)	0.70	1.00	3 404.4			3.50	3.50	1.10	487.0	3 891.4	400	0.93	0.000	0.000	3.12		3.12	Verifica	317.7	1.26	Verifica
P9	al B al 18	S7	186 (C)	0.70	1.00	3 393.2			3.50	3.50	1.10	487.0	3 880.2	400	0.92	0.000	0.000	3.11		3.11	Verifica	316.8	1.26	Verifica
P9	al B al 18	S7	187 (C)	0.70	1.00	2 806.7			3.50	3.50	1.10	487.0	3 293.7	400	0.85	0.000	0.000	2.87		2.87	Verifica	268.9	1.49	Verifica
P9	al B al 18	S7	188 (C)	0.70	1.00	3 279.6			3.50	3.50	1.10	487.0	3 766.6	400	0.91	0.000	0.000	3.07		3.07	Verifica	307.5	1.30	Verifica
P9	al B al 18	S7	189 (C)	0.70	1.00	2 806.7			3.50	3.50	1.10	487.0	3 293.7	400	0.85	0.000	0.000	2.87		2.87	Verifica	268.9	1.49	Verifica
P9	al B al 18	S7	190 (C)	0.70	1.00	2 806.7			3.50	3.50	1.10	487.0	3 293.7	400	0.85	0.000	0.000	2.87		2.87	Verifica	268.9	1.49	Verifica
P9	al B al 18	S7	191 (C)	0.70	1.00	2 803.8			3.50	3.50	1.10	487.0	3 290.8	400	0.85	0.000	0.000	2.87		2.87	Verifica	268.6	1.49	Verifica
P9	al B al 18	S7	192 (C)	0.70	1.00	2 792.7			3.50	3.50	1.10	487.0	3 279.7	400	0.85	0.000	0.000	2.86		2.86	Verifica	267.7	1.49	Verifica
P9	al B al 18	S7	193 (C)	0.70	1.00	3 279.6			3.50	3.50	1.10	487.0	3 766.6	400	0.91	0.000	0.000	3.07		3.07	Verifica	307.5	1.30	Verifica
P9	al B al 18	S7	194 (C)	0.70	1.00	3 279.6			3.50	3.50	1.10	487.0	3 766.6	400	0.91	0.000	0.000	3.07		3.07	Verifica	307.5	1.30	Verifica
P9	al B al 18	S7	195 (C)	0.70	1.00	3 276.8			3.50	3.50	1.10	487.0	3 763.8	400	0.91	0.000	0.000	3.07		3.07	Verifica	307.3	1.30	Verifica
P9	al B al 18	S7	196 (C)	0.70	1.00	3 265.7			3.50	3.50	1.10	487.0	3 752.7	400	0.91	0.000	0.000	3.06		3.06	Verifica	306.3	1.31	Verifica
P9	al B al 18	S7	197 (C)	0.70	1.00	2 557.4			3.50	3.50	1.10	487.0	3 044.4	400	0.82	0.000	0.000	2.76		2.76	Verifica	248.5	1.61	Verifica
P9	al B al 18	S7	198 (C)	0.70	1.00	3 030.4			3.50	3.50	1.10	487.0	3 517.4	400	0.88	0.000	0.000	2.97		2.97	Verifica	287.1	1.39	Verifica
P9	al B al 18	S7	199 (C)	0.70	1.00	2 732.7			3.50	3.50	1.10	487.0	3 219.7	400	0.84	0.000	0.000	2.84		2.84	Verifica	262.8	1.52	Verifica
P9	al B al 18	S7	200 (C)	0.70	1.00	2 557.4			3.50	3.50	1.10	487.0	3 044.4	400	0.82	0.000	0.000	2.76		2.76	Verifica	248.5	1.61	Verifica
P9	al B al 18	S7	201 (C)	0.70	1.00	2 557.4			3.50	3.50	1.10	487.0	3 044.4	400	0.82	0.000	0.000	2.76		2.76	Verifica	248.5	1.61	Verifica
P9	al B al 18	S7	202 (C)	0.70	1.00	2 554.6			3.50	3.50	1.10	487.0	3 041.6	400	0.82	0.000	0.000	2.76		2.76	Verifica	248.3	1.61	Verifica
P9	al B al 18	S7	203 (C)	0.70	1.00	2 543.4			3.50	3.50	1.10	487.0	3 030.4	400	0.82	0.000	0.000	2.75		2.75	Verifica	247.4	1.62	Verifica
P9	al B al 18	S7	204 (C)	0.70	1.00	3 205.7			3.50	3.50	1.10	487.0	3 692.7	400	0.90	0.000	0.000	3.04		3.04	Verifica	301.4	1.33	Verifica
P9	al B al 18	S7	205 (C)	0.70	1.00	3 030.4			3.50	3.50	1.10	487.0	3 517.4	400	0.88	0.000	0.000	2.97		2.97	Verifica	287.1	1.39	Verifica
P9	al B al 18	S7	206 (C)	0.70	1.00	3 030.4			3.50	3.50	1.10	487.0	3 517.4	400	0.88	0.000	0.000	2.97		2.97	Verifica	287.1	1.39	Verifica
P9	al B al 18	S7	207 (C)	0.70	1.00	3 027.6			3.50	3.50	1.10	487.0	3 514.6	400	0.88	0.000	0.000	2.96		2.96	Verifica	286.9	1.39	Verifica
P9	al B al 18	S7	208 (C)	0.70	1.00	3 016.4			3.50	3.50	1.10	487.0	3 503.4	400	0.88	0.000	0.000	2.96		2.96	Verifica	286.0	1.40	Verifica
P9	al B al 18	S7	209 (C)	0.70	1.00	2 732.7			3.50	3.50	1.10	487.0	3 219.7	400	0.84	0.000	0.000	2.84		2.84	Verifica	262.8	1.52	Verifica
P9	al B al 18	S7	210 (C)	0.70	1.00	2 732.7			3.50	3.50	1.10	487.0	3 219.7	400	0.84	0.000	0.000	2.84		2.84	Verifica	262.8	1.52	Verifica
P9	al B al 18	S7	211 (C)	0.70	1.00	2 729.9			3.50	3.50	1.10	487.0	3 216.9	400	0.84	0.000	0.000	2.84		2.84	Verifica	262.6	1.52	Verifica
P9	al B al 18	S7	212 (C)	0.70	1.00	2 718.8			3.50	3.50	1.10	487.0	3 205.8	400	0.84	0.000	0.000	2.83		2.83	Verifica	261.7	1.53	Verifica
P9	al B al 18	S7	213 (C)	0.70	1.00	3 205.7			3.50	3.50	1.10	487.0	3 692.7	400	0.90	0.000	0.000	3.04		3.04	Verifica	301.4	1.33	Verifica
P9	al B al 18	S7	214 (C)	0.70	1.00	3 205.7			3.50	3.50	1.10	487.0	3 692.7	400	0.90	0.000	0.000	3.04		3.04	Verifica	301.4		

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 10 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al B al 18	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4728.6	657.5	5386.1	0.000	0.000	1713.8	39.42	11.94	Ø20/0.15	20.93	1.75	1530.1	35.19	10.35	Ø20/0.15	20.93	2.02	Verifica
P9	al B al 18	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4465.5	657.5	5123.0	0.000	0.000	1630.0	37.49	11.36	Ø20/0.15	20.93	1.84	1455.4	33.47	9.85	Ø20/0.15	20.93	2.13	Verifica
P9	al B al 18	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4465.5	657.5	5123.0	0.000	0.000	1630.0	37.49	11.36	Ø20/0.15	20.93	1.84	1455.4	33.47	9.85	Ø20/0.15	20.93	2.13	Verifica
P9	al B al 18	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4461.3	657.5	5118.8	0.000	0.000	1628.7	37.46	11.35	Ø20/0.15	20.93	1.84	1454.2	33.45	9.84	Ø20/0.15	20.93	2.13	Verifica
P9	al B al 18	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4444.6	657.5	5102.1	0.000	0.000	1623.4	37.34	11.31	Ø20/0.15	20.93	1.85	1449.5	33.34	9.81	Ø20/0.15	20.93	2.13	Verifica
P9	al B al 18	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4728.6	657.5	5386.1	0.000	0.000	1713.8	39.42	11.94	Ø20/0.15	20.93	1.75	1530.1	35.19	10.35	Ø20/0.15	20.93	2.02	Verifica
P9	al B al 18	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4728.6	657.5	5386.1	0.000	0.000	1713.8	39.42	11.94	Ø20/0.15	20.93	1.75	1530.1	35.19	10.35	Ø20/0.15	20.93	2.02	Verifica
P9	al B al 18	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4724.4	657.5	5381.9	0.000	0.000	1712.4	39.39	11.94	Ø20/0.15	20.93	1.75	1528.9	35.17	10.34	Ø20/0.15	20.93	2.02	Verifica
P9	al B al 18	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4707.7	657.5	5365.2	0.000	0.000	1707.1	39.26	11.90	Ø20/0.15	20.93	1.76	1524.2	35.06	10.31	Ø20/0.15	20.93	2.03	Verifica
P9	al B al 18	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2931.9	657.5	3589.4	0.000	0.000	1142.1	26.27	7.96	Ø20/0.15	20.93	2.63	1019.7	23.45	6.90	Ø20/0.15	20.93	3.03	Verifica
P9	al B al 18	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3641.4	657.5	4298.9	0.000	0.000	1367.8	31.46	9.53	Ø20/0.15	20.93	2.20	1221.3	28.09	8.26	Ø20/0.15	20.93	2.53	Verifica
P9	al B al 18	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2931.9	657.5	3589.4	0.000	0.000	1142.1	26.27	7.96	Ø20/0.15	20.93	2.63	1019.7	23.45	6.90	Ø20/0.15	20.93	3.03	Verifica
P9	al B al 18	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2931.9	657.5	3589.4	0.000	0.000	1142.1	26.27	7.96	Ø20/0.15	20.93	2.63	1019.7	23.45	6.90	Ø20/0.15	20.93	3.03	Verifica
P9	al B al 18	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2927.7	657.5	3585.2	0.000	0.000	1140.7	26.24	7.95	Ø20/0.15	20.93	2.63	1018.5	23.43	6.89	Ø20/0.15	20.93	3.04	Verifica
P9	al B al 18	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2911.0	657.5	3568.5	0.000	0.000	1135.4	26.11	7.91	Ø20/0.15	20.93	2.64	1013.8	23.32	6.86	Ø20/0.15	20.93	3.05	Verifica
P9	al B al 18	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3641.4	657.5	4298.9	0.000	0.000	1367.8	31.46	9.53	Ø20/0.15	20.93	2.20	1221.3	28.09	8.26	Ø20/0.15	20.93	2.53	Verifica
P9	al B al 18	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3641.4	657.5	4298.9	0.000	0.000	1367.8	31.46	9.53	Ø20/0.15	20.93	2.20	1221.3	28.09	8.26	Ø20/0.15	20.93	2.53	Verifica
P9	al B al 18	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3637.2	657.5	4294.7	0.000	0.000	1366.5	31.43	9.52	Ø20/0.15	20.93	2.20	1220.1	28.06	8.25	Ø20/0.15	20.93	2.54	Verifica
P9	al B al 18	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3620.5	657.5	4278.0	0.000	0.000	1361.2	31.31	9.49	Ø20/0.15	20.93	2.21	1215.3	27.95	8.22	Ø20/0.15	20.93	2.55	Verifica
P9	al B al 18	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3453.9	657.5	4111.4	0.000	0.000	1308.2	30.09	9.12	Ø20/0.15	20.93	2.30	1168.0	26.86	7.90	Ø20/0.15	20.93	2.65	Verifica
P9	al B al 18	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4163.4	657.5	4820.9	0.000	0.000	1533.9	35.28	10.69	Ø20/0.15	20.93	1.96	1369.6	31.50	9.26	Ø20/0.15	20.93	2.26	Verifica
P9	al B al 18	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3716.9	657.5	4374.4	0.000	0.000	1391.8	32.01	9.70	Ø20/0.15	20.93	2.16	1242.7	28.58	8.41	Ø20/0.15	20.93	2.49	Verifica
P9	al B al 18	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3453.9	657.5	4111.4	0.000	0.000	1308.2	30.09	9.12	Ø20/0.15	20.93	2.30	1168.0	26.86	7.90	Ø20/0.15	20.93	2.65	Verifica
P9	al B al 18	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3453.9	657.5	4111.4	0.000	0.000	1308.2	30.09	9.12	Ø20/0.15	20.93	2.30	1168.0	26.86	7.90	Ø20/0.15	20.93	2.65	Verifica
P9	al B al 18	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3449.6	657.5	4107.1	0.000	0.000	1306.8	30.06	9.11	Ø20/0.15	20.93	2.30	1166.8	26.84	7.89	Ø20/0.15	20.93	2.65	Verifica
P9	al B al 18	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3432.9	657.5	4090.4	0.000	0.000	1301.5	29.93	9.07	Ø20/0.15	20.93	2.31	1162.0	26.73	7.86	Ø20/0.15	20.93	2.66	Verifica
P9	al B al 18	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4426.4	657.5	5083.9	0.000	0.000	1617.6	37.20	11.27	Ø20/0.15	20.93	1.86	1444.3	33.22	9.77	Ø20/0.15	20.93	2.14	Verifica
P9	al B al 18	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4163.4	657.5	4820.9	0.000	0.000	1533.9	35.28	10.69	Ø20/0.15	20.93	1.96	1369.6	31.50	9.26	Ø20/0.15	20.93	2.26	Verifica
P9	al B al 18	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4163.4	657.5	4820.9	0.000	0.000	1533.9	35.28	10.69	Ø20/0.15	20.93	1.96	1369.6	31.50	9.26	Ø20/0.15	20.93	2.26	Verifica
P9	al B al 18	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4159.1	657.5	4816.6	0.000	0.000	1532.5	35.25	10.68	Ø20/0.15	20.93	1.96	1368.3	31.47	9.26	Ø20/0.15	20.93	2.26	Verifica
P9	al B al 18	S7	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4142.4																	

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 10 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{reg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m ²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m ²)	(cm2/m)		(cm2/m)		(kN/m ²)					
P9	al B al 18	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	440	5 386.1			1077.0	0.000	0.000	1.00	658.7	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 18	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	418	5 123.0			1019.5	0.000	0.000	1.00	627.3	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al B al 18	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	418	5 123.0			1019.5	0.000	0.000	1.00	627.3	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al B al 18	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	418	5 118.8			1018.6	0.000	0.000	1.00	626.8	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al B al 18	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	416	5 102.1			1015.0	0.000	0.000	1.00	624.8	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 18	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	440	5 386.1			1077.0	0.000	0.000	1.00	658.7	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 18	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	440	5 386.1			1077.0	0.000	0.000	1.00	658.7	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 18	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	439	5 381.9			1076.1	0.000	0.000	1.00	658.2	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 18	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	438	5 365.2			1072.4	0.000	0.000	1.00	656.2	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al B al 18	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	293	3 589.4			684.6	0.000	0.000	1.00	444.0	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al B al 18	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	351	4 298.9			839.6	0.000	0.000	1.00	528.8	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 18	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	293	3 589.4			684.6	0.000	0.000	1.00	444.0	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al B al 18	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	293	3 589.4			684.6	0.000	0.000	1.00	444.0	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al B al 18	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	293	3 585.2			683.7	0.000	0.000	1.00	443.5	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al B al 18	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	291	3 568.5			680.0	0.000	0.000	1.00	441.6	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al B al 18	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	351	4 298.9			839.6	0.000	0.000	1.00	528.8	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 18	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	351	4 298.9			839.6	0.000	0.000	1.00	528.8	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 18	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	351	4 294.7			838.6	0.000	0.000	1.00	528.3	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 18	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	349	4 278.0			835.0	0.000	0.000	1.00	526.3	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 18	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	336	4 111.4			798.6	0.000	0.000	1.00	506.4	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al B al 18	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	394	4 820.9			953.6	0.000	0.000	1.00	591.2	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al B al 18	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	357	4 374.4			856.0	0.000	0.000	1.00	537.8	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 18	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	336	4 111.4			798.6	0.000	0.000	1.00	506.4	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al B al 18	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	336	4 111.4			798.6	0.000	0.000	1.00	506.4	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al B al 18	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	335	4 107.1			797.7	0.000	0.000	1.00	505.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al B al 18	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	334	4 090.4			794.0	0.000	0.000	1.00	503.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al B al 18	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	415	5 083.9			1011.0	0.000	0.000	1.00	622.6	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 18	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	394	4 820.9			953.6	0.000	0.000	1.00	591.2	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al B al 18	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	394	4 820.9			953.6	0.000	0.000	1.00	591.2	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al B al 18	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	393	4 816.6			952.6	0.000	0.000	1.00	590.7	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al B al 18	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	392	4 799.9			949.0	0.000	0.000	1.00	588.7	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al B al 18	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	415	5 083.9			1011.0	0.000	0.000	1.00	622.6	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 18	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	415	5 083.9			1011.0	0.000	0.000	1.00	622.6	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 18	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	2.68	415	5 079.7			1010.1	0.000	0									

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 18 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P9	al C al 18	S7	177 (C)	0.70	1.00	3 716.7			3.50	3.50	1.10	487.0	4 203.7	400	0.96	0.000	0.000	3.24		3.24	Verifica	343.2	1.17	Verifica
P9	al C al 18	S7	178 (C)	0.70	1.00	3 936.5			3.50	3.50	1.10	487.0	4 423.5	400	0.99	0.000	0.000	3.33		3.33	Verifica	361.1	1.11	Verifica
P9	al C al 18	S7	179 (C)	0.70	1.00	3 716.7			3.50	3.50	1.10	487.0	4 203.7	400	0.96	0.000	0.000	3.24		3.24	Verifica	343.2	1.17	Verifica
P9	al C al 18	S7	180 (C)	0.70	1.00	3 716.7			3.50	3.50	1.10	487.0	4 203.7	400	0.96	0.000	0.000	3.24		3.24	Verifica	343.2	1.17	Verifica
P9	al C al 18	S7	181 (C)	0.70	1.00	3 716.9			3.50	3.50	1.10	487.0	4 203.9	400	0.96	0.000	0.000	3.24		3.24	Verifica	343.2	1.17	Verifica
P9	al C al 18	S7	182 (C)	0.70	1.00	3 717.6			3.50	3.50	1.10	487.0	4 204.6	400	0.96	0.000	0.000	3.24		3.24	Verifica	343.2	1.17	Verifica
P9	al C al 18	S7	183 (C)	0.70	1.00	3 936.5			3.50	3.50	1.10	487.0	4 423.5	400	0.99	0.000	0.000	3.33		3.33	Verifica	361.1	1.11	Verifica
P9	al C al 18	S7	184 (C)	0.70	1.00	3 936.5			3.50	3.50	1.10	487.0	4 423.5	400	0.99	0.000	0.000	3.33		3.33	Verifica	361.1	1.11	Verifica
P9	al C al 18	S7	185 (C)	0.70	1.00	3 936.7			3.50	3.50	1.10	487.0	4 423.7	400	0.99	0.000	0.000	3.33		3.33	Verifica	361.1	1.11	Verifica
P9	al C al 18	S7	186 (C)	0.70	1.00	3 937.4			3.50	3.50	1.10	487.0	4 424.4	400	0.99	0.000	0.000	3.33		3.33	Verifica	361.2	1.11	Verifica
P9	al C al 18	S7	187 (C)	0.70	1.00	3 197.5			3.50	3.50	1.10	487.0	3 684.5	400	0.90	0.000	0.000	3.04		3.04	Verifica	300.8	1.33	Verifica
P9	al C al 18	S7	188 (C)	0.70	1.00	3 780.7			3.50	3.50	1.10	487.0	4 267.7	400	0.97	0.000	0.000	3.27		3.27	Verifica	348.4	1.15	Verifica
P9	al C al 18	S7	189 (C)	0.70	1.00	3 197.5			3.50	3.50	1.10	487.0	3 684.5	400	0.90	0.000	0.000	3.04		3.04	Verifica	300.8	1.33	Verifica
P9	al C al 18	S7	190 (C)	0.70	1.00	3 197.5			3.50	3.50	1.10	487.0	3 684.5	400	0.90	0.000	0.000	3.04		3.04	Verifica	300.8	1.33	Verifica
P9	al C al 18	S7	191 (C)	0.70	1.00	3 197.7			3.50	3.50	1.10	487.0	3 684.7	400	0.90	0.000	0.000	3.04		3.04	Verifica	300.8	1.33	Verifica
P9	al C al 18	S7	192 (C)	0.70	1.00	3 198.4			3.50	3.50	1.10	487.0	3 685.4	400	0.90	0.000	0.000	3.04		3.04	Verifica	300.9	1.33	Verifica
P9	al C al 18	S7	193 (C)	0.70	1.00	3 780.7			3.50	3.50	1.10	487.0	4 267.7	400	0.97	0.000	0.000	3.27		3.27	Verifica	348.4	1.15	Verifica
P9	al C al 18	S7	194 (C)	0.70	1.00	3 780.7			3.50	3.50	1.10	487.0	4 267.7	400	0.97	0.000	0.000	3.27		3.27	Verifica	348.4	1.15	Verifica
P9	al C al 18	S7	195 (C)	0.70	1.00	3 780.9			3.50	3.50	1.10	487.0	4 267.9	400	0.97	0.000	0.000	3.27		3.27	Verifica	348.4	1.15	Verifica
P9	al C al 18	S7	196 (C)	0.70	1.00	3 781.6			3.50	3.50	1.10	487.0	4 268.6	400	0.97	0.000	0.000	3.27		3.27	Verifica	348.5	1.15	Verifica
P9	al C al 18	S7	197 (C)	0.70	1.00	2 883.4			3.50	3.50	1.10	487.0	3 370.4	400	0.86	0.000	0.000	2.90		2.90	Verifica	275.1	1.45	Verifica
P9	al C al 18	S7	198 (C)	0.70	1.00	3 466.6			3.50	3.50	1.10	487.0	3 953.6	400	0.93	0.000	0.000	3.14		3.14	Verifica	322.7	1.24	Verifica
P9	al C al 18	S7	199 (C)	0.70	1.00	3 103.2			3.50	3.50	1.10	487.0	3 590.2	400	0.89	0.000	0.000	3.00		3.00	Verifica	293.1	1.36	Verifica
P9	al C al 18	S7	200 (C)	0.70	1.00	2 883.4			3.50	3.50	1.10	487.0	3 370.4	400	0.86	0.000	0.000	2.90		2.90	Verifica	275.1	1.45	Verifica
P9	al C al 18	S7	201 (C)	0.70	1.00	2 883.4			3.50	3.50	1.10	487.0	3 370.4	400	0.86	0.000	0.000	2.90		2.90	Verifica	275.1	1.45	Verifica
P9	al C al 18	S7	202 (C)	0.70	1.00	2 883.6			3.50	3.50	1.10	487.0	3 370.6	400	0.86	0.000	0.000	2.90		2.90	Verifica	275.2	1.45	Verifica
P9	al C al 18	S7	203 (C)	0.70	1.00	2 884.2			3.50	3.50	1.10	487.0	3 371.2	400	0.86	0.000	0.000	2.90		2.90	Verifica	275.2	1.45	Verifica
P9	al C al 18	S7	204 (C)	0.70	1.00	3 686.4			3.50	3.50	1.10	487.0	4 173.4	400	0.96	0.000	0.000	3.23		3.23	Verifica	340.7	1.17	Verifica
P9	al C al 18	S7	205 (C)	0.70	1.00	3 466.6			3.50	3.50	1.10	487.0	3 953.6	400	0.93	0.000	0.000	3.14		3.14	Verifica	322.7	1.24	Verifica
P9	al C al 18	S7	206 (C)	0.70	1.00	3 466.6			3.50	3.50	1.10	487.0	3 953.6	400	0.93	0.000	0.000	3.14		3.14	Verifica	322.7	1.24	Verifica
P9	al C al 18	S7	207 (C)	0.70	1.00	3 466.8			3.50	3.50	1.10	487.0	3 953.8	400	0.93	0.000	0.000	3.14		3.14	Verifica	322.8	1.24	Verifica
P9	al C al 18	S7	208 (C)	0.70	1.00	3 467.4			3.50	3.50	1.10	487.0	3 954.4	400	0.93	0.000	0.000	3.14		3.14	Verifica	322.8	1.24	Verifica
P9	al C al 18	S7	209 (C)	0.70	1.00	3 103.2			3.50	3.50	1.10	487.0	3 590.2	400	0.89	0.000	0.000	3.00		3.00	Verifica	293.1	1.36	Verifica
P9	al C al 18	S7	210 (C)	0.70	1.00	3 103.2			3.50	3.50	1.10	487.0	3 590.2	400	0.89	0.000	0.000	3.00		3.00	Verifica	293.1	1.36	Verifica
P9	al C al 18	S7	211 (C)	0.70	1.00	3 103.4			3.50	3.50	1.10	487.0	3 590.4	400	0.89	0.000	0.000	3.00		3.00	Verifica	293.1	1.36	Verifica
P9	al C al 18	S7	212 (C)	0.70	1.00	3 104.0			3.50	3.50	1.10	487.0	3 591.0	400	0.89	0.000	0.000	3.00		3.00	Verifica	293.1	1.36	Verifica
P9	al C al 18	S7	213 (C)	0.70	1.00	3 686.4			3.50	3.50	1.10	487.0	4 173.4	400	0.96	0.000	0.000	3.23		3.23	Verifica	340.7	1.17	Verifica
P9	al C al 18	S7	214 (C)	0.70	1.00	3 686.4			3.50	3.50	1.10	487												

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 10 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al C al 18	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5471.7	657.5	6129.2	0.000	0.000	2145.2	49.34	14.95	Ø20/0.15	20.93	1.40	1915.4	44.05	12.96	Ø20/0.15	20.93	1.62	Verifica
P9	al C al 18	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5142.0	657.5	5799.5	0.000	0.000	2029.8	46.69	14.15	Ø20/0.15	20.93	1.48	1812.3	41.68	12.26	Ø20/0.15	20.93	1.71	Verifica
P9	al C al 18	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5142.0	657.5	5799.5	0.000	0.000	2029.8	46.69	14.15	Ø20/0.15	20.93	1.48	1812.3	41.68	12.26	Ø20/0.15	20.93	1.71	Verifica
P9	al C al 18	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5142.3	657.5	5799.8	0.000	0.000	2029.9	46.69	14.15	Ø20/0.15	20.93	1.48	1812.4	41.69	12.26	Ø20/0.15	20.93	1.71	Verifica
P9	al C al 18	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5143.3	657.5	5800.8	0.000	0.000	2030.3	46.70	14.15	Ø20/0.15	20.93	1.48	1812.7	41.69	12.26	Ø20/0.15	20.93	1.71	Verifica
P9	al C al 18	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5471.7	657.5	6129.2	0.000	0.000	2145.2	49.34	14.95	Ø20/0.15	20.93	1.40	1915.4	44.05	12.96	Ø20/0.15	20.93	1.62	Verifica
P9	al C al 18	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5471.7	657.5	6129.2	0.000	0.000	2145.2	49.34	14.95	Ø20/0.15	20.93	1.40	1915.4	44.05	12.96	Ø20/0.15	20.93	1.62	Verifica
P9	al C al 18	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5472.0	657.5	6129.5	0.000	0.000	2145.3	49.34	14.95	Ø20/0.15	20.93	1.40	1915.5	44.06	12.96	Ø20/0.15	20.93	1.62	Verifica
P9	al C al 18	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5473.0	657.5	6130.5	0.000	0.000	2145.7	49.35	14.95	Ø20/0.15	20.93	1.40	1915.8	44.06	12.96	Ø20/0.15	20.93	1.62	Verifica
P9	al C al 18	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3354.5	657.5	4012.0	0.000	0.000	1404.2	32.30	9.79	Ø20/0.15	20.93	2.14	1253.7	28.84	8.48	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 18	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4229.3	657.5	4886.8	0.000	0.000	1710.4	39.34	11.92	Ø20/0.15	20.93	1.76	1527.1	35.12	10.33	Ø20/0.15	20.93	2.03	Verifica
P9	al C al 18	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3354.5	657.5	4012.0	0.000	0.000	1404.2	32.30	9.79	Ø20/0.15	20.93	2.14	1253.7	28.84	8.48	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 18	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3354.5	657.5	4012.0	0.000	0.000	1404.2	32.30	9.79	Ø20/0.15	20.93	2.14	1253.7	28.84	8.48	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 18	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3354.8	657.5	4012.3	0.000	0.000	1404.3	32.30	9.79	Ø20/0.15	20.93	2.14	1253.8	28.84	8.48	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 18	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3355.9	657.5	4013.4	0.000	0.000	1404.7	32.31	9.79	Ø20/0.15	20.93	2.14	1254.2	28.85	8.48	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 18	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4229.3	657.5	4886.8	0.000	0.000	1710.4	39.34	11.92	Ø20/0.15	20.93	1.76	1527.1	35.12	10.33	Ø20/0.15	20.93	2.03	Verifica
P9	al C al 18	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4229.3	657.5	4886.8	0.000	0.000	1710.4	39.34	11.92	Ø20/0.15	20.93	1.76	1527.1	35.12	10.33	Ø20/0.15	20.93	2.03	Verifica
P9	al C al 18	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4229.6	657.5	4887.1	0.000	0.000	1710.5	39.34	11.92	Ø20/0.15	20.93	1.76	1527.2	35.13	10.33	Ø20/0.15	20.93	2.03	Verifica
P9	al C al 18	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4230.7	657.5	4888.2	0.000	0.000	1710.9	39.35	11.92	Ø20/0.15	20.93	1.76	1527.6	35.13	10.33	Ø20/0.15	20.93	2.03	Verifica
P9	al C al 18	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.0	657.5	4549.5	0.000	0.000	1592.3	36.62	11.10	Ø20/0.15	20.93	1.89	1421.7	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 18	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4766.8	657.5	5424.3	0.000	0.000	1898.5	43.67	13.23	Ø20/0.15	20.93	1.58	1695.1	38.99	11.47	Ø20/0.15	20.93	1.83	Verifica
P9	al C al 18	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4221.7	657.5	4879.2	0.000	0.000	1707.7	39.28	11.90	Ø20/0.15	20.93	1.76	1524.7	35.07	10.31	Ø20/0.15	20.93	2.03	Verifica
P9	al C al 18	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.0	657.5	4549.5	0.000	0.000	1592.3	36.62	11.10	Ø20/0.15	20.93	1.89	1421.7	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 18	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.0	657.5	4549.5	0.000	0.000	1592.3	36.62	11.10	Ø20/0.15	20.93	1.89	1421.7	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 18	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.3	657.5	4549.8	0.000	0.000	1592.4	36.63	11.10	Ø20/0.15	20.93	1.89	1421.8	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 18	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3893.3	657.5	4550.8	0.000	0.000	1592.8	36.63	11.10	Ø20/0.15	20.93	1.89	1422.1	32.71	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 18	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5096.5	657.5	5754.0	0.000	0.000	2013.9	46.32	14.04	Ø20/0.15	20.93	1.49	1798.1	41.36	12.16	Ø20/0.15	20.93	1.72	Verifica
P9	al C al 18	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4766.8	657.5	5424.3	0.000	0.000	1898.5	43.67	13.23	Ø20/0.15	20.93	1.58	1695.1	38.99	11.47	Ø20/0.15	20.93	1.83	Verifica
P9	al C al 18	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4766.8	657.5	5424.3	0.000	0.000	1898.5	43.67	13.23	Ø20/0.15	20.93	1.58	1695.1	38.99	11.47	Ø20/0.15	20.93	1.83	Verifica
P9	al C al 18	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4767.1	657.5	5424.6	0.000	0.000	1898.6	43.67	13.23	Ø20/0.15	20.93	1.58	1695.2	38.99	11.47	Ø20/0.15	20.93	1.83	Verifica
P9	al C al 18	S7	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00	47																	

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 10 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{reg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)		(kN/m²)					
P9	al C al 18	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	500	6 129.2			1475.5	0.000	0.000	1.00	711.4	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 18	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	473	5 799.5			1389.8	0.000	0.000	1.00	674.1	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 18	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	473	5 799.5			1389.8	0.000	0.000	1.00	674.1	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 18	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	473	5 799.8			1389.9	0.000	0.000	1.00	674.1	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 18	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	474	5 800.8			1390.1	0.000	0.000	1.00	674.2	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 18	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	500	6 129.2			1475.5	0.000	0.000	1.00	711.4	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 18	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	500	6 129.2			1475.5	0.000	0.000	1.00	711.4	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 18	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	500	6 129.5			1475.6	0.000	0.000	1.00	711.4	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 18	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	500	6 130.5			1475.9	0.000	0.000	1.00	711.5	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 18	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	328	4 012.0			925.0	0.000	0.000	1.00	471.9	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 18	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	399	4 886.8			1152.5	0.000	0.000	1.00	570.9	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 18	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	328	4 012.0			925.0	0.000	0.000	1.00	471.9	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 18	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	328	4 012.0			925.0	0.000	0.000	1.00	471.9	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 18	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	328	4 012.3			925.1	0.000	0.000	1.00	471.9	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 18	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	328	4 013.4			925.4	0.000	0.000	1.00	472.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 18	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	399	4 886.8			1152.5	0.000	0.000	1.00	570.9	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 18	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	399	4 886.8			1152.5	0.000	0.000	1.00	570.9	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 18	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	399	4 887.1			1152.5	0.000	0.000	1.00	570.9	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 18	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	399	4 888.2			1152.8	0.000	0.000	1.00	571.0	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 18	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.5			1064.8	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 18	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	443	5 424.3			1292.2	0.000	0.000	1.00	631.7	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 18	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	398	4 879.2			1150.5	0.000	0.000	1.00	570.0	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 18	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.5			1064.8	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 18	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.5			1064.8	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 18	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.8			1064.8	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 18	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 550.8			1065.1	0.000	0.000	1.00	532.9	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 18	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	470	5 754.0			1378.0	0.000	0.000	1.00	669.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 18	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	443	5 424.3			1292.2	0.000	0.000	1.00	631.7	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 18	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	443	5 424.3			1292.2	0.000	0.000	1.00	631.7	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 18	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	443	5 424.6			1292.3	0.000	0.000	1.00	631.7	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 18	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	443	5 425.6			1292.6	0.000	0.000	1.00	631.8	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 18	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	470	5 754.0			1378.0	0.000	0.000	1.00	669.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 18	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	470	5 754.0			1378.0	0.000	0.000	1.00	669.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 18	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	470	5 754.3			1378.0	0										

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 19 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P7	al A' al 19	S6	177 (C)	0.70	1.40	3 736.7			4.00	4.00	1.30	715.3	4 256.7	400	0.97	0.000	0.000	3.26		3.26	Verifica	266.0	1.50	Verifica
P7	al A' al 19	S6	178 (C)	0.70	1.40	3 815.5			4.00	4.00	1.30	715.3	4 335.5	400	0.98	0.000	0.000	3.29		3.29	Verifica	271.0	1.48	Verifica
P7	al A' al 19	S6	179 (C)	0.70	1.40	3 736.7			4.00	4.00	1.30	715.3	4 256.7	400	0.97	0.000	0.000	3.26		3.26	Verifica	266.0	1.50	Verifica
P7	al A' al 19	S6	180 (C)	0.70	1.40	3 736.7			4.00	4.00	1.30	715.3	4 256.7	400	0.97	0.000	0.000	3.26		3.26	Verifica	266.0	1.50	Verifica
P7	al A' al 19	S6	181 (C)	0.70	1.40	3 702.5			4.00	4.00	1.30	715.3	4 222.5	400	0.96	0.000	0.000	3.25		3.25	Verifica	263.9	1.52	Verifica
P7	al A' al 19	S6	182 (C)	0.70	1.40	3 688.7			4.00	4.00	1.30	715.3	4 208.7	400	0.96	0.000	0.000	3.24		3.24	Verifica	263.0	1.52	Verifica
P7	al A' al 19	S6	183 (C)	0.70	1.40	3 815.5			4.00	4.00	1.30	715.3	4 335.5	400	0.98	0.000	0.000	3.29		3.29	Verifica	271.0	1.48	Verifica
P7	al A' al 19	S6	184 (C)	0.70	1.40	3 815.5			4.00	4.00	1.30	715.3	4 335.5	400	0.98	0.000	0.000	3.29		3.29	Verifica	271.0	1.48	Verifica
P7	al A' al 19	S6	185 (C)	0.70	1.40	3 781.3			4.00	4.00	1.30	715.3	4 301.3	400	0.97	0.000	0.000	3.28		3.28	Verifica	268.8	1.49	Verifica
P7	al A' al 19	S6	186 (C)	0.70	1.40	3 767.5			4.00	4.00	1.30	715.3	4 287.5	400	0.97	0.000	0.000	3.27		3.27	Verifica	268.0	1.49	Verifica
P7	al A' al 19	S6	187 (C)	0.70	1.40	3 201.2			4.00	4.00	1.30	715.3	3 721.2	400	0.91	0.000	0.000	3.05		3.05	Verifica	232.6	1.72	Verifica
P7	al A' al 19	S6	188 (C)	0.70	1.40	3 654.8			4.00	4.00	1.30	715.3	4 174.8	400	0.96	0.000	0.000	3.23		3.23	Verifica	260.9	1.53	Verifica
P7	al A' al 19	S6	189 (C)	0.70	1.40	3 201.2			4.00	4.00	1.30	715.3	3 721.2	400	0.91	0.000	0.000	3.05		3.05	Verifica	232.6	1.72	Verifica
P7	al A' al 19	S6	190 (C)	0.70	1.40	3 201.2			4.00	4.00	1.30	715.3	3 721.2	400	0.91	0.000	0.000	3.05		3.05	Verifica	232.6	1.72	Verifica
P7	al A' al 19	S6	191 (C)	0.70	1.40	3 167.0			4.00	4.00	1.30	715.3	3 687.0	400	0.90	0.000	0.000	3.04		3.04	Verifica	230.4	1.74	Verifica
P7	al A' al 19	S6	192 (C)	0.70	1.40	3 153.2			4.00	4.00	1.30	715.3	3 673.2	400	0.90	0.000	0.000	3.03		3.03	Verifica	229.6	1.74	Verifica
P7	al A' al 19	S6	193 (C)	0.70	1.40	3 654.8			4.00	4.00	1.30	715.3	4 174.8	400	0.96	0.000	0.000	3.23		3.23	Verifica	260.9	1.53	Verifica
P7	al A' al 19	S6	194 (C)	0.70	1.40	3 654.8			4.00	4.00	1.30	715.3	4 174.8	400	0.96	0.000	0.000	3.23		3.23	Verifica	260.9	1.53	Verifica
P7	al A' al 19	S6	195 (C)	0.70	1.40	3 620.6			4.00	4.00	1.30	715.3	4 140.6	400	0.96	0.000	0.000	3.22		3.22	Verifica	258.8	1.55	Verifica
P7	al A' al 19	S6	196 (C)	0.70	1.40	3 606.8			4.00	4.00	1.30	715.3	4 126.8	400	0.95	0.000	0.000	3.21		3.21	Verifica	257.9	1.55	Verifica
P7	al A' al 19	S6	197 (C)	0.70	1.40	3 104.0			4.00	4.00	1.30	715.3	3 624.0	400	0.89	0.000	0.000	3.01		3.01	Verifica	226.5	1.77	Verifica
P7	al A' al 19	S6	198 (C)	0.70	1.40	3 557.7			4.00	4.00	1.30	715.3	4 077.7	400	0.95	0.000	0.000	3.19		3.19	Verifica	254.9	1.57	Verifica
P7	al A' al 19	S6	199 (C)	0.70	1.40	3 182.8			4.00	4.00	1.30	715.3	3 702.8	400	0.90	0.000	0.000	3.04		3.04	Verifica	231.4	1.73	Verifica
P7	al A' al 19	S6	200 (C)	0.70	1.40	3 104.0			4.00	4.00	1.30	715.3	3 624.0	400	0.89	0.000	0.000	3.01		3.01	Verifica	226.5	1.77	Verifica
P7	al A' al 19	S6	201 (C)	0.70	1.40	3 104.0			4.00	4.00	1.30	715.3	3 624.0	400	0.89	0.000	0.000	3.01		3.01	Verifica	226.5	1.77	Verifica
P7	al A' al 19	S6	202 (C)	0.70	1.40	3 069.8			4.00	4.00	1.30	715.3	3 589.8	400	0.89	0.000	0.000	3.00		3.00	Verifica	224.4	1.78	Verifica
P7	al A' al 19	S6	203 (C)	0.70	1.40	3 056.1			4.00	4.00	1.30	715.3	3 576.1	400	0.89	0.000	0.000	2.99		2.99	Verifica	223.5	1.79	Verifica
P7	al A' al 19	S6	204 (C)	0.70	1.40	3 636.5			4.00	4.00	1.30	715.3	4 156.5	400	0.96	0.000	0.000	3.22		3.22	Verifica	259.8	1.54	Verifica
P7	al A' al 19	S6	205 (C)	0.70	1.40	3 557.7			4.00	4.00	1.30	715.3	4 077.7	400	0.95	0.000	0.000	3.19		3.19	Verifica	254.9	1.57	Verifica
P7	al A' al 19	S6	206 (C)	0.70	1.40	3 557.7			4.00	4.00	1.30	715.3	4 077.7	400	0.95	0.000	0.000	3.19		3.19	Verifica	254.9	1.57	Verifica
P7	al A' al 19	S6	207 (C)	0.70	1.40	3 523.5			4.00	4.00	1.30	715.3	4 043.5	400	0.94	0.000	0.000	3.18		3.18	Verifica	252.7	1.58	Verifica
P7	al A' al 19	S6	208 (C)	0.70	1.40	3 509.7			4.00	4.00	1.30	715.3	4 029.7	400	0.94	0.000	0.000	3.17		3.17	Verifica	251.9	1.59	Verifica
P7	al A' al 19	S6	209 (C)	0.70	1.40	3 182.8			4.00	4.00	1.30	715.3	3 702.8	400	0.90	0.000	0.000	3.04		3.04	Verifica	231.4	1.73	Verifica
P7	al A' al 19	S6	210 (C)	0.70	1.40	3 182.8			4.00	4.00	1.30	715.3	3 702.8	400	0.90	0.000	0.000	3.04		3.04	Verifica	231.4	1.73	Verifica
P7	al A' al 19	S6	211 (C)	0.70	1.40	3 148.6			4.00	4.00	1.30	715.3	3 668.6	400	0.90	0.000	0.000	3.03		3.03	Verifica	229.3	1.74	Verifica
P7	al A' al 19	S6	212 (C)	0.70	1.40	3 134.8			4.00	4.00	1.30	715.3	3 654.8	400	0.90	0.000	0.000	3.02		3.02	Verifica	228.4	1.75	Verifica
P7	al A' al 19	S6	213 (C)	0.70	1.40	3 636.5			4.00	4.00	1.30	715.3	4 156.5	400	0.96	0.000	0.000	3.22		3.22	Verifica	259.8	1.54	Verifica
P7	al A' al 19	S6	214 (C)	0.70	1.40	3 636.5			4.00	4.00	1.30	715.3	4 156.5	400	0.96	0.000	0.000	3.22		3.22	Verifica			

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 19 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P7	al A´ al 19	S6	105 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5268.5	965.6	6234.1	0.000	0.000	2143.0	49.29	12.97	Ø20/0.125	25.13	1.94	1688.4	38.83	9.96	Ø20/0.125	25.13	2.52	Verifica
P7	al A´ al 19	S6	106 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5150.3	965.6	6115.9	0.000	0.000	2102.3	48.35	12.72	Ø20/0.125	25.13	1.97	1656.4	38.10	9.77	Ø20/0.125	25.13	2.57	Verifica
P7	al A´ al 19	S6	107 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5150.3	965.6	6115.9	0.000	0.000	2102.3	48.35	12.72	Ø20/0.125	25.13	1.97	1656.4	38.10	9.77	Ø20/0.125	25.13	2.57	Verifica
P7	al A´ al 19	S6	108 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5099.0	965.6	6064.6	0.000	0.000	2084.7	47.95	12.62	Ø20/0.125	25.13	1.99	1642.5	37.78	9.69	Ø20/0.125	25.13	2.59	Verifica
P7	al A´ al 19	S6	109 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5078.3	965.6	6043.9	0.000	0.000	2077.6	47.78	12.57	Ø20/0.125	25.13	2.00	1636.9	37.65	9.65	Ø20/0.125	25.13	2.60	Verifica
P7	al A´ al 19	S6	110 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5268.5	965.6	6234.1	0.000	0.000	2143.0	49.29	12.97	Ø20/0.125	25.13	1.94	1688.4	38.83	9.96	Ø20/0.125	25.13	2.52	Verifica
P7	al A´ al 19	S6	111 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5268.5	965.6	6234.1	0.000	0.000	2143.0	49.29	12.97	Ø20/0.125	25.13	1.94	1688.4	38.83	9.96	Ø20/0.125	25.13	2.52	Verifica
P7	al A´ al 19	S6	112 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5217.2	965.6	6182.8	0.000	0.000	2125.3	48.88	12.86	Ø20/0.125	25.13	1.95	1674.5	38.51	9.88	Ø20/0.125	25.13	2.54	Verifica
P7	al A´ al 19	S6	113 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5196.5	965.6	6162.1	0.000	0.000	2118.2	48.72	12.82	Ø20/0.125	25.13	1.96	1668.9	38.38	9.84	Ø20/0.125	25.13	2.55	Verifica
P7	al A´ al 19	S6	114 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3257.4	965.6	4223.0	0.000	0.000	1451.7	33.39	8.79	Ø20/0.125	25.13	2.86	1143.7	26.31	6.75	Ø20/0.125	25.13	3.73	Verifica
P7	al A´ al 19	S6	115 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3937.9	965.6	4903.5	0.000	0.000	1685.6	38.77	10.20	Ø20/0.125	25.13	2.46	1328.0	30.54	7.83	Ø20/0.125	25.13	3.21	Verifica
P7	al A´ al 19	S6	116 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3257.4	965.6	4223.0	0.000	0.000	1451.7	33.39	8.79	Ø20/0.125	25.13	2.86	1143.7	26.31	6.75	Ø20/0.125	25.13	3.73	Verifica
P7	al A´ al 19	S6	117 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3257.4	965.6	4223.0	0.000	0.000	1451.7	33.39	8.79	Ø20/0.125	25.13	2.86	1143.7	26.31	6.75	Ø20/0.125	25.13	3.73	Verifica
P7	al A´ al 19	S6	118 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3206.1	965.6	4171.7	0.000	0.000	1434.0	32.98	8.68	Ø20/0.125	25.13	2.90	1129.8	25.99	6.66	Ø20/0.125	25.13	3.77	Verifica
P7	al A´ al 19	S6	119 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3185.4	965.6	4151.0	0.000	0.000	1426.9	32.82	8.64	Ø20/0.125	25.13	2.91	1124.2	25.86	6.63	Ø20/0.125	25.13	3.79	Verifica
P7	al A´ al 19	S6	120 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3937.9	965.6	4903.5	0.000	0.000	1685.6	38.77	10.20	Ø20/0.125	25.13	2.46	1328.0	30.54	7.83	Ø20/0.125	25.13	3.21	Verifica
P7	al A´ al 19	S6	121 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3937.9	965.6	4903.5	0.000	0.000	1685.6	38.77	10.20	Ø20/0.125	25.13	2.46	1328.0	30.54	7.83	Ø20/0.125	25.13	3.21	Verifica
P7	al A´ al 19	S6	122 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3886.6	965.6	4852.2	0.000	0.000	1667.9	38.36	10.10	Ø20/0.125	25.13	2.49	1314.1	30.23	7.75	Ø20/0.125	25.13	3.24	Verifica
P7	al A´ al 19	S6	123 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3865.9	965.6	4831.5	0.000	0.000	1660.8	38.20	10.05	Ø20/0.125	25.13	2.50	1308.5	30.10	7.72	Ø20/0.125	25.13	3.26	Verifica
P7	al A´ al 19	S6	124 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4201.3	965.6	5166.9	0.000	0.000	1776.1	40.85	10.75	Ø20/0.125	25.13	2.34	1399.4	32.19	8.25	Ø20/0.125	25.13	3.05	Verifica
P7	al A´ al 19	S6	125 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4881.8	965.6	5847.4	0.000	0.000	2010.0	46.23	12.17	Ø20/0.125	25.13	2.07	1583.7	36.42	9.34	Ø20/0.125	25.13	2.69	Verifica
P7	al A´ al 19	S6	126 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4319.5	965.6	5285.1	0.000	0.000	1816.8	41.79	11.00	Ø20/0.125	25.13	2.29	1431.4	32.92	8.44	Ø20/0.125	25.13	2.98	Verifica
P7	al A´ al 19	S6	127 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4201.3	965.6	5166.9	0.000	0.000	1776.1	40.85	10.75	Ø20/0.125	25.13	2.34	1399.4	32.19	8.25	Ø20/0.125	25.13	3.05	Verifica
P7	al A´ al 19	S6	128 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4201.3	965.6	5166.9	0.000	0.000	1776.1	40.85	10.75	Ø20/0.125	25.13	2.34	1399.4	32.19	8.25	Ø20/0.125	25.13	3.05	Verifica
P7	al A´ al 19	S6	129 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4150.0	965.6	5115.6	0.000	0.000	1758.5	40.45	10.64	Ø20/0.125	25.13	2.36	1385.5	31.87	8.17	Ø20/0.125	25.13	3.08	Verifica
P7	al A´ al 19	S6	130 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4129.3	965.6	5094.9	0.000	0.000	1751.4	40.28	10.60	Ø20/0.125	25.13	2.37	1379.9	31.74	8.14	Ø20/0.125	25.13	3.09	Verifica
P7	al A´ al 19	S6	131 (C)	0.70	1.40	4.00	4.00	1.30	1.20	5000.0	965.6	5965.6	0.000	0.000	2050.7	47.17	12.41	Ø20/0.125	25.13	2.02	1615.7	37.16	9.53	Ø20/0.125	25.13	2.64	Verifica
P7	al A´ al 19	S6	132 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4881.8	965.6	5847.4	0.000	0.000	2010.0	46.23	12.17	Ø20/0.125	25.13	2.07	1583.7	36.42	9.34	Ø20/0.125	25.13	2.69	Verifica
P7	al A´ al 19	S6	133 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4881.8	965.6	5847.4	0.000	0.000	2010.0	46.23	12.17	Ø20/0.125	25.13	2.07	1583.7	36.42	9.34	Ø20/0.125	25.13	2.69	Verifica
P7	al A´ al 19	S6	134 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4830.5	965.6	5796.1	0.000	0.000	1992.4	45.83	12.06	Ø20/0.125	25.13	2.08	1569.8	36.10	9.26	Ø20/0.125	25.13	2.71	Verifica
P7	al A´ al 19																										

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 19 - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	Q _{essg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)		(m)		(m)	(kN/m²)		(cm2/m)		(cm2/m)
P7	al A´ al 19	S6	105 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	390	6 234.1			1601.2	0.000	0.000	1.00	484.4	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	106 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	382	6 115.9			1567.0	0.000	0.000	1.00	475.6	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	107 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	382	6 115.9			1567.0	0.000	0.000	1.00	475.6	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	108 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	379	6 064.6			1552.1	0.000	0.000	1.00	471.8	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	109 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	378	6 043.9			1546.1	0.000	0.000	1.00	470.3	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P7	al A´ al 19	S6	110 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	390	6 234.1			1601.2	0.000	0.000	1.00	484.4	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	111 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	390	6 234.1			1601.2	0.000	0.000	1.00	484.4	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	112 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	386	6 182.8			1586.3	0.000	0.000	1.00	480.6	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	113 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	385	6 162.1			1580.3	0.000	0.000	1.00	479.1	1.41	25.13	25.13	0.002	1247.3	2.6	Verifica
P7	al A´ al 19	S6	114 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	264	4 223.0			1019.1	0.000	0.000	1.00	335.0	1.41	25.13	25.13	0.002	1247.3	3.7	Verifica
P7	al A´ al 19	S6	115 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	306	4 903.5			1216.1	0.000	0.000	1.00	385.6	1.41	25.13	25.13	0.002	1247.3	3.2	Verifica
P7	al A´ al 19	S6	116 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	264	4 223.0			1019.1	0.000	0.000	1.00	335.0	1.41	25.13	25.13	0.002	1247.3	3.7	Verifica
P7	al A´ al 19	S6	117 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	264	4 223.0			1019.1	0.000	0.000	1.00	335.0	1.41	25.13	25.13	0.002	1247.3	3.7	Verifica
P7	al A´ al 19	S6	118 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	261	4 171.7			1004.3	0.000	0.000	1.00	331.2	1.41	25.13	25.13	0.002	1247.3	3.8	Verifica
P7	al A´ al 19	S6	119 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	259	4 151.0			998.3	0.000	0.000	1.00	329.6	1.41	25.13	25.13	0.002	1247.3	3.8	Verifica
P7	al A´ al 19	S6	120 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	306	4 903.5			1216.1	0.000	0.000	1.00	385.6	1.41	25.13	25.13	0.002	1247.3	3.2	Verifica
P7	al A´ al 19	S6	121 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	306	4 903.5			1216.1	0.000	0.000	1.00	385.6	1.41	25.13	25.13	0.002	1247.3	3.2	Verifica
P7	al A´ al 19	S6	122 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	303	4 852.2			1201.2	0.000	0.000	1.00	381.7	1.41	25.13	25.13	0.002	1247.3	3.3	Verifica
P7	al A´ al 19	S6	123 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	302	4 831.5			1195.2	0.000	0.000	1.00	380.2	1.41	25.13	25.13	0.002	1247.3	3.3	Verifica
P7	al A´ al 19	S6	124 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	323	5 166.9			1292.3	0.000	0.000	1.00	405.1	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 19	S6	125 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	365	5 847.4			1489.3	0.000	0.000	1.00	455.7	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P7	al A´ al 19	S6	126 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	330	5 285.1			1326.5	0.000	0.000	1.00	413.9	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 19	S6	127 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	323	5 166.9			1292.3	0.000	0.000	1.00	405.1	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 19	S6	128 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	323	5 166.9			1292.3	0.000	0.000	1.00	405.1	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 19	S6	129 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	320	5 115.6			1277.5	0.000	0.000	1.00	401.3	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 19	S6	130 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	318	5 094.9			1271.5	0.000	0.000	1.00	399.8	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 19	S6	131 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	373	5 965.6			1523.5	0.000	0.000	1.00	464.5	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P7	al A´ al 19	S6	132 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	365	5 847.4			1489.3	0.000	0.000	1.00	455.7	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P7	al A´ al 19	S6	133 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	365	5 847.4			1489.3	0.000	0.000	1.00	455.7	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P7	al A´ al 19	S6	134 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	362	5 796.1			1474.4	0.000	0.000	1.00	451.9	1.41	25.13	25.13	0.002	1247.3	2.8	Verifica
P7	al A´ al 19	S6	135 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	361	5 775.4			1468.4	0.000	0.000	1.00	450.3	1.41	25.13	25.13	0.002	1247.3	2.8	Verifica
P7	al A´ al 19	S6	136 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	373	5 965.6			1523.5	0.000	0.000	1.00	464.5	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P7	al A´ al 19	S6	137 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	373	5 965.6			1523.5	0.000	0.000	1.00	464.5	1.41	25.13	25.13	0.002	1247.3	2.7	Verifica
P7	al A´ al 19	S6	138 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.97																	

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 19 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)				
P9	al B al 19	S7	177 (C)	0.70	1.00	3 230.3			3.50	3.50	1.10	487.0	3 717.3	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.5	1.32	Verifica
P9	al B al 19	S7	178 (C)	0.70	1.00	3 396.7			3.50	3.50	1.10	487.0	3 883.7	400	0.93	0.000	0.000	3.12		3.12	Verifica	317.0	1.26	Verifica
P9	al B al 19	S7	179 (C)	0.70	1.00	3 230.3			3.50	3.50	1.10	487.0	3 717.3	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.5	1.32	Verifica
P9	al B al 19	S7	180 (C)	0.70	1.00	3 230.3			3.50	3.50	1.10	487.0	3 717.3	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.5	1.32	Verifica
P9	al B al 19	S7	181 (C)	0.70	1.00	3 226.8			3.50	3.50	1.10	487.0	3 713.8	400	0.90	0.000	0.000	3.05		3.05	Verifica	303.2	1.32	Verifica
P9	al B al 19	S7	182 (C)	0.70	1.00	3 214.1			3.50	3.50	1.10	487.0	3 701.1	400	0.90	0.000	0.000	3.04		3.04	Verifica	302.1	1.32	Verifica
P9	al B al 19	S7	183 (C)	0.70	1.00	3 396.7			3.50	3.50	1.10	487.0	3 883.7	400	0.93	0.000	0.000	3.12		3.12	Verifica	317.0	1.26	Verifica
P9	al B al 19	S7	184 (C)	0.70	1.00	3 396.7			3.50	3.50	1.10	487.0	3 883.7	400	0.93	0.000	0.000	3.12		3.12	Verifica	317.0	1.26	Verifica
P9	al B al 19	S7	185 (C)	0.70	1.00	3 393.1			3.50	3.50	1.10	487.0	3 880.1	400	0.92	0.000	0.000	3.11		3.11	Verifica	316.7	1.26	Verifica
P9	al B al 19	S7	186 (C)	0.70	1.00	3 380.4			3.50	3.50	1.10	487.0	3 867.4	400	0.92	0.000	0.000	3.11		3.11	Verifica	315.7	1.27	Verifica
P9	al B al 19	S7	187 (C)	0.70	1.00	2 781.4			3.50	3.50	1.10	487.0	3 268.4	400	0.85	0.000	0.000	2.86		2.86	Verifica	266.8	1.50	Verifica
P9	al B al 19	S7	188 (C)	0.70	1.00	3 262.0			3.50	3.50	1.10	487.0	3 749.0	400	0.91	0.000	0.000	3.06		3.06	Verifica	306.0	1.31	Verifica
P9	al B al 19	S7	189 (C)	0.70	1.00	2 781.4			3.50	3.50	1.10	487.0	3 268.4	400	0.85	0.000	0.000	2.86		2.86	Verifica	266.8	1.50	Verifica
P9	al B al 19	S7	190 (C)	0.70	1.00	2 781.4			3.50	3.50	1.10	487.0	3 268.4	400	0.85	0.000	0.000	2.86		2.86	Verifica	266.8	1.50	Verifica
P9	al B al 19	S7	191 (C)	0.70	1.00	2 777.8			3.50	3.50	1.10	487.0	3 264.8	400	0.85	0.000	0.000	2.86		2.86	Verifica	266.5	1.50	Verifica
P9	al B al 19	S7	192 (C)	0.70	1.00	2 765.1			3.50	3.50	1.10	487.0	3 252.1	400	0.85	0.000	0.000	2.85		2.85	Verifica	265.5	1.51	Verifica
P9	al B al 19	S7	193 (C)	0.70	1.00	3 262.0			3.50	3.50	1.10	487.0	3 749.0	400	0.91	0.000	0.000	3.06		3.06	Verifica	306.0	1.31	Verifica
P9	al B al 19	S7	194 (C)	0.70	1.00	3 262.0			3.50	3.50	1.10	487.0	3 749.0	400	0.91	0.000	0.000	3.06		3.06	Verifica	306.0	1.31	Verifica
P9	al B al 19	S7	195 (C)	0.70	1.00	3 258.4			3.50	3.50	1.10	487.0	3 745.4	400	0.91	0.000	0.000	3.06		3.06	Verifica	305.7	1.31	Verifica
P9	al B al 19	S7	196 (C)	0.70	1.00	3 245.7			3.50	3.50	1.10	487.0	3 732.7	400	0.91	0.000	0.000	3.05		3.05	Verifica	304.7	1.31	Verifica
P9	al B al 19	S7	197 (C)	0.70	1.00	2 545.1			3.50	3.50	1.10	487.0	3 032.1	400	0.82	0.000	0.000	2.75		2.75	Verifica	247.5	1.62	Verifica
P9	al B al 19	S7	198 (C)	0.70	1.00	3 025.7			3.50	3.50	1.10	487.0	3 512.7	400	0.88	0.000	0.000	2.96		2.96	Verifica	286.8	1.39	Verifica
P9	al B al 19	S7	199 (C)	0.70	1.00	2 711.4			3.50	3.50	1.10	487.0	3 198.4	400	0.84	0.000	0.000	2.83		2.83	Verifica	261.1	1.53	Verifica
P9	al B al 19	S7	200 (C)	0.70	1.00	2 545.1			3.50	3.50	1.10	487.0	3 032.1	400	0.82	0.000	0.000	2.75		2.75	Verifica	247.5	1.62	Verifica
P9	al B al 19	S7	201 (C)	0.70	1.00	2 545.1			3.50	3.50	1.10	487.0	3 032.1	400	0.82	0.000	0.000	2.75		2.75	Verifica	247.5	1.62	Verifica
P9	al B al 19	S7	202 (C)	0.70	1.00	2 541.6			3.50	3.50	1.10	487.0	3 028.6	400	0.82	0.000	0.000	2.75		2.75	Verifica	247.2	1.62	Verifica
P9	al B al 19	S7	203 (C)	0.70	1.00	2 528.8			3.50	3.50	1.10	487.0	3 015.8	400	0.82	0.000	0.000	2.75		2.75	Verifica	246.2	1.62	Verifica
P9	al B al 19	S7	204 (C)	0.70	1.00	3 192.0			3.50	3.50	1.10	487.0	3 679.0	400	0.90	0.000	0.000	3.03		3.03	Verifica	300.3	1.33	Verifica
P9	al B al 19	S7	205 (C)	0.70	1.00	3 025.7			3.50	3.50	1.10	487.0	3 512.7	400	0.88	0.000	0.000	2.96		2.96	Verifica	286.8	1.39	Verifica
P9	al B al 19	S7	206 (C)	0.70	1.00	3 025.7			3.50	3.50	1.10	487.0	3 512.7	400	0.88	0.000	0.000	2.96		2.96	Verifica	286.8	1.39	Verifica
P9	al B al 19	S7	207 (C)	0.70	1.00	3 022.2			3.50	3.50	1.10	487.0	3 509.2	400	0.88	0.000	0.000	2.96		2.96	Verifica	286.5	1.40	Verifica
P9	al B al 19	S7	208 (C)	0.70	1.00	3 009.4			3.50	3.50	1.10	487.0	3 496.4	400	0.88	0.000	0.000	2.96		2.96	Verifica	285.4	1.40	Verifica
P9	al B al 19	S7	209 (C)	0.70	1.00	2 711.4			3.50	3.50	1.10	487.0	3 198.4	400	0.84	0.000	0.000	2.83		2.83	Verifica	261.1	1.53	Verifica
P9	al B al 19	S7	210 (C)	0.70	1.00	2 711.4			3.50	3.50	1.10	487.0	3 198.4	400	0.84	0.000	0.000	2.83		2.83	Verifica	261.1	1.53	Verifica
P9	al B al 19	S7	211 (C)	0.70	1.00	2 707.9			3.50	3.50	1.10	487.0	3 194.9	400	0.84	0.000	0.000	2.83		2.83	Verifica	260.8	1.53	Verifica
P9	al B al 19	S7	212 (C)	0.70	1.00	2 695.1			3.50	3.50	1.10	487.0	3 182.1	400	0.84	0.000	0.000	2.82		2.82	Verifica	259.8	1.54	Verifica
P9	al B al 19	S7	213 (C)	0.70	1.00	3 192.0			3.50	3.50	1.10	487.0	3 679.0	400	0.90	0.000	0.000	3.03		3.03	Verifica	300.3	1.33	Verifica
P9	al B al 19	S7	214 (C)	0.70	1.00	3 192.0			3.50	3.50	1.10	487.0	3 679.0	400	0.90	0.000	0.000	3.03		3.03	Verifica	300.3		

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 11 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al B al 19	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4714.9	657.5	6037.5	0.000	0.000	2113.1	48.60	14.73	Ø20/0.15	20.93	1.42	1886.7	43.39	12.76	Ø20/0.15	20.93	1.64	Verifica
P9	al B al 19	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4465.4	657.5	5759.1	0.000	0.000	2015.7	46.36	14.05	Ø20/0.15	20.93	1.49	1799.7	41.39	12.17	Ø20/0.15	20.93	1.72	Verifica
P9	al B al 19	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4465.4	657.5	5763.6	0.000	0.000	2017.3	46.40	14.06	Ø20/0.15	20.93	1.49	1801.1	41.43	12.18	Ø20/0.15	20.93	1.72	Verifica
P9	al B al 19	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4460.1	657.5	5801.7	0.000	0.000	2030.6	46.70	14.15	Ø20/0.15	20.93	1.48	1813.0	41.70	12.26	Ø20/0.15	20.93	1.71	Verifica
P9	al B al 19	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4441.0	657.5	5686.2	0.000	0.000	1990.2	45.77	13.87	Ø20/0.15	20.93	1.51	1776.9	40.87	12.02	Ø20/0.15	20.93	1.74	Verifica
P9	al B al 19	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4714.9	657.5	6041.5	0.000	0.000	2114.5	48.63	14.74	Ø20/0.15	20.93	1.42	1888.0	43.42	12.77	Ø20/0.15	20.93	1.64	Verifica
P9	al B al 19	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4714.9	657.5	6046.1	0.000	0.000	2116.1	48.67	14.75	Ø20/0.15	20.93	1.42	1889.4	43.46	12.78	Ø20/0.15	20.93	1.64	Verifica
P9	al B al 19	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4709.6	657.5	6084.2	0.000	0.000	2129.5	48.98	14.84	Ø20/0.15	20.93	1.41	1901.3	43.73	12.86	Ø20/0.15	20.93	1.63	Verifica
P9	al B al 19	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4690.5	657.5	5968.6	0.000	0.000	2089.0	48.05	14.56	Ø20/0.15	20.93	1.44	1865.2	42.90	12.62	Ø20/0.15	20.93	1.66	Verifica
P9	al B al 19	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2900.2	657.5	3566.8	0.000	0.000	1248.4	28.71	8.70	Ø20/0.15	20.93	2.41	1114.6	25.64	7.54	Ø20/0.15	20.93	2.78	Verifica
P9	al B al 19	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3621.1	657.5	4604.2	0.000	0.000	1611.5	37.06	11.23	Ø20/0.15	20.93	1.86	1438.8	33.09	9.73	Ø20/0.15	20.93	2.15	Verifica
P9	al B al 19	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2900.2	657.5	3570.9	0.000	0.000	1249.8	28.75	8.71	Ø20/0.15	20.93	2.40	1115.9	25.67	7.55	Ø20/0.15	20.93	2.77	Verifica
P9	al B al 19	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2900.2	657.5	3575.4	0.000	0.000	1251.4	28.78	8.72	Ø20/0.15	20.93	2.40	1117.3	25.70	7.56	Ø20/0.15	20.93	2.77	Verifica
P9	al B al 19	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2894.9	657.5	3613.5	0.000	0.000	1264.7	29.09	8.81	Ø20/0.15	20.93	2.37	1129.2	25.97	7.64	Ø20/0.15	20.93	2.74	Verifica
P9	al B al 19	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2875.8	657.5	3497.9	0.000	0.000	1224.3	28.16	8.53	Ø20/0.15	20.93	2.45	1093.1	25.14	7.39	Ø20/0.15	20.93	2.83	Verifica
P9	al B al 19	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3621.1	657.5	4608.3	0.000	0.000	1612.9	37.10	11.24	Ø20/0.15	20.93	1.86	1440.1	33.12	9.74	Ø20/0.15	20.93	2.15	Verifica
P9	al B al 19	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3621.1	657.5	4612.9	0.000	0.000	1614.5	37.13	11.25	Ø20/0.15	20.93	1.86	1441.5	33.16	9.75	Ø20/0.15	20.93	2.15	Verifica
P9	al B al 19	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3615.8	657.5	4650.9	0.000	0.000	1627.8	37.44	11.35	Ø20/0.15	20.93	1.84	1453.4	33.43	9.83	Ø20/0.15	20.93	2.13	Verifica
P9	al B al 19	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3596.7	657.5	4535.4	0.000	0.000	1587.4	36.51	11.06	Ø20/0.15	20.93	1.89	1417.3	32.60	9.59	Ø20/0.15	20.93	2.18	Verifica
P9	al B al 19	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3437.5	657.5	4278.2	0.000	0.000	1497.4	34.44	10.44	Ø20/0.15	20.93	2.01	1336.9	30.75	9.04	Ø20/0.15	20.93	2.31	Verifica
P9	al B al 19	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4158.4	657.5	5315.6	0.000	0.000	1860.5	42.79	12.97	Ø20/0.15	20.93	1.61	1661.1	38.21	11.24	Ø20/0.15	20.93	1.86	Verifica
P9	al B al 19	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3687.0	657.5	4560.6	0.000	0.000	1596.2	36.71	11.13	Ø20/0.15	20.93	1.88	1425.2	32.78	9.64	Ø20/0.15	20.93	2.17	Verifica
P9	al B al 19	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3437.5	657.5	4282.3	0.000	0.000	1498.8	34.47	10.45	Ø20/0.15	20.93	2.00	1338.2	30.78	9.05	Ø20/0.15	20.93	2.31	Verifica
P9	al B al 19	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3437.5	657.5	4286.8	0.000	0.000	1500.4	34.51	10.46	Ø20/0.15	20.93	2.00	1339.6	30.81	9.06	Ø20/0.15	20.93	2.31	Verifica
P9	al B al 19	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3432.2	657.5	4324.9	0.000	0.000	1513.7	34.82	10.55	Ø20/0.15	20.93	1.98	1351.5	31.09	9.14	Ø20/0.15	20.93	2.29	Verifica
P9	al B al 19	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3413.1	657.5	4209.3	0.000	0.000	1473.3	33.88	10.27	Ø20/0.15	20.93	2.04	1315.4	30.25	8.90	Ø20/0.15	20.93	2.35	Verifica
P9	al B al 19	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4407.9	657.5	5598.1	0.000	0.000	1959.3	45.06	13.66	Ø20/0.15	20.93	1.53	1749.4	40.24	11.83	Ø20/0.15	20.93	1.77	Verifica
P9	al B al 19	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4158.4	657.5	5319.7	0.000	0.000	1861.9	42.82	12.98	Ø20/0.15	20.93	1.61	1662.4	38.24	11.25	Ø20/0.15	20.93	1.86	Verifica
P9	al B al 19	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4158.4	657.5	5324.3	0.000	0.000	1863.5	42.86	12.99	Ø20/0.15	20.93	1.61	1663.8	38.27	11.26	Ø20/0.15	20.93	1.86	Verifica
P9	al B al 19	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4153.1	657.5	5362.3	0.000	0.000	1876.8	43.17	13.08	Ø20/0.15	20.93	1.60	1675.7	38.54	11.34	Ø20/0.15	20.93	1.85	Verifica
P9	al B al 19	S7	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00																		

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	ftcm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 11 - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{Edg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m ²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m ²)	(cm2/m)		(cm2/m)		(kN/m ²)					
P9	al B al 19	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	493	6 037.5			1451.7	0.000	0.000	1.00	701.0	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al B al 19	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	470	5 759.1			1379.3	0.000	0.000	1.00	669.5	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 19	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	470	5 763.6			1380.5	0.000	0.000	1.00	670.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 19	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	474	5 801.7			1390.4	0.000	0.000	1.00	674.4	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 19	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	464	5 686.2			1360.3	0.000	0.000	1.00	661.3	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al B al 19	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	493	6 041.5			1452.7	0.000	0.000	1.00	701.5	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al B al 19	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	494	6 046.1			1453.9	0.000	0.000	1.00	702.0	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al B al 19	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	497	6 084.2			1463.8	0.000	0.000	1.00	706.3	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al B al 19	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	487	5 968.6			1433.8	0.000	0.000	1.00	693.2	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al B al 19	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	291	3 566.8			809.2	0.000	0.000	1.00	421.5	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica
P9	al B al 19	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	376	4 604.2			1079.0	0.000	0.000	1.00	538.9	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 19	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	292	3 570.9			810.3	0.000	0.000	1.00	422.0	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica
P9	al B al 19	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	292	3 575.4			811.5	0.000	0.000	1.00	422.5	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica
P9	al B al 19	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	295	3 613.5			821.4	0.000	0.000	1.00	426.8	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica
P9	al B al 19	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	286	3 497.9			791.3	0.000	0.000	1.00	413.8	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al B al 19	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	376	4 608.3			1080.0	0.000	0.000	1.00	539.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 19	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	377	4 612.9			1081.2	0.000	0.000	1.00	539.9	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 19	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	380	4 650.9			1091.1	0.000	0.000	1.00	544.2	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 19	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	370	4 535.4			1061.1	0.000	0.000	1.00	531.1	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 19	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	349	4 278.2			994.2	0.000	0.000	1.00	502.0	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica
P9	al B al 19	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	434	5 315.6			1264.0	0.000	0.000	1.00	619.4	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 19	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	372	4 560.6			1067.6	0.000	0.000	1.00	534.0	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al B al 19	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	350	4 282.3			995.3	0.000	0.000	1.00	502.5	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica
P9	al B al 19	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	350	4 286.8			996.4	0.000	0.000	1.00	503.0	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al B al 19	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	353	4 324.9			1006.4	0.000	0.000	1.00	507.3	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al B al 19	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	344	4 209.3			976.3	0.000	0.000	1.00	494.2	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica
P9	al B al 19	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	457	5 598.1			1337.4	0.000	0.000	1.00	651.3	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al B al 19	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	434	5 319.7			1265.0	0.000	0.000	1.00	619.8	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 19	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	435	5 324.3			1266.2	0.000	0.000	1.00	620.3	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 19	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	438	5 362.3			1276.1	0.000	0.000	1.00	624.6	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 19	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	428	5 246.8			1246.1	0.000	0.000	1.00	611.6	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P9	al B al 19	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	457	5 602.2			1338.5	0.000	0.000	1.00	651.8	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al B al 19	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	458	5 606.7			1339.7	0.000	0.000	1.00	652.3	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al B al 19	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	461	5 644.8			13434											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 19 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)				
P9	al C al 19	S7	177 (C)	0.70	1.00	3 824.5			3.50	3.50	1.10	487.0	4 311.5	400	0.98	0.000	0.000	3.28		3.28	Verifica	352.0	1.14	Verifica
P9	al C al 19	S7	178 (C)	0.70	1.00	4 041.5			3.50	3.50	1.10	487.0	4 528.5	400	1.00	0.000	0.000	3.36		3.36	Verifica	369.7	1.08	Verifica
P9	al C al 19	S7	179 (C)	0.70	1.00	3 824.5			3.50	3.50	1.10	487.0	4 311.5	400	0.98	0.000	0.000	3.28		3.28	Verifica	352.0	1.14	Verifica
P9	al C al 19	S7	180 (C)	0.70	1.00	3 824.5			3.50	3.50	1.10	487.0	4 311.5	400	0.98	0.000	0.000	3.28		3.28	Verifica	352.0	1.14	Verifica
P9	al C al 19	S7	181 (C)	0.70	1.00	3 824.3			3.50	3.50	1.10	487.0	4 311.3	400	0.98	0.000	0.000	3.28		3.28	Verifica	351.9	1.14	Verifica
P9	al C al 19	S7	182 (C)	0.70	1.00	3 824.6			3.50	3.50	1.10	487.0	4 311.6	400	0.98	0.000	0.000	3.28		3.28	Verifica	352.0	1.14	Verifica
P9	al C al 19	S7	183 (C)	0.70	1.00	4 041.5			3.50	3.50	1.10	487.0	4 528.5	400	1.00	0.000	0.000	3.36		3.36	Verifica	369.7	1.08	Verifica
P9	al C al 19	S7	184 (C)	0.70	1.00	4 041.5			3.50	3.50	1.10	487.0	4 528.5	400	1.00	0.000	0.000	3.36		3.36	Verifica	369.7	1.08	Verifica
P9	al C al 19	S7	185 (C)	0.70	1.00	4 041.4			3.50	3.50	1.10	487.0	4 528.4	400	1.00	0.000	0.000	3.36		3.36	Verifica	369.7	1.08	Verifica
P9	al C al 19	S7	186 (C)	0.70	1.00	4 041.6			3.50	3.50	1.10	487.0	4 528.6	400	1.00	0.000	0.000	3.36		3.36	Verifica	369.7	1.08	Verifica
P9	al C al 19	S7	187 (C)	0.70	1.00	3 227.8			3.50	3.50	1.10	487.0	3 714.8	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.3	1.32	Verifica
P9	al C al 19	S7	188 (C)	0.70	1.00	3 862.5			3.50	3.50	1.10	487.0	4 349.5	400	0.98	0.000	0.000	3.30		3.30	Verifica	355.1	1.13	Verifica
P9	al C al 19	S7	189 (C)	0.70	1.00	3 227.8			3.50	3.50	1.10	487.0	3 714.8	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.3	1.32	Verifica
P9	al C al 19	S7	190 (C)	0.70	1.00	3 227.8			3.50	3.50	1.10	487.0	3 714.8	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.3	1.32	Verifica
P9	al C al 19	S7	191 (C)	0.70	1.00	3 227.6			3.50	3.50	1.10	487.0	3 714.6	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.2	1.32	Verifica
P9	al C al 19	S7	192 (C)	0.70	1.00	3 227.9			3.50	3.50	1.10	487.0	3 714.9	400	0.91	0.000	0.000	3.05		3.05	Verifica	303.3	1.32	Verifica
P9	al C al 19	S7	193 (C)	0.70	1.00	3 862.5			3.50	3.50	1.10	487.0	4 349.5	400	0.98	0.000	0.000	3.30		3.30	Verifica	355.1	1.13	Verifica
P9	al C al 19	S7	194 (C)	0.70	1.00	3 862.5			3.50	3.50	1.10	487.0	4 349.5	400	0.98	0.000	0.000	3.30		3.30	Verifica	355.1	1.13	Verifica
P9	al C al 19	S7	195 (C)	0.70	1.00	3 862.3			3.50	3.50	1.10	487.0	4 349.3	400	0.98	0.000	0.000	3.30		3.30	Verifica	355.0	1.13	Verifica
P9	al C al 19	S7	196 (C)	0.70	1.00	3 862.6			3.50	3.50	1.10	487.0	4 349.6	400	0.98	0.000	0.000	3.30		3.30	Verifica	355.1	1.13	Verifica
P9	al C al 19	S7	197 (C)	0.70	1.00	2 917.9			3.50	3.50	1.10	487.0	3 404.9	400	0.87	0.000	0.000	2.92		2.92	Verifica	278.0	1.44	Verifica
P9	al C al 19	S7	198 (C)	0.70	1.00	3 552.6			3.50	3.50	1.10	487.0	4 039.6	400	0.94	0.000	0.000	3.18		3.18	Verifica	329.8	1.21	Verifica
P9	al C al 19	S7	199 (C)	0.70	1.00	3 134.9			3.50	3.50	1.10	487.0	3 621.9	400	0.89	0.000	0.000	3.01		3.01	Verifica	295.7	1.35	Verifica
P9	al C al 19	S7	200 (C)	0.70	1.00	2 917.9			3.50	3.50	1.10	487.0	3 404.9	400	0.87	0.000	0.000	2.92		2.92	Verifica	278.0	1.44	Verifica
P9	al C al 19	S7	201 (C)	0.70	1.00	2 917.9			3.50	3.50	1.10	487.0	3 404.9	400	0.87	0.000	0.000	2.92		2.92	Verifica	278.0	1.44	Verifica
P9	al C al 19	S7	202 (C)	0.70	1.00	2 917.7			3.50	3.50	1.10	487.0	3 404.7	400	0.87	0.000	0.000	2.92		2.92	Verifica	277.9	1.44	Verifica
P9	al C al 19	S7	203 (C)	0.70	1.00	2 918.0			3.50	3.50	1.10	487.0	3 405.0	400	0.87	0.000	0.000	2.92		2.92	Verifica	278.0	1.44	Verifica
P9	al C al 19	S7	204 (C)	0.70	1.00	3 769.6			3.50	3.50	1.10	487.0	4 256.6	400	0.97	0.000	0.000	3.26		3.26	Verifica	347.5	1.15	Verifica
P9	al C al 19	S7	205 (C)	0.70	1.00	3 552.6			3.50	3.50	1.10	487.0	4 039.6	400	0.94	0.000	0.000	3.18		3.18	Verifica	329.8	1.21	Verifica
P9	al C al 19	S7	206 (C)	0.70	1.00	3 552.6			3.50	3.50	1.10	487.0	4 039.6	400	0.94	0.000	0.000	3.18		3.18	Verifica	329.8	1.21	Verifica
P9	al C al 19	S7	207 (C)	0.70	1.00	3 552.4			3.50	3.50	1.10	487.0	4 039.4	400	0.94	0.000	0.000	3.18		3.18	Verifica	329.7	1.21	Verifica
P9	al C al 19	S7	208 (C)	0.70	1.00	3 552.7			3.50	3.50	1.10	487.0	4 039.7	400	0.94	0.000	0.000	3.18		3.18	Verifica	329.8	1.21	Verifica
P9	al C al 19	S7	209 (C)	0.70	1.00	3 134.9			3.50	3.50	1.10	487.0	3 621.9	400	0.89	0.000	0.000	3.01		3.01	Verifica	295.7	1.35	Verifica
P9	al C al 19	S7	210 (C)	0.70	1.00	3 134.9			3.50	3.50	1.10	487.0	3 621.9	400	0.89	0.000	0.000	3.01		3.01	Verifica	295.7	1.35	Verifica
P9	al C al 19	S7	211 (C)	0.70	1.00	3 134.7			3.50	3.50	1.10	487.0	3 621.7	400	0.89	0.000	0.000	3.01		3.01	Verifica	295.7	1.35	Verifica
P9	al C al 19	S7	212 (C)	0.70	1.00	3 135.0			3.50	3.50	1.10	487.0	3 622.0	400	0.89	0.000	0.000	3.01		3.01	Verifica	295.7	1.35	Verifica
P9	al C al 19	S7	213 (C)	0.70	1.00	3 769.6			3.50	3.50	1.10	487.0	4 256.6	400	0.97	0.000	0.000	3.26		3.26	Verifica	347.5	1.15	Verifica
P9	al C al 19	S7	214 (C)	0.70	1.00	3 769.6			3.50	3.50	1.10	487.0	4 256.6	400	0.97	0.000	0.000	3.26		3.26	Verifica	347.5	1.15	Verifica

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 11 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	
P9	al C al 19	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5628.3	657.5	6285.8	0.000	0.000	2200.0	50.60	15.33	Ø20/0.15	20.93	1.36	1964.3	45.18	13.29	Ø20/0.15	20.93	1.58	Verifica
P9	al C al 19	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5302.8	657.5	5960.3	0.000	0.000	2086.1	47.98	14.54	Ø20/0.15	20.93	1.44	1862.6	42.84	12.60	Ø20/0.15	20.93	1.66	Verifica
P9	al C al 19	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5302.8	657.5	5960.3	0.000	0.000	2086.1	47.98	14.54	Ø20/0.15	20.93	1.44	1862.6	42.84	12.60	Ø20/0.15	20.93	1.66	Verifica
P9	al C al 19	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5302.5	657.5	5960.0	0.000	0.000	2086.0	47.98	14.54	Ø20/0.15	20.93	1.44	1862.5	42.84	12.60	Ø20/0.15	20.93	1.66	Verifica
P9	al C al 19	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5303.0	657.5	5960.5	0.000	0.000	2086.2	47.98	14.54	Ø20/0.15	20.93	1.44	1862.7	42.84	12.60	Ø20/0.15	20.93	1.66	Verifica
P9	al C al 19	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5628.3	657.5	6285.8	0.000	0.000	2200.0	50.60	15.33	Ø20/0.15	20.93	1.36	1964.3	45.18	13.29	Ø20/0.15	20.93	1.58	Verifica
P9	al C al 19	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5628.3	657.5	6285.8	0.000	0.000	2200.0	50.60	15.33	Ø20/0.15	20.93	1.36	1964.3	45.18	13.29	Ø20/0.15	20.93	1.58	Verifica
P9	al C al 19	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5628.1	657.5	6285.6	0.000	0.000	2200.0	50.60	15.33	Ø20/0.15	20.93	1.37	1964.2	45.18	13.29	Ø20/0.15	20.93	1.58	Verifica
P9	al C al 19	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5628.5	657.5	6286.0	0.000	0.000	2200.1	50.60	15.33	Ø20/0.15	20.93	1.36	1964.4	45.18	13.29	Ø20/0.15	20.93	1.58	Verifica
P9	al C al 19	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3382.8	657.5	4040.3	0.000	0.000	1414.1	32.52	9.86	Ø20/0.15	20.93	2.12	1262.6	29.04	8.54	Ø20/0.15	20.93	2.45	Verifica
P9	al C al 19	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4334.9	657.5	4992.4	0.000	0.000	1747.3	40.19	12.18	Ø20/0.15	20.93	1.72	1560.1	35.88	10.55	Ø20/0.15	20.93	1.98	Verifica
P9	al C al 19	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3382.8	657.5	4040.3	0.000	0.000	1414.1	32.52	9.86	Ø20/0.15	20.93	2.12	1262.6	29.04	8.54	Ø20/0.15	20.93	2.45	Verifica
P9	al C al 19	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3382.8	657.5	4040.3	0.000	0.000	1414.1	32.52	9.86	Ø20/0.15	20.93	2.12	1262.6	29.04	8.54	Ø20/0.15	20.93	2.45	Verifica
P9	al C al 19	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3382.5	657.5	4040.0	0.000	0.000	1414.0	32.52	9.86	Ø20/0.15	20.93	2.12	1262.5	29.04	8.54	Ø20/0.15	20.93	2.45	Verifica
P9	al C al 19	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3383.0	657.5	4040.5	0.000	0.000	1414.2	32.53	9.86	Ø20/0.15	20.93	2.12	1262.7	29.04	8.54	Ø20/0.15	20.93	2.45	Verifica
P9	al C al 19	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4334.9	657.5	4992.4	0.000	0.000	1747.3	40.19	12.18	Ø20/0.15	20.93	1.72	1560.1	35.88	10.55	Ø20/0.15	20.93	1.98	Verifica
P9	al C al 19	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4334.9	657.5	4992.4	0.000	0.000	1747.3	40.19	12.18	Ø20/0.15	20.93	1.72	1560.1	35.88	10.55	Ø20/0.15	20.93	1.98	Verifica
P9	al C al 19	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4334.6	657.5	4992.1	0.000	0.000	1747.2	40.19	12.18	Ø20/0.15	20.93	1.72	1560.0	35.88	10.55	Ø20/0.15	20.93	1.98	Verifica
P9	al C al 19	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4335.1	657.5	4992.6	0.000	0.000	1747.4	40.19	12.18	Ø20/0.15	20.93	1.72	1560.2	35.88	10.55	Ø20/0.15	20.93	1.98	Verifica
P9	al C al 19	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3942.8	657.5	4600.3	0.000	0.000	1610.1	37.03	11.22	Ø20/0.15	20.93	1.87	1437.6	33.06	9.72	Ø20/0.15	20.93	2.15	Verifica
P9	al C al 19	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4894.9	657.5	5552.4	0.000	0.000	1943.3	44.70	13.54	Ø20/0.15	20.93	1.55	1735.1	39.91	11.74	Ø20/0.15	20.93	1.78	Verifica
P9	al C al 19	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4268.4	657.5	4925.9	0.000	0.000	1724.1	39.65	12.02	Ø20/0.15	20.93	1.74	1539.3	35.40	10.41	Ø20/0.15	20.93	2.01	Verifica
P9	al C al 19	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3942.8	657.5	4600.3	0.000	0.000	1610.1	37.03	11.22	Ø20/0.15	20.93	1.87	1437.6	33.06	9.72	Ø20/0.15	20.93	2.15	Verifica
P9	al C al 19	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3942.8	657.5	4600.3	0.000	0.000	1610.1	37.03	11.22	Ø20/0.15	20.93	1.87	1437.6	33.06	9.72	Ø20/0.15	20.93	2.15	Verifica
P9	al C al 19	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3942.6	657.5	4600.1	0.000	0.000	1610.0	37.03	11.22	Ø20/0.15	20.93	1.87	1437.5	33.06	9.72	Ø20/0.15	20.93	2.15	Verifica
P9	al C al 19	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3943.0	657.5	4600.5	0.000	0.000	1610.2	37.03	11.22	Ø20/0.15	20.93	1.87	1437.7	33.07	9.73	Ø20/0.15	20.93	2.15	Verifica
P9	al C al 19	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5220.5	657.5	5878.0	0.000	0.000	2057.3	47.32	14.34	Ø20/0.15	20.93	1.46	1836.9	42.25	12.43	Ø20/0.15	20.93	1.68	Verifica
P9	al C al 19	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4894.9	657.5	5552.4	0.000	0.000	1943.3	44.70	13.54	Ø20/0.15	20.93	1.55	1735.1	39.91	11.74	Ø20/0.15	20.93	1.78	Verifica
P9	al C al 19	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4894.9	657.5	5552.4	0.000	0.000	1943.3	44.70	13.54	Ø20/0.15	20.93	1.55	1735.1	39.91	11.74	Ø20/0.15	20.93	1.78	Verifica
P9	al C al 19	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4894.7	657.5	5552.2	0.000	0.000	1943.3	44.70	13.54	Ø20/0.15	20.93	1.55	1735.1	39.91	11.74	Ø20/0.15	20.93	1.78	Verifica
P9	al C al 19	S7	135 (C)	0.70	1.00	3.50	3.50																				

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 11 - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{issg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m ²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m ²)	(cm2/m)		(cm2/m)		(kN/m ²)					
P9	al C al 19	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	513	6 285.8			1516.3	0.000	0.000	1.00	729.1	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 19	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	487	5 960.3			1431.6	0.000	0.000	1.00	692.3	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 19	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	487	5 960.3			1431.6	0.000	0.000	1.00	692.3	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 19	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	487	5 960.0			1431.5	0.000	0.000	1.00	692.3	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 19	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	487	5 960.5			1431.7	0.000	0.000	1.00	692.3	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 19	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	513	6 285.8			1516.3	0.000	0.000	1.00	729.1	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 19	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	513	6 285.8			1516.3	0.000	0.000	1.00	729.1	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 19	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	513	6 285.6			1516.2	0.000	0.000	1.00	729.1	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 19	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	513	6 286.0			1516.3	0.000	0.000	1.00	729.1	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P9	al C al 19	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	330	4 040.3			932.3	0.000	0.000	1.00	475.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 19	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	408	4 992.4			1179.9	0.000	0.000	1.00	582.8	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 19	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	330	4 040.3			932.3	0.000	0.000	1.00	475.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 19	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	330	4 040.3			932.3	0.000	0.000	1.00	475.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 19	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	330	4 040.0			932.3	0.000	0.000	1.00	475.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 19	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	330	4 040.5			932.4	0.000	0.000	1.00	475.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 19	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	408	4 992.4			1179.9	0.000	0.000	1.00	582.8	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 19	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	408	4 992.4			1179.9	0.000	0.000	1.00	582.8	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 19	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	408	4 992.1			1179.8	0.000	0.000	1.00	582.8	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 19	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	408	4 992.6			1180.0	0.000	0.000	1.00	582.8	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 19	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	376	4 600.3			1078.0	0.000	0.000	1.00	538.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 19	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	453	5 552.4			1325.5	0.000	0.000	1.00	646.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 19	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	402	4 925.9			1162.6	0.000	0.000	1.00	575.3	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P9	al C al 19	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	376	4 600.3			1078.0	0.000	0.000	1.00	538.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 19	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	376	4 600.3			1078.0	0.000	0.000	1.00	538.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 19	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	376	4 600.1			1077.9	0.000	0.000	1.00	538.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 19	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	376	4 600.5			1078.0	0.000	0.000	1.00	538.5	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 19	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	480	5 878.0			1410.2	0.000	0.000	1.00	683.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 19	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	453	5 552.4			1325.5	0.000	0.000	1.00	646.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 19	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	453	5 552.4			1325.5	0.000	0.000	1.00	646.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 19	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	453	5 552.2			1325.5	0.000	0.000	1.00	646.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 19	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	453	5 552.6			1325.6	0.000	0.000	1.00	646.2	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P9	al C al 19	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	480	5 878.0			1410.2	0.000	0.000	1.00	683.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 19	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	480	5 878.0			1410.2	0.000	0.000	1.00	683.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P9	al C al 19	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	480	5 877.7														

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P7	al A' al 21	S7	177 (C)	0.70	1.40	2 668.6			3.50	3.50	1.10	483.4	3 152.0	400	0.83	0.000	0.000	2.81		2.81	Verifica	257.3	1.55	Verifica
P7	al A' al 21	S7	178 (C)	0.70	1.40	2 744.7			3.50	3.50	1.10	483.4	3 228.1	400	0.84	0.000	0.000	2.84		2.84	Verifica	263.5	1.52	Verifica
P7	al A' al 21	S7	179 (C)	0.70	1.40	2 668.6			3.50	3.50	1.10	483.4	3 152.0	400	0.83	0.000	0.000	2.81		2.81	Verifica	257.3	1.55	Verifica
P7	al A' al 21	S7	180 (C)	0.70	1.40	2 668.6			3.50	3.50	1.10	483.4	3 152.0	400	0.83	0.000	0.000	2.81		2.81	Verifica	257.3	1.55	Verifica
P7	al A' al 21	S7	181 (C)	0.70	1.40	2 645.0			3.50	3.50	1.10	483.4	3 128.4	400	0.83	0.000	0.000	2.80		2.80	Verifica	255.4	1.57	Verifica
P7	al A' al 21	S7	182 (C)	0.70	1.40	2 644.7			3.50	3.50	1.10	483.4	3 128.1	400	0.83	0.000	0.000	2.80		2.80	Verifica	255.4	1.57	Verifica
P7	al A' al 21	S7	183 (C)	0.70	1.40	2 744.7			3.50	3.50	1.10	483.4	3 228.1	400	0.84	0.000	0.000	2.84		2.84	Verifica	263.5	1.52	Verifica
P7	al A' al 21	S7	184 (C)	0.70	1.40	2 744.7			3.50	3.50	1.10	483.4	3 228.1	400	0.84	0.000	0.000	2.84		2.84	Verifica	263.5	1.52	Verifica
P7	al A' al 21	S7	185 (C)	0.70	1.40	2 721.1			3.50	3.50	1.10	483.4	3 204.5	400	0.84	0.000	0.000	2.83		2.83	Verifica	261.6	1.53	Verifica
P7	al A' al 21	S7	186 (C)	0.70	1.40	2 720.8			3.50	3.50	1.10	483.4	3 204.2	400	0.84	0.000	0.000	2.83		2.83	Verifica	261.6	1.53	Verifica
P7	al A' al 21	S7	187 (C)	0.70	1.40	2 385.3			3.50	3.50	1.10	483.4	2 868.7	400	0.80	0.000	0.000	2.68		2.68	Verifica	234.2	1.71	Verifica
P7	al A' al 21	S7	188 (C)	0.70	1.40	2 659.7			3.50	3.50	1.10	483.4	3 143.1	400	0.83	0.000	0.000	2.80		2.80	Verifica	256.6	1.56	Verifica
P7	al A' al 21	S7	189 (C)	0.70	1.40	2 385.3			3.50	3.50	1.10	483.4	2 868.7	400	0.80	0.000	0.000	2.68		2.68	Verifica	234.2	1.71	Verifica
P7	al A' al 21	S7	190 (C)	0.70	1.40	2 385.3			3.50	3.50	1.10	483.4	2 868.7	400	0.80	0.000	0.000	2.68		2.68	Verifica	234.2	1.71	Verifica
P7	al A' al 21	S7	191 (C)	0.70	1.40	2 361.7			3.50	3.50	1.10	483.4	2 845.1	400	0.79	0.000	0.000	2.67		2.67	Verifica	232.3	1.72	Verifica
P7	al A' al 21	S7	192 (C)	0.70	1.40	2 361.3			3.50	3.50	1.10	483.4	2 844.7	400	0.79	0.000	0.000	2.67		2.67	Verifica	232.2	1.72	Verifica
P7	al A' al 21	S7	193 (C)	0.70	1.40	2 659.7			3.50	3.50	1.10	483.4	3 143.1	400	0.83	0.000	0.000	2.80		2.80	Verifica	256.6	1.56	Verifica
P7	al A' al 21	S7	194 (C)	0.70	1.40	2 659.7			3.50	3.50	1.10	483.4	3 143.1	400	0.83	0.000	0.000	2.80		2.80	Verifica	256.6	1.56	Verifica
P7	al A' al 21	S7	195 (C)	0.70	1.40	2 636.1			3.50	3.50	1.10	483.4	3 119.5	400	0.83	0.000	0.000	2.79		2.79	Verifica	254.7	1.57	Verifica
P7	al A' al 21	S7	196 (C)	0.70	1.40	2 635.8			3.50	3.50	1.10	483.4	3 119.2	400	0.83	0.000	0.000	2.79		2.79	Verifica	254.6	1.57	Verifica
P7	al A' al 21	S7	197 (C)	0.70	1.40	2 285.1			3.50	3.50	1.10	483.4	2 768.5	400	0.78	0.000	0.000	2.63		2.63	Verifica	226.0	1.77	Verifica
P7	al A' al 21	S7	198 (C)	0.70	1.40	2 559.5			3.50	3.50	1.10	483.4	3 042.9	400	0.82	0.000	0.000	2.76		2.76	Verifica	248.4	1.61	Verifica
P7	al A' al 21	S7	199 (C)	0.70	1.40	2 361.1			3.50	3.50	1.10	483.4	2 844.5	400	0.79	0.000	0.000	2.67		2.67	Verifica	232.2	1.72	Verifica
P7	al A' al 21	S7	200 (C)	0.70	1.40	2 285.1			3.50	3.50	1.10	483.4	2 768.5	400	0.78	0.000	0.000	2.63		2.63	Verifica	226.0	1.77	Verifica
P7	al A' al 21	S7	201 (C)	0.70	1.40	2 285.1			3.50	3.50	1.10	483.4	2 768.5	400	0.78	0.000	0.000	2.63		2.63	Verifica	226.0	1.77	Verifica
P7	al A' al 21	S7	202 (C)	0.70	1.40	2 261.5			3.50	3.50	1.10	483.4	2 744.9	400	0.78	0.000	0.000	2.62		2.62	Verifica	224.1	1.79	Verifica
P7	al A' al 21	S7	203 (C)	0.70	1.40	2 261.2			3.50	3.50	1.10	483.4	2 744.6	400	0.78	0.000	0.000	2.62		2.62	Verifica	224.0	1.79	Verifica
P7	al A' al 21	S7	204 (C)	0.70	1.40	2 635.6			3.50	3.50	1.10	483.4	3 119.0	400	0.83	0.000	0.000	2.79		2.79	Verifica	254.6	1.57	Verifica
P7	al A' al 21	S7	205 (C)	0.70	1.40	2 559.5			3.50	3.50	1.10	483.4	3 042.9	400	0.82	0.000	0.000	2.76		2.76	Verifica	248.4	1.61	Verifica
P7	al A' al 21	S7	206 (C)	0.70	1.40	2 559.5			3.50	3.50	1.10	483.4	3 042.9	400	0.82	0.000	0.000	2.76		2.76	Verifica	248.4	1.61	Verifica
P7	al A' al 21	S7	207 (C)	0.70	1.40	2 535.9			3.50	3.50	1.10	483.4	3 019.3	400	0.82	0.000	0.000	2.75		2.75	Verifica	246.5	1.62	Verifica
P7	al A' al 21	S7	208 (C)	0.70	1.40	2 535.6			3.50	3.50	1.10	483.4	3 019.0	400	0.82	0.000	0.000	2.75		2.75	Verifica	246.4	1.62	Verifica
P7	al A' al 21	S7	209 (C)	0.70	1.40	2 361.1			3.50	3.50	1.10	483.4	2 844.5	400	0.79	0.000	0.000	2.67		2.67	Verifica	232.2	1.72	Verifica
P7	al A' al 21	S7	210 (C)	0.70	1.40	2 361.1			3.50	3.50	1.10	483.4	2 844.5	400	0.79	0.000	0.000	2.67		2.67	Verifica	232.2	1.72	Verifica
P7	al A' al 21	S7	211 (C)	0.70	1.40	2 337.6			3.50	3.50	1.10	483.4	2 821.0	400	0.79	0.000	0.000	2.66		2.66	Verifica	230.3	1.74	Verifica
P7	al A' al 21	S7	212 (C)	0.70	1.40	2 337.2			3.50	3.50	1.10	483.4	2 820.6	400	0.79	0.000	0.000	2.66		2.66	Verifica	230.3	1.74	Verifica
P7	al A' al 21	S7	213 (C)	0.70	1.40	2 635.6			3.50	3.50	1.10	483.4	3 119.0	400	0.83	0.000	0.000	2.79		2.79	Verifica	254.6	1.57	Verifica
P7	al A' al 21	S7	214 (C)	0.70	1.40	2 635.6			3.50	3.50	1.10													

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P7	al A´ al 21	S7	105 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3777.2	652.6	4429.8	0.000	0.000	1550.4	35.66	10.81	Ø20/0.15	20.93	1.94	1162.8	26.74	7.87	Ø20/0.15	20.93	2.66	Verifica
P7	al A´ al 21	S7	106 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3663.1	652.6	4315.7	0.000	0.000	1510.5	34.74	10.53	Ø20/0.15	20.93	1.99	1132.9	26.06	7.66	Ø20/0.15	20.93	2.73	Verifica
P7	al A´ al 21	S7	107 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3663.1	652.6	4315.7	0.000	0.000	1510.5	34.74	10.53	Ø20/0.15	20.93	1.99	1132.9	26.06	7.66	Ø20/0.15	20.93	2.73	Verifica
P7	al A´ al 21	S7	108 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3627.8	652.6	4280.4	0.000	0.000	1498.1	34.46	10.44	Ø20/0.15	20.93	2.00	1123.6	25.84	7.60	Ø20/0.15	20.93	2.75	Verifica
P7	al A´ al 21	S7	109 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3627.3	652.6	4279.9	0.000	0.000	1498.0	34.45	10.44	Ø20/0.15	20.93	2.00	1123.5	25.84	7.60	Ø20/0.15	20.93	2.75	Verifica
P7	al A´ al 21	S7	110 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3777.2	652.6	4429.8	0.000	0.000	1550.4	35.66	10.81	Ø20/0.15	20.93	1.94	1162.8	26.74	7.87	Ø20/0.15	20.93	2.66	Verifica
P7	al A´ al 21	S7	111 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3777.2	652.6	4429.8	0.000	0.000	1550.4	35.66	10.81	Ø20/0.15	20.93	1.94	1162.8	26.74	7.87	Ø20/0.15	20.93	2.66	Verifica
P7	al A´ al 21	S7	112 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3741.8	652.6	4394.4	0.000	0.000	1538.0	35.37	10.72	Ø20/0.15	20.93	1.95	1153.5	26.53	7.80	Ø20/0.15	20.93	2.68	Verifica
P7	al A´ al 21	S7	113 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3741.4	652.6	4394.0	0.000	0.000	1537.9	35.37	10.72	Ø20/0.15	20.93	1.95	1153.4	26.53	7.80	Ø20/0.15	20.93	2.68	Verifica
P7	al A´ al 21	S7	114 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2439.6	652.6	3092.2	0.000	0.000	1082.3	24.89	7.54	Ø20/0.15	20.93	2.77	811.7	18.67	5.49	Ø20/0.15	20.93	3.81	Verifica
P7	al A´ al 21	S7	115 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2851.2	652.6	3503.8	0.000	0.000	1226.3	28.21	8.55	Ø20/0.15	20.93	2.45	919.7	21.15	6.22	Ø20/0.15	20.93	3.36	Verifica
P7	al A´ al 21	S7	116 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2439.6	652.6	3092.2	0.000	0.000	1082.3	24.89	7.54	Ø20/0.15	20.93	2.77	811.7	18.67	5.49	Ø20/0.15	20.93	3.81	Verifica
P7	al A´ al 21	S7	117 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2439.6	652.6	3092.2	0.000	0.000	1082.3	24.89	7.54	Ø20/0.15	20.93	2.77	811.7	18.67	5.49	Ø20/0.15	20.93	3.81	Verifica
P7	al A´ al 21	S7	118 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2404.2	652.6	3056.8	0.000	0.000	1069.9	24.61	7.46	Ø20/0.15	20.93	2.81	802.4	18.46	5.43	Ø20/0.15	20.93	3.86	Verifica
P7	al A´ al 21	S7	119 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2403.7	652.6	3056.3	0.000	0.000	1069.7	24.60	7.46	Ø20/0.15	20.93	2.81	802.3	18.45	5.43	Ø20/0.15	20.93	3.86	Verifica
P7	al A´ al 21	S7	120 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2851.2	652.6	3503.8	0.000	0.000	1226.3	28.21	8.55	Ø20/0.15	20.93	2.45	919.7	21.15	6.22	Ø20/0.15	20.93	3.36	Verifica
P7	al A´ al 21	S7	121 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2851.2	652.6	3503.8	0.000	0.000	1226.3	28.21	8.55	Ø20/0.15	20.93	2.45	919.7	21.15	6.22	Ø20/0.15	20.93	3.36	Verifica
P7	al A´ al 21	S7	122 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2815.8	652.6	3468.4	0.000	0.000	1213.9	27.92	8.46	Ø20/0.15	20.93	2.47	910.4	20.94	6.16	Ø20/0.15	20.93	3.40	Verifica
P7	al A´ al 21	S7	123 (C)	0.70	1.40	3.50	3.50	1.10	1.00	2815.3	652.6	3467.9	0.000	0.000	1213.8	27.92	8.46	Ø20/0.15	20.93	2.47	910.3	20.94	6.16	Ø20/0.15	20.93	3.40	Verifica
P7	al A´ al 21	S7	124 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3087.8	652.6	3740.4	0.000	0.000	1309.1	30.11	9.12	Ø20/0.15	20.93	2.29	981.8	22.58	6.64	Ø20/0.15	20.93	3.15	Verifica
P7	al A´ al 21	S7	125 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3499.5	652.6	4152.1	0.000	0.000	1453.2	33.42	10.13	Ø20/0.15	20.93	2.07	1089.9	25.07	7.37	Ø20/0.15	20.93	2.84	Verifica
P7	al A´ al 21	S7	126 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3201.9	652.6	3854.5	0.000	0.000	1349.1	31.03	9.40	Ø20/0.15	20.93	2.23	1011.8	23.27	6.84	Ø20/0.15	20.93	3.06	Verifica
P7	al A´ al 21	S7	127 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3087.8	652.6	3740.4	0.000	0.000	1309.1	30.11	9.12	Ø20/0.15	20.93	2.29	981.8	22.58	6.64	Ø20/0.15	20.93	3.15	Verifica
P7	al A´ al 21	S7	128 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3087.8	652.6	3740.4	0.000	0.000	1309.1	30.11	9.12	Ø20/0.15	20.93	2.29	981.8	22.58	6.64	Ø20/0.15	20.93	3.15	Verifica
P7	al A´ al 21	S7	129 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3052.5	652.6	3705.1	0.000	0.000	1296.8	29.83	9.04	Ø20/0.15	20.93	2.32	972.6	22.37	6.58	Ø20/0.15	20.93	3.18	Verifica
P7	al A´ al 21	S7	130 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3052.0	652.6	3704.6	0.000	0.000	1296.6	29.82	9.04	Ø20/0.15	20.93	2.32	972.4	22.37	6.58	Ø20/0.15	20.93	3.18	Verifica
P7	al A´ al 21	S7	131 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3613.5	652.6	4266.1	0.000	0.000	1493.1	34.34	10.41	Ø20/0.15	20.93	2.01	1119.8	25.76	7.58	Ø20/0.15	20.93	2.76	Verifica
P7	al A´ al 21	S7	132 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3499.5	652.6	4152.1	0.000	0.000	1453.2	33.42	10.13	Ø20/0.15	20.93	2.07	1089.9	25.07	7.37	Ø20/0.15	20.93	2.84	Verifica
P7	al A´ al 21	S7	133 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3499.5	652.6	4152.1	0.000	0.000	1453.2	33.42	10.13	Ø20/0.15	20.93	2.07	1089.9	25.07	7.37	Ø20/0.15	20.93	2.84	Verifica
P7	al A´ al 21	S7	134 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3464.1	652.6	4116.7	0.000	0.000	1440.8	33.14	10.04	Ø20/0.15	20.93	2.08	1080.6	24.85	7.31	Ø20/0.15	20.93	2.86	Verifica
P7	al A´ al 21	S7	135 (C)	0.70	1.40	3.50	3.50	1.10	1.00	3463.6	652.6	4116.2															

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação Estado Limite Último de Punçoamento																												
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	Q _{Ed}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.	
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)		(kN/m²)	(cm2/m)					
P7	al A´ al 21	S7	105 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	362	4 429.8			1254.3	0.000	0.000	1.00	432.5	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P7	al A´ al 21	S7	106 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	352	4 315.7			1218.3	0.000	0.000	1.00	421.9	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P7	al A´ al 21	S7	107 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	352	4 315.7			1218.3	0.000	0.000	1.00	421.9	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P7	al A´ al 21	S7	108 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	349	4 280.4			1207.1	0.000	0.000	1.00	418.6	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica	
P7	al A´ al 21	S7	109 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	349	4 279.9			1207.0	0.000	0.000	1.00	418.6	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica	
P7	al A´ al 21	S7	110 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	362	4 429.8			1254.3	0.000	0.000	1.00	432.5	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P7	al A´ al 21	S7	111 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	362	4 429.8			1254.3	0.000	0.000	1.00	432.5	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P7	al A´ al 21	S7	112 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	359	4 394.4			1243.1	0.000	0.000	1.00	429.2	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P7	al A´ al 21	S7	113 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	359	4 394.0			1243.0	0.000	0.000	1.00	429.2	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P7	al A´ al 21	S7	114 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	252	3 092.2			832.2	0.000	0.000	1.00	307.8	1.45	20.93	20.93	0.002	1281.6	4.2	Verifica	
P7	al A´ al 21	S7	115 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	286	3 503.8			962.1	0.000	0.000	1.00	346.2	1.45	20.93	20.93	0.002	1281.6	3.7	Verifica	
P7	al A´ al 21	S7	116 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	252	3 092.2			832.2	0.000	0.000	1.00	307.8	1.45	20.93	20.93	0.002	1281.6	4.2	Verifica	
P7	al A´ al 21	S7	117 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	252	3 092.2			832.2	0.000	0.000	1.00	307.8	1.45	20.93	20.93	0.002	1281.6	4.2	Verifica	
P7	al A´ al 21	S7	118 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	250	3 056.8			821.0	0.000	0.000	1.00	304.5	1.45	20.93	20.93	0.002	1281.6	4.2	Verifica	
P7	al A´ al 21	S7	119 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	249	3 056.3			820.9	0.000	0.000	1.00	304.5	1.45	20.93	20.93	0.002	1281.6	4.2	Verifica	
P7	al A´ al 21	S7	120 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	286	3 503.8			962.1	0.000	0.000	1.00	346.2	1.45	20.93	20.93	0.002	1281.6	3.7	Verifica	
P7	al A´ al 21	S7	121 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	286	3 503.8			962.1	0.000	0.000	1.00	346.2	1.45	20.93	20.93	0.002	1281.6	3.7	Verifica	
P7	al A´ al 21	S7	122 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	283	3 468.4			950.9	0.000	0.000	1.00	342.9	1.45	20.93	20.93	0.002	1281.6	3.7	Verifica	
P7	al A´ al 21	S7	123 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	283	3 467.9			950.8	0.000	0.000	1.00	342.9	1.45	20.93	20.93	0.002	1281.6	3.7	Verifica	
P7	al A´ al 21	S7	124 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	305	3 740.4			1036.7	0.000	0.000	1.00	368.3	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica	
P7	al A´ al 21	S7	125 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	339	4 152.1			1166.7	0.000	0.000	1.00	406.6	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P7	al A´ al 21	S7	126 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	315	3 854.5			1072.7	0.000	0.000	1.00	378.9	1.45	20.93	20.93	0.002	1281.6	3.4	Verifica	
P7	al A´ al 21	S7	127 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	305	3 740.4			1036.7	0.000	0.000	1.00	368.3	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica	
P7	al A´ al 21	S7	128 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	305	3 740.4			1036.7	0.000	0.000	1.00	368.3	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica	
P7	al A´ al 21	S7	129 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	302	3 705.1			1025.6	0.000	0.000	1.00	365.0	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica	
P7	al A´ al 21	S7	130 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	302	3 704.6			1025.4	0.000	0.000	1.00	364.9	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica	
P7	al A´ al 21	S7	131 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	348	4 266.1			1202.6	0.000	0.000	1.00	417.3	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica	
P7	al A´ al 21	S7	132 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	339	4 152.1			1166.7	0.000	0.000	1.00	406.6	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P7	al A´ al 21	S7	133 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	339	4 152.1			1166.7	0.000	0.000	1.00	406.6	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P7	al A´ al 21	S7	134 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	336	4 116.7			1155.5	0.000	0.000	1.00	403.3	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P7	al A´ al 21	S7	135 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	336	4 116.2			1155.3	0.000	0.000	1.00	403.3	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P7	al A´ al 21	S7	136 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	348	4 266.1			1202.6	0.000	0.000	1.00	417.3	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica	
P7	al A´ al 21	S7	137 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	348	4 266.1			1202.6	0.000	0.000	1.00	417.3	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica	
P7	al A´ al 21	S7	138 (C)	0.70	1.40	1.10	1.00	1.70	2.40	7.342	3.87	345	4 230.8															

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P7	al B al 21	S8	177 (C)	0.70	1.00	4 849.1			4.00	4.50	1.40	854.9	5 704.0	400	1.12	0.000	0.000	3.78		3.78	Verifica	316.9	1.26	Verifica
P7	al B al 21	S8	178 (C)	0.70	1.00	5 004.5			4.00	4.50	1.40	854.9	5 859.4	400	1.14	0.000	0.000	3.83		3.83	Verifica	325.5	1.23	Verifica
P7	al B al 21	S8	179 (C)	0.70	1.00	4 849.1			4.00	4.50	1.40	854.9	5 704.0	400	1.12	0.000	0.000	3.78		3.78	Verifica	316.9	1.26	Verifica
P7	al B al 21	S8	180 (C)	0.70	1.00	4 849.1			4.00	4.50	1.40	854.9	5 704.0	400	1.12	0.000	0.000	3.78		3.78	Verifica	316.9	1.26	Verifica
P7	al B al 21	S8	181 (C)	0.70	1.00	4 815.4			4.00	4.50	1.40	854.9	5 670.3	400	1.12	0.000	0.000	3.77		3.77	Verifica	315.0	1.27	Verifica
P7	al B al 21	S8	182 (C)	0.70	1.00	4 763.7			4.00	4.50	1.40	854.9	5 618.6	400	1.11	0.000	0.000	3.75		3.75	Verifica	312.1	1.28	Verifica
P7	al B al 21	S8	183 (C)	0.70	1.00	5 004.5			4.00	4.50	1.40	854.9	5 859.4	400	1.14	0.000	0.000	3.83		3.83	Verifica	325.5	1.23	Verifica
P7	al B al 21	S8	184 (C)	0.70	1.00	5 004.5			4.00	4.50	1.40	854.9	5 859.4	400	1.14	0.000	0.000	3.83		3.83	Verifica	325.5	1.23	Verifica
P7	al B al 21	S8	185 (C)	0.70	1.00	4 970.8			4.00	4.50	1.40	854.9	5 825.7	400	1.13	0.000	0.000	3.82		3.82	Verifica	323.7	1.24	Verifica
P7	al B al 21	S8	186 (C)	0.70	1.00	4 919.2			4.00	4.50	1.40	854.9	5 774.1	400	1.13	0.000	0.000	3.80		3.80	Verifica	320.8	1.25	Verifica
P7	al B al 21	S8	187 (C)	0.70	1.00	4 018.8			4.00	4.50	1.40	854.9	4 873.7	400	1.04	0.000	0.000	3.49		3.49	Verifica	270.8	1.48	Verifica
P7	al B al 21	S8	188 (C)	0.70	1.00	4 755.4			4.00	4.50	1.40	854.9	5 610.3	400	1.11	0.000	0.000	3.75		3.75	Verifica	311.7	1.28	Verifica
P7	al B al 21	S8	189 (C)	0.70	1.00	4 018.8			4.00	4.50	1.40	854.9	4 873.7	400	1.04	0.000	0.000	3.49		3.49	Verifica	270.8	1.48	Verifica
P7	al B al 21	S8	190 (C)	0.70	1.00	4 018.8			4.00	4.50	1.40	854.9	4 873.7	400	1.04	0.000	0.000	3.49		3.49	Verifica	270.8	1.48	Verifica
P7	al B al 21	S8	191 (C)	0.70	1.00	3 985.1			4.00	4.50	1.40	854.9	4 840.0	400	1.03	0.000	0.000	3.48		3.48	Verifica	268.9	1.49	Verifica
P7	al B al 21	S8	192 (C)	0.70	1.00	3 933.5			4.00	4.50	1.40	854.9	4 788.4	400	1.03	0.000	0.000	3.46		3.46	Verifica	266.0	1.50	Verifica
P7	al B al 21	S8	193 (C)	0.70	1.00	4 755.4			4.00	4.50	1.40	854.9	5 610.3	400	1.11	0.000	0.000	3.75		3.75	Verifica	311.7	1.28	Verifica
P7	al B al 21	S8	194 (C)	0.70	1.00	4 755.4			4.00	4.50	1.40	854.9	5 610.3	400	1.11	0.000	0.000	3.75		3.75	Verifica	311.7	1.28	Verifica
P7	al B al 21	S8	195 (C)	0.70	1.00	4 721.7			4.00	4.50	1.40	854.9	5 576.6	400	1.11	0.000	0.000	3.73		3.73	Verifica	309.8	1.29	Verifica
P7	al B al 21	S8	196 (C)	0.70	1.00	4 670.1			4.00	4.50	1.40	854.9	5 525.0	400	1.10	0.000	0.000	3.72		3.72	Verifica	306.9	1.30	Verifica
P7	al B al 21	S8	197 (C)	0.70	1.00	3 807.3			4.00	4.50	1.40	854.9	4 662.2	400	1.01	0.000	0.000	3.41		3.41	Verifica	259.0	1.54	Verifica
P7	al B al 21	S8	198 (C)	0.70	1.00	4 544.0			4.00	4.50	1.40	854.9	5 398.9	400	1.09	0.000	0.000	3.67		3.67	Verifica	299.9	1.33	Verifica
P7	al B al 21	S8	199 (C)	0.70	1.00	3 962.8			4.00	4.50	1.40	854.9	4 817.7	400	1.03	0.000	0.000	3.47		3.47	Verifica	267.7	1.49	Verifica
P7	al B al 21	S8	200 (C)	0.70	1.00	3 807.3			4.00	4.50	1.40	854.9	4 662.2	400	1.01	0.000	0.000	3.41		3.41	Verifica	259.0	1.54	Verifica
P7	al B al 21	S8	201 (C)	0.70	1.00	3 807.3			4.00	4.50	1.40	854.9	4 662.2	400	1.01	0.000	0.000	3.41		3.41	Verifica	259.0	1.54	Verifica
P7	al B al 21	S8	202 (C)	0.70	1.00	3 773.6			4.00	4.50	1.40	854.9	4 628.5	400	1.01	0.000	0.000	3.40		3.40	Verifica	257.1	1.56	Verifica
P7	al B al 21	S8	203 (C)	0.70	1.00	3 722.0			4.00	4.50	1.40	854.9	4 576.9	400	1.00	0.000	0.000	3.38		3.38	Verifica	254.3	1.57	Verifica
P7	al B al 21	S8	204 (C)	0.70	1.00	4 699.4			4.00	4.50	1.40	854.9	5 554.3	400	1.11	0.000	0.000	3.73		3.73	Verifica	308.6	1.30	Verifica
P7	al B al 21	S8	205 (C)	0.70	1.00	4 544.0			4.00	4.50	1.40	854.9	5 398.9	400	1.09	0.000	0.000	3.67		3.67	Verifica	299.9	1.33	Verifica
P7	al B al 21	S8	206 (C)	0.70	1.00	4 544.0			4.00	4.50	1.40	854.9	5 398.9	400	1.09	0.000	0.000	3.67		3.67	Verifica	299.9	1.33	Verifica
P7	al B al 21	S8	207 (C)	0.70	1.00	4 510.3			4.00	4.50	1.40	854.9	5 365.2	400	1.09	0.000	0.000	3.66		3.66	Verifica	298.1	1.34	Verifica
P7	al B al 21	S8	208 (C)	0.70	1.00	4 458.6			4.00	4.50	1.40	854.9	5 313.5	400	1.08	0.000	0.000	3.64		3.64	Verifica	295.2	1.36	Verifica
P7	al B al 21	S8	209 (C)	0.70	1.00	3 962.8			4.00	4.50	1.40	854.9	4 817.7	400	1.03	0.000	0.000	3.47		3.47	Verifica	267.7	1.49	Verifica
P7	al B al 21	S8	210 (C)	0.70	1.00	3 962.8			4.00	4.50	1.40	854.9	4 817.7	400	1.03	0.000	0.000	3.47		3.47	Verifica	267.7	1.49	Verifica
P7	al B al 21	S8	211 (C)	0.70	1.00	3 929.1			4.00	4.50	1.40	854.9	4 784.0	400	1.03	0.000	0.000	3.46		3.46	Verifica	265.8	1.51	Verifica
P7	al B al 21	S8	212 (C)	0.70	1.00	3 877.4			4.00	4.50	1.40	854.9	4 732.3	400	1.02	0.000	0.000	3.44		3.44	Verifica	262.9	1.52	Verifica
P7	al B al 21	S8	213 (C)	0.70	1.00	4 699.4			4.00	4.50	1.40	854.9	5 554.3	400	1.11	0.000	0.000	3.73		3.73	Verifica	308.6	1.30	Verifica
P7	al B al 21	S8	214 (C)	0.70	1.00	4 699.4			4.00	4.50	1.40	854.9	5 554.3											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	As,cal/s	Ø	As,ef/s	FS	(kN)	(cm2)	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	
P7	al B al 21	S8	105 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6949.7	1154.1	8103.8	0.000	0.000	2571.4	59.14	13.75	Ø20/0.15	20.93	1.52	2727.2	62.73	16.08	Ø20/0.15	20.93	1.30	Verifica
P7	al B al 21	S8	106 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6716.5	1154.1	7870.6	0.000	0.000	2497.4	57.44	13.36	Ø20/0.15	20.93	1.57	2648.8	60.92	15.62	Ø20/0.15	20.93	1.34	Verifica
P7	al B al 21	S8	107 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6716.5	1154.1	7870.6	0.000	0.000	2497.4	57.44	13.36	Ø20/0.15	20.93	1.57	2648.8	60.92	15.62	Ø20/0.15	20.93	1.34	Verifica
P7	al B al 21	S8	108 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6665.9	1154.1	7820.0	0.000	0.000	2481.4	57.07	13.27	Ø20/0.15	20.93	1.58	2631.7	60.53	15.52	Ø20/0.15	20.93	1.35	Verifica
P7	al B al 21	S8	109 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6588.5	1154.1	7742.6	0.000	0.000	2456.8	56.51	13.14	Ø20/0.15	20.93	1.59	2605.7	59.93	15.37	Ø20/0.15	20.93	1.36	Verifica
P7	al B al 21	S8	110 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6949.7	1154.1	8103.8	0.000	0.000	2571.4	59.14	13.75	Ø20/0.15	20.93	1.52	2727.2	62.73	16.08	Ø20/0.15	20.93	1.30	Verifica
P7	al B al 21	S8	111 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6949.7	1154.1	8103.8	0.000	0.000	2571.4	59.14	13.75	Ø20/0.15	20.93	1.52	2727.2	62.73	16.08	Ø20/0.15	20.93	1.30	Verifica
P7	al B al 21	S8	112 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6899.1	1154.1	8053.2	0.000	0.000	2555.3	58.77	13.67	Ø20/0.15	20.93	1.53	2710.2	62.33	15.98	Ø20/0.15	20.93	1.31	Verifica
P7	al B al 21	S8	113 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6821.6	1154.1	7975.7	0.000	0.000	2530.8	58.21	13.54	Ø20/0.15	20.93	1.55	2684.1	61.74	15.83	Ø20/0.15	20.93	1.32	Verifica
P7	al B al 21	S8	114 (C)	0.70	1.00	4.00	4.50	1.40	1.30	4129.9	1154.1	5284.0	0.000	0.000	1676.7	38.56	8.97	Ø20/0.15	20.93	2.33	1778.3	40.90	10.49	Ø20/0.15	20.93	2.00	Verifica
P7	al B al 21	S8	115 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5234.8	1154.1	6388.9	0.000	0.000	2027.3	46.63	10.84	Ø20/0.15	20.93	1.93	2150.1	49.45	12.68	Ø20/0.15	20.93	1.65	Verifica
P7	al B al 21	S8	116 (C)	0.70	1.00	4.00	4.50	1.40	1.30	4129.9	1154.1	5284.0	0.000	0.000	1676.7	38.56	8.97	Ø20/0.15	20.93	2.33	1778.3	40.90	10.49	Ø20/0.15	20.93	2.00	Verifica
P7	al B al 21	S8	117 (C)	0.70	1.00	4.00	4.50	1.40	1.30	4129.9	1154.1	5284.0	0.000	0.000	1676.7	38.56	8.97	Ø20/0.15	20.93	2.33	1778.3	40.90	10.49	Ø20/0.15	20.93	2.00	Verifica
P7	al B al 21	S8	118 (C)	0.70	1.00	4.00	4.50	1.40	1.30	4079.3	1154.1	5233.4	0.000	0.000	1660.6	38.19	8.88	Ø20/0.15	20.93	2.36	1761.2	40.51	10.39	Ø20/0.15	20.93	2.02	Verifica
P7	al B al 21	S8	119 (C)	0.70	1.00	4.00	4.50	1.40	1.30	4001.8	1154.1	5155.9	0.000	0.000	1636.0	37.63	8.75	Ø20/0.15	20.93	2.39	1735.2	39.91	10.23	Ø20/0.15	20.93	2.05	Verifica
P7	al B al 21	S8	120 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5234.8	1154.1	6388.9	0.000	0.000	2027.3	46.63	10.84	Ø20/0.15	20.93	1.93	2150.1	49.45	12.68	Ø20/0.15	20.93	1.65	Verifica
P7	al B al 21	S8	121 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5234.8	1154.1	6388.9	0.000	0.000	2027.3	46.63	10.84	Ø20/0.15	20.93	1.93	2150.1	49.45	12.68	Ø20/0.15	20.93	1.65	Verifica
P7	al B al 21	S8	122 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5184.2	1154.1	6338.3	0.000	0.000	2011.2	46.26	10.76	Ø20/0.15	20.93	1.95	2133.1	49.06	12.58	Ø20/0.15	20.93	1.66	Verifica
P7	al B al 21	S8	123 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5106.8	1154.1	6260.9	0.000	0.000	1986.6	45.69	10.63	Ø20/0.15	20.93	1.97	2107.0	48.46	12.43	Ø20/0.15	20.93	1.68	Verifica
P7	al B al 21	S8	124 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5153.9	1154.1	6308.0	0.000	0.000	2001.6	46.04	10.71	Ø20/0.15	20.93	1.95	2122.9	48.83	12.52	Ø20/0.15	20.93	1.67	Verifica
P7	al B al 21	S8	125 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6258.8	1154.1	7412.9	0.000	0.000	2352.2	54.10	12.58	Ø20/0.15	20.93	1.66	2494.7	57.38	14.71	Ø20/0.15	20.93	1.42	Verifica
P7	al B al 21	S8	126 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5387.0	1154.1	6541.1	0.000	0.000	2075.5	47.74	11.10	Ø20/0.15	20.93	1.89	2201.3	50.63	12.98	Ø20/0.15	20.93	1.61	Verifica
P7	al B al 21	S8	127 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5153.9	1154.1	6308.0	0.000	0.000	2001.6	46.04	10.71	Ø20/0.15	20.93	1.95	2122.9	48.83	12.52	Ø20/0.15	20.93	1.67	Verifica
P7	al B al 21	S8	128 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5153.9	1154.1	6308.0	0.000	0.000	2001.6	46.04	10.71	Ø20/0.15	20.93	1.95	2122.9	48.83	12.52	Ø20/0.15	20.93	1.67	Verifica
P7	al B al 21	S8	129 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5103.3	1154.1	6257.4	0.000	0.000	1985.5	45.67	10.62	Ø20/0.15	20.93	1.97	2105.9	48.43	12.42	Ø20/0.15	20.93	1.69	Verifica
P7	al B al 21	S8	130 (C)	0.70	1.00	4.00	4.50	1.40	1.30	5025.9	1154.1	6180.0	0.000	0.000	1961.0	45.10	10.49	Ø20/0.15	20.93	2.00	2079.8	47.84	12.27	Ø20/0.15	20.93	1.71	Verifica
P7	al B al 21	S8	131 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6492.0	1154.1	7646.1	0.000	0.000	2426.2	55.80	12.98	Ø20/0.15	20.93	1.61	2573.2	59.18	15.18	Ø20/0.15	20.93	1.38	Verifica
P7	al B al 21	S8	132 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6258.8	1154.1	7412.9	0.000	0.000	2352.2	54.10	12.58	Ø20/0.15	20.93	1.66	2494.7	57.38	14.71	Ø20/0.15	20.93	1.42	Verifica
P7	al B al 21	S8	133 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6258.8	1154.1	7412.9	0.000	0.000	2352.2	54.10	12.58	Ø20/0.15	20.93	1.66	2494.7	57.38	14.71	Ø20/0.15	20.93	1.42	Verifica
P7	al B al 21	S8	134 (C)	0.70	1.00	4.00	4.50	1.40	1.30	6208.3	1154.1	7362.4	0.000	0.000	2336.2	53.73	12.50	Ø20/0.15	20.93	1.67	2477.7	56.99	14.61	Ø20/0.15	20.93	1.43	Verifica
P7	al B al 21	S8	135 (C)	0.70	1.00	4.0																					

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{reg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)		(kN/m²)					
P7	al B al 21	S8	105 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	450	8 103.8			1707.5	0.000	0.000	1.00	657.4	1.39	20.93	20.93	0.002	1129.6	1.7	Verifica
P7	al B al 21	S8	106 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	437	7 870.6			1652.6	0.000	0.000	1.00	639.1	1.39	20.93	20.93	0.002	1129.6	1.8	Verifica
P7	al B al 21	S8	107 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	437	7 870.6			1652.6	0.000	0.000	1.00	639.1	1.39	20.93	20.93	0.002	1129.6	1.8	Verifica
P7	al B al 21	S8	108 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	434	7 820.0			1640.7	0.000	0.000	1.00	635.1	1.39	20.93	20.93	0.002	1129.6	1.8	Verifica
P7	al B al 21	S8	109 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	430	7 742.6			1622.5	0.000	0.000	1.00	629.0	1.39	20.93	20.93	0.002	1129.6	1.8	Verifica
P7	al B al 21	S8	110 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	450	8 103.8			1707.5	0.000	0.000	1.00	657.4	1.39	20.93	20.93	0.002	1129.6	1.7	Verifica
P7	al B al 21	S8	111 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	450	8 103.8			1707.5	0.000	0.000	1.00	657.4	1.39	20.93	20.93	0.002	1129.6	1.7	Verifica
P7	al B al 21	S8	112 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	447	8 053.2			1695.6	0.000	0.000	1.00	653.5	1.39	20.93	20.93	0.002	1129.6	1.7	Verifica
P7	al B al 21	S8	113 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	443	7 975.7			1677.3	0.000	0.000	1.00	647.4	1.39	20.93	20.93	0.002	1129.6	1.7	Verifica
P7	al B al 21	S8	114 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	294	5 284.0			1043.7	0.000	0.000	1.00	435.8	1.39	20.93	20.93	0.002	1129.6	2.6	Verifica
P7	al B al 21	S8	115 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	355	6 388.9			1303.8	0.000	0.000	1.00	522.7	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	116 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	294	5 284.0			1043.7	0.000	0.000	1.00	435.8	1.39	20.93	20.93	0.002	1129.6	2.6	Verifica
P7	al B al 21	S8	117 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	294	5 284.0			1043.7	0.000	0.000	1.00	435.8	1.39	20.93	20.93	0.002	1129.6	2.6	Verifica
P7	al B al 21	S8	118 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	291	5 233.4			1031.8	0.000	0.000	1.00	431.9	1.39	20.93	20.93	0.002	1129.6	2.6	Verifica
P7	al B al 21	S8	119 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	286	5 155.9			1013.5	0.000	0.000	1.00	425.8	1.39	20.93	20.93	0.002	1129.6	2.7	Verifica
P7	al B al 21	S8	120 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	355	6 388.9			1303.8	0.000	0.000	1.00	522.7	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	121 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	355	6 388.9			1303.8	0.000	0.000	1.00	522.7	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	122 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	352	6 338.3			1291.9	0.000	0.000	1.00	518.7	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	123 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	348	6 260.9			1273.6	0.000	0.000	1.00	512.6	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	124 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	350	6 308.0			1284.7	0.000	0.000	1.00	516.3	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	125 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	412	7 412.9			1544.8	0.000	0.000	1.00	603.1	1.39	20.93	20.93	0.002	1129.6	1.9	Verifica
P7	al B al 21	S8	126 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	363	6 541.1			1339.6	0.000	0.000	1.00	534.6	1.39	20.93	20.93	0.002	1129.6	2.1	Verifica
P7	al B al 21	S8	127 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	350	6 308.0			1284.7	0.000	0.000	1.00	516.3	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	128 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	350	6 308.0			1284.7	0.000	0.000	1.00	516.3	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	129 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	348	6 257.4			1272.8	0.000	0.000	1.00	512.3	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	130 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	343	6 180.0			1254.6	0.000	0.000	1.00	506.2	1.39	20.93	20.93	0.002	1129.6	2.2	Verifica
P7	al B al 21	S8	131 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	425	7 646.1			1599.7	0.000	0.000	1.00	621.5	1.39	20.93	20.93	0.002	1129.6	1.8	Verifica
P7	al B al 21	S8	132 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	412	7 412.9			1544.8	0.000	0.000	1.00	603.1	1.39	20.93	20.93	0.002	1129.6	1.9	Verifica
P7	al B al 21	S8	133 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	412	7 412.9			1544.8	0.000	0.000	1.00	603.1	1.39	20.93	20.93	0.002	1129.6	1.9	Verifica
P7	al B al 21	S8	134 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	409	7 362.4			1532.9	0.000	0.000	1.00	599.2	1.39	20.93	20.93	0.002	1129.6	1.9	Verifica
P7	al B al 21	S8	135 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	405	7 284.9			1514.7	0.000	0.000	1.00	593.1	1.39	20.93	20.93	0.002	1129.6	1.9	Verifica
P7	al B al 21	S8	136 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	425	7 646.1			1599.7	0.000	0.000	1.00	621.5	1.39	20.93	20.93	0.002	1129.6	1.8	Verifica
P7	al B al 21	S8	137 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	425	7 646.1			1599.7	0.000	0.000	1.00	621.5	1.39	20.93	20.93	0.002	1129.6	1.8	Verifica
P7	al B al 21	S8	138 (C)	0.70	1.00	1.40	1.30	2.00	2.30	7.484	4.24	422	7 595.5			1587.8	0.00										

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação da Rotura do Solo de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'	L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m ²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P9	al C al 21	S7	177 (C)	0.70	1.00	2 482.9			3.50	3.50	1.10	487.0	2 969.9	400	0.81	0.000	0.000	2.72	2.72	Verifica	242.4	1.65	Verifica
P9	al C al 21	S7	178 (C)	0.70	1.00	2 693.8			3.50	3.50	1.10	487.0	3 180.8	400	0.84	0.000	0.000	2.82	2.82	Verifica	259.7	1.54	Verifica
P9	al C al 21	S7	179 (C)	0.70	1.00	2 482.9			3.50	3.50	1.10	487.0	2 969.9	400	0.81	0.000	0.000	2.72	2.72	Verifica	242.4	1.65	Verifica
P9	al C al 21	S7	180 (C)	0.70	1.00	2 482.9			3.50	3.50	1.10	487.0	2 969.9	400	0.81	0.000	0.000	2.72	2.72	Verifica	242.4	1.65	Verifica
P9	al C al 21	S7	181 (C)	0.70	1.00	2 482.2			3.50	3.50	1.10	487.0	2 969.2	400	0.81	0.000	0.000	2.72	2.72	Verifica	242.4	1.65	Verifica
P9	al C al 21	S7	182 (C)	0.70	1.00	2 481.6			3.50	3.50	1.10	487.0	2 968.6	400	0.81	0.000	0.000	2.72	2.72	Verifica	242.3	1.65	Verifica
P9	al C al 21	S7	183 (C)	0.70	1.00	2 693.8			3.50	3.50	1.10	487.0	3 180.8	400	0.84	0.000	0.000	2.82	2.82	Verifica	259.7	1.54	Verifica
P9	al C al 21	S7	184 (C)	0.70	1.00	2 693.8			3.50	3.50	1.10	487.0	3 180.8	400	0.84	0.000	0.000	2.82	2.82	Verifica	259.7	1.54	Verifica
P9	al C al 21	S7	185 (C)	0.70	1.00	2 693.1			3.50	3.50	1.10	487.0	3 180.1	400	0.84	0.000	0.000	2.82	2.82	Verifica	259.6	1.54	Verifica
P9	al C al 21	S7	186 (C)	0.70	1.00	2 692.5			3.50	3.50	1.10	487.0	3 179.5	400	0.84	0.000	0.000	2.82	2.82	Verifica	259.6	1.54	Verifica
P9	al C al 21	S7	187 (C)	0.70	1.00	2 340.5			3.50	3.50	1.10	487.0	2 827.5	400	0.79	0.000	0.000	2.66	2.66	Verifica	230.8	1.73	Verifica
P9	al C al 21	S7	188 (C)	0.70	1.00	2 651.1			3.50	3.50	1.10	487.0	3 138.1	400	0.83	0.000	0.000	2.80	2.80	Verifica	256.2	1.56	Verifica
P9	al C al 21	S7	189 (C)	0.70	1.00	2 340.5			3.50	3.50	1.10	487.0	2 827.5	400	0.79	0.000	0.000	2.66	2.66	Verifica	230.8	1.73	Verifica
P9	al C al 21	S7	190 (C)	0.70	1.00	2 340.5			3.50	3.50	1.10	487.0	2 827.5	400	0.79	0.000	0.000	2.66	2.66	Verifica	230.8	1.73	Verifica
P9	al C al 21	S7	191 (C)	0.70	1.00	2 339.8			3.50	3.50	1.10	487.0	2 826.8	400	0.79	0.000	0.000	2.66	2.66	Verifica	230.8	1.73	Verifica
P9	al C al 21	S7	192 (C)	0.70	1.00	2 339.3			3.50	3.50	1.10	487.0	2 826.3	400	0.79	0.000	0.000	2.66	2.66	Verifica	230.7	1.73	Verifica
P9	al C al 21	S7	193 (C)	0.70	1.00	2 651.1			3.50	3.50	1.10	487.0	3 138.1	400	0.83	0.000	0.000	2.80	2.80	Verifica	256.2	1.56	Verifica
P9	al C al 21	S7	194 (C)	0.70	1.00	2 651.1			3.50	3.50	1.10	487.0	3 138.1	400	0.83	0.000	0.000	2.80	2.80	Verifica	256.2	1.56	Verifica
P9	al C al 21	S7	195 (C)	0.70	1.00	2 650.4			3.50	3.50	1.10	487.0	3 137.4	400	0.83	0.000	0.000	2.80	2.80	Verifica	256.1	1.56	Verifica
P9	al C al 21	S7	196 (C)	0.70	1.00	2 649.8			3.50	3.50	1.10	487.0	3 136.8	400	0.83	0.000	0.000	2.80	2.80	Verifica	256.1	1.56	Verifica
P9	al C al 21	S7	197 (C)	0.70	1.00	2 039.5			3.50	3.50	1.10	487.0	2 526.5	400	0.75	0.000	0.000	2.51	2.51	Verifica	206.2	1.94	Verifica
P9	al C al 21	S7	198 (C)	0.70	1.00	2 350.0			3.50	3.50	1.10	487.0	2 837.0	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.6	1.73	Verifica
P9	al C al 21	S7	199 (C)	0.70	1.00	2 250.4			3.50	3.50	1.10	487.0	2 737.4	400	0.78	0.000	0.000	2.62	2.62	Verifica	223.5	1.79	Verifica
P9	al C al 21	S7	200 (C)	0.70	1.00	2 039.5			3.50	3.50	1.10	487.0	2 526.5	400	0.75	0.000	0.000	2.51	2.51	Verifica	206.2	1.94	Verifica
P9	al C al 21	S7	201 (C)	0.70	1.00	2 039.5			3.50	3.50	1.10	487.0	2 526.5	400	0.75	0.000	0.000	2.51	2.51	Verifica	206.2	1.94	Verifica
P9	al C al 21	S7	202 (C)	0.70	1.00	2 038.8			3.50	3.50	1.10	487.0	2 525.8	400	0.75	0.000	0.000	2.51	2.51	Verifica	206.2	1.94	Verifica
P9	al C al 21	S7	203 (C)	0.70	1.00	2 038.2			3.50	3.50	1.10	487.0	2 525.2	400	0.75	0.000	0.000	2.51	2.51	Verifica	206.1	1.94	Verifica
P9	al C al 21	S7	204 (C)	0.70	1.00	2 560.9			3.50	3.50	1.10	487.0	3 047.9	400	0.82	0.000	0.000	2.76	2.76	Verifica	248.8	1.61	Verifica
P9	al C al 21	S7	205 (C)	0.70	1.00	2 350.0			3.50	3.50	1.10	487.0	2 837.0	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.6	1.73	Verifica
P9	al C al 21	S7	206 (C)	0.70	1.00	2 350.0			3.50	3.50	1.10	487.0	2 837.0	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.6	1.73	Verifica
P9	al C al 21	S7	207 (C)	0.70	1.00	2 349.3			3.50	3.50	1.10	487.0	2 836.3	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.5	1.73	Verifica
P9	al C al 21	S7	208 (C)	0.70	1.00	2 348.7			3.50	3.50	1.10	487.0	2 835.7	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.5	1.73	Verifica
P9	al C al 21	S7	209 (C)	0.70	1.00	2 250.4			3.50	3.50	1.10	487.0	2 737.4	400	0.78	0.000	0.000	2.62	2.62	Verifica	223.5	1.79	Verifica
P9	al C al 21	S7	210 (C)	0.70	1.00	2 250.4			3.50	3.50	1.10	487.0	2 737.4	400	0.78	0.000	0.000	2.62	2.62	Verifica	223.5	1.79	Verifica
P9	al C al 21	S7	211 (C)	0.70	1.00	2 249.7			3.50	3.50	1.10	487.0	2 736.7	400	0.78	0.000	0.000	2.62	2.62	Verifica	223.4	1.79	Verifica
P9	al C al 21	S7	212 (C)	0.70	1.00	2 249.1			3.50	3.50	1.10	487.0	2 736.1	400	0.78	0.000	0.000	2.62	2.62	Verifica	223.4	1.79	Verifica
P9	al C al 21	S7	213 (C)	0.70	1.00	2 560.9			3.50	3.50	1.10	487.0	3 047.9	400	0.82	0.000	0.000	2.76	2.76	Verifica	248.8	1.61	Verifica
P9	al C al 21	S7	214 (C)	0.70	1.00	2 560.9			3.50	3.50	1.10	487.0	3 047.9	400	0.82	0.000	0.000	2.76	2.76	Verifica	248.8	1.61	Verifica
P9	al C al 21	S7	215 (C)	0.70	1.00	2 560.2			3.50	3.50	1.10	487.0	3 047.2	400									

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 12 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al C al 21	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3734.7	657.5	4392.2	0.000	0.000	1537.3	35.36	10.71	Ø20/0.15	20.93	1.95	1372.6	31.57	9.28	Ø20/0.15	20.93	2.25	Verifica
P9	al C al 21	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3418.3	657.5	4075.8	0.000	0.000	1426.5	32.81	9.94	Ø20/0.15	20.93	2.11	1273.7	29.29	8.62	Ø20/0.15	20.93	2.43	Verifica
P9	al C al 21	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3418.3	657.5	4075.8	0.000	0.000	1426.5	32.81	9.94	Ø20/0.15	20.93	2.11	1273.7	29.29	8.62	Ø20/0.15	20.93	2.43	Verifica
P9	al C al 21	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3417.3	657.5	4074.8	0.000	0.000	1426.2	32.80	9.94	Ø20/0.15	20.93	2.11	1273.4	29.29	8.61	Ø20/0.15	20.93	2.43	Verifica
P9	al C al 21	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3416.4	657.5	4073.9	0.000	0.000	1425.9	32.79	9.94	Ø20/0.15	20.93	2.11	1273.1	29.28	8.61	Ø20/0.15	20.93	2.43	Verifica
P9	al C al 21	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3734.7	657.5	4392.2	0.000	0.000	1537.3	35.36	10.71	Ø20/0.15	20.93	1.95	1372.6	31.57	9.28	Ø20/0.15	20.93	2.25	Verifica
P9	al C al 21	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3734.7	657.5	4392.2	0.000	0.000	1537.3	35.36	10.71	Ø20/0.15	20.93	1.95	1372.6	31.57	9.28	Ø20/0.15	20.93	2.25	Verifica
P9	al C al 21	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3733.6	657.5	4391.1	0.000	0.000	1536.9	35.35	10.71	Ø20/0.15	20.93	1.95	1372.2	31.56	9.28	Ø20/0.15	20.93	2.25	Verifica
P9	al C al 21	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3732.8	657.5	4390.3	0.000	0.000	1536.6	35.34	10.71	Ø20/0.15	20.93	1.95	1372.0	31.56	9.28	Ø20/0.15	20.93	2.26	Verifica
P9	al C al 21	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2491.2	657.5	3148.7	0.000	0.000	1102.0	25.35	7.68	Ø20/0.15	20.93	2.72	984.0	22.63	6.66	Ø20/0.15	20.93	3.14	Verifica
P9	al C al 21	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2957.0	657.5	3614.5	0.000	0.000	1265.1	29.10	8.82	Ø20/0.15	20.93	2.37	1129.5	25.98	7.64	Ø20/0.15	20.93	2.74	Verifica
P9	al C al 21	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2491.2	657.5	3148.7	0.000	0.000	1102.0	25.35	7.68	Ø20/0.15	20.93	2.72	984.0	22.63	6.66	Ø20/0.15	20.93	3.14	Verifica
P9	al C al 21	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2491.2	657.5	3148.7	0.000	0.000	1102.0	25.35	7.68	Ø20/0.15	20.93	2.72	984.0	22.63	6.66	Ø20/0.15	20.93	3.14	Verifica
P9	al C al 21	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2490.1	657.5	3147.6	0.000	0.000	1101.7	25.34	7.68	Ø20/0.15	20.93	2.73	983.6	22.62	6.65	Ø20/0.15	20.93	3.15	Verifica
P9	al C al 21	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2489.3	657.5	3146.8	0.000	0.000	1101.4	25.33	7.68	Ø20/0.15	20.93	2.73	983.4	22.62	6.65	Ø20/0.15	20.93	3.15	Verifica
P9	al C al 21	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2957.0	657.5	3614.5	0.000	0.000	1265.1	29.10	8.82	Ø20/0.15	20.93	2.37	1129.5	25.98	7.64	Ø20/0.15	20.93	2.74	Verifica
P9	al C al 21	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2957.0	657.5	3614.5	0.000	0.000	1265.1	29.10	8.82	Ø20/0.15	20.93	2.37	1129.5	25.98	7.64	Ø20/0.15	20.93	2.74	Verifica
P9	al C al 21	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2955.9	657.5	3613.4	0.000	0.000	1264.7	29.09	8.81	Ø20/0.15	20.93	2.37	1129.2	25.97	7.64	Ø20/0.15	20.93	2.74	Verifica
P9	al C al 21	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2955.1	657.5	3612.6	0.000	0.000	1264.4	29.08	8.81	Ø20/0.15	20.93	2.38	1128.9	25.97	7.64	Ø20/0.15	20.93	2.74	Verifica
P9	al C al 21	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2753.2	657.5	3410.7	0.000	0.000	1193.7	27.46	8.32	Ø20/0.15	20.93	2.52	1065.8	24.51	7.21	Ø20/0.15	20.93	2.90	Verifica
P9	al C al 21	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3219.0	657.5	3876.5	0.000	0.000	1356.8	31.21	9.46	Ø20/0.15	20.93	2.21	1211.4	27.86	8.19	Ø20/0.15	20.93	2.55	Verifica
P9	al C al 21	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3069.6	657.5	3727.1	0.000	0.000	1304.5	30.00	9.09	Ø20/0.15	20.93	2.30	1164.7	26.79	7.88	Ø20/0.15	20.93	2.66	Verifica
P9	al C al 21	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2753.2	657.5	3410.7	0.000	0.000	1193.7	27.46	8.32	Ø20/0.15	20.93	2.52	1065.8	24.51	7.21	Ø20/0.15	20.93	2.90	Verifica
P9	al C al 21	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2753.2	657.5	3410.7	0.000	0.000	1193.7	27.46	8.32	Ø20/0.15	20.93	2.52	1065.8	24.51	7.21	Ø20/0.15	20.93	2.90	Verifica
P9	al C al 21	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2752.2	657.5	3409.7	0.000	0.000	1193.4	27.45	8.32	Ø20/0.15	20.93	2.52	1065.5	24.51	7.21	Ø20/0.15	20.93	2.90	Verifica
P9	al C al 21	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2751.3	657.5	3408.8	0.000	0.000	1193.1	27.44	8.32	Ø20/0.15	20.93	2.52	1065.2	24.50	7.21	Ø20/0.15	20.93	2.90	Verifica
P9	al C al 21	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3535.4	657.5	4192.9	0.000	0.000	1467.5	33.75	10.23	Ø20/0.15	20.93	2.05	1310.3	30.14	8.86	Ø20/0.15	20.93	2.36	Verifica
P9	al C al 21	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3219.0	657.5	3876.5	0.000	0.000	1356.8	31.21	9.46	Ø20/0.15	20.93	2.21	1211.4	27.86	8.19	Ø20/0.15	20.93	2.55	Verifica
P9	al C al 21	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3219.0	657.5	3876.5	0.000	0.000	1356.8	31.21	9.46	Ø20/0.15	20.93	2.21	1211.4	27.86	8.19	Ø20/0.15	20.93	2.55	Verifica
P9	al C al 21	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3218.0	657.5	3875.5	0.000	0.000	1356.4	31.20	9.45	Ø20/0.15	20.93	2.21	1211.1	27.86	8.19	Ø20/0.15	20.93	2.55	Verifica
P9	al C al 21	S7	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3217.1	657.5	3874.6	0.000	0													

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 12 - Verificação Estado Limite Último de Punçãoamento																												
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{issg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.	
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)		(kN/m²)	V _{Ed} ≤ V _{Rd}					
P9	al C al 21	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	359	4 392.2			1023.9	0.000	0.000	1.00	514.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica	
P9	al C al 21	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	333	4 075.8			941.6	0.000	0.000	1.00	479.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica	
P9	al C al 21	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	333	4 075.8			941.6	0.000	0.000	1.00	479.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica	
P9	al C al 21	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	333	4 074.8			941.3	0.000	0.000	1.00	479.0	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica	
P9	al C al 21	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	333	4 073.9			941.1	0.000	0.000	1.00	478.9	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica	
P9	al C al 21	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	359	4 392.2			1023.9	0.000	0.000	1.00	514.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica	
P9	al C al 21	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	359	4 392.2			1023.9	0.000	0.000	1.00	514.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica	
P9	al C al 21	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	358	4 391.1			1023.6	0.000	0.000	1.00	514.8	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica	
P9	al C al 21	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	358	4 390.3			1023.4	0.000	0.000	1.00	514.7	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica	
P9	al C al 21	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	257	3 148.7			700.5	0.000	0.000	1.00	374.2	1.45	20.93	20.93	0.002	1281.6	3.4	Verifica	
P9	al C al 21	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	295	3 614.5			821.6	0.000	0.000	1.00	426.9	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P9	al C al 21	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	257	3 148.7			700.5	0.000	0.000	1.00	374.2	1.45	20.93	20.93	0.002	1281.6	3.4	Verifica	
P9	al C al 21	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	257	3 148.7			700.5	0.000	0.000	1.00	374.2	1.45	20.93	20.93	0.002	1281.6	3.4	Verifica	
P9	al C al 21	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	257	3 147.6			700.2	0.000	0.000	1.00	374.1	1.45	20.93	20.93	0.002	1281.6	3.4	Verifica	
P9	al C al 21	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	257	3 146.8			700.0	0.000	0.000	1.00	374.0	1.45	20.93	20.93	0.002	1281.6	3.4	Verifica	
P9	al C al 21	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	295	3 614.5			821.6	0.000	0.000	1.00	426.9	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P9	al C al 21	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	295	3 614.5			821.6	0.000	0.000	1.00	426.9	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P9	al C al 21	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	295	3 613.4			821.3	0.000	0.000	1.00	426.8	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P9	al C al 21	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	295	3 612.6			821.1	0.000	0.000	1.00	426.7	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica	
P9	al C al 21	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	278	3 410.7			768.6	0.000	0.000	1.00	403.9	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P9	al C al 21	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	316	3 876.5			889.8	0.000	0.000	1.00	456.6	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica	
P9	al C al 21	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	304	3 727.1			850.9	0.000	0.000	1.00	439.7	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica	
P9	al C al 21	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	278	3 410.7			768.6	0.000	0.000	1.00	403.9	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P9	al C al 21	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	278	3 410.7			768.6	0.000	0.000	1.00	403.9	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P9	al C al 21	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	278	3 409.7			768.4	0.000	0.000	1.00	403.8	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P9	al C al 21	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	278	3 408.8			768.1	0.000	0.000	1.00	403.7	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica	
P9	al C al 21	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	342	4 192.9			972.0	0.000	0.000	1.00	492.4	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica	
P9	al C al 21	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	316	3 876.5			889.8	0.000	0.000	1.00	456.6	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica	
P9	al C al 21	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	316	3 876.5			889.8	0.000	0.000	1.00	456.6	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica	
P9	al C al 21	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	316	3 875.5			889.5	0.000	0.000	1.00	456.5	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica	
P9	al C al 21	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	316	3 874.6			889.3	0.000	0.000	1.00	456.4	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica	
P9	al C al 21	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	342	4 192.9			972.0	0.000	0.000	1.00	492.4	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica	
P9	al C al 21	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	342	4 192.9			972.0	0.000	0.000	1.00	492.4	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica	
P9	al C al 21	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	342	4 191.8			971.7	0.00											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B´		L´	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P7	al A´ al 22	S7	177 (C)	0.70	1.40	3 343.2			4.00	4.00	1.30	715.3	4 058.5	400	0.95	0.000	0.000	3.19		3.19	Verifica	253.7	1.58	Verifica
P7	al A´ al 22	S7	178 (C)	0.70	1.40	3 413.7			4.00	4.00	1.30	715.3	4 129.0	400	0.95	0.000	0.000	3.21		3.21	Verifica	258.1	1.55	Verifica
P7	al A´ al 22	S7	179 (C)	0.70	1.40	3 343.2			4.00	4.00	1.30	715.3	4 058.5	400	0.95	0.000	0.000	3.19		3.19	Verifica	253.7	1.58	Verifica
P7	al A´ al 22	S7	180 (C)	0.70	1.40	3 343.2			4.00	4.00	1.30	715.3	4 058.5	400	0.95	0.000	0.000	3.19		3.19	Verifica	253.7	1.58	Verifica
P7	al A´ al 22	S7	181 (C)	0.70	1.40	3 278.1			4.00	4.00	1.30	715.3	3 993.4	400	0.94	0.000	0.000	3.16		3.16	Verifica	249.6	1.60	Verifica
P7	al A´ al 22	S7	182 (C)	0.70	1.40	3 285.7			4.00	4.00	1.30	715.3	4 001.0	400	0.94	0.000	0.000	3.16		3.16	Verifica	250.1	1.60	Verifica
P7	al A´ al 22	S7	183 (C)	0.70	1.40	3 413.7			4.00	4.00	1.30	715.3	4 129.0	400	0.95	0.000	0.000	3.21		3.21	Verifica	258.1	1.55	Verifica
P7	al A´ al 22	S7	184 (C)	0.70	1.40	3 413.7			4.00	4.00	1.30	715.3	4 129.0	400	0.95	0.000	0.000	3.21		3.21	Verifica	258.1	1.55	Verifica
P7	al A´ al 22	S7	185 (C)	0.70	1.40	3 348.5			4.00	4.00	1.30	715.3	4 063.8	400	0.95	0.000	0.000	3.19		3.19	Verifica	254.0	1.57	Verifica
P7	al A´ al 22	S7	186 (C)	0.70	1.40	3 356.1			4.00	4.00	1.30	715.3	4 071.4	400	0.95	0.000	0.000	3.19		3.19	Verifica	254.5	1.57	Verifica
P7	al A´ al 22	S7	187 (C)	0.70	1.40	2 863.3			4.00	4.00	1.30	715.3	3 578.6	400	0.89	0.000	0.000	2.99		2.99	Verifica	223.7	1.79	Verifica
P7	al A´ al 22	S7	188 (C)	0.70	1.40	3 269.7			4.00	4.00	1.30	715.3	3 985.0	400	0.94	0.000	0.000	3.16		3.16	Verifica	249.1	1.61	Verifica
P7	al A´ al 22	S7	189 (C)	0.70	1.40	2 863.3			4.00	4.00	1.30	715.3	3 578.6	400	0.89	0.000	0.000	2.99		2.99	Verifica	223.7	1.79	Verifica
P7	al A´ al 22	S7	190 (C)	0.70	1.40	2 863.3			4.00	4.00	1.30	715.3	3 578.6	400	0.89	0.000	0.000	2.99		2.99	Verifica	223.7	1.79	Verifica
P7	al A´ al 22	S7	191 (C)	0.70	1.40	2 798.2			4.00	4.00	1.30	715.3	3 513.5	400	0.88	0.000	0.000	2.96		2.96	Verifica	219.6	1.82	Verifica
P7	al A´ al 22	S7	192 (C)	0.70	1.40	2 805.8			4.00	4.00	1.30	715.3	3 521.1	400	0.88	0.000	0.000	2.97		2.97	Verifica	220.1	1.82	Verifica
P7	al A´ al 22	S7	193 (C)	0.70	1.40	3 269.7			4.00	4.00	1.30	715.3	3 985.0	400	0.94	0.000	0.000	3.16		3.16	Verifica	249.1	1.61	Verifica
P7	al A´ al 22	S7	194 (C)	0.70	1.40	3 269.7			4.00	4.00	1.30	715.3	3 985.0	400	0.94	0.000	0.000	3.16		3.16	Verifica	249.1	1.61	Verifica
P7	al A´ al 22	S7	195 (C)	0.70	1.40	3 204.6			4.00	4.00	1.30	715.3	3 919.9	400	0.93	0.000	0.000	3.13		3.13	Verifica	245.0	1.63	Verifica
P7	al A´ al 22	S7	196 (C)	0.70	1.40	3 212.2			4.00	4.00	1.30	715.3	3 927.5	400	0.93	0.000	0.000	3.13		3.13	Verifica	245.5	1.63	Verifica
P7	al A´ al 22	S7	197 (C)	0.70	1.40	2 785.6			4.00	4.00	1.30	715.3	3 500.9	400	0.88	0.000	0.000	2.96		2.96	Verifica	218.8	1.83	Verifica
P7	al A´ al 22	S7	198 (C)	0.70	1.40	3 192.0			4.00	4.00	1.30	715.3	3 907.3	400	0.93	0.000	0.000	3.13		3.13	Verifica	244.2	1.64	Verifica
P7	al A´ al 22	S7	199 (C)	0.70	1.40	2 856.0			4.00	4.00	1.30	715.3	3 571.3	400	0.89	0.000	0.000	2.99		2.99	Verifica	223.2	1.79	Verifica
P7	al A´ al 22	S7	200 (C)	0.70	1.40	2 785.6			4.00	4.00	1.30	715.3	3 500.9	400	0.88	0.000	0.000	2.96		2.96	Verifica	218.8	1.83	Verifica
P7	al A´ al 22	S7	201 (C)	0.70	1.40	2 785.6			4.00	4.00	1.30	715.3	3 500.9	400	0.88	0.000	0.000	2.96		2.96	Verifica	218.8	1.83	Verifica
P7	al A´ al 22	S7	202 (C)	0.70	1.40	2 720.5			4.00	4.00	1.30	715.3	3 435.8	400	0.87	0.000	0.000	2.93		2.93	Verifica	214.7	1.86	Verifica
P7	al A´ al 22	S7	203 (C)	0.70	1.40	2 728.1			4.00	4.00	1.30	715.3	3 443.4	400	0.87	0.000	0.000	2.93		2.93	Verifica	215.2	1.86	Verifica
P7	al A´ al 22	S7	204 (C)	0.70	1.40	3 262.4			4.00	4.00	1.30	715.3	3 977.7	400	0.94	0.000	0.000	3.15		3.15	Verifica	248.6	1.61	Verifica
P7	al A´ al 22	S7	205 (C)	0.70	1.40	3 192.0			4.00	4.00	1.30	715.3	3 907.3	400	0.93	0.000	0.000	3.13		3.13	Verifica	244.2	1.64	Verifica
P7	al A´ al 22	S7	206 (C)	0.70	1.40	3 192.0			4.00	4.00	1.30	715.3	3 907.3	400	0.93	0.000	0.000	3.13		3.13	Verifica	244.2	1.64	Verifica
P7	al A´ al 22	S7	207 (C)	0.70	1.40	3 126.8			4.00	4.00	1.30	715.3	3 842.1	400	0.92	0.000	0.000	3.10		3.10	Verifica	240.1	1.67	Verifica
P7	al A´ al 22	S7	208 (C)	0.70	1.40	3 134.4			4.00	4.00	1.30	715.3	3 849.7	400	0.92	0.000	0.000	3.10		3.10	Verifica	240.6	1.66	Verifica
P7	al A´ al 22	S7	209 (C)	0.70	1.40	2 856.0			4.00	4.00	1.30	715.3	3 571.3	400	0.89	0.000	0.000	2.99		2.99	Verifica	223.2	1.79	Verifica
P7	al A´ al 22	S7	210 (C)	0.70	1.40	2 856.0			4.00	4.00	1.30	715.3	3 571.3	400	0.89	0.000	0.000	2.99		2.99	Verifica	223.2	1.79	Verifica
P7	al A´ al 22	S7	211 (C)	0.70	1.40	2 790.9			4.00	4.00	1.30	715.3	3 506.2	400	0.88	0.000	0.000	2.96		2.96	Verifica	219.1	1.83	Verifica
P7	al A´ al 22	S7	212 (C)	0.70	1.40	2 798.5			4.00	4.00	1.30	715.3	3 513.8	400	0.88	0.000	0.000	2.96		2.96	Verifica	219.6	1.82	Verifica
P7	al A´ al 22	S7	213 (C)	0.70	1.40	3 262.4			4.00	4.00	1.30	715.3	3 977.7	400	0.94	0.000	0.000	3.15		3.15	Verifica	248.6	1.61	Verifica
P7	al A´ al 22	S7	214 (C)	0.70	1.40	3 262.4																		

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P7	al A´ al 22	S7	105 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4720.1	965.6	5685.7	0.000	0.000	1954.5	44.95	11.83	Ø20/0.125	25.13	2.12	1539.9	35.42	9.08	Ø20/0.125	25.13	2.77	Verifica
P7	al A´ al 22	S7	106 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4614.4	965.6	5580.0	0.000	0.000	1918.1	44.12	11.61	Ø20/0.125	25.13	2.16	1511.3	34.76	8.91	Ø20/0.125	25.13	2.82	Verifica
P7	al A´ al 22	S7	107 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4614.4	965.6	5580.0	0.000	0.000	1918.1	44.12	11.61	Ø20/0.125	25.13	2.16	1511.3	34.76	8.91	Ø20/0.125	25.13	2.82	Verifica
P7	al A´ al 22	S7	108 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4516.7	965.6	5482.3	0.000	0.000	1884.5	43.34	11.41	Ø20/0.125	25.13	2.20	1484.8	34.15	8.76	Ø20/0.125	25.13	2.87	Verifica
P7	al A´ al 22	S7	109 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4528.1	965.6	5493.7	0.000	0.000	1888.5	43.43	11.43	Ø20/0.125	25.13	2.20	1487.9	34.22	8.77	Ø20/0.125	25.13	2.86	Verifica
P7	al A´ al 22	S7	110 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4720.1	965.6	5685.7	0.000	0.000	1954.5	44.95	11.83	Ø20/0.125	25.13	2.12	1539.9	35.42	9.08	Ø20/0.125	25.13	2.77	Verifica
P7	al A´ al 22	S7	111 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4720.1	965.6	5685.7	0.000	0.000	1954.5	44.95	11.83	Ø20/0.125	25.13	2.12	1539.9	35.42	9.08	Ø20/0.125	25.13	2.77	Verifica
P7	al A´ al 22	S7	112 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4622.4	965.6	5588.0	0.000	0.000	1920.9	44.18	11.63	Ø20/0.125	25.13	2.16	1513.4	34.81	8.93	Ø20/0.125	25.13	2.82	Verifica
P7	al A´ al 22	S7	113 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4633.8	965.6	5599.4	0.000	0.000	1924.8	44.27	11.65	Ø20/0.125	25.13	2.16	1516.5	34.88	8.94	Ø20/0.125	25.13	2.81	Verifica
P7	al A´ al 22	S7	114 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2913.6	965.6	3879.2	0.000	0.000	1333.5	30.67	8.07	Ø20/0.125	25.13	3.11	1050.6	24.16	6.20	Ø20/0.125	25.13	4.06	Verifica
P7	al A´ al 22	S7	115 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3523.2	965.6	4488.8	0.000	0.000	1543.0	35.49	9.34	Ø20/0.125	25.13	2.69	1215.7	27.96	7.17	Ø20/0.125	25.13	3.51	Verifica
P7	al A´ al 22	S7	116 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2913.6	965.6	3879.2	0.000	0.000	1333.5	30.67	8.07	Ø20/0.125	25.13	3.11	1050.6	24.16	6.20	Ø20/0.125	25.13	4.06	Verifica
P7	al A´ al 22	S7	117 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2913.6	965.6	3879.2	0.000	0.000	1333.5	30.67	8.07	Ø20/0.125	25.13	3.11	1050.6	24.16	6.20	Ø20/0.125	25.13	4.06	Verifica
P7	al A´ al 22	S7	118 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2815.9	965.6	3781.5	0.000	0.000	1299.9	29.90	7.87	Ø20/0.125	25.13	3.19	1024.2	23.56	6.04	Ø20/0.125	25.13	4.16	Verifica
P7	al A´ al 22	S7	119 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2827.3	965.6	3792.9	0.000	0.000	1303.8	29.99	7.89	Ø20/0.125	25.13	3.18	1027.2	23.63	6.06	Ø20/0.125	25.13	4.15	Verifica
P7	al A´ al 22	S7	120 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3523.2	965.6	4488.8	0.000	0.000	1543.0	35.49	9.34	Ø20/0.125	25.13	2.69	1215.7	27.96	7.17	Ø20/0.125	25.13	3.51	Verifica
P7	al A´ al 22	S7	121 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3523.2	965.6	4488.8	0.000	0.000	1543.0	35.49	9.34	Ø20/0.125	25.13	2.69	1215.7	27.96	7.17	Ø20/0.125	25.13	3.51	Verifica
P7	al A´ al 22	S7	122 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3425.5	965.6	4391.1	0.000	0.000	1509.4	34.72	9.14	Ø20/0.125	25.13	2.75	1189.3	27.35	7.01	Ø20/0.125	25.13	3.58	Verifica
P7	al A´ al 22	S7	123 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3436.9	965.6	4402.5	0.000	0.000	1513.4	34.81	9.16	Ø20/0.125	25.13	2.74	1192.3	27.42	7.03	Ø20/0.125	25.13	3.57	Verifica
P7	al A´ al 22	S7	124 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3777.9	965.6	4743.5	0.000	0.000	1630.6	37.50	9.87	Ø20/0.125	25.13	2.55	1284.7	29.55	7.58	Ø20/0.125	25.13	3.32	Verifica
P7	al A´ al 22	S7	125 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4387.5	965.6	5353.1	0.000	0.000	1840.1	42.32	11.14	Ø20/0.125	25.13	2.26	1449.8	33.35	8.55	Ø20/0.125	25.13	2.94	Verifica
P7	al A´ al 22	S7	126 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3883.6	965.6	4849.2	0.000	0.000	1666.9	38.34	10.09	Ø20/0.125	25.13	2.49	1313.3	30.21	7.75	Ø20/0.125	25.13	3.24	Verifica
P7	al A´ al 22	S7	127 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3777.9	965.6	4743.5	0.000	0.000	1630.6	37.50	9.87	Ø20/0.125	25.13	2.55	1284.7	29.55	7.58	Ø20/0.125	25.13	3.32	Verifica
P7	al A´ al 22	S7	128 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3777.9	965.6	4743.5	0.000	0.000	1630.6	37.50	9.87	Ø20/0.125	25.13	2.55	1284.7	29.55	7.58	Ø20/0.125	25.13	3.32	Verifica
P7	al A´ al 22	S7	129 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3680.2	965.6	4645.8	0.000	0.000	1597.0	36.73	9.67	Ø20/0.125	25.13	2.60	1258.2	28.94	7.42	Ø20/0.125	25.13	3.39	Verifica
P7	al A´ al 22	S7	130 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3691.6	965.6	4657.2	0.000	0.000	1600.9	36.82	9.69	Ø20/0.125	25.13	2.59	1261.3	29.01	7.44	Ø20/0.125	25.13	3.38	Verifica
P7	al A´ al 22	S7	131 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4493.1	965.6	5458.7	0.000	0.000	1876.4	43.16	11.36	Ø20/0.125	25.13	2.21	1478.4	34.00	8.72	Ø20/0.125	25.13	2.88	Verifica
P7	al A´ al 22	S7	132 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4387.5	965.6	5353.1	0.000	0.000	1840.1	42.32	11.14	Ø20/0.125	25.13	2.26	1449.8	33.35	8.55	Ø20/0.125	25.13	2.94	Verifica
P7	al A´ al 22	S7	133 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4387.5	965.6	5353.1	0.000	0.000	1840.1	42.32	11.14	Ø20/0.125	25.13	2.26	1449.8	33.35	8.55	Ø20/0.125	25.13	2.94	Verifica
P7	al A´ al 22	S7	134 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4289.8	965.6	5255.4	0.000	0.000	1806.5	41.55	10.93	Ø20/0.125	25.13	2.30	1423.3	32.74	8.39	Ø20/0.125	25.13	2.99	Verifica
P7	al A´ al 22	S7	135 (C)																								

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{issg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)		(m)		(m)	(kN/m²)		(cm2/m)		
P7	al A´ al 22	S7	105 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	355	5 685.7			1442.5	0.000	0.000	1.00	137.5	1.23	25.13	25.13	0.001	735.7	5.3	Verifica
P7	al A´ al 22	S7	106 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	349	5 580.0			1411.9	0.000	0.000	1.00	135.1	1.23	25.13	25.13	0.001	735.7	5.4	Verifica
P7	al A´ al 22	S7	107 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	349	5 580.0			1411.9	0.000	0.000	1.00	135.1	1.23	25.13	25.13	0.001	735.7	5.4	Verifica
P7	al A´ al 22	S7	108 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	343	5 482.3			1383.6	0.000	0.000	1.00	132.9	1.23	25.13	25.13	0.001	735.7	5.5	Verifica
P7	al A´ al 22	S7	109 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	343	5 493.7			1386.9	0.000	0.000	1.00	133.1	1.23	25.13	25.13	0.001	735.7	5.5	Verifica
P7	al A´ al 22	S7	110 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	355	5 685.7			1442.5	0.000	0.000	1.00	137.5	1.23	25.13	25.13	0.001	735.7	5.3	Verifica
P7	al A´ al 22	S7	111 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	355	5 685.7			1442.5	0.000	0.000	1.00	137.5	1.23	25.13	25.13	0.001	735.7	5.3	Verifica
P7	al A´ al 22	S7	112 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	349	5 588.0			1414.2	0.000	0.000	1.00	135.3	1.23	25.13	25.13	0.001	735.7	5.4	Verifica
P7	al A´ al 22	S7	113 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	350	5 599.4			1417.5	0.000	0.000	1.00	135.6	1.23	25.13	25.13	0.001	735.7	5.4	Verifica
P7	al A´ al 22	S7	114 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	242	3 879.2			919.6	0.000	0.000	1.00	95.9	1.23	25.13	25.13	0.001	735.7	7.7	Verifica
P7	al A´ al 22	S7	115 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	281	4 488.8			1096.0	0.000	0.000	1.00	110.0	1.23	25.13	25.13	0.001	735.7	6.7	Verifica
P7	al A´ al 22	S7	116 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	242	3 879.2			919.6	0.000	0.000	1.00	95.9	1.23	25.13	25.13	0.001	735.7	7.7	Verifica
P7	al A´ al 22	S7	117 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	242	3 879.2			919.6	0.000	0.000	1.00	95.9	1.23	25.13	25.13	0.001	735.7	7.7	Verifica
P7	al A´ al 22	S7	118 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	236	3 781.5			891.3	0.000	0.000	1.00	93.7	1.23	25.13	25.13	0.001	735.7	7.9	Verifica
P7	al A´ al 22	S7	119 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	237	3 792.9			894.6	0.000	0.000	1.00	93.9	1.23	25.13	25.13	0.001	735.7	7.8	Verifica
P7	al A´ al 22	S7	120 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	281	4 488.8			1096.0	0.000	0.000	1.00	110.0	1.23	25.13	25.13	0.001	735.7	6.7	Verifica
P7	al A´ al 22	S7	121 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	281	4 488.8			1096.0	0.000	0.000	1.00	110.0	1.23	25.13	25.13	0.001	735.7	6.7	Verifica
P7	al A´ al 22	S7	122 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	274	4 391.1			1067.8	0.000	0.000	1.00	107.7	1.23	25.13	25.13	0.001	735.7	6.8	Verifica
P7	al A´ al 22	S7	123 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	275	4 402.5			1071.1	0.000	0.000	1.00	108.0	1.23	25.13	25.13	0.001	735.7	6.8	Verifica
P7	al A´ al 22	S7	124 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	296	4 743.5			1169.8	0.000	0.000	1.00	115.8	1.23	25.13	25.13	0.001	735.7	6.4	Verifica
P7	al A´ al 22	S7	125 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	335	5 353.1			1346.2	0.000	0.000	1.00	129.9	1.23	25.13	25.13	0.001	735.7	5.7	Verifica
P7	al A´ al 22	S7	126 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	303	4 849.2			1200.3	0.000	0.000	1.00	118.3	1.23	25.13	25.13	0.001	735.7	6.2	Verifica
P7	al A´ al 22	S7	127 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	296	4 743.5			1169.8	0.000	0.000	1.00	115.8	1.23	25.13	25.13	0.001	735.7	6.4	Verifica
P7	al A´ al 22	S7	128 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	296	4 743.5			1169.8	0.000	0.000	1.00	115.8	1.23	25.13	25.13	0.001	735.7	6.4	Verifica
P7	al A´ al 22	S7	129 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	290	4 645.8			1141.5	0.000	0.000	1.00	113.6	1.23	25.13	25.13	0.001	735.7	6.5	Verifica
P7	al A´ al 22	S7	130 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	291	4 657.2			1144.8	0.000	0.000	1.00	113.9	1.23	25.13	25.13	0.001	735.7	6.5	Verifica
P7	al A´ al 22	S7	131 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	341	5 458.7			1376.8	0.000	0.000	1.00	132.3	1.23	25.13	25.13	0.001	735.7	5.6	Verifica
P7	al A´ al 22	S7	132 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	335	5 353.1			1346.2	0.000	0.000	1.00	129.9	1.23	25.13	25.13	0.001	735.7	5.7	Verifica
P7	al A´ al 22	S7	133 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	335	5 353.1			1346.2	0.000	0.000	1.00	129.9	1.23	25.13	25.13	0.001	735.7	5.7	Verifica
P7	al A´ al 22	S7	134 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	328	5 255.4			1317.9	0.000	0.000	1.00	127.6	1.23	25.13	25.13	0.001	735.7	5.8	Verifica
P7	al A´ al 22	S7	135 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	329	5 266.8			1321.2	0.000	0.000	1.00	127.9	1.23	25.13	25.13	0.001	735.7	5.8	Verifica
P7	al A´ al 22	S7	136 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	341	5 458.7			1376.8	0.000	0.000	1.00	132.3	1.23	25.13	25.13	0.001	735.7	5.6	Verifica
P7	al A´ al 22	S7	137 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	341	5 458.7			1376.8	0.000	0.000	1.00	132.3	1.23	25.13	25.13	0.001	735.7	5.6	Verifica
P7	al A´ al 22	S7	138 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	335	5 361.16														

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)						
P7	al B al 22	S8	177 (C)	0.70	1.00	3 448.2			3.50	3.50	1.10	487.0	3 935.2	400	0.93	0.000	0.000	1.00		1.00	Verifica	321.2	1.25	Verifica
P7	al B al 22	S8	178 (C)	0.70	1.00	3 604.1			3.50	3.50	1.10	487.0	4 091.1	400	0.95	0.000	0.000	1.00		1.00	Verifica	334.0	1.20	Verifica
P7	al B al 22	S8	179 (C)	0.70	1.00	3 448.2			3.50	3.50	1.10	487.0	3 935.2	400	0.93	0.000	0.000	1.00		1.00	Verifica	321.2	1.25	Verifica
P7	al B al 22	S8	180 (C)	0.70	1.00	3 448.2			3.50	3.50	1.10	487.0	3 935.2	400	0.93	0.000	0.000	1.00		1.00	Verifica	321.2	1.25	Verifica
P7	al B al 22	S8	181 (C)	0.70	1.00	3 441.3			3.50	3.50	1.10	487.0	3 928.3	400	0.93	0.000	0.000	1.00		1.00	Verifica	320.7	1.25	Verifica
P7	al B al 22	S8	182 (C)	0.70	1.00	3 413.4			3.50	3.50	1.10	487.0	3 900.4	400	0.93	0.000	0.000	1.00		1.00	Verifica	318.4	1.26	Verifica
P7	al B al 22	S8	183 (C)	0.70	1.00	3 604.1			3.50	3.50	1.10	487.0	4 091.1	400	0.95	0.000	0.000	1.00		1.00	Verifica	334.0	1.20	Verifica
P7	al B al 22	S8	184 (C)	0.70	1.00	3 604.1			3.50	3.50	1.10	487.0	4 091.1	400	0.95	0.000	0.000	1.00		1.00	Verifica	334.0	1.20	Verifica
P7	al B al 22	S8	185 (C)	0.70	1.00	3 597.3			3.50	3.50	1.10	487.0	4 084.3	400	0.95	0.000	0.000	1.00		1.00	Verifica	333.4	1.20	Verifica
P7	al B al 22	S8	186 (C)	0.70	1.00	3 569.3			3.50	3.50	1.10	487.0	4 056.3	400	0.95	0.000	0.000	1.00		1.00	Verifica	331.1	1.21	Verifica
P7	al B al 22	S8	187 (C)	0.70	1.00	2 952.5			3.50	3.50	1.10	487.0	3 439.5	400	0.87	0.000	0.000	1.00		1.00	Verifica	280.8	1.42	Verifica
P7	al B al 22	S8	188 (C)	0.70	1.00	3 455.4			3.50	3.50	1.10	487.0	3 942.4	400	0.93	0.000	0.000	1.00		1.00	Verifica	321.8	1.24	Verifica
P7	al B al 22	S8	189 (C)	0.70	1.00	2 952.5			3.50	3.50	1.10	487.0	3 439.5	400	0.87	0.000	0.000	1.00		1.00	Verifica	280.8	1.42	Verifica
P7	al B al 22	S8	190 (C)	0.70	1.00	2 952.5			3.50	3.50	1.10	487.0	3 439.5	400	0.87	0.000	0.000	1.00		1.00	Verifica	280.8	1.42	Verifica
P7	al B al 22	S8	191 (C)	0.70	1.00	2 945.7			3.50	3.50	1.10	487.0	3 432.7	400	0.87	0.000	0.000	1.00		1.00	Verifica	280.2	1.43	Verifica
P7	al B al 22	S8	192 (C)	0.70	1.00	2 917.7			3.50	3.50	1.10	487.0	3 404.7	400	0.87	0.000	0.000	1.00		1.00	Verifica	277.9	1.44	Verifica
P7	al B al 22	S8	193 (C)	0.70	1.00	3 455.4			3.50	3.50	1.10	487.0	3 942.4	400	0.93	0.000	0.000	1.00		1.00	Verifica	321.8	1.24	Verifica
P7	al B al 22	S8	194 (C)	0.70	1.00	3 455.4			3.50	3.50	1.10	487.0	3 942.4	400	0.93	0.000	0.000	1.00		1.00	Verifica	321.8	1.24	Verifica
P7	al B al 22	S8	195 (C)	0.70	1.00	3 448.6			3.50	3.50	1.10	487.0	3 935.6	400	0.93	0.000	0.000	1.00		1.00	Verifica	321.3	1.25	Verifica
P7	al B al 22	S8	196 (C)	0.70	1.00	3 420.6			3.50	3.50	1.10	487.0	3 907.6	400	0.93	0.000	0.000	1.00		1.00	Verifica	319.0	1.25	Verifica
P7	al B al 22	S8	197 (C)	0.70	1.00	2 732.2			3.50	3.50	1.10	487.0	3 219.2	400	0.84	0.000	0.000	1.00		1.00	Verifica	262.8	1.52	Verifica
P7	al B al 22	S8	198 (C)	0.70	1.00	3 235.1			3.50	3.50	1.10	487.0	3 722.1	400	0.91	0.000	0.000	1.00		1.00	Verifica	303.8	1.32	Verifica
P7	al B al 22	S8	199 (C)	0.70	1.00	2 888.2			3.50	3.50	1.10	487.0	3 375.2	400	0.86	0.000	0.000	1.00		1.00	Verifica	275.5	1.45	Verifica
P7	al B al 22	S8	200 (C)	0.70	1.00	2 732.2			3.50	3.50	1.10	487.0	3 219.2	400	0.84	0.000	0.000	1.00		1.00	Verifica	262.8	1.52	Verifica
P7	al B al 22	S8	201 (C)	0.70	1.00	2 732.2			3.50	3.50	1.10	487.0	3 219.2	400	0.84	0.000	0.000	1.00		1.00	Verifica	262.8	1.52	Verifica
P7	al B al 22	S8	202 (C)	0.70	1.00	2 725.4			3.50	3.50	1.10	487.0	3 212.4	400	0.84	0.000	0.000	1.00		1.00	Verifica	262.2	1.53	Verifica
P7	al B al 22	S8	203 (C)	0.70	1.00	2 697.4			3.50	3.50	1.10	487.0	3 184.4	400	0.84	0.000	0.000	1.00		1.00	Verifica	260.0	1.54	Verifica
P7	al B al 22	S8	204 (C)	0.70	1.00	3 391.1			3.50	3.50	1.10	487.0	3 878.1	400	0.92	0.000	0.000	1.00		1.00	Verifica	316.6	1.26	Verifica
P7	al B al 22	S8	205 (C)	0.70	1.00	3 235.1			3.50	3.50	1.10	487.0	3 722.1	400	0.91	0.000	0.000	1.00		1.00	Verifica	303.8	1.32	Verifica
P7	al B al 22	S8	206 (C)	0.70	1.00	3 235.1			3.50	3.50	1.10	487.0	3 722.1	400	0.91	0.000	0.000	1.00		1.00	Verifica	303.8	1.32	Verifica
P7	al B al 22	S8	207 (C)	0.70	1.00	3 228.3			3.50	3.50	1.10	487.0	3 715.3	400	0.91	0.000	0.000	1.00		1.00	Verifica	303.3	1.32	Verifica
P7	al B al 22	S8	208 (C)	0.70	1.00	3 200.3			3.50	3.50	1.10	487.0	3 687.3	400	0.90	0.000	0.000	1.00		1.00	Verifica	301.0	1.33	Verifica
P7	al B al 22	S8	209 (C)	0.70	1.00	2 888.2			3.50	3.50	1.10	487.0	3 375.2	400	0.86	0.000	0.000	1.00		1.00	Verifica	275.5	1.45	Verifica
P7	al B al 22	S8	210 (C)	0.70	1.00	2 888.2			3.50	3.50	1.10	487.0	3 375.2	400	0.86	0.000	0.000	1.00		1.00	Verifica	275.5	1.45	Verifica
P7	al B al 22	S8	211 (C)	0.70	1.00	2 881.3			3.50	3.50	1.10	487.0	3 368.3	400	0.86	0.000	0.000	1.00		1.00	Verifica	275.0	1.45	Verifica
P7	al B al 22	S8	212 (C)	0.70	1.00	2 853.4			3.50	3.50	1.10	487.0	3 340.4	400	0.86	0.000	0.000	1.00		1.00	Verifica	272.7	1.47	Verifica
P7	al B al 22	S8	213 (C)	0.70	1.00	3 391.1			3.50	3.50	1.10	487.0	3 878.1	400	0.92	0.000	0.000	1.00		1.00	Verifica	316.6	1.26	Verifica
P7	al B al 22	S8	214 (C)	0.70	1.00	3 391.1			3.50	3.50	1.10	487.0	3 878.1	400	0.92	0.000	0.000	1.00		1.00	Verifica	316.6	1.26	Verifica</

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P7	al B al 22	S8	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4995.8	657.5	5653.3	0.000	0.000	1978.6	45.51	13.79	Ø20/0.15	20.93	1.52	1766.7	40.63	11.95	Ø20/0.15	20.93	1.75	Verifica
P7	al B al 22	S8	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4761.8	657.5	5419.3	0.000	0.000	1896.7	43.63	13.22	Ø20/0.15	20.93	1.58	1693.5	38.95	11.46	Ø20/0.15	20.93	1.83	Verifica
P7	al B al 22	S8	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4761.8	657.5	5419.3	0.000	0.000	1896.7	43.63	13.22	Ø20/0.15	20.93	1.58	1693.5	38.95	11.46	Ø20/0.15	20.93	1.83	Verifica
P7	al B al 22	S8	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4751.6	657.5	5409.1	0.000	0.000	1893.2	43.54	13.19	Ø20/0.15	20.93	1.59	1690.3	38.88	11.43	Ø20/0.15	20.93	1.83	Verifica
P7	al B al 22	S8	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4709.6	657.5	5367.1	0.000	0.000	1878.5	43.21	13.09	Ø20/0.15	20.93	1.60	1677.2	38.58	11.35	Ø20/0.15	20.93	1.84	Verifica
P7	al B al 22	S8	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4995.8	657.5	5653.3	0.000	0.000	1978.6	45.51	13.79	Ø20/0.15	20.93	1.52	1766.7	40.63	11.95	Ø20/0.15	20.93	1.75	Verifica
P7	al B al 22	S8	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4995.8	657.5	5653.3	0.000	0.000	1978.6	45.51	13.79	Ø20/0.15	20.93	1.52	1766.7	40.63	11.95	Ø20/0.15	20.93	1.75	Verifica
P7	al B al 22	S8	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4985.5	657.5	5643.0	0.000	0.000	1975.0	45.43	13.77	Ø20/0.15	20.93	1.52	1763.4	40.56	11.93	Ø20/0.15	20.93	1.75	Verifica
P7	al B al 22	S8	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4943.6	657.5	5601.1	0.000	0.000	1960.4	45.09	13.66	Ø20/0.15	20.93	1.53	1750.3	40.26	11.84	Ø20/0.15	20.93	1.77	Verifica
P7	al B al 22	S8	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3063.9	657.5	3721.4	0.000	0.000	1302.5	29.96	9.08	Ø20/0.15	20.93	2.31	1162.9	26.75	7.87	Ø20/0.15	20.93	2.66	Verifica
P7	al B al 22	S8	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3818.3	657.5	4475.8	0.000	0.000	1566.5	36.03	10.92	Ø20/0.15	20.93	1.92	1398.7	32.17	9.46	Ø20/0.15	20.93	2.21	Verifica
P7	al B al 22	S8	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3063.9	657.5	3721.4	0.000	0.000	1302.5	29.96	9.08	Ø20/0.15	20.93	2.31	1162.9	26.75	7.87	Ø20/0.15	20.93	2.66	Verifica
P7	al B al 22	S8	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3063.9	657.5	3721.4	0.000	0.000	1302.5	29.96	9.08	Ø20/0.15	20.93	2.31	1162.9	26.75	7.87	Ø20/0.15	20.93	2.66	Verifica
P7	al B al 22	S8	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3053.7	657.5	3711.2	0.000	0.000	1298.9	29.88	9.05	Ø20/0.15	20.93	2.31	1159.7	26.67	7.85	Ø20/0.15	20.93	2.67	Verifica
P7	al B al 22	S8	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3011.7	657.5	3669.2	0.000	0.000	1284.2	29.54	8.95	Ø20/0.15	20.93	2.34	1146.6	26.37	7.76	Ø20/0.15	20.93	2.70	Verifica
P7	al B al 22	S8	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3818.3	657.5	4475.8	0.000	0.000	1566.5	36.03	10.92	Ø20/0.15	20.93	1.92	1398.7	32.17	9.46	Ø20/0.15	20.93	2.21	Verifica
P7	al B al 22	S8	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3818.3	657.5	4475.8	0.000	0.000	1566.5	36.03	10.92	Ø20/0.15	20.93	1.92	1398.7	32.17	9.46	Ø20/0.15	20.93	2.21	Verifica
P7	al B al 22	S8	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3808.1	657.5	4465.6	0.000	0.000	1563.0	35.95	10.89	Ø20/0.15	20.93	1.92	1395.5	32.10	9.44	Ø20/0.15	20.93	2.22	Verifica
P7	al B al 22	S8	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3766.1	657.5	4423.6	0.000	0.000	1548.3	35.61	10.79	Ø20/0.15	20.93	1.94	1382.4	31.79	9.35	Ø20/0.15	20.93	2.24	Verifica
P7	al B al 22	S8	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3687.9	657.5	4345.4	0.000	0.000	1520.9	34.98	10.60	Ø20/0.15	20.93	1.97	1357.9	31.23	9.19	Ø20/0.15	20.93	2.28	Verifica
P7	al B al 22	S8	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4442.3	657.5	5099.8	0.000	0.000	1784.9	41.05	12.44	Ø20/0.15	20.93	1.68	1593.7	36.65	10.78	Ø20/0.15	20.93	1.94	Verifica
P7	al B al 22	S8	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3921.8	657.5	4579.3	0.000	0.000	1602.7	36.86	11.17	Ø20/0.15	20.93	1.87	1431.0	32.91	9.68	Ø20/0.15	20.93	2.16	Verifica
P7	al B al 22	S8	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3687.9	657.5	4345.4	0.000	0.000	1520.9	34.98	10.60	Ø20/0.15	20.93	1.97	1357.9	31.23	9.19	Ø20/0.15	20.93	2.28	Verifica
P7	al B al 22	S8	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3687.9	657.5	4345.4	0.000	0.000	1520.9	34.98	10.60	Ø20/0.15	20.93	1.97	1357.9	31.23	9.19	Ø20/0.15	20.93	2.28	Verifica
P7	al B al 22	S8	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3677.6	657.5	4335.1	0.000	0.000	1517.3	34.90	10.57	Ø20/0.15	20.93	1.98	1354.7	31.16	9.16	Ø20/0.15	20.93	2.28	Verifica
P7	al B al 22	S8	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3635.7	657.5	4293.2	0.000	0.000	1502.6	34.56	10.47	Ø20/0.15	20.93	2.00	1341.6	30.86	9.08	Ø20/0.15	20.93	2.31	Verifica
P7	al B al 22	S8	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4676.2	657.5	5333.7	0.000	0.000	1866.8	42.94	13.01	Ø20/0.15	20.93	1.61	1666.8	38.34	11.28	Ø20/0.15	20.93	1.86	Verifica
P7	al B al 22	S8	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4442.3	657.5	5099.8	0.000	0.000	1784.9	41.05	12.44	Ø20/0.15	20.93	1.68	1593.7	36.65	10.78	Ø20/0.15	20.93	1.94	Verifica
P7	al B al 22	S8	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4442.3	657.5	5099.8	0.000	0.000	1784.9	41.05	12.44	Ø20/0.15	20.93	1.68	1593.7	36.65	10.78	Ø20/0.15	20.93	1.94	Verifica
P7	al B al 22	S8	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4432.0	657.5	5089.5	0.000	0.000	1781.3	40.97	12.42	Ø20/0.15	20.93	1.69	1590.5	36.58	10.76	Ø20/0.15	20.93	1.95	Verifica
P7	al B al 22	S8	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00	439																	

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{Ed}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m ²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m ²)	(cm2/m)		(cm2/m)		(kN/m ²)					
P7	al B al 22	S8	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	461	5 653.3			1351.8	1.000	0.000	2.51	657.6	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 22	S8	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	442	5 419.3			1290.9	1.000	0.000	2.51	631.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 22	S8	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	442	5 419.3			1290.9	1.000	0.000	2.51	631.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 22	S8	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	442	5 409.1			1288.3	1.000	0.000	2.51	629.9	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 22	S8	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	438	5 367.1			1277.4	1.000	0.000	2.51	625.2	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 22	S8	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	461	5 653.3			1351.8	1.000	0.000	2.51	657.6	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 22	S8	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	461	5 653.3			1351.8	1.000	0.000	2.51	657.6	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 22	S8	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	461	5 643.0			1349.1	1.000	0.000	2.51	656.4	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 22	S8	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	457	5 601.1			1338.2	1.000	0.000	2.51	651.7	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 22	S8	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	304	3 721.4			849.4	1.000	0.000	2.51	439.0	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P7	al B al 22	S8	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	365	4 475.8			1045.6	1.000	0.000	2.51	524.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 22	S8	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	304	3 721.4			849.4	1.000	0.000	2.51	439.0	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P7	al B al 22	S8	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	304	3 721.4			849.4	1.000	0.000	2.51	439.0	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P7	al B al 22	S8	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	303	3 711.2			846.8	1.000	0.000	2.51	437.9	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P7	al B al 22	S8	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	300	3 669.2			835.8	1.000	0.000	2.51	433.1	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica
P7	al B al 22	S8	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	365	4 475.8			1045.6	1.000	0.000	2.51	524.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 22	S8	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	365	4 475.8			1045.6	1.000	0.000	2.51	524.4	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 22	S8	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	365	4 465.6			1042.9	1.000	0.000	2.51	523.2	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 22	S8	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	361	4 423.6			1032.0	1.000	0.000	2.51	518.5	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P7	al B al 22	S8	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	355	4 345.4			1011.7	1.000	0.000	2.51	509.6	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P7	al B al 22	S8	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	416	5 099.8			1207.9	1.000	0.000	2.51	595.0	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P7	al B al 22	S8	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	374	4 579.3			1072.5	1.000	0.000	2.51	536.1	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 22	S8	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	355	4 345.4			1011.7	1.000	0.000	2.51	509.6	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P7	al B al 22	S8	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	355	4 345.4			1011.7	1.000	0.000	2.51	509.6	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P7	al B al 22	S8	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	354	4 335.1			1009.0	1.000	0.000	2.51	508.5	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P7	al B al 22	S8	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	350	4 293.2			998.1	1.000	0.000	2.51	503.7	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P7	al B al 22	S8	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	435	5 333.7			1268.7	1.000	0.000	2.51	621.4	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P7	al B al 22	S8	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	416	5 099.8			1207.9	1.000	0.000	2.51	595.0	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P7	al B al 22	S8	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	416	5 099.8			1207.9	1.000	0.000	2.51	595.0	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P7	al B al 22	S8	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	415	5 089.5			1205.2	1.000	0.000	2.51	593.8	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P7	al B al 22	S8	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	412	5 047.6			1194.3	1.000	0.000	2.51	589.0	1.45	20.93	20.93	0.002	1281.6	2.2	Verifica
P7	al B al 22	S8	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	435	5 333.7			1268.7	1.000	0.000	2.51	621.4	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P7	al B al 22	S8	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	435	5 333.7			1268.7	1.000	0.000	2.51	621.4	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P7	al B al 22	S8	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	435	5 323.5		</												

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação da Rotura do Solo de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'	L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m ²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P9	al C al 22	S7	177 (C)	0.70	1.00	2 420.5			3.50	3.50	1.10	487.0	2 907.5	400	0.80	0.000	0.000	2.70	2.70	Verifica	237.3	1.69	Verifica
P9	al C al 22	S7	178 (C)	0.70	1.00	2 630.6			3.50	3.50	1.10	487.0	3 117.6	400	0.83	0.000	0.000	2.79	2.79	Verifica	254.5	1.57	Verifica
P9	al C al 22	S7	179 (C)	0.70	1.00	2 420.5			3.50	3.50	1.10	487.0	2 907.5	400	0.80	0.000	0.000	2.70	2.70	Verifica	237.3	1.69	Verifica
P9	al C al 22	S7	180 (C)	0.70	1.00	2 420.5			3.50	3.50	1.10	487.0	2 907.5	400	0.80	0.000	0.000	2.70	2.70	Verifica	237.3	1.69	Verifica
P9	al C al 22	S7	181 (C)	0.70	1.00	2 420.8			3.50	3.50	1.10	487.0	2 907.8	400	0.80	0.000	0.000	2.70	2.70	Verifica	237.4	1.69	Verifica
P9	al C al 22	S7	182 (C)	0.70	1.00	2 420.5			3.50	3.50	1.10	487.0	2 907.5	400	0.80	0.000	0.000	2.70	2.70	Verifica	237.3	1.69	Verifica
P9	al C al 22	S7	183 (C)	0.70	1.00	2 630.6			3.50	3.50	1.10	487.0	3 117.6	400	0.83	0.000	0.000	2.79	2.79	Verifica	254.5	1.57	Verifica
P9	al C al 22	S7	184 (C)	0.70	1.00	2 630.6			3.50	3.50	1.10	487.0	3 117.6	400	0.83	0.000	0.000	2.79	2.79	Verifica	254.5	1.57	Verifica
P9	al C al 22	S7	185 (C)	0.70	1.00	2 631.0			3.50	3.50	1.10	487.0	3 118.0	400	0.83	0.000	0.000	2.79	2.79	Verifica	254.5	1.57	Verifica
P9	al C al 22	S7	186 (C)	0.70	1.00	2 630.7			3.50	3.50	1.10	487.0	3 117.7	400	0.83	0.000	0.000	2.79	2.79	Verifica	254.5	1.57	Verifica
P9	al C al 22	S7	187 (C)	0.70	1.00	2 295.8			3.50	3.50	1.10	487.0	2 782.8	400	0.78	0.000	0.000	2.64	2.64	Verifica	227.2	1.76	Verifica
P9	al C al 22	S7	188 (C)	0.70	1.00	2 593.2			3.50	3.50	1.10	487.0	3 080.2	400	0.82	0.000	0.000	2.77	2.77	Verifica	251.4	1.59	Verifica
P9	al C al 22	S7	189 (C)	0.70	1.00	2 295.8			3.50	3.50	1.10	487.0	2 782.8	400	0.78	0.000	0.000	2.64	2.64	Verifica	227.2	1.76	Verifica
P9	al C al 22	S7	190 (C)	0.70	1.00	2 295.8			3.50	3.50	1.10	487.0	2 782.8	400	0.78	0.000	0.000	2.64	2.64	Verifica	227.2	1.76	Verifica
P9	al C al 22	S7	191 (C)	0.70	1.00	2 296.1			3.50	3.50	1.10	487.0	2 783.1	400	0.78	0.000	0.000	2.64	2.64	Verifica	227.2	1.76	Verifica
P9	al C al 22	S7	192 (C)	0.70	1.00	2 295.8			3.50	3.50	1.10	487.0	2 782.8	400	0.78	0.000	0.000	2.64	2.64	Verifica	227.2	1.76	Verifica
P9	al C al 22	S7	193 (C)	0.70	1.00	2 593.2			3.50	3.50	1.10	487.0	3 080.2	400	0.82	0.000	0.000	2.77	2.77	Verifica	251.4	1.59	Verifica
P9	al C al 22	S7	194 (C)	0.70	1.00	2 593.2			3.50	3.50	1.10	487.0	3 080.2	400	0.82	0.000	0.000	2.77	2.77	Verifica	251.4	1.59	Verifica
P9	al C al 22	S7	195 (C)	0.70	1.00	2 593.6			3.50	3.50	1.10	487.0	3 080.6	400	0.82	0.000	0.000	2.78	2.78	Verifica	251.5	1.59	Verifica
P9	al C al 22	S7	196 (C)	0.70	1.00	2 593.3			3.50	3.50	1.10	487.0	3 080.3	400	0.82	0.000	0.000	2.78	2.78	Verifica	251.5	1.59	Verifica
P9	al C al 22	S7	197 (C)	0.70	1.00	1 995.4			3.50	3.50	1.10	487.0	2 482.4	400	0.74	0.000	0.000	2.49	2.49	Verifica	202.6	1.97	Verifica
P9	al C al 22	S7	198 (C)	0.70	1.00	2 292.8			3.50	3.50	1.10	487.0	2 779.8	400	0.78	0.000	0.000	2.64	2.64	Verifica	226.9	1.76	Verifica
P9	al C al 22	S7	199 (C)	0.70	1.00	2 205.6			3.50	3.50	1.10	487.0	2 692.6	400	0.77	0.000	0.000	2.59	2.59	Verifica	219.8	1.82	Verifica
P9	al C al 22	S7	200 (C)	0.70	1.00	1 995.4			3.50	3.50	1.10	487.0	2 482.4	400	0.74	0.000	0.000	2.49	2.49	Verifica	202.6	1.97	Verifica
P9	al C al 22	S7	201 (C)	0.70	1.00	1 995.4			3.50	3.50	1.10	487.0	2 482.4	400	0.74	0.000	0.000	2.49	2.49	Verifica	202.6	1.97	Verifica
P9	al C al 22	S7	202 (C)	0.70	1.00	1 995.7			3.50	3.50	1.10	487.0	2 482.7	400	0.74	0.000	0.000	2.49	2.49	Verifica	202.7	1.97	Verifica
P9	al C al 22	S7	203 (C)	0.70	1.00	1 995.4			3.50	3.50	1.10	487.0	2 482.4	400	0.74	0.000	0.000	2.49	2.49	Verifica	202.6	1.97	Verifica
P9	al C al 22	S7	204 (C)	0.70	1.00	2 503.0			3.50	3.50	1.10	487.0	2 990.0	400	0.81	0.000	0.000	2.73	2.73	Verifica	244.1	1.64	Verifica
P9	al C al 22	S7	205 (C)	0.70	1.00	2 292.8			3.50	3.50	1.10	487.0	2 779.8	400	0.78	0.000	0.000	2.64	2.64	Verifica	226.9	1.76	Verifica
P9	al C al 22	S7	206 (C)	0.70	1.00	2 292.8			3.50	3.50	1.10	487.0	2 779.8	400	0.78	0.000	0.000	2.64	2.64	Verifica	226.9	1.76	Verifica
P9	al C al 22	S7	207 (C)	0.70	1.00	2 293.2			3.50	3.50	1.10	487.0	2 780.2	400	0.78	0.000	0.000	2.64	2.64	Verifica	227.0	1.76	Verifica
P9	al C al 22	S7	208 (C)	0.70	1.00	2 292.9			3.50	3.50	1.10	487.0	2 779.9	400	0.78	0.000	0.000	2.64	2.64	Verifica	226.9	1.76	Verifica
P9	al C al 22	S7	209 (C)	0.70	1.00	2 205.6			3.50	3.50	1.10	487.0	2 692.6	400	0.77	0.000	0.000	2.59	2.59	Verifica	219.8	1.82	Verifica
P9	al C al 22	S7	210 (C)	0.70	1.00	2 205.6			3.50	3.50	1.10	487.0	2 692.6	400	0.77	0.000	0.000	2.59	2.59	Verifica	219.8	1.82	Verifica
P9	al C al 22	S7	211 (C)	0.70	1.00	2 205.9			3.50	3.50	1.10	487.0	2 692.9	400	0.77	0.000	0.000	2.59	2.59	Verifica	219.8	1.82	Verifica
P9	al C al 22	S7	212 (C)	0.70	1.00	2 205.6			3.50	3.50	1.10	487.0	2 692.6	400	0.77	0.000	0.000	2.59	2.59	Verifica	219.8	1.82	Verifica
P9	al C al 22	S7	213 (C)	0.70	1.00	2 503.0			3.50	3.50	1.10	487.0	2 990.0	400	0.81	0.000	0.000	2.73	2.73	Verifica	244.1	1.64	Verifica
P9	al C al 22	S7	214 (C)	0.70	1.00	2 503.0			3.50	3.50	1.10	487.0	2 990.0	400	0.81	0.000	0.000	2.73	2.73	Verifica	244.1	1.64	Verifica
P9	al C al 22	S7	215 (C)	0.70	1.00	2 503.4			3.50	3.50	1.10	487.0	2 990.4	400									

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al C al 22	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3646.1	657.5	4303.6	0.000	0.000	1506.3	34.64	10.50	Ø20/0.15	20.93	1.99	1344.9	30.93	9.10	Ø20/0.15	20.93	2.30	Verifica
P9	al C al 22	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3330.8	657.5	3988.3	0.000	0.000	1395.9	32.11	9.73	Ø20/0.15	20.93	2.15	1246.3	28.67	8.43	Ø20/0.15	20.93	2.48	Verifica
P9	al C al 22	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3330.8	657.5	3988.3	0.000	0.000	1395.9	32.11	9.73	Ø20/0.15	20.93	2.15	1246.3	28.67	8.43	Ø20/0.15	20.93	2.48	Verifica
P9	al C al 22	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3331.3	657.5	3988.8	0.000	0.000	1396.1	32.11	9.73	Ø20/0.15	20.93	2.15	1246.5	28.67	8.43	Ø20/0.15	20.93	2.48	Verifica
P9	al C al 22	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3330.9	657.5	3988.4	0.000	0.000	1395.9	32.11	9.73	Ø20/0.15	20.93	2.15	1246.4	28.67	8.43	Ø20/0.15	20.93	2.48	Verifica
P9	al C al 22	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3646.1	657.5	4303.6	0.000	0.000	1506.3	34.64	10.50	Ø20/0.15	20.93	1.99	1344.9	30.93	9.10	Ø20/0.15	20.93	2.30	Verifica
P9	al C al 22	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3646.1	657.5	4303.6	0.000	0.000	1506.3	34.64	10.50	Ø20/0.15	20.93	1.99	1344.9	30.93	9.10	Ø20/0.15	20.93	2.30	Verifica
P9	al C al 22	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3646.6	657.5	4304.1	0.000	0.000	1506.4	34.65	10.50	Ø20/0.15	20.93	1.99	1345.0	30.94	9.10	Ø20/0.15	20.93	2.30	Verifica
P9	al C al 22	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3646.1	657.5	4303.6	0.000	0.000	1506.3	34.64	10.50	Ø20/0.15	20.93	1.99	1344.9	30.93	9.10	Ø20/0.15	20.93	2.30	Verifica
P9	al C al 22	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2445.9	657.5	3103.4	0.000	0.000	1086.2	24.98	7.57	Ø20/0.15	20.93	2.76	969.8	22.31	6.56	Ø20/0.15	20.93	3.19	Verifica
P9	al C al 22	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2892.1	657.5	3549.6	0.000	0.000	1242.4	28.57	8.66	Ø20/0.15	20.93	2.42	1109.2	25.51	7.50	Ø20/0.15	20.93	2.79	Verifica
P9	al C al 22	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2445.9	657.5	3103.4	0.000	0.000	1086.2	24.98	7.57	Ø20/0.15	20.93	2.76	969.8	22.31	6.56	Ø20/0.15	20.93	3.19	Verifica
P9	al C al 22	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2445.9	657.5	3103.4	0.000	0.000	1086.2	24.98	7.57	Ø20/0.15	20.93	2.76	969.8	22.31	6.56	Ø20/0.15	20.93	3.19	Verifica
P9	al C al 22	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2446.4	657.5	3103.9	0.000	0.000	1086.4	24.99	7.57	Ø20/0.15	20.93	2.76	970.0	22.31	6.56	Ø20/0.15	20.93	3.19	Verifica
P9	al C al 22	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2445.9	657.5	3103.4	0.000	0.000	1086.2	24.98	7.57	Ø20/0.15	20.93	2.76	969.8	22.31	6.56	Ø20/0.15	20.93	3.19	Verifica
P9	al C al 22	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2892.1	657.5	3549.6	0.000	0.000	1242.4	28.57	8.66	Ø20/0.15	20.93	2.42	1109.2	25.51	7.50	Ø20/0.15	20.93	2.79	Verifica
P9	al C al 22	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2892.1	657.5	3549.6	0.000	0.000	1242.4	28.57	8.66	Ø20/0.15	20.93	2.42	1109.2	25.51	7.50	Ø20/0.15	20.93	2.79	Verifica
P9	al C al 22	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2892.6	657.5	3550.1	0.000	0.000	1242.5	28.58	8.66	Ø20/0.15	20.93	2.42	1109.4	25.52	7.50	Ø20/0.15	20.93	2.79	Verifica
P9	al C al 22	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2892.1	657.5	3549.6	0.000	0.000	1242.4	28.57	8.66	Ø20/0.15	20.93	2.42	1109.2	25.51	7.50	Ø20/0.15	20.93	2.79	Verifica
P9	al C al 22	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2693.2	657.5	3350.7	0.000	0.000	1172.7	26.97	8.17	Ø20/0.15	20.93	2.56	1047.1	24.08	7.08	Ø20/0.15	20.93	2.95	Verifica
P9	al C al 22	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3139.4	657.5	3796.9	0.000	0.000	1328.9	30.56	9.26	Ø20/0.15	20.93	2.26	1186.5	27.29	8.03	Ø20/0.15	20.93	2.61	Verifica
P9	al C al 22	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3008.5	657.5	3666.0	0.000	0.000	1283.1	29.51	8.94	Ø20/0.15	20.93	2.34	1145.6	26.35	7.75	Ø20/0.15	20.93	2.70	Verifica
P9	al C al 22	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2693.2	657.5	3350.7	0.000	0.000	1172.7	26.97	8.17	Ø20/0.15	20.93	2.56	1047.1	24.08	7.08	Ø20/0.15	20.93	2.95	Verifica
P9	al C al 22	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2693.2	657.5	3350.7	0.000	0.000	1172.7	26.97	8.17	Ø20/0.15	20.93	2.56	1047.1	24.08	7.08	Ø20/0.15	20.93	2.95	Verifica
P9	al C al 22	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2693.7	657.5	3351.2	0.000	0.000	1172.9	26.98	8.17	Ø20/0.15	20.93	2.56	1047.2	24.09	7.08	Ø20/0.15	20.93	2.95	Verifica
P9	al C al 22	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2693.2	657.5	3350.7	0.000	0.000	1172.7	26.97	8.17	Ø20/0.15	20.93	2.56	1047.1	24.08	7.08	Ø20/0.15	20.93	2.95	Verifica
P9	al C al 22	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3454.6	657.5	4112.1	0.000	0.000	1439.2	33.10	10.03	Ø20/0.15	20.93	2.09	1285.0	29.56	8.69	Ø20/0.15	20.93	2.41	Verifica
P9	al C al 22	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3139.4	657.5	3796.9	0.000	0.000	1328.9	30.56	9.26	Ø20/0.15	20.93	2.26	1186.5	27.29	8.03	Ø20/0.15	20.93	2.61	Verifica
P9	al C al 22	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3139.4	657.5	3796.9	0.000	0.000	1328.9	30.56	9.26	Ø20/0.15	20.93	2.26	1186.5	27.29	8.03	Ø20/0.15	20.93	2.61	Verifica
P9	al C al 22	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3139.9	657.5	3797.4	0.000	0.000	1329.1	30.57	9.26	Ø20/0.15	20.93	2.26	1186.7	27.29	8.03	Ø20/0.15	20.93	2.61	Verifica
P9	al C al 22	S7	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3139.4	657.5	3796.9	0.000	0.000													

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 22 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{reg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)		(kN/m²)	FS		V _{Ed} ≤ V _{Rd}		
P9	al C al 22	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	351	4 303.6			1000.8	0.000	0.000	1.00	504.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 22	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	326	3 988.3			918.8	0.000	0.000	1.00	469.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 22	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	326	3 988.3			918.8	0.000	0.000	1.00	469.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 22	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	326	3 988.8			919.0	0.000	0.000	1.00	469.3	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 22	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	326	3 988.4			918.9	0.000	0.000	1.00	469.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 22	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	351	4 303.6			1000.8	0.000	0.000	1.00	504.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 22	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	351	4 303.6			1000.8	0.000	0.000	1.00	504.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 22	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	351	4 304.1			1000.9	0.000	0.000	1.00	504.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 22	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	351	4 303.6			1000.8	0.000	0.000	1.00	504.9	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 22	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	253	3 103.4			688.7	0.000	0.000	1.00	369.1	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica
P9	al C al 22	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	290	3 549.6			804.7	0.000	0.000	1.00	419.6	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 22	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	253	3 103.4			688.7	0.000	0.000	1.00	369.1	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica
P9	al C al 22	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	253	3 103.4			688.7	0.000	0.000	1.00	369.1	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica
P9	al C al 22	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	253	3 103.9			688.9	0.000	0.000	1.00	369.2	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica
P9	al C al 22	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	253	3 103.4			688.7	0.000	0.000	1.00	369.1	1.45	20.93	20.93	0.002	1281.6	3.5	Verifica
P9	al C al 22	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	290	3 549.6			804.7	0.000	0.000	1.00	419.6	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 22	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	290	3 549.6			804.7	0.000	0.000	1.00	419.6	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 22	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	290	3 550.1			804.9	0.000	0.000	1.00	419.7	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 22	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	290	3 549.6			804.7	0.000	0.000	1.00	419.6	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 22	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	274	3 350.7			753.0	0.000	0.000	1.00	397.1	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica
P9	al C al 22	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	310	3 796.9			869.1	0.000	0.000	1.00	447.6	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 22	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	299	3 666.0			835.0	0.000	0.000	1.00	432.8	1.45	20.93	20.93	0.002	1281.6	3.0	Verifica
P9	al C al 22	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	274	3 350.7			753.0	0.000	0.000	1.00	397.1	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica
P9	al C al 22	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	274	3 350.7			753.0	0.000	0.000	1.00	397.1	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica
P9	al C al 22	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	274	3 351.2			753.2	0.000	0.000	1.00	397.2	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica
P9	al C al 22	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	274	3 350.7			753.0	0.000	0.000	1.00	397.1	1.45	20.93	20.93	0.002	1281.6	3.2	Verifica
P9	al C al 22	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	336	4 112.1			951.0	0.000	0.000	1.00	483.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 22	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	310	3 796.9			869.1	0.000	0.000	1.00	447.6	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 22	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	310	3 796.9			869.1	0.000	0.000	1.00	447.6	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 22	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	310	3 797.4			869.2	0.000	0.000	1.00	447.6	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 22	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	310	3 796.9			869.1	0.000	0.000	1.00	447.6	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 22	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	336	4 112.1			951.0	0.000	0.000	1.00	483.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 22	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	336	4 112.1			951.0	0.000	0.000	1.00	483.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 22	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	336	4 112.7			951.2											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação da Rotura do Solo de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B´	L´	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)		
P7	al A´ al 23	S7	177 (C)	0.70	1.40	3 210.5			4.00	4.00	1.30	715.3	3 925.8	400	0.93	0.000	0.000	3.13	3.13	Verifica	245.4	1.63	Verifica
P7	al A´ al 23	S7	178 (C)	0.70	1.40	3 275.9			4.00	4.00	1.30	715.3	3 991.2	400	0.94	0.000	0.000	3.16	3.16	Verifica	249.4	1.60	Verifica
P7	al A´ al 23	S7	179 (C)	0.70	1.40	3 210.5			4.00	4.00	1.30	715.3	3 925.8	400	0.93	0.000	0.000	3.13	3.13	Verifica	245.4	1.63	Verifica
P7	al A´ al 23	S7	180 (C)	0.70	1.40	3 210.5			4.00	4.00	1.30	715.3	3 925.8	400	0.93	0.000	0.000	3.13	3.13	Verifica	245.4	1.63	Verifica
P7	al A´ al 23	S7	181 (C)	0.70	1.40	3 131.4			4.00	4.00	1.30	715.3	3 846.7	400	0.92	0.000	0.000	3.10	3.10	Verifica	240.4	1.66	Verifica
P7	al A´ al 23	S7	182 (C)	0.70	1.40	3 133.5			4.00	4.00	1.30	715.3	3 848.8	400	0.92	0.000	0.000	3.10	3.10	Verifica	240.5	1.66	Verifica
P7	al A´ al 23	S7	183 (C)	0.70	1.40	3 275.9			4.00	4.00	1.30	715.3	3 991.2	400	0.94	0.000	0.000	3.16	3.16	Verifica	249.4	1.60	Verifica
P7	al A´ al 23	S7	184 (C)	0.70	1.40	3 275.9			4.00	4.00	1.30	715.3	3 991.2	400	0.94	0.000	0.000	3.16	3.16	Verifica	249.4	1.60	Verifica
P7	al A´ al 23	S7	185 (C)	0.70	1.40	3 196.8			4.00	4.00	1.30	715.3	3 912.1	400	0.93	0.000	0.000	3.13	3.13	Verifica	244.5	1.64	Verifica
P7	al A´ al 23	S7	186 (C)	0.70	1.40	3 198.9			4.00	4.00	1.30	715.3	3 914.2	400	0.93	0.000	0.000	3.13	3.13	Verifica	244.6	1.64	Verifica
P7	al A´ al 23	S7	187 (C)	0.70	1.40	2 692.0			4.00	4.00	1.30	715.3	3 407.3	400	0.87	0.000	0.000	2.92	2.92	Verifica	213.0	1.88	Verifica
P7	al A´ al 23	S7	188 (C)	0.70	1.40	3 120.4			4.00	4.00	1.30	715.3	3 835.7	400	0.92	0.000	0.000	3.10	3.10	Verifica	239.7	1.67	Verifica
P7	al A´ al 23	S7	189 (C)	0.70	1.40	2 692.0			4.00	4.00	1.30	715.3	3 407.3	400	0.87	0.000	0.000	2.92	2.92	Verifica	213.0	1.88	Verifica
P7	al A´ al 23	S7	190 (C)	0.70	1.40	2 692.0			4.00	4.00	1.30	715.3	3 407.3	400	0.87	0.000	0.000	2.92	2.92	Verifica	213.0	1.88	Verifica
P7	al A´ al 23	S7	191 (C)	0.70	1.40	2 612.9			4.00	4.00	1.30	715.3	3 328.2	400	0.86	0.000	0.000	2.88	2.88	Verifica	208.0	1.92	Verifica
P7	al A´ al 23	S7	192 (C)	0.70	1.40	2 615.1			4.00	4.00	1.30	715.3	3 330.4	400	0.86	0.000	0.000	2.89	2.89	Verifica	208.1	1.92	Verifica
P7	al A´ al 23	S7	193 (C)	0.70	1.40	3 120.4			4.00	4.00	1.30	715.3	3 835.7	400	0.92	0.000	0.000	3.10	3.10	Verifica	239.7	1.67	Verifica
P7	al A´ al 23	S7	194 (C)	0.70	1.40	3 120.4			4.00	4.00	1.30	715.3	3 835.7	400	0.92	0.000	0.000	3.10	3.10	Verifica	239.7	1.67	Verifica
P7	al A´ al 23	S7	195 (C)	0.70	1.40	3 041.2			4.00	4.00	1.30	715.3	3 756.5	400	0.91	0.000	0.000	3.06	3.06	Verifica	234.8	1.70	Verifica
P7	al A´ al 23	S7	196 (C)	0.70	1.40	3 043.4			4.00	4.00	1.30	715.3	3 758.7	400	0.91	0.000	0.000	3.07	3.07	Verifica	234.9	1.70	Verifica
P7	al A´ al 23	S7	197 (C)	0.70	1.40	2 631.6			4.00	4.00	1.30	715.3	3 346.9	400	0.86	0.000	0.000	2.89	2.89	Verifica	209.2	1.91	Verifica
P7	al A´ al 23	S7	198 (C)	0.70	1.40	3 059.9			4.00	4.00	1.30	715.3	3 775.2	400	0.91	0.000	0.000	3.07	3.07	Verifica	235.9	1.70	Verifica
P7	al A´ al 23	S7	199 (C)	0.70	1.40	2 697.0			4.00	4.00	1.30	715.3	3 412.3	400	0.87	0.000	0.000	2.92	2.92	Verifica	213.3	1.88	Verifica
P7	al A´ al 23	S7	200 (C)	0.70	1.40	2 631.6			4.00	4.00	1.30	715.3	3 346.9	400	0.86	0.000	0.000	2.89	2.89	Verifica	209.2	1.91	Verifica
P7	al A´ al 23	S7	201 (C)	0.70	1.40	2 631.6			4.00	4.00	1.30	715.3	3 346.9	400	0.86	0.000	0.000	2.89	2.89	Verifica	209.2	1.91	Verifica
P7	al A´ al 23	S7	202 (C)	0.70	1.40	2 552.5			4.00	4.00	1.30	715.3	3 267.8	400	0.85	0.000	0.000	2.86	2.86	Verifica	204.2	1.96	Verifica
P7	al A´ al 23	S7	203 (C)	0.70	1.40	2 554.6			4.00	4.00	1.30	715.3	3 269.9	400	0.85	0.000	0.000	2.86	2.86	Verifica	204.4	1.96	Verifica
P7	al A´ al 23	S7	204 (C)	0.70	1.40	3 125.3			4.00	4.00	1.30	715.3	3 840.6	400	0.92	0.000	0.000	3.10	3.10	Verifica	240.0	1.67	Verifica
P7	al A´ al 23	S7	205 (C)	0.70	1.40	3 059.9			4.00	4.00	1.30	715.3	3 775.2	400	0.91	0.000	0.000	3.07	3.07	Verifica	235.9	1.70	Verifica
P7	al A´ al 23	S7	206 (C)	0.70	1.40	3 059.9			4.00	4.00	1.30	715.3	3 775.2	400	0.91	0.000	0.000	3.07	3.07	Verifica	235.9	1.70	Verifica
P7	al A´ al 23	S7	207 (C)	0.70	1.40	2 980.8			4.00	4.00	1.30	715.3	3 696.1	400	0.90	0.000	0.000	3.04	3.04	Verifica	231.0	1.73	Verifica
P7	al A´ al 23	S7	208 (C)	0.70	1.40	2 983.0			4.00	4.00	1.30	715.3	3 698.3	400	0.90	0.000	0.000	3.04	3.04	Verifica	231.1	1.73	Verifica
P7	al A´ al 23	S7	209 (C)	0.70	1.40	2 697.0			4.00	4.00	1.30	715.3	3 412.3	400	0.87	0.000	0.000	2.92	2.92	Verifica	213.3	1.88	Verifica
P7	al A´ al 23	S7	210 (C)	0.70	1.40	2 697.0			4.00	4.00	1.30	715.3	3 412.3	400	0.87	0.000	0.000	2.92	2.92	Verifica	213.3	1.88	Verifica
P7	al A´ al 23	S7	211 (C)	0.70	1.40	2 617.9			4.00	4.00	1.30	715.3	3 333.2	400	0.86	0.000	0.000	2.89	2.89	Verifica	208.3	1.92	Verifica
P7	al A´ al 23	S7	212 (C)	0.70	1.40	2 620.0			4.00	4.00	1.30	715.3	3 335.3	400	0.86	0.000	0.000	2.89	2.89	Verifica	208.5	1.92	Verifica
P7	al A´ al 23	S7	213 (C)	0.70	1.40	3 125.3			4.00	4.00	1.30	715.3	3 840.6	400	0.92	0.000	0.000	3.10	3.10	Verifica	240.0	1.67	Verifica
P7	al A´ al 23	S7	214 (C)	0.70	1.40	3 125.3			4.00	4.00	1.30	715.3	3 840.6	400	0.92	0.000	0.000	3.10	3.10	Verifica	240.0	1.67	Verifica
P7	al A´ al 23	S7	215 (C)	0.70	1.40	3 046.2			4.00	4.00	1.30												

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	
P7	al A´ al 23	S7	105 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4542.9	965.6	5508.5	0.000	0.000	1893.5	43.55	11.46	Ø20/0.125	25.13	2.19	1491.9	34.31	8.80	Ø20/0.125	25.13	2.86	Verifica
P7	al A´ al 23	S7	106 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4444.8	965.6	5410.4	0.000	0.000	1859.8	42.78	11.26	Ø20/0.125	25.13	2.23	1465.3	33.70	8.64	Ø20/0.125	25.13	2.91	Verifica
P7	al A´ al 23	S7	107 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4444.8	965.6	5410.4	0.000	0.000	1859.8	42.78	11.26	Ø20/0.125	25.13	2.23	1465.3	33.70	8.64	Ø20/0.125	25.13	2.91	Verifica
P7	al A´ al 23	S7	108 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4326.1	965.6	5291.7	0.000	0.000	1819.0	41.84	11.01	Ø20/0.125	25.13	2.28	1433.2	32.96	8.45	Ø20/0.125	25.13	2.97	Verifica
P7	al A´ al 23	S7	109 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4329.3	965.6	5294.9	0.000	0.000	1820.1	41.86	11.02	Ø20/0.125	25.13	2.28	1434.0	32.98	8.46	Ø20/0.125	25.13	2.97	Verifica
P7	al A´ al 23	S7	110 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4542.9	965.6	5508.5	0.000	0.000	1893.5	43.55	11.46	Ø20/0.125	25.13	2.19	1491.9	34.31	8.80	Ø20/0.125	25.13	2.86	Verifica
P7	al A´ al 23	S7	111 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4542.9	965.6	5508.5	0.000	0.000	1893.5	43.55	11.46	Ø20/0.125	25.13	2.19	1491.9	34.31	8.80	Ø20/0.125	25.13	2.86	Verifica
P7	al A´ al 23	S7	112 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4424.2	965.6	5389.8	0.000	0.000	1852.7	42.61	11.21	Ø20/0.125	25.13	2.24	1459.7	33.57	8.61	Ø20/0.125	25.13	2.92	Verifica
P7	al A´ al 23	S7	113 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4427.4	965.6	5393.0	0.000	0.000	1853.8	42.64	11.22	Ø20/0.125	25.13	2.24	1460.6	33.59	8.61	Ø20/0.125	25.13	2.92	Verifica
P7	al A´ al 23	S7	114 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2738.7	965.6	3704.3	0.000	0.000	1273.4	29.29	7.71	Ø20/0.125	25.13	3.26	1003.2	23.07	5.92	Ø20/0.125	25.13	4.25	Verifica
P7	al A´ al 23	S7	115 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3381.2	965.6	4346.8	0.000	0.000	1494.2	34.37	9.04	Ø20/0.125	25.13	2.78	1177.3	27.08	6.94	Ø20/0.125	25.13	3.62	Verifica
P7	al A´ al 23	S7	116 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2738.7	965.6	3704.3	0.000	0.000	1273.4	29.29	7.71	Ø20/0.125	25.13	3.26	1003.2	23.07	5.92	Ø20/0.125	25.13	4.25	Verifica
P7	al A´ al 23	S7	117 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2738.7	965.6	3704.3	0.000	0.000	1273.4	29.29	7.71	Ø20/0.125	25.13	3.26	1003.2	23.07	5.92	Ø20/0.125	25.13	4.25	Verifica
P7	al A´ al 23	S7	118 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2620.0	965.6	3585.6	0.000	0.000	1232.6	28.35	7.46	Ø20/0.125	25.13	3.37	971.1	22.34	5.73	Ø20/0.125	25.13	4.39	Verifica
P7	al A´ al 23	S7	119 (C)	0.70	1.40	4.00	4.00	1.30	1.20	2623.3	965.6	3588.9	0.000	0.000	1233.7	28.37	7.47	Ø20/0.125	25.13	3.37	972.0	22.36	5.73	Ø20/0.125	25.13	4.38	Verifica
P7	al A´ al 23	S7	120 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3381.2	965.6	4346.8	0.000	0.000	1494.2	34.37	9.04	Ø20/0.125	25.13	2.78	1177.3	27.08	6.94	Ø20/0.125	25.13	3.62	Verifica
P7	al A´ al 23	S7	121 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3381.2	965.6	4346.8	0.000	0.000	1494.2	34.37	9.04	Ø20/0.125	25.13	2.78	1177.3	27.08	6.94	Ø20/0.125	25.13	3.62	Verifica
P7	al A´ al 23	S7	122 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3262.5	965.6	4228.1	0.000	0.000	1453.4	33.43	8.80	Ø20/0.125	25.13	2.86	1145.1	26.34	6.75	Ø20/0.125	25.13	3.72	Verifica
P7	al A´ al 23	S7	123 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3265.7	965.6	4231.3	0.000	0.000	1454.5	33.45	8.80	Ø20/0.125	25.13	2.85	1146.0	26.36	6.76	Ø20/0.125	25.13	3.72	Verifica
P7	al A´ al 23	S7	124 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3576.5	965.6	4542.1	0.000	0.000	1561.3	35.91	9.45	Ø20/0.125	25.13	2.66	1230.2	28.29	7.25	Ø20/0.125	25.13	3.46	Verifica
P7	al A´ al 23	S7	125 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4218.9	965.6	5184.5	0.000	0.000	1782.2	40.99	10.79	Ø20/0.125	25.13	2.33	1404.1	32.30	8.28	Ø20/0.125	25.13	3.03	Verifica
P7	al A´ al 23	S7	126 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3674.5	965.6	4640.1	0.000	0.000	1595.0	36.69	9.65	Ø20/0.125	25.13	2.60	1256.7	28.90	7.41	Ø20/0.125	25.13	3.39	Verifica
P7	al A´ al 23	S7	127 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3576.5	965.6	4542.1	0.000	0.000	1561.3	35.91	9.45	Ø20/0.125	25.13	2.66	1230.2	28.29	7.25	Ø20/0.125	25.13	3.46	Verifica
P7	al A´ al 23	S7	128 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3576.5	965.6	4542.1	0.000	0.000	1561.3	35.91	9.45	Ø20/0.125	25.13	2.66	1230.2	28.29	7.25	Ø20/0.125	25.13	3.46	Verifica
P7	al A´ al 23	S7	129 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3457.7	965.6	4423.3	0.000	0.000	1520.5	34.97	9.20	Ø20/0.125	25.13	2.73	1198.0	27.55	7.06	Ø20/0.125	25.13	3.56	Verifica
P7	al A´ al 23	S7	130 (C)	0.70	1.40	4.00	4.00	1.30	1.20	3461.0	965.6	4426.6	0.000	0.000	1521.6	35.00	9.21	Ø20/0.125	25.13	2.73	1198.9	27.57	7.07	Ø20/0.125	25.13	3.55	Verifica
P7	al A´ al 23	S7	131 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4317.0	965.6	5282.6	0.000	0.000	1815.9	41.77	10.99	Ø20/0.125	25.13	2.29	1430.7	32.91	8.44	Ø20/0.125	25.13	2.98	Verifica
P7	al A´ al 23	S7	132 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4218.9	965.6	5184.5	0.000	0.000	1782.2	40.99	10.79	Ø20/0.125	25.13	2.33	1404.1	32.30	8.28	Ø20/0.125	25.13	3.03	Verifica
P7	al A´ al 23	S7	133 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4218.9	965.6	5184.5	0.000	0.000	1782.2	40.99	10.79	Ø20/0.125	25.13	2.33	1404.1	32.30	8.28	Ø20/0.125	25.13	3.03	Verifica
P7	al A´ al 23	S7	134 (C)	0.70	1.40	4.00	4.00	1.30	1.20	4100.2	965.6	5065.8	0.000	0.000	1741.4	40.05	10.54	Ø20/0.125	25.13	2.38	1372.0	31.56	8.09	Ø20/0.125	25.13	3.11	Verifica
P7	al A´ al 23	S7	135 (C)	0																							

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	Q _{essg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)		(m)		(m)	(kN/m²)		(cm2/m)		(cm2/m)
P7	al A´ al 23	S7	105 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	344	5 508.5			1391.2	0.000	0.000	1.00	430.5	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P7	al A´ al 23	S7	106 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	338	5 410.4			1362.8	0.000	0.000	1.00	423.2	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P7	al A´ al 23	S7	107 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	338	5 410.4			1362.8	0.000	0.000	1.00	423.2	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P7	al A´ al 23	S7	108 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	331	5 291.7			1328.4	0.000	0.000	1.00	414.4	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 23	S7	109 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	331	5 294.9			1329.4	0.000	0.000	1.00	414.6	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 23	S7	110 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	344	5 508.5			1391.2	0.000	0.000	1.00	430.5	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P7	al A´ al 23	S7	111 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	344	5 508.5			1391.2	0.000	0.000	1.00	430.5	1.41	25.13	25.13	0.002	1247.3	2.9	Verifica
P7	al A´ al 23	S7	112 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	337	5 389.8			1356.8	0.000	0.000	1.00	421.7	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 23	S7	113 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	337	5 393.0			1357.7	0.000	0.000	1.00	421.9	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 23	S7	114 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	232	3 704.3			869.0	0.000	0.000	1.00	296.5	1.41	25.13	25.13	0.002	1247.3	4.2	Verifica
P7	al A´ al 23	S7	115 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	272	4 346.8			1054.9	0.000	0.000	1.00	344.2	1.41	25.13	25.13	0.002	1247.3	3.6	Verifica
P7	al A´ al 23	S7	116 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	232	3 704.3			869.0	0.000	0.000	1.00	296.5	1.41	25.13	25.13	0.002	1247.3	4.2	Verifica
P7	al A´ al 23	S7	117 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	232	3 704.3			869.0	0.000	0.000	1.00	296.5	1.41	25.13	25.13	0.002	1247.3	4.2	Verifica
P7	al A´ al 23	S7	118 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	224	3 585.6			834.6	0.000	0.000	1.00	287.6	1.41	25.13	25.13	0.002	1247.3	4.3	Verifica
P7	al A´ al 23	S7	119 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	224	3 588.9			835.6	0.000	0.000	1.00	287.9	1.41	25.13	25.13	0.002	1247.3	4.3	Verifica
P7	al A´ al 23	S7	120 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	272	4 346.8			1054.9	0.000	0.000	1.00	344.2	1.41	25.13	25.13	0.002	1247.3	3.6	Verifica
P7	al A´ al 23	S7	121 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	272	4 346.8			1054.9	0.000	0.000	1.00	344.2	1.41	25.13	25.13	0.002	1247.3	3.6	Verifica
P7	al A´ al 23	S7	122 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	264	4 228.1			1020.6	0.000	0.000	1.00	335.4	1.41	25.13	25.13	0.002	1247.3	3.7	Verifica
P7	al A´ al 23	S7	123 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	264	4 231.3			1021.5	0.000	0.000	1.00	335.6	1.41	25.13	25.13	0.002	1247.3	3.7	Verifica
P7	al A´ al 23	S7	124 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	284	4 542.1			1111.5	0.000	0.000	1.00	358.7	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P7	al A´ al 23	S7	125 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	324	5 184.5			1297.4	0.000	0.000	1.00	406.4	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 23	S7	126 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	290	4 640.1			1139.8	0.000	0.000	1.00	366.0	1.41	25.13	25.13	0.002	1247.3	3.4	Verifica
P7	al A´ al 23	S7	127 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	284	4 542.1			1111.5	0.000	0.000	1.00	358.7	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P7	al A´ al 23	S7	128 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	284	4 542.1			1111.5	0.000	0.000	1.00	358.7	1.41	25.13	25.13	0.002	1247.3	3.5	Verifica
P7	al A´ al 23	S7	129 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	276	4 423.3			1077.1	0.000	0.000	1.00	349.9	1.41	25.13	25.13	0.002	1247.3	3.6	Verifica
P7	al A´ al 23	S7	130 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	277	4 426.6			1078.0	0.000	0.000	1.00	350.1	1.41	25.13	25.13	0.002	1247.3	3.6	Verifica
P7	al A´ al 23	S7	131 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	330	5 282.6			1325.8	0.000	0.000	1.00	413.7	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 23	S7	132 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	324	5 184.5			1297.4	0.000	0.000	1.00	406.4	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 23	S7	133 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	324	5 184.5			1297.4	0.000	0.000	1.00	406.4	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 23	S7	134 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	317	5 065.8			1263.0	0.000	0.000	1.00	397.6	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 23	S7	135 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	317	5 069.1			1264.0	0.000	0.000	1.00	397.9	1.41	25.13	25.13	0.002	1247.3	3.1	Verifica
P7	al A´ al 23	S7	136 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	330	5 282.6			1325.8	0.000	0.000	1.00	413.7	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 23	S7	137 (C)	0.70	1.40	1.30	1.20	1.90	2.60	7.970	4.63	330	5 282.6			1325.8	0.000	0.000	1.00	413.7	1.41	25.13	25.13	0.002	1247.3	3.0	Verifica
P7	al A´ al 23	S7	138 (C)	0.70	1.40	1.30	1.20	1.90	2.60																		

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação da Rotura do Solo de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'	L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m ²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P7	al B al 23	S7	177 (C)	0.70	1.00	3 677.1			3.50	3.50	1.10	487.0	4 164.1	400	0.96	0.000	0.000	3.23	3.23	Verifica	339.9	1.18	Verifica
P7	al B al 23	S7	178 (C)	0.70	1.00	3 846.6			3.50	3.50	1.10	487.0	4 333.6	400	0.98	0.000	0.000	3.29	3.29	Verifica	353.8	1.13	Verifica
P7	al B al 23	S7	179 (C)	0.70	1.00	3 677.1			3.50	3.50	1.10	487.0	4 164.1	400	0.96	0.000	0.000	3.23	3.23	Verifica	339.9	1.18	Verifica
P7	al B al 23	S7	180 (C)	0.70	1.00	3 677.1			3.50	3.50	1.10	487.0	4 164.1	400	0.96	0.000	0.000	3.23	3.23	Verifica	339.9	1.18	Verifica
P7	al B al 23	S7	181 (C)	0.70	1.00	3 661.0			3.50	3.50	1.10	487.0	4 148.0	400	0.96	0.000	0.000	3.22	3.22	Verifica	338.6	1.18	Verifica
P7	al B al 23	S7	182 (C)	0.70	1.00	3 627.6			3.50	3.50	1.10	487.0	4 114.6	400	0.95	0.000	0.000	3.21	3.21	Verifica	335.9	1.19	Verifica
P7	al B al 23	S7	183 (C)	0.70	1.00	3 846.6			3.50	3.50	1.10	487.0	4 333.6	400	0.98	0.000	0.000	3.29	3.29	Verifica	353.8	1.13	Verifica
P7	al B al 23	S7	184 (C)	0.70	1.00	3 846.6			3.50	3.50	1.10	487.0	4 333.6	400	0.98	0.000	0.000	3.29	3.29	Verifica	353.8	1.13	Verifica
P7	al B al 23	S7	185 (C)	0.70	1.00	3 830.5			3.50	3.50	1.10	487.0	4 317.5	400	0.98	0.000	0.000	3.29	3.29	Verifica	352.5	1.13	Verifica
P7	al B al 23	S7	186 (C)	0.70	1.00	3 797.1			3.50	3.50	1.10	487.0	4 284.1	400	0.97	0.000	0.000	3.27	3.27	Verifica	349.7	1.14	Verifica
P7	al B al 23	S7	187 (C)	0.70	1.00	3 108.9			3.50	3.50	1.10	487.0	3 595.9	400	0.89	0.000	0.000	3.00	3.00	Verifica	293.5	1.36	Verifica
P7	al B al 23	S7	188 (C)	0.70	1.00	3 676.1			3.50	3.50	1.10	487.0	4 163.1	400	0.96	0.000	0.000	3.23	3.23	Verifica	339.8	1.18	Verifica
P7	al B al 23	S7	189 (C)	0.70	1.00	3 108.9			3.50	3.50	1.10	487.0	3 595.9	400	0.89	0.000	0.000	3.00	3.00	Verifica	293.5	1.36	Verifica
P7	al B al 23	S7	190 (C)	0.70	1.00	3 108.9			3.50	3.50	1.10	487.0	3 595.9	400	0.89	0.000	0.000	3.00	3.00	Verifica	293.5	1.36	Verifica
P7	al B al 23	S7	191 (C)	0.70	1.00	3 092.8			3.50	3.50	1.10	487.0	3 579.8	400	0.89	0.000	0.000	2.99	2.99	Verifica	292.2	1.37	Verifica
P7	al B al 23	S7	192 (C)	0.70	1.00	3 059.5			3.50	3.50	1.10	487.0	3 546.5	400	0.88	0.000	0.000	2.98	2.98	Verifica	289.5	1.38	Verifica
P7	al B al 23	S7	193 (C)	0.70	1.00	3 676.1			3.50	3.50	1.10	487.0	4 163.1	400	0.96	0.000	0.000	3.23	3.23	Verifica	339.8	1.18	Verifica
P7	al B al 23	S7	194 (C)	0.70	1.00	3 676.1			3.50	3.50	1.10	487.0	4 163.1	400	0.96	0.000	0.000	3.23	3.23	Verifica	339.8	1.18	Verifica
P7	al B al 23	S7	195 (C)	0.70	1.00	3 660.0			3.50	3.50	1.10	487.0	4 147.0	400	0.96	0.000	0.000	3.22	3.22	Verifica	338.5	1.18	Verifica
P7	al B al 23	S7	196 (C)	0.70	1.00	3 626.7			3.50	3.50	1.10	487.0	4 113.7	400	0.95	0.000	0.000	3.21	3.21	Verifica	335.8	1.19	Verifica
P7	al B al 23	S7	197 (C)	0.70	1.00	2 870.8			3.50	3.50	1.10	487.0	3 357.8	400	0.86	0.000	0.000	2.90	2.90	Verifica	274.1	1.46	Verifica
P7	al B al 23	S7	198 (C)	0.70	1.00	3 438.0			3.50	3.50	1.10	487.0	3 925.0	400	0.93	0.000	0.000	3.13	3.13	Verifica	320.4	1.25	Verifica
P7	al B al 23	S7	199 (C)	0.70	1.00	3 040.2			3.50	3.50	1.10	487.0	3 527.2	400	0.88	0.000	0.000	2.97	2.97	Verifica	287.9	1.39	Verifica
P7	al B al 23	S7	200 (C)	0.70	1.00	2 870.8			3.50	3.50	1.10	487.0	3 357.8	400	0.86	0.000	0.000	2.90	2.90	Verifica	274.1	1.46	Verifica
P7	al B al 23	S7	201 (C)	0.70	1.00	2 870.8			3.50	3.50	1.10	487.0	3 357.8	400	0.86	0.000	0.000	2.90	2.90	Verifica	274.1	1.46	Verifica
P7	al B al 23	S7	202 (C)	0.70	1.00	2 854.7			3.50	3.50	1.10	487.0	3 341.7	400	0.86	0.000	0.000	2.89	2.89	Verifica	272.8	1.47	Verifica
P7	al B al 23	S7	203 (C)	0.70	1.00	2 821.3			3.50	3.50	1.10	487.0	3 308.3	400	0.85	0.000	0.000	2.88	2.88	Verifica	270.1	1.48	Verifica
P7	al B al 23	S7	204 (C)	0.70	1.00	3 607.4			3.50	3.50	1.10	487.0	4 094.4	400	0.95	0.000	0.000	3.20	3.20	Verifica	334.2	1.20	Verifica
P7	al B al 23	S7	205 (C)	0.70	1.00	3 438.0			3.50	3.50	1.10	487.0	3 925.0	400	0.93	0.000	0.000	3.13	3.13	Verifica	320.4	1.25	Verifica
P7	al B al 23	S7	206 (C)	0.70	1.00	3 438.0			3.50	3.50	1.10	487.0	3 925.0	400	0.93	0.000	0.000	3.13	3.13	Verifica	320.4	1.25	Verifica
P7	al B al 23	S7	207 (C)	0.70	1.00	3 421.9			3.50	3.50	1.10	487.0	3 908.9	400	0.93	0.000	0.000	3.13	3.13	Verifica	319.1	1.25	Verifica
P7	al B al 23	S7	208 (C)	0.70	1.00	3 388.5			3.50	3.50	1.10	487.0	3 875.5	400	0.92	0.000	0.000	3.11	3.11	Verifica	316.4	1.26	Verifica
P7	al B al 23	S7	209 (C)	0.70	1.00	3 040.2			3.50	3.50	1.10	487.0	3 527.2	400	0.88	0.000	0.000	2.97	2.97	Verifica	287.9	1.39	Verifica
P7	al B al 23	S7	210 (C)	0.70	1.00	3 040.2			3.50	3.50	1.10	487.0	3 527.2	400	0.88	0.000	0.000	2.97	2.97	Verifica	287.9	1.39	Verifica
P7	al B al 23	S7	211 (C)	0.70	1.00	3 024.1			3.50	3.50	1.10	487.0	3 511.1	400	0.88	0.000	0.000	2.96	2.96	Verifica	286.6	1.40	Verifica
P7	al B al 23	S7	212 (C)	0.70	1.00	2 990.8			3.50	3.50	1.10	487.0	3 477.8	400	0.88	0.000	0.000	2.95	2.95	Verifica	283.9	1.41	Verifica
P7	al B al 23	S7	213 (C)	0.70	1.00	3 607.4			3.50	3.50	1.10	487.0	4 094.4	400	0.95	0.000	0.000	3.20	3.20	Verifica	334.2	1.20	Verifica
P7	al B al 23	S7	214 (C)	0.70	1.00	3 607.4			3.50	3.50	1.10	487.0	4 094.4	400	0.95	0.000	0.000	3.20	3.20	Verifica	334.2	1.20	Verifica
P7	al B al 23	S7	215 (C)	0.70	1.00	3 591.3			3.50	3.50	1.10	487.0	4 078.3	400	0.95	0.000							

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/s)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P7	al B al 23	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5339.6	657.5	5997.1	0.000	0.000	2099.0	48.28	14.63	Ø20/0.15	20.93	1.43	1874.1	43.10	12.68	Ø20/0.15	20.93	1.65	Verifica
P7	al B al 23	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5085.3	657.5	5742.8	0.000	0.000	2010.0	46.23	14.01	Ø20/0.15	20.93	1.49	1794.6	41.28	12.14	Ø20/0.15	20.93	1.72	Verifica
P7	al B al 23	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5085.3	657.5	5742.8	0.000	0.000	2010.0	46.23	14.01	Ø20/0.15	20.93	1.49	1794.6	41.28	12.14	Ø20/0.15	20.93	1.72	Verifica
P7	al B al 23	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5061.2	657.5	5718.7	0.000	0.000	2001.5	46.04	13.95	Ø20/0.15	20.93	1.50	1787.1	41.10	12.09	Ø20/0.15	20.93	1.73	Verifica
P7	al B al 23	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5011.1	657.5	5668.6	0.000	0.000	1984.0	45.63	13.83	Ø20/0.15	20.93	1.51	1771.4	40.74	11.98	Ø20/0.15	20.93	1.75	Verifica
P7	al B al 23	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5339.6	657.5	5997.1	0.000	0.000	2099.0	48.28	14.63	Ø20/0.15	20.93	1.43	1874.1	43.10	12.68	Ø20/0.15	20.93	1.65	Verifica
P7	al B al 23	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5339.6	657.5	5997.1	0.000	0.000	2099.0	48.28	14.63	Ø20/0.15	20.93	1.43	1874.1	43.10	12.68	Ø20/0.15	20.93	1.65	Verifica
P7	al B al 23	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5315.4	657.5	5972.9	0.000	0.000	2090.5	48.08	14.57	Ø20/0.15	20.93	1.44	1866.5	42.93	12.63	Ø20/0.15	20.93	1.66	Verifica
P7	al B al 23	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	5265.3	657.5	5922.8	0.000	0.000	2073.0	47.68	14.45	Ø20/0.15	20.93	1.45	1850.9	42.57	12.52	Ø20/0.15	20.93	1.67	Verifica
P7	al B al 23	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3230.0	657.5	3887.5	0.000	0.000	1360.6	31.29	9.48	Ø20/0.15	20.93	2.21	1214.8	27.94	8.22	Ø20/0.15	20.93	2.55	Verifica
P7	al B al 23	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4080.8	657.5	4738.3	0.000	0.000	1658.4	38.14	11.56	Ø20/0.15	20.93	1.81	1480.7	34.06	10.02	Ø20/0.15	20.93	2.09	Verifica
P7	al B al 23	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3230.0	657.5	3887.5	0.000	0.000	1360.6	31.29	9.48	Ø20/0.15	20.93	2.21	1214.8	27.94	8.22	Ø20/0.15	20.93	2.55	Verifica
P7	al B al 23	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3230.0	657.5	3887.5	0.000	0.000	1360.6	31.29	9.48	Ø20/0.15	20.93	2.21	1214.8	27.94	8.22	Ø20/0.15	20.93	2.55	Verifica
P7	al B al 23	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3205.8	657.5	3863.3	0.000	0.000	1352.1	31.10	9.42	Ø20/0.15	20.93	2.22	1207.3	27.77	8.17	Ø20/0.15	20.93	2.56	Verifica
P7	al B al 23	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3155.8	657.5	3813.3	0.000	0.000	1334.6	30.70	9.30	Ø20/0.15	20.93	2.25	1191.7	27.41	8.06	Ø20/0.15	20.93	2.60	Verifica
P7	al B al 23	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4080.8	657.5	4738.3	0.000	0.000	1658.4	38.14	11.56	Ø20/0.15	20.93	1.81	1480.7	34.06	10.02	Ø20/0.15	20.93	2.09	Verifica
P7	al B al 23	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4080.8	657.5	4738.3	0.000	0.000	1658.4	38.14	11.56	Ø20/0.15	20.93	1.81	1480.7	34.06	10.02	Ø20/0.15	20.93	2.09	Verifica
P7	al B al 23	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4056.6	657.5	4714.1	0.000	0.000	1649.9	37.95	11.50	Ø20/0.15	20.93	1.82	1473.2	33.88	9.97	Ø20/0.15	20.93	2.10	Verifica
P7	al B al 23	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4006.6	657.5	4664.1	0.000	0.000	1632.4	37.55	11.38	Ø20/0.15	20.93	1.84	1457.5	33.52	9.86	Ø20/0.15	20.93	2.12	Verifica
P7	al B al 23	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3875.8	657.5	4533.3	0.000	0.000	1586.6	36.49	11.06	Ø20/0.15	20.93	1.89	1416.7	32.58	9.58	Ø20/0.15	20.93	2.18	Verifica
P7	al B al 23	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4726.6	657.5	5384.1	0.000	0.000	1884.4	43.34	13.13	Ø20/0.15	20.93	1.59	1682.5	38.70	11.38	Ø20/0.15	20.93	1.84	Verifica
P7	al B al 23	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4130.0	657.5	4787.5	0.000	0.000	1675.6	38.54	11.68	Ø20/0.15	20.93	1.79	1496.1	34.41	10.12	Ø20/0.15	20.93	2.07	Verifica
P7	al B al 23	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3875.8	657.5	4533.3	0.000	0.000	1586.6	36.49	11.06	Ø20/0.15	20.93	1.89	1416.7	32.58	9.58	Ø20/0.15	20.93	2.18	Verifica
P7	al B al 23	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3875.8	657.5	4533.3	0.000	0.000	1586.6	36.49	11.06	Ø20/0.15	20.93	1.89	1416.7	32.58	9.58	Ø20/0.15	20.93	2.18	Verifica
P7	al B al 23	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3851.6	657.5	4509.1	0.000	0.000	1578.2	36.30	11.00	Ø20/0.15	20.93	1.90	1409.1	32.41	9.53	Ø20/0.15	20.93	2.20	Verifica
P7	al B al 23	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3801.6	657.5	4459.1	0.000	0.000	1560.7	35.90	10.88	Ø20/0.15	20.93	1.92	1393.5	32.05	9.43	Ø20/0.15	20.93	2.22	Verifica
P7	al B al 23	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4980.8	657.5	5638.3	0.000	0.000	1973.4	45.39	13.75	Ø20/0.15	20.93	1.52	1762.0	40.53	11.92	Ø20/0.15	20.93	1.76	Verifica
P7	al B al 23	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4726.6	657.5	5384.1	0.000	0.000	1884.4	43.34	13.13	Ø20/0.15	20.93	1.59	1682.5	38.70	11.38	Ø20/0.15	20.93	1.84	Verifica
P7	al B al 23	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4726.6	657.5	5384.1	0.000	0.000	1884.4	43.34	13.13	Ø20/0.15	20.93	1.59	1682.5	38.70	11.38	Ø20/0.15	20.93	1.84	Verifica
P7	al B al 23	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4702.5	657.5	5360.0	0.000	0.000	1876.0	43.15	13.08	Ø20/0.15	20.93	1.60	1675.0	38.52	11.33	Ø20/0.15	20.93	1.85	Verifica
P7	al B al 23	S7	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00	4652.4																	

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{Ed}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)		(kN/m²)					
P7	al B al 23	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	490	5 997.1			1441.2	0.000	0.000	1.00	696.5	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P7	al B al 23	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	469	5 742.8			1375.1	0.000	0.000	1.00	667.7	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 23	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	469	5 742.8			1375.1	0.000	0.000	1.00	667.7	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 23	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	467	5 718.7			1368.8	0.000	0.000	1.00	665.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 23	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	463	5 668.6			1355.8	0.000	0.000	1.00	659.3	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 23	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	490	5 997.1			1441.2	0.000	0.000	1.00	696.5	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P7	al B al 23	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	490	5 997.1			1441.2	0.000	0.000	1.00	696.5	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P7	al B al 23	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	488	5 972.9			1434.9	0.000	0.000	1.00	693.7	1.45	20.93	20.93	0.002	1281.6	1.8	Verifica
P7	al B al 23	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	483	5 922.8			1421.9	0.000	0.000	1.00	688.0	1.45	20.93	20.93	0.002	1281.6	1.9	Verifica
P7	al B al 23	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	317	3 887.5			892.6	0.000	0.000	1.00	457.8	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica
P7	al B al 23	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	387	4 738.3			1113.8	0.000	0.000	1.00	554.1	1.45	20.93	20.93	0.002	1281.6	2.3	Verifica
P7	al B al 23	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	317	3 887.5			892.6	0.000	0.000	1.00	457.8	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica
P7	al B al 23	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	317	3 887.5			892.6	0.000	0.000	1.00	457.8	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica
P7	al B al 23	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	315	3 863.3			886.3	0.000	0.000	1.00	455.1	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica
P7	al B al 23	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	311	3 813.3			873.3	0.000	0.000	1.00	449.4	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P7	al B al 23	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	387	4 738.3			1113.8	0.000	0.000	1.00	554.1	1.45	20.93	20.93	0.002	1281.6	2.3	Verifica
P7	al B al 23	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	387	4 738.3			1113.8	0.000	0.000	1.00	554.1	1.45	20.93	20.93	0.002	1281.6	2.3	Verifica
P7	al B al 23	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	385	4 714.1			1107.6	0.000	0.000	1.00	551.3	1.45	20.93	20.93	0.002	1281.6	2.3	Verifica
P7	al B al 23	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	381	4 664.1			1094.6	0.000	0.000	1.00	545.7	1.45	20.93	20.93	0.002	1281.6	2.3	Verifica
P7	al B al 23	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	370	4 533.3			1060.5	0.000	0.000	1.00	530.9	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 23	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	440	5 384.1			1281.8	0.000	0.000	1.00	627.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 23	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	391	4 787.5			1126.6	0.000	0.000	1.00	559.6	1.45	20.93	20.93	0.002	1281.6	2.3	Verifica
P7	al B al 23	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	370	4 533.3			1060.5	0.000	0.000	1.00	530.9	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 23	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	370	4 533.3			1060.5	0.000	0.000	1.00	530.9	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 23	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	368	4 509.1			1054.3	0.000	0.000	1.00	528.1	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P7	al B al 23	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	364	4 459.1			1041.2	0.000	0.000	1.00	522.5	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P7	al B al 23	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	460	5 638.3			1347.9	0.000	0.000	1.00	655.9	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 23	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	440	5 384.1			1281.8	0.000	0.000	1.00	627.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 23	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	440	5 384.1			1281.8	0.000	0.000	1.00	627.1	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 23	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	438	5 360.0			1275.5	0.000	0.000	1.00	624.4	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P7	al B al 23	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	433	5 309.9			1262.5	0.000	0.000	1.00	618.7	1.45	20.93	20.93	0.002	1281.6	2.1	Verifica
P7	al B al 23	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	460	5 638.3			1347.9	0.000	0.000	1.00	655.9	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 23	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	460	5 638.3			1347.9	0.000	0.000	1.00	655.9	1.45	20.93	20.93	0.002	1281.6	2.0	Verifica
P7	al B al 23	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	458	5 614.2			1341.6	0.000	0									

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck (MPa)	fcd (MPa)	fctm (MPa)	fyk (MPa)	fyd (MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação da Rotura do Solo de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'	L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m ²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P9	al C al 23	S7	177 (C)	0.70	1.00	2 581.9			3.50	3.50	1.10	487.0	3 068.9	400	0.82	0.000	0.000	2.77	2.77	Verifica	250.5	1.60	Verifica
P9	al C al 23	S7	178 (C)	0.70	1.00	2 807.7			3.50	3.50	1.10	487.0	3 294.7	400	0.85	0.000	0.000	2.87	2.87	Verifica	269.0	1.49	Verifica
P9	al C al 23	S7	179 (C)	0.70	1.00	2 581.9			3.50	3.50	1.10	487.0	3 068.9	400	0.82	0.000	0.000	2.77	2.77	Verifica	250.5	1.60	Verifica
P9	al C al 23	S7	180 (C)	0.70	1.00	2 581.9			3.50	3.50	1.10	487.0	3 068.9	400	0.82	0.000	0.000	2.77	2.77	Verifica	250.5	1.60	Verifica
P9	al C al 23	S7	181 (C)	0.70	1.00	2 582.1			3.50	3.50	1.10	487.0	3 069.1	400	0.82	0.000	0.000	2.77	2.77	Verifica	250.5	1.60	Verifica
P9	al C al 23	S7	182 (C)	0.70	1.00	2 581.8			3.50	3.50	1.10	487.0	3 068.8	400	0.82	0.000	0.000	2.77	2.77	Verifica	250.5	1.60	Verifica
P9	al C al 23	S7	183 (C)	0.70	1.00	2 807.7			3.50	3.50	1.10	487.0	3 294.7	400	0.85	0.000	0.000	2.87	2.87	Verifica	269.0	1.49	Verifica
P9	al C al 23	S7	184 (C)	0.70	1.00	2 807.7			3.50	3.50	1.10	487.0	3 294.7	400	0.85	0.000	0.000	2.87	2.87	Verifica	269.0	1.49	Verifica
P9	al C al 23	S7	185 (C)	0.70	1.00	2 807.9			3.50	3.50	1.10	487.0	3 294.9	400	0.85	0.000	0.000	2.87	2.87	Verifica	269.0	1.49	Verifica
P9	al C al 23	S7	186 (C)	0.70	1.00	2 807.6			3.50	3.50	1.10	487.0	3 294.6	400	0.85	0.000	0.000	2.87	2.87	Verifica	268.9	1.49	Verifica
P9	al C al 23	S7	187 (C)	0.70	1.00	2 448.5			3.50	3.50	1.10	487.0	2 935.5	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.6	1.67	Verifica
P9	al C al 23	S7	188 (C)	0.70	1.00	2 767.7			3.50	3.50	1.10	487.0	3 254.7	400	0.85	0.000	0.000	2.85	2.85	Verifica	265.7	1.51	Verifica
P9	al C al 23	S7	189 (C)	0.70	1.00	2 448.5			3.50	3.50	1.10	487.0	2 935.5	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.6	1.67	Verifica
P9	al C al 23	S7	190 (C)	0.70	1.00	2 448.5			3.50	3.50	1.10	487.0	2 935.5	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.6	1.67	Verifica
P9	al C al 23	S7	191 (C)	0.70	1.00	2 448.7			3.50	3.50	1.10	487.0	2 935.7	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.7	1.67	Verifica
P9	al C al 23	S7	192 (C)	0.70	1.00	2 448.3			3.50	3.50	1.10	487.0	2 935.3	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.6	1.67	Verifica
P9	al C al 23	S7	193 (C)	0.70	1.00	2 767.7			3.50	3.50	1.10	487.0	3 254.7	400	0.85	0.000	0.000	2.85	2.85	Verifica	265.7	1.51	Verifica
P9	al C al 23	S7	194 (C)	0.70	1.00	2 767.7			3.50	3.50	1.10	487.0	3 254.7	400	0.85	0.000	0.000	2.85	2.85	Verifica	265.7	1.51	Verifica
P9	al C al 23	S7	195 (C)	0.70	1.00	2 767.9			3.50	3.50	1.10	487.0	3 254.9	400	0.85	0.000	0.000	2.85	2.85	Verifica	265.7	1.51	Verifica
P9	al C al 23	S7	196 (C)	0.70	1.00	2 767.5			3.50	3.50	1.10	487.0	3 254.5	400	0.85	0.000	0.000	2.85	2.85	Verifica	265.7	1.51	Verifica
P9	al C al 23	S7	197 (C)	0.70	1.00	2 125.8			3.50	3.50	1.10	487.0	2 612.8	400	0.76	0.000	0.000	2.56	2.56	Verifica	213.3	1.88	Verifica
P9	al C al 23	S7	198 (C)	0.70	1.00	2 445.0			3.50	3.50	1.10	487.0	2 932.0	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.3	1.67	Verifica
P9	al C al 23	S7	199 (C)	0.70	1.00	2 351.6			3.50	3.50	1.10	487.0	2 838.6	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.7	1.73	Verifica
P9	al C al 23	S7	200 (C)	0.70	1.00	2 125.8			3.50	3.50	1.10	487.0	2 612.8	400	0.76	0.000	0.000	2.56	2.56	Verifica	213.3	1.88	Verifica
P9	al C al 23	S7	201 (C)	0.70	1.00	2 125.8			3.50	3.50	1.10	487.0	2 612.8	400	0.76	0.000	0.000	2.56	2.56	Verifica	213.3	1.88	Verifica
P9	al C al 23	S7	202 (C)	0.70	1.00	2 126.0			3.50	3.50	1.10	487.0	2 613.0	400	0.76	0.000	0.000	2.56	2.56	Verifica	213.3	1.88	Verifica
P9	al C al 23	S7	203 (C)	0.70	1.00	2 125.6			3.50	3.50	1.10	487.0	2 612.6	400	0.76	0.000	0.000	2.56	2.56	Verifica	213.3	1.88	Verifica
P9	al C al 23	S7	204 (C)	0.70	1.00	2 670.8			3.50	3.50	1.10	487.0	3 157.8	400	0.83	0.000	0.000	2.81	2.81	Verifica	257.8	1.55	Verifica
P9	al C al 23	S7	205 (C)	0.70	1.00	2 445.0			3.50	3.50	1.10	487.0	2 932.0	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.3	1.67	Verifica
P9	al C al 23	S7	206 (C)	0.70	1.00	2 445.0			3.50	3.50	1.10	487.0	2 932.0	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.3	1.67	Verifica
P9	al C al 23	S7	207 (C)	0.70	1.00	2 445.2			3.50	3.50	1.10	487.0	2 932.2	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.4	1.67	Verifica
P9	al C al 23	S7	208 (C)	0.70	1.00	2 444.9			3.50	3.50	1.10	487.0	2 931.9	400	0.80	0.000	0.000	2.71	2.71	Verifica	239.3	1.67	Verifica
P9	al C al 23	S7	209 (C)	0.70	1.00	2 351.6			3.50	3.50	1.10	487.0	2 838.6	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.7	1.73	Verifica
P9	al C al 23	S7	210 (C)	0.70	1.00	2 351.6			3.50	3.50	1.10	487.0	2 838.6	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.7	1.73	Verifica
P9	al C al 23	S7	211 (C)	0.70	1.00	2 351.8			3.50	3.50	1.10	487.0	2 838.8	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.7	1.73	Verifica
P9	al C al 23	S7	212 (C)	0.70	1.00	2 351.5			3.50	3.50	1.10	487.0	2 838.5	400	0.79	0.000	0.000	2.66	2.66	Verifica	231.7	1.73	Verifica
P9	al C al 23	S7	213 (C)	0.70	1.00	2 670.8			3.50	3.50	1.10	487.0	3 157.8	400	0.83	0.000	0.000	2.81	2.81	Verifica	257.8	1.55	Verifica
P9	al C al 23	S7	214 (C)	0.70	1.00	2 670.8			3.50	3.50	1.10	487.0	3 157.8	400	0.83	0.000	0.000	2.81	2.81	Verifica	257.8	1.55	Verifica
P9	al C al 23	S7	215 (C)	0.70	1.00	2 671.0			3.50	3.50	1.10	487.0	3 158.0	400									

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	FS
P9	al C al 23	S7	105 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.0	657.5	4549.5	0.000	0.000	1592.3	36.62	11.10	Ø20/0.15	20.93	1.89	1421.7	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 23	S7	106 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3553.3	657.5	4210.8	0.000	0.000	1473.8	33.90	10.27	Ø20/0.15	20.93	2.04	1315.9	30.27	8.90	Ø20/0.15	20.93	2.35	Verifica
P9	al C al 23	S7	107 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3553.3	657.5	4210.8	0.000	0.000	1473.8	33.90	10.27	Ø20/0.15	20.93	2.04	1315.9	30.27	8.90	Ø20/0.15	20.93	2.35	Verifica
P9	al C al 23	S7	108 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3553.7	657.5	4211.2	0.000	0.000	1473.9	33.90	10.27	Ø20/0.15	20.93	2.04	1316.0	30.27	8.90	Ø20/0.15	20.93	2.35	Verifica
P9	al C al 23	S7	109 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3553.1	657.5	4210.6	0.000	0.000	1473.7	33.90	10.27	Ø20/0.15	20.93	2.04	1315.8	30.26	8.90	Ø20/0.15	20.93	2.35	Verifica
P9	al C al 23	S7	110 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.0	657.5	4549.5	0.000	0.000	1592.3	36.62	11.10	Ø20/0.15	20.93	1.89	1421.7	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 23	S7	111 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.0	657.5	4549.5	0.000	0.000	1592.3	36.62	11.10	Ø20/0.15	20.93	1.89	1421.7	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 23	S7	112 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3892.4	657.5	4549.9	0.000	0.000	1592.5	36.63	11.10	Ø20/0.15	20.93	1.89	1421.8	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 23	S7	113 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3891.8	657.5	4549.3	0.000	0.000	1592.2	36.62	11.10	Ø20/0.15	20.93	1.89	1421.7	32.70	9.62	Ø20/0.15	20.93	2.18	Verifica
P9	al C al 23	S7	114 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2609.8	657.5	3267.3	0.000	0.000	1143.5	26.30	7.97	Ø20/0.15	20.93	2.63	1021.0	23.48	6.91	Ø20/0.15	20.93	3.03	Verifica
P9	al C al 23	S7	115 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3088.6	657.5	3746.1	0.000	0.000	1311.1	30.16	9.14	Ø20/0.15	20.93	2.29	1170.7	26.92	7.92	Ø20/0.15	20.93	2.64	Verifica
P9	al C al 23	S7	116 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2609.8	657.5	3267.3	0.000	0.000	1143.5	26.30	7.97	Ø20/0.15	20.93	2.63	1021.0	23.48	6.91	Ø20/0.15	20.93	3.03	Verifica
P9	al C al 23	S7	117 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2609.8	657.5	3267.3	0.000	0.000	1143.5	26.30	7.97	Ø20/0.15	20.93	2.63	1021.0	23.48	6.91	Ø20/0.15	20.93	3.03	Verifica
P9	al C al 23	S7	118 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2610.1	657.5	3267.6	0.000	0.000	1143.7	26.30	7.97	Ø20/0.15	20.93	2.63	1021.1	23.49	6.91	Ø20/0.15	20.93	3.03	Verifica
P9	al C al 23	S7	119 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2609.6	657.5	3267.1	0.000	0.000	1143.5	26.30	7.97	Ø20/0.15	20.93	2.63	1021.0	23.48	6.91	Ø20/0.15	20.93	3.03	Verifica
P9	al C al 23	S7	120 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3088.6	657.5	3746.1	0.000	0.000	1311.1	30.16	9.14	Ø20/0.15	20.93	2.29	1170.7	26.92	7.92	Ø20/0.15	20.93	2.64	Verifica
P9	al C al 23	S7	121 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3088.6	657.5	3746.1	0.000	0.000	1311.1	30.16	9.14	Ø20/0.15	20.93	2.29	1170.7	26.92	7.92	Ø20/0.15	20.93	2.64	Verifica
P9	al C al 23	S7	122 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3088.9	657.5	3746.4	0.000	0.000	1311.2	30.16	9.14	Ø20/0.15	20.93	2.29	1170.7	26.93	7.92	Ø20/0.15	20.93	2.64	Verifica
P9	al C al 23	S7	123 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3088.4	657.5	3745.9	0.000	0.000	1311.1	30.15	9.14	Ø20/0.15	20.93	2.29	1170.6	26.92	7.92	Ø20/0.15	20.93	2.64	Verifica
P9	al C al 23	S7	124 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2869.1	657.5	3526.6	0.000	0.000	1234.3	28.39	8.60	Ø20/0.15	20.93	2.43	1102.1	25.35	7.46	Ø20/0.15	20.93	2.81	Verifica
P9	al C al 23	S7	125 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3347.9	657.5	4005.4	0.000	0.000	1401.9	32.24	9.77	Ø20/0.15	20.93	2.14	1251.7	28.79	8.47	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 23	S7	126 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3207.8	657.5	3865.3	0.000	0.000	1352.8	31.12	9.43	Ø20/0.15	20.93	2.22	1207.9	27.78	8.17	Ø20/0.15	20.93	2.56	Verifica
P9	al C al 23	S7	127 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2869.1	657.5	3526.6	0.000	0.000	1234.3	28.39	8.60	Ø20/0.15	20.93	2.43	1102.1	25.35	7.46	Ø20/0.15	20.93	2.81	Verifica
P9	al C al 23	S7	128 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2869.1	657.5	3526.6	0.000	0.000	1234.3	28.39	8.60	Ø20/0.15	20.93	2.43	1102.1	25.35	7.46	Ø20/0.15	20.93	2.81	Verifica
P9	al C al 23	S7	129 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2869.5	657.5	3527.0	0.000	0.000	1234.4	28.39	8.60	Ø20/0.15	20.93	2.43	1102.2	25.35	7.46	Ø20/0.15	20.93	2.81	Verifica
P9	al C al 23	S7	130 (C)	0.70	1.00	3.50	3.50	1.10	1.00	2868.9	657.5	3526.4	0.000	0.000	1234.2	28.39	8.60	Ø20/0.15	20.93	2.43	1102.0	25.35	7.45	Ø20/0.15	20.93	2.81	Verifica
P9	al C al 23	S7	131 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3686.7	657.5	4344.2	0.000	0.000	1520.5	34.97	10.60	Ø20/0.15	20.93	1.98	1357.6	31.22	9.18	Ø20/0.15	20.93	2.28	Verifica
P9	al C al 23	S7	132 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3347.9	657.5	4005.4	0.000	0.000	1401.9	32.24	9.77	Ø20/0.15	20.93	2.14	1251.7	28.79	8.47	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 23	S7	133 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3347.9	657.5	4005.4	0.000	0.000	1401.9	32.24	9.77	Ø20/0.15	20.93	2.14	1251.7	28.79	8.47	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 23	S7	134 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3348.3	657.5	4005.8	0.000	0.000	1402.0	32.25	9.77	Ø20/0.15	20.93	2.14	1251.8	28.79	8.47	Ø20/0.15	20.93	2.47	Verifica
P9	al C al 23	S7	135 (C)	0.70	1.00	3.50	3.50	1.10	1.00	3347.7	657.5	4005.2															

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{Ed}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)		(kN/m²)	FS		V _{Ed} ≤ V _{Rd}		
P9	al C al 23	S7	105 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.5			1064.8	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 23	S7	106 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	344	4 210.8			976.7	0.000	0.000	1.00	494.4	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica
P9	al C al 23	S7	107 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	344	4 210.8			976.7	0.000	0.000	1.00	494.4	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica
P9	al C al 23	S7	108 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	344	4 211.2			976.8	0.000	0.000	1.00	494.4	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica
P9	al C al 23	S7	109 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	344	4 210.6			976.6	0.000	0.000	1.00	494.4	1.45	20.93	20.93	0.002	1281.6	2.6	Verifica
P9	al C al 23	S7	110 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.5			1064.8	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 23	S7	111 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.5			1064.8	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 23	S7	112 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.9			1064.9	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 23	S7	113 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	371	4 549.3			1064.7	0.000	0.000	1.00	532.7	1.45	20.93	20.93	0.002	1281.6	2.4	Verifica
P9	al C al 23	S7	114 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	267	3 267.3			731.3	0.000	0.000	1.00	387.7	1.45	20.93	20.93	0.002	1281.6	3.3	Verifica
P9	al C al 23	S7	115 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	306	3 746.1			855.8	0.000	0.000	1.00	441.8	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 23	S7	116 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	267	3 267.3			731.3	0.000	0.000	1.00	387.7	1.45	20.93	20.93	0.002	1281.6	3.3	Verifica
P9	al C al 23	S7	117 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	267	3 267.3			731.3	0.000	0.000	1.00	387.7	1.45	20.93	20.93	0.002	1281.6	3.3	Verifica
P9	al C al 23	S7	118 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	267	3 267.6			731.4	0.000	0.000	1.00	387.7	1.45	20.93	20.93	0.002	1281.6	3.3	Verifica
P9	al C al 23	S7	119 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	267	3 267.1			731.3	0.000	0.000	1.00	387.6	1.45	20.93	20.93	0.002	1281.6	3.3	Verifica
P9	al C al 23	S7	120 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	306	3 746.1			855.8	0.000	0.000	1.00	441.8	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 23	S7	121 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	306	3 746.1			855.8	0.000	0.000	1.00	441.8	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 23	S7	122 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	306	3 746.4			855.9	0.000	0.000	1.00	441.9	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 23	S7	123 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	306	3 745.9			855.8	0.000	0.000	1.00	441.8	1.45	20.93	20.93	0.002	1281.6	2.9	Verifica
P9	al C al 23	S7	124 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	288	3 526.6			798.8	0.000	0.000	1.00	417.0	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 23	S7	125 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	327	4 005.4			923.3	0.000	0.000	1.00	471.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 23	S7	126 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	316	3 865.3			886.8	0.000	0.000	1.00	455.3	1.45	20.93	20.93	0.002	1281.6	2.8	Verifica
P9	al C al 23	S7	127 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	288	3 526.6			798.8	0.000	0.000	1.00	417.0	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 23	S7	128 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	288	3 526.6			798.8	0.000	0.000	1.00	417.0	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 23	S7	129 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	288	3 527.0			798.9	0.000	0.000	1.00	417.0	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 23	S7	130 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	288	3 526.4			798.7	0.000	0.000	1.00	417.0	1.45	20.93	20.93	0.002	1281.6	3.1	Verifica
P9	al C al 23	S7	131 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	355	4 344.2			1011.4	0.000	0.000	1.00	509.5	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 23	S7	132 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	327	4 005.4			923.3	0.000	0.000	1.00	471.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 23	S7	133 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	327	4 005.4			923.3	0.000	0.000	1.00	471.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 23	S7	134 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	327	4 005.8			923.4	0.000	0.000	1.00	471.2	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 23	S7	135 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	327	4 005.2			923.2	0.000	0.000	1.00	471.1	1.45	20.93	20.93	0.002	1281.6	2.7	Verifica
P9	al C al 23	S7	136 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	355	4 344.2			1011.4	0.000	0.000	1.00	509.5	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 23	S7	137 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	355	4 344.2			1011.4	0.000	0.000	1.00	509.5	1.45	20.93	20.93	0.002	1281.6	2.5	Verifica
P9	al C al 23	S7	138 (C)	0.70	1.00	1.10	1.00	1.70	2.00	6.542	3.19	355	4 344.5			10110											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 24 - Verificação da Rotura do Solo de Fundação																							
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'	L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)			
P12	al B al 24a-24b	S1	177 (C)	0.90	1.70	4 878.4			4.50	5.50	1.30	1106.2	5 984.6	400	1.15	0.000	0.000	3.87	3.87	Verifica	241.8	1.65	Verifica
P12	al B al 24a-24b	S1	178 (C)	0.90	1.70	5 029.0			4.50	5.50	1.30	1106.2	6 135.2	400	1.16	0.000	0.000	3.92	3.92	Verifica	247.9	1.61	Verifica
P12	al B al 24a-24b	S1	179 (C)	0.90	1.70	4 878.4			4.50	5.50	1.30	1106.2	5 984.6	400	1.15	0.000	0.000	3.87	3.87	Verifica	241.8	1.65	Verifica
P12	al B al 24a-24b	S1	180 (C)	0.90	1.70	4 878.4			4.50	5.50	1.30	1106.2	5 984.6	400	1.15	0.000	0.000	3.87	3.87	Verifica	241.8	1.65	Verifica
P12	al B al 24a-24b	S1	181 (C)	0.90	1.70	4 818.6			4.50	5.50	1.30	1106.2	5 924.8	400	1.14	0.000	0.000	3.85	3.85	Verifica	239.4	1.67	Verifica
P12	al B al 24a-24b	S1	182 (C)	0.90	1.70	4 807.0			4.50	5.50	1.30	1106.2	5 913.2	400	1.14	0.000	0.000	3.84	3.84	Verifica	238.9	1.67	Verifica
P12	al B al 24a-24b	S1	183 (C)	0.90	1.70	5 029.0			4.50	5.50	1.30	1106.2	6 135.2	400	1.16	0.000	0.000	3.92	3.92	Verifica	247.9	1.61	Verifica
P12	al B al 24a-24b	S1	184 (C)	0.90	1.70	5 029.0			4.50	5.50	1.30	1106.2	6 135.2	400	1.16	0.000	0.000	3.92	3.92	Verifica	247.9	1.61	Verifica
P12	al B al 24a-24b	S1	185 (C)	0.90	1.70	4 969.2			4.50	5.50	1.30	1106.2	6 075.4	400	1.16	0.000	0.000	3.90	3.90	Verifica	245.5	1.63	Verifica
P12	al B al 24a-24b	S1	186 (C)	0.90	1.70	4 957.6			4.50	5.50	1.30	1106.2	6 063.8	400	1.16	0.000	0.000	3.89	3.89	Verifica	245.0	1.63	Verifica
P12	al B al 24a-24b	S1	187 (C)	0.90	1.70	4 062.8			4.50	5.50	1.30	1106.2	5 169.0	400	1.07	0.000	0.000	3.59	3.59	Verifica	208.8	1.92	Verifica
P12	al B al 24a-24b	S1	188 (C)	0.90	1.70	4 784.4			4.50	5.50	1.30	1106.2	5 890.6	400	1.14	0.000	0.000	3.84	3.84	Verifica	238.0	1.68	Verifica
P12	al B al 24a-24b	S1	189 (C)	0.90	1.70	4 062.8			4.50	5.50	1.30	1106.2	5 169.0	400	1.07	0.000	0.000	3.59	3.59	Verifica	208.8	1.92	Verifica
P12	al B al 24a-24b	S1	190 (C)	0.90	1.70	4 062.8			4.50	5.50	1.30	1106.2	5 169.0	400	1.07	0.000	0.000	3.59	3.59	Verifica	208.8	1.92	Verifica
P12	al B al 24a-24b	S1	191 (C)	0.90	1.70	4 002.8			4.50	5.50	1.30	1106.2	5 109.0	400	1.06	0.000	0.000	3.57	3.57	Verifica	206.4	1.94	Verifica
P12	al B al 24a-24b	S1	192 (C)	0.90	1.70	3 991.4			4.50	5.50	1.30	1106.2	5 097.6	400	1.06	0.000	0.000	3.57	3.57	Verifica	206.0	1.94	Verifica
P12	al B al 24a-24b	S1	193 (C)	0.90	1.70	4 784.4			4.50	5.50	1.30	1106.2	5 890.6	400	1.14	0.000	0.000	3.84	3.84	Verifica	238.0	1.68	Verifica
P12	al B al 24a-24b	S1	194 (C)	0.90	1.70	4 784.4			4.50	5.50	1.30	1106.2	5 890.6	400	1.14	0.000	0.000	3.84	3.84	Verifica	238.0	1.68	Verifica
P12	al B al 24a-24b	S1	195 (C)	0.90	1.70	4 724.4			4.50	5.50	1.30	1106.2	5 830.6	400	1.13	0.000	0.000	3.82	3.82	Verifica	235.6	1.70	Verifica
P12	al B al 24a-24b	S1	196 (C)	0.90	1.70	4 712.8			4.50	5.50	1.30	1106.2	5 819.0	400	1.13	0.000	0.000	3.81	3.81	Verifica	235.1	1.70	Verifica
P12	al B al 24a-24b	S1	197 (C)	0.90	1.70	3 858.2			4.50	5.50	1.30	1106.2	4 964.4	400	1.05	0.000	0.000	3.52	3.52	Verifica	200.6	1.99	Verifica
P12	al B al 24a-24b	S1	198 (C)	0.90	1.70	4 579.8			4.50	5.50	1.30	1106.2	5 686.0	400	1.12	0.000	0.000	3.77	3.77	Verifica	229.7	1.74	Verifica
P12	al B al 24a-24b	S1	199 (C)	0.90	1.70	4 008.8			4.50	5.50	1.30	1106.2	5 115.0	400	1.06	0.000	0.000	3.58	3.58	Verifica	206.7	1.94	Verifica
P12	al B al 24a-24b	S1	200 (C)	0.90	1.70	3 858.2			4.50	5.50	1.30	1106.2	4 964.4	400	1.05	0.000	0.000	3.52	3.52	Verifica	200.6	1.99	Verifica
P12	al B al 24a-24b	S1	201 (C)	0.90	1.70	3 858.2			4.50	5.50	1.30	1106.2	4 964.4	400	1.05	0.000	0.000	3.52	3.52	Verifica	200.6	1.99	Verifica
P12	al B al 24a-24b	S1	202 (C)	0.90	1.70	3 798.4			4.50	5.50	1.30	1106.2	4 904.6	400	1.04	0.000	0.000	3.50	3.50	Verifica	198.2	2.02	Verifica
P12	al B al 24a-24b	S1	203 (C)	0.90	1.70	3 786.8			4.50	5.50	1.30	1106.2	4 893.0	400	1.04	0.000	0.000	3.50	3.50	Verifica	197.7	2.02	Verifica
P12	al B al 24a-24b	S1	204 (C)	0.90	1.70	4 730.4			4.50	5.50	1.30	1106.2	5 836.6	400	1.13	0.000	0.000	3.82	3.82	Verifica	235.8	1.70	Verifica
P12	al B al 24a-24b	S1	205 (C)	0.90	1.70	4 579.8			4.50	5.50	1.30	1106.2	5 686.0	400	1.12	0.000	0.000	3.77	3.77	Verifica	229.7	1.74	Verifica
P12	al B al 24a-24b	S1	206 (C)	0.90	1.70	4 579.8			4.50	5.50	1.30	1106.2	5 686.0	400	1.12	0.000	0.000	3.77	3.77	Verifica	229.7	1.74	Verifica
P12	al B al 24a-24b	S1	207 (C)	0.90	1.70	4 519.8			4.50	5.50	1.30	1106.2	5 626.0	400	1.11	0.000	0.000	3.75	3.75	Verifica	227.3	1.76	Verifica
P12	al B al 24a-24b	S1	208 (C)	0.90	1.70	4 508.4			4.50	5.50	1.30	1106.2	5 614.6	400	1.11	0.000	0.000	3.75	3.75	Verifica	226.9	1.76	Verifica
P12	al B al 24a-24b	S1	209 (C)	0.90	1.70	4 008.8			4.50	5.50	1.30	1106.2	5 115.0	400	1.06	0.000	0.000	3.58	3.58	Verifica	206.7	1.94	Verifica
P12	al B al 24a-24b	S1	210 (C)	0.90	1.70	4 008.8			4.50	5.50	1.30	1106.2	5 115.0	400	1.06	0.000	0.000	3.58	3.58	Verifica	206.7	1.94	Verifica
P12	al B al 24a-24b	S1	211 (C)	0.90	1.70	3 949.0			4.50	5.50	1.30	1106.2	5 055.2	400	1.06	0.000	0.000	3.56	3.56	Verifica	204.3	1.96	Verifica
P12	al B al 24a-24b	S1	212 (C)	0.90	1.70	3 937.4			4.50	5.50	1.30	1106.2	5 043.6	400	1.05	0.000	0.000	3.55	3.55	Verifica	203.8	1.96	Verifica
P12	al B al 24a-24b	S1	213 (C)	0.90	1.70	4 730.4			4.50	5.50	1.30	1106.2	5 836.6	400	1.13	0.000	0.000	3.82	3.82	Verifica	235.8		

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 24 - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
															(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	
P12	al B al 24a-24b	S1	105 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 976.0	1493.4	8469.4	0.000	0.000	3176.0	73.05	13.78	Ø25/0.15	32.72	2.37	3352.5	77.11	17.52	Ø25/0.15	32.72	1.87	Verifica
P12	al B al 24a-24b	S1	106 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 750.2	1493.4	8243.6	0.000	0.000	3091.4	71.10	13.42	Ø25/0.15	32.72	2.44	3263.1	75.05	17.06	Ø25/0.15	32.72	1.92	Verifica
P12	al B al 24a-24b	S1	107 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 750.2	1493.4	8243.6	0.000	0.000	3091.4	71.10	13.42	Ø25/0.15	32.72	2.44	3263.1	75.05	17.06	Ø25/0.15	32.72	1.92	Verifica
P12	al B al 24a-24b	S1	108 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 660.2	1493.4	8153.6	0.000	0.000	3057.6	70.32	13.27	Ø25/0.15	32.72	2.47	3227.5	74.23	16.87	Ø25/0.15	32.72	1.94	Verifica
P12	al B al 24a-24b	S1	109 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 643.0	1493.4	8136.4	0.000	0.000	3051.2	70.18	13.24	Ø25/0.15	32.72	2.47	3220.7	74.08	16.84	Ø25/0.15	32.72	1.94	Verifica
P12	al B al 24a-24b	S1	110 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 976.0	1493.4	8469.4	0.000	0.000	3176.0	73.05	13.78	Ø25/0.15	32.72	2.37	3352.5	77.11	17.52	Ø25/0.15	32.72	1.87	Verifica
P12	al B al 24a-24b	S1	111 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 976.0	1493.4	8469.4	0.000	0.000	3176.0	73.05	13.78	Ø25/0.15	32.72	2.37	3352.5	77.11	17.52	Ø25/0.15	32.72	1.87	Verifica
P12	al B al 24a-24b	S1	112 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 886.2	1493.4	8379.6	0.000	0.000	3142.4	72.27	13.64	Ø25/0.15	32.72	2.40	3316.9	76.29	17.34	Ø25/0.15	32.72	1.89	Verifica
P12	al B al 24a-24b	S1	113 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 868.8	1493.4	8362.2	0.000	0.000	3135.8	72.12	13.61	Ø25/0.15	32.72	2.40	3310.0	76.13	17.30	Ø25/0.15	32.72	1.89	Verifica
P12	al B al 24a-24b	S1	114 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 170.4	1493.4	5663.8	0.000	0.000	2123.9	48.85	9.22	Ø25/0.15	32.72	3.55	2241.9	51.56	11.72	Ø25/0.15	32.72	2.79	Verifica
P12	al B al 24a-24b	S1	115 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 252.8	1493.4	6746.2	0.000	0.000	2529.8	58.19	10.98	Ø25/0.15	32.72	2.98	2670.4	61.42	13.96	Ø25/0.15	32.72	2.34	Verifica
P12	al B al 24a-24b	S1	116 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 170.4	1493.4	5663.8	0.000	0.000	2123.9	48.85	9.22	Ø25/0.15	32.72	3.55	2241.9	51.56	11.72	Ø25/0.15	32.72	2.79	Verifica
P12	al B al 24a-24b	S1	117 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 170.4	1493.4	5663.8	0.000	0.000	2123.9	48.85	9.22	Ø25/0.15	32.72	3.55	2241.9	51.56	11.72	Ø25/0.15	32.72	2.79	Verifica
P12	al B al 24a-24b	S1	118 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 080.4	1493.4	5573.8	0.000	0.000	2090.2	48.07	9.07	Ø25/0.15	32.72	3.61	2206.3	50.74	11.53	Ø25/0.15	32.72	2.84	Verifica
P12	al B al 24a-24b	S1	119 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 063.2	1493.4	5556.6	0.000	0.000	2083.7	47.93	9.04	Ø25/0.15	32.72	3.62	2199.5	50.59	11.50	Ø25/0.15	32.72	2.85	Verifica
P12	al B al 24a-24b	S1	120 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 252.8	1493.4	6746.2	0.000	0.000	2529.8	58.19	10.98	Ø25/0.15	32.72	2.98	2670.4	61.42	13.96	Ø25/0.15	32.72	2.34	Verifica
P12	al B al 24a-24b	S1	121 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 252.8	1493.4	6746.2	0.000	0.000	2529.8	58.19	10.98	Ø25/0.15	32.72	2.98	2670.4	61.42	13.96	Ø25/0.15	32.72	2.34	Verifica
P12	al B al 24a-24b	S1	122 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 162.8	1493.4	6656.2	0.000	0.000	2496.1	57.41	10.83	Ø25/0.15	32.72	3.02	2634.8	60.60	13.77	Ø25/0.15	32.72	2.38	Verifica
P12	al B al 24a-24b	S1	123 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 145.4	1493.4	6638.8	0.000	0.000	2489.6	57.26	10.80	Ø25/0.15	32.72	3.03	2627.9	60.44	13.74	Ø25/0.15	32.72	2.38	Verifica
P12	al B al 24a-24b	S1	124 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 220.0	1493.4	6713.4	0.000	0.000	2517.5	57.90	10.93	Ø25/0.15	32.72	2.99	2657.4	61.12	13.89	Ø25/0.15	32.72	2.36	Verifica
P12	al B al 24a-24b	S1	125 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 302.2	1493.4	7795.6	0.000	0.000	2923.4	67.24	12.69	Ø25/0.15	32.72	2.58	3085.8	70.97	16.13	Ø25/0.15	32.72	2.03	Verifica
P12	al B al 24a-24b	S1	126 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 445.8	1493.4	6939.2	0.000	0.000	2602.2	59.85	11.29	Ø25/0.15	32.72	2.90	2746.8	63.18	14.36	Ø25/0.15	32.72	2.28	Verifica
P12	al B al 24a-24b	S1	127 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 220.0	1493.4	6713.4	0.000	0.000	2517.5	57.90	10.93	Ø25/0.15	32.72	2.99	2657.4	61.12	13.89	Ø25/0.15	32.72	2.36	Verifica
P12	al B al 24a-24b	S1	128 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 220.0	1493.4	6713.4	0.000	0.000	2517.5	57.90	10.93	Ø25/0.15	32.72	2.99	2657.4	61.12	13.89	Ø25/0.15	32.72	2.36	Verifica
P12	al B al 24a-24b	S1	129 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 130.0	1493.4	6623.4	0.000	0.000	2483.8	57.13	10.78	Ø25/0.15	32.72	3.04	2621.8	60.30	13.70	Ø25/0.15	32.72	2.39	Verifica
P12	al B al 24a-24b	S1	130 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 112.6	1493.4	6606.0	0.000	0.000	2477.3	56.98	10.75	Ø25/0.15	32.72	3.04	2614.9	60.14	13.67	Ø25/0.15	32.72	2.39	Verifica
P12	al B al 24a-24b	S1	131 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 528.2	1493.4	8021.6	0.000	0.000	3008.1	69.19	13.05	Ø25/0.15	32.72	2.51	3175.2	73.03	16.60	Ø25/0.15	32.72	1.97	Verifica
P12	al B al 24a-24b	S1	132 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 302.2	1493.4	7795.6	0.000	0.000	2923.4	67.24	12.69	Ø25/0.15	32.72	2.58	3085.8	70.97	16.13	Ø25/0.15	32.72	2.03	Verifica
P12	al B al 24a-24b	S1	133 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 302.2	1493.4	7795.6	0.000	0.000	2923.4	67.24	12.69	Ø25/0.15	32.72	2.58	3085.8	70.97	16.13	Ø25/0.15	32.72	2.03	Verifica
P12	al B al 24a-24b	S1	134 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 212.2	1493.4	7															

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 24 - Verificação Estado Limite Último de Punçoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{seg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	ρl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(cm2/m)	(cm2/m)		(kN/m²)	V _{Ed} ≤ V _{Rd}						
P12	al B al 24a-24b	S1	105 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	342	8 469.4			1724.6	0.000	0.000	1.00	626.6	1.41	32.72	32.72	0.003	1362.0	2.2	Verifica
P12	al B al 24a-24b	S1	106 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	333	8 243.6			1671.9	0.000	0.000	1.00	610.5	1.41	32.72	32.72	0.003	1362.0	2.2	Verifica
P12	al B al 24a-24b	S1	107 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	333	8 243.6			1671.9	0.000	0.000	1.00	610.5	1.41	32.72	32.72	0.003	1362.0	2.2	Verifica
P12	al B al 24a-24b	S1	108 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	329	8 153.6			1650.8	0.000	0.000	1.00	604.1	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al B al 24a-24b	S1	109 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	329	8 136.4			1646.8	0.000	0.000	1.00	602.9	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al B al 24a-24b	S1	110 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	342	8 469.4			1724.6	0.000	0.000	1.00	626.6	1.41	32.72	32.72	0.003	1362.0	2.2	Verifica
P12	al B al 24a-24b	S1	111 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	342	8 469.4			1724.6	0.000	0.000	1.00	626.6	1.41	32.72	32.72	0.003	1362.0	2.2	Verifica
P12	al B al 24a-24b	S1	112 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	339	8 379.6			1703.6	0.000	0.000	1.00	620.2	1.41	32.72	32.72	0.003	1362.0	2.2	Verifica
P12	al B al 24a-24b	S1	113 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	338	8 362.2			1699.6	0.000	0.000	1.00	619.0	1.41	32.72	32.72	0.003	1362.0	2.2	Verifica
P12	al B al 24a-24b	S1	114 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	229	5 663.8			1069.3	0.000	0.000	1.00	426.8	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al B al 24a-24b	S1	115 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	273	6 746.2			1322.1	0.000	0.000	1.00	503.9	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	116 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	229	5 663.8			1069.3	0.000	0.000	1.00	426.8	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al B al 24a-24b	S1	117 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	229	5 663.8			1069.3	0.000	0.000	1.00	426.8	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al B al 24a-24b	S1	118 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	225	5 573.8			1048.3	0.000	0.000	1.00	420.4	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al B al 24a-24b	S1	119 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	225	5 556.6			1044.2	0.000	0.000	1.00	419.2	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al B al 24a-24b	S1	120 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	273	6 746.2			1322.1	0.000	0.000	1.00	503.9	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	121 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	273	6 746.2			1322.1	0.000	0.000	1.00	503.9	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	122 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	269	6 656.2			1301.1	0.000	0.000	1.00	497.5	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	123 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	268	6 638.8			1297.0	0.000	0.000	1.00	496.3	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	124 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	271	6 713.4			1314.4	0.000	0.000	1.00	501.6	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	125 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	315	7 795.6			1567.2	0.000	0.000	1.00	578.6	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al B al 24a-24b	S1	126 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	280	6 939.2			1367.2	0.000	0.000	1.00	517.7	1.41	32.72	32.72	0.003	1362.0	2.6	Verifica
P12	al B al 24a-24b	S1	127 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	271	6 713.4			1314.4	0.000	0.000	1.00	501.6	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	128 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	271	6 713.4			1314.4	0.000	0.000	1.00	501.6	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al B al 24a-24b	S1	129 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	268	6 623.4			1293.4	0.000	0.000	1.00	495.2	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al B al 24a-24b	S1	130 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	267	6 606.0			1289.4	0.000	0.000	1.00	493.9	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al B al 24a-24b	S1	131 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	324	8 021.6			1620.0	0.000	0.000	1.00	594.7	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al B al 24a-24b	S1	132 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	315	7 795.6			1567.2	0.000	0.000	1.00	578.6	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al B al 24a-24b	S1	133 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	315	7 795.6			1567.2	0.000	0.000	1.00	578.6	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al B al 24a-24b	S1	134 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	311	7 705.6			1546.2	0.000	0.000	1.00	572.2	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al B al 24a-24b	S1	135 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	311	7 688.4			1542.2	0.000	0.000	1.00	571.0	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al B al 24a-24b	S1	136 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	324	8 021.6			1620.0	0.000	0.000	1.00	594.7	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al B al 24a-24b	S1	137 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	324	8 021.6			1620.0											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 24a - Verificação da Rotura do Solo de Fundação																								
PILAR	Eixos	Sapata	Caso	b	l	N	MX	MY	Bpj	Lpj	Hproj	Terra +massame+P psap	N1	q _{seg}	Hmin	ex	ey	B'		L'	Rigidey	σ	FS	Obs
				(m)	(m)	(kN)	(kNm)	(kNm)	(m)	(m)	(m)	(kN)	(kN/m²)	(m)	(m)	(m)	(m)	(m)	Y	(kPa)				
P12	al C al 24a-24b	S6	177 (C)	0.90	1.70	4 558.6			4.50	5.50	1.30	1106.2	5 664.8	400	1.12	0.000	0.000	3.76		3.76	Verifica	228.9	1.75	Verifica
P12	al C al 24a-24b	S6	178 (C)	0.90	1.70	4 742.4			4.50	5.50	1.30	1106.2	5 848.6	400	1.14	0.000	0.000	3.82		3.82	Verifica	236.3	1.69	Verifica
P12	al C al 24a-24b	S6	179 (C)	0.90	1.70	4 558.6			4.50	5.50	1.30	1106.2	5 664.8	400	1.12	0.000	0.000	3.76		3.76	Verifica	228.9	1.75	Verifica
P12	al C al 24a-24b	S6	180 (C)	0.90	1.70	4 558.6			4.50	5.50	1.30	1106.2	5 664.8	400	1.12	0.000	0.000	3.76		3.76	Verifica	228.9	1.75	Verifica
P12	al C al 24a-24b	S6	181 (C)	0.90	1.70	4 520.4			4.50	5.50	1.30	1106.2	5 626.6	400	1.11	0.000	0.000	3.75		3.75	Verifica	227.3	1.76	Verifica
P12	al C al 24a-24b	S6	182 (C)	0.90	1.70	4 524.6			4.50	5.50	1.30	1106.2	5 630.8	400	1.11	0.000	0.000	3.75		3.75	Verifica	227.5	1.76	Verifica
P12	al C al 24a-24b	S6	183 (C)	0.90	1.70	4 742.4			4.50	5.50	1.30	1106.2	5 848.6	400	1.14	0.000	0.000	3.82		3.82	Verifica	236.3	1.69	Verifica
P12	al C al 24a-24b	S6	184 (C)	0.90	1.70	4 742.4			4.50	5.50	1.30	1106.2	5 848.6	400	1.14	0.000	0.000	3.82		3.82	Verifica	236.3	1.69	Verifica
P12	al C al 24a-24b	S6	185 (C)	0.90	1.70	4 704.2			4.50	5.50	1.30	1106.2	5 810.4	400	1.13	0.000	0.000	3.81		3.81	Verifica	234.8	1.70	Verifica
P12	al C al 24a-24b	S6	186 (C)	0.90	1.70	4 708.4			4.50	5.50	1.30	1106.2	5 814.6	400	1.13	0.000	0.000	3.81		3.81	Verifica	234.9	1.70	Verifica
P12	al C al 24a-24b	S6	187 (C)	0.90	1.70	3 988.4			4.50	5.50	1.30	1106.2	5 094.6	400	1.06	0.000	0.000	3.57		3.57	Verifica	205.8	1.94	Verifica
P12	al C al 24a-24b	S6	188 (C)	0.90	1.70	4 571.2			4.50	5.50	1.30	1106.2	5 677.4	400	1.12	0.000	0.000	3.77		3.77	Verifica	229.4	1.74	Verifica
P12	al C al 24a-24b	S6	189 (C)	0.90	1.70	3 988.4			4.50	5.50	1.30	1106.2	5 094.6	400	1.06	0.000	0.000	3.57		3.57	Verifica	205.8	1.94	Verifica
P12	al C al 24a-24b	S6	190 (C)	0.90	1.70	3 988.4			4.50	5.50	1.30	1106.2	5 094.6	400	1.06	0.000	0.000	3.57		3.57	Verifica	205.8	1.94	Verifica
P12	al C al 24a-24b	S6	191 (C)	0.90	1.70	3 950.2			4.50	5.50	1.30	1106.2	5 056.4	400	1.06	0.000	0.000	3.56		3.56	Verifica	204.3	1.96	Verifica
P12	al C al 24a-24b	S6	192 (C)	0.90	1.70	3 954.4			4.50	5.50	1.30	1106.2	5 060.6	400	1.06	0.000	0.000	3.56		3.56	Verifica	204.5	1.96	Verifica
P12	al C al 24a-24b	S6	193 (C)	0.90	1.70	4 571.2			4.50	5.50	1.30	1106.2	5 677.4	400	1.12	0.000	0.000	3.77		3.77	Verifica	229.4	1.74	Verifica
P12	al C al 24a-24b	S6	194 (C)	0.90	1.70	4 571.2			4.50	5.50	1.30	1106.2	5 677.4	400	1.12	0.000	0.000	3.77		3.77	Verifica	229.4	1.74	Verifica
P12	al C al 24a-24b	S6	195 (C)	0.90	1.70	4 533.2			4.50	5.50	1.30	1106.2	5 639.4	400	1.12	0.000	0.000	3.75		3.75	Verifica	227.9	1.76	Verifica
P12	al C al 24a-24b	S6	196 (C)	0.90	1.70	4 537.4			4.50	5.50	1.30	1106.2	5 643.6	400	1.12	0.000	0.000	3.76		3.76	Verifica	228.0	1.75	Verifica
P12	al C al 24a-24b	S6	197 (C)	0.90	1.70	3 726.6			4.50	5.50	1.30	1106.2	4 832.8	400	1.03	0.000	0.000	3.48		3.48	Verifica	195.3	2.05	Verifica
P12	al C al 24a-24b	S6	198 (C)	0.90	1.70	4 309.6			4.50	5.50	1.30	1106.2	5 415.8	400	1.09	0.000	0.000	3.68		3.68	Verifica	218.8	1.83	Verifica
P12	al C al 24a-24b	S6	199 (C)	0.90	1.70	3 910.4			4.50	5.50	1.30	1106.2	5 016.6	400	1.05	0.000	0.000	3.54		3.54	Verifica	202.7	1.97	Verifica
P12	al C al 24a-24b	S6	200 (C)	0.90	1.70	3 726.6			4.50	5.50	1.30	1106.2	4 832.8	400	1.03	0.000	0.000	3.48		3.48	Verifica	195.3	2.05	Verifica
P12	al C al 24a-24b	S6	201 (C)	0.90	1.70	3 726.6			4.50	5.50	1.30	1106.2	4 832.8	400	1.03	0.000	0.000	3.48		3.48	Verifica	195.3	2.05	Verifica
P12	al C al 24a-24b	S6	202 (C)	0.90	1.70	3 688.4			4.50	5.50	1.30	1106.2	4 794.6	400	1.03	0.000	0.000	3.46		3.46	Verifica	193.7	2.06	Verifica
P12	al C al 24a-24b	S6	203 (C)	0.90	1.70	3 692.8			4.50	5.50	1.30	1106.2	4 799.0	400	1.03	0.000	0.000	3.46		3.46	Verifica	193.9	2.06	Verifica
P12	al C al 24a-24b	S6	204 (C)	0.90	1.70	4 493.2			4.50	5.50	1.30	1106.2	5 599.4	400	1.11	0.000	0.000	3.74		3.74	Verifica	226.2	1.77	Verifica
P12	al C al 24a-24b	S6	205 (C)	0.90	1.70	4 309.6			4.50	5.50	1.30	1106.2	5 415.8	400	1.09	0.000	0.000	3.68		3.68	Verifica	218.8	1.83	Verifica
P12	al C al 24a-24b	S6	206 (C)	0.90	1.70	4 309.6			4.50	5.50	1.30	1106.2	5 415.8	400	1.09	0.000	0.000	3.68		3.68	Verifica	218.8	1.83	Verifica
P12	al C al 24a-24b	S6	207 (C)	0.90	1.70	4 271.4			4.50	5.50	1.30	1106.2	5 377.6	400	1.09	0.000	0.000	3.67		3.67	Verifica	217.3	1.84	Verifica
P12	al C al 24a-24b	S6	208 (C)	0.90	1.70	4 275.6			4.50	5.50	1.30	1106.2	5 381.8	400	1.09	0.000	0.000	3.67		3.67	Verifica	217.4	1.84	Verifica
P12	al C al 24a-24b	S6	209 (C)	0.90	1.70	3 910.4			4.50	5.50	1.30	1106.2	5 016.6	400	1.05	0.000	0.000	3.54		3.54	Verifica	202.7	1.97	Verifica
P12	al C al 24a-24b	S6	210 (C)	0.90	1.70	3 910.4			4.50	5.50	1.30	1106.2	5 016.6	400	1.05	0.000	0.000	3.54		3.54	Verifica	202.7	1.97	Verifica
P12	al C al 24a-24b	S6	211 (C)	0.90	1.70	3 872.2			4.50	5.50	1.30	1106.2	4 978.4	400	1.05	0.000	0.000	3.53		3.53	Verifica	201.1	1.99	Verifica
P12	al C al 24a-24b	S6	212 (C)	0.90	1.70	3 876.4			4.50	5.50	1.30	1106.2	4 982.6	400	1.05	0.000	0.000	3.53		3.53	Verifica	201.3	1.99	Verifica
P12	al C al 24a-24b	S6	213 (C)	0.90																				

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 24a - Verificação de Armaduras																											
Pilar	Nó	Sapata	Caso	b	l	B	L	H	d	NEd	Terra +massame+P psap	NEd,1	ex	ey	Direcção XX					Direcção YY					Obs		
				(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(kN)	(m)	(m)	Ft	As	As,cal/s	Ø	As,ef/s	FS	Ft	As	As/s	Ø		As,ef/s	FS
															(kN)	(cm2)	(cm2/m)	(mm)/m	(cm2/m)		(kN)	(cm2)	(cm2/m)	(mm)/m		(cm2/m)	
P12	al C al 24a-24b	S6	105 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 564.6	1493.4	8058.0	0.000	0.000	3021.8	69.50	13.11	Ø25/0.15	32.72	2.50	3189.6	73.36	16.67	Ø25/0.15	32.72	1.96	Verifica
P12	al C al 24a-24b	S6	106 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 288.8	1493.4	7782.2	0.000	0.000	2918.3	67.12	12.66	Ø25/0.15	32.72	2.58	3080.5	70.85	16.10	Ø25/0.15	32.72	2.03	Verifica
P12	al C al 24a-24b	S6	107 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 288.8	1493.4	7782.2	0.000	0.000	2918.3	67.12	12.66	Ø25/0.15	32.72	2.58	3080.5	70.85	16.10	Ø25/0.15	32.72	2.03	Verifica
P12	al C al 24a-24b	S6	108 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 231.6	1493.4	7725.0	0.000	0.000	2896.9	66.63	12.57	Ø25/0.15	32.72	2.60	3057.8	70.33	15.98	Ø25/0.15	32.72	2.05	Verifica
P12	al C al 24a-24b	S6	109 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 238.0	1493.4	7731.4	0.000	0.000	2899.3	66.68	12.58	Ø25/0.15	32.72	2.60	3060.4	70.39	16.00	Ø25/0.15	32.72	2.05	Verifica
P12	al C al 24a-24b	S6	110 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 564.6	1493.4	8058.0	0.000	0.000	3021.8	69.50	13.11	Ø25/0.15	32.72	2.50	3189.6	73.36	16.67	Ø25/0.15	32.72	1.96	Verifica
P12	al C al 24a-24b	S6	111 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 564.6	1493.4	8058.0	0.000	0.000	3021.8	69.50	13.11	Ø25/0.15	32.72	2.50	3189.6	73.36	16.67	Ø25/0.15	32.72	1.96	Verifica
P12	al C al 24a-24b	S6	112 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 507.4	1493.4	8000.8	0.000	0.000	3000.3	69.01	13.02	Ø25/0.15	32.72	2.51	3167.0	72.84	16.55	Ø25/0.15	32.72	1.98	Verifica
P12	al C al 24a-24b	S6	113 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 513.6	1493.4	8007.0	0.000	0.000	3002.6	69.06	13.03	Ø25/0.15	32.72	2.51	3169.4	72.90	16.57	Ø25/0.15	32.72	1.97	Verifica
P12	al C al 24a-24b	S6	114 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 119.6	1493.4	5613.0	0.000	0.000	2104.9	48.41	9.13	Ø25/0.15	32.72	3.58	2221.8	51.10	11.61	Ø25/0.15	32.72	2.82	Verifica
P12	al C al 24a-24b	S6	115 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 994.0	1493.4	6487.4	0.000	0.000	2432.8	55.95	10.56	Ø25/0.15	32.72	3.10	2567.9	59.06	13.42	Ø25/0.15	32.72	2.44	Verifica
P12	al C al 24a-24b	S6	116 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 119.6	1493.4	5613.0	0.000	0.000	2104.9	48.41	9.13	Ø25/0.15	32.72	3.58	2221.8	51.10	11.61	Ø25/0.15	32.72	2.82	Verifica
P12	al C al 24a-24b	S6	117 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 119.6	1493.4	5613.0	0.000	0.000	2104.9	48.41	9.13	Ø25/0.15	32.72	3.58	2221.8	51.10	11.61	Ø25/0.15	32.72	2.82	Verifica
P12	al C al 24a-24b	S6	118 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 062.4	1493.4	5555.8	0.000	0.000	2083.4	47.92	9.04	Ø25/0.15	32.72	3.62	2199.2	50.58	11.50	Ø25/0.15	32.72	2.85	Verifica
P12	al C al 24a-24b	S6	119 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 068.8	1493.4	5562.2	0.000	0.000	2085.8	47.97	9.05	Ø25/0.15	32.72	3.61	2201.7	50.64	11.51	Ø25/0.15	32.72	2.84	Verifica
P12	al C al 24a-24b	S6	120 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 994.0	1493.4	6487.4	0.000	0.000	2432.8	55.95	10.56	Ø25/0.15	32.72	3.10	2567.9	59.06	13.42	Ø25/0.15	32.72	2.44	Verifica
P12	al C al 24a-24b	S6	121 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 994.0	1493.4	6487.4	0.000	0.000	2432.8	55.95	10.56	Ø25/0.15	32.72	3.10	2567.9	59.06	13.42	Ø25/0.15	32.72	2.44	Verifica
P12	al C al 24a-24b	S6	122 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 936.8	1493.4	6430.2	0.000	0.000	2411.3	55.46	10.46	Ø25/0.15	32.72	3.13	2545.3	58.54	13.30	Ø25/0.15	32.72	2.46	Verifica
P12	al C al 24a-24b	S6	123 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 943.2	1493.4	6436.6	0.000	0.000	2413.7	55.52	10.47	Ø25/0.15	32.72	3.12	2547.8	58.60	13.32	Ø25/0.15	32.72	2.46	Verifica
P12	al C al 24a-24b	S6	124 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 041.0	1493.4	6534.4	0.000	0.000	2450.4	56.36	10.63	Ø25/0.15	32.72	3.08	2586.5	59.49	13.52	Ø25/0.15	32.72	2.42	Verifica
P12	al C al 24a-24b	S6	125 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 915.2	1493.4	7408.6	0.000	0.000	2778.2	63.90	12.06	Ø25/0.15	32.72	2.71	2932.6	67.45	15.33	Ø25/0.15	32.72	2.13	Verifica
P12	al C al 24a-24b	S6	126 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 316.6	1493.4	6810.0	0.000	0.000	2553.8	58.74	11.08	Ø25/0.15	32.72	2.95	2695.6	62.00	14.09	Ø25/0.15	32.72	2.32	Verifica
P12	al C al 24a-24b	S6	127 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 041.0	1493.4	6534.4	0.000	0.000	2450.4	56.36	10.63	Ø25/0.15	32.72	3.08	2586.5	59.49	13.52	Ø25/0.15	32.72	2.42	Verifica
P12	al C al 24a-24b	S6	128 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 041.0	1493.4	6534.4	0.000	0.000	2450.4	56.36	10.63	Ø25/0.15	32.72	3.08	2586.5	59.49	13.52	Ø25/0.15	32.72	2.42	Verifica
P12	al C al 24a-24b	S6	129 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 983.8	1493.4	6477.2	0.000	0.000	2429.0	55.87	10.54	Ø25/0.15	32.72	3.10	2563.9	58.97	13.40	Ø25/0.15	32.72	2.44	Verifica
P12	al C al 24a-24b	S6	130 (C)	0.90	1.70	4.50	5.50	1.30	1.20	4 990.0	1493.4	6483.4	0.000	0.000	2431.3	55.92	10.55	Ø25/0.15	32.72	3.10	2566.4	59.03	13.42	Ø25/0.15	32.72	2.44	Verifica
P12	al C al 24a-24b	S6	131 (C)	0.90	1.70	4.50	5.50	1.30	1.20	6 191.0	1493.4	7684.4	0.000	0.000	2881.7	66.28	12.51	Ø25/0.15	32.72	2.62	3041.7	69.96	15.90	Ø25/0.15	32.72	2.06	Verifica
P12	al C al 24a-24b	S6	132 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 915.2	1493.4	7408.6	0.000	0.000	2778.2	63.90	12.06	Ø25/0.15	32.72	2.71	2932.6	67.45	15.33	Ø25/0.15	32.72	2.13	Verifica
P12	al C al 24a-24b	S6	133 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 915.2	1493.4	7408.6	0.000	0.000	2778.2	63.90	12.06	Ø25/0.15	32.72	2.71	2932.6	67.45	15.33	Ø25/0.15	32.72	2.13	Verifica
P12	al C al 24a-24b	S6	134 (C)	0.90	1.70	4.50	5.50	1.30	1.20	5 858.0	1493.4																

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS ISOLADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 24a - Verificação Estado Limite Último de Punçãoamento																											
Pilar	Nó	Sapata	Caso	b	l	Hproj	d	bx	by	u1	Ao	q _{seg}	V _{Ed}	MX	MY	ΔV _{Ed,red}	ex	ey	β	V _{Ed}	k	As,X	As,Y	pl	V _{Rd}	FS	Obs.
				(m)	(m)	(m)	(m)	(m)	(m2)	(kN/m²)	(kN)	(kNm)	(kNm)	(kN)	(m)	(m)	(kN/m²)	(cm2/m)		(cm2/m)	(kN/m²)						
P12	al C al 24a-24b	S6	105 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	326	8 058.0			1628.5	0.000	0.000	1.00	597.3	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al C al 24a-24b	S6	106 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	314	7 782.2			1564.1	0.000	0.000	1.00	577.7	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al C al 24a-24b	S6	107 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	314	7 782.2			1564.1	0.000	0.000	1.00	577.7	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al C al 24a-24b	S6	108 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	312	7 725.0			1550.7	0.000	0.000	1.00	573.6	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al C al 24a-24b	S6	109 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	312	7 731.4			1552.2	0.000	0.000	1.00	574.1	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al C al 24a-24b	S6	110 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	326	8 058.0			1628.5	0.000	0.000	1.00	597.3	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al C al 24a-24b	S6	111 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	326	8 058.0			1628.5	0.000	0.000	1.00	597.3	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al C al 24a-24b	S6	112 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	323	8 000.8			1615.1	0.000	0.000	1.00	593.2	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al C al 24a-24b	S6	113 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	324	8 007.0			1616.6	0.000	0.000	1.00	593.7	1.41	32.72	32.72	0.003	1362.0	2.3	Verifica
P12	al C al 24a-24b	S6	114 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	227	5 613.0			1057.4	0.000	0.000	1.00	423.2	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al C al 24a-24b	S6	115 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	262	6 487.4			1261.7	0.000	0.000	1.00	485.5	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	116 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	227	5 613.0			1057.4	0.000	0.000	1.00	423.2	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al C al 24a-24b	S6	117 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	227	5 613.0			1057.4	0.000	0.000	1.00	423.2	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al C al 24a-24b	S6	118 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	224	5 555.8			1044.1	0.000	0.000	1.00	419.2	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al C al 24a-24b	S6	119 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	225	5 562.2			1045.6	0.000	0.000	1.00	419.6	1.41	32.72	32.72	0.003	1362.0	3.2	Verifica
P12	al C al 24a-24b	S6	120 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	262	6 487.4			1261.7	0.000	0.000	1.00	485.5	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	121 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	262	6 487.4			1261.7	0.000	0.000	1.00	485.5	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	122 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	260	6 430.2			1248.3	0.000	0.000	1.00	481.4	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	123 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	260	6 436.6			1249.8	0.000	0.000	1.00	481.9	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	124 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	264	6 534.4			1272.6	0.000	0.000	1.00	488.8	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	125 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	299	7 408.6			1476.8	0.000	0.000	1.00	551.1	1.41	32.72	32.72	0.003	1362.0	2.5	Verifica
P12	al C al 24a-24b	S6	126 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	275	6 810.0			1337.0	0.000	0.000	1.00	508.5	1.41	32.72	32.72	0.003	1362.0	2.7	Verifica
P12	al C al 24a-24b	S6	127 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	264	6 534.4			1272.6	0.000	0.000	1.00	488.8	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	128 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	264	6 534.4			1272.6	0.000	0.000	1.00	488.8	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	129 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	262	6 477.2			1259.3	0.000	0.000	1.00	484.8	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	130 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	262	6 483.4			1260.7	0.000	0.000	1.00	485.2	1.41	32.72	32.72	0.003	1362.0	2.8	Verifica
P12	al C al 24a-24b	S6	131 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	310	7 684.4			1541.2	0.000	0.000	1.00	570.7	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al C al 24a-24b	S6	132 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	299	7 408.6			1476.8	0.000	0.000	1.00	551.1	1.41	32.72	32.72	0.003	1362.0	2.5	Verifica
P12	al C al 24a-24b	S6	133 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	299	7 408.6			1476.8	0.000	0.000	1.00	551.1	1.41	32.72	32.72	0.003	1362.0	2.5	Verifica
P12	al C al 24a-24b	S6	134 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	297	7 351.4			1463.5	0.000	0.000	1.00	547.0	1.41	32.72	32.72	0.003	1362.0	2.5	Verifica
P12	al C al 24a-24b	S6	135 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	297	7 357.8			1465.0	0.000	0.000	1.00	547.5	1.41	32.72	32.72	0.003	1362.0	2.5	Verifica
P12	al C al 24a-24b	S6	136 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	310	7 684.4			1541.2	0.000	0.000	1.00	570.7	1.41	32.72	32.72	0.003	1362.0	2.4	Verifica
P12	al C al 24a-24b	S6	137 (C)	0.90	1.70	1.30	1.20	2.10	2.90	8.970	5.78	310	7 684.4			1541.2	0.000	0.000									

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 16 - Verificação da Rótura do Solo de Fundação																													
Sapata	PILAR	Eixos	b ₁₀	l ₅	PILAR	Eixos	b ₅	l ₅	Caso	N ₁₀	N ₅	C ₁	l	B ₁₁	L ₁₁	C ₂	H ₁₀₀	Pp=Terra +massame+P pass	N(P1+P2)+P p	x	e	L ⁺	H ₁₀₀	Rigidez	Q _{ult}	Q _{ult}	FS		
			(m)	(m)			(m)	(m)		(kN)	(kN)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(m)	(m)	(m)	(m)	(m)	(kPa)	(kPa)		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	177 (C)	1260.9	4 108.00	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 231.2	3.34	0.187	6.63	0.95	Verifica	293.8	400	1.36		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	178 (C)	1273.9	4 262.40	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 398.6	3.36	0.206	6.59	0.95	Verifica	303.5	400	1.32		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	179 (C)	1260.8	4 107.90	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 230.9	3.34	0.187	6.63	0.95	Verifica	293.8	400	1.36		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	180 (C)	1255.3	4 105.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 222.9	3.34	0.189	6.62	0.95	Verifica	293.7	400	1.36		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	181 (C)	1238.5	4 088.00	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 188.8	3.35	0.195	6.61	0.95	Verifica	292.6	400	1.37		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	182 (C)	1297.9	4 148.40	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 308.6	3.32	0.174	6.65	0.95	Verifica	296.4	400	1.35		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	183 (C)	1273.7	4 262.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 398.3	3.36	0.206	6.59	0.95	Verifica	303.5	400	1.32		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	184 (C)	1268.3	4 259.70	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 390.2	3.36	0.208	6.58	0.95	Verifica	303.3	400	1.32		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	185 (C)	1251.5	4 242.40	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 356.2	3.36	0.214	6.57	0.95	Verifica	302.2	400	1.32		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	186 (C)	1310.9	4 302.80	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 475.9	3.34	0.193	6.61	0.95	Verifica	296.5	400	1.31		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	187 (C)	957.9	3 497.50	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 317.6	3.40	0.255	6.49	0.95	Verifica	256.0	400	1.56		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	188 (C)	1183.0	4 079.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 124.5	3.37	0.224	6.55	0.95	Verifica	292.1	400	1.37		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	189 (C)	957.7	3 497.40	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 317.4	3.40	0.255	6.49	0.95	Verifica	256.0	400	1.56		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	190 (C)	862.2	3 484.80	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 308.3	3.41	0.258	6.48	0.95	Verifica	255.9	400	1.56		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	191 (C)	935.4	3 477.50	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 275.2	3.42	0.265	6.47	0.95	Verifica	254.8	400	1.57		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	192 (C)	994.9	3 537.90	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 395.0	3.39	0.239	6.52	0.95	Verifica	258.5	400	1.55		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	193 (C)	1162.8	4 079.20	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 124.3	3.37	0.224	6.55	0.95	Verifica	292.1	400	1.37		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	194 (C)	1177.3	4 076.60	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 116.2	3.38	0.227	6.55	0.95	Verifica	292.0	400	1.37		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	195 (C)	1160.6	4 059.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 082.2	3.38	0.233	6.53	0.95	Verifica	290.9	400	1.38		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	196 (C)	1220.0	4 119.60	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 201.8	3.36	0.211	6.58	0.95	Verifica	294.5	400	1.36		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	197 (C)	939.5	3 276.60	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 078.4	3.37	0.224	6.55	0.95	Verifica	242.2	400	1.65		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	198 (C)	1164.6	3 858.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 885.2	3.35	0.196	6.61	0.95	Verifica	278.3	400	1.44		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	199 (C)	952.5	3 431.00	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 245.8	3.40	0.246	6.51	0.95	Verifica	251.9	400	1.59		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	200 (C)	939.3	3 276.50	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 078.1	3.37	0.224	6.55	0.95	Verifica	242.2	400	1.65		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	201 (C)	933.8	3 273.90	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 070.0	3.38	0.227	6.55	0.95	Verifica	242.0	400	1.65		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	202 (C)	917.1	3 256.50	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 035.8	3.38	0.235	6.53	0.95	Verifica	241.0	400	1.66		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	203 (C)	976.5	3 316.90	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 155.6	3.36	0.208	6.58	0.95	Verifica	244.7	400	1.63		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	204 (C)	1177.6	4 012.70	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 052.6	3.37	0.216	6.57	0.95	Verifica	288.0	400	1.39		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	205 (C)	1164.4	3 858.20	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 884.9	3.35	0.196	6.61	0.95	Verifica	278.3	400	1.44		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	206 (C)	1159.0	3 855.60	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 876.8	3.35	0.199	6.60	0.95	Verifica	278.2	400	1.44		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	207 (C)	1142.2	3 838.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 842.8	3.36	0.205	6.59	0.95	Verifica	277.1	400	1.44		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	208 (C)	1201.6	3 898.70	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 962.6	3.33	0.183	6.63	0.95	Verifica	280.8	400	1.42		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	209 (C)	952.3	3 430.90	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 245.5	3.40	0.246	6.51	0.95	Verifica	251.9	400	1.59		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	210 (C)	946.8	3 428.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 237.4	3.40	0.249	6.50	0.95	Verifica	251.7	400	1.59		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	211 (C)	930.1	3 410.90	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 203.3	3.41	0.256	6.49	0.95	Verifica	250.6	400	1.60		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	212 (C)	989.5	3 471.30	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 323.1	3.38	0.230	6.54	0.95	Verifica	254.3	400	1.57		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	213 (C)	1177.4	4 012.60	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 052.3	3.37	0.216	6.57	0.95	Verifica	288.0	400	1.39		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	214 (C)	1172.0	4 010.00	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 044.2	3.37	0.219	6.56	0.95	Verifica	287.8	400	1.39		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	215 (C)	1155.2	3 992.70	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 010.1	3.37	0.225	6.55	0.95	Verifica	286.7	400	1.39		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	216 (C)	1214.8	4 053.10	0.00	4.40	3.20	7.00	2.25	1.20	862.3	6 126.9	3.35	0.202	6.60	0.95	Verifica	290.5	400	1.38		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	217 (C)	939.0	3 276.80	0.00	4.40	3.20	7.00	2.25	1.20	862.3	5 078.2	3.39	0.224	6.55	0.95	Verifica	242.3	400	1.65		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	218 (C)	1164.1	3 858.50	0.00	4.40	3.20	7.00	2.													

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

[illegible]

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)				Aço (A500 NR)			
fck	fcd	fctm	fyk	fyk	fyd		
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)		
30	20.0	2.9	500	500	435		

Alinhamento 16 - Verificação Estado Limite Último de Punçãoamento																																							
Sapata	Pilar	Nº	b ₁ (m)	l ₁ (m)	PILAR	Eixos	b ₁ (m)	l ₁ (m)	H (m)	d (m)	Caso	N _{desl.} (kN)	by13 (m)	bz13 (m)	u1 (m)	Ao (m²)	q _{desl.} (kN/m²)	A _{As,desl.} (cm²)	V _{desl.} (kN)	k	As.X (cm²/m)	As.Y (cm²/m)	pl	v _{desl.} (kN/m²)	FS	N _{desl.} (kN)	by22 (m)	bz22 (m)	u1 (m)	Ao (m²)	q _{desl.} (kN/m²)	A _{As,desl.} (cm²)	V _{desl.} (kN)	k	As.X (cm²/m)	As.Y (cm²/m)	pl	v _{desl.} (kN/m²)	FS
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	105 (C)	1770.07	2.00	1.80	3.528	0.0	456.1	1.43	25.13	20.94	0.0021	630.8	1.4	5900.5	2.00	1.80	6.656	3.34	410	1268.5	632.7	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	106 (C)	1750.27	2.00	1.80	3.528	0.0	451.0	1.43	25.13	20.94	0.0021	630.8	1.4	5668.7	2.00	1.80	6.656	3.34	394	1214.7	608.4	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	107 (C)	1742.10	2.00	1.80	3.528	0.0	448.9	1.43	25.13	20.94	0.0021	630.8	1.4	5668.3	2.00	1.80	6.656	3.34	393	1210.9	608.4	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	108 (C)	1716.93	2.00	1.80	3.528	0.0	442.4	1.43	25.13	20.94	0.0021	630.8	1.4	5638.8	2.00	1.80	6.656	3.34	392	1207.8	605.2	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	109 (C)	1806.00	2.00	1.80	3.528	0.0	465.4	1.43	25.13	20.94	0.0021	630.8	1.4	5729.5	2.00	1.80	6.656	3.34	398	1228.8	614.7	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	110 (C)	1769.80	2.00	1.80	3.528	0.0	456.1	1.43	25.13	20.94	0.0021	630.8	1.4	5900.2	2.00	1.80	6.656	3.34	410	1268.4	632.6	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	111 (C)	1761.57	2.00	1.80	3.528	0.0	453.9	1.43	25.13	20.94	0.0021	630.8	1.4	5896.3	2.00	1.80	6.656	3.34	409	1267.5	632.2	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	112 (C)	1736.40	2.00	1.80	3.528	0.0	447.4	1.43	25.13	20.94	0.0021	630.8	1.4	5870.4	2.00	1.80	6.656	3.34	408	1261.5	629.5	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	113 (C)	1825.53	2.00	1.80	3.528	0.0	470.4	1.43	25.13	20.94	0.0021	630.8	1.3	5961.1	2.00	1.80	6.656	3.34	414	1282.6	639.0	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	114 (C)	1867.13	2.00	1.80	3.528	0.0	482.2	1.43	25.13	20.94	0.0021	630.8	2.5	3807.8	2.00	1.80	6.656	3.34	251	736.7	392.2	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	115 (C)	1304.87	2.00	1.80	3.528	0.0	336.2	1.43	25.13	20.94	0.0021	630.8	1.9	4480.4	2.00	1.80	6.656	3.34	311	938.1	483.7	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	116 (C)	966.87	2.00	1.80	3.528	0.0	249.1	1.43	25.13	20.94	0.0021	630.8	2.5	3807.6	2.00	1.80	6.656	3.34	251	736.6	392.1	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	117 (C)	958.67	2.00	1.80	3.528	0.0	247.0	1.43	25.13	20.94	0.0021	630.8	2.6	3633.7	2.00	1.80	6.656	3.34	250	735.7	391.7	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	118 (C)	933.50	2.00	1.80	3.528	0.0	240.6	1.43	25.13	20.94	0.0021	630.8	2.6	3577.7	2.00	1.80	6.656	3.34	248	729.7	389.0	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	119 (C)	1022.63	2.00	1.80	3.528	0.0	263.5	1.43	25.13	20.94	0.0021	630.8	2.4	3668.4	2.00	1.80	6.656	3.34	255	750.7	398.5	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	120 (C)	1304.57	2.00	1.80	3.528	0.0	336.2	1.43	25.13	20.94	0.0021	630.8	1.9	4480.2	2.00	1.80	6.656	3.34	311	938.1	483.7	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	121 (C)	1296.37	2.00	1.80	3.528	0.0	334.1	1.43	25.13	20.94	0.0021	630.8	1.9	4476.3	2.00	1.80	6.656	3.34	311	938.1	483.3	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	122 (C)	1271.20	2.00	1.80	3.528	0.0	327.6	1.43	25.13	20.94	0.0021	630.8	1.9	4450.4	2.00	1.80	6.656	3.34	309	932.1	480.5	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	123 (C)	1360.30	2.00	1.80	3.528	0.0	350.5	1.43	25.13	20.94	0.0021	630.8	1.8	4541.0	2.00	1.80	6.656	3.34	315	953.2	490.1	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	124 (C)	1268.40	2.00	1.80	3.528	0.0	326.9	1.43	25.13	20.94	0.0021	630.8	1.9	4421.7	2.00	1.80	6.656	3.34	307	925.5	477.5	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	125 (C)	1606.13	2.00	1.80	3.528	0.0	413.9	1.43	25.13	20.94	0.0021	630.8	1.5	5294.3	2.00	1.80	6.656	3.34	368	1127.9	569.1	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	126 (C)	1287.90	2.00	1.80	3.528	0.0	331.9	1.43	25.13	20.94	0.0021	630.8	1.9	4653.3	2.00	1.80	6.656	3.34	323	979.2	501.8	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	127 (C)	1268.13	2.00	1.80	3.528	0.0	326.8	1.43	25.13	20.94	0.0021	630.8	1.9	4421.5	2.00	1.80	6.656	3.34	307	925.4	477.5	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	128 (C)	1259.90	2.00	1.80	3.528	0.0	324.7	1.43	25.13	20.94	0.0021	630.8	1.9	4417.5	2.00	1.80	6.656	3.34	307	924.5	477.1	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	129 (C)	1234.77	2.00	1.80	3.528	0.0	318.2	1.43	25.13	20.94	0.0021	630.8	2.0	4391.6	2.00	1.80	6.656	3.34	305	918.5	474.4	1.43	25.13	20.94	0.0021	1261.6	2.7		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	130 (C)	1233.90	2.00	1.80	3.528	0.0	317.2	1.43	25.13	20.94	0.0021	630.8	1.9	4482.2	2.00	1.80	6.656	3.34	311	939.5	483.9	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	131 (C)	1625.60	2.00	1.80	3.528	0.0	418.9	1.43	25.13	20.94	0.0021	630.8	1.5	5255.9	2.00	1.80	6.656	3.34	384	1181.6	593.4	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	132 (C)	1605.83	2.00	1.80	3.528	0.0	413.8	1.43	25.13	20.94	0.0021	630.8	1.5	5294.1	2.00	1.80	6.656	3.34	368	1127.8	569.1	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P13	al E al 16	0.90	0.70	P12	al D al 16	0.90	0.70	1.20	1.10	133 (C)	1597.63	2.00	1.80	3.528	0.0	411.7	1.43	25.13	20.94	0.0021	630.8																	

Betão (C30/37)			Aço (A500 NR)		
fck	fcld	ftcm	fyk	fyd	
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	
30	20.0	2.9	500	435	

Alinhamento 17 - Verificação da Rotura do Solo de Fundação																											
Sapata	PILAR	Eixos	b ₁₂	l ₁₀	PILAR	Eixos	b ₉	l ₅	Caso	N ₁₂		c ₁	l	B ₁₂	L ₁₂	c ₂	H ₁₂	Pp=Terra +massame+P _{psap}	N(P1+P2)+P _p	x	e	L'	H ₁₀₀	Rigidez	Q _{ult}	Q _{usq}	FS
										(kN)	(kN)																
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	177 (C)	512.0	4427.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 802.8	3.83	0.676	5.65	0.88	Verifica	321.1	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	178 (C)	533.6	4624.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 020.9	3.83	0.681	5.64	0.88	Verifica	333.7	400	1.20
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	179 (C)	512.0	4427.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 802.8	3.83	0.676	5.65	0.88	Verifica	321.1	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	180 (C)	512.0	4427.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 802.8	3.83	0.676	5.65	0.88	Verifica	321.1	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	181 (C)	511.0	4427.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 801.6	3.83	0.677	5.65	0.88	Verifica	321.1	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	182 (C)	488.4	4441.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 792.6	3.84	0.693	5.61	0.88	Verifica	322.4	400	1.24
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	183 (C)	533.6	4624.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 020.9	3.83	0.681	5.64	0.88	Verifica	333.7	400	1.20
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	184 (C)	533.6	4624.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 020.9	3.83	0.681	5.64	0.88	Verifica	333.7	400	1.20
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	185 (C)	532.5	4624.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 019.6	3.83	0.682	5.64	0.88	Verifica	333.7	400	1.20
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	186 (C)	509.9	4637.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 010.6	3.85	0.697	5.61	0.88	Verifica	335.1	400	1.19
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	187 (C)	650.1	3740.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 253.8	3.65	0.500	6.00	0.88	Verifica	273.7	400	1.46
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	188 (C)	575.1	4418.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 856.2	3.78	0.634	5.73	0.88	Verifica	319.2	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	189 (C)	650.1	3740.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 253.8	3.65	0.500	6.00	0.88	Verifica	273.7	400	1.46
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	190 (C)	650.1	3740.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 253.8	3.65	0.500	6.00	0.88	Verifica	273.7	400	1.46
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	191 (C)	649.1	3740.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 252.6	3.65	0.501	6.00	0.88	Verifica	273.7	400	1.46
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	192 (C)	626.5	3754.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 243.6	3.67	0.519	5.96	0.88	Verifica	274.8	400	1.46
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	193 (C)	575.1	4418.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 856.2	3.78	0.634	5.73	0.88	Verifica	319.2	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	194 (C)	575.1	4418.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 856.2	3.78	0.634	5.73	0.88	Verifica	319.2	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	195 (C)	574.0	4418.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 854.9	3.78	0.634	5.73	0.88	Verifica	319.2	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	196 (C)	551.4	4431.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 845.9	3.80	0.650	5.70	0.88	Verifica	320.6	400	1.25
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	197 (C)	619.4	3460.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 942.3	3.63	0.480	6.04	0.88	Verifica	255.7	400	1.56
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	198 (C)	544.4	4137.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 544.8	3.77	0.623	5.75	0.88	Verifica	301.2	400	1.33
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	199 (C)	641.1	3656.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 160.5	3.64	0.494	6.01	0.88	Verifica	268.3	400	1.49
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	200 (C)	619.4	3460.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 942.3	3.63	0.480	6.04	0.88	Verifica	255.7	400	1.56
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	201 (C)	619.4	3460.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 942.3	3.63	0.480	6.04	0.88	Verifica	255.7	400	1.56
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	202 (C)	618.3	3459.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 941.0	3.63	0.481	6.04	0.88	Verifica	255.7	400	1.56
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	203 (C)	595.7	3473.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 932.0	3.65	0.500	6.00	0.88	Verifica	266.9	400	1.56
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	204 (C)	566.0	4334.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 762.9	3.78	0.631	5.74	0.88	Verifica	313.8	400	1.27
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	205 (C)	544.4	4137.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 544.8	3.77	0.623	5.75	0.88	Verifica	301.2	400	1.33
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	206 (C)	544.4	4137.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 544.8	3.77	0.623	5.75	0.88	Verifica	301.2	400	1.33
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	207 (C)	543.3	4137.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 543.5	3.77	0.624	5.75	0.88	Verifica	301.2	400	1.33
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	208 (C)	520.8	4150.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 534.6	3.79	0.641	5.72	0.88	Verifica	302.5	400	1.32
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	209 (C)	641.1	3656.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 160.5	3.64	0.494	6.01	0.88	Verifica	268.3	400	1.49
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	210 (C)	641.1	3656.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 160.5	3.64	0.494	6.01	0.88	Verifica	268.3	400	1.49
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	211 (C)	639.9	3656.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 159.1	3.65	0.495	6.01	0.88	Verifica	268.3	400	1.49
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	212 (C)	617.3	3669.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 150.1	3.66	0.513	5.97	0.88	Verifica	269.4	400	1.48
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	213 (C)	566.0	4334.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 762.9	3.78	0.631	5.74	0.88	Verifica	313.8	400	1.27
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	214 (C)	566.0	4334.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 762.9	3.78	0.631	5.74	0.88	Verifica	313.8	400	1.27
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	215 (C)	564.8	4333.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 761.5	3.78	0.631	5.74	0.88	Verifica	313.8	400	1.27
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	216 (C)	542.2	4347.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 752.5	3.80	0.646	5.70	0.88	Verifica	315.1	400	1.27
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	217 (C)	619.3	3460.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 942.3	3.63	0.480	6.04	0.88	Verifica	255.7	400	1.56
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	218 (C)	544.2	4137.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 544.6	3.77	0.624	5.75	0.88	Verifica	301.2	400	1.33
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	219 (C)	640.9	3656.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 160.4	3.64	0.495	6.01	0.88	Verifica</			

[illegible]

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)		
fck	fcld	ftcm	fyk	fyd	
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	
30	20.0	2.9	500	435	

Alinhamento 17 - Verificação Estado Limite Último de Punçãoamento																																							
Sapata	Pilar	Nº	b _{xi} (m)	l _{xi} (m)	PILAR	Eixos	b _{yi} (m)	l _{yi} (m)	H (m)	d (m)	Caso	N _{desl} (kN)	by10 (m)	bx10 (m)	ut (m)	Ao (m2)	q _{desl} (kN/m²)	ΔV _{desl} (kN)	V _{xi} (kN)	k	A _{s,X} (cm2/m)	A _{s,Y} (cm2/m)	ρl	V _{desl} (kN/m²)	FS	N _{desl} (kN)	by2 (m)	bx2 (m)	ut (m)	Ao (m2)	q _{desl} (kN/m²)	ΔV _{desl} (kN)	V _{xi} (kN)	k	A _{s,X} (cm2/m)	A _{s,Y} (cm2/m)	ρl	V _{desl} (kN/m²)	FS
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	105 (C)	707.90	1.80	1.80	3.128	0.0	205.7	1.43	25.13	20.94	0.0021	630.8	3.1	6418.2	1.80	2.10	6.856	3.52	446	1463.4	657.0	1.43	25.13	20.94	0.0021	1261.6	1.9		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	106 (C)	675.50	1.80	1.80	3.128	0.0	196.3	1.43	25.13	20.94	0.0021	630.8	3.2	6123.4	1.80	2.10	6.856	3.52	425	1391.4	627.5	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	107 (C)	675.50	1.80	1.80	3.128	0.0	196.3	1.43	25.13	20.94	0.0021	630.8	3.2	6123.4	1.80	2.10	6.856	3.52	425	1391.4	627.5	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	108 (C)	673.90	1.80	1.80	3.128	0.0	195.9	1.43	25.13	20.94	0.0021	630.8	3.2	6123.1	1.80	2.10	6.856	3.52	425	1391.3	627.5	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	109 (C)	640.00	1.80	1.80	3.128	0.0	186.0	1.43	25.13	20.94	0.0021	630.8	3.4	6143.5	1.80	2.10	6.856	3.52	427	1396.3	629.5	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	110 (C)	707.90	1.80	1.80	3.128	0.0	205.7	1.43	25.13	20.94	0.0021	630.8	3.1	6418.2	1.80	2.10	6.856	3.52	446	1463.4	657.0	1.43	25.13	20.94	0.0021	1261.6	1.9		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	111 (C)	707.90	1.80	1.80	3.128	0.0	205.7	1.43	25.13	20.94	0.0021	630.8	3.1	6418.2	1.80	2.10	6.856	3.52	446	1463.4	657.0	1.43	25.13	20.94	0.0021	1261.6	1.9		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	112 (C)	706.20	1.80	1.80	3.128	0.0	205.3	1.43	25.13	20.94	0.0021	630.8	3.1	6417.9	1.80	2.10	6.856	3.52	446	1463.4	657.0	1.43	25.13	20.94	0.0021	1261.6	1.9		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	113 (C)	672.30	1.80	1.80	3.128	0.0	195.4	1.43	25.13	20.94	0.0021	630.8	3.2	6438.2	1.80	2.10	6.856	3.52	447	1468.3	659.0	1.43	25.13	20.94	0.0021	1261.6	1.9		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	114 (C)	665.60	1.80	1.80	3.128	0.0	193.5	1.43	25.13	20.94	0.0021	630.8	3.3	3881.1	1.80	2.10	6.856	3.52	270	843.2	402.8	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	115 (C)	553.00	1.80	1.80	3.128	0.0	160.7	1.43	25.13	20.94	0.0021	630.8	3.9	4897.3	1.80	2.10	6.856	3.52	340	1091.6	504.6	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	116 (C)	665.60	1.80	1.80	3.128	0.0	193.5	1.43	25.13	20.94	0.0021	630.8	3.3	3881.1	1.80	2.10	6.856	3.52	270	843.2	402.8	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	117 (C)	665.60	1.80	1.80	3.128	0.0	193.5	1.43	25.13	20.94	0.0021	630.8	3.3	3881.1	1.80	2.10	6.856	3.52	270	843.2	402.8	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	118 (C)	664.00	1.80	1.80	3.128	0.0	193.0	1.43	25.13	20.94	0.0021	630.8	3.3	3880.8	1.80	2.10	6.856	3.52	270	843.1	402.8	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	119 (C)	630.10	1.80	1.80	3.128	0.0	183.1	1.43	25.13	20.94	0.0021	630.8	3.4	3901.2	1.80	2.10	6.856	3.52	271	848.1	404.8	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	120 (C)	553.00	1.80	1.80	3.128	0.0	160.7	1.43	25.13	20.94	0.0021	630.8	3.9	4897.3	1.80	2.10	6.856	3.52	340	1091.6	504.6	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	121 (C)	553.00	1.80	1.80	3.128	0.0	160.7	1.43	25.13	20.94	0.0021	630.8	3.9	4897.3	1.80	2.10	6.856	3.52	340	1091.6	504.6	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	122 (C)	551.30	1.80	1.80	3.128	0.0	160.2	1.43	25.13	20.94	0.0021	630.8	3.9	4897.0	1.80	2.10	6.856	3.52	340	1091.5	504.6	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	123 (C)	517.40	1.80	1.80	3.128	0.0	150.4	1.43	25.13	20.94	0.0021	630.8	4.2	4917.4	1.80	2.10	6.856	3.52	341	1096.5	506.7	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	124 (C)	836.50	1.80	1.80	3.128	0.0	243.1	1.43	25.13	20.94	0.0021	630.8	2.6	4671.6	1.80	2.10	6.856	3.52	324	1036.4	482.0	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	125 (C)	724.00	1.80	1.80	3.128	0.0	210.4	1.43	25.13	20.94	0.0021	630.8	3.0	5687.8	1.80	2.10	6.856	3.52	395	1284.9	583.8	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	126 (C)	868.90	1.80	1.80	3.128	0.0	252.5	1.43	25.13	20.94	0.0021	630.8	2.5	4966.4	1.80	2.10	6.856	3.52	345	1108.5	511.6	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	127 (C)	836.50	1.80	1.80	3.128	0.0	243.1	1.43	25.13	20.94	0.0021	630.8	2.6	4671.6	1.80	2.10	6.856	3.52	324	1036.4	482.0	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	128 (C)	836.50	1.80	1.80	3.128	0.0	243.1	1.43	25.13	20.94	0.0021	630.8	2.6	4671.6	1.80	2.10	6.856	3.52	324	1036.4	482.0	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	129 (C)	801.10	1.80	1.80	3.128	0.0	232.8	1.43	25.13	20.94	0.0021	630.8	2.7	4691.7	1.80	2.10	6.856	3.52	326	1041.4	484.0	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	131 (C)	756.40	1.80	1.80	3.128	0.0	219.8	1.43	25.13	20.94	0.0021	630.8	2.9	5682.6	1.80	2.10	6.856	3.52	415	1356.9	613.4	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	132 (C)	724.00	1.80	1.80	3.128	0.0	210.4	1.43	25.13	20.94	0.0021	630.8	3.0	5687.8	1.80	2.10	6.856	3.52	395	1284.9	583.8	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	133 (C)	724.00	1.80	1.80	3.128	0.0	210.4	1.43	25.13	20.94	0.0021	630.8	3.0	5687.8	1.80	2.10	6.856	3.52	395	1284.9	583.8	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 17	0.70	0.70	P9	al D al 17	0.70	1.00	1.20	1.10	134 (C)	722.30	1.80	1.80	3.128	0.0	209.9	1.43	25.13	20.94	0.0021	630.8	3.0	5687.5	1.80	2.10	6.856	3.											

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37				Aço (A500 NR)	
fck	fcid	ftcm	fyk	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	29.9	2.9	500	500	435

Alinhamento 18 - Verificação da Rotura do Solo de Fundação																												
Sapata	PILAR	Eixos	b ₁₀	l ₁₀	PILAR	Eixos	b ₅	l ₅	Caso	N ₀₁	N ₀₂	c ₁	l	B ₀₁	L ₀₁	c ₂	H ₀₀₁	Pp=Terra+massa+m _{psap}	N/(P1+P2)+P _p	x	e	L ²	H _{min}	Rigidez	q _{ult}	q _{usd}	FS	
			(m)	(m)			(m)	(m)		(kN)	(kN)	(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(m)	(m)	(m)	(m)	(m)		(kPa)	(kPa)	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	177 (C)	721.3	3577.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 162.1	3.58	0.426	6.15	0.88	Verifica	262.4	400	1.52	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	178 (C)	735.7	3771.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 369.6	3.60	0.446	6.11	0.88	Verifica	274.8	400	1.46	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	179 (C)	719.8	3577.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 160.5	3.58	0.427	6.15	0.88	Verifica	262.4	400	1.52	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	180 (C)	718.2	3577.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 159.9	3.58	0.428	6.14	0.88	Verifica	262.4	400	1.52	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	181 (C)	712.3	3577.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 152.8	3.58	0.432	6.14	0.88	Verifica	262.5	400	1.52	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	182 (C)	704.3	3578.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 145.1	3.59	0.438	6.12	0.88	Verifica	262.6	400	1.52	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	183 (C)	737.2	3771.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 371.2	3.60	0.445	6.11	0.88	Verifica	274.7	400	1.46	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	184 (C)	736.7	3771.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 370.6	3.60	0.446	6.11	0.88	Verifica	274.7	400	1.46	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	185 (C)	729.7	3771.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 363.5	3.60	0.450	6.10	0.88	Verifica	274.8	400	1.46	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	186 (C)	744.3	3771.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 348.4	3.61	0.461	6.08	0.88	Verifica	275.0	400	1.45	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	187 (C)	767.4	3044.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 674.9	3.45	0.297	6.41	0.88	Verifica	228.1	400	1.75	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	188 (C)	745.5	3611.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 219.5	3.56	0.415	6.17	0.88	Verifica	264.3	400	1.51	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	189 (C)	762.8	3044.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 670.3	3.45	0.300	6.40	0.88	Verifica	228.1	400	1.75	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	190 (C)	762.3	3044.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 660.7	3.45	0.301	6.40	0.88	Verifica	228.1	400	1.75	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	191 (C)	755.4	3044.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 662.7	3.46	0.306	6.39	0.88	Verifica	228.1	400	1.75	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	192 (C)	750.5	3044.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 658.0	3.46	0.310	6.38	0.88	Verifica	228.1	400	1.75	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	193 (C)	750.1	3611.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 224.1	3.56	0.412	6.18	0.88	Verifica	264.3	400	1.51	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	194 (C)	749.5	3611.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 223.5	3.56	0.412	6.18	0.88	Verifica	264.3	400	1.51	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	195 (C)	742.7	3611.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 216.6	3.57	0.417	6.17	0.88	Verifica	264.4	400	1.51	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	196 (C)	726.4	3611.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 200.4	3.58	0.428	6.14	0.88	Verifica	264.5	400	1.51	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	197 (C)	742.8	2768.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 374.0	3.41	0.256	6.49	0.88	Verifica	210.7	400	1.90	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	198 (C)	722.5	3334.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 920.1	3.53	0.385	6.23	0.88	Verifica	246.8	400	1.62	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	199 (C)	754.2	2961.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 578.5	3.44	0.290	6.42	0.88	Verifica	222.9	400	1.79	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	200 (C)	738.3	2768.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 369.4	3.41	0.260	6.48	0.88	Verifica	210.7	400	1.90	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	201 (C)	737.7	2768.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 368.9	3.41	0.260	6.48	0.88	Verifica	210.7	400	1.90	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	202 (C)	730.8	2768.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 361.8	3.42	0.266	6.47	0.88	Verifica	210.7	400	1.90	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	203 (C)	727.4	2768.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 358.6	3.42	0.268	6.46	0.88	Verifica	210.7	400	1.90	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	204 (C)	741.3	3528.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 132.2	3.55	0.404	6.19	0.88	Verifica	259.0	400	1.54	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	205 (C)	725.4	3334.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 923.1	3.53	0.383	6.23	0.88	Verifica	246.8	400	1.62	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	206 (C)	724.9	3334.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 922.5	3.53	0.383	6.23	0.88	Verifica	246.8	400	1.62	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	207 (C)	718.0	3334.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 915.6	3.54	0.388	6.22	0.88	Verifica	246.8	400	1.62	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	208 (C)	705.5	3334.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 903.3	3.55	0.397	6.21	0.88	Verifica	246.9	400	1.62	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	209 (C)	755.8	2961.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 580.1	3.44	0.288	6.42	0.88	Verifica	222.8	400	1.80	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	210 (C)	755.2	2961.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 579.5	3.44	0.289	6.42	0.88	Verifica	222.8	400	1.80	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	211 (C)	748.2	2961.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 572.5	3.44	0.294	6.41	0.88	Verifica	222.9	400	1.79	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	212 (C)	743.3	2961.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 567.7	3.45	0.296	6.40	0.88	Verifica	222.9	400	1.79	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	213 (C)	742.9	3528.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 133.6	3.55	0.403	6.19	0.88	Verifica	259.0	400	1.54	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	214 (C)	742.3	3528.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 133.2	3.55	0.404	6.19	0.88	Verifica	259.0	400	1.54	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	215 (C)	735.5	3527.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 126.3	3.56	0.408	6.18	0.88	Verifica	259.1	400	1.54	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	216 (C)	719.8	3528.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 110.9	3.57	0.419	6.16	0.88	Verifica	259.2	400	1.54	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	217 (C)	742.5	2768.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 373.9	3.41	0.257	6.49	0.88	Verifica	210.7	400	1.90	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	218 (C)	722.2	3335.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 920.2	3.53	0.385	6.23	0.88	Verifica	246.8	400	1.62	
SS	P10	al E al 18	0.70	0.70	P1	al D al 18</																						

[illegible]

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)				Aço (A500 NR)			
fck	fcid	ftcm		fyk	fyd		
(MPa)	(MPa)	(MPa)		(MPa)	(MPa)		
30	29,8	2,9		500	435		

Alinhamento 18 - Verificação Estado Limite Último de Punçãoamento																																							
Sapata	Pilar	Nº	b _h (m)	l _h (m)	PILAR	Eixos	b _h (m)	l _h (m)	H (m)	d (m)	Caso	N _{desl.} (kN)	by10 (m)	bz10 (m)	u1 (m)	Ao (m²)	q _{desl.} (kN/m²)	ΔV _{desl.} (kN)	V _{desl.} (kN)	k	A _{s,X} (cm²/m)	A _{s,Y} (cm²/m)	ρ _l	V _{desl.} (kN/m²)	FS	N _{desl.} (kN)	by2 (m)	bz2 (m)	u1 (m)	Ao (m²)	q _{desl.} (kN/m²)	ΔV _{desl.} (kN)	V _{desl.} (kN)	k	A _{s,X} (cm²/m)	A _{s,Y} (cm²/m)	ρ _l	V _{desl.} (kN/m²)	FS
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	105 (C)	993.40	1.80	1.80	3.128	0.0	288.7	1.43	25.13	20.94	0.0021	630.8	2.2	5241.2	1.80	2.10	6.856	3.52	364	1175.7	539.1	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	106 (C)	967.15	1.80	1.80	3.128	0.0	281.1	1.43	25.13	20.94	0.0021	630.8	2.2	5241.2	1.80	2.10	6.856	3.52	344	1104.8	510.1	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	107 (C)	967.15	1.80	1.80	3.128	0.0	288.7	1.43	25.13	20.94	0.0021	630.8	2.2	5241.2	1.80	2.10	6.856	3.52	364	1175.7	539.1	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	108 (C)	957.15	1.80	1.80	3.128	0.0	278.2	1.43	25.13	20.94	0.0021	630.8	2.3	4951.2	1.80	2.10	6.856	3.52	344	1104.8	510.0	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	109 (C)	939.60	1.80	1.80	3.128	0.0	273.1	1.43	25.13	20.94	0.0021	630.8	2.3	4951.6	1.80	2.10	6.856	3.52	344	1104.9	510.1	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	110 (C)	993.40	1.80	1.80	3.128	0.0	288.7	1.43	25.13	20.94	0.0021	630.8	2.2	5241.2	1.80	2.10	6.856	3.52	364	1175.7	539.1	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	111 (C)	983.35	1.80	1.80	3.128	0.0	288.7	1.43	25.13	20.94	0.0021	630.8	2.2	5241.2	1.80	2.10	6.856	3.52	364	1175.7	539.1	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	112 (C)	983.35	1.80	1.80	3.128	0.0	285.8	1.43	25.13	20.94	0.0021	630.8	2.2	5241.0	1.80	2.10	6.856	3.52	364	1175.6	539.1	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	113 (C)	965.75	1.80	1.80	3.128	0.0	280.7	1.43	25.13	20.94	0.0021	630.8	2.2	5241.4	1.80	2.10	6.856	3.52	364	1175.7	539.1	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	114 (C)	775.40	1.80	1.80	3.128	0.0	225.4	1.43	25.13	20.94	0.0021	630.8	2.8	3182.6	1.80	2.10	6.856	3.52	221	672.4	332.9	1.43	25.13	20.94	0.0021	1261.6	3.8		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	115 (C)	756.20	1.80	1.80	3.128	0.0	219.8	1.43	25.13	20.94	0.0021	630.8	2.9	4032.4	1.80	2.10	6.856	3.52	280	880.2	418.0	1.43	25.13	20.94	0.0021	1261.6	3.0		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	116 (C)	775.40	1.80	1.80	3.128	0.0	225.4	1.43	25.13	20.94	0.0021	630.8	2.8	3182.6	1.80	2.10	6.856	3.52	221	672.4	332.9	1.43	25.13	20.94	0.0021	1261.6	3.8		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	117 (C)	775.40	1.80	1.80	3.128	0.0	225.4	1.43	25.13	20.94	0.0021	630.8	2.8	3182.6	1.80	2.10	6.856	3.52	221	672.4	332.9	1.43	25.13	20.94	0.0021	1261.6	3.8		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	118 (C)	765.35	1.80	1.80	3.128	0.0	222.4	1.43	25.13	20.94	0.0021	630.8	2.8	3182.4	1.80	2.10	6.856	3.52	221	672.4	332.8	1.43	25.13	20.94	0.0021	1261.6	3.8		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	119 (C)	747.75	1.80	1.80	3.128	0.0	217.3	1.43	25.13	20.94	0.0021	630.8	2.9	3182.8	1.80	2.10	6.856	3.52	221	672.5	332.9	1.43	25.13	20.94	0.0021	1261.6	3.8		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	120 (C)	756.20	1.80	1.80	3.128	0.0	219.8	1.43	25.13	20.94	0.0021	630.8	2.9	4032.4	1.80	2.10	6.856	3.52	280	880.2	418.0	1.43	25.13	20.94	0.0021	1261.6	3.0		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	121 (C)	756.20	1.80	1.80	3.128	0.0	219.8	1.43	25.13	20.94	0.0021	630.8	2.9	4032.4	1.80	2.10	6.856	3.52	280	880.2	418.0	1.43	25.13	20.94	0.0021	1261.6	3.0		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	122 (C)	746.30	1.80	1.80	3.128	0.0	216.9	1.43	25.13	20.94	0.0021	630.8	2.9	4032.2	1.80	2.10	6.856	3.52	280	880.1	418.0	1.43	25.13	20.94	0.0021	1261.6	3.0		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	123 (C)	728.65	1.80	1.80	3.128	0.0	211.8	1.43	25.13	20.94	0.0021	630.8	3.0	4032.6	1.80	2.10	6.856	3.52	280	880.2	418.0	1.43	25.13	20.94	0.0021	1261.6	3.0		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	124 (C)	694.90	1.80	1.80	3.128	0.0	209.2	1.43	25.13	20.94	0.0021	630.8	2.2	3737.0	1.80	2.10	6.856	3.52	260	808.0	388.4	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	125 (C)	975.85	1.80	1.80	3.128	0.0	283.6	1.43	25.13	20.94	0.0021	630.8	2.2	4586.8	1.80	2.10	6.856	3.52	319	1015.7	473.5	1.43	25.13	20.94	0.0021	1261.6	2.7		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	126 (C)	1021.05	1.80	1.80	3.128	0.0	296.8	1.43	25.13	20.94	0.0021	630.8	2.1	4026.9	1.80	2.10	6.856	3.52	280	878.8	417.4	1.43	25.13	20.94	0.0021	1261.6	3.0		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	127 (C)	994.90	1.80	1.80	3.128	0.0	289.2	1.43	25.13	20.94	0.0021	630.8	2.2	3737.0	1.80	2.10	6.856	3.52	260	808.0	388.4	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	128 (C)	994.90	1.80	1.80	3.128	0.0	289.2	1.43	25.13	20.94	0.0021	630.8	2.2	3737.0	1.80	2.10	6.856	3.52	260	808.0	388.4	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	129 (C)	984.95	1.80	1.80	3.128	0.0	286.3	1.43	25.13	20.94	0.0021	630.8	2.2	3736.9	1.80	2.10	6.856	3.52	260	807.9	388.4	1.43	25.13	20.94	0.0021	1261.6	3.2		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	130 (C)	984.95	1.80	1.80	3.128	0.0	281.2	1.43	25.13	20.94	0.0021	630.8	2.2	4876.6	1.80	2.10	6.856	3.52	339	1086.6	502.6	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	131 (C)	1001.95	1.80	1.80	3.128	0.0	291.2	1.43	25.13	20.94	0.0021	630.8	2.2	4876.6	1.80	2.10	6.856	3.52	339	1086.6	502.6	1.43	25.13	20.94	0.0021	1261.6	2.5		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	132 (C)	975.85	1.80	1.80	3.128	0.0	283.6	1.43	25.13	20.94	0.0021	630.8	2.2	4586.8	1.80	2.10	6.856	3.52	319	1015.7	473.5	1.43	25.13	20.94	0.0021	1261.6	2.7		
S5	P10	al E al 18	0.70	0.70	P1	al D al 18	0.70	1.00	1.20	1.10	133 (C)	975.85	1.80	1.80	3.128	0.0	283.6	1.43	25.13	20.94	0.0021	630.8	2.2	4586.8	1.80	2.10	6.856												

Betão (C30/37)			Aço (A500 NR)	
fck	fcid	ftcm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	28.0	2.9	500	435

Alinhamento 19 - Verificação da Rotura do Solo de Fundação																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Sapata	PILAR	Eixos	b ₁₀	h ₁₀	PILAR	Eixos	b ₅	h ₅	Caso	N ₁₀	N ₅	C ₁	l	B ₁₀	L ₁₀	C ₂	H ₁₀₀	Pp=Terra +massa m ₁ +P ₁₀₀	N(P1+P2)+P p	x	e	L'	H _{min}	Rigidez	Q _{ult}	Q _{des}	FS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)		
fck	fcid	fcim	fyk	fyd	
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	
30	20.9	2.9	500	425	

Sapata		Pilar	Nó	dx	lx	PILAR	Eixos	dy	ly	Caso	Alinhamento 19 - Verificação de Armaduras																Direção XX																Direção YY																Obs																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
											N _{des}		C _x	I	B	L	x	L'	C _x	H	d	P _{pr} Terra +massame+P _{ps} ap		N _{du}	Q _{du} B	M _{KX11}	μ	α	A _{cal,ap} ²	A _{cal}	Ø	A _{cal} ²	Obs	q ₁₂	q ₁₂	M _{xy}	s _y	q ₂	M _{xy}	μ	α	A _{cal,ap} ²	Ø	A _{cal,ap} ²	Obs																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
											(kN)	(kN)										(mm²)	(mm²)																							(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)		(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)	(mm²)

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)				Aço (A500 NR)			
fcyk	fcdd	fcfcm		fyk	fyd		
(MPa)	(MPa)	(MPa)		(MPa)	(MPa)		
30	28.0	2.9		500	435		

Alinhamento 19 - Verificação Estado Limite Último de Punçãoamento																																							
Sapata	Pilar	Nó	b _{xs} (m)	l _{xs} (m)	PILAR	Eixos	b _y (m)	l _y (m)	H (m)	d (m)	Caso	N _{desl} (kN)	by10 (m)	bz10 (m)	u1 (m)	Ao (m ²)	q _{desl} (kN/m ²)	ΔV _{desl} (kN)	V _{desl} (kN)	k	As _X (cm ² /m)	As _Y (cm ² /m)	ρ _l	V _{desl} (kN/m ²)	FS	N _{desl} (kN)	by2 (m)	bz2 (m)	u1 (m)	Ao (m ²)	q _{desl} (kN/m ²)	ΔV _{desl} (kN)	V _{desl} (kN)	k	As _X (cm ² /m)	As _Y (cm ² /m)	ρ _l	V _{desl} (kN/m ²)	FS
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	105 (C)	993.40	1.80	1.80	3.128	1.49	288.7	1.43	25.13	20.94	0.0021	630.8	2.2	5052.4	1.80	2.10	6.856	3.52	351	1129.5	520.2	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	106 (C)	967.15	1.80	1.80	3.128	1.49	281.1	1.43	25.13	20.94	0.0021	630.8	2.2	4784.0	1.80	2.10	6.856	3.52	332	1063.9	493.3	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	107 (C)	967.15	1.80	1.80	3.128	1.49	281.1	1.43	25.13	20.94	0.0021	630.8	2.2	4784.0	1.80	2.10	6.856	3.52	332	1063.9	493.3	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	108 (C)	957.15	1.80	1.80	3.128	1.49	278.2	1.43	25.13	20.94	0.0021	630.8	2.3	4783.0	1.80	2.10	6.856	3.52	332	1063.7	493.2	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	109 (C)	939.60	1.80	1.80	3.128	1.49	273.1	1.43	25.13	20.94	0.0021	630.8	2.3	4783.3	1.80	2.10	6.856	3.52	332	1063.8	493.2	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	110 (C)	993.40	1.80	1.80	3.128	1.49	288.7	1.43	25.13	20.94	0.0021	630.8	2.2	5052.4	1.80	2.10	6.856	3.52	351	1129.5	520.2	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	111 (C)	993.40	1.80	1.80	3.128	1.49	288.7	1.43	25.13	20.94	0.0021	630.8	2.2	5052.4	1.80	2.10	6.856	3.52	351	1129.5	520.2	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	112 (C)	983.35	1.80	1.80	3.128	1.49	285.8	1.43	25.13	20.94	0.0021	630.8	2.2	5051.4	1.80	2.10	6.856	3.52	351	1129.3	520.1	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	113 (C)	965.75	1.80	1.80	3.128	1.49	280.7	1.43	25.13	20.94	0.0021	630.8	2.2	5051.7	1.80	2.10	6.856	3.52	351	1129.4	520.1	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	114 (C)	775.40	1.80	1.80	3.128	1.49	225.4	1.43	25.13	20.94	0.0021	630.8	2.8	3040.8	1.80	2.10	6.856	3.52	211	637.8	318.6	1.43	25.13	20.94	0.0021	1261.6	4.0		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	115 (C)	756.20	1.80	1.80	3.128	1.49	219.8	1.43	25.13	20.94	0.0021	630.8	2.9	3877.8	1.80	2.10	6.856	3.52	269	842.4	402.5	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	116 (C)	775.40	1.80	1.80	3.128	1.49	225.4	1.43	25.13	20.94	0.0021	630.8	2.8	3040.8	1.80	2.10	6.856	3.52	211	637.8	318.6	1.43	25.13	20.94	0.0021	1261.6	4.0		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	117 (C)	775.40	1.80	1.80	3.128	1.49	225.4	1.43	25.13	20.94	0.0021	630.8	2.8	3040.8	1.80	2.10	6.856	3.52	211	637.8	318.6	1.43	25.13	20.94	0.0021	1261.6	4.0		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	118 (C)	765.35	1.80	1.80	3.128	1.49	222.4	1.43	25.13	20.94	0.0021	630.8	2.8	3039.8	1.80	2.10	6.856	3.52	211	637.5	318.5	1.43	25.13	20.94	0.0021	1261.6	4.0		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	119 (C)	747.75	1.80	1.80	3.128	1.49	217.3	1.43	25.13	20.94	0.0021	630.8	2.9	3040.1	1.80	2.10	6.856	3.52	211	637.6	318.6	1.43	25.13	20.94	0.0021	1261.6	4.0		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	120 (C)	756.20	1.80	1.80	3.128	1.49	219.8	1.43	25.13	20.94	0.0021	630.8	2.9	3877.8	1.80	2.10	6.856	3.52	269	842.4	402.5	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	121 (C)	756.20	1.80	1.80	3.128	1.49	219.8	1.43	25.13	20.94	0.0021	630.8	2.9	3877.8	1.80	2.10	6.856	3.52	269	842.4	402.5	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	122 (C)	746.30	1.80	1.80	3.128	1.49	216.9	1.43	25.13	20.94	0.0021	630.8	2.9	3876.8	1.80	2.10	6.856	3.52	269	842.1	402.4	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	123 (C)	728.65	1.80	1.80	3.128	1.49	211.8	1.43	25.13	20.94	0.0021	630.8	3.0	3877.1	1.80	2.10	6.856	3.52	269	842.2	402.4	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	124 (C)	994.90	1.80	1.80	3.128	1.49	289.2	1.43	25.13	20.94	0.0021	630.8	2.2	3996.3	1.80	2.10	6.856	3.52	250	773.3	374.2	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	125 (C)	975.85	1.80	1.80	3.128	1.49	283.6	1.43	25.13	20.94	0.0021	630.8	2.2	4432.4	1.80	2.10	6.856	3.52	308	978.0	458.1	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	126 (C)	1021.05	1.80	1.80	3.128	1.49	296.8	1.43	25.13	20.94	0.0021	630.8	2.1	3863.7	1.80	2.10	6.856	3.52	268	838.9	401.1	1.43	25.13	20.94	0.0021	1261.6	3.1		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	127 (C)	994.90	1.80	1.80	3.128	1.49	289.2	1.43	25.13	20.94	0.0021	630.8	2.2	3996.3	1.80	2.10	6.856	3.52	250	773.3	374.2	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	128 (C)	994.90	1.80	1.80	3.128	1.49	289.2	1.43	25.13	20.94	0.0021	630.8	2.2	3996.3	1.80	2.10	6.856	3.52	250	773.3	374.2	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	129 (C)	984.95	1.80	1.80	3.128	1.49	286.3	1.43	25.13	20.94	0.0021	630.8	2.2	3994.4	1.80	2.10	6.856	3.52	250	773.1	374.1	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	130 (C)	967.35	1.80	1.80	3.128	1.49	281.2	1.43	25.13	20.94	0.0021	630.8	2.2	3994.6	1.80	2.10	6.856	3.52	250	773.2	374.1	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	131 (C)	1001.95	1.80	1.80	3.128	1.49	291.2	1.43	25.13	20.94	0.0021	630.8	2.2	4700.7	1.80	2.10	6.856	3.52	326	1043.6	484.9	1.43	25.13	20.94	0.0021	1261.6	2.6		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	132 (C)	975.85	1.80	1.80	3.128	1.49	283.6	1.43	25.13	20.94	0.0021	630.8	2.2	4432.4	1.80	2.10	6.856	3.52	308	978.0	458.1	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	al E al 19	0.70	0.70	P1	al D al 19	0.70	1.00	1.20	1.10	133 (C)	975.85	1.80	1.80	3.128	1.49	283.6	1.43	25.																				

Betão (C30/37)			Aço (A500 NR)	
fck	fcid	fcim	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	29.9	2.9	500	435

Alinhamento 21 - Verificação da Rotura do Solo de Fundação																													
Sapata	PILAR	Eixos	b ₁₀	l ₅	PILAR	Eixos	b ₅	l ₅	Caso	N ₁₀	N ₅	C ₁	l	B _{5L}	L _{5L}	C ₂	H _{perq}	Pp=Terra +massama _{net} P _{passap}	N/(P1+P2)+P p	x	e	L ¹	H _{min}	Rigidez	Q _{ult}	Q _{seg}	FS		
S5	P10	al E al 21	(m)	(m)	P9	al D al 21	(m)	(m)	177 (C)	(kN)	(kN)	(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(m)	(m)	(m)	(m)	(m)	Verifica	(kPa)	(kPa)		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	177 (C)	915.9	4839.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 618.3	3.63	0.478	6.04	0.88	Verifica	342.2	400	1.17		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	178 (C)	928.4	4997.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 788.5	3.64	0.489	6.02	0.88	Verifica	352.3	400	1.14		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	179 (C)	915.9	4839.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 618.3	3.63	0.478	6.04	0.88	Verifica	342.2	400	1.17		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	180 (C)	915.9	4839.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 618.3	3.63	0.478	6.04	0.88	Verifica	342.2	400	1.17		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	181 (C)	911.6	4822.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 596.8	3.63	0.478	6.04	0.88	Verifica	341.1	400	1.17		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	182 (C)	919.0	4861.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 643.2	3.63	0.479	6.04	0.88	Verifica	343.6	400	1.16		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	183 (C)	928.4	4997.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 788.5	3.64	0.489	6.02	0.88	Verifica	352.3	400	1.14		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	184 (C)	928.4	4997.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 788.5	3.64	0.489	6.02	0.88	Verifica	352.3	400	1.14		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	185 (C)	924.1	4890.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 767.0	3.64	0.490	6.02	0.88	Verifica	351.2	400	1.14		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	186 (C)	931.4	5019.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 813.4	3.64	0.490	6.02	0.88	Verifica	353.7	400	1.13		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	187 (C)	722.1	4955.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 640.6	3.65	0.495	6.01	0.88	Verifica	293.3	400	1.36		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	188 (C)	870.2	4762.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 495.2	3.64	0.494	6.01	0.88	Verifica	337.7	400	1.18		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	189 (C)	722.1	4955.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 640.6	3.65	0.495	6.01	0.88	Verifica	293.3	400	1.36		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	190 (C)	722.1	4955.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 640.6	3.65	0.495	6.01	0.88	Verifica	293.3	400	1.36		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	191 (C)	717.8	4938.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 619.1	3.65	0.496	6.01	0.88	Verifica	292.3	400	1.37		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	192 (C)	725.2	4977.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 665.5	3.65	0.496	6.01	0.88	Verifica	294.7	400	1.36		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	193 (C)	870.2	4762.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 495.2	3.64	0.494	6.01	0.88	Verifica	337.7	400	1.18		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	194 (C)	870.2	4762.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 495.2	3.64	0.494	6.01	0.88	Verifica	337.7	400	1.18		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	195 (C)	865.9	4744.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 473.7	3.64	0.495	6.01	0.88	Verifica	336.6	400	1.19		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	196 (C)	873.3	4783.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 520.1	3.65	0.495	6.01	0.88	Verifica	339.0	400	1.18		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	197 (C)	705.4	3846.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 414.5	3.63	0.478	6.04	0.88	Verifica	279.9	400	1.43		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	198 (C)	853.5	4552.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 269.1	3.63	0.479	6.04	0.88	Verifica	324.2	400	1.23		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	199 (C)	717.8	4938.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 584.7	3.64	0.491	6.02	0.88	Verifica	290.0	400	1.38		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	200 (C)	705.4	3846.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 414.5	3.63	0.478	6.04	0.88	Verifica	279.9	400	1.43		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	201 (C)	705.4	3846.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 414.5	3.63	0.478	6.04	0.88	Verifica	279.9	400	1.43		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	202 (C)	701.1	3829.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 393.0	3.63	0.478	6.04	0.88	Verifica	278.8	400	1.43		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	203 (C)	708.4	3868.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 439.3	3.63	0.479	6.04	0.88	Verifica	281.3	400	1.42		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	204 (C)	865.9	4710.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 439.2	3.64	0.491	6.02	0.88	Verifica	334.4	400	1.20		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	205 (C)	853.5	4552.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 269.1	3.63	0.479	6.04	0.88	Verifica	324.2	400	1.23		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	206 (C)	853.5	4552.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 269.1	3.63	0.479	6.04	0.88	Verifica	324.2	400	1.23		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	207 (C)	849.2	4535.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 247.6	3.63	0.479	6.04	0.88	Verifica	323.2	400	1.24		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	208 (C)	856.5	4574.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 293.9	3.63	0.480	6.04	0.88	Verifica	326.6	400	1.23		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	209 (C)	717.8	4938.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 584.7	3.64	0.491	6.02	0.88	Verifica	290.0	400	1.38		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	210 (C)	717.8	4938.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 584.7	3.64	0.491	6.02	0.88	Verifica	290.0	400	1.38		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	211 (C)	713.5	3986.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 563.2	3.64	0.492	6.02	0.88	Verifica	289.0	400	1.38		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	212 (C)	720.9	4925.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 609.6	3.64	0.492	6.02	0.88	Verifica	291.4	400	1.37		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	213 (C)	865.9	4710.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 439.2	3.64	0.491	6.02	0.88	Verifica	334.4	400	1.20		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	214 (C)	865.9	4710.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 439.2	3.64	0.491	6.02	0.88	Verifica	334.4	400	1.20		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	215 (C)	861.6	4693.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 417.7	3.64	0.491	6.02	0.88	Verifica	333.3	400	1.20		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	216 (C)	866.0	4732.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 464.2	3.64	0.492	6.02	0.88	Verifica	335.7	400	1.19		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	217 (C)	704.3	3830.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 397.4	3.63	0.476	6.05	0.88	Verifica	278.9	400	1.43		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	218 (C)	852.4	4536.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	6 252.0	3.63	0.478	6.04	0.88	Verifica	323.2	400			

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)	
f _{ck}	f _{cd}	f _{ctm}	f _{yk}	f _{yd}
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 21 - Verificação de Armaduras																														Direção XX										Direção YY									
Sapata	Pilar	No	b1	H	PILAR	Excos	b2	I2	NEd/P2	NEd/P1	c1	I	B	L	x	L'	c2	H	d	Pp+Terra +massame+pns	NEd	qse/B	MXX(-)	μ	e	Ascal,sup	As,efis	MXX(+)	μ	e	Ascal,inf	As,efis	Obs	s1	kP1	MYY	s2	kP2	MYY	μ	e	Ascal,inf	As,efis	Obs					
(m)	(m)		(m)	(m)		(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(mm/ks)	(kN)	(kN/m)	(kNm)			(cm2)	(mm/ks)	(kNm)			(cm2)	(mm/ks)		(m)	(kPa)	(kNm/m)	(m)	(kPa)	(kNm/m)			(cm2)	(mm/ks)						
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	108 (C)	12886	69138	0.00	4.40	3.20	7.00	3.66	5.99	2.25	1.20	1.10	862.9	9065.9	1513.7	-179.0	0.023	0.023	11.84	0.010/125	16.08	3519.51	0.045	0.047	23.54	0.020/125	25.13	Verifica	1.53	264.1	206.3	2.65	815.3	637.0	0.026	0.027	13.50	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	108 (C)	12886	69138	0.00	4.40	3.20	7.00	3.66	5.99	2.25	1.20	1.10	862.9	9065.9	1513.7	-179.0	0.023	0.023	11.84	0.010/125	16.08	3519.51	0.045	0.047	23.54	0.020/125	25.13	Verifica	1.53	264.1	206.3	2.65	815.3	637.0	0.026	0.027	13.50	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	107 (C)	12699	69771	0.00	4.40	3.20	7.00	3.64	6.01	2.25	1.20	1.10	862.9	9080.3	1480.9	-179.0	0.023	0.023	11.55	0.010/125	16.08	3396.40	0.044	0.045	22.50	0.020/125	25.13	Verifica	1.53	260.2	203.3	2.65	787.4	612.8	0.025	0.026	13.03	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	108 (C)	12634	66513	0.00	4.40	3.20	7.00	3.64	6.01	2.25	1.20	1.10	862.9	8777.6	1459.9	-174.12	0.022	0.023	11.51	0.010/125	16.08	3383.39	0.044	0.045	22.81	0.020/125	25.13	Verifica	1.53	258.9	202.3	2.65	784.4	612.8	0.025	0.026	12.98	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	109 (C)	12744	6709.9	0.00	4.40	3.20	7.00	3.64	6.01	2.25	1.20	1.10	862.9	8847.2	1477.1	-175.48	0.023	0.023	11.60	0.010/125	16.08	3413.28	0.044	0.045	22.62	0.020/125	25.13	Verifica	1.53	261.1	204.0	2.65	791.3	618.2	0.026	0.026	13.09	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	109 (C)	12744	6709.9	0.00	4.40	3.20	7.00	3.64	6.01	2.25	1.20	1.10	862.9	8847.2	1477.1	-175.48	0.023	0.023	11.60	0.010/125	16.08	3413.28	0.044	0.045	22.62	0.020/125	25.13	Verifica	1.53	261.1	204.0	2.65	791.3	618.2	0.026	0.026	13.09	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	111 (C)	12886	69138	0.00	4.40	3.20	7.00	3.66	5.99	2.25	1.20	1.10	862.9	9065.9	1513.7	-179.0	0.023	0.023	11.84	0.010/125	16.08	3519.51	0.045	0.047	23.54	0.020/125	25.13	Verifica	1.53	264.1	206.3	2.65	815.3	637.0	0.026	0.027	13.50	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	112 (C)	12821	68880	0.00	4.40	3.20	7.00	3.66	5.99	2.25	1.20	1.10	862.9	9003.0	1508.6	-178.43	0.023	0.023	11.80	0.010/125	16.08	3506.50	0.045	0.046	23.46	0.020/125	25.13	Verifica	1.53	262.7	205.3	2.65	812.3	634.0	0.026	0.027	13.45	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	113 (C)	12931	69486	0.00	4.40	3.20	7.00	3.66	5.99	2.25	1.20	1.10	862.9	9102.6	1520.4	-179.79	0.023	0.023	11.89	0.010/125	16.08	3536.40	0.046	0.047	23.66	0.020/125	25.13	Verifica	1.53	265.0	207.0	2.65	819.2	640.0	0.026	0.027	13.56	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	114 (C)	13015	70120	0.00	4.40	3.20	7.00	3.66	5.99	2.25	1.20	1.10	862.9	9138.9	1527.1	-179.79	0.018	0.018	9.19	0.010/125	16.08	3571.14	0.047	0.048	23.91	0.020/125	25.13	Verifica	1.53	267.5	209.4	2.65	824.0	646.4	0.027	0.028	13.67	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	115 (C)	12932	69280	0.00	4.40	3.20	7.00	3.65	6.00	2.25	1.20	1.10	862.9	9041.4	1477.6	-139.37	0.018	0.018	9.19	0.010/125	16.08	3561.16	0.034	0.035	17.04	0.020/125	25.13	Verifica	1.53	195.3	152.6	2.65	616.5	481.6	0.020	0.020	10.17	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	116 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	117 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	118 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	119 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	120 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	121 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	122 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	123 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	124 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	125 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	126 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	127 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	128 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99	2.25	1.20	1.10	862.9	8762.2	1456.8	-113.88	0.015	0.015	7.50	0.010/125	16.08	3522.65	0.027	0.028	14.47	0.020/125	25.13	Verifica	1.53	149.8	117.0	2.65	491.5	384.0	0.016	0.016	8.69	0.020/15	20.94	Verifica	
SS	P10	aI al [aI 21]	0.70	0.70	P9	aII al [aI 21]	0.70	1.00	129 (C)	12731	67103	0.00	4.40	3.20	7.00	3.65	5.99																																

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)				Aço (A500 NR)			
fcyk	fcdd	fcfm		fyk	fyd		
(MPa)	(MPa)	(MPa)		(MPa)	(MPa)		
30	29.9	2.9		500	435		

Alinhamento 21 - Verificação Estado Limite Último de Punçãoamento																																							
Sapata	Pilar	Nó	b _x (m)	b _y (m)	PILAR	Eixos	b _x (m)	b _y (m)	H (m)	d (m)	Caso	N _{Ed,ult} (kN)	b _{y10} (m)	b _{z10} (m)	u1 (m)	Ao (m²)	q _{Ed,ult} (kN/m²)	ΔV _{Ed,ult} (kN)	V _{Ed} (kN)	k	A _{s,X} (cm²/m)	A _{s,Y} (cm²/m)	ρ _l	V _{Ed} (kN/m²)	FS	N _{Ed,ult} (kN)	b _{y2} (m)	b _{z2} (m)	u1 (m)	Ao (m²)	q _{Ed,ult} (kN/m²)	ΔV _{Ed,ult} (kN)	V _{Ed} (kN)	k	A _{s,X} (cm²/m)	A _{s,Y} (cm²/m)	ρ _l	V _{Ed} (kN/m²)	FS
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	105 (C)	1288.60	1.80	1.80	3.128	1.49	374.5	1.43	25.13	20.94	0.0021	630.8	1.7	6913.8	1.80	2.10	6.856	3.52	480	1584.6	706.7	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	106 (C)	1269.90	1.80	1.80	3.128	1.49	369.1	1.43	25.13	20.94	0.0021	630.8	1.7	6677.1	1.80	2.10	6.856	3.52	464	1526.7	685.0	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	107 (C)	1269.90	1.80	1.80	3.128	1.49	374.5	1.43	25.13	20.94	0.0021	630.8	1.7	6913.8	1.80	2.10	6.856	3.52	480	1584.6	706.7	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	108 (C)	1263.40	1.80	1.80	3.128	1.49	367.2	1.43	25.13	20.94	0.0021	630.8	1.7	6651.3	1.80	2.10	6.856	3.52	462	1520.4	680.4	1.43	25.13	20.94	0.0021	1261.6	1.9		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	109 (C)	1274.40	1.80	1.80	3.128	1.49	370.4	1.43	25.13	20.94	0.0021	630.8	1.7	6709.9	1.80	2.10	6.856	3.52	466	1534.7	686.2	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	110 (C)	1288.60	1.80	1.80	3.128	1.49	374.5	1.43	25.13	20.94	0.0021	630.8	1.7	6913.8	1.80	2.10	6.856	3.52	480	1584.6	706.7	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	111 (C)	1288.60	1.80	1.80	3.128	1.49	374.5	1.43	25.13	20.94	0.0021	630.8	1.7	6913.8	1.80	2.10	6.856	3.52	480	1584.6	706.7	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	112 (C)	1282.10	1.80	1.80	3.128	1.49	372.6	1.43	25.13	20.94	0.0021	630.8	1.7	6888.0	1.80	2.10	6.856	3.52	478	1578.3	704.1	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	113 (C)	1293.10	1.80	1.80	3.128	1.49	375.8	1.43	25.13	20.94	0.0021	630.8	1.7	6946.6	1.80	2.10	6.856	3.52	482	1592.6	710.0	1.43	25.13	20.94	0.0021	1261.6	1.8		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	114 (C)	1311.00	1.80	1.80	3.128	1.49	381.9	1.43	25.13	20.94	0.0021	630.8	1.7	7071.0	1.80	2.10	6.856	3.52	489	1626.7	720.0	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	115 (C)	953.20	1.80	1.80	3.128	1.49	277.0	1.43	25.13	20.94	0.0021	630.8	2.3	5228.0	1.80	2.10	6.856	3.52	363	1172.5	537.8	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	116 (C)	731.00	1.80	1.80	3.128	1.49	212.5	1.43	25.13	20.94	0.0021	630.8	3.0	4168.3	1.80	2.10	6.856	3.52	289	913.4	431.6	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	117 (C)	731.00	1.80	1.80	3.128	1.49	212.5	1.43	25.13	20.94	0.0021	630.8	3.0	4168.3	1.80	2.10	6.856	3.52	289	913.4	431.6	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	118 (C)	724.60	1.80	1.80	3.128	1.49	210.6	1.43	25.13	20.94	0.0021	630.8	3.0	4142.5	1.80	2.10	6.856	3.52	288	907.1	429.0	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	119 (C)	735.60	1.80	1.80	3.128	1.49	213.8	1.43	25.13	20.94	0.0021	630.8	3.0	4201.1	1.80	2.10	6.856	3.52	292	921.4	434.9	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	120 (C)	953.20	1.80	1.80	3.128	1.49	277.0	1.43	25.13	20.94	0.0021	630.8	2.3	5228.0	1.80	2.10	6.856	3.52	363	1172.5	537.8	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	121 (C)	953.20	1.80	1.80	3.128	1.49	277.0	1.43	25.13	20.94	0.0021	630.8	2.3	5228.0	1.80	2.10	6.856	3.52	363	1172.5	537.8	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	122 (C)	946.80	1.80	1.80	3.128	1.49	275.2	1.43	25.13	20.94	0.0021	630.8	2.3	5187.2	1.80	2.10	6.856	3.52	361	1166.2	535.2	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	123 (C)	957.80	1.80	1.80	3.128	1.49	278.4	1.43	25.13	20.94	0.0021	630.8	2.3	5260.8	1.80	2.10	6.856	3.52	365	1180.5	541.1	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	124 (C)	954.00	1.80	1.80	3.128	1.49	277.3	1.43	25.13	20.94	0.0021	630.8	2.3	5197.2	1.80	2.10	6.856	3.52	360	1162.5	533.7	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	125 (C)	1176.20	1.80	1.80	3.128	1.49	341.9	1.43	25.13	20.94	0.0021	630.8	1.8	6246.9	1.80	2.10	6.856	3.52	434	1421.6	639.9	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	126 (C)	972.70	1.80	1.80	3.128	1.49	282.7	1.43	25.13	20.94	0.0021	630.8	2.2	5423.9	1.80	2.10	6.856	3.52	377	1220.4	557.4	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	127 (C)	954.00	1.80	1.80	3.128	1.49	277.3	1.43	25.13	20.94	0.0021	630.8	2.3	5187.2	1.80	2.10	6.856	3.52	360	1162.5	533.7	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	128 (C)	954.00	1.80	1.80	3.128	1.49	277.3	1.43	25.13	20.94	0.0021	630.8	2.3	5187.2	1.80	2.10	6.856	3.52	360	1162.5	533.7	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	129 (C)	947.60	1.80	1.80	3.128	1.49	275.4	1.43	25.13	20.94	0.0021	630.8	2.3	5161.4	1.80	2.10	6.856	3.52	358	1156.2	531.1	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	130 (C)	958.50	1.80	1.80	3.128	1.49	278.6	1.43	25.13	20.94	0.0021	630.8	2.3	5199.9	1.80	2.10	6.856	3.52	362	1170.5	537.0	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	131 (C)	1194.90	1.80	1.80	3.128	1.49	347.3	1.43	25.13	20.94	0.0021	630.8	1.8	6483.6	1.80	2.10	6.856	3.52	450	1479.4	653.6	1.43	25.13	20.94	0.0021	1261.6	1.9		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	132 (C)	1176.20	1.80	1.80	3.128	1.49	341.9	1.43	25.13	20.94	0.0021	630.8	1.8	6246.9	1.80	2.10	6.856	3.52	434	1421.6	639.9	1.43	25.13	20.94	0.0021	1261.6	2.0		
S5	P10	al E al 21	0.70	0.70	P9	al D al 21	0.70	1.00	1.20	1.10	133 (C)	1176.20	1.80	1.80																									

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)		
fck	ftcd	ftcm	fyk	fyd	
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	
30	20.0	2.9	500	435	

Alinhamento 22 - Verificação da Rotura do Solo de Fundação																													
Sapata	PILAR	Eixos	b _{is}		l _{is}	PILAR	Eixos	b _s		l _s	Caso	N _{ris}		c ₁	l	B _H	L _H	c ₂	H _{ru}	Pp+Terra +massame+ P _{psap}	N(P1+P2)+Pp	x	e	L'	H _{min}	Rigidez	Q _{ult}	Q _{usd}	FS
			(m)	(m)				(m)	(m)			(kN)	(kN)																
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	177 (C)	614.2	3944.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 421.9	3.70	0.553	5.89	0.88	Verifica	287.4	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	178 (C)	635.5	4131.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 630.2	3.71	0.562	5.88	0.88	Verifica	299.4	400	1.34		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	179 (C)	614.2	3944.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 421.9	3.70	0.553	5.89	0.88	Verifica	287.4	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	180 (C)	614.2	3944.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 421.9	3.70	0.553	5.89	0.88	Verifica	287.4	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	181 (C)	599.4	3944.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 407.0	3.71	0.563	5.87	0.88	Verifica	287.6	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	182 (C)	567.9	3969.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 400.0	3.74	0.588	5.82	0.88	Verifica	289.7	400	1.38		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	183 (C)	635.5	4131.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 630.2	3.71	0.562	5.88	0.88	Verifica	299.4	400	1.34		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	184 (C)	635.5	4131.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 630.2	3.71	0.562	5.88	0.88	Verifica	299.4	400	1.34		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	185 (C)	620.7	4131.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 615.3	3.72	0.572	5.86	0.88	Verifica	299.6	400	1.34		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	186 (C)	589.1	4158.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 608.2	3.75	0.595	5.81	0.88	Verifica	301.7	400	1.33		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	187 (C)	755.6	3371.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 990.3	3.52	0.368	6.26	0.88	Verifica	248.9	400	1.61		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	188 (C)	677.8	3959.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 500.6	3.66	0.512	5.98	0.88	Verifica	287.6	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	189 (C)	755.6	3371.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 990.3	3.52	0.368	6.26	0.88	Verifica	248.9	400	1.61		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	190 (C)	755.6	3371.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 990.3	3.52	0.368	6.26	0.88	Verifica	248.9	400	1.61		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	191 (C)	740.7	3371.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 975.3	3.53	0.378	6.24	0.88	Verifica	249.0	400	1.61		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	192 (C)	709.2	3396.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 968.3	3.55	0.405	6.19	0.88	Verifica	250.8	400	1.59		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	193 (C)	677.8	3959.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 500.6	3.66	0.512	5.98	0.88	Verifica	287.6	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	194 (C)	677.8	3959.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 500.6	3.66	0.512	5.98	0.88	Verifica	287.6	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	195 (C)	663.1	3959.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 485.8	3.67	0.522	5.96	0.88	Verifica	287.8	400	1.39		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	196 (C)	631.5	3984.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 478.7	3.70	0.546	5.91	0.88	Verifica	289.8	400	1.38		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	197 (C)	725.5	3104.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 692.8	3.49	0.340	6.32	0.88	Verifica	232.0	400	1.72		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	198 (C)	647.7	3692.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 203.1	3.64	0.495	6.01	0.88	Verifica	270.6	400	1.48		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	200 (C)	746.7	3291.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 901.0	3.51	0.360	6.28	0.88	Verifica	243.8	400	1.64		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	206 (C)	725.5	3104.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 692.8	3.49	0.340	6.32	0.88	Verifica	232.0	400	1.72		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	201 (C)	725.5	3104.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 692.8	3.49	0.340	6.32	0.88	Verifica	232.0	400	1.72		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	202 (C)	710.6	3104.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 677.8	3.50	0.351	6.30	0.88	Verifica	232.1	400	1.72		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	203 (C)	679.1	3128.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 670.8	3.53	0.379	6.24	0.88	Verifica	233.8	400	1.71		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	204 (C)	669.1	3879.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 411.6	3.66	0.507	5.99	0.88	Verifica	282.5	400	1.42		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	205 (C)	647.7	3692.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 203.1	3.64	0.495	6.01	0.88	Verifica	270.6	400	1.48		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	206 (C)	647.7	3692.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 203.1	3.64	0.495	6.01	0.88	Verifica	270.6	400	1.48		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	207 (C)	633.0	3692.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 188.3	3.66	0.505	5.99	0.88	Verifica	270.7	400	1.48		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	208 (C)	601.4	3716.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 181.2	3.68	0.531	5.94	0.88	Verifica	272.7	400	1.47		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	209 (C)	746.7	3291.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 901.0	3.51	0.360	6.28	0.88	Verifica	243.8	400	1.64		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	210 (C)	746.7	3291.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 901.0	3.51	0.360	6.28	0.88	Verifica	243.8	400	1.64		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	211 (C)	732.0	3291.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 886.2	3.52	0.370	6.26	0.88	Verifica	243.9	400	1.64		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	212 (C)	700.3	3315.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 879.0	3.55	0.397	6.21	0.88	Verifica	245.7	400	1.63		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	213 (C)	669.1	3879.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 411.6	3.66	0.507	5.99	0.88	Verifica	282.5	400	1.42		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	214 (C)	669.1	3879.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 411.6	3.66	0.507	5.99	0.88	Verifica	282.5	400	1.42		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	215 (C)	654.3	3879.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 396.6	3.67	0.517	5.97	0.88	Verifica	282.6	400	1.42		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	216 (C)	622.8	3863.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 380.6	3.69	0.541	5.92	0.88	Verifica	284.6	400	1.41		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	217 (C)	725.1	3104.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4 692.6	3.49	0.340	6.32	0.88	Verifica	232.0	400	1.72		
S5	P10	al E al 22	0.70	0.70	P9	al D al 22	0.70	1.00	218 (C)	647.5	3692.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5 203.2	3.65	0.495	6.01	0.88	Verifica	270.6	400	1.48		
S5	P10	al E																											

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

[illegible]

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Botão (C30/37)			Aço (A500 NR)		
fck	fcld	fcfm	fyk	fyd	
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	
30	20.0	2.9	500	435	

#VALOR!
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-1595521.7

Alinhamento 22 - Verificação Estado Limite Último de Punçãoamento																																							
Sapata	Pilar	Nº	b _u (m)	l _u (m)	PILAR	Eixos	b _v (m)	l _v (m)	H (m)	d (m)	Caso	N _{desn.} (kN)	by10 (m)	bz10 (m)	u1 (m)	Ao (m2)	q _{desn.} (kN/m²)	A _{desn.} (m²)	V _{desn.} (kN)	k	Ao X (cm2/m)	As Y (cm2/m)	ρl	V _{desn.} (kN/m²)	FS	N _{desn.} (kN)	by2 (m)	bz2 (m)	u1 (m)	Ao (m2)	q _{desn.} (kN/m²)	A _{desn.} (m²)	V _{desn.} (kN)	k	Ao X (cm2/m)	As Y (cm2/m)	ρl	V _{desn.} (kN/m²)	FS
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	105 (C)	845.00	1.80	1.80	3.128	1.49	245.6	1.43	25.13	20.94	0.0021	630.8	2.6	5725.1	1.80	2.10	6.856	3.52	398	1294.0	587.6	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	106 (C)	813.00	1.80	1.80	3.128	1.49	236.3	1.43	25.13	20.94	0.0021	630.8	2.7	5444.5	1.80	2.10	6.856	3.52	378	1225.4	559.5	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	107 (C)	813.00	1.80	1.80	3.128	1.49	236.3	1.43	25.13	20.94	0.0021	630.8	2.7	5444.5	1.80	2.10	6.856	3.52	378	1225.4	559.5	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	108 (C)	790.80	1.80	1.80	3.128	1.49	229.8	1.43	25.13	20.94	0.0021	630.8	2.7	5444.3	1.80	2.10	6.856	3.52	378	1225.3	559.4	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	109 (C)	743.40	1.80	1.80	3.128	1.49	216.1	1.43	25.13	20.94	0.0021	630.8	2.9	5481.1	1.80	2.10	6.856	3.52	381	1234.3	563.1	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	110 (C)	845.00	1.80	1.80	3.128	1.49	245.6	1.43	25.13	20.94	0.0021	630.8	2.6	5725.1	1.80	2.10	6.856	3.52	398	1294.0	587.6	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	111 (C)	822.80	1.80	1.80	3.128	1.49	239.1	1.43	25.13	20.94	0.0021	630.8	2.6	5724.9	1.80	2.10	6.856	3.52	398	1293.9	587.6	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	112 (C)	775.40	1.80	1.80	3.128	1.49	225.4	1.43	25.13	20.94	0.0021	630.8	2.8	5761.6	1.80	2.10	6.856	3.52	400	1302.9	591.2	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	114 (C)	770.70	1.80	1.80	3.128	1.49	224.0	1.43	25.13	20.94	0.0021	630.8	2.8	3505.4	1.80	2.10	6.856	3.52	243	751.3	365.2	1.43	25.13	20.94	0.0021	1261.6	3.5		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	115 (C)	654.30	1.80	1.80	3.128	1.49	190.2	1.43	25.13	20.94	0.0021	630.8	3.3	4387.6	1.80	2.10	6.856	3.52	305	967.0	453.6	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	116 (C)	770.70	1.80	1.80	3.128	1.49	224.0	1.43	25.13	20.94	0.0021	630.8	2.8	3505.4	1.80	2.10	6.856	3.52	243	751.3	365.2	1.43	25.13	20.94	0.0021	1261.6	3.5		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	117 (C)	770.70	1.80	1.80	3.128	1.49	224.0	1.43	25.13	20.94	0.0021	630.8	2.8	3505.4	1.80	2.10	6.856	3.52	243	751.3	365.2	1.43	25.13	20.94	0.0021	1261.6	3.5		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	118 (C)	748.50	1.80	1.80	3.128	1.49	217.5	1.43	25.13	20.94	0.0021	630.8	2.9	3505.2	1.80	2.10	6.856	3.52	243	751.3	365.2	1.43	25.13	20.94	0.0021	1261.6	3.5		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	119 (C)	701.20	1.80	1.80	3.128	1.49	203.8	1.43	25.13	20.94	0.0021	630.8	3.1	3541.9	1.80	2.10	6.856	3.52	246	769.3	368.9	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	120 (C)	654.30	1.80	1.80	3.128	1.49	190.2	1.43	25.13	20.94	0.0021	630.8	3.3	4387.6	1.80	2.10	6.856	3.52	305	967.0	453.6	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	121 (C)	654.30	1.80	1.80	3.128	1.49	190.2	1.43	25.13	20.94	0.0021	630.8	3.3	4387.6	1.80	2.10	6.856	3.52	305	967.0	453.6	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	122 (C)	632.10	1.80	1.80	3.128	1.49	183.7	1.43	25.13	20.94	0.0021	630.8	3.4	4387.4	1.80	2.10	6.856	3.52	305	967.0	453.6	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	123 (C)	584.70	1.80	1.80	3.128	1.49	169.9	1.43	25.13	20.94	0.0021	630.8	3.7	4424.1	1.80	2.10	6.856	3.52	307	979.9	457.2	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	124 (C)	979.90	1.80	1.80	3.128	1.49	284.8	1.43	25.13	20.94	0.0021	630.8	2.2	4183.9	1.80	2.10	6.856	3.52	291	917.2	433.2	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	125 (C)	863.40	1.80	1.80	3.128	1.49	250.9	1.43	25.13	20.94	0.0021	630.8	2.5	5066.1	1.80	2.10	6.856	3.52	352	1132.9	521.6	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	126 (C)	1011.90	1.80	1.80	3.128	1.49	294.1	1.43	25.13	20.94	0.0021	630.8	2.1	4464.4	1.80	2.10	6.856	3.52	310	985.8	461.3	1.43	25.13	20.94	0.0021	1261.6	2.7		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	127 (C)	979.90	1.80	1.80	3.128	1.49	284.8	1.43	25.13	20.94	0.0021	630.8	2.2	4183.9	1.80	2.10	6.856	3.52	291	917.2	433.2	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	128 (C)	979.90	1.80	1.80	3.128	1.49	284.8	1.43	25.13	20.94	0.0021	630.8	2.2	4183.9	1.80	2.10	6.856	3.52	291	917.2	433.2	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	129 (C)	957.70	1.80	1.80	3.128	1.49	278.3	1.43	25.13	20.94	0.0021	630.8	2.3	4183.7	1.80	2.10	6.856	3.52	291	917.2	433.2	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	130 (C)	910.30	1.80	1.80	3.128	1.49	261.6	1.43	25.13	20.94	0.0021	630.8	2.4	4220.5	1.80	2.10	6.856	3.52	293	926.2	436.8	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	131 (C)	895.20	1.80	1.80	3.128	1.49	260.2	1.43	25.13	20.94	0.0021	630.8	2.4	5346.6	1.80	2.10	6.856	3.52	371	1201.5	549.7	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	132 (C)	863.40	1.80	1.80	3.128	1.49	250.9	1.43	25.13	20.94	0.0021	630.8	2.5	5066.1	1.80	2.10	6.856	3.52	352	1132.9	521.6	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	133 (C)	863.40	1.80	1.80	3.128	1.49	250.9	1.43	25.13	20.94	0.0021	630.8	2.5	5066.1	1.80	2.10	6.856	3.52	352	1132.9	521.6	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	af E al 22	0.70	0.70	P9	af D al 22	0.70	1.00	1.20	1.10	134 (C)	841.20	1.80	1.80	3.128	1.49	244.5	1.43	25.13	20.94	0.0021																		

TN_CORPO 3_ VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)				Aço (A500 NR)			
fck	fc'd	fctm		fyk		fyd	
(MPa)	(MPa)	(MPa)		(MPa)		(MPa)	
30	20.0	2.9		500		435	

Alinhamento 23 - Verificação da Rotura do Solo de Fundação																																					
Sapata	PILAR	Eixos	b ₁₂		l ₁₂	PILAR	Eixos	b ₁₂		l ₁₂	Caso	N ₁₂		c ₁	I	B ₁₂	L _H	c ₂	H _{tot}	Pp-Terra +massame+ Ppsap	N(P1+P2)+Pp	x	e	L'	H _{min}	Rigidez	Q _{ult}	Q _{usd}	FS								
			(m)					(m)				(kN)																									
			(m)	(m)				(m)	(m)			(m)	(m)	(m)	(m)	(m)	(m)	(m)	(kN)	(kN)	(m)	(m)	(m)	(m)	(m)					(m)	(m)	(kN)	(kN)	(m)	(m)	(m)	(m)
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	177 (C)	583.1	3964.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.410.2	3.73	0.576	5.85	0.88	Verifica	301.6	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	178 (C)	604.7	4157.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.625.5	3.74	0.585	5.83	0.88	Verifica	289.1	400	1.33										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	179 (C)	583.1	3964.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.410.2	3.73	0.576	5.85	0.88	Verifica	289.1	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	180 (C)	583.1	3964.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.410.2	3.73	0.576	5.85	0.88	Verifica	289.1	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	181 (C)	566.7	3964.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.394.5	3.74	0.588	5.82	0.88	Verifica	289.4	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	182 (C)	531.6	3987.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.382.3	3.77	0.615	5.77	0.88	Verifica	291.5	400	1.37										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	183 (C)	604.7	4157.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.625.5	3.74	0.585	5.83	0.88	Verifica	301.6	400	1.33										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	184 (C)	604.7	4157.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.625.5	3.74	0.585	5.83	0.88	Verifica	301.6	400	1.33										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	185 (C)	588.4	4158.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.609.9	3.75	0.596	5.81	0.88	Verifica	301.9	400	1.33										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	186 (C)	553.4	4181.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.597.8	3.77	0.622	5.76	0.88	Verifica	303.9	400	1.32										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	187 (C)	730.0	3413.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.003.5	3.54	0.393	6.21	0.88	Verifica	251.8	400	1.59										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	188 (C)	648.8	3992.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.504.4	3.69	0.535	5.93	0.88	Verifica	290.1	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	189 (C)	730.0	3413.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.004.4	3.54	0.393	6.21	0.88	Verifica	251.8	400	1.59										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	190 (C)	730.0	3413.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.003.5	3.54	0.393	6.21	0.88	Verifica	251.8	400	1.59										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	191 (C)	713.6	3414.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.990.7	3.55	0.405	6.19	0.88	Verifica	251.9	400	1.59										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	192 (C)	678.4	3437.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.978.3	3.58	0.434	6.13	0.88	Verifica	253.7	400	1.58										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	193 (C)	648.8	3992.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.504.4	3.69	0.535	5.93	0.88	Verifica	290.1	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	194 (C)	648.8	3992.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.504.4	3.69	0.535	5.93	0.88	Verifica	290.1	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	195 (C)	632.4	3993.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.488.7	3.70	0.547	5.91	0.88	Verifica	290.4	400	1.38										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	196 (C)	597.4	4016.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.476.6	3.72	0.573	5.85	0.88	Verifica	292.4	400	1.37										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	197 (C)	699.3	3136.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.687.7	3.52	0.366	6.27	0.88	Verifica	234.2	400	1.71										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	198 (C)	618.1	3715.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.196.9	3.67	0.519	5.96	0.88	Verifica	272.4	400	1.47										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	199 (C)	720.9	3330.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.914.2	3.54	0.385	6.23	0.88	Verifica	246.5	400	1.62										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	200 (C)	699.3	3136.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.688.9	3.52	0.366	6.27	0.88	Verifica	234.2	400	1.71										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	201 (C)	699.3	3136.7	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.688.9	3.52	0.366	6.27	0.88	Verifica	234.2	400	1.71										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	202 (C)	682.9	3137.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.683.2	3.53	0.378	6.24	0.88	Verifica	234.4	400	1.71										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	203 (C)	647.8	3160.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.671.0	3.56	0.409	6.18	0.88	Verifica	236.1	400	1.69										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	204 (C)	639.9	3909.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.412.4	3.68	0.531	5.94	0.88	Verifica	284.6	400	1.40										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	205 (C)	618.1	3715.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.196.9	3.67	0.519	5.96	0.88	Verifica	272.4	400	1.47										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	206 (C)	618.1	3715.9	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.196.9	3.67	0.519	5.96	0.88	Verifica	272.4	400	1.47										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	207 (C)	601.6	3716.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.181.1	3.68	0.531	5.94	0.88	Verifica	272.7	400	1.47										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	208 (C)	566.7	3739.5	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.169.1	3.71	0.559	5.88	0.88	Verifica	274.6	400	1.46										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	209 (C)	720.9	3330.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.914.2	3.54	0.385	6.23	0.88	Verifica	246.5	400	1.62										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	210 (C)	720.9	3330.4	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.914.2	3.54	0.385	6.23	0.88	Verifica	246.5	400	1.62										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	211 (C)	704.5	3331.1	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.898.5	3.55	0.397	6.21	0.88	Verifica	246.7	400	1.62										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	212 (C)	669.5	3354.0	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.886.4	3.58	0.426	6.15	0.88	Verifica	249.4	400	1.61										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	213 (C)	639.9	3909.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.412.4	3.68	0.531	5.94	0.88	Verifica	284.6	400	1.40										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	214 (C)	639.9	3909.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.412.4	3.68	0.531	5.94	0.88	Verifica	284.6	400	1.40										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	215 (C)	623.4	3910.3	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.386.6	3.69	0.542	5.92	0.88	Verifica	285.0	400	1.40										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	216 (C)	588.3	3932.2	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.384.4	3.72	0.569	5.86	0.88	Verifica	287.0	400	1.39										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	217 (C)	699.1	3136.8	0.00	4.40	3.20	7.00	2.25	1.20	862.9	4.698.8	3.52	0.366	6.27	0.88	Verifica	234.3	400	1.71										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	218 (C)	618.1	3716.6	0.00	4.40	3.20	7.00	2.25	1.20	862.9	5.196.9	3.67	0.519	5.96	0.88	Verifica	272.4	400	1.47										
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	219 (C)	720.7	3330.																										

Betão (C30/37)			Aço (A500 NR)	
fck	fcd	fctm	fyk	fyd
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
30	20.0	2.9	500	435

Alinhamento 23 - Verificação de Armaduras

		Direção XX																				Direção YY																			
Sapata	Pilar	Nº	b _{ba}	i _{ba}	PILAR	Eixos	Caso	N _{Ed,xx}	N _{Ed,yy}	C _x	I	B	L	X	L'	C _y	H	d	PptTerra Armazenagem ap	N _{Ed,x}	Q _{uE} B	M _{Ed,xx}	μ	e	A _{s,Ed,xx} (cm²)	A _{s,Ed,y} (cm²/mm)	A _{s,Ed,yy} (cm²)	Ø	A _{s,Ed} (cm²/mm)	Obs	n _{is}	q _{iso} (kPa)	K _{N,MV}	e _p	r _{is}	μ	e	A _{s,Ed,xx} (cm²/mm)	Ø	A _{s,Ed} (cm²/mm)	Obs
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	100 (C)	862.8	5756.0	0.00	4.40	3.20	7.00	3.78	5.74	2.25	1.20	1.0	862.9	7421.7	1232.4	-1375.8	0.018	0.018	8.07	0.010	0.010	25.13	Verifica	1.53	164.5	128.5	2.65	678.8	530.3	0.022	0.022	11.21	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	105 (C)	862.8	5756.0	0.00	4.40	3.20	7.00	3.78	5.74	2.25	1.20	1.0	862.9	7421.7	1232.4	-1375.8	0.017	0.017	8.07	0.010	0.010	25.13	Verifica	1.53	164.5	128.5	2.65	678.8	530.3	0.021	0.021	11.21	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	107 (C)	770.3	5465.5	0.00	4.40	3.20	7.00	3.77	5.76	2.25	1.20	1.0	862.9	7098.7	1227.7	-1332.3	0.017	0.017	8.07	0.010	0.010	25.13	Verifica	1.53	157.8	123.3	2.65	644.5	503.3	0.021	0.021	10.64	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	108 (C)	745.6	5466.6	0.00	4.40	3.20	7.00	3.78	5.73	2.25	1.20	1.0	862.9	7075.1	1234.3	-1356.9	0.017	0.017	8.61	0.010	0.010	25.13	Verifica	1.53	152.8	118.4	2.65	644.5	503.6	0.021	0.021	10.64	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	109 (C)	693.5	5466.6	0.00	4.40	3.20	7.00	3.78	5.72	2.25	1.20	1.0	862.9	7030.0	1244.6	-1370.0	0.017	0.017	8.61	0.010	0.010	25.13	Verifica	1.53	142.0	108.0	2.65	609.0	506.8	0.021	0.021	10.71	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	110 (C)	862.8	5756.0	0.00	4.40	3.20	7.00	3.78	5.74	2.25	1.20	1.0	862.9	7421.7	1232.4	-1375.8	0.018	0.018	8.07	0.010	0.010	25.13	Verifica	1.53	164.5	128.5	2.65	678.8	530.3	0.022	0.022	11.21	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	111 (C)	802.8	5756.0	0.00	4.40	3.20	7.00	3.78	5.74	2.25	1.20	1.0	862.9	7421.7	1232.4	-1375.8	0.018	0.018	8.07	0.010	0.010	25.13	Verifica	1.53	164.5	128.5	2.65	678.8	530.3	0.022	0.022	11.21	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	112 (C)	778.2	5757.1	0.00	4.40	3.20	7.00	3.79	5.72	2.25	1.20	1.0	862.9	7398.2	1240.0	-1359.0	0.018	0.018	8.96	0.010	0.010	25.13	Verifica	1.53	159.5	124.6	2.65	678.9	530.4	0.022	0.022	11.21	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	113 (C)	754.6	5756.0	0.00	4.40	3.20	7.00	3.79	5.74	2.25	1.20	1.0	862.9	7421.7	1232.4	-1375.8	0.018	0.018	8.96	0.010	0.010	25.13	Verifica	1.53	164.5	128.5	2.65	678.9	530.4	0.022	0.022	11.21	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	114 (C)	745.5	3551.8	0.00	4.40	3.20	7.00	3.56	6.19	2.25	1.20	1.0	862.9	5160.2	1331.4	-1044.8	0.013	0.014	6.87	0.010	0.010	25.13	Verifica	1.53	152.8	119.3	2.65	418.8	327.2	0.014	0.014	6.89	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	115 (C)	623.7	4420.7	0.00	4.40	3.20	7.00	3.55	6.19	2.25	1.20	1.0	862.9	5607.3	1019.5	-1113.7	0.014	0.014	7.33	0.010	0.010	25.13	Verifica	1.53	127.8	99.8	2.65	521.3	407.3	0.017	0.017	8.59	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	116 (C)	745.5	3551.8	0.00	4.40	3.20	7.00	3.56	6.19	2.25	1.20	1.0	862.9	5160.2	1331.4	-1044.8	0.013	0.014	6.87	0.010	0.010	25.13	Verifica	1.53	152.8	119.3	2.65	418.8	327.2	0.014	0.014	6.89	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	117 (C)	651.8	3551.8	0.00	4.40	3.20	7.00	3.56	6.19	2.25	1.20	1.0	862.9	5160.2	1331.4	-1044.8	0.013	0.014	6.87	0.010	0.010	25.13	Verifica	1.53	152.8	119.3	2.65	418.8	327.2	0.014	0.014	6.89	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	118 (C)	720.8	3551.8	0.00	4.40	3.20	7.00	3.57	6.15	2.25	1.20	1.0	862.9	5160.2	1331.4	-1044.8	0.013	0.013	6.82	0.010	0.010	25.13	Verifica	1.53	147.7	115.4	2.65	419.0	327.3	0.014	0.014	6.89	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	119 (C)	668.3	3587.2	0.00	4.40	3.20	7.00	3.61	6.07	2.25	1.20	1.0	862.9	5118.4	1343.2	-1024.2	0.013	0.013	6.74	0.010	0.010	25.13	Verifica	1.53	136.9	107.0	2.65	423.3	330.5	0.014	0.014	6.96	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	120 (C)	623.7	4420.7	0.00	4.40	3.20	7.00	3.55	5.79	2.25	1.20	1.0	862.9	5607.3	1019.5	-1113.7	0.014	0.014	7.33	0.010	0.010	25.13	Verifica	1.53	127.8	99.8	2.65	521.3	407.3	0.017	0.017	8.59	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	121 (C)	640.3	4420.7	0.00	4.40	3.20	7.00	3.63	5.79	2.25	1.20	1.0	862.9	5607.3	1019.5	-1113.7	0.014	0.014	7.33	0.010	0.010	25.13	Verifica	1.53	127.8	99.8	2.65	521.3	407.3	0.017	0.017	8.59	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	122 (C)	599.1	4421.7	0.00	4.40	3.20	7.00	3.77	5.76	2.25	1.20	1.0	862.9	5883.7	1021.0	-1098.1	0.014	0.014	7.23	0.010	0.010	25.13	Verifica	1.53	122.8	95.9	2.65	521.4	407.4	0.017	0.017	8.59	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	123 (C)	546.6	4456.0	0.00	4.40	3.20	7.00	3.81	5.69	2.25	1.20	1.0	862.9	5865.5	1031.2	-1065.7	0.014	0.014	7.01	0.010	0.010	25.13	Verifica	1.53	112.0	87.5	2.65	525.5	410.5	0.017	0.017	8.66	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	124 (C)	944.6	4224.2	0.00	4.40	3.20	7.00	3.53	6.24	2.25	1.20	1.0	862.9	6031.7	967.3	-1224.5	0.016	0.016	8.07	0.010	0.010	25.13	Verifica	1.53	193.6	151.2	2.65	498.8	389.2	0.016	0.016	8.20	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	125 (C)	509.3	4224.2	0.00	4.40	3.20	7.00	3.53	6.24	2.25	1.20	1.0	862.9	6031.7	967.3	-1224.5	0.016	0.016	8.07	0.010	0.010	25.13	Verifica	1.53	193.6	151.2	2.65	498.8	389.2	0.016	0.016	8.20	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	126 (C)	977.1	4514.7	0.00	4.40	3.20	7.00	3.55	6.19	2.25	1.20	1.0	862.9	6354.7	1026.2	-1287.0	0.017	0.017	8.48	0.010	0.010	25.13	Verifica	1.53	200.2	156.4	2.65	532.4	415.9	0.017	0.017	8.77	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	127 (C)	944.6	4224.2	0.00	4.40	3.20	7.00	3.53	6.24	2.25	1.20	1.0	862.9	6031.7	967.3	-1224.5	0.016	0.016	8.07	0.010	0.010	25.13	Verifica	1.53	193.6	151.2	2.65	498.8	389.2	0.016	0.016	8.20	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	128 (C)	444.6	4224.2	0.00	4.40	3.20	7.00	3.53	6.24	2.25	1.20	1.0	862.9	6031.7	967.3	-1224.5	0.016	0.016	8.07	0.010	0.010	25.13	Verifica	1.53	193.6	151.2	2.65	498.8	389.2	0.016	0.016	8.20	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	129 (C)	919.9	4225.3	0.00	4.40	3.20	7.00	3.55	6.21	2.25	1.20	1.0	862.9	6008.1	988.0	-1277.8	0.016	0.016	8.02	0.010	0.010	25.13	Verifica	1.53	189.5	147.3	2.65	498.3	389.3	0.016	0.016	8.21	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	130 (C)	867.2	4259.6	0.00	4.40	3.20	7.00	3.58	6.13	2.25	1.20	1.0	862.9	5989.7	976.4	-1207.3	0.016	0.016	7.95	0.010	0.010	25.13	Verifica	1.53	177.7	138.8	2.65	503.3	392.4	0.016	0.016	8.27	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	131 (C)	855.4	5383.6	0.00	4.40	3.20	7.00	3.72	5.86	2.25	1.20	1.0	862.9	7101.9	1211.2	-1365.4	0.018	0.018	8.00	0.010	0.010	25.13	Verifica	1.53	175.3	136.9	2.65	634.9	460.0	0.020	0.020	10.48	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	132 (C)	822.9	5093.0	0.00	4.40	3.20	7.00	3.72	5.86	2.25	1.20	1.0	862.9	6773.8	1151.6	-1310.7	0.017	0.017	8.48	0.010	0.010	25.13	Verifica	1.53	168.6	131.7	2.65	600.5	469.2	0.019	0.020	9.91	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	133 (C)	798.2	5094.1	0.00	4.40	3.20	7.00	3.71	5.89	2.25	1.20	1.0	862.9	6773.8	1151.6	-1310.7	0.017	0.017	8.48	0.010	0.010	25.13	Verifica	1.53	168.6	131.7	2.65	600.5	469.2	0.019	0.020	9.91	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	134 (C)	745.6	5128.4	0.00	4.40	3.20	7.00	3.75	5.79	2.25	1.20	1.0	862.9	6736.9	1162.7	-1307.0	0.016	0.017	8.37	0.010	0.010	25.13	Verifica	1.53	152.8	119.4	2.65	604.8	472.5	0.020	0.020	9.98	0.20	Verifica	
SS	P10	aI E al 23	0.70	0.70	P9	aD al 23	135 (C)	753.5	5128.4	0.00	4.40	3.20	7.00	3.72	5.86	2.25	1.20	1.0	862.9	6736.9	1162.7	-1307.0	0.016	0.017	8.37	0.010	0.010	25.13	Verifica	1.53	152.8	119.4	2.65	604.8	472.5	0.020	0				

TN_CORPO_3_VERIFICAÇÃO DE FUNDAÇÕES_SAPATAS COMBINADAS

Betão (C30/37)			Aço (A500 NR)		
fck	fc'd	fctm	fyk	fyd	
(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	
30	20.0	2.9	500	455	

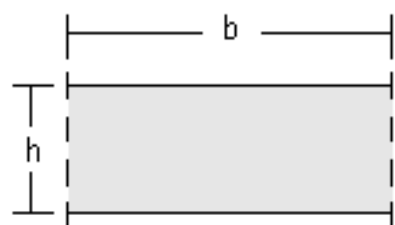
Alinhamento 23 - Verificação Estado Limite Último de Punçãoamento																																							
Sapata	Pilar	Nº	b ₁ (m)	l ₁ (m)	PILAR	Eixos	b ₂ (m)	l ₂ (m)	H (m)	d (m)	Caso	N _{des} (kN)	by10 (m)	bz10 (m)	u1 (m)	Ao (m2)	q _{des} (kN/m²)	A _{Vdes} (kN)	V _{des} (kN)	k	Ao.X (cm2/m)	As.Y (cm2/m)	pl	V _{des} (kN/m²)	FS	N _{des} (kN)	by2 (m)	bz2 (m)	u1 (m)	Ao (m2)	q _{des} (kN/m²)	A _{Vdes} (kN)	V _{des} (kN)	k	As.X (cm2/m)	As.Y (cm2/m)	pl	V _{des} (kN/m²)	FS
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	105 (C)	802.80	1.80	1.80	3.128	1.49	233.3	1.43	25.13	20.94	0.0021	630.8	2.7	5766.0	1.80	2.10	6.856	3.52	400	1301.5	590.7	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	106 (C)	770.30	1.80	1.80	3.128	1.49	223.9	1.43	25.13	20.94	0.0021	630.8	2.8	5465.5	1.80	2.10	6.856	3.52	380	1290.5	561.6	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	107 (C)	770.30	1.80	1.80	3.128	1.49	223.9	1.43	25.13	20.94	0.0021	630.8	2.8	5465.5	1.80	2.10	6.856	3.52	380	1290.5	561.6	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	108 (C)	745.60	1.80	1.80	3.128	1.49	216.7	1.43	25.13	20.94	0.0021	630.8	2.9	5466.6	1.80	2.10	6.856	3.52	380	1230.8	561.7	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	109 (C)	693.00	1.80	1.80	3.128	1.49	201.4	1.43	25.13	20.94	0.0021	630.8	3.1	5500.8	1.80	2.10	6.856	3.52	382	1239.2	565.1	1.43	25.13	20.94	0.0021	1261.6	2.2		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	110 (C)	802.80	1.80	1.80	3.128	1.49	233.3	1.43	25.13	20.94	0.0021	630.8	2.7	5756.0	1.80	2.10	6.856	3.52	400	1301.5	590.7	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	111 (C)	802.80	1.80	1.80	3.128	1.49	233.3	1.43	25.13	20.94	0.0021	630.8	2.7	5756.0	1.80	2.10	6.856	3.52	400	1301.5	590.7	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	112 (C)	778.20	1.80	1.80	3.128	1.49	226.2	1.43	25.13	20.94	0.0021	630.8	2.8	5757.1	1.80	2.10	6.856	3.52	400	1301.8	590.8	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	113 (C)	725.60	1.80	1.80	3.128	1.49	210.9	1.43	25.13	20.94	0.0021	630.8	3.0	5791.4	1.80	2.10	6.856	3.52	402	1310.2	594.2	1.43	25.13	20.94	0.0021	1261.6	2.1		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	114 (C)	745.50	1.80	1.80	3.128	1.49	216.7	1.43	25.13	20.94	0.0021	630.8	2.9	3551.8	1.80	2.10	6.856	3.52	247	762.7	369.8	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	115 (C)	623.70	1.80	1.80	3.128	1.49	181.3	1.43	25.13	20.94	0.0021	630.8	3.5	4420.7	1.80	2.10	6.856	3.52	307	975.1	456.9	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	116 (C)	745.50	1.80	1.80	3.128	1.49	216.7	1.43	25.13	20.94	0.0021	630.8	2.9	3551.8	1.80	2.10	6.856	3.52	247	762.7	369.8	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	117 (C)	745.50	1.80	1.80	3.128	1.49	216.7	1.43	25.13	20.94	0.0021	630.8	2.9	3551.8	1.80	2.10	6.856	3.52	247	762.7	369.8	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	118 (C)	720.80	1.80	1.80	3.128	1.49	209.5	1.43	25.13	20.94	0.0021	630.8	3.0	3552.9	1.80	2.10	6.856	3.52	247	763.0	370.0	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	119 (C)	668.30	1.80	1.80	3.128	1.49	194.2	1.43	25.13	20.94	0.0021	630.8	3.2	3587.2	1.80	2.10	6.856	3.52	249	771.3	373.4	1.43	25.13	20.94	0.0021	1261.6	3.4		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	120 (C)	623.70	1.80	1.80	3.128	1.49	181.3	1.43	25.13	20.94	0.0021	630.8	3.5	4420.7	1.80	2.10	6.856	3.52	307	975.1	456.9	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	121 (C)	623.70	1.80	1.80	3.128	1.49	181.3	1.43	25.13	20.94	0.0021	630.8	3.5	4420.7	1.80	2.10	6.856	3.52	307	975.1	456.9	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	122 (C)	599.10	1.80	1.80	3.128	1.49	174.1	1.43	25.13	20.94	0.0021	630.8	3.6	4421.7	1.80	2.10	6.856	3.52	307	975.4	457.0	1.43	25.13	20.94	0.0021	1261.6	2.8		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	123 (C)	546.60	1.80	1.80	3.128	1.49	158.9	1.43	25.13	20.94	0.0021	630.8	4.0	4456.0	1.80	2.10	6.856	3.52	309	983.7	460.4	1.43	25.13	20.94	0.0021	1261.6	2.7		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	124 (C)	944.60	1.80	1.80	3.128	1.49	274.5	1.43	25.13	20.94	0.0021	630.8	2.3	4224.2	1.80	2.10	6.856	3.52	293	927.1	437.2	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	125 (C)	822.90	1.80	1.80	3.128	1.49	239.2	1.43	25.13	20.94	0.0021	630.8	2.6	5093.0	1.80	2.10	6.856	3.52	354	1139.5	524.2	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	126 (C)	977.10	1.80	1.80	3.128	1.49	284.0	1.43	25.13	20.94	0.0021	630.8	2.2	4514.7	1.80	2.10	6.856	3.52	314	998.1	466.3	1.43	25.13	20.94	0.0021	1261.6	2.7		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	127 (C)	944.60	1.80	1.80	3.128	1.49	274.5	1.43	25.13	20.94	0.0021	630.8	2.3	4224.2	1.80	2.10	6.856	3.52	293	927.1	437.2	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	128 (C)	944.60	1.80	1.80	3.128	1.49	274.5	1.43	25.13	20.94	0.0021	630.8	2.3	4224.2	1.80	2.10	6.856	3.52	293	927.1	437.2	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	129 (C)	919.90	1.80	1.80	3.128	1.49	267.4	1.43	25.13	20.94	0.0021	630.8	2.4	4225.3	1.80	2.10	6.856	3.52	293	927.3	437.3	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	130 (C)	867.20	1.80	1.80	3.128	1.49	252.0	1.43	25.13	20.94	0.0021	630.8	2.5	4296.6	1.80	2.10	6.856	3.52	296	935.7	440.8	1.43	25.13	20.94	0.0021	1261.6	2.9		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	131 (C)	855.40	1.80	1.80	3.128	1.49	248.6	1.43	25.13	20.94	0.0021	630.8	2.5	5383.6	1.80	2.10	6.856	3.52	374	1210.5	553.4	1.43	25.13	20.94	0.0021	1261.6	2.3		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	132 (C)	822.90	1.80	1.80	3.128	1.49	239.2	1.43	25.13	20.94	0.0021	630.8	2.6	5093.0	1.80	2.10	6.856	3.52	354	1139.5	524.2	1.43	25.13	20.94	0.0021	1261.6	2.4		
S5	P10	al E al 23	0.70	0.70	P9	al D al 23	0.70	1.00	1.20	1.10	133 (C)	822.90	1.80	1.80	3.128	1.49	239.2	1.43	25.13	20.94	0.0021	630.8	2.6	5093.0	1.80														

9.8 REFORÇO ESTRUTURAL

9.8.1 REFORÇO DE LAJES PISO

S&P FRP Lamella

reforço à flexão e ao corte usando materiais de FRP



seccção transversal

geometria

laje

b = 100 [cm]

h = 20 [cm]

betão

classe: C 30/37

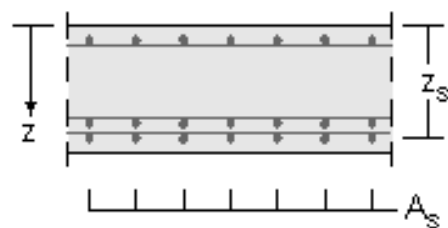
$f_{ck} = 30$ [N/mm²]
 $\epsilon_{cu} = 3,5$ [‰]
 $\epsilon_{c2} = 2$ [‰]

$\alpha_{cc} = 1$ [-]
 $E_{cm} = 32837$ [N/mm²]
 $f_{ctm} = 2,9$ [N/mm²]
 $\alpha_{ct} = 1$ [-]

$\gamma_c = 1,5$ [-]

aço

$\gamma_s = 1,15$ [-]



armadura de flexão

varões principais

No.	A _s [cm ²]	z _s [cm]	classe do aço	f _{yk} [N/mm ²]	E _s [N/mm ²]	d _s [mm]
1	7,54	15,8	A 500	500	200000	12

solicitações

<u>situação pré-reforço</u>	momento no vão (positivo)	força de compressão
no instante do reforço	$M = 12,15$ [kNm]	$N_{Ek0} = 0$ [kN]
pré-esforço (estaticamente determinado)	$M_{p0} = 0$ [kNm]	$N_p = 0$ [kN]
zona de flexo-tracção não fissurada		

<u>situação pós-reforço</u>	momento no vão (positivo)	força de compressão
estado limite último	$M_{Ed} = 68$ [kNm]	$N_{Ed} = 0$ [kN]
coeficiente de segurança parcial	$\gamma_{M,m} = 1,7$ [-]	$\gamma_{N,m} = 0$ [-]
estado de serviço	$M_{Ek} = 40$ [kNm]	$N_{Ek} = 0$ [kN]

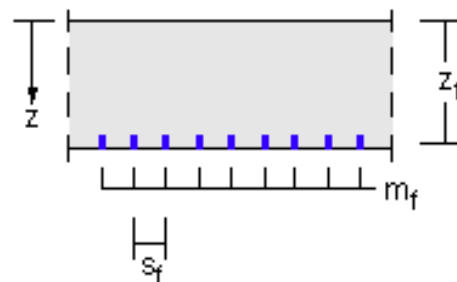
reforço à flexão

sistema FRP

S&P CFK 150/2000
S&P Resin 220

laminados inseridos

$$\begin{aligned} E_{fk} &= 170000 \text{ [N/mm}^2\text{]} \\ f_{fk} &= 2800 \text{ [N/mm}^2\text{]} \\ \varepsilon_{fu} &= 16 \text{ [‰]} \\ \gamma_f &= 1,2 \text{ [-]} \\ k &= 0,8 \text{ [-]} \\ \varepsilon_{f,limite}^{\varepsilon} &= 10,98 \text{ [‰]} \end{aligned}$$



secção transversal do FRP

No.	secção [mm/mm]	n_f [pcs]	m_f [pcs]	s_f [cm]	A_f [cm ²]	z_f [cm]
1	10 / 1.4	1	5	20	0,7	20

análise

Eurocódigo 2

em referencia a

DIBt Zulassungen Z-36.12-62 / Z-36.12-67

situação pré-reforço

resistência da secção não reforçada:

$$M_{Rd0} = 49 \quad [\text{kNm}]$$

$$M_{Re0} = 56,6 \quad [\text{kNm}]$$

situação pós-reforço

nível de reforço: $\eta_M = 1,39 \quad [-]$

segurança em caso de
perda dos laminados: $\gamma_{Me} = 1,42 \quad [-]$

dimensionamento

$$A_{f,nec} = 0,59 \quad [\text{cm}^2]$$

$$A_{f,efet} = 0,7 \quad [\text{cm}^2]$$

$$M_{Ed} = 68 \quad [\text{kNm}]$$

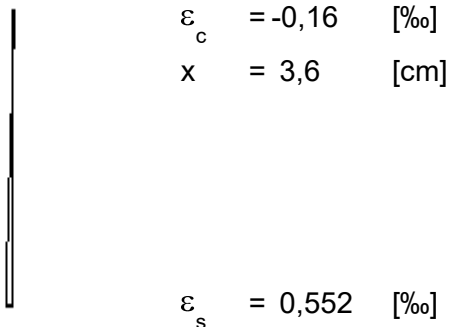
$$M_{Rd} = 71,5 \quad [\text{kNm}]$$

verificação

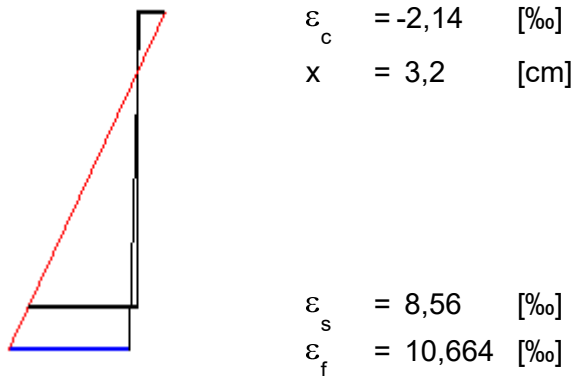
$$M_{Rd} > M_{Ed}$$



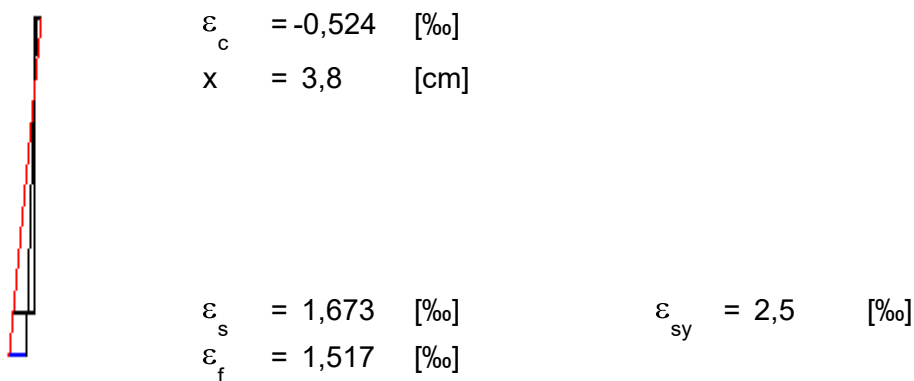
extensões iniciais



extensões - estado limite último ($A_{f,nec}$)



extensões / tensão - estado limite de serviço ($A_{f,efet}$)



tensões

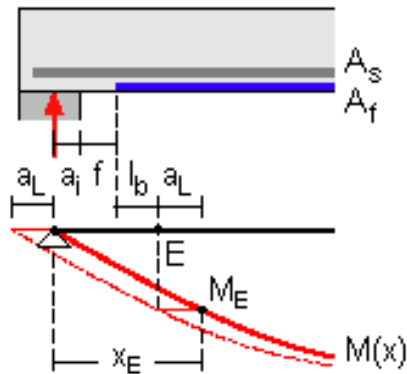
betão	$\sigma_{c,max} = -13,67$	[N/mm ²]
aço	$\sigma_{s,max} = 334,68$	[N/mm ²]
material FRP	$\sigma_{f,max} = 257,82$	[N/mm ²]

tensões limites

$\sigma_{c,limite} = -18$	[N/mm ²]
$\sigma_{s,limite} = 400$	[N/mm ²]



amarração do FRP na extremidade



$a_i = 0 \quad [\text{cm}]$
 $a_f = 17 \quad [\text{cm}]$

resistência adesiva de corte
S&P Resin 220
 $\gamma_b = 1,5 \quad [-]$

forças internas no ponto E

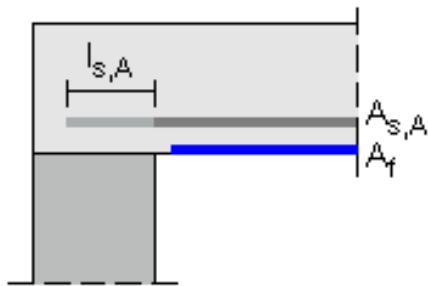
$x_E = 0 \quad [\text{cm}]$
 $M_{Ed,E} = 0 \quad [\text{kNm}]$
 $N_{Ed,E} = 0 \quad [\text{kN}]$

armadura no ponto E

No.	A_s [cm ²]	z_s [cm]
1	7,54	15,8

cálculo não efectuado !

amarração da armadura de flexão no apoio



apoio extremo

apoio directo

inserida na extremidade

resistência adesiva de corte

S&P Resin 220

forças internas no apoio

$V_{Ed,A}$
=
0
[kN]

$N_{Ed,A}$
=
0
[kN]

armadura no apoio

	A_s	z_s	d_s	$l_{s,A}$	$\alpha_{1..5}$	secção
No.	[cm²]	[cm]	[mm]	[cm]	[-]	
1	7,54	15,8	12	0	1	nervurado

cálculo não efectuado !

reforço ao corte

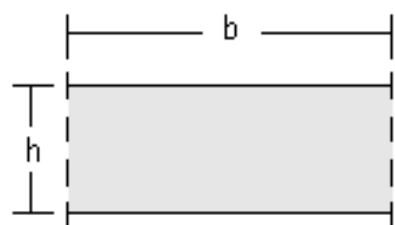
forças internas no ponto X

$V_{Ed,x}$	= 90	[kN]	x_x	= 0	[cm]
$M_{Ed,x}$	= 68	[kNm]			
$N_{Ed,x}$	= 0	[kN]			força de compressão

cálculo não efectuado !

S&P FRP Lamella

reforço à flexão e ao corte usando materiais de FRP



seccção transversal

geometria

laje

b = 100 [cm]
h = 20 [cm]

betão

classe:

C 30/37

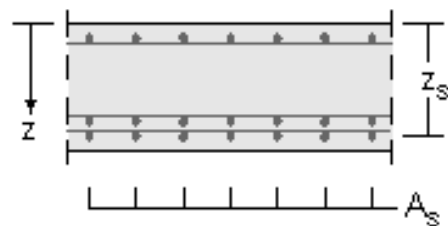
$f_{ck} = 30$ [N/mm²]
 $\epsilon_{cu} = 3,5$ [‰]
 $\epsilon_{c2} = 2$ [‰]

$\alpha_{cc} = 1$ [-]
 $E_{cm} = 32837$ [N/mm²]
 $f_{ctm} = 2,9$ [N/mm²]
 $\alpha_{ct} = 1$ [-]

$\gamma_c = 1,5$ [-]

aço

$\gamma_s = 1,15$ [-]



armadura de flexão

varões principais

No.	A_s [cm ²]	z_s [cm]	classe do aço	f_{yk} [N/mm ²]	E_s [N/mm ²]	d_s [mm]
1	11,31	15,8	A 500	500	200000	12

solicitações

<u>situação pré-reforço</u>	momento no vão (positivo)	força de compressão
no instante do reforço	$M = 12$ [kNm]	$N_{Ek0} = 0$ [kN]
pré-esforço (estaticamente determinado)	$M_{P0} = 0$ [kNm]	$N_P = 0$ [kN]
zona de flexo-tracção não fissurada		

<u>situação pós-reforço</u>	momento no vão (positivo)	força de compressão
estado limite último	$M_{Ed} = 91$ [kNm]	$N_{Ed} = 0$ [kN]
coeficiente de segurança parcial	$\gamma_{M,m} = 1,6$ [-]	$\gamma_{N,m} = 0$ [-]
estado de serviço	$M_{Ek} = 57$ [kNm]	$N_{Ek} = 0$ [kN]

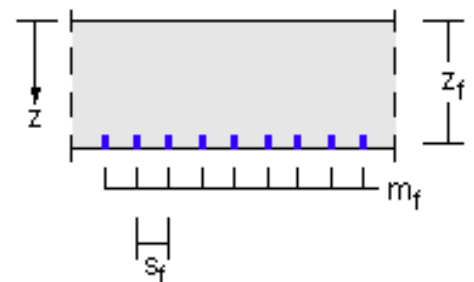
reforço à flexão

sistema FRP

S&P CFK 150/2000
S&P Resin 220

laminados inseridos

$$\begin{aligned} E_{fk} &= 170000 \text{ [N/mm}^2\text{]} \\ f_{fk} &= 2800 \text{ [N/mm}^2\text{]} \\ \varepsilon_{fu} &= 16 \text{ [‰]} \\ \gamma_f &= 1,2 \text{ [-]} \\ k &= 0,8 \text{ [-]} \\ \varepsilon_{f,limite}^{\varepsilon} &= 10,98 \text{ [‰]} \end{aligned}$$



secção transversal do FRP

No.	secção [mm/mm]	n_f [pcs]	m_f [pcs]	s_f [cm]	A_f [cm ²]	z_f [cm]
1	10 / 1.4	1	5	20	0,7	20

análise

Eurocódigo 2

em referencia a

DIBt Zulassungen Z-36.12-62 / Z-36.12-67

situação pré-reforço

resistência da secção não reforçada:

$$M_{Rd0} = 71,5 \quad [\text{kNm}]$$

$$M_{Re0} = 82,8 \quad [\text{kNm}]$$

situação pós-reforço

nível de reforço: $\eta_M = 1,27 \quad [-]$

segurança em caso de
perda dos laminados: $\gamma_{Me} = 1,45 \quad [-]$

dimensionamento

$$A_{f,nec} = 0,63 \quad [\text{cm}^2]$$

$$A_{f,efet} = 0,7 \quad [\text{cm}^2]$$

$$M_{Ed} = 91 \quad [\text{kNm}]$$

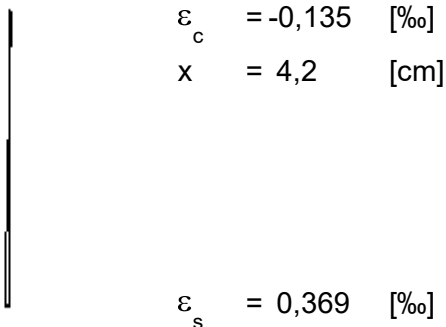
$$M_{Rd} = 93 \quad [\text{kNm}]$$

verificação

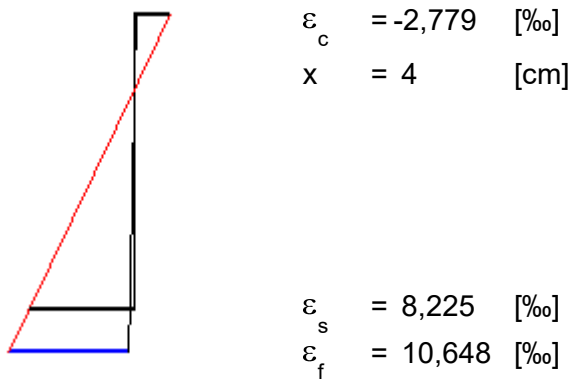
$$M_{Rd} > M_{Ed}$$



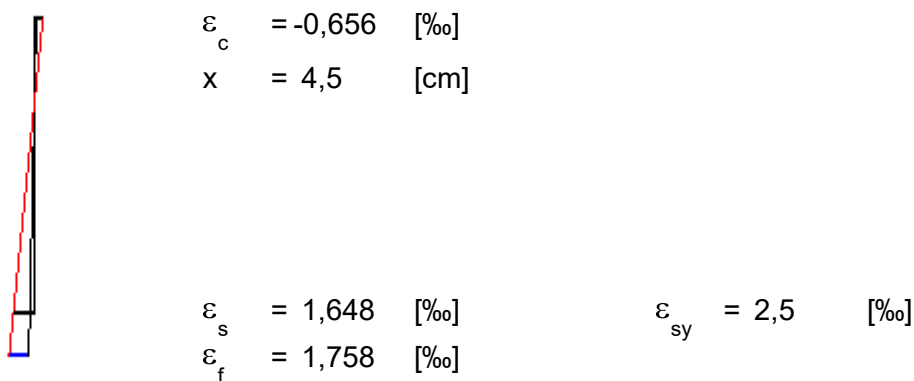
extensões iniciais



extensões - estado limite último ($A_{f,nec}$)



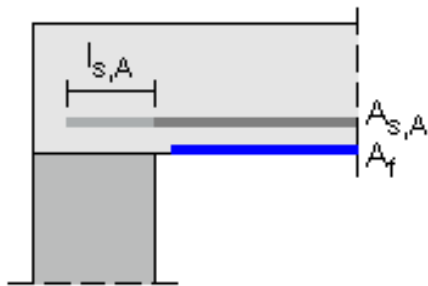
extensões / tensão - estado limite de serviço ($A_{f,efet}$)



tensões

betão	$\sigma_{c,max} = -16,44 \quad [N/mm^2]$
aço	$\sigma_{s,max} = 329,61 \quad [N/mm^2]$
material FRP	$\sigma_{f,max} = 298,79 \quad [N/mm^2]$

amarração da armadura de flexão no apoio



apoio extremo

apoio directo

inserida na extremidade

resistência adesiva de corte

S&P Resin 220

forças internas no apoio

$V_{Ed,A}$
=
0
[kN]

$N_{Ed,A}$
=
0
[kN]

armadura no apoio

	A_s	z_s	d_s	$l_{s,A}$	$\alpha_{1..5}$	secção
No.	[cm²]	[cm]	[mm]	[cm]	[-]	
1	7,54	15,8	12	0	1	nervurado

cálculo não efectuado !

reforço ao corte

forças internas no ponto X

$$\begin{array}{llll} V & = & 100 & [\text{kN}] \\ M_{\text{Ed},x} & = & 68 & [\text{kNm}] \\ N_{\text{Ed},x} & = & 0 & [\text{kN}] \end{array} \quad \begin{array}{ll} x_x & = & 0 & [\text{cm}] \\ & & & \text{força de compressão} \end{array}$$

resistência ao corte

$$V_{\text{Rd},c} = 107,33 \quad [\text{kN}]$$

verificação

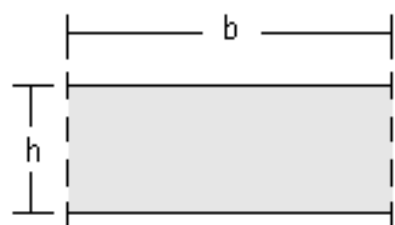
$$V_{\text{Ed}} < V_{\text{Rd},c}$$



corte ok

S&P FRP Lamella

reforço à flexão e ao corte usando materiais de FRP



seccção transversal

geometria

laje

b = 100 [cm]

h = 19 [cm]

betão

classe: C 30/37

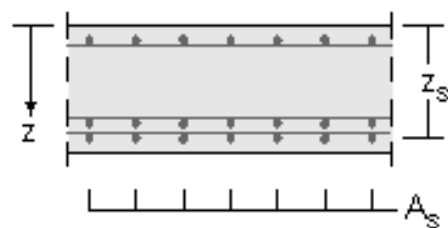
$f_{ck} = 30$ [N/mm²]
 $\epsilon_{cu} = 3,5$ [‰]
 $\epsilon_{c2} = 2$ [‰]

$\alpha_{cc} = 1$ [-]
 $E_{cm} = 32837$ [N/mm²]
 $f_{ctm} = 2,9$ [N/mm²]
 $\alpha_{ct} = 1$ [-]

$\gamma_c = 1,5$ [-]

aço

$\gamma_s = 1,15$ [-]



armadura de flexão

varões principais

No.	A _s [cm ²]	z _s [cm]	classe do aço	f _{yk} [N/mm ²]	E _s [N/mm ²]	d _s [mm]
1	4,52	3,5	A 500	500	200000	12
2	3,14	3,5	A 500	500	200000	10

solicitações

<u>situação pré-reforço</u>	momento no apoio (negativo)	força de compressão
no instante do reforço	$M = 16,3$ [kNm]	$N_{Ek0} = 0$ [kN]
pré-esforço (estaticamente determinado)	$M_{p0} = 0$ [kNm]	$N_p = 0$ [kN]
zona de flexo-tracção não fissurada		

<u>situação pós-reforço</u>	momento no apoio (negativo)	força de compressão
estado limite último	$M_{Ed} = 56,7$ [kNm]	$N_{Ed} = 0$ [kN]
coeficiente de segurança parcial	$\gamma_{M,m} = 1,72$ [-]	$\gamma_{N,m} = 0$ [-]
estado de serviço	$M_{Ek} = 32,9$ [kNm]	$N_{Ek} = 0$ [kN]

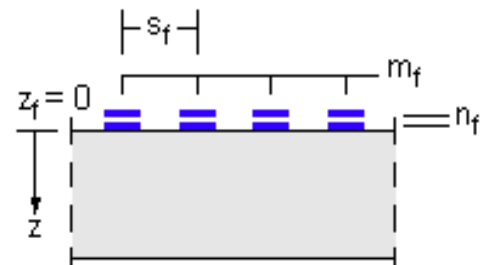
reforço à flexão

sistema FRP

S&P CFK 150/2000
S&P Resin 220

aderido externamente

$$\begin{aligned} E_{fk} &= 170000 \text{ [N/mm}^2\text{]} \\ f_{fk} &= 2800 \text{ [N/mm}^2\text{]} \\ \varepsilon_{fu} &= 16 \text{ [‰]} \\ \gamma_f &= 1,2 \text{ [-]} \\ \varepsilon_{f,limite} &= 7,5 \text{ [‰]} \end{aligned}$$



secção transversal do FRP

No.	secção	n_f	m_f	s_f	A_f	z_f
	[mm/mm]	[pcs]	[pcs]	[cm]	[cm ²]	[cm]
1	50 / 1.2	1	1,05	95	0,63	0

análise

em referencia a

Eurocódigo 2

DIBt Zulassungen Z-36.12-62 / Z-36.12-67

situação pré-reforço

resistência da secção não reforçada:

$$M_{Rd0} = 48,8 \quad [\text{kNm}]$$

$$M_{Re0} = 56,3 \quad [\text{kNm}]$$

situação pós-reforço

nível de reforço: $\eta_M = 1,16 \quad [-]$

segurança em caso de
perda dos laminados: $\gamma_{Me} = 1,71 \quad [-]$

dimensionamento

$$A_{f,nec} = 0,39 \quad [\text{cm}^2]$$

$$A_{f,efet} = 0,63 \quad [\text{cm}^2]$$

$$M_{Ed} = 56,7 \quad [\text{kNm}]$$

$$M_{Rd} = 61,9 \quad [\text{kNm}]$$

verificação

$$M_{Rd} > M_{Ed}$$



extensões iniciais

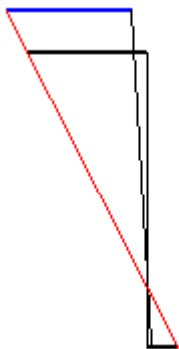


$$\varepsilon_s = 0,744 \quad [‰]$$

$$x = 3,6 \quad [\text{cm}]$$

$$\varepsilon_c = -0,222 \quad [‰]$$

extensões - estado limite último ($A_{f,nec}$)



$$\varepsilon_f = 7,5 \quad [‰]$$

$$\varepsilon_s = 6,592 \quad [‰]$$

$$x = 3,2 \quad [\text{cm}]$$

$$\varepsilon_c = -1,688 \quad [‰]$$

extensões / tensão - estado limite de serviço ($A_{f,efet}$)



$$\varepsilon_f = 0,892 \quad [‰]$$

$$\varepsilon_s = 1,43 \quad [‰]$$

$$\varepsilon_{sy} = 2,5 \quad [‰]$$



$$x = 3,7 \quad [\text{cm}]$$

$$\varepsilon_c = -0,447 \quad [‰]$$

tensões

betão

$$\sigma_{c,max} = -11,9 \quad [\text{N/mm}^2]$$

aço

$$\sigma_{s,max} = 285,98 \quad [\text{N/mm}^2]$$

material FRP

$$\sigma_{f,max} = 151,56 \quad [\text{N/mm}^2]$$

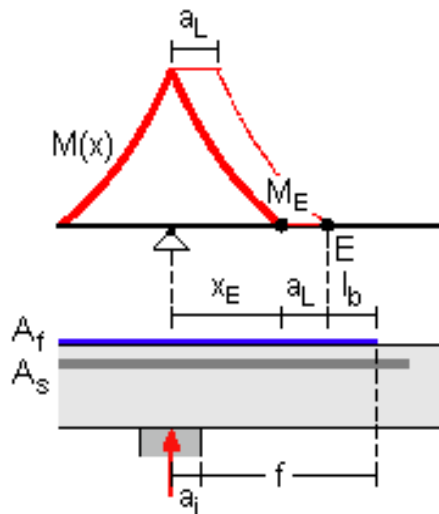
tensões limites

$$\sigma_{c,limite} = -18 \quad [\text{N/mm}^2]$$

$$\sigma_{s,limite} = 400 \quad [\text{N/mm}^2]$$



amarração do FRP na extremidade



apoio intermédio

$$a_i = 15 \text{ [cm]}$$

$$a_l = 16,2 \text{ [cm]}$$

tensão de aderência do substrato

$$f_{\text{csm}} = 1,5 \text{ [N/mm}^2\text{]}$$

resistência à compressão do betão

$$f_{\text{cm,cube}} = 37 \text{ [N/mm}^2\text{]}$$

forças internas no ponto E

$$x_E = 125 \text{ [cm]}$$

$$M_{\text{Ed,E}} = 0 \text{ [kNm]}$$

$$N_{\text{Ed,E}} = 0 \text{ [kN]}$$

armadura no ponto E

No.	A_s [cm ²]	z_s [cm]
1	4,52	3,5
2	3,14	3,5

força de amarração

No.	$F_{\text{fd,E}}$ [kN]	$F_{\text{bd,max}}$ [kN]
1	0	11,65

comprimento de amarração

$l_{\text{b,max}}$ [cm]	f_{min} [cm]
24,2	150,4

recomendado

l_b [cm]	f [cm]
100	226,2

verificação

amarração ok



aderência do FRP - cintagem mínima do reforço à flexão no ponto E

não é requerida cintagem no ponto E



reforço ao corte

forças internas no ponto X

$$\begin{array}{llll} V_{Ed,x} & = & 0 & [\text{kN}] \\ M_{Ed,x} & = & 0 & [\text{kNm}] \\ N_{Ed,x} & = & 0 & [\text{kN}] \end{array} \quad \begin{array}{ll} x_x & = & 0 & [\text{cm}] \\ & & & \text{força de compressão} \end{array}$$

cálculo não efectuado !

9.9 DIMENSIONAMENTO DOS PERFIS METÁLICOS

Nas figuras abaixo apresentam-se os elementos metálicos que existem no Corpo 3:

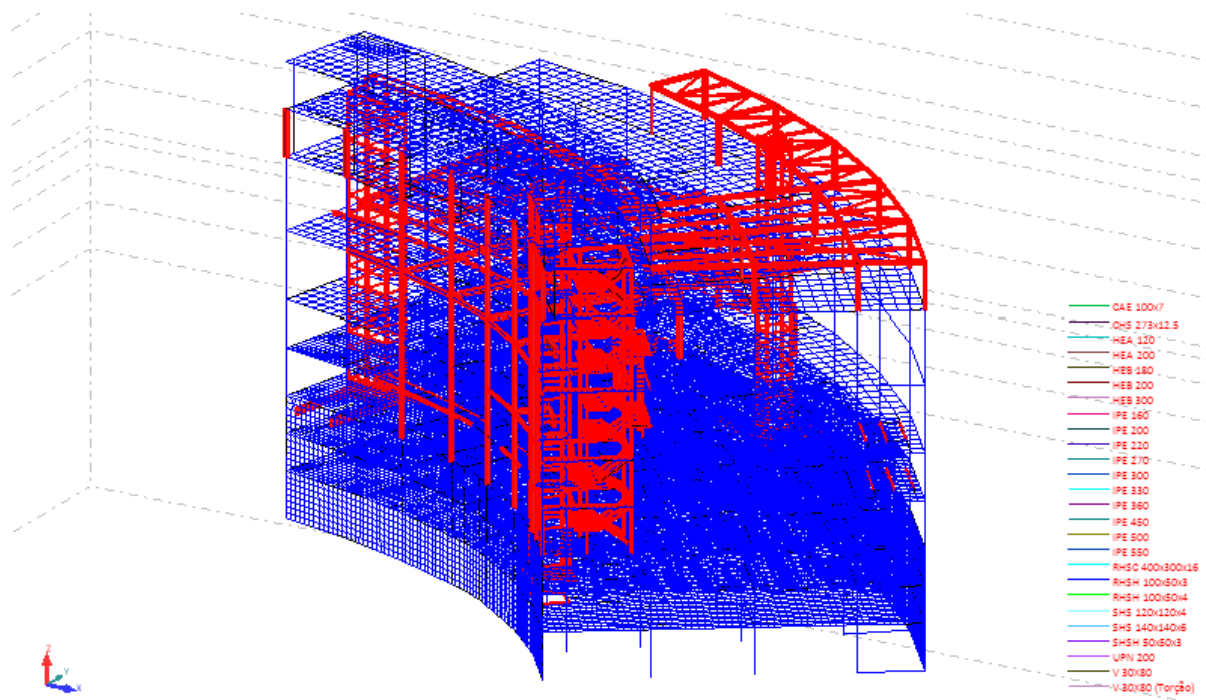


Figura 19 – Elementos estruturais metálicos no modelo global.

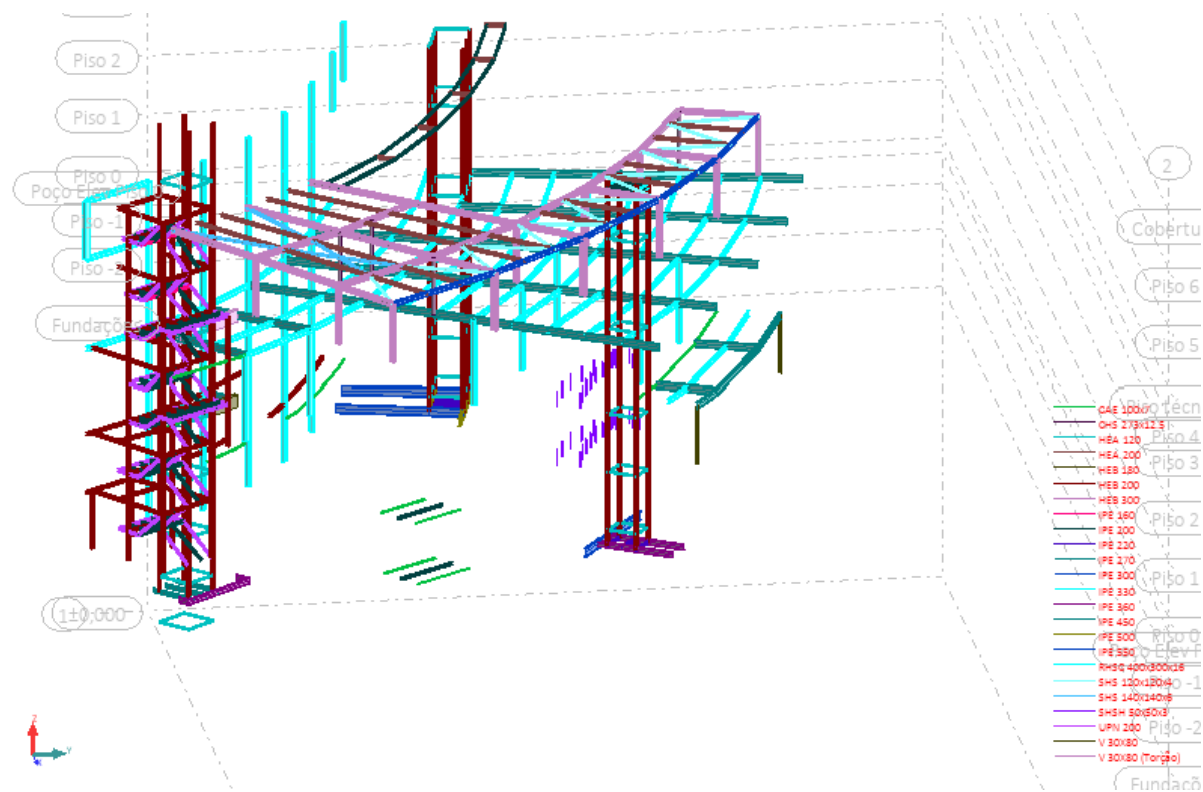


Figura 20 – Elementos estruturais metálicos.

9.9.1 PILARES

Apresenta-se a tabela resumo com os rácios de segurança da verificação dos elementos metálicos dos pilares.

Tabela 25 – Pilares – rácios de segurança das barras.

Membro	Secção	Material	Relação	Caso
6	RHSC 400x300x16	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
69	RHSC 400x300x16	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
70	RHSC 400x300x16	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
71	RHSC 400x300x16	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
72	RHSC 400x300x16	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
146	HEB 200	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
150	HEB 200	S 275	0.17	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
208	HEB 200	S 275	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
272	HEB 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
311	HEB 200	S 275	0.23	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
312	HEB 200	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
317	HEB 200	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
328	HEB 200	S 275	0.27	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
331	HEB 200	S 275	0.37	104 UNFAV_AVB SC
367	HEB 200	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
368	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
369	HEB 200	S 275	0.17	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
371	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
472	RHSC 400x300x16	S 275	0.25	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
473	RHSC 400x300x16	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
482	RHSC 400x300x16	S 275	0.25	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
483	RHSC 400x300x16	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
484	RHSC 400x300x16	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
485	RHSC 400x300x16	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
486	RHSC 400x300x16	S 275	0.20	113 UNFAV_AVB SC_SC Garagem+W270
487	RHSC 400x300x16	S 275	0.20	113 UNFAV_AVB SC_SC Garagem+W270
582	HEB 200	S 275	0.17	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
583	HEB 200	S 275	0.26	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
584	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
585	HEB 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
586	HEB 200	S 275	0.12	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
587	HEB 200	S 275	0.34	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
588	HEB 200	S 275	0.13	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
589	HEB 200	S 275	0.28	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
624	HEB 200	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
626	HEB 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
645	HEB 200	S 275	0.04	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
647	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z

649	HEB 200	S 275	0.42	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
650	HEB 200	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
651	HEB 200	S 275	0.08	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
652	HEB 200	S 275	0.16	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
653	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
654	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
655	HEB 200	S 275	0.16	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
656	HEB 200	S 275	0.17	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
659	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
664	HEB 200	S 275	0.10	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
665	HEB 200	S 275	0.14	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
666	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
730	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
738	HEB 200	S 275	0.13	113 UNFAV_AVB SC_SC Garagem+W270
740	HEB 200	S 275	0.08	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
741	HEB 200	S 275	0.10	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
743	HEB 200	S 275	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
764	HEB 200	S 275	0.42	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
765	HEB 200	S 275	0.22	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
766	HEB 200	S 275	0.36	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
767	HEB 200	S 275	0.41	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
768	HEB 200	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
769	HEB 200	S 275	0.47	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
770	HEB 200	S 275	0.43	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
771	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
772	HEB 200	S 275	0.45	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
773	HEB 200	S 275	0.27	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
774	HEB 200	S 275	0.11	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
775	HEB 200	S 275	0.41	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
776	HEB 200	S 275	0.36	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
777	HEB 200	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
778	HEB 200	S 275	0.31	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
779	HEB 200	S 275	0.45	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
780	HEB 200	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
781	HEB 200	S 275	0.35	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
782	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
783	HEB 200	S 275	0.05	135 UNFAV_AVB SC COB_SC+W270
784	HEB 200	S 275	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
785	HEB 200	S 275	0.13	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
786	HEB 200	S 275	0.06	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
787	HEB 200	S 275	0.05	113 UNFAV_AVB SC_SC Garagem+W270
788	HEB 200	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
789	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
790	HEB 200	S 275	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
791	HEB 200	S 275	0.05	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
792	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z

793	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
794	HEB 200	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
795	HEB 200	S 275	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
796	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
797	HEB 200	S 275	0.15	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
798	HEB 200	S 275	0.15	113 UNFAV_AVB SC_SC Garagem+W270
799	HEB 200	S 275	0.06	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
800	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
801	HEB 200	S 275	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
802	HEB 200	S 275	0.06	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
803	HEB 200	S 275	0.06	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
804	HEB 200	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
805	HEB 200	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
806	HEB 200	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
807	HEB 200	S 275	0.08	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
808	HEB 200	S 275	0.08	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
809	HEB 200	S 275	0.12	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
810	HEB 200	S 275	0.22	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
811	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
812	HEB 200	S 275	0.13	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
813	HEB 200	S 275	0.21	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
814	HEB 200	S 275	0.18	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
815	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
816	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
817	HEB 200	S 275	0.24	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
818	HEB 200	S 275	0.21	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
819	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
820	HEB 200	S 275	0.08	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
821	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
822	HEB 200	S 275	0.18	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
823	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
824	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
825	HEB 200	S 275	0.20	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
826	HEB 200	S 275	0.11	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
827	HEB 200	S 275	0.08	109 UNFAV_AVB SC_W270
828	HEB 200	S 275	0.16	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
829	HEB 200	S 275	0.11	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
830	HEB 200	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
831	HEB 200	S 275	0.05	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
832	HEB 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
833	HEB 200	S 275	0.08	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
834	HEB 200	S 275	0.21	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
835	HEB 200	S 275	0.16	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
836	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
837	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
838	HEB 200	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z

839	HEB 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
840	HEB 200	S 275	0.25	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
841	HEB 200	S 275	0.15	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
842	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
843	HEB 200	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
844	HEB 200	S 275	0.08	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
845	HEB 200	S 275	0.23	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
846	HEB 200	S 275	0.15	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
847	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
848	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
849	HEB 200	S 275	0.22	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
850	HEB 200	S 275	0.11	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
851	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
852	HEB 200	S 275	0.23	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
853	HEB 200	S 275	0.11	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
854	HEB 200	S 275	0.11	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
855	HEB 200	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
856	HEB 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
857	HEB 200	S 275	0.15	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
858	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
859	HEB 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
860	HEB 200	S 275	0.13	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
863	HEB 200	S 275	0.56	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
866	HEB 200	S 275	0.67	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
869	HEB 200	S 275	0.21	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
872	HEB 200	S 275	0.34	104 UNFAV_AVB SC
873	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
874	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
875	HEB 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
876	HEB 200	S 275	0.26	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
877	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
878	HEB 200	S 275	0.26	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
879	HEB 200	S 275	0.32	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
880	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
881	HEB 200	S 275	0.32	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
882	HEB 200	S 275	0.38	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
883	HEB 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
884	HEB 200	S 275	0.39	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
885	HEB 200	S 275	0.29	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
886	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
887	HEB 200	S 275	0.30	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
888	HEB 200	S 275	0.37	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
889	HEB 200	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
890	HEB 200	S 275	0.42	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
891	HEB 200	S 275	0.13	105 UNFAV_AVB SC_SC Garagem
892	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z

893	HEB 200	S 275	0.19	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
894	HEB 200	S 275	0.22	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
895	HEB 200	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
896	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
897	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
898	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
899	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
900	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
901	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
902	HEB 200	S 275	0.13	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
903	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
904	HEB 200	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
905	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
906	HEB 200	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
907	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
908	HEB 200	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
909	HEB 200	S 275	0.11	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
910	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
911	HEB 200	S 275	0.16	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
912	HEB 200	S 275	0.13	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
913	HEB 200	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
914	HEB 200	S 275	0.15	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
915	HEB 200	S 275	0.27	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
916	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
917	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
918	HEB 200	S 275	0.35	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
919	HEB 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
920	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
921	HEB 200	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
922	HEB 200	S 275	0.20	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
923	HEB 200	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
924	HEB 200	S 275	0.15	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
925	HEB 200	S 275	0.31	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
926	HEB 200	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
927	HEB 200	S 275	0.37	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
928	HEB 200	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
929	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
930	HEB 200	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
931	HEB 200	S 275	0.20	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
932	HEB 200	S 275	0.25	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
933	HEB 200	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
934	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
935	HEB 200	S 275	0.25	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
936	HEB 200	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
937	HEB 200	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
943	HEB 200	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z

953	HEB 200	S 275	0.13	113 UNFAV_AVB SC_SC Garagem+W270
954	HEB 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
955	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
956	HEB 200	S 275	0.07	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
957	HEB 200	S 275	0.06	113 UNFAV_AVB SC_SC Garagem+W270
958	HEB 200	S 275	0.08	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
959	HEB 200	S 275	0.13	105 UNFAV_AVB SC_SC Garagem
960	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
961	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
962	HEB 200	S 275	0.08	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
963	HEB 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
964	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
965	HEB 200	S 275	0.29	113 UNFAV_AVB SC_SC Garagem+W270
968	HEB 200	S 275	0.17	109 UNFAV_AVB SC_W270
971	HEB 200	S 275	0.22	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1003	HEB 200	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1009	HEB 200	S 275	0.08	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1010	HEB 200	S 275	0.16	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1011	HEB 200	S 275	0.16	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1012	HEB 200	S 275	0.05	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1013	HEB 200	S 275	0.15	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1014	HEB 200	S 275	0.16	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1015	HEB 200	S 275	0.08	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1016	HEB 200	S 275	0.15	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1017	HEB 200	S 275	0.23	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1018	HEB 200	S 275	0.13	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1019	HEB 200	S 275	0.05	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1020	HEB 200	S 275	0.16	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1021	HEB 200	S 275	0.10	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1022	HEB 200	S 275	0.03	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1023	HEB 200	S 275	0.29	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1024	HEB 200	S 275	0.15	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1025	HEB 200	S 275	0.06	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1026	HEB 200	S 275	0.22	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1027	HEB 200	S 275	0.12	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1028	HEB 200	S 275	0.04	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1031	HEB 200	S 275	0.32	246 FUND_Sismo Tipo 2_-X-0.3Y+0.3Z
1034	HEB 200	S 275	0.27	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
1037	HEB 200	S 275	0.33	246 FUND_Sismo Tipo 2_-X-0.3Y+0.3Z
1040	HEB 200	S 275	0.32	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
1041	HEB 200	S 275	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1042	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1043	HEB 200	S 275	0.08	104 UNFAV_AVB SC
1044	HEB 200	S 275	0.20	105 UNFAV_AVB SC_SC Garagem
1045	HEB 200	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1046	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z

1047	HEB 200	S 275	0.05	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1048	HEB 200	S 275	0.09	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1049	HEB 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1050	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1051	HEB 200	S 275	0.08	105 UNFAV_AVB SC_SC Garagem
1052	HEB 200	S 275	0.11	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1053	HEB 200	S 275	0.18	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1054	HEB 200	S 275	0.11	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1055	HEB 200	S 275	0.08	104 UNFAV_AVB SC
1056	HEB 200	S 275	0.28	104 UNFAV_AVB SC
1057	HEB 200	S 275	0.10	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1058	HEB 200	S 275	0.06	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1059	HEB 200	S 275	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1060	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1061	HEB 200	S 275	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1062	HEB 200	S 275	0.05	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1063	HEB 200	S 275	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1064	HEB 200	S 275	0.12	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1065	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1066	HEB 200	S 275	0.08	105 UNFAV_AVB SC_SC Garagem
1067	HEB 200	S 275	0.05	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1068	HEB 200	S 275	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1069	HEB 200	S 275	0.08	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1070	HEB 200	S 275	0.07	113 UNFAV_AVB SC_SC Garagem+W270
1071	HEB 200	S 275	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1072	HEB 200	S 275	0.13	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1086	HEB 200	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1088	HEB 200	S 275	0.21	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1089	HEB 200	S 275	0.47	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1090	HEB 200	S 275	0.10	104 UNFAV_AVB SC
1091	HEB 200	S 275	0.14	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1092	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1093	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1095	HEB 200	S 275	0.15	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1096	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1097	HEB 200	S 275	0.27	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1098	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1099	HEB 200	S 275	0.37	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1100	HEB 200	S 275	0.17	104 UNFAV_AVB SC
1101	HEB 200	S 275	0.20	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1108	HEB 200	S 275	0.56	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1109	HEB 200	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1110	HEB 200	S 275	0.21	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1112	HEB 200	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1113	HEB 200	S 275	0.11	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1115	HEB 200	S 275	0.13	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z

1116	HEB 200	S 275	0.29	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1117	HEB 200	S 275	0.12	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1118	HEB 200	S 275	0.28	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1119	HEB 200	S 275	0.14	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1120	HEB 200	S 275	0.24	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1121	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5140	RHSC 400x300x16	S 275	0.28	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5141	RHSC 400x300x16	S 275	0.27	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5142	RHSC 400x300x16	S 275	0.26	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5143	RHSC 400x300x16	S 275	0.25	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5144	RHSC 400x300x16	S 275	0.31	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5145	RHSC 400x300x16	S 275	0.28	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5146	RHSC 400x300x16	S 275	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5147	RHSC 400x300x16	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5150	RHSC 400x300x16	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
5988	RHSC 400x300x16	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6063	RHSC 400x300x16	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6064	RHSC 400x300x16	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6065	RHSC 400x300x16	S 275	0.05	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6066	RHSC 400x300x16	S 275	0.04	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6067	RHSC 400x300x16	S 275	0.04	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6068	RHSC 400x300x16	S 275	0.04	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6069	RHSC 400x300x16	S 275	0.04	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6549	HEB 300	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
6550	HEB 300	S 275	0.17	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
6551	HEB 300	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
6552	CHS 273x12.5	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6553	CHS 273x12.5	S 275	0.16	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6554	HEB 300	S 275	0.12	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6556	HEB 300	S 275	0.20	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6557	HEB 300	S 275	0.15	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6560	HEB 300	S 275	0.10	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6561	HEB 300	S 275	0.12	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6562	HEB 300	S 275	0.11	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6563	HEB 300	S 275	0.09	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
6564	CHS 273x12.5	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6565	HEB 300	S 275	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
6820	RHSC 400x300x16	S 275	0.09	104 UNFAV_AVB SC
6821	RHSC 400x300x16	S 275	0.06	104 UNFAV_AVB SC
7435	RHSC 400x300x16	S 275	0.12	104 UNFAV_AVB SC
7436	RHSC 400x300x16	S 275	0.22	112 UNFAV_AVB SC_SC Garagem+W90
7437	RHSC 400x300x16	S 275	0.22	112 UNFAV_AVB SC_SC Garagem+W90
8561	HEB 200	S 275	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8638	HEB 200	S 275	0.26	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8664	HEB 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8670	HEB 200	S 275	0.09	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z

8671	HEB 200	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8885	CHS 273x12.5	S 275	0.32	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
8902	HEB 200	S 275	0.20	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8903	HEB 200	S 275	0.20	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8905	HEB 200	S 275	0.16	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8906	HEB 200	S 275	0.42	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8919	HEB 180	S 275	0.62	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8920	HEB 180	S 275	0.67	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8948	HEB 200	S 275	0.05	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8949	HEB 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z

Apresenta-se a figura com a identificação dos elementos mais esforçados por tipo de secção metálica:

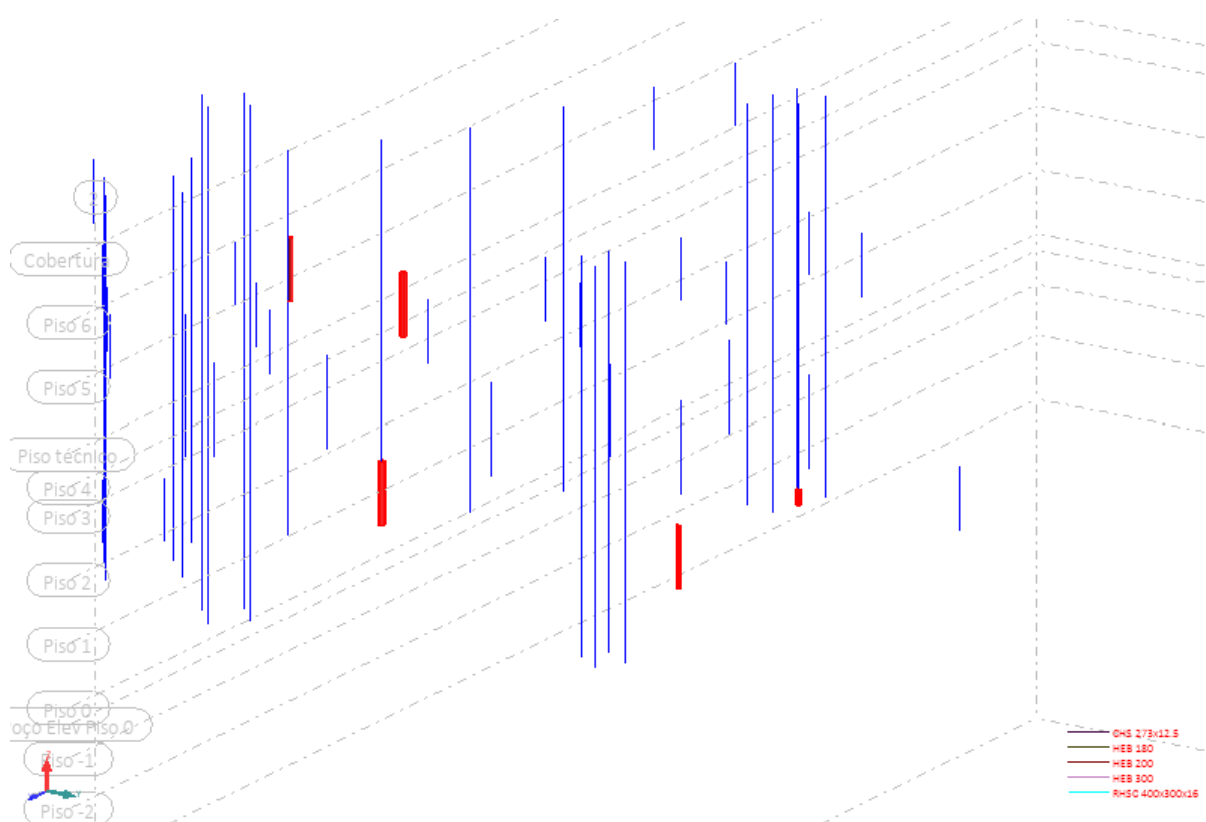


Figura 21 – Pilares – elementos mais solicitados.

Apresenta-se a verificação detalhada de cada tipo de secção metálica, para o elemento mais esforçado:

HEB 180

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:**MEMBRO:** 8920 Pilar metálico_8920**PONTO:**

1

COORDENADAS: x = 0.00 L = 0.000 m**CARGAS:**

Caso de carga atuante: 233 FUND_Sismo Tipo 1_X+0.3Y+0.3Z
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+44)*1.00+(2
 4+27+28+30+31)*0.60+(25+26+29+45+46)*0.30

MATERIAL:S 275 (S 275) $f_y = 275.00$ MPa**PARÂMETROS DA SECÇÃO: HEB 180**

h=18.0 cm	gM0=1.00	gM1=1.00	
b=18.0 cm	Ay=54.88 cm ²	Az=20.24 cm ²	Ax=65.25 cm ²
tw=0.9 cm	Iy=3831.13 cm ⁴	Iz=1362.85 cm ⁴	Ix=45.10 cm ⁴
tf=1.4 cm	Wply=481.47 cm ³	Wplz=231.02 cm ³	

FORÇAS INTERNAS E CAPACIDADES:

N,Ed = 144.2 kN	My,Ed = -16.9 kN*m	Mz,Ed = 9.1 kN*m	Vy,Ed = 4.8 kN
Nc,Rd = 1794.4 kN	My,Ed,max = -16.9 kN*m		Mz,Ed,max = 9.1 kN*m
	Vy,T,Rd = 871.2 kN		
Nb,Rd = 379.0 kN	My,c,Rd = 132.4 kN*m	Mz,c,Rd = 63.5 kN*m	Vz,Ed = 8.8 kN
	MN,y,Rd = 132.4 kN*m	MN,z,Rd = 63.5 kN*m	Vz,T,Rd = 321.3 kN
	Mb,Rd = 120.0 kN*m		Tt,Ed = 0.0 kN*m
			Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:**

z = 0.00	Mcr = 403.9 kN*m	Curva,LT - b	XLT = 0.85
Lcr,low=3.800 m	Lam_LT = 0.57	fi,LT = 0.73	XLT,mod = 0.91

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:

Ly = 3.800 m

Lam_y = 1.14



Em torno do eixo z:

Lz = 3.800 m

Lam_z = 1.92

Lcr,y = 7.600 m	Xy = 0.51	Lcr,z = 7.600 m	Xz = 0.21
Lamy = 99.18	kzy = 0.61	Lamz = 166.30	kzz = 1.42

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{c,Rd} = 0.08 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.13 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.14 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^2 + (M_{z,Ed}/M_{N,z,Rd})^1 = 0.16 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.01 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.03 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\tau_y/(\sqrt{3} \cdot gM0)) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_z/(\sqrt{3} \cdot gM0)) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y,Ed} = 99.18 < \lambda_{y,max} = 210.00 \quad \lambda_{z,Ed} = 166.30 < \lambda_{z,max} = 210.00$$

ESTÁVEL

$$M_{y,Ed,max}/M_{b,Rd} = 0.14 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(X_y \cdot N_{Rk}/gM1) + k_{yy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rk}/gM1) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/gM1) = 0.51 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(X_z \cdot N_{Rk}/gM1) + k_{zy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rk}/gM1) + k_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/gM1) = 0.67 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):** Não analisados**Deslocamentos (SISTEMA GLOBAL):**

$$v_x = 0.417 \text{ mm} < v_{x,max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 365 RARA_AVB TEMP(+)_SC+W270
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + (24+25+26+27+29+30+31) \cdot 0.70 + 36 \cdot 0.60$

$$v_y = 0.485 \text{ mm} < v_{y,max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 335 RARA_AVB W270_SC+TEMP(+)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + (24+25+26+27+29+30+31) \cdot 0.70 + 37 \cdot 0.60$

Secção OK !!!

HEB 200

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 866 Pilar escadas_866

PONTO:

3

COORDENADAS: $x = 1.00$ $L = 1.000$ m

CARGAS:

Caso de carga atuante: 250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+49)*0.30+47*-0.30+48*-1.00$

MATERIAL:

S 275 (S 275) $f_y = 275.00$ MPa



PARÂMETROS DA SECÇÃO: HEB 200

$h=20.0$ cm	$gM0=1.00$	$gM1=1.00$	
$b=20.0$ cm	$A_y=66.02$ cm ²	$A_z=24.83$ cm ²	$A_x=78.08$ cm ²
$t_w=0.9$ cm	$I_y=5696.18$ cm ⁴	$I_z=2003.37$ cm ⁴	$I_x=61.40$ cm ⁴
$t_f=1.5$ cm	$W_{ply}=642.58$ cm ³	$W_{plz}=305.82$ cm ³	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = -54.3$ kN	$M_{y,Ed} = 117.6$ kN*m	$M_{z,Ed} = -4.1$ kN*m	$V_{y,Ed} = -6.3$ kN
$N_{t,Rd} = 2147.2$ kN	$M_{y,pl,Rd} = 176.7$ kN*m	$M_{z,pl,Rd} = 84.1$ kN*m	$V_{y,T,Rd} = 1044.0$ kN
	$M_{y,c,Rd} = 176.7$ kN*m	$M_{z,c,Rd} = 84.1$ kN*m	$V_{z,Ed} = -160.2$ kN
	$MN_{y,Rd} = 176.7$ kN*m	$MN_{z,Rd} = 84.1$ kN*m	$V_{z,T,Rd} = 393.3$ kN
	$M_{b,Rd} = 176.7$ kN*m		$T_{t,Ed} = -0.1$ kN*m
			Classe da Secção = 1



PARÂMETROS DE FLAMBAGEM LATERAL:

$z = 0.00$	$M_{cr} = 6552.8$ kN*m	Curva,LT - b	$XL_T = 1.00$
$L_{cr,upp}=1.000$ m	$\lambda_{m\_LT} = 0.16$	$\phi_{i,LT} = 0.51$	$XL_{T,mod} = 1.00$

PARÂMETROS DE FLAMBAGEM:



Em torno do eixo y:



Em torno do eixo z:

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{t,Rd} = 0.03 < 1.00 \quad (6.2.3.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.67 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.05 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^2 + (M_{z,Ed}/M_{N,z,Rd})^1 = 0.49 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.01 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.41 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\sigma_{fy}/(\sqrt{3} \cdot \sigma_{M0})) = 0.01 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\sigma_{fy}/(\sqrt{3} \cdot \sigma_{M0})) = 0.01 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$M_{y,Ed}/M_{b,Rd} = 0.67 < 1.00 \quad (6.3.2.1.(1))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):** Não analisados**Deslocamentos (SISTEMA GLOBAL):**

$$v_x = 0.179 \text{ mm} < v_{x \text{ max}} = L/150.00 = 6.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 349 RARA_AVB TEMP(+)_SC Garagem
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + 28 \cdot 0.70$

$$v_y = 0.491 \text{ mm} < v_{y \text{ max}} = L/150.00 = 6.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 271 RARA_AVB SC_SC Garagem+W270+TEMP(+)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + 28 \cdot 0.70 + (36+37) \cdot 0.60$

Secção OK !!!

CHS 273x12.5

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.**TIPO DE ANÁLISE:** Verificação de membro

GRUPO DE CÓDIGO:**MEMBRO:** 8885 Pilar metálico_8885**PONTO:**

3

COORDENADAS: x = 1.00 L = 3.800 m**CARGAS:**

Caso de carga atuante: 236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+46)*0.30+44*-1.00+45*-0.30$

MATERIAL:S 275 (S 275) $f_y = 275.00$ MPa**PARÂMETROS DA SECÇÃO: CHS 273x12.5**

h=27.3 cm	gM0=1.00	gM1=1.00	
	Ay=64.94 cm ²	Az=64.94 cm ²	Ax=102.00 cm ²
tw=1.2 cm	Iy=8697.00 cm ⁴	Iz=8697.00 cm ⁴	Ix=17390.00 cm ⁴
	Wply=848.90 cm ³	Wplz=848.90 cm ³	

FORÇAS INTERNAS E CAPACIDADES:

N,Ed = 26.5 kN	My,Ed = 5.2 kN*m	Mz,Ed = -86.1 kN*m	Vy,Ed = -19.5 kN
Nc,Rd = 2805.0 kN	My,Ed,max = 5.2 kN*m	Mz,Ed,max = -86.1 kN*m	Vy,T,Rd = 1021.7 kN
Nb,Rd = 1968.0 kN	My,c,Rd = 233.4 kN*m	Mz,c,Rd = 233.4 kN*m	Vz,Ed = -1.2 kN
	MN,y,Rd = 233.4 kN*m	MN,z,Rd = 233.4 kN*m	Vz,T,Rd = 1021.7 kN
			Tt,Ed = -1.8 kN*m
			Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:****PARÂMETROS DE FLAMBAGEM:**

Em torno do eixo y:



Em torno do eixo z:

Ly = 3.800 m	Lam_y = 0.95	Lz = 3.800 m	Lam_z = 0.95
Lcr,y = 7.600 m	Xy = 0.70	Lcr,z = 7.600 m	Xz = 0.70
Lamy = 82.31	kzy = 0.48	Lamz = 82.31	kzz = 0.79

FÓRMULAS DE VERIFICAÇÃO:

Verificação de resistência de Secção:

$$N_{Ed}/N_{c,Rd} = 0.01 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.02 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.37 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^2 + (M_{z,Ed}/M_{N,z,Rd})^2 = 0.14 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.02 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(f_y/(\sqrt{3} \cdot g_{M0})) = 0.01 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(f_y/(\sqrt{3} \cdot g_{M0})) = 0.01 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y} = 82.31 < \lambda_{y,max} = 210.00 \quad \lambda_{z} = 82.31 < \lambda_{z,max} = 210.00$$

ESTÁVEL

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.21 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(X_z \cdot N_{Rk}/g_{M1}) + k_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.32 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):** Não analisados**Deslocamentos (SISTEMA GLOBAL):**

$$v_x = 0.832 \text{ mm} < v_{x,max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 322 RARA_AVB W270_TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + 38 \cdot 0.60$

$$v_y = 1.241 \text{ mm} < v_{y,max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 322 RARA_AVB W270_TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + 38 \cdot 0.60$

Secção OK !!!

RHS 400x300x16

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.**TIPO DE ANÁLISE:** Verificação de membro**GRUPO DE CÓDIGO:**

MEMBRO: 5144 Pilar metálico_5144**PONTO:**

1

COORDENADAS: $x = 0.00$ $L = 0.000$ m**CARGAS:**

Caso de carga atuante: 237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+45)*1.00+(24+27+28+30+31)*0.60+(25+26+29+44+46)*0.30$

MATERIAL:S 275 (S 275) $f_y = 275.00$ MPa**PARÂMETROS DA SECÇÃO: RHSC 400x300x16**

$h=40.0$ cm	$gM0=1.00$	$gM1=1.00$	
$b=30.0$ cm	$A_y=87.00$ cm ²	$A_z=116.00$ cm ²	$A_x=203.00$ cm ²
$t_w=1.6$ cm	$I_y=44350.00$ cm ⁴	$I_z=28535.00$ cm ⁴	$I_x=58730.00$ cm ⁴
$t_f=1.6$ cm	$W_{ply}=2708.00$ cm ³	$W_{plz}=2228.00$ cm ³	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 1411.9$ kN	$V_{y,Ed} = -0.0$ kN
$N_{c,Rd} = 5582.5$ kN	$V_{y,T,Rd} = 1377.5$ kN
$N_{b,Rd} = 4627.8$ kN	$V_{z,Ed} = 0.0$ kN
	$V_{z,T,Rd} = 1836.6$ kN
	$T_{t,Ed} = 1.5$ kN*m
	Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:****PARÂMETROS DE FLAMBAGEM:**

Em torno do eixo y:

$L_y = 3.800$ m	$\lambda_{m,y} = 0.59$
$L_{cr,y} = 7.600$ m	$X_y = 0.89$
$\lambda_{m,y} = 51.42$	



Em torno do eixo z:

$L_z = 3.800$ m	$\lambda_{m,z} = 0.74$
$L_{cr,z} = 7.600$ m	$X_z = 0.83$
$\lambda_{m,z} = 64.10$	

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{c,Rd} = 0.25 < 1.00 \quad (6.2.4.(1))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\tau_y/(\sqrt{3} \cdot gM_0)) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_z/(\sqrt{3} \cdot gM_0)) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{b,y} = 51.42 < \lambda_{b,max} = 210.00 \quad \lambda_{b,z} = 64.10 < \lambda_{b,max} = 210.00$$

ESTÁVEL

$$N_{Ed}/N_{b,Rd} = 0.31 < 1.00 \quad (6.3.1.1.(1))$$

DESLOCAMENTOS DE LIMITE



Deflexões (SISTEMA LOCAL): Não analisados



Deslocamentos (SISTEMA GLOBAL):

$$v_x = 0.393 \text{ mm} < v_x \text{ max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 382 RARA_AVB TEMP(+)_SC+SC Garagem+W270
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + (24+25+26+27+29+30+31+28) \cdot 0.70 + 36 \cdot 0.60$

$$v_y = 1.165 \text{ mm} < v_y \text{ max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 382 RARA_AVB TEMP(+)_SC+SC Garagem+W270
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + (24+25+26+27+29+30+31+28) \cdot 0.70 + 36 \cdot 0.60$

Secção OK !!!

HEB 300

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 6556 Pilar metálico_6556

PONTO:

3

COORDENADAS: x = 1.00 L = 3.800 m

CARGAS:

Caso de carga atuante: 240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23) \cdot 1.00 + (24+27+28+30+31) \cdot 0.60 + (25+26+29+46) \cdot 0.30 + 44 \cdot -0.30 + 45 \cdot -1.00$

MATERIAL:S 275 (S 275) $f_y = 275.00 \text{ MPa}$ **PARÂMETROS DA SECÇÃO: HEB 300**

$h=30.0 \text{ cm}$	$gM0=1.00$	$gM1=1.00$	
$b=30.0 \text{ cm}$	$A_y=126.20 \text{ cm}^2$	$A_z=47.43 \text{ cm}^2$	$A_x=149.08 \text{ cm}^2$
$tw=1.1 \text{ cm}$	$I_y=25165.70 \text{ cm}^4$	$I_z=8562.83 \text{ cm}^4$	$I_x=186.00 \text{ cm}^4$
$tf=1.9 \text{ cm}$	$W_{ply}=1868.80 \text{ cm}^3$	$W_{plz}=870.16 \text{ cm}^3$	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 26.0 \text{ kN}$	$M_{y,Ed} = 100.4 \text{ kN}\cdot\text{m}$	$M_{z,Ed} = -0.9 \text{ kN}\cdot\text{m}$	$V_{y,Ed} = -0.2 \text{ kN}$
$N_{c,Rd} = 4099.6 \text{ kN}$	$M_{y,Ed,max} = 100.4 \text{ kN}\cdot\text{m}$		$M_{z,Ed,max} = -0.9 \text{ kN}\cdot\text{m}$
	$V_{y,T,Rd} = 2000.0 \text{ kN}$		
$N_{b,Rd} = 1868.4 \text{ kN}$	$M_{y,c,Rd} = 513.9 \text{ kN}\cdot\text{m}$	$M_{z,c,Rd} = 239.3 \text{ kN}\cdot\text{m}$	$V_{z,Ed} = -17.7 \text{ kN}$
	$MN_{y,Rd} = 513.9 \text{ kN}\cdot\text{m}$	$MN_{z,Rd} = 239.3 \text{ kN}\cdot\text{m}$	$V_{z,T,Rd} = 752.2 \text{ kN}$
	$M_{b,Rd} = 513.9 \text{ kN}\cdot\text{m}$		$T_{t,Ed} = -0.1 \text{ kN}\cdot\text{m}$
			Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:**

$z = 0.00$	$M_{cr} = 4131.0 \text{ kN}\cdot\text{m}$	Curva,LT - b	$X_{LT} = 0.94$
$L_{cr,upp}=3.800 \text{ m}$	$\lambda_{m\_LT} = 0.35$	$\phi_{i,LT} = 0.59$	$X_{LT,mod} = 1.00$

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:

$L_y = 3.800 \text{ m}$	$\lambda_{m\_y} = 0.67$
$L_{cr,y} = 7.600 \text{ m}$	$X_y = 0.80$
$\lambda_{my} = 58.49$	$k_{yy} = 0.79$



Em torno do eixo z:

$L_z = 3.800 \text{ m}$	$\lambda_{m\_z} = 1.16$
$L_{cr,z} = 7.600 \text{ m}$	$X_z = 0.46$
$\lambda_{mz} = 100.28$	$k_{yz} = 0.55$

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{c,Rd} = 0.01 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.20 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.00 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^{2.00} + (M_{z,Ed}/M_{N,z,Rd})^{1.00} = 0.04 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.02 < 1.00 \quad (6.2.6-7)$$

$$\tau_{y,Ed}/(\tau_y/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{z,Ed}/(\tau_z/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y} = 58.49 < \lambda_{y,max} = 210.00 \quad \lambda_{z} = 100.28 < \lambda_{z,max} = 210.00$$

ESTÁVEL

$$M_{y,Ed,max}/M_{b,Rd} = 0.20 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.16 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(X_z \cdot N_{Rk}/g_{M1}) + k_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.10 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE



Deflexões (SISTEMA LOCAL): Não analisados



Deslocamentos (SISTEMA GLOBAL):

$$v_x = 1.260 \text{ mm} < v_{x,max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 381 RARA_AVB TEMP(+)_SC+SC Garagem+W90
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + (24+25+26+27+29+30+31+28) \cdot 0.70 + 35 \cdot 0.60$

$$v_y = 1.465 \text{ mm} < v_{y,max} = L/300.00 = 12.667 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 322 RARA_AVB W270_TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + 38 \cdot 0.60$
 0

Secção OK !!!

9.9.2 VIGAS MISTAS

Na figura abaixo apresentam-se os elementos estruturais das vigas mistas.

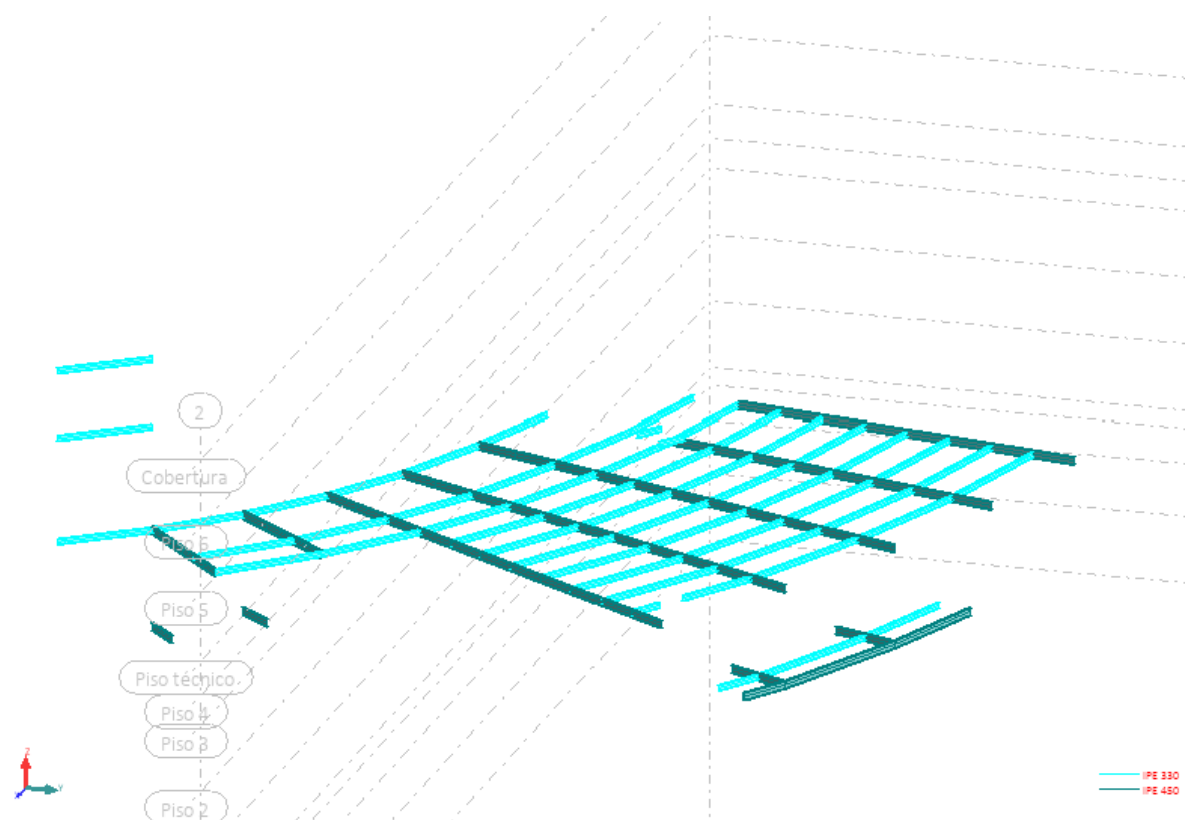


Figura 22 – Modelo estrutural das vigas e escadas.

As vigas mistas foram dimensionadas com recurso ao software “ArcelorMittal Beams Calculator”.

Vigas secundárias IPE 330

 ArcelorMittal ArcelorMittal Beams Calculator v3.52	...	
	Project name :	
	Project reference :	
	Beam reference :	
Preliminary Design Note DATA		
WARNING! This calculation has been performed in Expert mode. Some data may be out of the scope of the programme.		
General parameters		
COMPOSITE BEAM		
Main span	L = 8.800 m	
Intermediate beam		
Width on the left	L ₁ = 2.600 m	Max. participating width L ₁ = 1.300 m
Width on the right	L ₂ = 2.600 m	Max. participating width L ₂ = 1.300 m
Slab		
Slab with profiled sheeting	Total thickness = 13.00 cm	
Profiled steel sheeting "Haircol_59S 0.75 AMC" , perpendicular to the beam - pre-punched sheetings (h = 59.0 mm ; e = 205.0 mm ; b ₁ = 58.0 mm ; b ₂ = 121.0 mm ; t = 0.75 mm ; f _y = 320 N/mm ² ; M = 8.62 daN/m ²) Sheeting not interrupted at beam		
Section		
IPE 330 - S275 EC3		
h _t = 330.0 mm	A = 62.61 cm ²	
b _f = 160.0 mm	A _v = 30.81 cm ²	
t _w = 7.5 mm	I _y = 11766.90 cm ⁴	
t _f = 11.5 mm	I _z = 788.14 cm ⁴	
r = 18.0 mm	I _t = 28.15 cm ⁶	
	I _w = 199097.30 cm ⁶	
	W _{el,y} = 713.15 cm ³	
	W _{pl,y} = 804.33 cm ³	
Materials		
Steel	E = 210000 N/mm ²	
	ρ = 7850 kg/m ³	
Steel grade S275 EC3 - Reduction of f _y with thickness according to Table 3.1 Databases 2020_02		
Flanges	f _{yt} = 275 N/mm ²	
Web	f _{yw} = 275 N/mm ²	
<i>Software use conditions apply</i>		
Date : 24/09/2021	User's name : ...	Page 1 / 14
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 ArcelorMittal Beams Calculator v3.52		...	
		Project name :	
		Project reference :	
		Beam reference :	
Section $f_y = 275 \text{ N/mm}^2$ $\varepsilon = 0.924$ Concrete slab C25/30 $f_{ck} = 25 \text{ N/mm}^2$ $E_{cm} = 31476 \text{ N/mm}^2$ Modular ratio for LONG TERM $C_{eq} = 23.99$ Modular ratio for SHORT TERM $C_{eq} = 6.67$ Shrinkage (R) - Long term $\varepsilon = 300.10^{-6}$ Density of the concrete (slab) $\rho = 25.00 \text{ kN/m}^3$ Reinforcement steel $f_{yk} = 500 \text{ N/mm}^2$ <u>Connection</u> Connectors Diameter 19-100 $\phi = 19.0 \text{ mm}$ $h = 100.0 \text{ mm}$ $f_y = 350.0 \text{ N/mm}^2$ $f_u = 450.0 \text{ N/mm}^2$ Main span $L = 8.800 \text{ m} \quad e = 0.205 \text{ m} \quad n = 1 \text{ row(s)}$ Total number of connectors : 43 <u>Lateral restraint of the beam - The beam is laterally restrained at supports</u> Main span $x = 4.40 \text{ m} \quad (\text{upper and lower flange laterally restrained})$ <u>Propping in the construction stage</u> Number of proppings in the span : 1 <u>Loads</u> Loads at construction stage Permanent loads (g) Dead weight of the profile 0.48 kN/m Dead weight of the slab (2.50 kN/m^2) 6.49 kN/m <i>Software use conditions apply</i>			
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 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>		...	
		Project name :	
		Project reference :	
		Beam reference :	
Construction load (Q_c) $Q_c = 0.75 \text{ kN/m}^2$ 1.95 kN/m			
Loads at final stage			
Permanent loads			
	Dead weight of the profile		0.48 kN/m
	Dead weight of the slab (2.50 kN/m^2)		6.49 kN/m
Span	Surface load = 1.30 kN/m^2		
Live load case n° 1 ($\psi_0 = 0.70$)			
Span	Surface load = 3.00 kN/m^2		
<u>Partial Factors</u>			
Permanent loads	$\gamma_{G.sup} = 1.35$	Structural steel	$\gamma_{M0} = 1.00$
	$\gamma_{G.inf} = 1.00$	Structural steel (instabilities)	$\gamma_{M1} = 1.00$
Live loads	$\gamma_Q = 1.50$	Concrete	$\gamma_c = 1.50$
		Reinforcement bars	$\gamma_s = 1.15$
		Connectors	$\gamma_v = 1.25$
		Shear resistance of the steel sheeting	$\gamma_{ap} = 1.10$
<u>Combinations of actions</u>			
ULS combination (construction stage)		$1.35 G + 1.50 Q_c$	
ULS combination(s)		$1.35 G + 1.50 Q_1$	
SLS combination(s)		$G + R + Q_1$	
<i>Software use conditions apply</i>			
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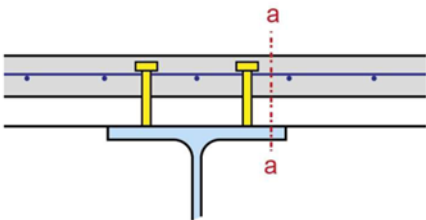
 ArcelorMittal ArcelorMittal Beams Calculator v3.52	...		
	Project name :		
	Project reference :		
	Beam reference :		
<u>CONSTRUCTION stage</u>			
Moment resistance	Section Class 1	$M_{Rd} =$	221.19 kN.m
Plastic shear force resistance	$V_{pl,Rd} =$	489.15 kN	($\eta = 1.20$)
No risk of shear buckling ($h_w / t_w < 72 \varepsilon / \eta$ EN 1993-1-1 § 6.2.6(6))			
ULS combination (construction stage) : 1.35 G + 1.50 Q_c			
Support reactions		$R_{V1} =$	20.35 kN
		$R_{V2} =$	67.86 kN
		$R_{V3} =$	20.35 kN
Critical amplification factor / Lateral Torsional Buckling			
$\mu_{cr} = 8.10$ (LTBeam calc. module)			
$M_{Ed,max(+)} =$	16.78 kN.m	$M_{Ed,max(-)} =$	-29.87 kN.m
$V_{Ed,max} =$	33.93 kN	$\Gamma_M =$	0.135 (x = 4.400 m)
		$\Gamma_V =$	0.069 (x = 4.400 m)
		$\Gamma_{MV} =$	0.135 (x = 4.400 m)
		$\Gamma_{LT} =$	0.203
Support reactions		$R_{V1} =$	21.16 kN
		$R_{V2} =$	59.82 kN
		$R_{V3} =$	14.72 kN
Critical amplification factor / Lateral Torsional Buckling			
$\mu_{cr} = 8.78$ (LTBeam calc. module)			
$M_{Ed,max(+)} =$	18.13 kN.m	$M_{Ed,max(-)} =$	-26.33 kN.m
$V_{Ed,max} =$	33.13 kN	$\Gamma_M =$	0.119 (x = 4.400 m)
		$\Gamma_V =$	0.068 (x = 4.400 m)
		$\Gamma_{MV} =$	0.119 (x = 4.400 m)
<i>Software use conditions apply</i>			
Date : 24/09/2021	User's name : ...		Page 4 / 14
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 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>	...	
	Project name :	
	Project reference :	
	Beam reference :	
$\Gamma_{LT} = 0.182$		
Maximum criterion for bending resistance	$\Gamma_{M,max} =$	0.135
Maximum criterion for shear force resistance	$\Gamma_{V,max} =$	0.069
Maximum criterion for bending moment - shear force interaction	$\Gamma_{MV,max} =$	0.135
Maximum criterion for lateral torsional buckling	$\Gamma_{LT,max} =$	0.203
<i>Software use conditions apply</i>		
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 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>	...		
	Project name :		
	Project reference :		
	Beam reference :		
<u>Serviceability Limit States</u> (CONSTRUCTION stage) <u>Deflections per load case</u> Case 'Dead weight' Span $v_{max} =$ 0.6 mm Case 'Construction load' (Q_c) <u>Arrangement n° 1</u> Span $v_{max} =$ 0.2 mm Total deflection $v_{max} =$ 0.7 mm Case 'Construction load' (Q_c) <u>Arrangement n° 2</u> Span $v_{max} =$ 0.3 mm Total deflection $v_{max} =$ 0.8 mm <i>Software use conditions apply</i>			
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 ArcelorMittal ArcelorMittal Beams Calculator v3.52		...	
		Project name :	
		Project reference :	
		Beam reference :	
<u>FINAL stage</u>			
<u>Participating width</u>		on left support	1.650 m
		L / 4 (= 2.200 m)	2.200 m
		3 L / 4 (= 6.600 m)	2.200 m
		on right support	1.650 m
<u>Moments of inertia</u>		...at mid-span	
Long-term	33532 cm ⁴		
Short-term	46014 cm ⁴		
Resistance of the connectors		$P_{Rd} = 54.82 \text{ kN}$	
Verification of the degree of connection			
Minimum degree of connection = 0.400			
F_{Steel}	=	1721.67 kN	
$F_{Concrete}$	=	2212.83 kN	
Degree of connection = 0.669 > 0.400			
The degree of connection is calculated for the section with maximum bending moment			
Plastic resistance with partial connection			
Plastic shear force resistance		$V_{pl,Rd} =$	489.15 kN ($\eta = 1.20$)
No risk of shear buckling ($h_w / t_w < 72 \varepsilon / \eta$)			
ULS combination : 1.35 G + 1.50 Q₁			
Support reactions		$R_{V1} =$	112.98 kN
		$R_{V2} =$	112.97 kN
Calculation of the transverse reinforcement ratio of slab :		$A_s/s_f > 0.57 \text{ cm}^2/\text{m}$	
$M_{Ed,max}(+) =$	248.55 kN.m	$\Gamma_M =$	0.616 (x = 4.840 m)
$V_{Ed,max} =$	112.97 kN	$\Gamma_V =$	0.231 (x = 8.800 m)
<i>Software use conditions apply</i>			
Date : 24/09/2021	User's name : ...		Page 7 / 14
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 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>	...	
	Project name :	
	Project reference :	
	Beam reference :	
$\Gamma_{Mv} = 0.616 \quad (x = 4.840 \text{ m})$ $\Gamma_{vh} = 0.492$		
<i>Software use conditions apply</i>		
Date : 24/09/2021	User's name : ...	Page 8 / 14
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 ArcelorMittal Beams Calculator v3.52		...	
		Project name :	
		Project reference :	
		Beam reference :	
Longitudinal shear resistance of the slab - Transverse reinforcing bars Minimum transverse reinforcement ratio : $\rho_{w,min} = 0.08 \%$ (EN 1994-1-1 §6.6.6.3 & EN 1992-1-1 §9.2.2(5)) $A_s/s_f > 0.57 \text{ cm}^2/\text{m}$ Reinforcement ratio (EN 1992-1-1 §6.2.4) : $A_s/s_f > 0.57 \text{ cm}^2/\text{m} (\rho_w > 0.08 \%)$ Note: this result is provided as an indication. Calculations must be performed in order to take into account specific conceptual details. Note particularly that the calculations do not include the design of the slab.			
			
Calculation according to the reinforcement configuration displayed above Transverse reinforcement is assumed to be uniform along the length of the beam Any other configuration requires a specific calculation the reinforcement of a composite slab is generally provided by one layer only. In order to transfer the longitudinal shear, the connectors should necessarily go through the reinforcement. When another layer is added either in the sheeting ribs or in the slab, their influence can be considered with a specific calculation. The contribution of non continuous profiled steel sheeting to the longitudinal shear resistance has not been considered.			
Plastic moment in span		$M_{pl,Rd} =$	410.63 kN.m
Maximum criterion for bending resistance		$\Gamma_{M,max} =$	0.616
Maximum criterion for shear force resistance		$\Gamma_{V,max} =$	0.231
Maximum criterion for bending moment - shear force interaction		$\Gamma_{MV,max} =$	0.616
Maximum criterion for longitudinal shear force resistance of slab		$\Gamma_{Vh,max} =$	0.492
<i>Software use conditions apply</i>			
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 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>	...																																						
	Project name :																																						
	Project reference :																																						
	Beam reference :																																						
<u>Serviceability Limit States</u> <u>Deflections per load case</u> <table> <tr> <td>Case 'Dead weight'</td> <td>$v_{max} =$</td> <td>7.8 mm (L / 1135)</td> </tr> <tr> <td>Case 'Other permanent loads'</td> <td>$v_{max} =$</td> <td>3.8 mm (L / 2339)</td> </tr> <tr> <td>Case 'Q₁'</td> <td>$v_{max} =$</td> <td>6.3 mm (L / 1393)</td> </tr> <tr> <td>Case 'Shrinkage (R) - Long term'</td> <td>$v_{max} =$</td> <td>8.0 mm (L / 1095)</td> </tr> </table> <u>Deflections per combination</u> <table> <tr> <td>Combination SLS 'G + R + Q₁'</td> <td>$v_{max} =$</td> <td>25.9 mm (L / 340)</td> </tr> </table> <u>Estimation of the first natural frequency</u> <table> <tr><td>G + 0.00 Q₁ :</td><td>6.14 Hz</td></tr> <tr><td>G + 0.10 Q₁ :</td><td>5.92 Hz</td></tr> <tr><td>G + 0.20 Q₁ :</td><td>5.72 Hz</td></tr> <tr><td>G + 0.30 Q₁ :</td><td>5.54 Hz</td></tr> <tr><td>G + 0.40 Q₁ :</td><td>5.38 Hz</td></tr> <tr><td>G + 0.50 Q₁ :</td><td>5.23 Hz</td></tr> <tr><td>G + 0.60 Q₁ :</td><td>5.09 Hz</td></tr> <tr><td>G + 0.70 Q₁ :</td><td>4.96 Hz</td></tr> <tr><td>G + 0.80 Q₁ :</td><td>4.85 Hz</td></tr> <tr><td>G + 0.90 Q₁ :</td><td>4.74 Hz</td></tr> <tr><td>G + 1.00 Q₁ :</td><td>4.63 Hz</td></tr> </table> Resistance criteria satisfied in the CONSTRUCTION stage <i>Software use conditions apply</i>			Case 'Dead weight'	$v_{max} =$	7.8 mm (L / 1135)	Case 'Other permanent loads'	$v_{max} =$	3.8 mm (L / 2339)	Case 'Q ₁ '	$v_{max} =$	6.3 mm (L / 1393)	Case 'Shrinkage (R) - Long term'	$v_{max} =$	8.0 mm (L / 1095)	Combination SLS 'G + R + Q ₁ '	$v_{max} =$	25.9 mm (L / 340)	G + 0.00 Q ₁ :	6.14 Hz	G + 0.10 Q ₁ :	5.92 Hz	G + 0.20 Q ₁ :	5.72 Hz	G + 0.30 Q ₁ :	5.54 Hz	G + 0.40 Q ₁ :	5.38 Hz	G + 0.50 Q ₁ :	5.23 Hz	G + 0.60 Q ₁ :	5.09 Hz	G + 0.70 Q ₁ :	4.96 Hz	G + 0.80 Q ₁ :	4.85 Hz	G + 0.90 Q ₁ :	4.74 Hz	G + 1.00 Q ₁ :	4.63 Hz
Case 'Dead weight'	$v_{max} =$	7.8 mm (L / 1135)																																					
Case 'Other permanent loads'	$v_{max} =$	3.8 mm (L / 2339)																																					
Case 'Q ₁ '	$v_{max} =$	6.3 mm (L / 1393)																																					
Case 'Shrinkage (R) - Long term'	$v_{max} =$	8.0 mm (L / 1095)																																					
Combination SLS 'G + R + Q ₁ '	$v_{max} =$	25.9 mm (L / 340)																																					
G + 0.00 Q ₁ :	6.14 Hz																																						
G + 0.10 Q ₁ :	5.92 Hz																																						
G + 0.20 Q ₁ :	5.72 Hz																																						
G + 0.30 Q ₁ :	5.54 Hz																																						
G + 0.40 Q ₁ :	5.38 Hz																																						
G + 0.50 Q ₁ :	5.23 Hz																																						
G + 0.60 Q ₁ :	5.09 Hz																																						
G + 0.70 Q ₁ :	4.96 Hz																																						
G + 0.80 Q ₁ :	4.85 Hz																																						
G + 0.90 Q ₁ :	4.74 Hz																																						
G + 1.00 Q ₁ :	4.63 Hz																																						
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Vigas principais IPE 450

 ArcelorMittal ArcelorMittal Beams Calculator v3.52	...		
	Project name :		
	Project reference :		
	Beam reference :		
Preliminary Design Note DATA			
WARNING! This calculation has been performed in Expert mode. Some data may be out of the scope of the programme.			
<u>General parameters</u>		COMPOSITE BEAM	
Main span	L = 7.800 m		
Intermediate beam			
Width on the left	L ₁ = 8.800 m	Max. participating width	L ₁ = 4.400 m
Width on the right	L ₂ = 8.800 m	Max. participating width	L ₂ = 4.400 m
<u>Slab</u>			
Slab with profiled sheeting	Total thickness = 13.00 cm		
Profiled steel sheeting "Haircol_59S 0.75 AMC", parallel to the beam (h = 59.0 mm ; e = 205.0 mm ; b ₁ = 58.0 mm ; b ₂ = 121.0 mm ; t = 0.75 mm ; f _y = 320 N/mm ² ; M = 8.62 daN/m ²)			
<u>Section</u>	IPE 450 - S275 EC3		
	h _t = 450.0 mm	A = 98.82 cm ²	
	b _f = 190.0 mm	A _v = 50.85 cm ²	
	t _w = 9.4 mm	I _y = 33742.94 cm ⁴	
	t _f = 14.6 mm	I _z = 1675.86 cm ⁴	
	r = 21.0 mm	I _t = 66.87 cm ⁴	
		I _w = 791005.10 cm ⁶	
		W _{el,y} = 1499.69 cm ³	
		W _{pl,y} = 1701.79 cm ³	
<u>Materials</u>			
Steel	E = 210000 N/mm ²		
	ρ = 7850 kg/m ³		
Steel grade S275 EC3 - Reduction of f _y with thickness according to Table 3.1			
Databases 2020_02	Flanges	f _{yt} = 275 N/mm ²	
	Web	f _{yw} = 275 N/mm ²	
	Section	f _y = 275 N/mm ²	
	ε	0.924	
Software use conditions apply			
Date : 24/09/2021	User's name : ...		Page 1 / 13

 ArcelorMittal Beams Calculator v3.52		...	
		Project name :	
		Project reference :	
		Beam reference :	
Concrete slab C25/30 $f_{ck} = 25 \text{ N/mm}^2$ $E_{cm} = 31476 \text{ N/mm}^2$ Modular ratio for LONG TERM $C_{eq} = 23.99$ Modular ratio for SHORT TERM $C_{eq} = 6.67$ Shrinkage (R) - Long term $\varepsilon = 300.10^{-6}$ Density of the concrete (slab) $\rho = 25.00 \text{ kN/m}^3$ Reinforcement steel $f_{yk} = 500 \text{ N/mm}^2$			
Connection		Connectors Diameter 19-100 $\phi = 19.0 \text{ mm}$ $h = 100.0 \text{ mm}$ $f_y = 350.0 \text{ N/mm}^2$ $f_u = 450.0 \text{ N/mm}^2$	
Main span		$L = 7.800 \text{ m} \quad e = 0.150 \text{ m} \quad n = 1 \text{ row(s)}$	
Total number of connectors : 52			
<u>Lateral restraint of the beam</u> - The beam is laterally restrained at supports			
Main span		$x = 2.60 \text{ m}$ (upper and lower flange laterally restrained) $x = 5.20 \text{ m}$ (upper and lower flange laterally restrained)	
<u>Propping in the construction stage</u>		Number of proppings in the span : 1	
<u>Loads</u>			
Loads at construction stage			
Permanent loads (g)		Dead weight of the profile 0.76 kN/m Dead weight of the slab (2.50 kN/m^2) 21.97 kN/m	
Construction load (Q_c)		$Q_c = 0.75 \text{ kN/m}^2$ 6.60 kN/m	
<i>Software use conditions apply</i>			
Date : 24/09/2021	User's name : ...		Page 2 / 13

 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>		...	
		Project name :	
		Project reference :	
		Beam reference :	
Loads at final stage			
Permanent loads		Dead weight of the profile	0.76 kN/m
		Dead weight of the slab (2.50 kN/m ²)	21.97 kN/m
Span		Surface load = 1.30 kN/m ²	
Live load case n° 1 ($\psi_0 = 0.70$)			
Span		Surface load = 3.00 kN/m ²	
<u>Partial Factors</u>			
Permanent loads	$\gamma_{G.sup} = 1.35$	Structural steel	$\gamma_{M0} = 1.00$
	$\gamma_{G.inf} = 1.00$	Structural steel (instabilities)	$\gamma_{M1} = 1.00$
Live loads	$\gamma_Q = 1.50$	Concrete	$\gamma_c = 1.50$
		Reinforcement bars	$\gamma_s = 1.15$
		Connectors	$\gamma_v = 1.25$
		Shear resistance of the steel sheeting	$\gamma_{ap} = 1.10$
<u>Combinations of actions</u>			
ULS combination (construction stage)		1.35 G + 1.50 Q _c	
ULS combination(s)		1.35 G + 1.50 Q ₁	
SLS combination(s)		G + R + Q ₁	
<i>Software use conditions apply</i>			
Date : 24/09/2021	User's name : ...		Page 3 / 13

 ArcelorMittal ArcelorMittal Beams Calculator v3.52	...		
	Project name :		
	Project reference :		
	Beam reference :		
<u>CONSTRUCTION stage</u>			
Moment resistance	Section Class 1	$M_{Rd} =$	467.99 kN.m
Plastic shear force resistance	$V_{pl,Rd} =$	807.28 kN ($\eta = 1.20$)	
No risk of shear buckling ($h_w / t_w < 72 \varepsilon / \eta$ EN 1993-1-1 § 6.2.6(6))			
ULS combination (construction stage) : 1.35 G + 1.50 Q_c			
Support reactions		$R_{V1} =$	59.35 kN
		$R_{V2} =$	197.85 kN
		$R_{V3} =$	59.35 kN
Critical amplification factor / Lateral Torsional Buckling			
$\mu_{cr} = 14.27$ (LTBeam calc. module)			
$M_{Ed,max(+)} =$	43.38 kN.m	$M_{Ed,max(-)} =$	-77.17 kN.m
$V_{Ed,max} =$	-98.92 kN	$\Gamma_M =$	0.165 (x = 3.900 m)
		$\Gamma_V =$	0.123 (x = 3.900 m)
		$\Gamma_{MV} =$	0.165 (x = 3.900 m)
		$\Gamma_{LT} =$	0.193
Support reactions		$R_{V1} =$	61.76 kN
		$R_{V2} =$	173.71 kN
		$R_{V3} =$	42.46 kN
Critical amplification factor / Lateral Torsional Buckling			
$\mu_{cr} = 9.55$ (LTBeam calc. module)			
$M_{Ed,max(+)} =$	46.97 kN.m	$M_{Ed,max(-)} =$	-67.76 kN.m
$V_{Ed,max} =$	96.51 kN	$\Gamma_M =$	0.145 (x = 3.900 m)
		$\Gamma_V =$	0.120 (x = 3.900 m)
		$\Gamma_{MV} =$	0.145 (x = 3.900 m)
		$\Gamma_{LT} =$	0.198
<i>Software use conditions apply</i>			
Date : 24/09/2021	User's name : ...		Page 4 / 13

 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>		...													
		Project name :													
		Project reference :													
		Beam reference :													
<table> <tr> <td>Maximum criterion for bending resistance</td> <td>$\Gamma_{M,max} =$</td> <td>0.165</td> </tr> <tr> <td>Maximum criterion for shear force resistance</td> <td>$\Gamma_{V,max} =$</td> <td>0.123</td> </tr> <tr> <td>Maximum criterion for bending moment - shear force interaction</td> <td>$\Gamma_{MV,max} =$</td> <td>0.165</td> </tr> <tr> <td>Maximum criterion for lateral torsional buckling</td> <td>$\Gamma_{LT,max} =$</td> <td>0.198</td> </tr> </table>				Maximum criterion for bending resistance	$\Gamma_{M,max} =$	0.165	Maximum criterion for shear force resistance	$\Gamma_{V,max} =$	0.123	Maximum criterion for bending moment - shear force interaction	$\Gamma_{MV,max} =$	0.165	Maximum criterion for lateral torsional buckling	$\Gamma_{LT,max} =$	0.198
Maximum criterion for bending resistance	$\Gamma_{M,max} =$	0.165													
Maximum criterion for shear force resistance	$\Gamma_{V,max} =$	0.123													
Maximum criterion for bending moment - shear force interaction	$\Gamma_{MV,max} =$	0.165													
Maximum criterion for lateral torsional buckling	$\Gamma_{LT,max} =$	0.198													
<i>Software use conditions apply</i>															
Date : 24/09/2021	User's name : ...		Page 5 / 13												

 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>	...		
	Project name :		
	Project reference :		
	Beam reference :		
<u>Serviceability Limit States</u> (CONSTRUCTION stage) <u>Deflections per load case</u> Case 'Dead weight' Span $v_{max} =$ 0.4 mm Case 'Construction load' (Q_c) <u>Arrangement n° 1</u> Span $v_{max} =$ 0.1 mm Total deflection $v_{max} =$ 0.5 mm Case 'Construction load' (Q_c) <u>Arrangement n° 2</u> Span $v_{max} =$ 0.2 mm Total deflection $v_{max} =$ 0.6 mm			
<i>Software use conditions apply</i>			
Date : 24/09/2021	User's name : ...		Page 6 / 13

 ArcelorMittal ArcelorMittal Beams Calculator v3.52		...	
		Project name :	
		Project reference :	
		Beam reference :	
<u>FINAL stage</u>			
<u>Participating width</u>		on left support	1.463 m
		L / 4 (= 1.950 m)	1.950 m
		3 L / 4 (= 5.850 m)	1.950 m
		on right support	1.463 m
<u>Moments of inertia</u>		...at mid-span	
Long-term	71174 cm ⁴		
Short-term	102949 cm ⁴		
Resistance of the connectors		$P_{Rd} = 46.99 \text{ kN}$	
Verification of the degree of connection			
Minimum degree of connection = 0.400			
F_{Steel}	=	2717.57 kN	
$F_{Concrete}$	=	1961.38 kN	
Degree of connection = 0.623 > 0.400			
The degree of connection is calculated for the section with maximum bending moment			
Plastic resistance with partial connection			
Plastic shear force resistance		$V_{pl,Rd} =$	807.28 kN ($\eta = 1.20$)
No risk of shear buckling ($h_w / t_w < 72 \varepsilon / \eta$)			
ULS combination : 1.35 G + 1.50 Q₁			
Support reactions		$R_{V1} =$	334.34 kN
		$R_{V2} =$	334.33 kN
Calculation of the transverse reinforcement ratio of slab :		$A_s/s_f > 1.66 \text{ cm}^2/\text{m}$	
$M_{Ed,max(+)} =$	651.86 kN.m	$M_{Ed,max(-)} =$	0.00 kN.m
$V_{Ed,max} =$	-334.33 kN	$\Gamma_M =$	0.899 (x = 3.510 m)
		$\Gamma_V =$	0.414 (x = 0.000 m)
		$\Gamma_{MV} =$	0.899 (x = 3.510 m)
<i>Software use conditions apply</i>			
Date : 24/09/2021	User's name : ...		Page 7 / 13

 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>	...	
	Project name :	
	Project reference :	
	Beam reference :	
$\Gamma_{vh} = 0.547$		
<i>Software use conditions apply</i>		
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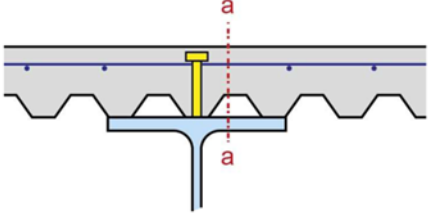
 ArcelorMittal ArcelorMittal Beams Calculator v3.52	...	
	Project name :	
	Project reference :	
	Beam reference :	

Longitudinal shear resistance of the slab - Transverse reinforcing bars

Minimum transverse reinforcement ratio : $\rho_{w,min} = 0.08 \%$
(EN 1994-1-1 §6.6.6.3 & EN 1992-1-1 §9.2.2(5))
 $A_s/s_f > 0.57 \text{ cm}^2/\text{m}$

Reinforcement ratio (EN 1992-1-1 §6.2.4) : $A_s/s_f > 1.66 \text{ cm}^2/\text{m}$ ($\rho_w > 0.23 \%$)

Note: this result is provided as an indication.
Calculations must be performed in order to take into account specific conceptual details.
Note particularly that the calculations do not include the design of the slab.



Calculation according to the reinforcement configuration displayed above
Transverse reinforcement is assumed to be uniform along the length of the beam
Any other configuration requires a specific calculation
the reinforcement of a composite slab is generally provided by one layer only.
In order to transfer the longitudinal shear, the connectors should necessarily go through the reinforcement.
When another layer is added either in the sheeting ribs or in the slab,
their influence can be considered with a specific calculation.
The contribution of non continuous profiled steel sheeting to the longitudinal shear resistance
has not been considered.

Plastic moment in span	$M_{pl,Rd} =$	732.56 kN.m
Maximum criterion for bending resistance	$\Gamma_{M,max} =$	0.899
Maximum criterion for shear force resistance	$\Gamma_{V,max} =$	0.414
Maximum criterion for bending moment - shear force interaction	$\Gamma_{MV,max} =$	0.899
Maximum criterion for longitudinal shear force resistance of slab	$\Gamma_{Vh,max} =$	0.547

Software use conditions apply

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 ArcelorMittal <i>ArcelorMittal Beams Calculator v3.52</i>	...																																						
	Project name :																																						
	Project reference :																																						
	Beam reference :																																						
<u>Serviceability Limit States</u> <u>Deflections per load case</u> <table> <tr> <td>Case 'Dead weight'</td> <td>$v_{max} =$</td> <td>7.3 mm (L / 1061)</td> </tr> <tr> <td>Case 'Other permanent loads'</td> <td>$v_{max} =$</td> <td>3.7 mm (L / 2106)</td> </tr> <tr> <td>Case 'Q₁'</td> <td>$v_{max} =$</td> <td>5.9 mm (L / 1322)</td> </tr> <tr> <td>Case 'Shrinkage (R) - Long term'</td> <td>$v_{max} =$</td> <td>4.3 mm (L / 1807)</td> </tr> </table> <u>Deflections per combination</u> <table> <tr> <td>Combination SLS 'G + R + Q₁'</td> <td>$v_{max} =$</td> <td>21.3 mm (L / 367)</td> </tr> </table> <u>Estimation of the first natural frequency</u> <table> <tr><td>G + 0.00 Q₁ :</td><td>6.43 Hz</td></tr> <tr><td>G + 0.10 Q₁ :</td><td>6.19 Hz</td></tr> <tr><td>G + 0.20 Q₁ :</td><td>5.98 Hz</td></tr> <tr><td>G + 0.30 Q₁ :</td><td>5.79 Hz</td></tr> <tr><td>G + 0.40 Q₁ :</td><td>5.62 Hz</td></tr> <tr><td>G + 0.50 Q₁ :</td><td>5.46 Hz</td></tr> <tr><td>G + 0.60 Q₁ :</td><td>5.31 Hz</td></tr> <tr><td>G + 0.70 Q₁ :</td><td>5.18 Hz</td></tr> <tr><td>G + 0.80 Q₁ :</td><td>5.05 Hz</td></tr> <tr><td>G + 0.90 Q₁ :</td><td>4.94 Hz</td></tr> <tr><td>G + 1.00 Q₁ :</td><td>4.83 Hz</td></tr> </table> Resistance criteria satisfied in the CONSTRUCTION stage Resistance criteria satisfied in the FINAL stage <i>Software use conditions apply</i>			Case 'Dead weight'	$v_{max} =$	7.3 mm (L / 1061)	Case 'Other permanent loads'	$v_{max} =$	3.7 mm (L / 2106)	Case 'Q ₁ '	$v_{max} =$	5.9 mm (L / 1322)	Case 'Shrinkage (R) - Long term'	$v_{max} =$	4.3 mm (L / 1807)	Combination SLS 'G + R + Q ₁ '	$v_{max} =$	21.3 mm (L / 367)	G + 0.00 Q ₁ :	6.43 Hz	G + 0.10 Q ₁ :	6.19 Hz	G + 0.20 Q ₁ :	5.98 Hz	G + 0.30 Q ₁ :	5.79 Hz	G + 0.40 Q ₁ :	5.62 Hz	G + 0.50 Q ₁ :	5.46 Hz	G + 0.60 Q ₁ :	5.31 Hz	G + 0.70 Q ₁ :	5.18 Hz	G + 0.80 Q ₁ :	5.05 Hz	G + 0.90 Q ₁ :	4.94 Hz	G + 1.00 Q ₁ :	4.83 Hz
Case 'Dead weight'	$v_{max} =$	7.3 mm (L / 1061)																																					
Case 'Other permanent loads'	$v_{max} =$	3.7 mm (L / 2106)																																					
Case 'Q ₁ '	$v_{max} =$	5.9 mm (L / 1322)																																					
Case 'Shrinkage (R) - Long term'	$v_{max} =$	4.3 mm (L / 1807)																																					
Combination SLS 'G + R + Q ₁ '	$v_{max} =$	21.3 mm (L / 367)																																					
G + 0.00 Q ₁ :	6.43 Hz																																						
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G + 0.40 Q ₁ :	5.62 Hz																																						
G + 0.50 Q ₁ :	5.46 Hz																																						
G + 0.60 Q ₁ :	5.31 Hz																																						
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G + 0.80 Q ₁ :	5.05 Hz																																						
G + 0.90 Q ₁ :	4.94 Hz																																						
G + 1.00 Q ₁ :	4.83 Hz																																						
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9.9.3 VIGAS E ESCADAS

Na figura abaixo apresentam-se os elementos estruturais das vigas e escadas.

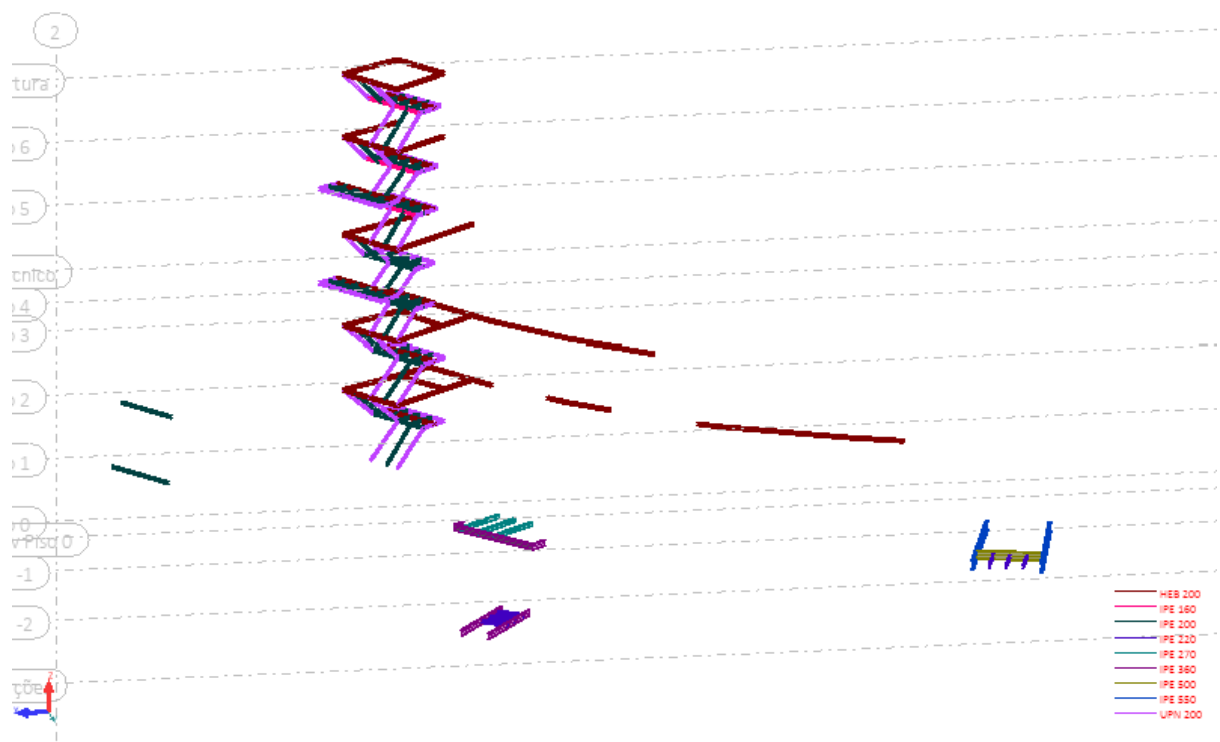


Figura 23 – Modelo estrutural das vigas e escadas.

Apresenta-se a tabela resumo com os rácios de segurança da verificação dos elementos metálicos das vigas e escadas:

Tabela 26 – Vigas – rácios de segurança das barras.

Membro	Secção	Material	Relação	Caso
68	HEB 200	S 275	0.06	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
74	HEB 200	S 275	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
75	HEB 200	S 275	0.26	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
158	IPE 550	S 275	0.11	104 UNFAV_AVB SC
169	HEB 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
217	HEB 200	S 275	0.02	113 UNFAV_AVB SC_SC Garagem+W270
314	HEB 200	S 275	0.03	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
336	IPE 360	S 275	0.10	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
337	IPE 360	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
346	IPE 220	S 275	0.61	104 UNFAV_AVB SC
348	IPE 550	S 275	0.10	113 UNFAV_AVB SC_SC Garagem+W270
361	IPE 500	S 275	0.24	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
373	IPE 500	S 275	0.24	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
375	IPE 500	S 275	0.48	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
377	IPE 500	S 275	0.48	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
385	IPE 220	S 275	0.82	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
386	IPE 550	S 275	0.12	113 UNFAV_AVB SC_SC Garagem+W270
387	IPE 550	S 275	0.13	104 UNFAV_AVB SC
391	IPE 360	S 275	0.17	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
392	IPE 360	S 275	0.37	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
393	IPE 270	S 275	0.30	113 UNFAV_AVB SC_SC Garagem+W270
394	IPE 360	S 275	0.36	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
393	IPE 270	S 275	0.33	113 UNFAV_AVB SC_SC Garagem+W270
492	IPE 360	S 275	0.11	109 UNFAV_AVB SC_W270
496	IPE 360	S 275	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
497	IPE 360	S 275	0.34	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
498	IPE 360	S 275	0.34	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
541	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
625	HEB 200	S 275	0.13	104 UNFAV_AVB SC
627	IPE 360	S 275	0.15	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
628	IPE 360	S 275	0.03	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
629	HEB 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
630	IPE 200	S 275	0.01	112 UNFAV_AVB SC_SC Garagem+W90
631	UPN 200	S 275	0.54	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
632	UPN 200	S 275	0.53	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
633	IPE 200	S 275	0.20	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
634	UPN 200	S 275	0.18	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
635	UPN 200	S 275	0.18	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
636	IPE 200	S 275	0.09	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
637	IPE 200	S 275	0.10	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
638	IPE 200	S 275	0.10	113 UNFAV_AVB SC_SC Garagem+W270
639	IPE 200	S 275	0.06	108 UNFAV_AVB SC_W90
640	IPE 200	S 275	0.05	108 UNFAV_AVB SC_W90
641	UPN 200	S 275	0.17	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
642	UPN 200	S 275	0.03	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z

Membro	Secção	Material	Relação	Caso
643	UPN 200	S 275	0.04	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
644	UPN 200	S 275	0.33	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
646	IPE 200	S 275	0.85	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
648	UPN 200	S 275	0.30	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
657	HEB 200	S 275	0.01	104 UNFAV_AVB SC
660	HEB 200	S 275	0.05	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
661	HEB 200	S 275	0.14	108 UNFAV_AVB SC_W90
662	IPE 200	S 275	0.01	104 UNFAV_AVB SC
663	IPE 160	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
677	IPE 160	S 275	0.01	108 UNFAV_AVB SC_W90
679	UPN 200	S 275	0.04	108 UNFAV_AVB SC_W90
685	UPN 200	S 275	0.05	109 UNFAV_AVB SC_W270
686	UPN 200	S 275	0.04	113 UNFAV_AVB SC_SC Garagem+W270
687	UPN 200	S 275	0.05	109 UNFAV_AVB SC_W270
689	IPE 160	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
690	IPE 160	S 275	0.01	108 UNFAV_AVB SC_W90
691	IPE 200	S 275	0.01	104 UNFAV_AVB SC
692	IPE 160	S 275	0.02	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
693	IPE 200	S 275	0.02	113 UNFAV_AVB SC_SC Garagem+W270
694	IPE 200	S 275	0.01	104 UNFAV_AVB SC
695	IPE 200	S 275	0.01	104 UNFAV_AVB SC
696	UPN 200	S 275	0.04	108 UNFAV_AVB SC_W90
697	IPE 200	S 275	0.00	104 UNFAV_AVB SC
698	IPE 160	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
699	IPE 160	S 275	0.01	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
700	UPN 200	S 275	0.04	104 UNFAV_AVB SC
701	UPN 200	S 275	0.31	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
702	IPE 160	S 275	0.02	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
704	IPE 200	S 275	0.11	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
705	UPN 200	S 275	0.30	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
719	IPE 200	S 275	0.23	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
731	HEB 200	S 275	0.25	112 UNFAV_AVB SC_SC Garagem+W90
732	HEB 200	S 275	0.24	105 UNFAV_AVB SC_SC Garagem
744	IPE 360	S 275	0.27	105 UNFAV_AVB SC_SC Garagem
746	IPE 360	S 275	0.27	105 UNFAV_AVB SC_SC Garagem
747	IPE 360	S 275	0.06	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
1073	HEB 200	S 275	0.07	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1076	HEB 200	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1077	HEB 200	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1078	HEB 200	S 275	0.02	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1079	HEB 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1080	HEB 200	S 275	0.04	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1082	UPN 200	S 275	0.29	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1083	HEB 200	S 275	0.01	108 UNFAV_AVB SC_W90
1084	UPN 200	S 275	0.05	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z

Membro	Secção	Material	Relação	Caso
1085	UPN 200	S 275	0.03	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1087	UPN 200	S 275	0.32	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1094	HEB 200	S 275	0.08	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1102	UPN 200	S 275	0.47	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1103	HEB 200	S 275	0.06	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1104	UPN 200	S 275	0.05	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1105	UPN 200	S 275	0.03	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1106	HEB 200	S 275	0.05	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1107	UPN 200	S 275	0.27	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
1111	HEB 200	S 275	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1122	HEB 200	S 275	0.27	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1124	HEB 200	S 275	0.30	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
1128	HEB 200	S 275	0.33	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
1129	HEB 200	S 275	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8265	HEB 200	S 275	0.15	113 UNFAV_AVB SC_SC Garagem+W270
8267	HEB 200	S 275	0.03	113 UNFAV_AVB SC_SC Garagem+W270
8268	HEB 200	S 275	0.10	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8269	HEB 200	S 275	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8293	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8294	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8298	HEB 200	S 275	0.14	113 UNFAV_AVB SC_SC Garagem+W270
8299	HEB 200	S 275	0.06	113 UNFAV_AVB SC_SC Garagem+W270
8300	HEB 200	S 275	0.06	113 UNFAV_AVB SC_SC Garagem+W270
8343	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8555	IPE 220	S 275	0.86	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
8557	IPE 220	S 275	0.01	104 UNFAV_AVB SC
8573	IPE 200	S 275	0.03	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8574	UPN 200	S 275	0.11	105 UNFAV_AVB SC_SC Garagem
8575	UPN 200	S 275	0.11	105 UNFAV_AVB SC_SC Garagem
8576	IPE 200	S 275	0.03	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8577	IPE 200	S 275	0.01	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8578	IPE 200	S 275	0.01	112 UNFAV_AVB SC_SC Garagem+W90
8579	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8580	UPN 200	S 275	0.23	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8582	UPN 200	S 275	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8583	UPN 200	S 275	0.32	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8584	UPN 200	S 275	0.06	108 UNFAV_AVB SC_W90
8585	IPE 200	S 275	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8586	IPE 200	S 275	0.10	113 UNFAV_AVB SC_SC Garagem+W270
8591	HEB 200	S 275	0.11	113 UNFAV_AVB SC_SC Garagem+W270
8592	IPE 200	S 275	0.01	109 UNFAV_AVB SC_W270
8593	UPN 200	S 275	0.51	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8594	UPN 200	S 275	0.40	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
8595	UPN 200	S 275	0.14	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
8596	IPE 200	S 275	0.01	109 UNFAV_AVB SC_W270

Membro	Secção	Material	Relação	Caso
8597	UPN 200	S 275	0.15	243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
8598	UPN 200	S 275	0.11	113 UNFAV_AVB SC_SC Garagem+W270
8599	UPN 200	S 275	0.12	113 UNFAV_AVB SC_SC Garagem+W270
8600	IPE 200	S 275	0.02	109 UNFAV_AVB SC_W270
8601	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8602	IPE 200	S 275	0.01	109 UNFAV_AVB SC_W270
8603	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8604	IPE 200	S 275	0.12	109 UNFAV_AVB SC_W270
8605	UPN 200	S 275	0.24	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8607	UPN 200	S 275	0.13	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8608	UPN 200	S 275	0.26	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8609	UPN 200	S 275	0.08	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
8610	IPE 200	S 275	0.11	113 UNFAV_AVB SC_SC Garagem+W270
8614	HEB 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8615	IPE 200	S 275	0.05	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
8616	IPE 200	S 275	0.06	108 UNFAV_AVB SC_W90
8617	UPN 200	S 275	0.17	113 UNFAV_AVB SC_SC Garagem+W270
8618	UPN 200	S 275	0.54	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8619	IPE 200	S 275	0.01	248 FUND_Sismo Tipo 2_-0.3X+Y+0.3Z
8620	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8621	IPE 200	S 275	0.01	109 UNFAV_AVB SC_W270
8622	IPE 200	S 275	0.01	105 UNFAV_AVB SC_SC Garagem
8623	IPE 200	S 275	0.01	108 UNFAV_AVB SC_W90
8624	UPN 200	S 275	0.25	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8625	IPE 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8626	IPE 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8627	IPE 200	S 275	0.08	108 UNFAV_AVB SC_W90
8628	IPE 200	S 275	0.05	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
8629	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8630	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8631	IPE 200	S 275	0.01	104 UNFAV_AVB SC
8632	UPN 200	S 275	0.26	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8633	IPE 200	S 275	0.65	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8634	UPN 200	S 275	0.29	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8635	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8639	UPN 200	S 275	0.64	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8640	UPN 200	S 275	0.27	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8641	IPE 200	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8642	IPE 200	S 275	0.03	105 UNFAV_AVB SC_SC Garagem
8643	IPE 200	S 275	0.03	108 UNFAV_AVB SC_W90
8644	IPE 200	S 275	0.03	113 UNFAV_AVB SC_SC Garagem+W270
8645	IPE 200	S 275	0.03	108 UNFAV_AVB SC_W90
8646	IPE 200	S 275	0.02	113 UNFAV_AVB SC_SC Garagem+W270
8647	IPE 200	S 275	0.01	108 UNFAV_AVB SC_W90
8648	IPE 200	S 275	0.01	108 UNFAV_AVB SC_W90

Membro	Secção	Material	Relação	Caso
8649	IPE 200	S 275	0.01	108 UNFAV_AVB SC_W90
8650	IPE 200	S 275	0.01	104 UNFAV_AVB SC
8651	IPE 200	S 275	0.00	250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
8652	UPN 200	S 275	0.23	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8653	UPN 200	S 275	0.45	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8654	UPN 200	S 275	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8655	IPE 200	S 275	0.01	248 FUND_Sismo Tipo 2_-0.3X+Y+0.3Z
8656	UPN 200	S 275	0.42	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8710	HEB 200	S 275	0.07	109 UNFAV_AVB SC_W270
8711	IPE 200	S 275	0.18	113 UNFAV_AVB SC_SC Garagem+W270
8712	IPE 200	S 275	0.46	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8713	UPN 200	S 275	0.11	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8714	UPN 200	S 275	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8715	IPE 200	S 275	0.37	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8716	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8717	IPE 200	S 275	0.00	108 UNFAV_AVB SC_W90
8718	IPE 200	S 275	0.28	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8719	IPE 200	S 275	0.02	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8720	IPE 200	S 275	0.00	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
8721	IPE 200	S 275	0.35	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8722	IPE 200	S 275	0.02	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8723	IPE 200	S 275	0.00	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8727	UPN 200	S 275	0.34	113 UNFAV_AVB SC_SC Garagem+W270
8728	UPN 200	S 275	0.02	104 UNFAV_AVB SC
8729	UPN 200	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8730	UPN 200	S 275	0.05	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8731	UPN 200	S 275	0.05	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8732	IPE 200	S 275	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8733	IPE 200	S 275	0.03	113 UNFAV_AVB SC_SC Garagem+W270
8734	IPE 200	S 275	0.03	113 UNFAV_AVB SC_SC Garagem+W270
8735	IPE 200	S 275	0.03	113 UNFAV_AVB SC_SC Garagem+W270
8736	IPE 200	S 275	0.03	104 UNFAV_AVB SC
8737	HEB 200	S 275	0.10	109 UNFAV_AVB SC_W270
8738	IPE 200	S 275	0.27	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8739	UPN 200	S 275	0.84	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8740	UPN 200	S 275	0.82	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
8745	HEB 200	S 275	0.06	113 UNFAV_AVB SC_SC Garagem+W270
8746	IPE 200	S 275	0.14	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
8747	IPE 160	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8749	UPN 200	S 275	0.06	109 UNFAV_AVB SC_W270
8750	IPE 160	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8753	IPE 160	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8754	IPE 160	S 275	0.01	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8755	IPE 200	S 275	0.11	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8756	IPE 200	S 275	0.01	109 UNFAV_AVB SC_W270

Membro	Secção	Material	Relação	Caso
8757	IPE 200	S 275	0.00	60 FAV_AVB SC_SC Garagem+W270
8758	IPE 200	S 275	0.32	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8759	IPE 200	S 275	0.01	109 UNFAV_AVB SC_W270
8760	IPE 200	S 275	0.00	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8761	IPE 200	S 275	0.08	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8762	IPE 200	S 275	0.01	105 UNFAV_AVB SC_SC Garagem
8763	IPE 200	S 275	0.00	51 FAV_AVB SC
8765	UPN 200	S 275	0.06	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8766	IPE 200	S 275	0.04	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8767	UPN 200	S 275	0.27	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8768	UPN 200	S 275	0.19	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8769	IPE 200	S 275	0.02	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8770	UPN 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8771	IPE 200	S 275	0.22	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8774	UPN 200	S 275	0.09	108 UNFAV_AVB SC_W90
8775	UPN 200	S 275	0.43	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8776	UPN 200	S 275	0.12	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8777	IPE 200	S 275	0.03	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8778	UPN 200	S 275	0.42	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8779	IPE 200	S 275	0.09	113 UNFAV_AVB SC_SC Garagem+W270
8780	UPN 200	S 275	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8791	IPE 200	S 275	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8792	IPE 200	S 275	0.01	113 UNFAV_AVB SC_SC Garagem+W270
8793	IPE 200	S 275	0.00	104 UNFAV_AVB SC
8794	IPE 200	S 275	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8795	IPE 200	S 275	0.01	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8796	IPE 200	S 275	0.00	112 UNFAV_AVB SC_SC Garagem+W90
8880	IPE 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8908	HEB 200	S 275	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8914	HEB 200	S 275	0.07	104 UNFAV_AVB SC
8918	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8936	HEB 200	S 275	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8937	HEB 200	S 275	0.11	240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
8938	HEB 200	S 275	0.05	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8939	HEB 200	S 275	0.05	236 FUND_Sismo Tipo 1_-X-0.3Y+0.3Z
8940	HEB 200	S 275	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8941	HEB 200	S 275	0.11	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8942	HEB 200	S 275	0.09	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
8943	HEB 200	S 275	0.08	113 UNFAV_AVB SC_SC Garagem+W270
8944	HEB 200	S 275	0.12	104 UNFAV_AVB SC
8945	HEB 200	S 275	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
8950	HEB 200	S 275	0.06	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
9003	IPE 220	S 275	0.56	109 UNFAV_AVB SC_W270
9009	IPE 270	S 275	0.96	113 UNFAV_AVB SC_SC Garagem+W270
9010	IPE 220	S 275	0.89	109 UNFAV_AVB SC_W270

Apresenta-se a figura com a identificação dos elementos mais esforçados por tipo de secção metálica:

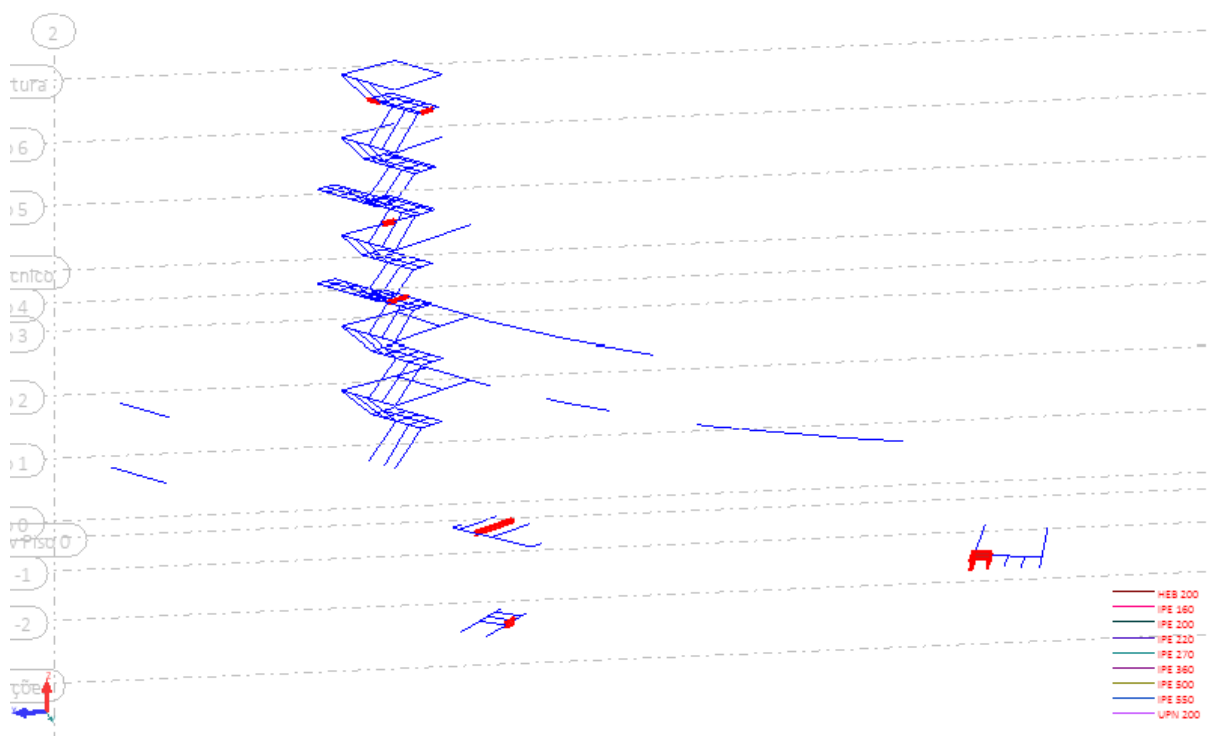


Figura 24 – Vigas – elementos mais solicitados.

Apresenta-se a verificação detalhada de cada tipo de secção metálica, para o elemento mais esforçado:

IPE 270

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 9009 Viga Piso_9009 **PONTO:** 2
1.627 m

COORDENADAS: $x = 0.49$ $L =$

CARGAS:

Caso de carga atuante: 113 UNFAV_AVB SC_SC Garagem+W270
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+(24+25+26+27+29+30+31)*1.50+28*1.05+36*0.90$

MATERIAL:S 275 (S 275) $f_y = 275.00 \text{ MPa}$ **PARÂMETROS DA SECÇÃO: IPE 270**

$h=27.0 \text{ cm}$	$gM0=1.00$	$gM1=1.00$	
$b=13.5 \text{ cm}$	$A_y=31.45 \text{ cm}^2$	$A_z=22.14 \text{ cm}^2$	$A_x=45.94 \text{ cm}^2$
$tw=0.7 \text{ cm}$	$I_y=5789.78 \text{ cm}^4$	$I_z=419.87 \text{ cm}^4$	$I_x=14.93 \text{ cm}^4$
$tf=1.0 \text{ cm}$	$W_{ply}=484.03 \text{ cm}^3$	$W_{plz}=96.95 \text{ cm}^3$	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 2.1 \text{ kN}$	$M_{y,Ed} = 127.1 \text{ kN}\cdot\text{m}$		
$N_{c,Rd} = 1263.5 \text{ kN}$	$M_{y,Ed,max} = 127.2 \text{ kN}\cdot\text{m}$		
$N_{b,Rd} = 1221.8 \text{ kN}$	$M_{y,c,Rd} = 133.1 \text{ kN}\cdot\text{m}$	$V_{z,Ed} = 3.4 \text{ kN}$	
	$M_{N,y,Rd} = 133.1 \text{ kN}\cdot\text{m}$	$V_{z,T,Rd} = 351.4 \text{ kN}$	
	$M_{b,Rd} = 133.1 \text{ kN}\cdot\text{m}$	$T_{t,Ed} = 0.0 \text{ kN}\cdot\text{m}$	
		Classe da Secção = 1	

**PARÂMETROS DE FLAMBAGEM LATERAL:**

$z = 0.00$	$M_{cr} = 300056.8 \text{ kN}\cdot\text{m}$	Curva,LT - b	$X_{LT} = 1.00$
$L_{cr,upp}=0.003 \text{ m}$	$\lambda_{m\_LT} = 0.02$	$f_{i,LT} = 0.47$	$X_{LT,mod} = 1.00$

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:

$L_y = 3.351 \text{ m}$	$\lambda_{m\_y} = 0.34$
$L_{cr,y} = 3.351 \text{ m}$	$X_y = 0.97$
$\lambda_{my} = 29.85$	$k_{yy} = 1.00$



Em torno do eixo z:

$L_z = 3.351 \text{ m}$	$\lambda_{m\_z} = 0.00$
$L_{cr,z} = 0.003 \text{ m}$	$X_z = 1.00$
$\lambda_{mz} = 0.11$	$k_{zy} = 0.52$

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{c,Rd} = 0.00 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{y,c,Rd} = 0.95 < 1.00 \quad (6.2.5.(1))$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.01 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(f_y/(\sqrt{3})gM0) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{Ed}/(f_y/(\sqrt{3})\cdot g_{M0}) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y,Ed} = 29.85 < \lambda_{y,max} = 210.00 \quad \lambda_{z,Ed} = 0.11 < \lambda_{z,max} = 210.00 \quad \text{ESTÁVEL}$$

$$M_{y,Ed,max}/M_{b,Rd} = 0.96 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) = 0.96 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(X_z \cdot N_{Rk}/g_{M1}) + k_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) = 0.50 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.000 \text{ mm} < u_{y,max} = L/250.00 = 13.404 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 272 RARA_AVB SC_SC Garagem+W270+TEMP(-)
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)
 *1.00+28*0.70+(36+38)*0.60

$$u_z = 8.096 \text{ mm} < u_{z,max} = L/250.00 = 13.404 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 264 RARA_AVB SC_W270+TEMP(-)
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)
 *1.00+(36+38)*0.60

**Deslocamentos (SISTEMA GLOBAL): Não analisados****Secção OK !!!****IPE 220****PROJETO DE AÇO****CÓDIGO:** EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.**TIPO DE ANÁLISE:** Verificação de membro**GRUPO DE CÓDIGO:****MEMBRO:** 9010
1.075 m**PONTO:** 2**COORDENADAS:** x = 0.50 L =**CARGAS:**

Caso de carga atuante: 109 UNFAV_AVB SC_W270
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+(24+25+26+27+29+30+31)*1.50+36*0.90

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$ **PARÂMETROS DA SECÇÃO: IPE 220**

$h=22.0 \text{ cm}$	$gM0=1.00$	$gM1=1.00$	
$b=11.0 \text{ cm}$	$A_y=22.89 \text{ cm}^2$	$A_z=15.88 \text{ cm}^2$	$A_x=33.37 \text{ cm}^2$
$t_w=0.6 \text{ cm}$	$I_y=2771.84 \text{ cm}^4$	$I_z=204.89 \text{ cm}^4$	$I_x=8.86 \text{ cm}^4$
$t_f=0.9 \text{ cm}$	$W_{ply}=285.43 \text{ cm}^3$	$W_{plz}=58.11 \text{ cm}^3$	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = -1.4 \text{ kN}$	$M_{y,Ed} = 69.5 \text{ kN}\cdot\text{m}$	
$N_{t,Rd} = 917.7 \text{ kN}$	$M_{y,pl,Rd} = 78.5 \text{ kN}\cdot\text{m}$	
	$M_{y,c,Rd} = 78.5 \text{ kN}\cdot\text{m}$	$V_{z,Ed} = -0.0 \text{ kN}$
	$M_{N,y,Rd} = 78.5 \text{ kN}\cdot\text{m}$	$V_{z,T,Rd} = 252.1 \text{ kN}$
		$T_{t,Ed} = -0.0 \text{ kN}\cdot\text{m}$
		Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:****PARÂMETROS DE FLAMBAGEM:**

Em torno do eixo y:



Em torno do eixo z:

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$N_{Ed}/N_{t,Rd} = 0.00 < 1.00$ (6.2.3.(1))
$M_{y,Ed}/M_{y,c,Rd} = 0.89 < 1.00$ (6.2.5.(1))
$V_{z,Ed}/V_{z,T,Rd} = 0.00 < 1.00$ (6.2.6-7)
$\tau_{ty,Ed}/(f_y/(\sqrt{3})\cdot gM0) = 0.00 < 1.00$ (6.2.6)
$\tau_{tz,Ed}/(f_y/(\sqrt{3})\cdot gM0) = 0.00 < 1.00$ (6.2.6)

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$u_y = 0.000 \text{ mm} < u_{y \text{ max}} = L/250.00 = 8.598 \text{ mm}$	Verificado

Caso de carga atuante: 263 RARA_AVB SC_W270+TEMP(+)
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)
 *1.00+(36+37)*0.60

uz = 3.867 mm < uz max = L/250.00 = 8.598 mm Verificado

Caso de carga atuante: 255 RARA_AVB SC_SC Garagem+TEMP(+)
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)
 *1.00+28*0.70+37*0.60



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

UPN 200

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 8739 Viga escadas_8739

PONTO: 1

COORDENADAS: x = 0.00 L = 0.000 m

CARGAS:

Caso de carga atuante: 237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+45)*1.00+(24+27+28+30+31)*0.60+(25+26+29+44+46)*0.30

MATERIAL:

S 275 (S 275) fy = 275.00 MPa



PARÂMETROS DA SECÇÃO: UPN 200

h=20.0 cm	gM0=1.00	gM1=1.00	
b=7.5 cm	Ay=18.93 cm ²	Az=17.07 cm ²	Ax=32.02 cm ²
tw=0.9 cm	Iy=1910.50 cm ⁴	Iz=147.81 cm ⁴	Ix=11.03 cm ⁴
tf=1.1 cm	Wply=227.71 cm ³	Wplz=51.78 cm ³	

FORÇAS INTERNAS E CAPACIDADES:

N,Ed = 62.9 kN	My,Ed = -51.3 kN*m	Mz,Ed = 0.3 kN*m	Vy,Ed = 0.8 kN
Nc,Rd = 880.6 kN	My,Ed,max = -51.3 kN*m	Mz,Ed,max = 0.6 kN*m	Vy,T,Rd = 299.0 kN
Nb,Rd = 738.3 kN	My,c,Rd = 62.6 kN*m	Mz,c,Rd = 14.2 kN*m	Vz,Ed = 55.9 kN
	MN,y,Rd = 62.3 kN*m	MN,z,Rd = 14.2 kN*m	Vz,T,Rd = 270.0 kN
	Mb,Rd = 62.6 kN*m		Tt,Ed = 0.0 kN*m
			Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:**

z = 0.00	Mcr = 1291.7 kN*m	Curva,LT - d	XLT = 0.98
Lcr,low=0.474 m	Lam_LT = 0.22	fi,LT = 0.53	XLT,mod = 1.00

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:

Ly = 0.948 m	Lam_y = 0.14
Lcr,y = 0.948 m	Xy = 1.00
Lamy = 12.27	kyy = 0.79



Em torno do eixo z:

Lz = 0.948 m	Lam_z = 0.51
Lcr,z = 0.948 m	Xz = 0.84
Lamz = 44.12	kyz = 0.57

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N,Ed/Nc,Rd = 0.07 < 1.00 \quad (6.2.4.(1))$$

$$My,Ed/MN,y,Rd = 0.82 < 1.00 \quad (6.2.9.1.(2))$$

$$Mz,Ed/MN,z,Rd = 0.02 < 1.00 \quad (6.2.9.1.(2))$$

$$(My,Ed/MN,y,Rd)^1.00 + (Mz,Ed/MN,z,Rd)^1.00 = 0.84 < 1.00 \quad (6.2.9.1.(6))$$

$$Vy,Ed/Vy,T,Rd = 0.00 < 1.00 \quad (6.2.6-7)$$

$$Vz,Ed/Vz,T,Rd = 0.21 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(f_y/(\sqrt{3} \cdot gM0)) = 0.01 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(f_y/(\sqrt{3} \cdot gM0)) = 0.01 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y,y} = 12.27 < \lambda_{y,max} = 210.00 \quad \lambda_{z,z} = 44.12 < \lambda_{z,max} = 210.00 \quad \text{ESTÁVEL}$$

$$My,Ed,max/Mb,Rd = 0.82 < 1.00 \quad (6.3.2.1.(1))$$

$$N,Ed/(X_y \cdot N_{Rk}/gM1) + k_{yy} \cdot My,Ed,max/(XLT \cdot My_{Rk}/gM1) + k_{yz} \cdot Mz,Ed,max/(Mz_{Rk}/gM1) = 0.75 < 1.00 \quad (6.3.3.(4))$$

$$N,Ed/(X_z \cdot N_{Rk}/gM1) + k_{zy} \cdot My,Ed,max/(XLT \cdot My_{Rk}/gM1) + k_{zz} \cdot Mz,Ed,max/(Mz_{Rk}/gM1) = 0.47 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.005 \text{ mm} < u_y \text{ max} = L/250.00 = 3.792 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 262 RARA_AVB SC_W90+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + (35+38) \cdot 0.60$

$$u_z = 0.179 \text{ mm} < u_z \text{ max} = L/250.00 = 3.792 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 346 RARA_AVB W270_SC+SC Garagem+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + (24+25+26+27+29+30+31+28) \cdot 0.70 + 38 \cdot 0.60$

**Deslocamentos (SISTEMA GLOBAL): Não analisados**

Secção OK !!!

IPE 200

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 646 Viga escadas_646 **PONTO:** 1
 0.000 m

COORDENADAS: x = 0.00 L =

CARGAS:

Caso de carga atuante: 240 FUND_Sismo Tipo 1_-0.3X-Y+0.3Z
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23) \cdot 1.00 + (24+27+28+30+31) \cdot 0.60 + (25+26+29+46) \cdot 0.30 + 44 \cdot -0.30 + 45 \cdot -1.00$

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$

**PARÂMETROS DA SECÇÃO: IPE 200**

h=20.0 cm	gM0=1.00	gM1=1.00	
b=10.0 cm	Ay=19.58 cm ²	Az=14.00 cm ²	Ax=28.48 cm ²
tw=0.6 cm	Iy=1943.17 cm ⁴	Iz=142.37 cm ⁴	Ix=6.46 cm ⁴

tf=0.9 cm

Wply=220.66 cm³Wplz=44.61 cm³**FORÇAS INTERNAS E CAPACIDADES:**

N,Ed = -2.4 kN

My,Ed = 10.2 kN*m

Mz,Ed = -10.1 kN*m

Vy,Ed = -12.5 kN

Nt,Rd = 783.3 kN

My,pl,Rd = 60.7 kN*m

Mz,pl,Rd = 12.3 kN*m

Vy,T,Rd = 310.1 kN

My,c,Rd = 60.7 kN*m

Mz,c,Rd = 12.3 kN*m

Vz,Ed = -1.4 kN

MN,y,Rd = 60.7 kN*m

MN,z,Rd = 12.3 kN*m

Vz,T,Rd = 221.9 kN

Mb,Rd = 60.7 kN*m

Tt,Ed = -0.0 kN*m

Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:**

z = 0.00

Mcr = 553.0 kN*m

Curva,LT - b

XLT = 0.95

Lcr,upp=0.823 m

Lam_LT = 0.33

fi,LT = 0.58

XLT,mod = 1.00

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:



Em torno do eixo z:

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N,Ed/Nt,Rd = 0.00 < 1.00 \quad (6.2.3.(1))$$

$$My,Ed/MN,y,Rd = 0.17 < 1.00 \quad (6.2.9.1.(2))$$

$$Mz,Ed/MN,z,Rd = 0.82 < 1.00 \quad (6.2.9.1.(2))$$

$$(My,Ed/MN,y,Rd)^{2.00} + (Mz,Ed/MN,z,Rd)^{1.00} = 0.85 < 1.00 \quad (6.2.9.1.(6))$$

$$Vy,Ed/Vy,T,Rd = 0.04 < 1.00 \quad (6.2.6-7)$$

$$Vz,Ed/Vz,T,Rd = 0.01 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\tau_y/(\sqrt{3} \cdot gM0)) = 0.01 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_z/(\sqrt{3} \cdot gM0)) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$My,Ed/Mb,Rd = 0.17 < 1.00 \quad (6.3.2.1.(1))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.253 \text{ mm} < u_{y \text{ max}} = L/250.00 = 6.586 \text{ mm}$$

Verificado

Caso de carga atuante: 262 RARA_AVB SC_W90+TEMP(-)
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)
 *1.00+(35+38)*0.60

uz = 0.225 mm < uz max = L/250.00 = 6.586 mm Verificado

Caso de carga atuante: 272 RARA_AVB SC_SC Garagem+W270+TEMP(-)
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)
 *1.00+28*0.70+(36+38)*0.60



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

IPE 500

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 377
 0.000 m

PONTO: 1

COORDENADAS: x = 0.00 L =

CARGAS:

Caso de carga atuante: 250 FUND_Sismo Tipo 2_-0.3X-Y+0.3Z
 (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+49)*0.30+47*-0.30+48*-1.00

MATERIAL:

S 275 (S 275) fy = 275.00 MPa



PARÂMETROS DA SECÇÃO: IPE 500

h=50.0 cm	gM0=1.00	gM1=1.00	
b=20.0 cm	Ay=72.07 cm ²	Az=59.87 cm ²	Ax=115.52 cm ²
tw=1.0 cm	Iy=48198.50 cm ⁴	Iz=2141.69 cm ⁴	Ix=89.00 cm ⁴
tf=1.6 cm	Wply=2194.26 cm ³	Wplz=335.89 cm ³	

FORÇAS INTERNAS E CAPACIDADES:

N,Ed = -17.0 kN	My,Ed = 68.8 kN*m	Mz,Ed = -43.3 kN*m	Vy,Ed = -44.2 kN
Nt,Rd = 3176.9 kN	My,pl,Rd = 603.4 kN*m	Mz,pl,Rd = 92.4 kN*m	Vy,T,Rd = 1130.9 kN
	My,c,Rd = 603.4 kN*m	Mz,c,Rd = 92.4 kN*m	Vz,Ed = -69.8 kN
	MN,y,Rd = 603.4 kN*m	MN,z,Rd = 92.4 kN*m	Vz,T,Rd = 943.6 kN
			Tt,Ed = -0.3 kN*m
			Classe da Secção = 1



PARÂMETROS DE FLAMBAGEM LATERAL:

PARÂMETROS DE FLAMBAGEM:



Em torno do eixo y:



Em torno do eixo z:

FÓRMULAS DE VERIFICAÇÃO:

Verificação de resistência de Secção:

$$N,Ed/Nt,Rd = 0.01 < 1.00 \quad (6.2.3.(1))$$

$$My,Ed/MN,y,Rd = 0.11 < 1.00 \quad (6.2.9.1.(2))$$

$$Mz,Ed/MN,z,Rd = 0.47 < 1.00 \quad (6.2.9.1.(2))$$

$$(My,Ed/MN,y,Rd)^{2.00} + (Mz,Ed/MN,z,Rd)^{1.00} = 0.48 < 1.00 \quad (6.2.9.1.(6))$$

$$Vy,Ed/Vy,T,Rd = 0.04 < 1.00 \quad (6.2.6-7)$$

$$Vz,Ed/Vz,T,Rd = 0.07 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\tau_y/(\sqrt{3} \cdot gM_0)) = 0.03 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_z/(\sqrt{3} \cdot gM_0)) = 0.02 < 1.00 \quad (6.2.6)$$

DESLOCAMENTOS DE LIMITE



Deflexões (SISTEMA LOCAL):

$$u_y = 0.011 \text{ mm} < u_{y \text{ max}} = L/250.00 = 3.915 \text{ mm}$$

Verificado

Caso de carga atuante:

253

RARA_AVB

SC_TEMP(+)

$$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + 37 \cdot 0.60$$

$$u_z = 0.054 \text{ mm} < u_{z \text{ max}} = L/250.00 = 3.915 \text{ mm}$$

Verificado

Caso de carga atuante:

253

RARA_AVB

SC_TEMP(+)

$$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + 37 \cdot 0.60$$



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

IPE 360

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 392
1.000 m

PONTO: 3

COORDENADAS: $x = 1.00$ $L =$

CARGAS:

Caso de carga atuante: 243 FUND_Sismo Tipo 2_+X+0.3Y+0.3Z
(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+47)*1.00+(24+27+28+30+31)*0.60+(25+26+29+48+49)*0.30

MATERIAL:

S 275 (S 275) $f_y = 275.00$ MPa



PARÂMETROS DA SECÇÃO: IPE 360

$h=36.0$ cm	$gM0=1.00$	$gM1=1.00$	
$b=17.0$ cm	$A_y=48.84$ cm ²	$A_z=35.14$ cm ²	$A_x=72.73$ cm ²
$t_w=0.8$ cm	$I_y=16265.60$ cm ⁴	$I_z=1043.45$ cm ⁴	$I_x=36.20$ cm ⁴
$t_f=1.3$ cm	$W_{ply}=1019.22$ cm ³	$W_{plz}=191.10$ cm ³	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 55.2$ kN	$M_{y,Ed} = 20.5$ kN*m	$M_{z,Ed} = 16.3$ kN*m	$V_{y,Ed} = 20.0$ kN
$N_{c,Rd} = 2000.1$ kN	$M_{y,Ed,max} = 20.5$ kN*m	$M_{z,Ed,max} = 16.3$ kN*m	$V_{y,T,Rd} = 775.1$ kN
$N_{b,Rd} = 2000.1$ kN	$M_{y,c,Rd} = 280.3$ kN*m	$M_{z,c,Rd} = 52.6$ kN*m	$V_{z,Ed} = 40.6$ kN
	$M_{N,y,Rd} = 280.3$ kN*m	$M_{N,z,Rd} = 52.6$ kN*m	$V_{z,T,Rd} = 557.7$ kN
			$T_{t,Ed} = 0.0$ kN*m
			Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:****PARÂMETROS DE FLAMBAGEM:**

Em torno do eixo y:

$$L_y = 1.000 \text{ m}$$

$$\text{Lam}_y = 0.08$$

$$\text{Lcr},y = 1.000 \text{ m}$$

$$X_y = 1.00$$

$$\text{Lamy} = 6.69$$

$$k_{zy} = 0.52$$



Em torno do eixo z:

$$L_z = 1.000 \text{ m}$$

$$\text{Lam}_z = 0.00$$

$$\text{Lcr},z = 0.001 \text{ m}$$

$$X_z = 1.00$$

$$\text{Lamz} = 0.03$$

$$k_{zz} = 0.97$$

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N,Ed/N_c,Rd = 0.03 < 1.00 \quad (6.2.4.(1))$$

$$M_y,Ed/MN,y,Rd = 0.07 < 1.00 \quad (6.2.9.1.(2))$$

$$M_z,Ed/MN,z,Rd = 0.31 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_y,Ed/MN,y,Rd)^{2.00} + (M_z,Ed/MN,z,Rd)^{1.00} = 0.32 < 1.00 \quad (6.2.9.1.(6))$$

$$V_y,Ed/V_{y,T},Rd = 0.03 < 1.00 \quad (6.2.6-7)$$

$$V_z,Ed/V_{z,T},Rd = 0.07 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty},Ed/(\tau_{fy}/(\sqrt{3}) \cdot gM_0) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{tz},Ed/(\tau_{fy}/(\sqrt{3}) \cdot gM_0) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y} = 6.69 < \lambda_{y,max} = 210.00 \quad \lambda_{z} = 0.03 < \lambda_{z,max} = 210.00 \quad \text{ESTÁVEL}$$

$$N,Ed/(X_y \cdot N,Rk/gM_1) + k_{yy} \cdot M_y,Ed,max/(XLT \cdot M_y,Rk/gM_1) + k_{yz} \cdot M_z,Ed,max/(M_z,Rk/gM_1) = 0.31 < 1.00 \quad (6.3.3.(4))$$

$$N,Ed/(X_z \cdot N,Rk/gM_1) + k_{zy} \cdot M_y,Ed,max/(XLT \cdot M_y,Rk/gM_1) + k_{zz} \cdot M_z,Ed,max/(M_z,Rk/gM_1) = 0.37 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.015 \text{ mm} < u_{y,max} = L/250.00 = 4.000 \text{ mm}$$

Verificado

Caso de carga atuante:

263

RARA_AVB

SC_W270+TEMP(+)

$$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + (36+37) \cdot 0.60$$

$$u_z = 0.048 \text{ mm} < u_{z,max} = L/250.00 = 4.000 \text{ mm}$$

Verificado

Caso de carga atuante:

263

RARA_AVB

SC_W270+TEMP(+)

$$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + (36+37) \cdot 0.60$$



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

HEB 200

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 1128
0.882 m

PONTO: 3

COORDENADAS: x = 1.00 L =

CARGAS:

Caso de carga atuante: 237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+45)*1.00+(24+27+28+30+31)*0.60+(25+26+29+44+46)*0.30

MATERIAL:

S 275 (S 275) $f_y = 275.00$ MPa



PARÂMETROS DA SECÇÃO: HEB 200

h=20.0 cm	gM0=1.00	gM1=1.00	
b=20.0 cm	Ay=66.02 cm ²	Az=24.83 cm ²	Ax=78.08 cm ²
tw=0.9 cm	Iy=5696.18 cm ⁴	Iz=2003.37 cm ⁴	Ix=61.40 cm ⁴
tf=1.5 cm	Wply=642.58 cm ³	Wplz=305.82 cm ³	

FORÇAS INTERNAS E CAPACIDADES:

N _{Ed} = 123.5 kN	My _{Ed} = -39.2 kN*m	Mz _{Ed} = 6.3 kN*m	Vy _{Ed} = 6.7 kN
N _{c,Rd} = 2147.2 kN	My _{Ed,max} = -39.2 kN*m	Mz _{Ed,max} = 6.3 kN*m	Vy _{T,Rd} = 1044.1 kN
N _{b,Rd} = 2147.2 kN	My _{c,Rd} = 176.7 kN*m	Mz _{c,Rd} = 84.1 kN*m	Vz _{Ed} = 23.5 kN
	MN _{y,Rd} = 176.7 kN*m	MN _{z,Rd} = 84.1 kN*m	Vz _{T,Rd} = 393.3 kN
	Mb _{Rd} = 176.7 kN*m		Tt _{Ed} = 0.1 kN*m
			Classe da Secção = 1



PARÂMETROS DE FLAMBAGEM LATERAL:

$z = 0.00$	$M_{cr} = 3729.3 \text{ kN}\cdot\text{m}$	Curva, LT - b	$X_{LT} = 0.99$
$L_{cr,low} = 0.882 \text{ m}$	$\lambda_{LT} = 0.22$	$\phi_{LT} = 0.53$	$X_{LT,mod} = 1.00$

PARÂMETROS DE FLAMBAGEM:



Em torno do eixo y:

$L_y = 0.882 \text{ m}$	$\lambda_{y} = 0.12$
$L_{cr,y} = 0.882 \text{ m}$	$\chi_y = 1.00$
$\lambda_{my} = 10.33$	$\phi_{yy} = 0.99$



Em torno do eixo z:

$L_z = 0.882 \text{ m}$	$\lambda_{z} = 0.00$
$L_{cr,z} = 0.001 \text{ m}$	$\chi_z = 1.00$
$\lambda_{mz} = 0.02$	$\phi_{yz} = 0.65$

FÓRMULAS DE VERIFICAÇÃO:

Verificação de resistência de Secção:

$$N_{Ed}/N_{c,Rd} = 0.06 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.22 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.08 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^{2.00} + (M_{z,Ed}/M_{N,z,Rd})^{1.00} = 0.12 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.01 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.06 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\phi_y/(\sqrt{3})\cdot gM_0) = 0.01 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\phi_z/(\sqrt{3})\cdot gM_0) = 0.01 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y} = 10.33 < \lambda_{y,max} = 210.00 \quad \lambda_{z} = 0.02 < \lambda_{z,max} = 210.00 \quad \text{ESTÁVEL}$$

$$M_{y,Ed,max}/M_{b,Rd} = 0.22 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(\chi_y \cdot N_{Rk}/gM_1) + \phi_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/gM_1) + \phi_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/gM_1) = 0.33 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(\chi_z \cdot N_{Rk}/gM_1) + \phi_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/gM_1) + \phi_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/gM_1) = 0.24 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE



Deflexões (SISTEMA LOCAL):

$$u_y = 0.008 \text{ mm} < u_{y,max} = L/250.00 = 3.529 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 368 RARA_AVB TEMP(+)_SC Garagem+W90
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + 28 \cdot 0.70 + 35 \cdot 0.60$

$uz = 0.034 \text{ mm} < uz_{\text{max}} = L/250.00 = 3.529 \text{ mm}$

Verificado

Caso de carga atuante: 262 RARA_AVB SC_W90+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)$
 $*1.00+(35+38)*0.60$



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

IPE 550

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 387

PONTO: 1

COORDENADAS: $x = 0.00 \text{ L} =$

0.000 m

CARGAS:

Caso de carga atuante: 104 UNFAV_AVB SC
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22)*1.35+39*1.30+(24+25+26+27+29+30+31)*1.50$

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$



PARÂMETROS DA SECÇÃO: IPE 550

$h=55.0 \text{ cm}$	$gM0=1.00$	$gM1=1.00$	
$b=21.0 \text{ cm}$	$A_y=82.51 \text{ cm}^2$	$A_z=72.34 \text{ cm}^2$	$A_x=134.42 \text{ cm}^2$
$t_w=1.1 \text{ cm}$	$I_y=67116.50 \text{ cm}^4$	$I_z=2667.58 \text{ cm}^4$	$I_x=118.40 \text{ cm}^4$
$t_f=1.7 \text{ cm}$	$W_{ply}=2787.21 \text{ cm}^3$	$W_{plz}=400.55 \text{ cm}^3$	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 3.4 \text{ kN}$	$M_{y,Ed} = 92.0 \text{ kN}\cdot\text{m}$	$M_{z,Ed} = 0.9 \text{ kN}\cdot\text{m}$	$V_{y,Ed} = 0.4 \text{ kN}$
$N_{c,Rd} = 3696.4 \text{ kN}$	$M_{y,Ed,max} = 92.0 \text{ kN}\cdot\text{m}$	$M_{z,Ed,max} = 0.9 \text{ kN}\cdot\text{m}$	$V_{y,T,Rd} = 1306.3 \text{ kN}$
$N_{b,Rd} = 3696.4 \text{ kN}$	$M_{y,c,Rd} = 766.5 \text{ kN}\cdot\text{m}$	$M_{z,c,Rd} = 110.2 \text{ kN}\cdot\text{m}$	$V_{z,Ed} = -41.3 \text{ kN}$

$$MN_{y,Rd} = 766.5 \text{ kN}\cdot\text{m} \quad MN_{z,Rd} = 110.2 \text{ kN}\cdot\text{m} \quad Vz_{T,Rd} = 1146.4 \text{ kN}$$

$$Tt_{Ed} = 0.1 \text{ kN}\cdot\text{m}$$

Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:****PARÂMETROS DE FLAMBAGEM:**

Em torno do eixo y:

$$Ly = 2.150 \text{ m}$$

$$\lambda_{m,y} = 0.11$$

$$L_{cr,y} = 2.150 \text{ m}$$

$$\chi_y = 1.00$$

$$\lambda_{my} = 9.62$$

$$k_{yy} = 1.00$$



Em torno do eixo z:

$$Lz = 2.150 \text{ m}$$

$$\lambda_{m,z} = 0.00$$

$$L_{cr,z} = 0.002 \text{ m}$$

$$\chi_z = 1.00$$

$$\lambda_{mz} = 0.05$$

$$k_{yz} = 0.69$$

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{c,Rd} = 0.00 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.12 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.01 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^2 + (M_{z,Ed}/M_{N,z,Rd})^1 = 0.02 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.04 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\sigma_{fy}/(\sqrt{3} \cdot gM0)) = 0.01 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\sigma_{fy}/(\sqrt{3} \cdot gM0)) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{m,y} = 9.62 < \lambda_{m,max} = 210.00 \quad \lambda_{m,z} = 0.05 < \lambda_{m,max} = 210.00 \quad \text{ESTÁVEL}$$

$$N_{Ed}/(\chi_y \cdot N_{Rk}/gM1) + k_{yy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rk}/gM1) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/gM1) = 0.13 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(\chi_z \cdot N_{Rk}/gM1) + k_{zy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rk}/gM1) + k_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/gM1) = 0.07 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.034 \text{ mm} < u_{y,max} = L/250.00 = 8.601 \text{ mm}$$

Verificado

Caso de carga atuante: 256 RARA_AVB SC_SC Garagem+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)$
 $\cdot 1.00 + 28 \cdot 0.70 + 38 \cdot 0.60$

$u_z = 0.143 \text{ mm} < u_z \text{ max} = L/250.00 = 8.601 \text{ mm}$

Verificado

Caso de carga atuante:

253

RARA_AVB

SC_TEMP(+)

(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31)
*1.00+37*0.60



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

IPE 160

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 702 Viga escadas_702 **PONTO:** 2
0.507 m

COORDENADAS: $x = 0.50 L =$

CARGAS:

Caso de carga atuante:

236

FUND_Sismo

Tipo

1_-X-0.3Y+0.3Z

(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23)*1.00+(24+27+28+30+31)*0.60+(25+26+29+46)*0.30+44*-1.00+45*-0.30

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$



PARÂMETROS DA SECÇÃO: IPE 160

$h=16.0 \text{ cm}$

$gM0=1.00$

$gM1=1.00$

$b=8.2 \text{ cm}$

$A_y=13.73 \text{ cm}^2$

$A_z=9.66 \text{ cm}^2$

$A_x=20.09 \text{ cm}^2$

$t_w=0.5 \text{ cm}$

$I_y=869.29 \text{ cm}^4$

$I_z=68.31 \text{ cm}^4$

$I_x=3.53 \text{ cm}^4$

$t_f=0.7 \text{ cm}$

$W_{ply}=123.87 \text{ cm}^3$

$W_{plz}=26.10 \text{ cm}^3$

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = -2.2 \text{ kN}$

$M_{y,Ed} = 0.1 \text{ kN}\cdot\text{m}$

$N_{t,Rd} = 552.5 \text{ kN}$

$M_{y,pl,Rd} = 34.1 \text{ kN}\cdot\text{m}$

$M_{y,c,Rd} = 34.1 \text{ kN}\cdot\text{m}$

$$M_{N,y,Rd} = 34.1 \text{ kN}\cdot\text{m}$$

$$T_{t,Ed} = -0.0 \text{ kN}\cdot\text{m}$$

Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:****PARÂMETROS DE FLAMBAGEM:**

Em torno do eixo y:



Em torno do eixo z:

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{t,Rd} = 0.00 < 1.00 \quad (6.2.3.(1))$$

$$M_{y,Ed}/M_{y,c,Rd} = 0.00 < 1.00 \quad (6.2.5.(1))$$

$$\tau_{u,ty,Ed}/(f_y/(\sqrt{3})\cdot gM_0) = 0.02 < 1.00 \quad (6.2.6)$$

$$\tau_{u,tz,Ed}/(f_y/(\sqrt{3})\cdot gM_0) = 0.01 < 1.00 \quad (6.2.6)$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.000 \text{ mm} < u_{y \text{ max}} = L/250.00 = 4.055 \text{ mm}$$

Verificado

Caso de carga atuante:

226

RARA_AVB

W270

$$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00$$

$$u_z = 0.006 \text{ mm} < u_{z \text{ max}} = L/250.00 = 4.055 \text{ mm}$$

Verificado

Caso de carga atuante:

253

RARA_AVB

SC_TEMP(+)

$$(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + 37 \cdot 0.60$$

**Deslocamentos (SISTEMA GLOBAL): Não analisados****Secção OK !!!****9.9.4 COBERTURA**

Na figura abaixo apresentam-se os elementos estruturais da cobertura.

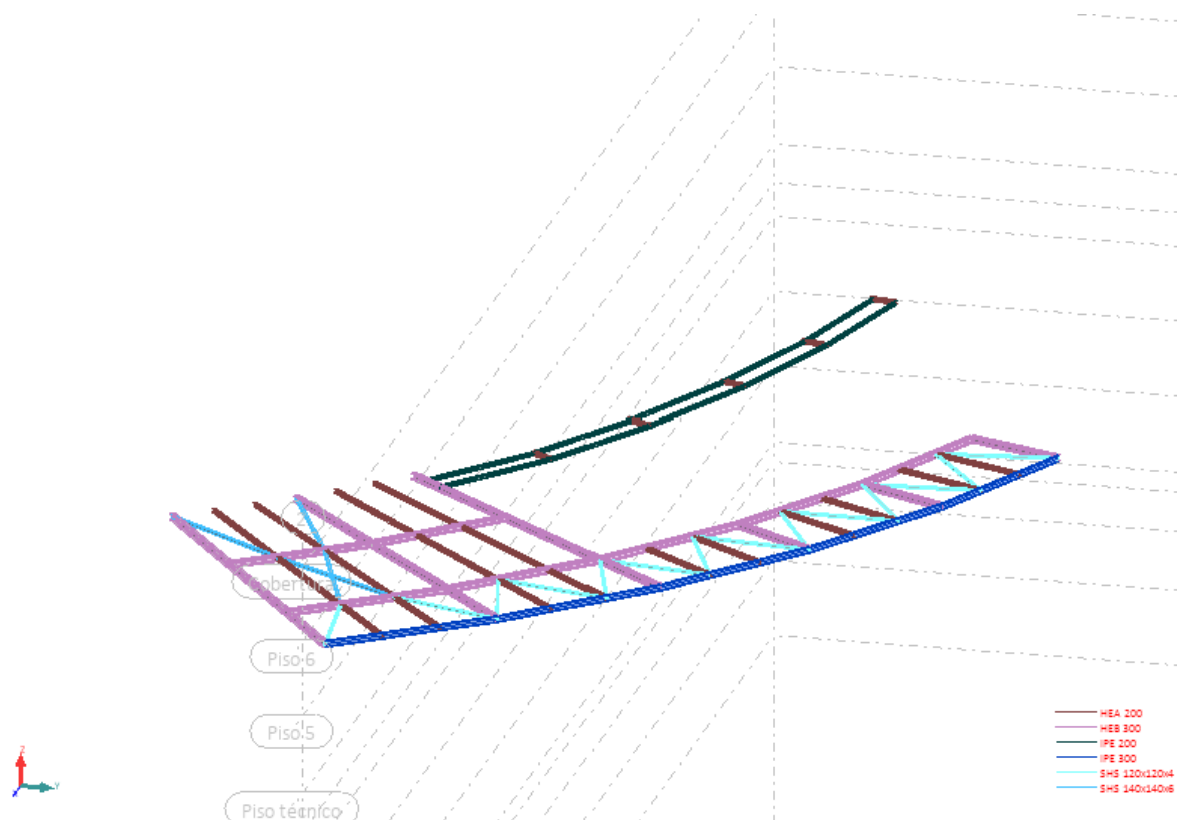


Figura 25 – Modelo estrutural da cobertura.

Apresenta-se a tabela resumo com os rácios de segurança da verificação dos elementos metálicos da cobertura:

Tabela 27 – Cobertura – rácios de segurança das barras.

Membro	Secção	Material	Lay	Laz	Relação	Caso
121	HEB 300	S 275	39.02	66.90	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
202	HEB 300	S 275	39.02	66.90	0.14	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
258	HEB 300	S 275	59.65	102.26	0.26	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
300	HEB 300	S 275	39.02	66.90	0.16	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
309	HEB 300	S 275	59.65	102.26	0.19	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
313	HEB 300	S 275	59.65	102.26	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
316	HEB 300	S 275	59.65	102.26	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z

Membro	Secção	Material	Lay	Laz	Relação	Caso
323	HEB 300	S 275	39.03	66.92	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
329	HEB 300	S 275	59.65	102.26	0.14	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
330	HEB 300	S 275	59.65	102.26	0.17	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
333	HEB 300	S 275	39.02	66.90	0.20	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
334	HEB 300	S 275	39.02	66.90	0.20	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
380	IPE 200	S 275	88.48	326.90	0.41	96 FAV_AVB W90_SC
749	HEA 200	S 275	16.30	27.10	0.10	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
750	HEA 200	S 275	16.30	27.10	0.10	126 UNFAV_AVB SC COB_SC Garagem
751	IPE 200	S 275	87.83	324.49	0.40	97 FAV_AVB W90_SC Garagem
752	HEA 200	S 275	16.30	27.10	0.12	126 UNFAV_AVB SC COB_SC Garagem
753	IPE 200	S 275	82.93	306.39	0.34	97 FAV_AVB W90_SC Garagem
755	HEA 200	S 275	16.30	27.10	0.11	97 FAV_AVB W90_SC Garagem
756	HEA 200	S 275	16.30	27.10	0.07	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
2470	IPE 300	S 275	73.45	90.17	0.34	102 FAV_AVB W270_SC+SC Garagem
2473	IPE 300	S 275	73.18	89.84	0.24	125 UNFAV_AVB SC COB_SC
2524	IPE 300	S 275	73.15	89.81	0.24	125 UNFAV_AVB SC COB_SC
2525	IPE 300	S 275	72.78	89.35	0.33	101 FAV_AVB W270_SC Garagem
2526	HEB 300	S 275	65.34	36.97	0.17	131 UNFAV_AVB SC COB_SC+SC Garagem
2527	HEB 300	S 275	65.01	36.78	0.19	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
2528	HEB 300	S 275	57.97	32.80	0.18	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
2529	HEB 300	S 275	57.67	32.63	0.16	131 UNFAV_AVB SC COB_SC+SC Garagem

Membro	Secção	Material	Lay	Laz	Relação	Caso
2648	HEB 300	S 275	66.69	37.73	0.09	124 UNFAV_AVB SC COB
2670	HEB 300	S 275	65.37	36.98	0.09	131 UNFAV_AVB SC COB_SC+SC Garagem
6558	HEB 300	S 275	65.35	36.97	0.08	125 UNFAV_AVB SC COB_SC
6559	IPE 300	S 275	73.21	89.88	0.25	131 UNFAV_AVB SC COB_SC+SC Garagem
7444	HEA 200	S 275	61.12	101.62	0.29	102 FAV_AVB W270_SC+SC Garagem
7445	HEA 200	S 275	93.42	155.33	0.37	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7446	HEA 200	S 275	61.12	101.62	0.29	102 FAV_AVB W270_SC+SC Garagem
7447	HEA 200	S 275	93.42	155.33	0.36	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7448	HEA 200	S 275	61.12	101.63	0.19	100 FAV_AVB W270_SC
7449	HEA 200	S 275	93.42	155.33	0.32	96 FAV_AVB W90_SC
7450	HEA 200	S 275	61.13	101.64	0.19	102 FAV_AVB W270_SC+SC Garagem
7451	HEA 200	S 275	93.42	155.33	0.32	98 FAV_AVB W90_SC+SC Garagem
7452	HEA 200	S 275	61.13	101.64	0.19	96 FAV_AVB W90_SC
7453	HEA 200	S 275	61.12	101.63	0.19	98 FAV_AVB W90_SC+SC Garagem
7454	HEA 200	S 275	61.11	101.62	0.19	101 FAV_AVB W270_SC Garagem
7455	HEA 200	S 275	61.12	101.62	0.19	98 FAV_AVB W90_SC+SC Garagem
7456	HEA 200	S 275	61.16	101.69	0.30	97 FAV_AVB W90_SC Garagem
7457	HEA 200	S 275	61.16	101.68	0.30	95 FAV_AVB W90
7458	HEA 200	S 275	93.42	155.33	0.27	98 FAV_AVB W90_SC+SC Garagem
7459	HEA 200	S 275	93.42	155.33	0.27	98 FAV_AVB W90_SC+SC Garagem
7460	HEA 200	S 275	93.42	155.33	0.27	96 FAV_AVB W90_SC
7461	HEA 200	S 275	93.42	155.33	0.28	98 FAV_AVB W90_SC+SC Garagem

Membro	Secção	Material	Lay	Laz	Relação	Caso
7462	SHS 120x120x4	S 275	126.23	126.23	0.30	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7463	SHS 140x140x6	S 275	150.62	150.62	0.63	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7464	SHS 140x140x6	S 275	147.23	147.23	0.97	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7465	SHS 140x140x6	S 275	147.23	147.23	0.97	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7466	SHS 140x140x6	S 275	150.62	150.62	0.97	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7467	SHS 120x120x4	S 275	126.22	126.22	0.97	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7468	SHS 120x120x4	S 275	126.40	126.40	0.31	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7469	SHS 120x120x4	S 275	124.14	124.14	0.25	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7470	SHS 120x120x4	S 275	121.98	121.98	0.24	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7471	SHS 120x120x4	S 275	121.98	121.98	0.23	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7472	SHS 120x120x4	S 275	124.16	124.16	0.18	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7473	SHS 120x120x4	S 275	126.41	126.41	0.27	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7474	SHS 120x120x4	S 275	126.42	126.42	0.15	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7475	SHS 120x120x4	S 275	124.15	124.15	0.13	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7476	SHS 120x120x4	S 275	121.94	121.94	0.12	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7477	SHS 120x120x4	S 275	122.30	122.30	0.09	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
7478	SHS 120x120x4	S 275	125.12	125.12	0.07	233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
7479	SHS 120x120x4	S 275	125.80	125.80	0.10	237 FUND_Sismo Tipo 1_0.3X+Y+0.3Z
9011	IPE 200	S 275	82.85	306.10	0.34	97 FAV_AVB W90_SC Garagem

Membro	Secção	Material	Lay	Laz	Relação	Caso
9012	IPE 200	S 275	89.14	329.32	0.42	98 FAV_AVB W90_SC+SC Garagem
9013	IPE 200	S 275	81.14	299.77	0.33	97 FAV_AVB W90_SC Garagem
9014	IPE 200	S 275	81.05	299.45	0.32	97 FAV_AVB W90_SC Garagem
9015	IPE 200	S 275	87.73	324.12	0.40	97 FAV_AVB W90_SC Garagem
9016	IPE 200	S 275	87.12	321.87	0.37	96 FAV_AVB W90_SC
9017	IPE 200	S 275	86.48	319.50	0.39	98 FAV_AVB W90_SC+SC Garagem

Apresenta-se a figura com a identificação dos elementos mais esforçados por tipo de secção metálica:

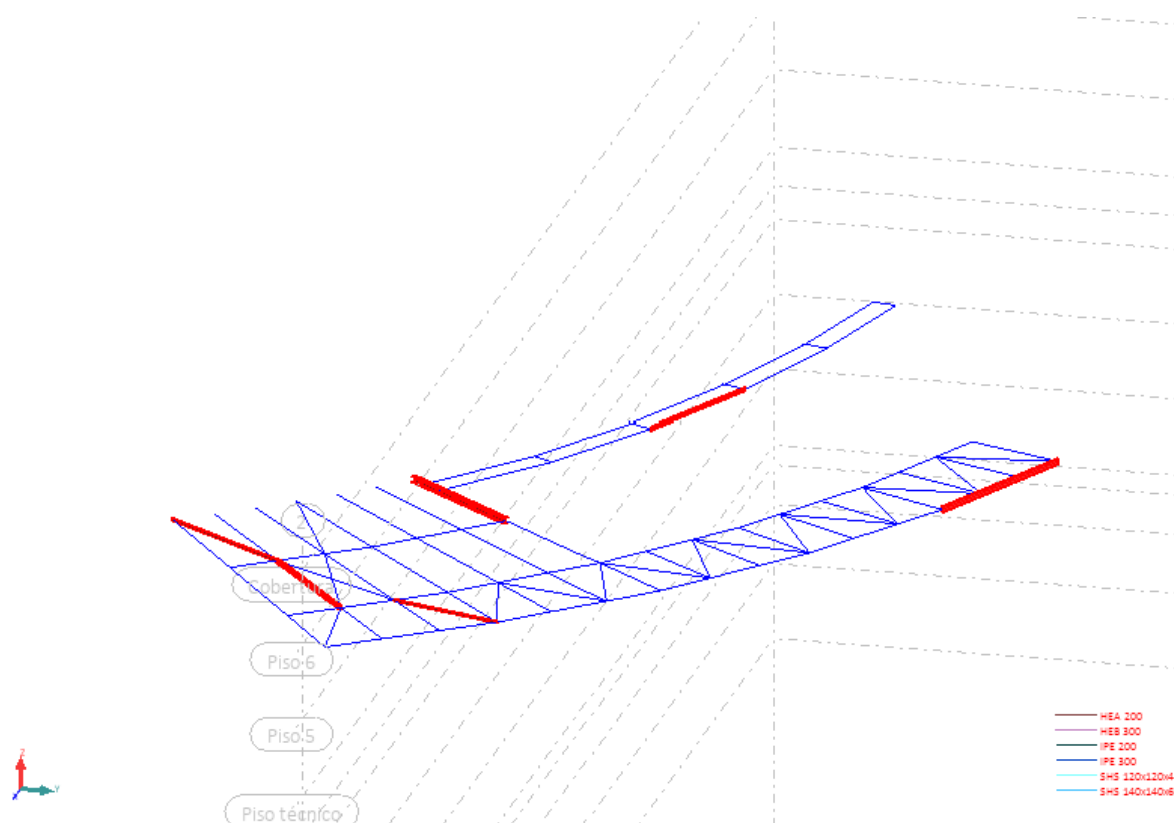


Figura 26 – Cobertura – elementos mais solicitados.

Apresenta-se a verificação detalhada de cada tipo de secção metálica, para o elemento mais esforçado:

IPE 200

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 9012 Madre_9012 **PONTO:** 2
3.681 m

COORDENADAS: x = 0.50 L =

CARGAS:

Caso de carga atuante: 98 FAV_AVB W90_SC+SC Garagem
(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39)*1.00+35*1.50+(24+25+26+27+29+30+31+28)*1.05

MATERIAL:

S 275 (S 275) $f_y = 275.00$ MPa



PARÂMETROS DA SECÇÃO: IPE 200

h=20.0 cm	gM0=1.00	gM1=1.00	
b=10.0 cm	Ay=19.58 cm ²	Az=14.00 cm ²	Ax=28.48 cm ²
tw=0.6 cm	Iy=1943.17 cm ⁴	Iz=142.37 cm ⁴	Ix=6.46 cm ⁴
tf=0.9 cm	Wply=220.66 cm ³	Wplz=44.61 cm ³	

FORÇAS INTERNAS E CAPACIDADES:

N,Ed = -0.1 kN	My,Ed = -6.0 kN*m	Mz,Ed = 0.0 kN*m	Vy,Ed = -0.0 kN
Nt,Rd = 783.3 kN	My,pl,Rd = 60.7 kN*m	Mz,pl,Rd = 12.3 kN*m	Vy,T,Rd = 310.9 kN
	My,c,Rd = 60.7 kN*m	Mz,c,Rd = 12.3 kN*m	
	MN,y,Rd = 60.7 kN*m	MN,z,Rd = 12.3 kN*m	
	Mb,Rd = 14.3 kN*m		Tt,Ed = 0.0 kN*m
			Classe da Secção = 1



PARÂMETROS DE FLAMBAGEM LATERAL:

z = 0.00	Mcr = 17.3 kN*m	Curva,LT - b	XLT = 0.24
Lcr,low=7.362 m	Lam_LT = 1.87	fi,LT = 2.53	XLT,mod = 0.24

PARÂMETROS DE FLAMBAGEM:



Em torno do eixo y:



Em torno do eixo z:

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{t,Rd} = 0.00 < 1.00 \quad (6.2.3.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.10 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.00 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^2 + (M_{z,Ed}/M_{N,z,Rd})^1 = 0.01 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\tau_{fy}/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_{fy}/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$M_{y,Ed}/M_{b,Rd} = 0.42 < 1.00 \quad (6.3.2.1.(1))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.610 \text{ mm} < u_{y \text{ max}} = L/200.00 = 36.812 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 381 RARA_AVB TEMP(+)_SC+SC Garagem+W90
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + (24+25+26+27+29+30+31+28) \cdot 0.70 + 35 \cdot 0.60$

$$u_z = 6.552 \text{ mm} < u_{z \text{ max}} = L/200.00 = 36.812 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 296 RARA_AVB SC COBERTURA_SC+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32) \cdot 1.00 + (24+25+26+27+29+30+31) \cdot 0.70 + 38 \cdot 0.60$

**Deslocamentos (SISTEMA GLOBAL): Não analisados****Secção OK !!!**

HEA 200

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 7445 Madre_7445 **PONTO:** 2
3.868 m

COORDENADAS: x = 0.50 L =

CARGAS:

Caso de carga atuante: 233 FUND_Sismo Tipo 1_X+0.3Y+0.3Z
(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+44)*1.00+(24+27+28+30+31)*0.60+(25+26+29+45+46)*0.30

MATERIAL:

S 275 (S 275) $f_y = 275.00$ MPa

**PARÂMETROS DA SECÇÃO: HEA 200**

h=19.0 cm	gM0=1.00	gM1=1.00	
b=20.0 cm	Ay=45.12 cm ²	Az=18.08 cm ²	Ax=53.83 cm ²
tw=0.7 cm	Iy=3692.15 cm ⁴	Iz=1335.51 cm ⁴	Ix=18.60 cm ⁴
tf=1.0 cm	Wply=429.52 cm ³	Wplz=203.82 cm ³	

FORÇAS INTERNAS E CAPACIDADES:

N _{Ed} = 216.9 kN	My _{Ed} = 11.0 kN*m	
N _{c,Rd} = 1480.4 kN	My _{Ed,max} = 11.0 kN*m	
N _{b,Rd} = 813.7 kN	My _{c,Rd} = 118.1 kN*m	
	MN _{y,Rd} = 115.7 kN*m	
		Tt _{Ed} = 0.0 kN*m
		Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:****PARÂMETROS DE FLAMBAGEM:**

Em torno do eixo y:



Em torno do eixo z:

Ly = 7.737 m	Lam _y = 1.08	
Lcr _y = 7.737 m	Xy = 0.55	
Lam _y = 93.42	kyy = 1.13	kzy = 1.00

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{c,Rd} = 0.15 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{y,c,Rd} = 0.09 < 1.00 \quad (6.2.5.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.10 < 1.00 \quad (6.2.9.1.(2))$$

$$\tau_{ty,Ed}/(\tau_{fy}/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_{fy}/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{b,y} = 93.42 < \lambda_{b,max} = 210.00 \quad \text{ESTÁVEL}$$

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) = 0.37 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.000 \text{ mm} < u_{y,max} = L/200.00 = 38.685 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 261 RARA_AVB SC_W90+TEMP(+)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + (35+37) \cdot 0.60$

$$u_z = 15.253 \text{ mm} < u_{z,max} = L/200.00 = 38.685 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 204 RARA_AVB SC COBERTURA_SC+SC Garagem
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+32) \cdot 1.00 + (24+25+26+27+29+30+31+28) \cdot 0.70$

**Deslocamentos (SISTEMA GLOBAL): Não analisados****Secção OK !!!****SHS 120x4****PROJETO DE AÇO****CÓDIGO:** EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.**TIPO DE ANÁLISE:** Verificação de membro**GRUPO DE CÓDIGO:****MEMBRO:** 7467 Travamento_7467**PONTO:**

2

COORDENADAS: x = 0.50 L = 2.974 m**CARGAS:**

Caso de carga atuante: 233 FUND_Sismo Tipo 1_X+0.3Y+0.3Z
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+44)*1.00+(24+27+28+30+31)*0.60+(25+26+29+45+46)*0.30$

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$

**PARÂMETROS DA SECÇÃO: SHS 120x120x4**

$h=12.0 \text{ cm}$	$gM0=1.00$	$gM1=1.00$	
$b=12.0 \text{ cm}$	$A_y=9.05 \text{ cm}^2$	$A_z=9.05 \text{ cm}^2$	$A_x=18.10 \text{ cm}^2$
$t_w=0.4 \text{ cm}$	$I_y=402.00 \text{ cm}^4$	$I_z=402.00 \text{ cm}^4$	$I_x=637.00 \text{ cm}^4$
$t_f=0.4 \text{ cm}$	$W_{ply}=78.30 \text{ cm}^3$	$W_{plz}=78.30 \text{ cm}^3$	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 62.8 \text{ kN}$	$M_{y,Ed} = 0.6 \text{ kN}\cdot\text{m}$		
$N_{c,Rd} = 497.8 \text{ kN}$	$M_{y,Ed,max} = 0.6 \text{ kN}\cdot\text{m}$		
$N_{b,Rd} = 195.4 \text{ kN}$	$M_{y,c,Rd} = 21.5 \text{ kN}\cdot\text{m}$		
	$M_{N,y,Rd} = 21.5 \text{ kN}\cdot\text{m}$		
	$M_{b,Rd} = 21.2 \text{ kN}\cdot\text{m}$	$T_{t,Ed} = 1.0 \text{ kN}\cdot\text{m}$	
		Classe da Secção = 1	

**PARÂMETROS DE FLAMBAGEM LATERAL:**

$z = 0.00$	$M_{cr} = 390.4 \text{ kN}\cdot\text{m}$	Curva,LT - d	$X_{LT} = 0.97$
$L_{cr,upp}=5.949 \text{ m}$	$\lambda_{m\_LT} = 0.23$	$f_{i,LT} = 0.54$	$X_{LT,mod} = 0.98$

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:

$L_y = 5.949 \text{ m}$	$\lambda_{m\_y} = 1.45$
$L_{cr,y} = 5.949 \text{ m}$	$X_y = 0.39$
$\lambda_{my} = 126.22$	$k_{yy} = 1.20$



Em torno do eixo z:

$L_z = 5.949 \text{ m}$	$\lambda_{m\_z} = 1.45$
$L_{cr,z} = 5.949 \text{ m}$	$X_z = 0.39$
$\lambda_{mz} = 126.22$	$k_{zy} = 0.90$

FÓRMULAS DE VERIFICAÇÃO:**Verificação de resistência de Secção:**

$$N_{Ed}/N_{c,Rd} = 0.13 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{y,c,Rd} = 0.03 < 1.00 \quad (6.2.5.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.03 < 1.00 \quad (6.2.9.1.(2))$$

$$\tau_{ty,Ed}/(f_y/(\sqrt{3} \cdot g_{M0})) = 0.06 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(f_y/(\sqrt{3} \cdot g_{M0})) = 0.06 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y,Ed} = 126.22 < \lambda_{b,max} = 210.00 \quad \lambda_{z,Ed} = 126.22 < \lambda_{b,max} = 210.00 \quad \text{ESTÁVEL}$$

$$M_{y,Ed,max}/M_{b,Rd} = 0.03 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) = 0.36 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(X_z \cdot N_{Rk}/g_{M1}) + k_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) = 0.35 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE



Deflexões (SISTEMA LOCAL):

$$u_y = 0.000 \text{ mm} < u_{y,max} = L/200.00 = 29.743 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 336 RARA_AVB W270_SC+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + (24+25+26+27+29+30+31) \cdot 0.70 + 38 \cdot 0.60$

$$u_z = 2.692 \text{ mm} < u_{z,max} = L/200.00 = 29.743 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 270 RARA_AVB SC_SC Garagem+W90+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+24+25+26+27+29+30+31) \cdot 1.00 + 28 \cdot 0.70 + (35+38) \cdot 0.60$



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

IPE 300

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 2470 Viga apoio_2470 **PONTO:** 1
6.102 m

COORDENADAS: x = 0.67 L =

CARGAS:

Caso de carga atuante: 102 FAV_AVB W270_SC+SC Garagem
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39) \cdot 1.00 + 36 \cdot 1.50 + (24+25+2$

6+27+29+30+31+28)*1.05

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$



PARÂMETROS DA SECÇÃO: IPE 300

$h=30.0 \text{ cm}$	$gM0=1.00$	$gM1=1.00$	
$b=15.0 \text{ cm}$	$A_y=36.16 \text{ cm}^2$	$A_z=25.68 \text{ cm}^2$	$A_x=53.81 \text{ cm}^2$
$tw=0.7 \text{ cm}$	$I_y=8356.11 \text{ cm}^4$	$I_z=603.78 \text{ cm}^4$	$I_x=19.47 \text{ cm}^4$
$tf=1.1 \text{ cm}$	$W_{ply}=628.40 \text{ cm}^3$	$W_{plz}=125.22 \text{ cm}^3$	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 7.4 \text{ kN}$	$M_{y,Ed} = -51.1 \text{ kN}\cdot\text{m}$	$M_{z,Ed} = 0.0 \text{ kN}\cdot\text{m}$	$V_{y,Ed} = 0.0 \text{ kN}$
$N_{c,Rd} = 1479.8 \text{ kN}$	$M_{y,Ed,max} = -51.5 \text{ kN}\cdot\text{m}$	$M_{z,Ed,max} = 0.0 \text{ kN}\cdot\text{m}$	$V_{y,T,Rd} = 574.0 \text{ kN}$
$N_{b,Rd} = 847.5 \text{ kN}$	$M_{y,c,Rd} = 172.8 \text{ kN}\cdot\text{m}$	$M_{z,c,Rd} = 34.4 \text{ kN}\cdot\text{m}$	$V_{z,Ed} = 17.4 \text{ kN}$
	$MN_{y,Rd} = 172.8 \text{ kN}\cdot\text{m}$	$MN_{z,Rd} = 34.4 \text{ kN}\cdot\text{m}$	$V_{z,T,Rd} = 407.7 \text{ kN}$
	$M_{b,Rd} = 153.5 \text{ kN}\cdot\text{m}$		$T_{t,Ed} = 0.0 \text{ kN}\cdot\text{m}$
			Classe da Secção = 1



PARÂMETROS DE FLAMBAGEM LATERAL:

$z = 0.00$	$M_{cr} = 345.7 \text{ kN}\cdot\text{m}$	Curva,LT - b	$XLT = 0.78$
$L_{cr,low}=3.020 \text{ m}$	$\lambda_{m\_LT} = 0.71$	$f_{i,LT} = 0.84$	$XLT,mod = 0.89$

PARÂMETROS DE FLAMBAGEM:



Em torno do eixo y:

$L_y = 9.153 \text{ m}$	$\lambda_{m\_y} = 0.85$
$L_{cr,y} = 9.153 \text{ m}$	$X_y = 0.77$
$\lambda_{my} = 73.45$	$k_{yy} = 1.01$



Em torno do eixo z:

$L_z = 9.153 \text{ m}$	$\lambda_{m\_z} = 1.04$
$L_{cr,z} = 3.020 \text{ m}$	$X_z = 0.57$
$\lambda_{mz} = 90.17$	$k_{yz} = 0.98$

FÓRMULAS DE VERIFICAÇÃO:

Verificação de resistência de Secção:

$$N_{Ed}/N_{c,Rd} = 0.01 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.30 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.00 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^2 + (M_{z,Ed}/M_{N,z,Rd})^1 = 0.09 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.04 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\tau_{fy}/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_{fy}/(\sqrt{3} \cdot g_{M0})) = 0.00 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{y,Ed} = 73.45 < \lambda_{y,max} = 210.00 \quad \lambda_{z,Ed} = 90.17 < \lambda_{z,max} = 210.00 \quad \text{ESTÁVEL}$$

$$M_{y,Ed,max}/M_{b,Rd} = 0.34 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.34 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(X_z \cdot N_{Rk}/g_{M1}) + k_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.18 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE



Deflexões (SISTEMA LOCAL):

$$u_y = 0.004 \text{ mm} < u_{y,max} = L/200.00 = 45.764 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 335 RARA_AVB W270_SC+TEMP(+)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + (24+25+26+27+29+30+31) \cdot 0.70 + 37 \cdot 0.60$

$$u_z = 14.188 \text{ mm} < u_{z,max} = L/200.00 = 45.764 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 344 RARA_AVB W90_SC+SC Garagem+TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+35) \cdot 1.00 + (24+25+26+27+29+30+31+28) \cdot 0.70 + 38 \cdot 0.60$



Deslocamentos (SISTEMA GLOBAL): Não analisados

Secção OK !!!

HEB 300

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

TIPO DE ANÁLISE: Verificação de membro

GRUPO DE CÓDIGO:

MEMBRO: 258 Madre_258
2.200 m

PONTO: 1

COORDENADAS: x = 0.28 L =

CARGAS:

Caso de carga atuante: 233 FUND_Sismo Tipo 1_+X+0.3Y+0.3Z
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+23+44)*1.00+(24+27+28+30+31)*0.60+(25+26+29+45+46)*0.30$

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$

**PARÂMETROS DA SECÇÃO: HEB 300**

$h=30.0 \text{ cm}$	$gM0=1.00$	$gM1=1.00$	
$b=30.0 \text{ cm}$	$A_y=126.20 \text{ cm}^2$	$A_z=47.43 \text{ cm}^2$	$A_x=149.08 \text{ cm}^2$
$t_w=1.1 \text{ cm}$	$I_y=25165.70 \text{ cm}^4$	$I_z=8562.83 \text{ cm}^4$	$I_x=186.00 \text{ cm}^4$
$t_f=1.9 \text{ cm}$	$W_{ply}=1868.80 \text{ cm}^3$	$W_{plz}=870.16 \text{ cm}^3$	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 87.1 \text{ kN}$	$M_{y,Ed} = -30.6 \text{ kN*m}$	$M_{z,Ed} = 21.3 \text{ kN*m}$	$V_{y,Ed} = 3.9 \text{ kN}$
$N_{c,Rd} = 4099.6 \text{ kN}$	$M_{y,Ed,max} = -59.3 \text{ kN*m}$	$M_{z,Ed,max} = 21.3 \text{ kN*m}$	$V_{y,T,Rd} = 1996.4 \text{ kN}$
$N_{b,Rd} = 3242.6 \text{ kN}$	$M_{y,c,Rd} = 513.9 \text{ kN*m}$	$M_{z,c,Rd} = 239.3 \text{ kN*m}$	$V_{z,Ed} = 15.3 \text{ kN}$
	$M_{N,y,Rd} = 513.9 \text{ kN*m}$	$M_{N,z,Rd} = 239.3 \text{ kN*m}$	$V_{z,T,Rd} = 751.4 \text{ kN}$
	$M_{b,Rd} = 362.3 \text{ kN*m}$		$T_{t,Ed} = 0.1 \text{ kN*m}$
			Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:**

$z = 0.00$	$M_{cr} = 687.7 \text{ kN*m}$	Curva,LT - b	$X_{LT} = 0.68$
$L_{cr,low}=7.750 \text{ m}$	$\lambda_{m\_LT} = 0.86$	$\phi_{i,LT} = 0.99$	$X_{LT,mod} = 0.70$

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:



Em torno do eixo z:

$L_y = 7.750 \text{ m}$	$\lambda_{m\_y} = 0.69$	
$L_{cr,y} = 7.750 \text{ m}$	$X_y = 0.79$	
$\lambda_{my} = 59.65$	$k_{yy} = 1.01$	$k_{yz} = 0.77$

FÓRMULAS DE VERIFICAÇÃO:

Verificação de resistência de Secção:

$$N_{Ed}/N_{c,Rd} = 0.02 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.06 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.09 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^2 + (M_{z,Ed}/M_{N,z,Rd})^1 = 0.09 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.02 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\tau_{fy}/(\sqrt{3}) \cdot g_{M0}) = 0.01 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\tau_{fy}/(\sqrt{3}) \cdot g_{M0}) = 0.01 < 1.00 \quad (6.2.6)$$

Verificação de estabilidade global de membro:

$$\lambda_{b,y} = 59.65 < \lambda_{b,max} = 210.00 \quad \text{ESTÁVEL}$$

$$M_{y,Ed,max}/M_{b,Rd} = 0.16 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.26 < 1.00 \quad (6.3.3.(4))$$

DESLOCAMENTOS DE LIMITE**Deflexões (SISTEMA LOCAL):**

$$u_y = 0.718 \text{ mm} < u_{y,max} = L/200.00 = 38.750 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 368 RARA_AVB TEMP(+)_SC Garagem+W90
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+37) \cdot 1.00 + 28 \cdot 0.70 + 35 \cdot 0.60$

$$u_z = 0.823 \text{ mm} < u_{z,max} = L/200.00 = 38.750 \text{ mm} \quad \text{Verificado}$$

Caso de carga atuante: 322 RARA_AVB W270_TEMP(-)
 $(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19+20+21+22+39+36) \cdot 1.00 + 38 \cdot 0.60$

**Deslocamentos (SISTEMA GLOBAL): Não analisados****Secção OK !!!**

SHS 140x6

PROJETO DE AÇO

CÓDIGO: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.**TIPO DE ANÁLISE:** Verificação de membro**GRUPO DE CÓDIGO:****MEMBRO:** 7465 Travamento_7465**PONTO:**

COORDENADAS:**CARGAS:***Caso de carga atuante:* Manual**MATERIAL:**S 275 (S 275) $f_y = 275.00$ MPa**PARÂMETROS DA SECÇÃO: SHS 140x140x6**

$h=14.0$ cm	$gM0=1.00$	$gM1=1.00$	
$b=14.0$ cm	$A_y=15.60$ cm ²	$A_z=15.60$ cm ²	$A_x=31.20$ cm ²
$t_w=0.6$ cm	$I_y=920.00$ cm ⁴	$I_z=920.00$ cm ⁴	$I_x=1479.00$ cm ⁴
$t_f=0.6$ cm	$W_{ply}=155.00$ cm ³	$W_{plz}=155.00$ cm ³	

FORÇAS INTERNAS E CAPACIDADES:

$N_{Ed} = 230.4$ kN	$M_{y,Ed} = 1.9$ kN*m
$N_{c,Rd} = 858.0$ kN	$M_{y,Ed,max} = 1.9$ kN*m
$N_{b,Rd} = 258.0$ kN	$M_{y,c,Rd} = 42.6$ kN*m
	$M_{N,y,Rd} = 40.5$ kN*m
	$M_{b,Rd} = 41.4$ kN*m

Classe da Secção = 1

**PARÂMETROS DE FLAMBAGEM LATERAL:**

$z = 0.00$	$M_{cr} = 668.5$ kN*m	Curva,LT - d	$X_{LT} = 0.96$
$L_{cr,upp}=7.995$ m	$\lambda_{m\_LT} = 0.25$	$f_{i,LT} = 0.55$	$X_{LT,mod} = 0.97$

PARÂMETROS DE FLAMBAGEM:

Em torno do eixo y:

$L_y = 7.995$ m	$\lambda_{m\_y} = 1.70$
$L_{cr,y} = 7.995$ m	$X_y = 0.30$
$\lambda_{my} = 147.23$	$k_{yy} = 1.57$



Em torno do eixo z:

$L_z = 7.995$ m	$\lambda_{m\_z} = 1.70$
$L_{cr,z} = 7.995$ m	$X_z = 0.30$
$\lambda_{mz} = 147.23$	$k_{zy} = 1.57$

FÓRMULAS DE VERIFICAÇÃO:

Verificação de resistência de Secção:

$$N,Ed/N_{c,Rd} = 0.27 < 1.00 \quad (6.2.4.(1))$$

$$M_{y,Ed}/M_{y,c,Rd} = 0.05 < 1.00 \quad (6.2.5.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.05 < 1.00 \quad (6.2.9.1.(2))$$

Verificação de estabilidade global de membro:

$$\lambda_{y} = 147.23 < \lambda_{max} = 210.00 \quad \lambda_{z} = 147.23 < \lambda_{max} = 210.00 \quad \text{ESTÁVEL}$$

$$M_{y,Ed,max}/M_{b,Rd} = 0.05 < 1.00 \quad (6.3.2.1.(1))$$

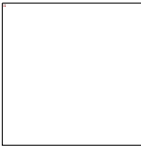
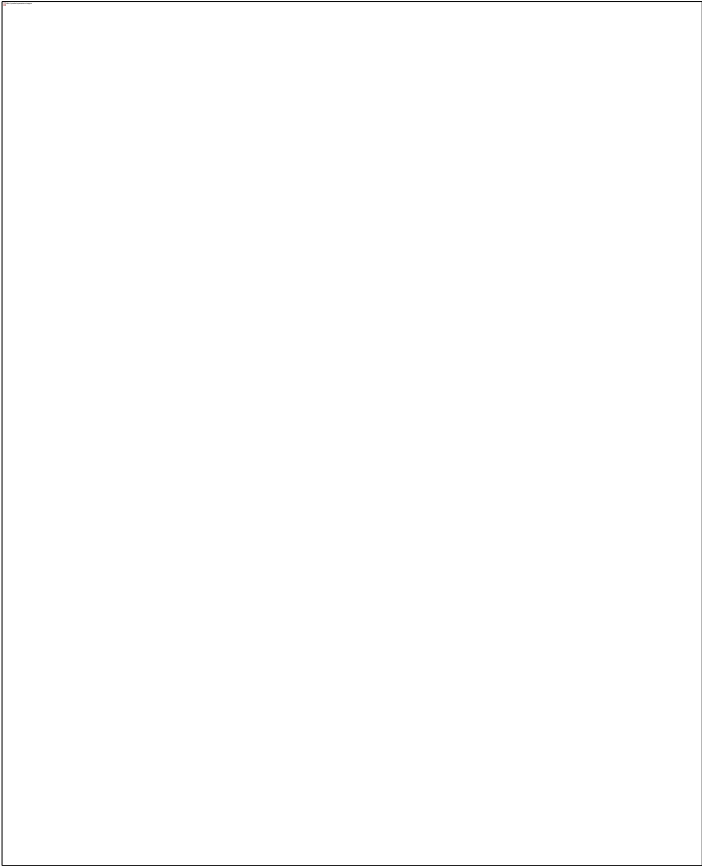
$$N,Ed/(X_y \cdot N_{Rk}/gM1) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/gM1) = 0.97 < 1.00 \quad (6.3.3.(4))$$

$$N,Ed/(X_z \cdot N_{Rk}/gM1) + k_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/gM1) = 0.97 < 1.00 \quad (6.3.3.(4))$$

Secção OK !!!

9.9.5 LIGAÇÕES

Ligação Viga Piso IPE 450

	Autodesk Robot Structural Analysis Professional 2021 Cálculo da conexão viga - coluna (alma) EN 1993-1-8:2005/AC:2009	 Relação 0,90
		

Geral

Nº de conexão: 1

Nome da conexão: Beam-column (web)

Geometria

Coluna

Seção: HEA 300

$\alpha =$ -90,0 [Deg] Âng. de inclinação

$h_c =$ 290 [mm] Altura da seção da coluna

Seção: HEA 300

$\alpha =$ -90,0 [Deg] Âng. de inclinação

$b_{fc} =$ 300 [mm] Largura da seção da coluna

$t_{wc} =$ 9 [mm] Espessura da alma da seção da coluna

$t_{fc} =$ 14 [mm] Espessura da mesa da seção da coluna

$r_c =$ 27 [mm] Raio de concordância de seção da coluna

$A_c =$ 112,53 [cm²] Área de seção transversal do pilar

$I_{yc} =$ 18263,50 [cm⁴] Momento de inércia da seção do pilar

Material: S 275

$f_{yc} =$ 275,00 [MPa] Resistência do projeto

$f_{uc} =$ 430,00 [MPa] Resistência à tensão

Viga**Seção:** IPE 450

$\alpha =$ 0,0 [Deg] Âng. de inclinação

$h_b =$ 450 [mm] Altura da seção da viga

$b_b =$ 190 [mm] Largura da seção da viga

$t_{wb} =$ 9 [mm] Espessura da alma da seção da viga

$t_{fb} =$ 15 [mm] Espessura da mesa da seção da viga

$r_b =$ 21 [mm] Raio de concordância da seção da viga

$A_b =$ 98,82 [cm²] Área de seção transversal da viga

$I_{yb} =$ 33742,90 [cm⁴] Momento de inércia da seção da viga

Material: S 275

$f_{yb} =$ 275,00 [MPa] Resistência do projeto

$f_{ub} =$ 430,00 [MPa] Resistência à tensão

Placa**Tipo:** unilateral

$l_p =$ 180 [mm] Comprimento da placa

$h_p =$ 350 [mm] Altura da placa

$t_p =$ 15 [mm] Espessura da placa

Material: S 275

$f_{yp} = 275,00$ [MPa] Resistência do projeto

$f_{up} = 430,00$ [MPa] Resistência à tensão

Parafusos

Parafusos conectando a viga e a placa

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe = 8.8 Classe do parafuso

$d = 20$ [mm] Diâmetro do parafuso

$d_0 = 22$ [mm] Diâmetro da abertura do parafuso

$A_s = 2,45$ [cm²] Área efetiva da seção de um parafuso

$A_v = 3,14$ [cm²] Área de seção do parafuso

$f_{ub} = 800,00$ [MPa] Resistência à tensão

$k = 2$ Número de colunas de parafusos

$w = 4$ Número de linhas de parafusos

$e_1 = 40$ [mm] Nível do primeiro parafuso

$p_2 = 80$ [mm] Espaçamento horizontal

$p_1 = 90$ [mm] Espaçamento vertical

Soldas

$a_{cp} = 5$ [mm] Soldas de concordância conectando a placa à coluna

Fatores de material

$\gamma_{M0} = 1,00$ Fator de segurança parcial [2.2]

$\gamma_{M2} = 1,25$ Fator de segurança parcial [2.2]

Cargas

Caso: Cálculos manuais.

$N_{b,Ed} = 89,00$ [kN] Força axial

$V_{b,Ed} = 351,00$ [kN] Força de cisalhamento

$M_{b,Ed} = 0,00$ [kN*m] Momento fletor

Resultados

Parafusos conectando a viga e a placa**Capacidades dos parafusos**

$$F_{v,Rd} = 94,0 \text{ [kN Resistência do parafuso ao cisalhamento na parte com rosca de um parafuso]} \quad F_{v,Rd} = 0,6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$$

Apoio do parafuso na viga

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2,8 \cdot (e_1/d_0) - 1,7, 1,4 \cdot (p_1/d_0) - 1,7, 2,5]$$

$$k_{1x} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), p_2/(3 \cdot d_0) - 0,25, f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0,0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1x} = 97,99 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2,8 \cdot (e_2/d_0) - 1,7, 1,4 \cdot (p_2/d_0) - 1,7, 2,5]$$

$$k_{1z} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 1,00 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0,25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0,0 \quad 1,00 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1z} = 161,68 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Apoio do parafuso na placa

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2,8 \cdot (e_1/d_0) - 1,7, 1,4 \cdot (p_1/d_0) - 1,7, 2,5]$$

$$k_{1x} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,68 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), p_2/(3 \cdot d_0) - 0,25, f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0,0 \quad 0,68 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 175,91 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2,8 \cdot (e_2/d_0) - 1,7, 1,4 \cdot (p_2/d_0) - 1,7, 2,5]$$

$$k_{1z} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0,25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0,0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2z} = 156,36 \text{ [kN]} \quad \text{Resistência portante de um único parafuso}$$

$$F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Forças atuantes nos parafusos da conexão da placa com a viga

Cisalhamento do parafuso

$$e = 99 \text{ [mm]} \quad \text{Distância entre o centroide de um grupo de parafusos e o centro da alma do pilar}$$

$$M_0 = 34,8 \text{ [kN} \cdot \text{m]} \quad \text{Momento fletor real}$$

$$M_0 = M_{b,Ed} + V_{b,Ed} \cdot e$$

$$F_{Nx} = 11,1 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força longitudinal}$$

$$F_{Nx} = |N_{b,Ed}| / n$$

$$F_{Vz} = 43,8 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força de cisalhamento}$$

$$F_{Vz} = |V_{b,Ed}| / n$$

$$F_{Mx} = 50,1 \text{ [kN]} \quad \text{Componente de força em um parafuso devido a influência do momento na direção x}$$

$$F_{Mx} = |M_0| \cdot z_i / \sum (x_i^2 + z_i^2)$$

$$F_{Mz} = 14,8 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência do momento ao redor do eixo z}$$

$$F_{Mz} = |M_0| \cdot x_i / \sum (x_i^2 + z_i^2)$$

$$F_{x,Ed} = 61,2 \text{ [kN]} \quad \text{Força total do projeto em um parafuso na direção x}$$

$$F_{x,Ed} = F_{Nx} + F_{Mx}$$

$$F_{z,Ed} = 58,7 \text{ [kN]} \quad \text{Força de projeto total em um parafuso na direção z}$$

$$F_{z,Ed} = F_{Vz} + F_{Mz}$$

$$F_{Ed} = 84,8 \text{ [kN]} \quad \text{Força de cisalhamento resultante no parafuso}$$

$$F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$$F_{Rdx} = 97,9 \text{ [kN]} \quad \text{Capacidade de projeto efetiva de um parafuso na direção x}$$

$$F_{Rdx} = \min(F_{bRd1x}, F_{bRd2x})$$

$$F_{Rdz} = 156,36 \text{ [kN]} \quad \text{Capacidade de projeto efetiva de um parafuso na direção z}$$

$$F_{Rdz} = \min(F_{bRd1z}, F_{bRd2z})$$

$ F_{x,Ed} \leq F_{Rdx}$	$ 61,26 < 97,99$	verificado	(0,63)
$ F_{z,Ed} \leq F_{Rdz}$	$ 58,73 < 156,36$	verificado	(0,38)
$F_{Ed} \leq F_{v,Rd}$	$84,87 < 94,08$	verificado	(0,90)

Verificação da seção devido ao rompimento do bloco (força axial)

Placa

$$A_{nt} = 30,60 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 27,60 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 1490,85 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b,Ed}| \leq V_{effRd} \quad |89,00| < 1490,85 \quad \text{verificado} \quad (0,06)$$

Viga

$$A_{nt} = 19,18 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 16,36 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 919,34 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b,Ed}| \leq V_{effRd} \quad |89,00| < 919,34 \quad \text{verificado} \quad (0,10)$$

Verificação da seção devido ao rompimento do bloco (força de cisalhamento)**Placa**

$$A_{nt} = 13,80 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 34,95 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 792,27 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b,Ed}| \leq V_{effRd} \quad |351,00| < 792,27 \quad \text{verificado} \quad (0,44)$$

Viga

$$A_{nt} = 8,18 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 26,60 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 563,03 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b,Ed}| \leq V_{effRd} \quad |351,00| < 563,03 \quad \text{verificado} \quad (0,62)$$

Verificação de uma placa enfraquecida por aberturas

$$A_t = 30,16 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 23,56 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,70 < 0,80 \quad \#$$

$$W_{net} = 284,56 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 78,25 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |34,84| < 78,25 \quad \text{verificado} \quad (0,45)$$

$$A_v = 52,50 \text{ [cm}^2\text{]} \quad \text{Área da seção efetiva quanto a cisalhamento} \quad A_v = h_p \cdot t_p$$

$$A_{v,net} = 39,30 \text{ [cm}^2\text{]} \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 833,55 \text{ [kN]} \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$V_{b,Ed} \leq V_{pl,Rd} \quad |351,00| < 833,55 \quad \text{verificado} \quad (0,42)$$

Verificação de uma seção de viga enfraquecida por aberturas

$$A_t = 25,20 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 19,00 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,68 < 0,80 \quad \#$$

$$W_{net} = 294,46 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 80,98 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |34,84| < 80,98 \quad \text{verificado} \quad (0,43)$$

$$A_v = 42,30 \text{ [cm}^2\text{]} \quad \text{Área da seção efetiva quanto a cisalhamento}$$

$$A_{v,net} = 34,03 \text{ [cm}^2\text{]} \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 671,60 \text{ [kN]} \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$V_{b,Ed} \leq V_{pl,Rd} \quad |351,00| < 671,60 \quad \text{verificado} \quad (0,52)$$

Resistência da solda

Soldas de concordância conectando a placa à coluna

$$A_w = 17,50 \text{ [cm}^2\text{]} \quad \text{Área da solda} \quad A_w = h_p \cdot a_{gp}$$

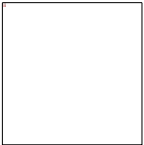
$$\sigma = 188,75 \text{ [MPa]} \quad \text{Tensão normal em uma solda} \quad \sigma = 0.5 \cdot [N_{b,Ed}/A_s + M_0/W_{yw}]$$

$$\sigma_{\perp} = 133,47 \text{ [MPa]} \quad \text{Tensão perpendicular normal na solda} \quad \sigma_{\perp} = \sigma / \sqrt{2}$$

$ \sigma_{\perp} \leq 0.9 \cdot f_u / \gamma_{M2}$		$ 133,47 < 309,60$		verificado	(0,43)
$\tau_{\perp} =$	133,47	[MPa]	Tensão tangencial perpendicular		$\tau_{\perp} = \sigma_{\perp}$
$\tau_{\parallel} =$	100,29	[MPa]	Tensão tangencial paralela		$\tau_{\parallel} = 0.5 \cdot V_{b,Ed} / A_s$
$\beta_w =$	0,85	Coeficiente de correlação			[Tabela 4.1]
$\sqrt{[\sigma_{\perp}^2 + 3 \cdot (\tau_{\parallel}^2 + \tau_{\perp}^2)]} \leq f_u / (\beta_w \cdot \gamma_{M2})$		$318,47 < 404,71$		verificado	(0,79)
A conexão está em conformidade com a norma.					Relação 0,90

#

Ligação Viga Piso IPE 330

	Autodesk Robot Structural Analysis Professional 2021 Cálculo da conexão viga - viga (alma) EN 1993-1-8:2005/AC:2009	 Relação 0,93

Geral

Nº de conexão: 2

Nome da conexão: Beam-beam (web)

Geometria

Viga principal

Seção: IPE 450

$\alpha = -90,0$ [Deg] Âng. de inclinação

$h_g = 450$ [mm] Altura da seção da viga principal

$b_{fg} = 190$ [mm] Largura da mesa da seção da viga principal

Seção: IPE 450

$\alpha = -90,0$ [Deg] Âng. de inclinação

$t_{wg} = 9$ [mm] Espessura da mesa da seção da viga principal

$t_{fg} = 15$ [mm] Espessura da mesa da seção da viga principal

$r_g = 21$ [mm] Raio de concordância da alma da seção da viga principal

$A_p = 98,82$ [cm²] Área de seção transversal da viga principal

$I_{yp} = 33742,90$ [cm⁴] Momento de inércia da seção da viga principal

Material: S 235

$f_{yg} = 235,00$ [MPa] Resistência do projeto

$f_{ug} = 360,00$ [MPa] Resistência à tensão

Lado esquerdo

Viga

Seção: IPE 330

$\alpha = 0,0$ [Deg] Âng. de inclinação

$h_{bl} = 330$ [mm] Altura da seção da viga

$b_{bl} = 160$ [mm] Largura da seção da viga

$t_{wbl} = 8$ [mm] Espessura da alma da seção da viga

$t_{rbl} = 12$ [mm] Espessura da mesa da seção da viga

$r_{bl} = 18$ [mm] Raio de concordância da seção da viga

$A_b = 62,61$ [cm²] Área de seção transversal da viga

$I_{ybl} = 11766,90$ [cm⁴] Momento de inércia da seção da viga

Material: S 275

$f_{ybl} = 275,00$ [MPa] Resistência do projeto

$f_{ubl} = 430,00$ [MPa] Resistência à tensão

Corte da viga

$h_1 = 30$ [mm] Entalhe superior

$h_2 = 0$ [mm] Entalhe inferior

$l = 80$ [mm] Comprimento do entalhe

Ângulo

Seção: CAE 100x10

$\alpha =$	0,0	[Deg]	Âng. de inclinação
$h_{kl} =$	100	[mm]	Altura da seção do ângulo
$b_{kl} =$	100	[mm]	Largura da seção do ângulo
$t_{rkl} =$	10	[mm]	Espessura da mesa da seção do ângulo
$r_{kl} =$	12	[mm]	Raio de concordância da alma da seção do ângulo
$l_{kl} =$	240	[mm]	Comprimento do ângulo

Material: S 275

$f_{ykl} =$	275,00	[MPa]	Resistência do projeto
$f_{ukl} =$	430,00	[MPa]	Resistência à tensão

Parafusos

Parafusos conectando o ângulo à viga

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe =	8.8		Classe do parafuso
$d =$	16	[mm]	Diâmetro do parafuso
$d_0 =$	18	[mm]	Diâmetro da abertura do parafuso
$A_s =$	1,57	[cm ²]	Área efetiva da seção de um parafuso
$A_v =$	2,01	[cm ²]	Área de seção do parafuso
$f_{ub} =$	800,00	[MPa]	Resistência à tensão
$k =$	1		Número de colunas de parafusos
$w =$	3		Número de linhas de parafusos
$e_1 =$	40	[mm]	Nível do primeiro parafuso
$p_1 =$	80	[mm]	Espaçamento vertical

Lado direito

Viga

Seção: IPE 330

$\alpha =$	0,0	[Deg]	Âng. de inclinação
$h_{br} =$	330	[mm]	Altura da seção da viga
$b_{br} =$	160	[mm]	Largura da seção da viga
$t_{wbr} =$	8	[mm]	Espessura da alma da seção da viga
$t_{fbr} =$	12	[mm]	Espessura da mesa da seção da viga
$r_{br} =$	18	[mm]	Raio de concordância da seção da viga
$A_{br} =$	62,61	[cm ²]	Área de seção transversal da viga
$I_{ybr} =$	11766,90	[cm ⁴]	Momento de inércia da seção da viga

Material: S 275

$f_{ybr} = 275,00$ [MPa] Resistência do projeto

$f_{ubr} = 430,00$ [MPa] Resistência à tensão

Corte da viga

$h_1 =$	30	[mm]	Entalhe superior
$h_2 =$	0	[mm]	Entalhe inferior
$l =$	80	[mm]	Comprimento do entalhe

Ângulo

Seção: CAE 100x10

$h_{kr} =$	100	[mm]	Altura da seção do ângulo
$b_{kr} =$	100	[mm]	Largura da seção do ângulo
$t_{fkr} =$	10	[mm]	Espessura da mesa da seção do ângulo
$r_{kr} =$	12	[mm]	Raio de concordância da alma da seção do ângulo
$l_{kr} =$	240	[mm]	Comprimento do ângulo

Material: S 275

$f_{ykr} = 275,00$ [MPa] Resistência do projeto

$f_{ukr} = 430,00$ [MPa] Resistência à tensão

Parafusos

Parafusos conectando o ângulo à viga principal

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe =	8 . 8		Classe do parafuso
d =	16	[mm]	Diâmetro do parafuso
d ₀ =	18	[mm]	Diâmetro da abertura do parafuso
A _s =	1, 57	[cm ²]	Área efetiva da seção de um parafuso
A _v =	2, 01	[cm ²]	Área de seção do parafuso
f _{ub} =	800, 00	[MPa]	Resistência à tensão
k =	1		Número de colunas de parafusos
w =	3		Número de linhas de parafusos
e ₁ =	40	[mm]	Nível do primeiro parafuso
p ₁ =	80	[mm]	Espaçamento vertical

Parafusos conectando o ângulo à viga

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe =	8 . 8		Classe do parafuso
d =	16	[mm]	Diâmetro do parafuso
d ₀ =	18	[mm]	Diâmetro da abertura do parafuso
A _s =	1, 57	[cm ²]	Área efetiva da seção de um parafuso
A _v =	2, 01	[cm ²]	Área de seção do parafuso
f _{ub} =	800, 00	[MPa]	Resistência à tensão
k =	1		Número de colunas de parafusos
w =	3		Número de linhas de parafusos
e ₁ =	40	[mm]	Nível do primeiro parafuso
p ₁ =	80	[mm]	Espaçamento vertical

Fatores de material

γ _{M0} =	1, 00	Fator de segurança parcial	[2.2]
γ _{M2} =	1, 25	Fator de segurança parcial	[2.2]

Cargas

Caso: Cálculos manuais.

Lado esquerdo

$N_{b2,Ed} = 33,00$ [kN] Força axial
 $V_{b2,Ed} = 150,00$ [kN] Força de cisalhamento
 $M_{b2,Ed} = 0,00$ [kN*m] Momento fletor

Lado direito

$N_{b1,Ed} = 33,00$ [kN] Força axial
 $V_{b1,Ed} = 115,00$ [kN] Força de cisalhamento
 $M_{b1,Ed} = 0,00$ [kN*m] Momento fletor

Resultados**Lado esquerdo****Parafusos conectando o ângulo à viga principal****Capacidades dos parafusos**

$F_{v,Rd} = 60,2$ [kN Resistência do parafuso ao cisalhamento na parte com rosca de um
 $= 9$] parafuso $F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$
 $F_{t,Rd} = 90,4$ [kN Resistência de um parafuso à tensão $F_{t,Rd} = 0.9 \cdot f_u \cdot A_s / \gamma_{M2}$
 $= 3$]

Apoio do parafuso no ângulo**Direção x**

$k_{1x} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$
 $k_{1x} > 0.0$ $2,50 > 0,00$ verificado
 $\alpha_{bx} = 0,74$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$
 $\alpha_{bx} > 0.0$ $0,74 > 0,00$ verificado
 $F_{b,Rd2x} = 101,93$ [kN] Resistência portante de um único parafuso $F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$

Direção z

$k_{1z} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$
 $k_{1z} > 0.0$ $2,50 > 0,00$ verificado
 $\alpha_{bz} = 0,74$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$
 $\alpha_{bz} > 0.0$ $0,74 > 0,00$ verificado

$F_{b,Rd2z} = 101,93$ [kN] Resistência portante de um único parafuso

$$F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Forças atuantes em parafusos na conexão da viga principal com o ângulo

Cisalhamento do parafuso

$e = 64$ [mm] Distância entre o centroide de um grupo de parafusos de um ângulo e o centro da alma da viga

$M_0 = 4,78$ [kN*m] Momento fletor real

$$M_0 = 0.5 \cdot V_{b2,Ed} \cdot e$$

$F_{Vz} = 25,0$ [kN] Força do componente em um parafuso devido à influência da força de cisalhamento

$$F_{Vz} = 0.5 \cdot |V_{b1,Ed}| / n$$

$F_{Mx} = 29,8$ [kN] Força componente no parafuso devido ao impacto do momento

$$F_{Mx} = |M_0| \cdot z_i / \sum z_i^2$$

$F_{x2,Ed} = 29,8$ [kN] Força total do projeto em um parafuso na direção x

$$F_{x2,Ed} = F_{Mx}$$

$F_{z2,Ed} = 25,0$ [kN] Força de projeto total em um parafuso na direção z

$$F_{z2,Ed} = F_{Vz} + F_{Mz}$$

$F_{Ed} = 38,9$ [kN] Força de cisalhamento resultante no parafuso

$$F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$F_{Rdx} = 101,93$ [kN] Capacidade de projeto efetiva de um parafuso na direção x

$$F_{Rdx} = F_{bRd2x}$$

$F_{Rdz} = 101,93$ [kN] Capacidade de projeto efetiva de um parafuso na direção z

$$F_{Rdz} = F_{bRd2z}$$

$ F_{x2,Ed} \leq F_{Rdx}$	$ 29,88 < 101,93$	verificado	(0,29)
$ F_{z2,Ed} \leq F_{Rdz}$	$ 25,00 < 101,93$	verificado	(0,25)
$F_{Ed} \leq F_{v,Rd}$	$38,96 < 60,29$	verificado	(0,65)

Tração do parafuso

$e = 65$ [mm] Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal

$M_{0t} = 4,8$ [kN*m] Momento fletor real

$$M_{0t} = 0.5 \cdot V_{b2,Ed} \cdot e$$

$F_{t,Ed} = 35,83$ [kN] Força de tração no parafuso mais externo

$$F_{t,Ed} = M_{0t} \cdot z_{max} / \sum z_i^2 + 0.5 \cdot N_{b2,Ed} / n$$

$F_{t,Ed} \leq F_{tRd}$	$35,83 < 90,43$	verificado	(0,40)

Ação simultânea de uma força de tração e uma força de cisalhamento no parafuso

$$F_{v,Ed} = 38,96 \text{ [kN]} \quad \text{Força de cisalhamento resultante no parafuso} \quad F_{v,Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$$F_{v,Ed}/F_{v,Rd} + F_{t,Ed}/(1.4 \cdot F_{t,Rd}) \leq 1.0 \quad 0,93 < 1,00 \quad \text{verificado} \quad (0,93)$$

Parafusos conectando o ângulo à viga**Capacidades dos parafusos**

$$F_{v,Rd} = 120,5 \text{ [kN]} \quad \text{Resistência do parafuso ao cisalhamento na parte com rosca de um} \quad F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$$

$$= 8 \text{] parafuso}$$

Apoio do parafuso na viga

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,83 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,83 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1x} = 86,00 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 1,00 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 1,00 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1z} = 103,20 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Apoio do parafuso no ângulo

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,74 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,74 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 203,85 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,74 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 0,74 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2z} = 203,85 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t / \gamma_{M2}$$

Forças atuantes nos parafusos da conexão do ângulo com a viga

Cisalhamento do parafuso

$$e = 65 \quad [\text{mm}] \quad \text{Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal}$$

$$M_0 = 9,71 \quad \begin{matrix} [\text{kN} \cdot \text{m}] \\ \text{m} \end{matrix} \quad \text{Momento fletor real} \quad M_0 = M_{b2,Ed} + V_{b2,Ed} \cdot e$$

$$F_{Nx} = 11,0 \quad [\text{kN}] \quad \text{Força do componente em um parafuso devido à influência da força longitudinal} \quad F_{Nx} = |N_{b2,Ed}|/n$$

$$F_{Vz} = 50,0 \quad [\text{kN}] \quad \text{Força do componente em um parafuso devido à influência da força de cisalhamento} \quad F_{Vz} = |V_{b2,Ed}|/n$$

$$F_{Mx} = 60,6 \quad [\text{kN}] \quad \text{Componente de força em um parafuso devido a influência do momento na direção x} \quad F_{Mx} = |M_0| \cdot z_i / \sum (x_i^2 + z_i^2)$$

$$F_{Mz} = 0,00 \quad [\text{kN}] \quad \text{Força do componente em um parafuso devido à influência do momento ao redor do eixo z} \quad F_{Mz} = |M_0| \cdot x_i / \sum (x_i^2 + z_i^2)$$

$$F_{x,Ed} = 71,6 \quad [\text{kN}] \quad \text{Força total do projeto em um parafuso na direção x} \quad F_{x,Ed} = F_{Nx} + F_{Mx}$$

$$F_{z2,Ed} = 50,0 \quad [\text{kN}] \quad \text{Força de projeto total em um parafuso na direção z} \quad F_{z2,Ed} = F_{Vz} + F_{Mz}$$

$$F_{Ed} = 87,3 \quad [\text{kN}] \quad \text{Força de cisalhamento resultante no parafuso} \quad F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$$F_{Rdx} = 86,0 \quad [\text{kN}] \quad \text{Capacidade de projeto efetiva de um parafuso na direção x} \quad F_{Rdx} = \min(F_{bRd1x}, F_{bRd2x})$$

$$F_{Rdz} = 103,20 \quad [\text{kN}] \quad \text{Capacidade de projeto efetiva de um parafuso na direção z} \quad F_{Rdz} = \min(F_{bRd1z}, F_{bRd2z})$$

$$|F_{x,Ed}| \leq F_{Rdx} \quad |71,66| < 86,00 \quad \text{verificado} \quad (0,83)$$

$$|F_{z,Ed}| \leq F_{Rdz} \quad |50,00| < 103,20 \quad \text{verificado} \quad (0,48)$$

$$F_{Ed} \leq F_{v,Rd} \quad 87,38 < 120,58 \quad \text{verificado} \quad (0,72)$$

Verificação da seção devido ao rompimento do bloco (força axial)

Ângulo

$$A_{nt} = 12,40 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 6,20 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 525,0 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|0.5 \cdot N_{b2,Ed}| \leq V_{effRd} \quad |16,50| < 525,00 \quad \text{verificado} \quad (0,03)$$

Viga

$$A_{nt} = 9,30 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 5,40 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 405,6 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b2,Ed}| \leq V_{effRd} \quad |33,00| < 405,66 \quad \text{verificado} \quad (0,08)$$

Verificação da seção devido ao rompimento do bloco (força de cisalhamento)

Ângulo

$$A_{nt} = 3,10 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 15,50 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 299,4 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|0.5 \cdot V_{b2,Ed}| \leq V_{effRd} \quad |75,00| < 299,42 \quad \text{verificado} \quad (0,25)$$

Viga

$$A_{nt} = 2,70 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 12,75 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

Viga

$$A_{nt} = 2,70 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$V_{effRd} = 248,8 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b2,Ed}| \leq V_{effRd} \quad |150,00| < 248,87 \quad \text{verificado} \quad (0,60)$$

Verificação da seção de ângulo enfraquecido por aberturas

$$A_t = 13,63 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 10,03 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,66 < 0,80 \quad \#$$

$$W_{net} = 90,81 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 24,97 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |4,85| < 24,97 \quad \text{verificado} \quad (0,19)$$

$$A_v = 24,00 \text{ [cm}^2\text{]} \quad \text{Área da seção efetiva quanto a cisalhamento} \quad A_v = I_a \cdot t_{fa}$$

$$A_{v,net} = 18,60 \text{ [cm}^2\text{]} \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 381,05 \text{ [kN]} \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$|0.5 \cdot V_{b2,Ed}| \leq V_{pl,Rd} \quad |75,00| < 381,05 \quad \text{verificado} \quad (0,20)$$

Verificação de uma seção de viga enfraquecida por aberturas

$$A_t = 13,16 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 10,46 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,72 < 0,80 \quad \#$$

$$W_{net} = 106,31 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 29,24 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |9,71| < 29,24 \quad \text{verificado} \quad (0,33)$$

$$A_v = 22,50 \text{ [cm}^2\text{]} \quad \text{Área da seção efetiva quanto a cisalhamento}$$

$$A_{v,net} = 18,45 \text{ [cm}^2\text{]} \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 357,24 \text{ [kN]} \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$V_{b2,Ed} \leq V_{pl,Rd} \quad |150,00| < 357,24 \quad \text{verificado} \quad (0,42)$$

Lado direito**Parafusos conectando o ângulo à viga principal****Capacidades dos parafusos**

$$F_{v,Rd} = 60,2 \text{ [kN]} \quad \text{Resistência do parafuso ao cisalhamento na parte com rosca de um parafuso} \quad F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$$

$$F_{t,Rd} = 90,4 \text{ [kN]} \quad \text{Resistência de um parafuso à tensão} \quad F_{t,Rd} = 0.9 \cdot f_u \cdot A_s / \gamma_{M2}$$

Apoio do parafuso no ângulo**Direção x**

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,74 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,74 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 101,93 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,74 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 0,74 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2z} = 101,93 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Forças atuantes em parafusos na conexão da viga principal com o ângulo**Cisalhamento do parafuso**

$$e = 64 \text{ [mm]} \quad \text{Distância entre o centroide de um grupo de parafusos de um ângulo e o centro da alma da viga}$$

$$M_0 = 3,67 \frac{\text{[kN} \cdot \text{m]}}{\text{m}} \quad \text{Momento fletor real} \quad M_0 = 0.5 \cdot V_{b2,Ed} \cdot e$$

$$F_{Vz} = 19,17 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força de cisalhamento} \quad F_{Vz} = 0.5 \cdot |V_{b2,Ed}| / n$$

$$F_{Mx} = 22,91 \text{ [kN]} \quad \text{Força componente no parafuso devido ao impacto do momento} \quad F_{Mx} = |M_0| \cdot z_i / \sum z_i^2$$

Cisalhamento do parafuso

$e = 64$ [mm] Distância entre o centroide de um grupo de parafusos de um ângulo e o centro da alma da viga

$$F_{x1,Ed} = 22,9 \text{ [kN]} \text{ Força total do projeto em um parafuso na direção x} \quad F_{x1,Ed} = F_{Mx}$$

$$F_{z1,Ed} = 19,1 \text{ [kN]} \text{ Força de projeto total em um parafuso na direção z} \quad F_{z1,Ed} = F_{Vz} + F_{Mz}$$

$$F_{Ed} = 29,8 \text{ [kN]} \text{ Força de cisalhamento resultante no parafuso} \quad F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$$F_{Rdx} = 101,93 \text{ [kN]} \text{ Capacidade de projeto efetiva de um parafuso na direção x} \quad F_{Rdx} = F_{bRd2x}$$

$$F_{Rdz} = 101,93 \text{ [kN]} \text{ Capacidade de projeto efetiva de um parafuso na direção z} \quad F_{Rdz} = F_{bRd2z}$$

$ F_{x1,Ed} \leq F_{Rdx}$	$ 22,91 < 101,93$	verificado	(0,22)
$ F_{z1,Ed} \leq F_{Rdz}$	$ 19,17 < 101,93$	verificado	(0,19)
$F_{Ed} \leq F_{v,Rd}$	$29,87 < 60,29$	verificado	(0,50)

Tração do parafuso

$e = 65$ [mm] Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal

$$M_{0t} = 3,7 \text{ [kN* m]} \text{ Momento fletor real} \quad M_{0t} = 0.5 * V_{b1,Ed} * e$$

$$F_{t,Ed} = 28,75 \text{ [kN]} \text{ Força de tração no parafuso mais externo} \quad F_{t,Ed} = M_{0t} * z_{max} / \sum z_i^2 + 0.5 * N_{b2,Ed} / n$$

$$F_{t,Ed} \leq F_{t,Rd} \quad 28,75 < 90,43 \quad \text{verificado} \quad (0,32)$$

Ação simultânea de uma força de tração e uma força de cisalhamento no parafuso

$$F_{v,Ed} = 29,87 \text{ [kN]} \text{ Força de cisalhamento resultante no parafuso} \quad F_{v,Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$$F_{v,Ed} / F_{v,Rd} + F_{t,Ed} / (1.4 * F_{t,Rd}) \leq 1.0 \quad 0,72 < 1,00 \quad \text{verificado} \quad (0,72)$$

Parafusos conectando o ângulo à viga

Capacidades dos parafusos

$$F_{v,Rd} = 120,5 \text{ [kN]} \text{ Resistência do parafuso ao cisalhamento na parte com rosca de um parafuso} \quad F_{v,Rd} = 0.6 * f_{ub} * A_s * m / \gamma_{M2}$$

Apoio do parafuso na viga

Direção x

$k_{1x} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1x} = \min[2.8*(e_1/d_0)-1.7, 1.4*(p_1/d_0)-1.7, 2.5]$

$k_{1x} > 0.0$ $2,50 > 0,00$ verificado

$\alpha_{bx} = 0,83$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bx} = \min[e_2/(3*d_0), f_{ub}/f_u, 1]$

$\alpha_{bx} > 0.0$ $0,83 > 0,00$ verificado

$F_{b,Rd1x} = 86,00$ [kN] Resistência portante de um único parafuso $F_{b,Rd1x} = k_{1x} * \alpha_{bx} * f_u * d * t_i / \gamma_{M2}$

Direção z

$k_{1z} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1z} = \min[2.8*(e_2/d_0)-1.7, 2.5]$

$k_{1z} > 0.0$ $2,50 > 0,00$ verificado

$\alpha_{bz} = 1,00$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bz} = \min[e_1/(3*d_0), p_1/(3*d_0)-0.25, f_{ub}/f_u, 1]$

$\alpha_{bz} > 0.0$ $1,00 > 0,00$ verificado

$F_{b,Rd1z} = 103,20$ [kN] Resistência portante de um único parafuso $F_{b,Rd1z} = k_{1z} * \alpha_{bz} * f_u * d * t_i / \gamma_{M2}$

Apoio do parafuso no ângulo**Direção x**

$k_{1x} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1x} = \min[2.8*(e_1/d_0)-1.7, 1.4*(p_1/d_0)-1.7, 2.5]$

$k_{1x} > 0.0$ $2,50 > 0,00$ verificado

$\alpha_{bx} = 0,74$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bx} = \min[e_2/(3*d_0), f_{ub}/f_u, 1]$

$\alpha_{bx} > 0.0$ $0,74 > 0,00$ verificado

$F_{b,Rd2x} = 203,85$ [kN] Resistência portante de um único parafuso $F_{b,Rd2x} = k_{1x} * \alpha_{bx} * f_u * d * t_i / \gamma_{M2}$

Direção z

$k_{1z} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1z} = \min[2.8*(e_2/d_0)-1.7, 2.5]$

$k_{1z} > 0.0$ $2,50 > 0,00$ verificado

$\alpha_{bz} = 0,74$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bz} = \min[e_1/(3*d_0), p_1/(3*d_0)-0.25, f_{ub}/f_u, 1]$

$\alpha_{bz} > 0.0$ $0,74 > 0,00$ verificado

$F_{b,Rd2z} = 203,85$ [kN] Resistência portante de um único parafuso $F_{b,Rd2z} = k_{1z} * \alpha_{bz} * f_u * d * t_i / \gamma_{M2}$

Forças atuantes nos parafusos da conexão do ângulo com a viga

Cisalhamento do parafuso

$e = 65$ [mm] Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal

$M_0 = 7,44$ [kN*m] Momento fletor real $M_0 = V_{b1,Ed} * e$

$F_{Nx} = 11,0$ [kN] Força do componente em um parafuso devido à influência da força longitudinal $F_{Nx} = |N_{b1,Ed}|/n$

$F_{Vz} = 38,3$ [kN] Força do componente em um parafuso devido à influência da força de cisalhamento $F_{Vz} = |V_{b1,Ed}|/n$

$F_{Mx} = 46,5$ [kN] Componente de força em um parafuso devido a influência do momento na direção x $F_{Mx} = |M_0| * z_i / \sum (x_i^2 + z_i^2)$

$F_{Mz} = 0,00$ [kN] Força do componente em um parafuso devido à influência do momento ao redor do eixo z $F_{Mz} = |M_0| * x_i / \sum (x_i^2 + z_i^2)$

$F_{x,Ed} = 57,5$ [kN] Força total do projeto em um parafuso na direção x $F_{x,Ed} = F_{Nx} + F_{Mx}$

$F_{z1,Ed} = 38,3$ [kN] Força de projeto total em um parafuso na direção z $F_{z1,Ed} = F_{Vz} + F_{Mz}$

$F_{Ed} = 69,1$ [kN] Força de cisalhamento resultante no parafuso $F_{Ed} = \sqrt{(F_{x,Ed}^2 + F_{z,Ed}^2)}$

$F_{Rdx} = 86,0$ [kN] Capacidade de projeto efetiva de um parafuso na direção x $F_{Rdx} = \min(F_{bRd1x}, F_{bRd2x})$

$F_{Rdz} = 103,20$ [kN] Capacidade de projeto efetiva de um parafuso na direção z $F_{Rdz} = \min(F_{bRd1z}, F_{bRd2z})$

$ F_{x,Ed} \leq F_{Rdx}$	$ 57,50 < 86,00$	verificado	(0,67)
$ F_{z,Ed} \leq F_{Rdz}$	$ 38,33 < 103,20$	verificado	(0,37)
$F_{Ed} \leq F_{v,Rd}$	$69,11 < 120,58$	verificado	(0,57)

Verificação da seção devido ao rompimento do bloco (força axial)

Ângulo

$A_{nt} = 12,40$ [cm²] Área líquida da seção em tração

$A_{nv} = 6,20$ [cm²] Área da seção em cisalhamento

$$A_{nt} = 12,40 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$V_{effRd} = 525,0 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|0.5 \cdot N_{b1,Ed}| \leq V_{effRd} \quad |16,50| < 525,00 \quad \text{verificado} \quad (0,03)$$

9.9.5.1 VIGA

$$A_{nt} = 9,30 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 5,40 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 405,6 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b1,Ed}| \leq V_{effRd} \quad |33,00| < 405,66 \quad \text{verificado} \quad (0,08)$$

Verificação da seção devido ao rompimento do bloco (força de cisalhamento)

Ângulo

$$A_{nt} = 3,10 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 15,50 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 299,4 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|0.5 \cdot V_{b1,Ed}| \leq V_{effRd} \quad |57,50| < 299,42 \quad \text{verificado} \quad (0,19)$$

Viga

$$A_{nt} = 2,70 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 12,75 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 248,8 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b1,Ed}| \leq V_{effRd} \quad |115,00| < 248,87 \quad \text{verificado} \quad (0,46)$$

Verificação da seção de ângulo enfraquecido por aberturas

$A_t = 14,13 \text{ [cm}^2\text{]}$ Área da zona de tensão da seção bruta

$A_{t,net} = 10,53 \text{ [cm}^2\text{]}$ Área líquida da seção em tração

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,67 < 0,80 \quad \#$$

$W_{net} = 90,81 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$M_{c,Rdnet} = 24,97 \text{ [kN}\cdot\text{m]}$ Resistência do projeto da seção em flexão $M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$

$$|M_0| \leq M_{c,Rdnet} \quad |3,72| < 24,97 \quad \text{verificado} \quad (0,15)$$

$A_v = 24,00 \text{ [cm}^2\text{]}$ Área da seção efetiva quanto a cisalhamento $A_v = I_a \cdot t_{fa}$

$A_{v,net} = 18,60 \text{ [cm}^2\text{]}$ Área líquida de uma seção efetiva quanto a cisalhamento $A_{v,net} = A_v - n_v \cdot d_0$

$V_{pl,Rd} = 381,05 \text{ [kN]}$ Resistência plástica do projeto para cisalhamento $V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$

$$|0.5 \cdot V_{b1,Ed}| \leq V_{pl,Rd} \quad |57,50| < 381,05 \quad \text{verificado} \quad (0,15)$$

Verificação de uma seção de viga enfraquecida por aberturas

$A_t = 13,74 \text{ [cm}^2\text{]}$ Área da zona de tensão da seção bruta

$A_{t,net} = 11,04 \text{ [cm}^2\text{]}$ Área líquida da seção em tração

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,72 < 0,80 \quad \#$$

$W_{net} = 106,31 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$M_{c,Rdnet} = 29,24 \text{ [kN}\cdot\text{m]}$ Resistência do projeto da seção em flexão $M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$

$$|M_0| \leq M_{c,Rdnet} \quad |7,44| < 29,24 \quad \text{verificado} \quad (0,25)$$

$A_v = 22,50 \text{ [cm}^2\text{]}$ Área da seção efetiva quanto a cisalhamento

$A_{v,net} = 18,45 \text{ [cm}^2\text{]}$ Área líquida de uma seção efetiva quanto a cisalhamento $A_{v,net} = A_v - n_v \cdot d_0$

$V_{pl,Rd} = 357,24 \text{ [kN]}$ Resistência plástica do projeto para cisalhamento $V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$

$$|V_{b1,Ed}| \leq V_{pl,Rd} \quad |115,00| < 357,24 \quad \text{verificado} \quad (0,32)$$

Verificação da viga principal

Apoio do parafuso na alma da viga principal

Direção x

$k_x = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_x = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$

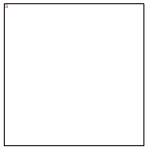
$$k_x > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$\alpha_{bx} = 1,00$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$

$\alpha_b > 0.0$	$1,00 > 0,00$	verificado	
$F_{b,Rdx} = 108,29$ [kN]	Resistência portante de um único parafuso	$F_{b,Rdx} = k_x \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$	
Direção z			
$k_z = 2,50$	Coeficiente para o cálculo de $F_{b,Rd}$	$k_z = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$	
$k_z > 0.0$	$2,50 > 0,00$	verificado	
$\alpha_{bz} = 1,00$	Coeficiente para o cálculo de $F_{b,Rd}$	$\alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$	
$\alpha_{bz} > 0.0$	$1,00 > 0,00$	verificado	
$F_{b,Rdz} = 108,29$ [kN]	Resistência portante de um único parafuso	$F_{b,Rdz} = k_z \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$	
Força resultante atuante no parafuso externo			
$F_{x,Ed} = 52,79$ [kN]	Força total do projeto em um parafuso na direção x	$F_{x,Ed} = F_{x1,Ed} + F_{x2,Ed}$	
$F_{z,Ed} = 44,17$ [kN]	Força de projeto total em um parafuso na direção z	$F_{z,Ed} = F_{z1,Ed} + F_{z2,Ed}$	
$ F_{x,Ed} \leq F_{b,Rdx}$	$ 52,79 < 108,29$	verificado	(0,49)
$ F_{z,Ed} \leq F_{b,Rdz}$	$ 44,17 < 108,29$	verificado	(0,41)
A conexão está em conformidade com a norma.		Relação	0,93

#

Ligação Viga IPE 300

	Autodesk Robot Structural Analysis Professional 2021 Cálculo da conexão viga - coluna (alma) EN 1993-1-8:2005/AC:2009	 Relação 0,53

Geral

Nº de conexão: 3

Nome da conexão: Beam-column (web)

Geometria

Coluna

Seção: HEB 300

α = -90,0 [Deg] Âng. de inclinação

h_c = 300 [mm] Altura da seção da coluna

b_{fc} = 300 [mm] Largura da seção da coluna

Seção: HEB 300

$\alpha =$ -90,0 [Deg] Âng. de inclinação

$t_{wc} =$ 11 [mm] Espessura da alma da seção da coluna

$t_{fc} =$ 19 [mm] Espessura da mesa da seção da coluna

$r_c =$ 27 [mm] Raio de concordância de seção da coluna

$A_c =$ 149,08 [cm²] Área de seção transversal do pilar

$I_{yc} =$ 25165,70 [cm⁴] Momento de inércia da seção do pilar

Material: S 275

$f_{yc} =$ 275,00 [MPa] Resistência do projeto

$f_{uc} =$ 430,00 [MPa] Resistência à tensão

Viga**Seção:** IPE 300

$\alpha =$ 0,0 [Deg] Âng. de inclinação

$h_b =$ 300 [mm] Altura da seção da viga

$b_b =$ 150 [mm] Largura da seção da viga

$t_{wb} =$ 7 [mm] Espessura da alma da seção da viga

$t_{fb} =$ 11 [mm] Espessura da mesa da seção da viga

$r_b =$ 15 [mm] Raio de concordância da seção da viga

$A_b =$ 53,81 [cm²] Área de seção transversal da viga

$I_{yb} =$ 8356,11 [cm⁴] Momento de inércia da seção da viga

Material: S 275

$f_{yb} =$ 275,00 [MPa] Resistência do projeto

$f_{ub} =$ 430,00 [MPa] Resistência à tensão

Placa**Tipo:** unilateral

$l_p =$ 100 [mm] Comprimento da placa

$h_p =$ 200 [mm] Altura da placa

$t_p =$ 12 [mm] Espessura da placa

Material: S 275

$f_{yp} = 275,00$ [MPa] Resistência do projeto

$f_{up} = 430,00$ [MPa] Resistência à tensão

Parafusos

Parafusos conectando a viga e a placa

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe = 8.8 Classe do parafuso

$d = 16$ [mm] Diâmetro do parafuso

$d_0 = 18$ [mm] Diâmetro da abertura do parafuso

$A_s = 1,57$ [cm²] Área efetiva da seção de um parafuso

$A_v = 2,01$ [cm²] Área de seção do parafuso

$f_{ub} = 800,00$ [MPa] Resistência à tensão

$k = 1$ Número de colunas de parafusos

$w = 3$ Número de linhas de parafusos

$e_1 = 30$ [mm] Nível do primeiro parafuso

$p_1 = 70$ [mm] Espaçamento vertical

Soldas

$a_{cp} = 5$ [mm] Soldas de concordância conectando a placa à coluna

Fatores de material

$\gamma_{M0} = 1,00$ Fator de segurança parcial [2.2]

$\gamma_{M2} = 1,25$ Fator de segurança parcial [2.2]

Cargas

Caso: Cálculos manuais.

$N_{b,Ed} = 75,00$ [kN] Força axial

$V_{b,Ed} = 15,00$ [kN] Força de cisalhamento

$M_{b,Ed} = 0,00$ [kN*m] Momento fletor

Resultados

Parafusos conectando a viga e a placa**Capacidades dos parafusos**

$$F_{v,Rd} = 60,2 \text{ [kN Resistência do parafuso ao cisalhamento na parte com rosca de um parafuso]} \quad F_{v,Rd} = 0,6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$$

Apoio do parafuso na viga

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2,8 \cdot (e_1/d_0) - 1,7, 1,4 \cdot (p_1/d_0) - 1,7, 2,5]$$

$$k_{1x} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,74 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0,0 \quad 0,74 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1x} = 72,37 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2,8 \cdot (e_2/d_0) - 1,7, 2,5]$$

$$k_{1z} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 1,00 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0,25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0,0 \quad 1,00 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1z} = 97,70 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Apoio do parafuso na placa

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2,8 \cdot (e_1/d_0) - 1,7, 1,4 \cdot (p_1/d_0) - 1,7, 2,5]$$

$$k_{1x} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,83 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0,0 \quad 0,83 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 137,60 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2,8 \cdot (e_2/d_0) - 1,7, 2,5]$$

$$k_{1z} > 0,0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,56 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0,25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0,0 \quad 0,56 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2z} = 91,73 \text{ [kN]} \quad \text{Resistência portante de um único parafuso}$$

$$F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Forças atuantes nos parafusos da conexão da placa com a viga

Cisalhamento do parafuso

$$e = 61 \text{ [mm]} \quad \text{Distância entre o centroide de um grupo de parafusos e o centro da alma do pilar}$$

$$M_0 = 0,91 \text{ [kN} \cdot \text{m]} \quad \text{Momento fletor real}$$

$$M_0 = M_{b,Ed} + V_{b,Ed} \cdot e$$

$$F_{Nx} = 25,0 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força longitudinal}$$

$$F_{Nx} = |N_{b,Ed}| / n$$

$$F_{Vz} = 5,00 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força de cisalhamento}$$

$$F_{Vz} = |V_{b,Ed}| / n$$

$$F_{Mx} = 6,48 \text{ [kN]} \quad \text{Componente de força em um parafuso devido a influência do momento na direção x}$$

$$F_{Mx} = |M_0| \cdot z_i / \sum (x_i^2 + z_i^2)$$

$$F_{Mz} = 0,00 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência do momento ao redor do eixo z}$$

$$F_{Mz} = |M_0| \cdot x_i / \sum (x_i^2 + z_i^2)$$

$$F_{x,Ed} = 31,48 \text{ [kN]} \quad \text{Força total do projeto em um parafuso na direção x}$$

$$F_{x,Ed} = F_{Nx} + F_{Mx}$$

$$F_{z,Ed} = 5,00 \text{ [kN]} \quad \text{Força de projeto total em um parafuso na direção z}$$

$$F_{z,Ed} = F_{Vz} + F_{Mz}$$

$$F_{Ed} = 31,88 \text{ [kN]} \quad \text{Força de cisalhamento resultante no parafuso}$$

$$F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$$F_{Rdx} = 72,37 \text{ [kN]} \quad \text{Capacidade de projeto efetiva de um parafuso na direção x}$$

$$F_{Rdx} = \min(F_{bRd1x}, F_{bRd2x})$$

$$F_{Rdz} = 91,73 \text{ [kN]} \quad \text{Capacidade de projeto efetiva de um parafuso na direção z}$$

$$F_{Rdz} = \min(F_{bRd1z}, F_{bRd2z})$$

$ F_{x,Ed} \leq F_{Rdx}$	$ 31,48 < 72,37$	verificado	(0,44)
$ F_{z,Ed} \leq F_{Rdz}$	$ 5,00 < 91,73$	verificado	(0,05)
$F_{Ed} \leq F_{v,Rd}$	$31,88 < 60,29$	verificado	(0,53)

Verificação da seção devido ao rompimento do bloco (força axial)

Placa

$$A_{nt} = 12,48 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 8,64 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 566,49 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b,Ed}| \leq V_{effRd} \quad |75,00| < 566,49 \quad \text{verificado} \quad (0,13)$$

Viga

$$A_{nt} = 7,38 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 4,40 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 323,90 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b,Ed}| \leq V_{effRd} \quad |75,00| < 323,90 \quad \text{verificado} \quad (0,23)$$

Verificação da seção devido ao rompimento do bloco (força de cisalhamento)

Placa

$$A_{nt} = 4,32 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 15,00 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 312,46 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b,Ed}| \leq V_{effRd} \quad |15,00| < 312,46 \quad \text{verificado} \quad (0,05)$$

Viga

$$A_{nt} = 2,20 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 12,42 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 235,13 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b,Ed}| \leq V_{effRd} \quad |15,00| < 235,13 \quad \text{verificado} \quad (0,06)$$

Verificação de uma placa enfraquecida por aberturas

$$A_t = 24,00 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 17,52 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,66 < 0,80 \quad \#$$

$$W_{net} = 58,66 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 16,13 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |0,91| < 16,13 \quad \text{verificado} \quad (0,06)$$

$$A_v = 24,00 \text{ [cm}^2\text{]} \quad \text{Área da seção efetiva quanto a cisalhamento} \quad A_v = h_p \cdot t_p$$

$$A_{v,net} = 17,52 \text{ [cm}^2\text{]} \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 381,05 \text{ [kN]} \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$V_{b,Ed} \leq V_{pl,Rd} \quad |15,00| < 381,05 \quad \text{verificado} \quad (0,04)$$

Verificação de uma seção de viga enfraquecida por aberturas

$$A_t = 21,30 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 17,47 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,74 < 0,80 \quad \#$$

$$W_{net} = 97,42 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 26,79 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |0,91| < 26,79 \quad \text{verificado} \quad (0,03)$$

$$A_v = 21,30 \text{ [cm}^2\text{]} \quad \text{Área da seção efetiva quanto a cisalhamento}$$

$$A_{v,net} = 17,47 \text{ [cm}^2\text{]} \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 338,18 \text{ [kN]} \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$V_{b,Ed} \leq V_{pl,Rd} \quad |15,00| < 338,18 \quad \text{verificado} \quad (0,04)$$

Resistência da solda

Soldas de concordância conectando a placa à coluna

$$A_w = 10,00 \text{ [cm}^2\text{]} \quad \text{Área da solda} \quad A_w = h_p \cdot a_{gp}$$

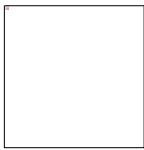
$$\sigma = 49,88 \text{ [MPa]} \quad \text{Tensão normal em uma solda} \quad \sigma = 0.5 \cdot [N_{b,Ed}/A_s + M_0/W_{yw}]$$

$$\sigma_{\perp} = 35,27 \text{ [MPa]} \quad \text{Tensão perpendicular normal na solda} \quad \sigma_{\perp} = \sigma / \sqrt{2}$$

$ \sigma_{\perp} \leq 0.9 \cdot f_u / \gamma_{M2}$		$ 35,27 < 309,60$		verificado	(0,11)
$\tau_{\perp} =$	35,27	[MPa]	Tensão tangencial perpendicular		$\tau_{\perp} = \sigma_{\perp}$
$\tau_{\parallel} =$	7,50	[MPa]	Tensão tangencial paralela		$\tau_{\parallel} = 0.5 \cdot V_{b,Ed} / A_s$
$\beta_w =$	0,85	Coeficiente de correlação			[Tabela 4.1]
$\sqrt{[\sigma_{\perp}^2 + 3 \cdot (\tau_{\parallel}^2 + \tau_{\perp}^2)]} \leq f_u / (\beta_w \cdot \gamma_{M2})$		$71,72 < 404,71$		verificado	(0,18)
A conexão está em conformidade com a norma.					Relação 0,53

#

Ligação Viga HEB 300 Encastrada

	Autodesk Robot Structural Analysis Professional 2021 Projeto de conexão viga-para-viga engastada EN 1993-1-8:2005/AC:2009	
		Relação 0,70

Geral

Nº de conexão: 4

Nome da conexão: Beam-Beam

Geometria

Lado esquerdo

Viga

Seção: HEB 300

$\alpha =$ -180,0 [Deg] Âng. de inclinação
 $h_{bl} =$ 300 [mm] Altura da seção da viga
 $b_{fbl} =$ 300 [mm] Largura da seção da viga
 $t_{wbl} =$ 11 [mm] Espessura da alma da seção da viga
 $t_{fbl} =$ 19 [mm] Espessura da mesa da seção da viga
 $r_{bl} =$ 27 [mm] Raio de concordância da seção da viga

$\alpha = -180,0$ [Deg] Âng. de inclinação
 $A_{bl} = 149,08$ [cm²] Área de seção transversal da viga
 $I_{xbl} = 25165,70$ [cm⁴] Momento de inércia da seção da viga

Material: S 275

$f_{yb} = 275,00$ [MPa] Resistência

Lado direito

Viga

Seção: HEB 300

$\alpha = 0,0$ [Deg] Âng. de inclinação
 $h_{br} = 300$ [mm] Altura da seção da viga
 $b_{fbr} = 300$ [mm] Largura da seção da viga
 $t_{wbr} = 11$ [mm] Espessura da alma da seção da viga
 $t_{fbr} = 19$ [mm] Espessura da mesa da seção da viga
 $r_{br} = 27$ [mm] Raio de concordância da seção da viga
 $A_{br} = 149,08$ [cm²] Área de seção transversal da viga
 $I_{xbr} = 25165,70$ [cm⁴] Momento de inércia da seção da viga

Material: S 275

$f_{yb} = 275,00$ [MPa] Resistência

Parafusos

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

$d = 24$ [mm] Diâmetro do parafuso
 Classe = 8.8 Classe do parafuso
 $F_{tRd} = 203,33$ [kN] Resistência à tensão de um parafuso
 $n_h = 2$ Número de colunas de parafusos
 $n_v = 3$ Número de linhas de parafusos
 $h_1 = 70$ [mm] Distância entre o primeiro parafuso e a borda superior da placa frontal
 Espaçamento horizontal $e_i = 150$ [mm] #
 Espaçamento vertical $p_i = 80; 80$ [mm] #

Placa $h_{pr} = 300 \text{ [mm]}$ Altura da placa $b_{pr} = 300 \text{ [mm]}$ Largura da placa $t_{pr} = 20 \text{ [mm]}$ Espessura da placa

Material: S 275

 $f_{ypr} = 275,00 \text{ [MPa]}$ Resistência**Soldas de concordância** $a_w = 5 \text{ [mm]}$ Solda da alma $a_f = 8 \text{ [mm]}$ Solda da mesa**Fatores de material** $\gamma_{M0} = 1,00$ Fator de segurança parcial [2.2] $\gamma_{M1} = 1,00$ Fator de segurança parcial [2.2] $\gamma_{M2} = 1,25$ Fator de segurança parcial [2.2] $\gamma_{M3} = 1,25$ Fator de segurança parcial [2.2]**Cargas****Estado limite definitivo**

Caso: Cálculos manuais.

 $M_{b1,Ed} = 84,00 \text{ [kN*m]}$ Momento fletor na viga direita $V_{b1,Ed} = 62,00 \text{ [kN]}$ Força de cisalhamento na viga direita $N_{b1,Ed} = 93,00 \text{ [kN]}$ Força axial na viga direita**Resultados****Resistências da viga****TRAÇÃO** $A_b = 149,08 \text{ [cm}^2\text{]}$ Área EN1993-1-1:[6.2.3] $N_{tb,Rd} = A_b f_{yb} / \gamma_{M0}$ $N_{tb,Rd} = 4099,65 \text{ [kN]}$ Resistência do projeto da seção à tração EN1993-1-1:[6.2.3]**CISALHAMENTO**

$A_{vb} = 47,43$ [cm²] Área de cisalhamento EN1993-1-1:[6.2.6.(3)]

$$V_{cb,Rd} = A_{vb} (f_{yb} / \sqrt{3}) / \gamma_{M0}$$

$V_{cb,Rd} = 753,02$ [kN] Resistência do projeto da seção ao cisalhamento EN1993-1-1:[6.2.6.(2)]

$$V_{b1,Ed} / V_{cb,Rd} \leq 1,0 \quad 0,08 < 1,00 \quad \text{verificado} \quad (0,08)$$

FLEXÃO - MOMENTO PLÁSTICO (SEM REFORÇOS)

$W_{plb} = 1868,80$ [cm³] Módulo plástico da seção EN1993-1-1:[6.2.5.(2)]

$$M_{b,pl,Rd} = W_{plb} f_{yb} / \gamma_{M0}$$

$M_{b,pl,Rd} = 513,92$ [kN*m] Resistência plástica da seção em flexão (sem enrijecedores) EN1993-1-1:[6.2.5.(2)]

FLEXÃO NA SUPERFÍCIE DE CONTATO COM A PLACA OU COM O ELEMENTO CONECTADO

$W_{pl} = 1868,80$ [cm³] Módulo plástico da seção EN1993-1-1:[6.2.5]

$$M_{cb,Rd} = W_{pl} f_{yb} / \gamma_{M0}$$

$M_{cb,Rd} = 513,92$ [kN*m] Resistência do projeto da seção em flexão EN1993-1-1:[6.2.5]

MESA E ALMA - COMPRESSÃO

$M_{cb,Rd} = 513,92$ [kN*m] Resistência do projeto da seção em flexão EN1993-1-1:[6.2.5]

$h_f = 281$ [mm] Distância entre os centroides das mesas [6.2.6.7.(1)]

$$F_{c,fb,Rd} = M_{cb,Rd} / h_f$$

$F_{c,fb,Rd} = 1828,90$ [kN] Resistência da mesa e da alma comprimidas [6.2.6.7.(1)]

Parâmetros geométricos da conexão

COMPRIMENTOS EFETIVOS E PARAMETROS - PLACA DIANTEIRA

Nr	m	m _x	e	e _x	p	l _{eff,cp}	l _{eff,nc}	l _{eff,1}	l _{eff,2}	l _{eff,cp,g}	l _{eff,nc,g}	l _{eff,1,g}	l _{eff,2,g}
1	64	–	75	–	80	401	424	401	424	281	289	281	289
2	64	–	75	–	80	401	349	349	349	160	80	80	80
3	64	–	75	–	80	401	349	349	349	281	215	215	215

m – Distância entre o parafuso e a alma

m_x – Distância entre o parafuso e a mesa da viga

e – Distância entre o parafuso e a borda exterior

e_x – Distância entre o parafuso e a borda exterior horizontal

p – Distância entre parafusos

l_{eff,cp} – Comprimento efetivo para um parafuso no modo de falha circular

m – Distância entre o parafuso e a alma

$l_{eff,nc}$ – Comprimento efetivo para um parafuso no modo de falha não circular

$l_{eff,1}$ – Comprimento efetivo para um parafuso para o modo 1

$l_{eff,2}$ – Comprimento efetivo para um parafuso para o modo 2

$l_{eff,cp,g}$ – Comprimento efetivo para um grupo de parafusos no modo de falha circular

$l_{eff,nc,g}$ – Comprimento efetivo para um grupo de parafusos no modo de falha não circular

$l_{eff,1,g}$ – Comprimento efetivo para um grupo de parafusos para o modo 1

$l_{eff,2,g}$ – Comprimento efetivo para um grupo de parafusos para o modo 2

Resistência da conexão à tração

$F_{t,Rd} = 203,33$ [kN] Resistência do parafuso a tensão [Tabela 3.4]

$B_{p,Rd} = 466,87$ [kN] Resistência do parafuso ao cisalhamento de punção [Tabela 3.4]

$N_{j,Rd} = \text{Min} (N_{tb,Rd}, n_v n_h F_{t,Rd}, n_v n_h B_{p,Rd})$

$N_{j,Rd} = 1219,97$ [kN] Resistência da conexão à tração [6.2]

$N_{b1,Ed} / N_{j,Rd} \leq 1,0$ $0,08 < 1,00$ verificado $(0,08)$

Resistência da conexão à flexão

$F_{t,Rd} = 203,33$ [kN] Resistência do parafuso a tensão [Tabela 3.4]

$B_{p,Rd} = 466,87$ [kN] Resistência do parafuso ao cisalhamento de punção [Tabela 3.4]

$F_{t,fc,Rd}$ – resistência da mesa da coluna devida a flexão

$F_{t,wc,Rd}$ – resistência da alma do pilar devida a tensão

$F_{t,ep,Rd}$ – resistência da placa frontal devida a flexão

$F_{t,wb,Rd}$ – resistência da alma em tensão

$F_{t,fc,Rd} = \text{Min} (F_{T,1,fc,Rd}, F_{T,2,fc,Rd}, F_{T,3,fc,Rd})$ [6.2.6.4], [Tab.6.2]

$F_{t,wc,Rd} = \omega b_{eff,t,wc} t_{wc} f_{yc} / \gamma_{M0}$ [6.2.6.3.(1)]

$F_{t,ep,Rd} = \text{Min} (F_{T,1,ep,Rd}, F_{T,2,ep,Rd}, F_{T,3,ep,Rd})$ [6.2.6.5], [Tab.6.2]

$F_{t,wb,Rd} = b_{eff,t,wb} t_{wb} f_{yb} / \gamma_{M0}$ [6.2.6.8.(1)]

RESISTÊNCIA DA LINHA DE PARAFUSOS Nº 1

$F_{t1,Rd,comp}$ - Fórmula	$F_{t1,Rd,comp}$	Componente
$F_{t1,Rd} = \text{Min} (F_{t1,Rd,comp})$	387,58	Resistência da linha de parafusos
$F_{t,ep,Rd(1)} = 387,58$	387,58	Placa dianteira - tração

F_{t1,Rd,comp} - Fórmula	F_{t1,Rd,comp}	Componente
$F_{t,wb,Rd(1)} = 1213,44$	1213,44	Alma da viga - tração
$B_{p,Rd} = 933,73$	933,73	Parafusos devido à punção de cisalhamento
$F_{c,fb,Rd} = 1828,90$	1828,90	Mesa da viga - compressão

RESISTÊNCIA DA LINHA DE PARAFUSOS Nº 2

F_{t2,Rd,comp} - Fórmula	F_{t2,Rd,comp}	Componente
$F_{t2,Rd} = \text{Min} (F_{t2,Rd,comp})$	198,05	Resistência da linha de parafusos
$F_{t,ep,Rd(2)} = 357,96$	357,96	Placa dianteira - tração
$F_{t,wb,Rd(2)} = 1056,10$	1056,10	Alma da viga - tração
$B_{p,Rd} = 933,73$	933,73	Parafusos devido à punção de cisalhamento
$F_{c,fb,Rd} - \sum_1^1 F_{tj,Rd} = 1828,90 - 387,58$	1441,31	Mesa da viga - compressão
$F_{t,ep,Rd(2+1)} - \sum_1^1 F_{tj,Rd} = 585,64 - 387,58$	198,05	Placa dianteira - tração - grupo
$F_{t,wb,Rd(2+1)} - \sum_1^1 F_{tj,Rd} = 1117,22 - 387,58$	729,63	Alma da viga - tração - grupo

RESISTÊNCIA DA LINHA DE PARAFUSOS Nº 3

F_{t3,Rd,comp} - Fórmula	F_{t3,Rd,comp}	Componente
$F_{t3,Rd} = \text{Min} (F_{t3,Rd,comp})$	304,66	Resistência da linha de parafusos
$F_{t,ep,Rd(3)} = 357,96$	357,96	Placa dianteira - tração
$F_{t,wb,Rd(3)} = 1056,10$	1056,10	Alma da viga - tração
$B_{p,Rd} = 933,73$	933,73	Parafusos devido à punção de cisalhamento
$F_{c,fb,Rd} - \sum_1^2 F_{tj,Rd} = 1828,90 - 585,64$	1243,26	Mesa da viga - compressão
$F_{t,ep,Rd(3+2)} - \sum_2^2 F_{tj,Rd} = 507,52 - 198,05$	309,47	Placa dianteira - tração - grupo
$F_{t,wb,Rd(3+2)} - \sum_2^2 F_{tj,Rd} = 891,05 - 198,05$	692,99	Alma da viga - tração - grupo
$F_{t,ep,Rd(3+2+1)} - \sum_2^1 F_{tj,Rd} = 890,30 - 585,64$	304,66	Placa dianteira - tração - grupo
$F_{t,wb,Rd(3+2+1)} - \sum_2^1 F_{tj,Rd} = 1766,26 - 585,64$	1180,63	Alma da viga - tração - grupo

Redução adicional da resistência da linha de parafusos

$$F_{t3,Rd} = F_{t1,Rd} h_3/h_1$$

$$F_{t3,Rd} = 106,34 \quad [\text{kN}] \quad \text{Resistência reduzida da linha de parafusos}$$

[6.2.7.2.(9)]

TABELA DE RESUMO DAS FORÇAS

Nr	h _j	F _{tj,Rd}	F _{t,fc,Rd}	F _{t,wc,Rd}	F _{t,ep,Rd}	F _{t,wb,Rd}	F _{t,Rd}	B _{p,Rd}
1	221	387,58	–	–	387,58	1213,44	406,66	933,73
2	141	198,05	–	–	357,96	1056,10	406,66	933,73
3	61	106,34	–	–	357,96	1056,10	406,66	933,73

RESISTÊNCIA DA CONEXÃO À FLEXÃO M_{j,Rd}

$$M_{j,Rd} = \sum h_j F_{tj,Rd}$$

$$M_{j,Rd} = 119,72 \text{ [kN*m]} \quad \text{Resistência da conexão à flexão} \quad [6.2]$$

$$M_{b1,Ed} / M_{j,Rd} \leq 1,0 \quad 0,70 < 1,00 \quad \text{verificado} \quad (0,70)$$

Resistência da conexão ao cisalhamento

$$\alpha_v = 0,60 \quad \text{Coeficiente para o cálculo de } F_{v,Rd} \quad [\text{Tabela 3.4}]$$

$$F_{v,Rd} = 135,55 \text{ [kN]} \quad \text{Resistência de um parafuso ao cisalhamento} \quad [\text{Tabela 3.4}]$$

$$F_{t,Rd,max} = 203,33 \text{ [kN]} \quad \text{Resistência de um parafuso à tensão} \quad [\text{Tabela 3.4}]$$

$$F_{b,Rd,int} = 320,18 \text{ [kN]} \quad \text{Resistência portante de um parafuso intermediário} \quad [\text{Tabela 3.4}]$$

$$F_{b,Rd,ext} = 370,46 \text{ [kN]} \quad \text{Resistência portante do parafuso mais externo} \quad [\text{Tabela 3.4}]$$

Nr	F _{tj,Rd,N}	F _{tj,Ed,N}	F _{tj,Rd,M}	F _{tj,Ed,M}	F _{tj,Ed}	F _{vj,Rd}
1	406,66	31,00	387,58	271,94	302,94	126,85
2	406,66	31,00	198,05	138,96	169,96	190,17
3	406,66	31,00	106,34	74,61	105,61	220,81

F_{tj,Rd,N} – Resistência da linha de parafusos para tensão simples

F_{tj,Ed,N} – Força em uma linha de parafusos devido à força axial

F_{tj,Rd,M} – Resistência da linha de parafusos para flexão simples

F_{tj,Ed,M} – Força em uma linha de parafusos devido ao momento

F_{tj,Ed} – Força de tração máximo em uma linha de parafusos

F_{vj,Rd} – Resistência reduzida da linha de parafusos

$$F_{tj,Ed,N} = N_{j,Ed} F_{tj,Rd,N} / N_{j,Rd}$$

$$F_{tj,Ed,M} = M_{j,Ed} F_{tj,Rd,M} / M_{j,Rd}$$

$$F_{tj,Ed} = F_{tj,Ed,N} + F_{tj,Ed,M}$$

$$F_{vj,Rd} = \text{Min} (n_h F_{v,Ed} (1 - F_{tj,Ed} / (1.4 n_h F_{t,Rd,max})), n_h F_{v,Rd}, n_h F_{b,Rd}))$$

$$V_{j,Rd} = n_h \sum_1^n F_{vj,Rd} \quad [\text{Tabela 3.4}]$$

$V_{j,Rd} = 537,83$ [kN] Resistência da conexão ao cisalhamento [Tabela 3.4]

$V_{b1,Ed} / V_{j,Rd} \leq 1,0$ $0,12 < 1,00$ verificado (0,12)

Resistência da solda

$A_w = 58,40$ [cm²] Área de todas as soldas [4.5.3.2(2)]

$A_{wy} = 37,60$ [cm²] Área das soldas horizontais [4.5.3.2(2)]

$A_{wz} = 20,80$ [cm²] Área das soldas verticais [4.5.3.2(2)]

$I_{wy} = 6816,4$ [cm⁴] Momento de inércia da disposição de soldas com relação ao eixo horizontal [4.5.3.2(5)]

$\sigma_{\perp max} = \tau_{\perp max} = 121,93$ [MPa] Tensão normal em uma solda [4.5.3.2(6)]

$\sigma_{\perp} = \tau_{\perp} = 101,88$ [MPa] Tensão na solda vertical [4.5.3.2(5)]

$\tau_{\parallel} = 29,81$ [MPa] Tensão tangente [4.5.3.2(5)]

$\beta_w = 0,85$ Coeficiente de correlação [4.5.3.2(7)]

$\sqrt{[\sigma_{\perp max}^2 + 3*(\tau_{\perp max}^2)]} \leq f_u/(\beta_w*\gamma_{M2})$ $243,85 < 404,71$ verificado (0,60)

$\sqrt{[\sigma_{\perp}^2 + 3*(\tau_{\perp}^2 + \tau_{\parallel}^2)]} \leq f_u/(\beta_w*\gamma_{M2})$ $210,21 < 404,71$ verificado (0,52)

$\sigma_{\perp} \leq 0.9*f_u/\gamma_{M2}$ $121,93 < 309,60$ verificado (0,39)

Rigidez da conexão

$t_{wash} = 5$ [mm] Espessura da arruela [6.2.6.3.(2)]

$h_{head} = 17$ [mm] Altura da cabeça do parafuso [6.2.6.3.(2)]

$h_{nut} = 24$ [mm] Altura da porca do parafuso [6.2.6.3.(2)]

$L_b = 70$ [mm] Comprimento do parafuso [6.2.6.3.(2)]

$k_{10} = 8$ [mm] Coeficiente de rigidez dos parafusos [6.3.2.(1)]

RIGIDEZ DAS LINHAS DE PARAFUSOS

Nr	h _j	k ₃	k ₄	k ₅	k _{eff,j}	k _{eff,j} h _j	k _{eff,j} h _j ²
					Soma	8,48	154,90

Nr	h _j	k ₃	k ₄	k ₅	k _{eff,j}	k _{eff,j} h _j	k _{eff,j} h _j ²
1	221	∞	∞	8	3	5,79	127,72
2	141	∞	∞	2	1	1,37	19,23
3	61	∞	∞	6	2	1,32	7,96

$$k_{eff,j} = 1 / (\sum 3^5 (1 / k_{i,j})) \quad [6.3.3.1.(2)]$$

$$Z_{eq} = \sum k_{eff,j} h_j^2 / \sum k_{eff,j} h_j$$

$$Z_{eq} = 183 \text{ [mm]} \quad \text{Braço da força equivalente} \quad [6.3.3.1.(3)]$$

$$k_{eq} = \sum k_{eff,j} h_j / Z_{eq}$$

$$k_{eq} = 5 \text{ [mm]} \quad \text{Coeficiente de rigidez equivalente em uma disposição de parafusos} \quad [6.3.3.1.(1)]$$

$$S_{j,ini} = E Z_{eq}^2 k_{eq} \quad [6.3.1.(4)]$$

$$S_{j,ini} = 32529,99 \text{ [kN*m]} \quad \text{Rigidez rotacional inicial} \quad [6.3.1.(4)]$$

$$\mu = 1,15 \quad \text{Coeficiente de rigidez de uma conexão} \quad [6.3.1.(6)]$$

$$S_j = S_{j,ini} / \mu \quad [6.3.1.(4)]$$

$$S_j = 28336,98 \text{ [kN*m]} \quad \text{Rigidez rotacional final} \quad [6.3.1.(4)]$$

Classificação da conexão devido à rigidez.

$$S_{j,rig} = 84556,75 \text{ [kN*m]} \quad \text{Resistência de uma conexão rígida} \quad [5.2.2.5]$$

$$S_{j,pin} = 5284,80 \text{ [kN*m]} \quad \text{Resistência de uma conexão rotulada} \quad [5.2.2.5]$$

$$S_{j,pin} \leq S_{j,ini} < S_{j,rig} \quad \text{SEMIRRÍGIDO}$$

A conexão está em conformidade com a norma.	Relação	0,70

#

Ligação Viga HEB 300 Rotulada

	Autodesk Robot Structural Analysis Professional 2021 Cálculo da conexão viga - coluna (alma) EN 1993-1-8:2005/AC:2009	
		Relação 0,52

Geral

Nº de conexão: 5

Nome da conexão: Beam-column (web)

Geometria

Coluna

Seção: HEB 300

$\alpha =$ -90,0 [Deg] Âng. de inclinação

$h_c =$ 300 [mm] Altura da seção da coluna

$b_{fc} =$ 300 [mm] Largura da seção da coluna

Seção: HEB 300

$\alpha =$ -90,0 [Deg] Âng. de inclinação

$t_{wc} =$ 11 [mm] Espessura da alma da seção da coluna

$t_{fc} =$ 19 [mm] Espessura da mesa da seção da coluna

$r_c =$ 27 [mm] Raio de concordância de seção da coluna

$A_c =$ 149,08 [cm²] Área de seção transversal do pilar

$I_{yc} =$ 25165,70 [cm⁴] Momento de inércia da seção do pilar

Material: S 275

$f_{yc} =$ 275,00 [MPa] Resistência do projeto

$f_{uc} =$ 430,00 [MPa] Resistência à tensão

Viga**Seção:** HEB 300

$\alpha =$ 0,0 [Deg] Âng. de inclinação

$h_b =$ 300 [mm] Altura da seção da viga

$b_b =$ 300 [mm] Largura da seção da viga

$t_{wb} =$ 11 [mm] Espessura da alma da seção da viga

$t_{fb} =$ 19 [mm] Espessura da mesa da seção da viga

$r_b =$ 27 [mm] Raio de concordância da seção da viga

$A_b =$ 149,08 [cm²] Área de seção transversal da viga

$I_{yb} =$ 25165,70 [cm⁴] Momento de inércia da seção da viga

Material: S 275

$f_{yb} =$ 275,00 [MPa] Resistência do projeto

$f_{ub} =$ 430,00 [MPa] Resistência à tensão

Placa**Tipo:** unilateral

$l_p =$ 100 [mm] Comprimento da placa

$h_p =$ 200 [mm] Altura da placa

$t_p =$ 15 [mm] Espessura da placa

Material: S 275

$f_{yp} = 275,00$ [MPa] Resistência do projeto

$f_{up} = 430,00$ [MPa] Resistência à tensão

Parafusos

Parafusos conectando a viga e a placa

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe = 8.8 Classe do parafuso

$d = 20$ [mm] Diâmetro do parafuso

$d_0 = 22$ [mm] Diâmetro da abertura do parafuso

$A_s = 2,45$ [cm²] Área efetiva da seção de um parafuso

$A_v = 3,14$ [cm²] Área de seção do parafuso

$f_{ub} = 800,00$ [MPa] Resistência à tensão

$k = 1$ Número de colunas de parafusos

$w = 3$ Número de linhas de parafusos

$e_1 = 30$ [mm] Nível do primeiro parafuso

$p_1 = 70$ [mm] Espaçamento vertical

Soldas

$a_{cp} = 5$ [mm] Soldas de concordância conectando a placa à coluna

Fatores de material

$\gamma_{M0} = 1,00$ Fator de segurança parcial [2.2]

$\gamma_{M2} = 1,25$ Fator de segurança parcial [2.2]

Cargas

Caso: Cálculos manuais.

$N_{b,Ed} = 93,00$ [kN] Força axial

$V_{b,Ed} = 37,00$ [kN] Força de cisalhamento

$M_{b,Ed} = 0,00$ [kN*m] Momento fletor

Resultados

Parafusos conectando a viga e a placa**Capacidades dos parafusos**

$$F_{v,Rd} = 94,0 \text{ [kN Resistência do parafuso ao cisalhamento na parte com rosca de um parafuso]} \quad F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$$

Apoio do parafuso na viga

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1x} = 114,67 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,81 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 0,81 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1z} = 153,37 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Apoio do parafuso na placa

Direção x

$$k_{1x} = 2,12 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,12 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,68 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,68 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 149,04 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,45 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 0,45 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2z} = 117,27 \text{ [kN]} \quad \text{Resistência portante de um único parafuso}$$

$$F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Forças atuantes nos parafusos da conexão da placa com a viga

Cisalhamento do parafuso

$$e = 61 \text{ [mm]} \quad \text{Distância entre o centroide de um grupo de parafusos e o centro da alma do pilar}$$

$$M_0 = 2,24 \frac{\text{[kN} \cdot \text{m]}}{\text{m}} \quad \text{Momento fletor real}$$

$$M_0 = M_{b,Ed} + V_{b,Ed} \cdot e$$

$$F_{Nx} = 31,0 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força longitudinal}$$

$$F_{Nx} = |N_{b,Ed}| / n$$

$$F_{Vz} = 12,3 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força de cisalhamento}$$

$$F_{Vz} = |V_{b,Ed}| / n$$

$$F_{Mx} = 15,9 \text{ [kN]} \quad \text{Componente de força em um parafuso devido a influência do momento na direção x}$$

$$F_{Mx} = |M_0| \cdot z_i / \sum (x_i^2 + z_i^2)$$

$$F_{Mz} = 0,00 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência do momento ao redor do eixo z}$$

$$F_{Mz} = |M_0| \cdot x_i / \sum (x_i^2 + z_i^2)$$

$$F_{x,Ed} = 46,9 \text{ [kN]} \quad \text{Força total do projeto em um parafuso na direção x}$$

$$F_{x,Ed} = F_{Nx} + F_{Mx}$$

$$F_{z,Ed} = 12,3 \text{ [kN]} \quad \text{Força de projeto total em um parafuso na direção z}$$

$$F_{z,Ed} = F_{Vz} + F_{Mz}$$

$$F_{Ed} = 48,5 \text{ [kN]} \quad \text{Força de cisalhamento resultante no parafuso}$$

$$F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$$

$$F_{Rdx} = 114,67 \text{ [kN]} \quad \text{Capacidade de projeto efetiva de um parafuso na direção x}$$

$$F_{Rdx} = \min(F_{bRd1x}, F_{bRd2x})$$

$$F_{Rdz} = 117,27 \text{ [kN]} \quad \text{Capacidade de projeto efetiva de um parafuso na direção z}$$

$$F_{Rdz} = \min(F_{bRd1z}, F_{bRd2z})$$

$ F_{x,Ed} \leq F_{Rdx}$	$ 46,99 < 114,67$	verificado	(0,41)
$ F_{z,Ed} \leq F_{Rdz}$	$ 12,33 < 117,27$	verificado	(0,11)
$F_{Ed} \leq F_{v,Rd}$	$48,58 < 94,08$	verificado	(0,52)

Verificação da seção devido ao rompimento do bloco (força axial)

Placa

$$A_{nt} = 14,40 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 10,20 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 657,31 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b,Ed}| \leq V_{effRd} \quad |93,00| < 657,31 \quad \text{verificado} \quad (0,14)$$

Viga

$$A_{nt} = 10,56 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 6,38 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 464,56 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b,Ed}| \leq V_{effRd} \quad |93,00| < 464,56 \quad \text{verificado} \quad (0,20)$$

Verificação da seção devido ao rompimento do bloco (força de cisalhamento)

Placa

$$A_{nt} = 5,10 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 17,25 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 361,60 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b,Ed}| \leq V_{effRd} \quad |37,00| < 361,60 \quad \text{verificado} \quad (0,10)$$

Viga

$$A_{nt} = 3,19 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$A_{nv} = 18,15 \text{ [cm}^2\text{]} \text{ Área da seção em cisalhamento}$$

$$V_{effRd} = 343,04 \text{ [kN]} \text{ Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b,Ed}| \leq V_{effRd} \quad |37,00| < 343,04 \quad \text{verificado} \quad (0,11)$$

Verificação de uma placa enfraquecida por aberturas

$$A_t = 30,00 \quad [cm^2] \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 20,10 \quad [cm^2] \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,60 < 0,80 \quad \#$$

$$W_{net} = 67,26 \quad [cm^3] \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 18,50 \quad [kN \cdot m] \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |2,24| < 18,50 \quad \text{verificado} \quad (0,12)$$

$$A_v = 30,00 \quad [cm^2] \quad \text{Área da seção efetiva quanto a cisalhamento} \quad A_v = h_p \cdot t_p$$

$$A_{v,net} = 20,10 \quad [cm^2] \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 476,31 \quad [kN] \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$V_{b,Ed} \leq V_{pl,Rd} \quad |37,00| < 476,31 \quad \text{verificado} \quad (0,08)$$

Verificação de uma seção de viga enfraquecida por aberturas

$$A_t = 33,00 \quad [cm^2] \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 25,74 \quad [cm^2] \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,70 < 0,80 \quad \#$$

$$W_{net} = 147,33 \quad [cm^3] \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 40,52 \quad [kN \cdot m] \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |2,24| < 40,52 \quad \text{verificado} \quad (0,06)$$

$$A_v = 33,00 \quad [cm^2] \quad \text{Área da seção efetiva quanto a cisalhamento}$$

$$A_{v,net} = 25,74 \quad [cm^2] \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0$$

$$V_{pl,Rd} = 523,95 \quad [kN] \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$$

$$V_{b,Ed} \leq V_{pl,Rd} \quad |37,00| < 523,95 \quad \text{verificado} \quad (0,07)$$

Resistência da solda

Soldas de concordância conectando a placa à coluna

$$A_w = 10,00 \quad [cm^2] \quad \text{Área da solda} \quad A_w = h_p \cdot a_{gp}$$

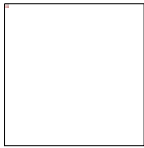
$$\sigma = 77,03 \quad [MPa] \quad \text{Tensão normal em uma solda} \quad \sigma = 0.5 \cdot [N_{b,Ed}/A_s + M_0/W_{yw}]$$

$$\sigma_{\perp} = 54,46 \quad [MPa] \quad \text{Tensão perpendicular normal na solda} \quad \sigma_{\perp} = \sigma / \sqrt{2}$$

$ \sigma_{\perp} \leq 0.9 \cdot f_u / \gamma_{M2}$		$ 54,46 < 309,60$		verificado	(0,18)
$\tau_{\perp} =$	54,46	[MPa]	Tensão tangencial perpendicular		$\tau_{\perp} = \sigma_{\perp}$
$\tau_{\parallel} =$	18,50	[MPa]	Tensão tangencial paralela		$\tau_{\parallel} = 0.5 \cdot V_{b,Ed} / A_s$
$\beta_w =$	0,85	Coeficiente de correlação			[Tabela 4.1]
$\sqrt{[\sigma_{\perp}^2 + 3 \cdot (\tau_{\parallel}^2 + \tau_{\perp}^2)]} \leq f_u / (\beta_w \cdot \gamma_{M2})$		$113,54 < 404,71$		verificado	(0,28)
A conexão está em conformidade com a norma.					Relação 0,52

#

Ligação Viga HEA 200

	Autodesk Robot Structural Analysis Professional 2021 Cálculo da conexão viga - viga (alma) EN 1993-1-8:2005/AC:2009	 Relação 0,79

Geral

N° de conexão: 7

Nome da conexão: Beam-beam (web)

Geometria

Viga principal

Seção: IPE 300

$\alpha = -90,0$ [Deg] Âng. de inclinação

$h_g = 300$ [mm] Altura da seção da viga principal

$b_{fg} = 150$ [mm] Largura da mesa da seção da viga principal

$t_{wg} = 7$ [mm] Espessura da mesa da seção da viga principal

Seção: IPE 300

$\alpha = -90,0$ [Deg] Âng. de inclinação

$t_{fg} = 11$ [mm] Espessura da mesa da seção da viga principal

$r_g = 15$ [mm] Raio de concordância da alma da seção da viga principal

$A_p = 53,81$ [cm²] Área de seção transversal da viga principal

$I_{yp} = 8356,11$ [cm⁴] Momento de inércia da seção da viga principal

Material: S 235

$f_{yg} = 235,00$ [MPa] Resistência do projeto

$f_{ug} = 360,00$ [MPa] Resistência à tensão

Lado esquerdo

Viga

Seção: HEA 200

$\alpha = 0,0$ [Deg] Âng. de inclinação

$h_{bl} = 190$ [mm] Altura da seção da viga

$b_{bl} = 200$ [mm] Largura da seção da viga

$t_{wbl} = 7$ [mm] Espessura da alma da seção da viga

$t_{fbl} = 10$ [mm] Espessura da mesa da seção da viga

$r_{bl} = 18$ [mm] Raio de concordância da seção da viga

$A_b = 53,83$ [cm²] Área de seção transversal da viga

$I_{ybl} = 3692,15$ [cm⁴] Momento de inércia da seção da viga

Material: S 275

$f_{ybl} = 275,00$ [MPa] Resistência do projeto

$f_{ubl} = 430,00$ [MPa] Resistência à tensão

Enrijecedor

$l_s = 150$ [mm] Comprimento do enrijecedor

$h_s = 279$ [mm] Altura do enrijecedor

$t_s = 10$ [mm] Espessura do enrijecedor

$d_s = 90$ [mm] Comprimento do entalhe

$h_{1s} = 20$ [mm] Entalhe superior

Enrijecedor

$l_s = 150$ [mm] Comprimento do enrijecedor

$h_{2s} = 135$ [mm] Entalhe inferior

Material: S 275

$f_{ys} = 275,00$ [MPa] Resistência do projeto

$f_{us} = 430,00$ [MPa] Resistência à tensão

Parafusos**Parafusos conectando a viga e o enrijecedor**

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe = 8.8 Classe do parafuso

$d = 16$ [mm] Diâmetro do parafuso

$d_0 = 18$ [mm] Diâmetro da abertura do parafuso

$A_s = 1,57$ [cm²] Área efetiva da seção de um parafuso

$A_v = 2,01$ [cm²] Área de seção do parafuso

$f_{ub} = 800,00$ [MPa] Resistência à tensão

$k = 1$ Número de colunas de parafusos

$w = 2$ Número de linhas de parafusos

$p_1 = 27$ [mm] Nível do primeiro parafuso

$p_1 = 70$ [mm] Espaçamento vertical

Lado direito**Viga**

Seção: HEA 200

$\alpha = 0,0$ [Deg] Âng. de inclinação

$h_{br} = 190$ [mm] Altura da seção da viga

$b_{br} = 200$ [mm] Largura da seção da viga

$t_{wbr} = 7$ [mm] Espessura da alma da seção da viga

$t_{fbr} = 10$ [mm] Espessura da mesa da seção da viga

$r_{br} = 18$ [mm] Raio de concordância da seção da viga

Seção: HEA 200 $\alpha = 0,0$ [Deg] Âng. de inclinação $A_{br} = 53,83$ [cm²] Área de seção transversal da viga $I_{ybr} = 3692,15$ [cm⁴] Momento de inércia da seção da viga**Material:** S 275 $f_{ybr} = 275,00$ [MPa] Resistência do projeto $f_{ubr} = 430,00$ [MPa] Resistência à tensão**Enrijecedor** $l_s = 150$ [mm] Comprimento do enrijecedor $h_s = 279$ [mm] Altura do enrijecedor $t_s = 10$ [mm] Espessura do enrijecedor $d_s = 90$ [mm] Comprimento do entalhe $h_{1s} = 20$ [mm] Entalhe superior $h_{2s} = 135$ [mm] Entalhe inferior**Material:** S 275 $f_{ys} = 275,00$ [MPa] Resistência do projeto $f_{us} = 430,00$ [MPa] Resistência à tensão**Parafusos****Parafusos conectando a viga e o enrijecedor**

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe = 8.8 Classe do parafuso

 $d = 16$ [mm] Diâmetro do parafuso $d_0 = 18$ [mm] Diâmetro da abertura do parafuso $A_s = 1,57$ [cm²] Área efetiva da seção de um parafuso $A_v = 2,01$ [cm²] Área de seção do parafuso $f_{ub} = 800,00$ [MPa] Resistência à tensão $k = 1$ Número de colunas de parafusos $w = 2$ Número de linhas de parafusos $e_1 = 27$ [mm] Nível do primeiro parafuso

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Classe = 8.8 Classe do parafuso

$p_1 = 70$ [mm] Espaçamento vertical

Fatores de material

$\gamma_{M0} = 1,00$ Fator de segurança parcial [2.2]

$\gamma_{M2} = 1,25$ Fator de segurança parcial [2.2]

Cargas

Caso: Cálculos manuais.

Lado esquerdo

$N_{b2,Ed} = 61,00$ [kN] Força axial

$V_{b2,Ed} = 26,00$ [kN] Força de cisalhamento

$M_{b2,Ed} = -2,00$ [kN*m] Momento fletor

Lado direito

$N_{b1,Ed} = 61,00$ [kN] Força axial

$V_{b1,Ed} = 26,00$ [kN] Força de cisalhamento

$M_{b1,Ed} = -2,00$ [kN*m] Momento fletor

Resultados

Lado esquerdo

Parafusos conectando a viga e o enrijecedor

Capacidades dos parafusos

$F_{v,Rd} = 60,2$ [kN Resistência do parafuso ao cisalhamento na parte com rosca de um
= 9] parafuso $F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$

Apoio do parafuso na viga

Direção x

$k_{1x} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$

$k_{1x} > 0.0$ $2,50 > 0,00$ verificado

$\alpha_{bx} = 0,65$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$

$\alpha_{bx} > 0.0$ $0,65 > 0,00$ verificado

$$F_{b,Rd1x} = 57,97 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_z/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 1,00 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 1,00 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1z} = 89,44 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Apoio do parafuso no enrijecedor

Direção x

$$k_{1x} = 2,47 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,47 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,65 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,65 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 88,08 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_z/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 0,50 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2z} = 68,29 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Forças atuantes nos parafusos da conexão do enrijecedor com a viga**Cisalhamento do parafuso**

$$e = 119 \text{ [mm]} \quad \text{Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal}$$

$$M_0 = \frac{1,0}{8} \text{ [kN} \cdot \text{m]} \quad \text{Momento fletor real} \quad M_0 = V_{b2,Ed} \cdot e$$

$$F_{Nx} = \frac{30,}{50} \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força longitudinal} \quad F_{Nx} = |N_{b2,Ed}|/n$$

$$F_{Vz} = \frac{13,}{00} \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força de cisalhamento} \quad F_{Vz} = |V_{b2,Ed}|/n$$

e =	119	[mm]	Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal	
F _{Mx}	15,		Componente de força em um parafuso devido a influência do momento na	F _{Mx} = M ₀]*z _i /Σ(x _i ² +z _i ²)
=	46	[kN]	direção x	
F _{Mz}	0,0		Força do componente em um parafuso devido à influência do momento ao	F _{Mz} = M ₀]*x _i /Σ(x _i ² +z _i ²)
=	0	[kN]	redor do eixo z	
F _{x,Ed}	45,		Força total do projeto em um parafuso na direção x	F _{x,Ed} = F _{Nx} + F _{Mx}
=	96	[kN]		
F _{z,Ed}	13,		Força de projeto total em um parafuso na direção z	F _{z,Ed} = F _{Vz} + F _{Mz}
=	00	[kN]		
F _{Ed}	47,		Força de cisalhamento resultante no parafuso	F _{Ed} = √(F _{x,Ed} ² + F _{z,Ed} ²)
=	76	[kN]		
F _{Rdx}	57,		Capacidade de projeto efetiva de um parafuso na direção x	F _{Rdx} =min(F _{bRd1x} , F _{bRd2x})
=	97	[kN]		
F _{Rdz}	68,		Capacidade de projeto efetiva de um parafuso na direção z	F _{Rdz} =min(F _{bRd1z} , F _{bRd2z})
=	29	[kN]		

F _{x,Ed} ≤ F _{Rdx}	45,96 < 57,97	verifica do	(0,79)
F _{z,Ed} ≤ F _{Rdz}	13,00 < 68,29	verifica do	(0,19)
F _{Ed} ≤ F _{v,Rd}	47,76 < 60,29	verifica do	(0,79)

Verificação da seção devido ao rompimento do bloco (força axial)

Enrijecedor

$A_{nt} =$	$5,20$	$[cm^2]$	Área líquida da seção em tração	
$A_{nv} =$	$5,20$	$[cm^2]$	Área da seção em cisalhamento	
$V_{effRd} =$	$261,4$	$[kN]$	Capacidade do projeto de uma seção enfraquecida por aberturas	$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$
$ N_{b2,Ed} \leq V_{effRd}$				
	$ 61,00 $	$< 261,44$	verificado	$(0,23)$

Viga

$$A_{nt} = 3,38 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 3,38 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 169,94 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b2,Ed}| \leq V_{effRd} \quad |61,00| < 169,94 \quad \text{verificado} \quad (0,36)$$

Verificação da seção devido ao rompimento do bloco (força de cisalhamento)

Enrijecedor

$$A_{nt} = 2,60 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 12,34 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 240,64 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b2,Ed}| \leq V_{effRd} \quad |26,00| < 240,64 \quad \text{verificado} \quad (0,11)$$

Viga

$$A_{nt} = 1,69 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 6,53 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 132,79 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas}$$

$$V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b2,Ed}| \leq V_{effRd} \quad |26,00| < 132,79 \quad \text{verificado} \quad (0,00)$$

Verificação do enrijecedor enfraquecido por aberturas

$$A_t = 12,36 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 8,76 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,64 < 0,80 \quad \#$$

$$W_{net} = 18,17 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 5,00 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão}$$

$$M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$W_{net} = 18,17 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$|M_0| \leq M_{c,Rdnet}$ $|1,08| < 5,00$ verificado (0,22)

$A_v = 12,36 \text{ [cm}^2\text{]}$ Área da seção efetiva quanto a cisalhamento $A_v = h_s \cdot t_s$

$A_{v,net} = 8,76 \text{ [cm}^2\text{]}$ Área líquida de uma seção efetiva quanto a cisalhamento $A_{v,net} = A_v - n_v \cdot d_0$

$V_{pl,Rd} = 196,24 \text{ [kN]}$ Resistência plástica do projeto para cisalhamento $V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$

$V_{b2,Ed} \leq V_{pl,Rd}$ $|26,00| < 196,24$ verificado (0,13)

Verificação de uma seção de viga enfraquecida por aberturas

$A_t = 12,35 \text{ [cm}^2\text{]}$ Área da zona de tensão da seção bruta

$A_{t,net} = 10,01 \text{ [cm}^2\text{]}$ Área líquida da seção em tração

$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0})$ $0,73 < 0,80$ #

$W_{net} = 35,58 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$M_{c,Rdnet} = 9,78 \text{ [kN}\cdot\text{m]}$ Resistência do projeto da seção em flexão $M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$

$|M_0| \leq M_{c,Rdnet}$ $|1,08| < 9,78$ verificado (0,11)

$A_v = 12,35 \text{ [cm}^2\text{]}$ Área da seção efetiva quanto a cisalhamento

$A_{v,net} = 10,01 \text{ [cm}^2\text{]}$ Área líquida de uma seção efetiva quanto a cisalhamento $A_{v,net} = A_v - n_v \cdot d_0$

$V_{pl,Rd} = 196,08 \text{ [kN]}$ Resistência plástica do projeto para cisalhamento $V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$

$V_{b2,Ed} \leq V_{pl,Rd}$ $|26,00| < 196,08$ verificado (0,13)

Lado direito

Parafusos conectando a viga e o enrijecedor

Capacidades dos parafusos

$F_{v,Rd} = 60,2 \text{ [kN]}$ Resistência do parafuso ao cisalhamento na parte com rosca de um parafuso $F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$

Apoio do parafuso na viga

Direção x

$k_{1x} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$

$k_{1x} > 0.0$ $2,50 > 0,00$ verificado

$\alpha_{bx} = 0,65$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$

$\alpha_{bx} > 0.0$	$0,65 > 0,00$	verificado

$$F_{b,Rd1x} = 57,97 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$k_{1z} > 0.0$	$2,50 > 0,00$	verificado

$$\alpha_{bz} = 1,00 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$\alpha_{bz} > 0.0$	$1,00 > 0,00$	verificado

$$F_{b,Rd1z} = 89,44 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Apoio do parafuso no enrijecedor

Direção x

$$k_{1x} = 2,47 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$k_{1x} > 0.0$	$2,47 > 0,00$	verificado

$$\alpha_{bx} = 0,65 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$\alpha_{bx} > 0.0$	$0,65 > 0,00$	verificado

$$F_{b,Rd2x} = 88,08 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$k_{1z} > 0.0$	$2,50 > 0,00$	verificado

$$\alpha_{bz} = 0,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$\alpha_{bz} > 0.0$	$0,50 > 0,00$	verificado

$$F_{b,Rd2z} = 68,29 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot t_i / \gamma_{M2}$$

Forças atuantes nos parafusos da conexão do enrijecedor com a viga

Cisalhamento do parafuso

$$e = 119 \text{ [mm]} \quad \text{Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal}$$

$$M_0 = 1,08 \text{ [kN} \cdot \text{m]} \quad \text{Momento fletor real} \quad M_0 = V_{b1,Ed} \cdot e$$

$$F_{Nx} = 30,50 \text{ [kN]} \quad \text{Força do componente em um parafuso devido à influência da força longitudinal} \quad F_{Nx} = |N_{b1,Ed}|/n$$

Cisalhamento do parafuso

$e = 119$ [mm] Distância entre o centroide de um grupo de parafusos e o centro da alma da viga principal

$F_{Vz} = 13,0$ [kN] Força do componente em um parafuso devido à influência da força de cisalhamento $F_{Vz} = |V_{b1,Ed}|/n$

$F_{Mx} = 15,4$ [kN] Componente de força em um parafuso devido a influência do momento na direção x $F_{Mx} = |M_0| \cdot z_i / \sum (x_i^2 + z_i^2)$

$F_{Mz} = 0,00$ [kN] Força do componente em um parafuso devido à influência do momento ao redor do eixo z $F_{Mz} = |M_0| \cdot x_i / \sum (x_i^2 + z_i^2)$

$F_{x,Ed} = 45,9$ [kN] Força total do projeto em um parafuso na direção x $F_{x,Ed} = F_{Nx} + F_{Mx}$

$F_{z,Ed} = 13,0$ [kN] Força de projeto total em um parafuso na direção z $F_{z,Ed} = F_{Vz} + F_{Mz}$

$F_{Ed} = 47,7$ [kN] Força de cisalhamento resultante no parafuso $F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$

$F_{Rdx} = 57,9$ [kN] Capacidade de projeto efetiva de um parafuso na direção x $F_{Rdx} = \min(F_{bRd1x}, F_{bRd2x})$

$F_{Rdz} = 68,2$ [kN] Capacidade de projeto efetiva de um parafuso na direção z $F_{Rdz} = \min(F_{bRd1z}, F_{bRd2z})$

$|F_{x,Ed}| \leq F_{Rdx}$ $|45,96| < 57,97$ verificado (0,79)

$|F_{z,Ed}| \leq F_{Rdz}$ $|13,00| < 68,29$ verificado (0,19)

$F_{Ed} \leq F_{v,Rd}$ $47,76 < 60,29$ verificado (0,79)

Verificação da seção devido ao rompimento do bloco (força axial)

Enrijecedor

$A_{nt} = 5,20$ [cm²] Área líquida da seção em tração

$A_{nv} = 5,20$ [cm²] Área da seção em cisalhamento

$V_{effRd} = 261,4$ [kN] Capacidade do projeto de uma seção enfraquecida por aberturas $V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$

$|N_{b1,Ed}| \leq V_{effRd}$ $|61,00| < 261,44$ verificado (0,23)

Viga

$$A_{nt} = 3,38 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 3,38 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 169,9 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas} \quad V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|N_{b1,Ed}| \leq V_{effRd} \quad |61,00| < 169,94 \quad \text{verificado} \quad (0,36)$$

Verificação da seção devido ao rompimento do bloco (força de cisalhamento)**Enrijecedor**

$$A_{nt} = 2,60 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 12,34 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 240,6 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas} \quad V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b1,Ed}| \leq V_{effRd} \quad |26,00| < 240,64 \quad \text{verificado} \quad (0,11)$$

Viga

$$A_{nt} = 1,69 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$A_{nv} = 6,53 \text{ [cm}^2\text{]} \quad \text{Área da seção em cisalhamento}$$

$$V_{effRd} = 132,7 \text{ [kN]} \quad \text{Capacidade do projeto de uma seção enfraquecida por aberturas} \quad V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$|V_{b1,Ed}| \leq V_{effRd} \quad |26,00| < 132,79 \quad \text{verificado} \quad (0,20)$$

Verificação do enrijecedor enfraquecido por aberturas

$$A_t = 12,36 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 8,76 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,64 < 0,80 \quad \#$$

$$W_{net} = 18,17 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 5,00 \text{ [kN*m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$ M_0 \leq M_{c,Rdnet}$	$ 1,08 < 5,00$	verificado	(0,22)

$A_v = 12,36 \text{ [cm}^2\text{]}$	Área da seção efetiva quanto a cisalhamento	$A_v = h_s \cdot t_s$

$A_{v,net} = 8,76 \text{ [cm}^2\text{]}$	Área líquida de uma seção efetiva quanto a cisalhamento	$A_{v,net} = A_v - n_v \cdot d_0$

$V_{pl,Rd} = 196,24 \text{ [kN]}$	Resistência plástica do projeto para cisalhamento	$V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$

$ V_{b1,Ed} \leq V_{pl,Rd}$	$ 26,00 < 196,24$	verificado	(0,13)

Verificação de uma seção de viga enfraquecida por aberturas

$A_t = 12,35 \text{ [cm}^2\text{]}$	Área da zona de tensão da seção bruta

$A_{t,net} = 10,01 \text{ [cm}^2\text{]}$	Área líquida da seção em tração

$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0})$	$0,73 < 0,80$	#

$W_{net} = 35,58 \text{ [cm}^3\text{]}$	Módulo elástico da seção

$M_{c,Rdnet} = 9,78 \text{ [kN} \cdot \text{m]}$	Resistência do projeto da seção em flexão	$M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$

$ M_0 \leq M_{c,Rdnet}$	$ 1,08 < 9,78$	verificado	(0,11)

$A_v = 12,35 \text{ [cm}^2\text{]}$	Área da seção efetiva quanto a cisalhamento

$A_{v,net} = 10,01 \text{ [cm}^2\text{]}$	Área líquida de uma seção efetiva quanto a cisalhamento	$A_{v,net} = A_v - n_v \cdot d_0$

$V_{pl,Rd} = 196,08 \text{ [kN]}$	Resistência plástica do projeto para cisalhamento	$V_{pl,Rd} = (A_v \cdot f_y) / (\sqrt{3} \cdot \gamma_{M0})$

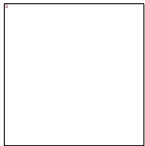
$ V_{b1,Ed} \leq V_{pl,Rd}$	$ 26,00 < 196,08$	verificado	(0,13)

A conexão está em conformidade com a norma.

Relação 0,79

#

Ligação Emenda Pilar

	Autodesk Robot Structural Analysis Professional 2021 Cálculo da conexão de sobreposição de emenda de coluna-para-coluna EN 1993-1-8:2005/AC:2009	 Relação 0,98

Geral

Nº de conexão: 8

Nome da conexão: Column Splice

Coluna inferior

Seção: HEB 200

$h_{c1} = 200$ [mm] Altura da seção da viga

$b_{fc1} = 200$ [mm] Largura da seção da viga

$t_{wc1} = 9$ [mm] Espessura da alma da seção da viga

$t_{fc1} = 15$ [mm] Espessura da mesa da seção da viga

Seção: HEB 200

$h_{c1} = 200$ [mm] Altura da seção da viga
 $r_{c1} = 18$ [mm] Raio de concordância da seção da viga
 $A_{c1} = 78,08$ [cm²] Área de seção transversal da viga
 $I_{yc1} = 5696,18$ [cm⁴] Momento de inércia da seção da viga

Material: S 275 $f_{yc1} = 275,00$ [MPa] Resistência $f_{uc1} = 430,00$ [MPa] #**Coluna superior****Seção:** HEB 200

$h_{c2} = 200$ [mm] Altura da seção da viga
 $b_{fc2} = 200$ [mm] Largura da seção da viga
 $t_{wc2} = 9$ [mm] Espessura da alma da seção da viga
 $t_{fc2} = 15$ [mm] Espessura da mesa da seção da viga
 $r_{c2} = 18$ [mm] Raio de concordância da seção da viga
 $A_{c2} = 78,08$ [cm²] Área de seção transversal da viga
 $I_{yc2} = 5696,18$ [cm⁴] Momento de inércia da seção da viga

Material: S 275 $f_{yc2} = 275,00$ [MPa] Resistência $f_{uc2} = 430,00$ [MPa] #**Placa de emenda****Tipo:** bilateral

$l_{pw} = 400$ [mm] Comprimento da placa
 $h_{pw} = 120$ [mm] Altura da placa
 $t_{pw} = 8$ [mm] Espessura da placa

Material: S 275 $f_{ypw} = 275,00$ [MPa] Resistência do projeto $f_{upw} = 430,00$ [MPa] Resistência à tensão

Placa externa direita

$l_{pe} = 400$ [mm] Comprimento da placa
 $h_{pe} = 200$ [mm] Altura da placa
 $t_{pe} = 15$ [mm] Espessura da placa
Material: S 275
 $f_{ype} = 275,00$ [MPa] Resistência do projeto
 $f_{upe} = 430,00$ [MPa] Resistência à tensão

Placa externa esquerda

$l_{pe} = 400$ [mm] Comprimento da placa
 $h_{pe} = 200$ [mm] Altura da placa
 $t_{pe} = 15$ [mm] Espessura da placa
Material: S 275
 $f_{ype} = 275,00$ [MPa] Resistência do projeto
 $f_{upe} = 430,00$ [MPa] Resistência à tensão

Lado inferior**Parafusos conectando uma placa de sobreposição de emenda com a alma da coluna**

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Categoria da conexão A

Classe = 8.8 Classe do parafuso
 $d = 16$ [mm] Diâmetro do parafuso
 $d_0 = 18$ [mm] Diâmetro da abertura do parafuso
 $A_s = 1,57$ [cm²] Área efetiva da seção de um parafuso
 $A_v = 2,01$ [cm²] Área de seção do parafuso
 $f_{yb} = 640,00$ [MPa] Resistência de produtividade do parafuso
 $f_{ub} = 800,00$ [MPa] Resistência do parafuso à tração
 $n_h = 3$ Número de colunas de parafusos
 $n_v = 2$ Número de linhas de parafusos
 $e_1 = 30$ [mm] Nível do primeiro parafuso
 $p_2 = 60$ [mm] Espaçamento horizontal

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

$p_1 = 60$ [mm] Espaçamento vertical

Parafusos conectando uma placa da mesa com a mesa direito da coluna

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Categoria da conexão A

Classe = 8.8 Classe do parafuso

$d = 20$ [mm] Diâmetro do parafuso

$d_0 = 22$ [mm] Diâmetro da abertura do parafuso

$A_s = 2,45$ [cm²] Área efetiva da seção de um parafuso

$A_v = 3,14$ [cm²] Área de seção do parafuso

$f_{yb} = 640,00$ [MPa] Resistência de produtividade do parafuso

$f_{ub} = 800,00$ [MPa] Resistência do parafuso à tração

$n_h = 1$ Número de colunas de parafusos

$n_v = 3$ Número de linhas de parafusos

$e_1 = 40$ [mm] Nível do primeiro parafuso

$p_1 = 60$ [mm] Espaçamento vertical

Parafusos conectando uma placa da mesa com a mesa esquerdo da coluna

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Categoria da conexão A

Classe = 8.8 Classe do parafuso

$d = 20$ [mm] Diâmetro do parafuso

$d_0 = 22$ [mm] Diâmetro da abertura do parafuso

$A_s = 2,45$ [cm²] Área efetiva da seção de um parafuso

$A_v = 3,14$ [cm²] Área de seção do parafuso

$f_{yb} = 640,00$ [MPa] Resistência de produtividade do parafuso

$f_{ub} = 800,00$ [MPa] Resistência do parafuso à tração

$n_h = 1$ Número de colunas de parafusos

$n_v = 3$ Número de linhas de parafusos

$e_1 = 40$ [mm] Nível do primeiro parafuso

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

$p_1 = 60$ [mm] Espaçamento vertical

Lado superior

Parafusos conectando uma placa de sobreposição de emenda com a alma da coluna

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Categoria da conexão A

Classe = 8.8 Classe do parafuso

$d = 16$ [mm] Diâmetro do parafuso

$d_0 = 18$ [mm] Diâmetro da abertura do parafuso

$A_s = 1,57$ [cm²] Área efetiva da seção de um parafuso

$A_v = 2,01$ [cm²] Área de seção do parafuso

$f_{yb} = 640,00$ [MPa] Resistência de produtividade do parafuso

$f_{ub} = 800,00$ [MPa] Resistência do parafuso à tração

$n_h = 3$ Número de colunas de parafusos

$n_v = 2$ Número de linhas de parafusos

$e_1 = 30$ [mm] Nível do primeiro parafuso

$p_2 = 60$ [mm] Espaçamento horizontal

$p_1 = 60$ [mm] Espaçamento vertical

Parafusos conectando uma placa da mesa com a mesa direito da coluna

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Categoria da conexão A

Classe = 8.8 Classe do parafuso

$d = 20$ [mm] Diâmetro do parafuso

$d_0 = 22$ [mm] Diâmetro da abertura do parafuso

$A_s = 2,45$ [cm²] Área efetiva da seção de um parafuso

$A_v = 3,14$ [cm²] Área de seção do parafuso

$f_{yb} = 640,00$ [MPa] Resistência de produtividade do parafuso

$f_{ub} = 800,00$ [MPa] Resistência do parafuso à tração

$n_h = 1$ Número de colunas de parafusos

Classe =	8 . 8	Classe do parafuso
$n_v =$	3	Número de linhas de parafusos
$e_1 =$	40 [mm]	Nível do primeiro parafuso
$p_1 =$	60 [mm]	Espaçamento vertical

Parafusos conectando uma placa da mesa com a mesa esquerdo da coluna

O plano de cisalhamento passa através da parte ROQUEADA do parafuso.

Categoria da conexão A

Classe =	8 . 8	Classe do parafuso
$d =$	20 [mm]	Diâmetro do parafuso
$d_0 =$	22 [mm]	Diâmetro da abertura do parafuso
$A_s =$	2 , 45 [cm ²]	Área efetiva da seção de um parafuso
$A_v =$	3 , 14 [cm ²]	Área de seção do parafuso
$f_{yb} =$	640 , 00 [MPa]	Resistência de produtividade do parafuso
$f_{ub} =$	800 , 00 [MPa]	Resistência do parafuso à tração
$n_h =$	1	Número de colunas de parafusos
$n_v =$	3	Número de linhas de parafusos
$e_1 =$	40 [mm]	Nível do primeiro parafuso
$p_1 =$	60 [mm]	Espaçamento vertical

Fatores de material

$\gamma_{M0} =$	1 , 00	Fator de segurança parcial	[2.2]
$\gamma_{M2} =$	1 , 25	Fator de segurança parcial	[2.2]

Cargas

Caso: Cálculos manuais.

Estado limite definitivo

$N_{Ed1} =$	172 , 00 [kN]	Força axial
$V_{y,Ed1} =$	10 , 00 [kN]	Força de cisalhamento
$V_{z,Ed1} =$	75 , 00 [kN]	Força de cisalhamento
$M_{y,Ed1} =$	72 , 00 [kN*m]	Momento fletor

Estado limite definitivo

$N_{Ed1} = 172,00$ [kN] Força axial

$M_{Vz,Ed1} = 16,00$ [kN*m] Momento fletor

$N_{Ed2} = 172,00$ [kN] Força axial

$V_{y,Ed2} = 10,00$ [kN] Força de cisalhamento

$V_{z,Ed2} = 75,00$ [kN] Força de cisalhamento

$M_{y,Ed2} = 72,00$ [kN*m] Momento fletor

$M_{Vz,Ed2} = 16,00$ [kN*m] Momento fletor

Resultados

Resultados para um lado de conexão (geometria e cargas são simétricas)

Força axial

Placa	A_i [cm ²]	FORÇAS EQUIVALENTES N_i [kN]	FORÇAS EQUIVALENTES $N_i(M_{y,Ed})$ [kN]	Força resultante $N_{Ed,i}$ [kN]
	$A_{pw} = 19,20$	41,70	-	$N_{Ed,pw} = 41,70$
	$A_{pfue} = 30,00$	65,15	324,13	$N_{Ed,pfue} = 389,28$
	$A_{pfle} = 30,00$	65,15	-324,13	$N_{Ed,pfle} = -258,98$

$$N_i = (N_{Ed} \cdot A_i) / (2 \cdot A_{wp} + A_{pfue} + A_{pfle})$$

$$N_{Ed,i} = N_i + N_i(M_{y,Ed})$$

Força de cisalhamento Z

Placa	A_i [cm ²]	$V_{z,Ed,i}$ [kN]
	$A_{z,pw} = 19,20$	$V_{z,Ed,pw} = 75,00$

Força de cisalhamento Y

Placa	$A_{y,i}$ [cm ²]	$V_{y,Ed,i}$ [kN]
	$A_{y,fupe} = 30,00$	$V_{y,Ed,fupe} = 5,00$
	$A_{y,flpe} = 30,00$	$V_{y,Ed,flpe} = 5,00$

Placa	$A_{y,i}$ [cm ²]	$V_{y,Ed,i}$ [kN]

$$V_{y,i} = (V_{y,Ed} * A_{y,i}) / (A_{pfue} + A_{pfle})$$

Momento fletor Y

Placa	$I_{y,i}$ [cm ⁴]	FORÇAS EQUIVALENTES $M_{y,i}$ [kN*m]	Força resultante $M_{y,Ed,i}$ [kN*m]
	$I_{y,pw} = 230,40$	2,31	$M_{y,Ed,pw} = 2,31$
	$I_{y,pfue} = 3472,50$	34,84	-
	$I_{y,pfle} = 3472,50$	34,84	-

$$M_{y,i} = (M_{y,Ed} * I_{y,i}) / (2 * I_{pw} + I_{pfue} + I_{pfle})$$

Momento fletor Z

Placa	$I_{z,i}$ [cm ⁴]	$M_{z,i}$ [kN*m]
	$I_{z,pfue} = 1000,00$	$M_{z,Ed,pfue} = 8,00$
	$I_{z,pfle} = 1000,00$	$M_{z,Ed,pfle} = 8,00$

$$M_i = (M_{z,Ed} * I_{z,i}) / (I_{z,pfue} + I_{z,pfle})$$

Parafusos conectando uma placa de sobreposição de emenda com a alma da coluna

Capacidades dos parafusos

$$F_{v,Rd} = 120,5 \text{ [kN Resistência do parafuso ao cisalhamento na parte com rosca de um parafuso]} \quad F_{v,Rd} = 0.6 * f_{ub} * A_s * m / \gamma_{M2}$$

Parafuso de suporte na alma da coluna

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 * (e_1/d_0) - 1.7, 1.4 * (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,74 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3*d_0), p_2/(3*d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,74 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1x} = 91,73 \text{ [kN]} \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} * \alpha_{bx} * f_u * d * \sum t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 1.4 \cdot (p_2/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,86 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 0,86 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1z} = 106,64 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$$

Apoio do parafuso na placa

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,74 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_2/(3 \cdot d_0), p_2/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,74 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 163,08 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$$

Direção z

$$k_{1z} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1z} = \min[2.8 \cdot (e_2/d_0) - 1.7, 1.4 \cdot (p_2/d_0) - 1.7, 2.5]$$

$$k_{1z} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bz} = 0,56 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bz} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bz} > 0.0 \quad 0,56 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2z} = 122,31 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2z} = k_{1z} \cdot \alpha_{bz} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$$

Estado limite definitivo

Cisalhamento do parafuso

$$e_0 = 100 \quad [\text{mm}] \quad \text{Excentricidade da força de cisalhamento relativa ao centro de gravidade do grupo de parafusos} \quad e_0 = e_{2b} + 0.5 \cdot (s_1 + (c - 1) \cdot p_2)$$

$$M_y = 9,81 \quad [\text{kN} \cdot \text{m}] \quad \text{Momento fletor real} \quad M_y = M_{y,Ed,pw} + V_{z,Ed,pw} \cdot e_0$$

$$F_{x,N} = 6,95 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência da força longitudinal na direção x} \quad F_{x,N} = |N_{Ed,pw}| / n_b$$

$$F_{z,Vz} = 12,5 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência da força de cisalhamento Vz na direção z} \quad F_{z,Vz} = |V_{z,Ed,pw}| / n_b$$

$$F_{x,M} = 14,8 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência do momento My na direção x} \quad F_{x,M} = |M_y| \cdot \sum z_i / (\sum x_i^2 + \sum z_i^2)$$

$e_0 = 100$	[mm Excentricidade da força de cisalhamento relativa ao centro de gravidade do grupo de parafusos]	$e_0 = e_{2b} + 0.5 \cdot (s_1 + (c-1) \cdot p_2)$
$F_{z,M_y} = 29,7$	[kN] Resistência do componente em um parafuso devido a influência do momento My na direção z	$F_{z,M_y} = M_y \cdot \sum (x_i^2 + z_i^2)$
$F_{x,Ed} = 21,8$	[kN] Força total do projeto em um parafuso na direção x	$F_{x,Ed} = F_{x,N} + F_{x,M_y}$
$F_{z,Ed} = 42,2$	[kN] Força de projeto total em um parafuso na direção z	$F_{z,Ed} = F_{z,Vz} + F_{z,M_y}$
$F_{Ed} = 47,5$	[kN] Força de cisalhamento resultante no parafuso	$F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{z,Ed}^2}$
$F_{Rd,x} = 91,7$	[kN] Capacidade de projeto efetiva de um parafuso na direção x	$F_{Rd,x} = \min(F_{bRd1,x}, F_{bRd2,x})$
$F_{Rd,z} = 106,6$	[kN] Capacidade de projeto efetiva de um parafuso na direção z	$F_{Rd,z} = \min(F_{bRd1,z}, F_{bRd2,z})$

$ F_{x,Ed} \leq F_{Rd,x}$	$ 21,82 < 91,73$	verificado	(0,24)
$ F_{z,Ed} \leq F_{Rd,z}$	$ 42,23 < 106,64$	verificado	(0,40)
$F_{Ed} \leq F_{v,Rd}$	$47,53 < 120,58$	verificado	(0,39)

Parafusos conectando uma placa da mesa com a mesa direito da coluna

Capacidades dos parafusos

$F_{v,Rd} = 94,08$ [kN] Resistência ao cisalhamento da haste de um parafuso simples $F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$

Apoio do parafuso na mesa da coluna

Direção x

$k_{1x} = 2,50$ Coeficiente para o cálculo de $F_{b,Rd}$ $k_{1x} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$

$k_{1x} > 0.0$ $2,50 > 0,00$ verificado

$\alpha_{bx} = 0,61$ Coeficiente para o cálculo de $F_{b,Rd}$ $\alpha_{bx} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$

$\alpha_{bx} > 0.0$ $0,61 > 0,00$ verificado

$F_{b,Rd1x} = 156,36$ [kN] Resistência portante de um único parafuso $F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$

Direção y

$$k_{1y} = 2,12 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1y} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1y} > 0.0 \quad 2,12 > 0,00 \quad \text{verificado}$$

$$\alpha_{by} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{by} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{by} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1y} = 132,48 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1y} = k_{1y} \cdot \alpha_{by} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$$

Apoio do parafuso na placa**Direção x**

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 156,36 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$$

Direção y

$$k_{1y} = 2,12 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1y} = \min[2.8 \cdot (e_1/d_0) - 1.7, 1.4 \cdot (p_1/d_0) - 1.7, 2.5]$$

$$k_{1y} > 0.0 \quad 2,12 > 0,00 \quad \text{verificado}$$

$$\alpha_{by} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{by} = \min[e_2/(3 \cdot d_0), f_{ub}/f_u, 1]$$

$$\alpha_{by} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2y} = 132,48 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2y} = k_{1y} \cdot \alpha_{by} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$$

Estado limite definitivo**Cisalhamento do parafuso**

$$e_0 = 100 \quad [\text{mm}] \quad \text{Excentricidade da força de cisalhamento relativa ao centro de gravidade do grupo de parafusos} \quad e_0 = e_{1b} + 0.5 \cdot (r_1 - p_1)$$

$$M_z = 8,50 \quad [\text{kN} \cdot \text{m}] \quad \text{Momento fletor real} \quad M_z = M_{z,Ed,pr} + V_{y,Ed,p} \cdot e_0$$

$$F_{x,N} = 68,9 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência da força longitudinal na direção x} \quad F_{x,N} = |N_{Ed,pr}| / n_b$$

$$F_{y,Vy} = 0,83 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência da força de cisalhamento } V_y \text{ na direção y} \quad F_{y,Vy} = |V_{y,Ed,pr}| / n_b$$

Cisalhamento do parafuso

$$e_0 = 100 \text{ [mm]} \text{ Excentricidade da força de cisalhamento relativa ao centro de gravidade do grupo de parafusos} \quad e_0 = e_{1b} + 0.5 \cdot (r - 1) \cdot p_1$$

$$F_{x,Mz} = 14,1 \text{ [kN]} \text{ Resistência do componente em um parafuso devido a influência do momento } F_{x,Mz} = |M_z| \cdot y_i / \sum (x_i^2 + y_i^2)$$

$$F_{y,Mz} = 14,1 \text{ [kN]} \text{ Resistência do componente em um parafuso devido a influência do momento } F_{y,Mz} = |M_z| \cdot x_i / \sum (x_i^2 + y_i^2)$$

$$F_{x,Ed} = 83,1 \text{ [kN]} \text{ Força total do projeto em um parafuso na direção x} \quad F_{x,Ed} = F_{x,N} + F_{x,Mz}$$

$$F_{y,Ed} = 15,0 \text{ [kN]} \text{ Resistência total do projeto em um parafuso na direção y} \quad F_{y,Ed} = F_{y,Vy} + F_{y,Mz}$$

$$F_{Ed} = 84,4 \text{ [kN]} \text{ Força de cisalhamento resultante no parafuso} \quad F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{y,Ed}^2}$$

$$F_{x,Rd} = 156,36 \text{ [kN]} \text{ Capacidade de projeto efetiva de um parafuso na direção x} \quad F_{x,Rd} = \min(F_{x,bRd1}, F_{x,bRd2})$$

$$F_{y,Rd} = 132,48 \text{ [kN]} \text{ Capacidade efetiva do projeto de um parafuso na direção y} \quad F_{y,Rd} = \min(F_{y,bRd1}, F_{y,bRd2})$$

$ F_{x,Ed} \leq F_{x,Rd}$	$ 83,10 < 156,36$	verificado	(0,53)
$ F_{y,Ed} \leq F_{y,Rd}$	$ 15,00 < 132,48$	verificado	(0,11)
$F_{Ed} \leq F_{v,Rd}$	$84,44 < 94,08$	verificado	(0,90)

Parafusos conectando uma placa da mesa com a mesa esquerdo da coluna

Capacidades dos parafusos

$$F_{v,Rd} = 94,08 \text{ [kN]} \text{ Resistência ao cisalhamento da haste de um parafuso simples} \quad F_{v,Rd} = 0.6 \cdot f_{ub} \cdot A_s \cdot m / \gamma_{M2}$$

Apoio do parafuso na mesa da coluna

Direção x

$$k_{1x} = 2,50 \text{ Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8 \cdot (e_2/d_0) - 1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,61 \text{ Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_1/(3 \cdot d_0), p_1/(3 \cdot d_0) - 0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1x} = 156,36 \text{ [kN]} \text{ Resistência portante de um único parafuso} \quad F_{b,Rd1x} = k_{1x} \cdot \alpha_{bx} \cdot f_u \cdot d \cdot \sum t_i / \gamma_{M2}$$

Direção y

$$k_{1y} = 2,12 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1y} = \min[2.8*(e_1/d_0)-1.7, 1.4*(p_1/d_0)-1.7, 2.5]$$

$$k_{1y} > 0.0 \quad 2,12 > 0,00 \quad \text{verificado}$$

$$\alpha_{by} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{by} = \min[e_2/(3*d_0), f_{ub}/f_u, 1]$$

$$\alpha_{by} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd1y} = 132,48 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd1y} = k_{1y} * \alpha_{by} * f_u * d * \sum t_i / \gamma_{M2}$$

Apoio do parafuso na placa

Direção x

$$k_{1x} = 2,50 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1x} = \min[2.8*(e_2/d_0)-1.7, 2.5]$$

$$k_{1x} > 0.0 \quad 2,50 > 0,00 \quad \text{verificado}$$

$$\alpha_{bx} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{bx} = \min[e_1/(3*d_0), p_1/(3*d_0)-0.25, f_{ub}/f_u, 1]$$

$$\alpha_{bx} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2x} = 156,36 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2x} = k_{1x} * \alpha_{bx} * f_u * d * \sum t_i / \gamma_{M2}$$

Direção y

$$k_{1y} = 2,12 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad k_{1y} = \min[2.8*(e_1/d_0)-1.7, 1.4*(p_1/d_0)-1.7, 2.5]$$

$$k_{1y} > 0.0 \quad 2,12 > 0,00 \quad \text{verificado}$$

$$\alpha_{by} = 0,61 \quad \text{Coeficiente para o cálculo de } F_{b,Rd} \quad \alpha_{by} = \min[e_2/(3*d_0), f_{ub}/f_u, 1]$$

$$\alpha_{by} > 0.0 \quad 0,61 > 0,00 \quad \text{verificado}$$

$$F_{b,Rd2y} = 132,48 \quad [\text{kN}] \quad \text{Resistência portante de um único parafuso} \quad F_{b,Rd2y} = k_{1y} * \alpha_{by} * f_u * d * \sum t_i / \gamma_{M2}$$

Estado limite definitivo

Cisalhamento do parafuso

$$e_0 = 100 \quad [\text{mm}] \quad \text{Excentricidade da força de cisalhamento relativa ao centro de gravidade do grupo de parafusos} \quad e_0 = e_{1b} + 0.5*(r_1 - p_1)$$

$$M_z = 8,50 \quad [\text{kN} \cdot \text{m}] \quad \text{Momento fletor real} \quad M_z = M_{z,Ed,pf} + V_{y,Ed,pf} * e_0$$

$$F_{x,N} = 47,2 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência da força longitudinal na direção x} \quad F_{x,N} = |N_{Ed,pf}| / n_b$$

$$F_{y,Vy} = 0,83 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência da força de cisalhamento } V_y \text{ na direção y} \quad F_{y,Vy} = |V_{y,Ed,pf}| / n_b$$

$$F_{x,Mz} = 14,1 \quad [\text{kN}] \quad \text{Resistência do componente em um parafuso devido a influência do momento } M_z \text{ na direção x} \quad F_{x,Mz} = |M_z| * y_i / \sum (x_i^2 + y_i^2)$$

$e_0 = 100$	[mm Excentricidade da força de cisalhamento relativa ao centro de gravidade do grupo de parafusos]	$e_0 = e_{1b} + 0.5 \cdot (r - 1) \cdot p_1$
$F_{y,Mz} = 14,1$	[kN] Resistência do componente em um parafuso devido a influência do momento Mz na direção y	$F_{y,Mz} = \frac{ M_z \cdot x_i}{\sum (x_i^2 + y_i^2)}$
$F_{x,Ed} = 33,0$	[kN] Força total do projeto em um parafuso na direção x	$F_{x,Ed} = F_{x,N} + F_{x,Mz}$
$F_{y,Ed} = 15,0$	[kN] Resistência total do projeto em um parafuso na direção y	$F_{y,Ed} = F_{y,Mz} + F_{y,N}$
$F_{Ed} = 36,2$	[kN] Força de cisalhamento resultante no parafuso	$F_{Ed} = \sqrt{F_{x,Ed}^2 + F_{y,Ed}^2}$
$F_{x,Rd} = 156,36$	[kN] Capacidade de projeto efetiva de um parafuso na direção x	$F_{x,Rd} = \min(F_{x,bRd1}, F_{x,bRd2})$
$F_{y,Rd} = 132,48$	[kN] Capacidade efetiva do projeto de um parafuso na direção y	$F_{y,Rd} = \min(F_{y,bRd1}, F_{y,bRd2})$

$ F_{x,Ed} \leq F_{x,Rd}$	$ -33,05 < 156,36$	verificado	(0,21)
$ F_{y,Ed} \leq F_{y,Rd}$	$ 15,00 < 132,48$	verificado	(0,11)
$F_{Ed} \leq F_{v,Rd}$	$36,29 < 94,08$	verificado	(0,39)

Verificação da seção devida ao rompimento do bloco - [3.10]

Coluna

Nr	Modelo	A_{nv} [cm ²]	A_{nt} [cm ²]	V_0 [kN]	$V_{eff,Rd}$ [kN]	$ V_0 /V_{eff,Rd}$	Status
1		9,27	10,35	75,00 (*1)	325,20 (*)	0,23	verificado
2		10,35	44,40	41,70 (*2)	1691,54 (**)	0,02	verificado
3		10,35	44,40	41,70 (*2)	1691,54 (**)	0,02	verificado
4		20,70	3,78	41,70 (*2)	458,69 (**)	0,09	verificado
5		15,75	4,35	413,59 (*3)	799,41 (***)	0,52	verificado

$$(*1) V_0 = V_{zEd1}$$

$$(*2) V_0 = N_{wEd}$$

$$(*3) V_0 = N_{fuEd}$$

$$(*) V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$(**) V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$(***) V_{effRd} = 2 \cdot [f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}]$$

Placa de emenda

Nr	Modelo	A _{nv} [cm ²]	A _{nt} [cm ²]	V ₀ [kN]	V _{eff,Rd} [kN]	V ₀ /V _{eff,Rd}	Status
1		5,04	9,20	37,50 (*1)	238,26 (*)	0,16	verificado
2		9,20	5,04	20,85 (*2)	319,45 (**)	0,07	verificado
3		9,20	5,04	20,85 (*2)	319,45 (**)	0,07	verificado
4		18,40	3,36	20,85 (*2)	407,72 (**)	0,05	verificado

$$(*1) V_0 = 0.5 \cdot V_{zEd1}$$

$$(*2) V_0 = 0.5 \cdot N_{wEd}$$

$$(*) V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$(**) V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

Placa externa direita

Nr	Modelo	A _{nv} [cm ²]	A _{nt} [cm ²]	V ₀ [kN]	V _{eff,Rd} [kN]	V ₀ /V _{eff,Rd}	Status
1		13,05	15,75	5,00 (*1)	478,10 (*)	0,01	verificado
2		15,75	19,05	389,28 (*2)	905,38 (**)	0,43	verificado
3		31,50	14,70	389,28 (*2)	1005,81 (**)	0,39	verificado

$$(*1) V_0 = 0.5 \cdot V_{yEd1}$$

$$(*2) V_0 = N_{fueEd}$$

$$(*) V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

$$(**) V_{effRd} = f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

Placa externa esquerda

Nr	Modelo	A _{nv} [cm ²]	A _{nt} [cm ²]	V ₀ [kN]	V _{eff,Rd} [kN]	V ₀ /V _{eff,Rd}	Status
1		13,05	15,75	5,00 (*)	478,10 (*)	0,01	verificado

$$(*) V_0 = 0.5 \cdot V_{yEd1}$$

$$(*) V_{effRd} = 0.5 \cdot f_u \cdot A_{nt} / \gamma_{M2} + (1/\sqrt{3}) \cdot f_y \cdot A_{nv} / \gamma_{M0}$$

Verificação de seções enfraquecidas por aberturas - [5.4]

Coluna

$$A_t = 40,61 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 32,39 \text{ [cm}^2\text{]} \quad \text{Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,72 < 0,80 \quad \#$$

$$W = 569,62 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$W_{net} = 569,62 \text{ [cm}^3\text{]} \quad \text{Módulo elástico da seção}$$

$$M_{c,Rdnet} = 156,64 \text{ [kN}\cdot\text{m]} \quad \text{Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |72,00| < 156,64 \quad \text{verificado} \quad (0,46)$$

$$A = 78,08 \text{ [cm}^2\text{]} \quad \text{Área da zona de tensão da seção bruta} \quad A = h_{pi} \cdot t_{pi}$$

$$A_{net} = 61,64 \text{ [cm}^2\text{]} \quad \text{Área da seção transversal líquida} \quad A_{net} = A - n_v \cdot d_0 \cdot t_{pi}$$

$$N_{pl,Rd} = 2147,23 \text{ [kN]} \quad \text{Resistência plástica do projeto da seção bruta} \quad N_{pl,Rd} = A \cdot f_y / \gamma_{M0}$$

$$N_{u,Rd} = 1908,41 \text{ [kN]} \quad \text{Projeto de resistência máxima à força normal da seção líquida} \quad N_{u,Rd} = 0.9 \cdot A_{net} \cdot f_u / \gamma_{M2}$$

$$F_{Ed} = 172,00 \text{ [kN]} \quad A = h_{pi} \cdot t_{pi}$$

$$|F_{Ed}| \leq N_{u,Rd} \quad |172,00| < 1908,41 \quad \text{verificado} \quad (0,09)$$

$$|F_{Ed}| \leq N_{pl,Rd} \quad |172,00| < 2147,23 \quad \text{verificado} \quad (0,08)$$

$$A_v = 18,00 \text{ [cm}^2\text{]} \quad \text{Área da seção efetiva quanto a cisalhamento} \quad A_v = h_p \cdot t_p$$

$$A_{v,net} = 14,76 \text{ [cm}^2\text{]} \quad \text{Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0 \cdot t_p$$

$$V_{pl,Rd} = 285,79 \text{ [kN]} \quad \text{Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_{yp}) / (\sqrt{3} \cdot \gamma_{M0})$$

$$|V_0| \leq V_{pl,Rd} \quad |75,00| < 285,79 \quad \text{verificado} \quad (0,26)$$

Placa de emenda

$A_t = 5,21 \text{ [cm}^2\text{]}$ Área da zona de tensão da seção bruta

$A_{t,net} = 3,77 \text{ [cm}^2\text{]}$ Área líquida da seção em tração

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,65 < 0,80 \quad \#$$

$W = 19,20 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$W_{net} = 18,20 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$M_{c,Rdnet} = 5,00 \text{ [kN}\cdot\text{m]}$ Resistência do projeto da seção em flexão $M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$

$$|M_0| \leq M_{c,Rdnet} \quad |4,91| < 5,00 \quad \text{verificado} \quad (0,98)$$

$A = 9,60 \text{ [cm}^2\text{]}$ Área da zona de tensão da seção bruta $A = h_{pi} \cdot t_{pi}$

$A_{net} = 6,72 \text{ [cm}^2\text{]}$ Área da seção transversal líquida $A_{net} = A - n_v \cdot d_0 \cdot t_{pi}$

$N_{pl,Rd} = 264,00 \text{ [kN]}$ Resistência plástica do projeto da seção bruta $N_{pl,Rd} = A \cdot f_y / \gamma_{M0}$

$N_{u,Rd} = 208,05 \text{ [kN]}$ Projeto de resistência máxima à força normal da seção líquida $N_{u,Rd} = 0.9 \cdot A_{net} \cdot f_u / \gamma_{M2}$

$F_{Ed} = 20,85 \text{ [kN]}$ $F_{Ed} = N_{Ed,pw}$

$$|F_{Ed}| \leq N_{u,Rd} \quad |20,85| < 208,05 \quad \text{verificado} \quad (0,10)$$

$$|F_{Ed}| \leq N_{pl,Rd} \quad |20,85| < 264,00 \quad \text{verificado} \quad (0,08)$$

$A_v = 9,60 \text{ [cm}^2\text{]}$ Área da seção efetiva quanto a cisalhamento $A_v = h_p \cdot t_p$

$A_{v,net} = 6,72 \text{ [cm}^2\text{]}$ Área líquida de uma seção efetiva quanto a cisalhamento $A_{v,net} = A_v - n_v \cdot d_0 \cdot t_p$

$V_{pl,Rd} = 152,42 \text{ [kN]}$ Resistência plástica do projeto para cisalhamento $V_{pl,Rd} = (A_v \cdot f_{yp}) / (\sqrt{3} \cdot \gamma_{M0})$

$$|V_0| \leq V_{pl,Rd} \quad |37,50| < 152,42 \quad \text{verificado} \quad (0,25)$$

Placa externa direita

$A_t = 30,00 \text{ [cm}^2\text{]}$ Área da zona de tensão da seção bruta

$A_{t,net} = 23,40 \text{ [cm}^2\text{]}$ Área líquida da seção em tração

$$0.9 \cdot (A_{t,net}/A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,70 < 0,80 \quad \#$$

$W = 100,00 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$W_{net} = 75,97 \text{ [cm}^3\text{]}$ Módulo elástico da seção

$M_{c,Rdnet} = 20,89 \text{ [kN}\cdot\text{m]}$ Resistência do projeto da seção em flexão $M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$

$$|M_0| \leq M_{c,Rdnet} \quad |8,00| < 20,89 \quad \text{verificado} \quad (0,38)$$

$A = 30,00 \text{ [cm}^2\text{]}$ Área da zona de tensão da seção bruta $A = h_{pi} \cdot t_{pi}$

$A_{net} = 23,40 \text{ [cm}^2\text{]}$ Área da seção transversal líquida $A_{net} = A - n_v \cdot d_0 \cdot t_{pi}$

$N_{pl,Rd} = 825,00 \text{ [kN]}$ Resistência plástica do projeto da seção bruta $N_{pl,Rd} = A \cdot f_y / \gamma_{M0}$

$$A = 30,00 \text{ [cm}^2\text{]} \text{ Área da zona de tensão da seção bruta} \quad A = h_{pi} \cdot t_{pi}$$

$$N_{u,Rd} = 724,46 \text{ [kN]} \text{ Projeto de resistência máxima à força normal da seção líquida} \quad N_{u,Rd} = 0.9 \cdot A_{net} \cdot f_u / \gamma_{M2}$$

$$F_{Ed} = 389,28 \text{ [kN]} \quad F_{Ed} = N_{Ed,pfue}$$

$$|F_{Ed}| \leq N_{u,Rd} \quad |389,28| < 724,46 \quad \text{verificado} \quad (0,54)$$

$$|F_{Ed}| \leq N_{pl,Rd} \quad |389,28| < 825,00 \quad \text{verificado} \quad (0,47)$$

$$A_v = 30,00 \text{ [cm}^2\text{]} \text{ Área da seção efetiva quanto a cisalhamento} \quad A_v = h_p \cdot t_p$$

$$A_{v,net} = 23,40 \text{ [cm}^2\text{]} \text{ Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0 \cdot t_p$$

$$V_{pl,Rd} = 476,31 \text{ [kN]} \text{ Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_{yp}) / (\sqrt{3} \cdot \gamma_{M0})$$

$$|V_0| \leq V_{pl,Rd} \quad |5,00| < 476,31 \quad \text{verificado} \quad (0,01)$$

Placa externa esquerda

$$A_t = 30,00 \text{ [cm}^2\text{]} \text{ Área da zona de tensão da seção bruta}$$

$$A_{t,net} = 23,40 \text{ [cm}^2\text{]} \text{ Área líquida da seção em tração}$$

$$0.9 \cdot (A_{t,net} / A_t) \geq (f_y \cdot \gamma_{M2}) / (f_u \cdot \gamma_{M0}) \quad 0,70 < 0,80 \quad \#$$

$$W = 100,00 \text{ [cm}^3\text{]} \text{ Módulo elástico da seção}$$

$$W_{net} = 75,97 \text{ [cm}^3\text{]} \text{ Módulo elástico da seção}$$

$$M_{c,Rdnet} = 20,89 \text{ [kN} \cdot \text{m]} \text{ Resistência do projeto da seção em flexão} \quad M_{c,Rdnet} = W_{net} \cdot f_{yp} / \gamma_{M0}$$

$$|M_0| \leq M_{c,Rdnet} \quad |8,00| < 20,89 \quad \text{verificado} \quad (0,38)$$

$$A = 30,00 \text{ [cm}^2\text{]} \text{ Área da zona de tensão da seção bruta} \quad A = h_{pi} \cdot t_{pi}$$

$$A_{net} = 23,40 \text{ [cm}^2\text{]} \text{ Área da seção transversal líquida} \quad A_{net} = A - n_v \cdot d_0 \cdot t_{pi}$$

$$N_{pl,Rd} = 825,00 \text{ [kN]} \text{ Resistência plástica do projeto da seção bruta} \quad N_{pl,Rd} = A \cdot f_y / \gamma_{M0}$$

$$N_{u,Rd} = 724,46 \text{ [kN]} \text{ Projeto de resistência máxima à força normal da seção líquida} \quad N_{u,Rd} = 0.9 \cdot A_{net} \cdot f_u / \gamma_{M2}$$

$$F_{Ed} = -258,98 \text{ [kN]} \quad F_{Ed} = N_{Ed,pfli}$$

$$|F_{Ed}| \leq N_{u,Rd} \quad |-258,98| < 724,46 \quad \text{verificado} \quad (0,36)$$

$$|F_{Ed}| \leq N_{pl,Rd} \quad |-258,98| < 825,00 \quad \text{verificado} \quad (0,31)$$

$$A_v = 30,00 \text{ [cm}^2\text{]} \text{ Área da seção efetiva quanto a cisalhamento} \quad A_v = h_p \cdot t_p$$

$$A_{v,net} = 23,40 \text{ [cm}^2\text{]} \text{ Área líquida de uma seção efetiva quanto a cisalhamento} \quad A_{v,net} = A_v - n_v \cdot d_0 \cdot t_p$$

$$V_{pl,Rd} = 476,31 \text{ [kN]} \text{ Resistência plástica do projeto para cisalhamento} \quad V_{pl,Rd} = (A_v \cdot f_{yp}) / (\sqrt{3} \cdot \gamma_{M0})$$

$$|V_0| \leq V_{pl,Rd} \quad |5,00| < 476,31 \quad \text{verificado} \quad (0,01)$$

A conexão está em conformidade com a norma.	Relação	0,98

#

9.9.6 LAJE COLABORANTE

As lajes colaborantes foram dimensionadas com recurso ao software “Cofra 5.2 Dim” da ArcelorMittal.



NOTE DE CALCUL DETAILLEE

Topo norte

Laje mista [1]

COFRA 5.2 DIM

Samuel Pereira

DTA

Profil choisi :

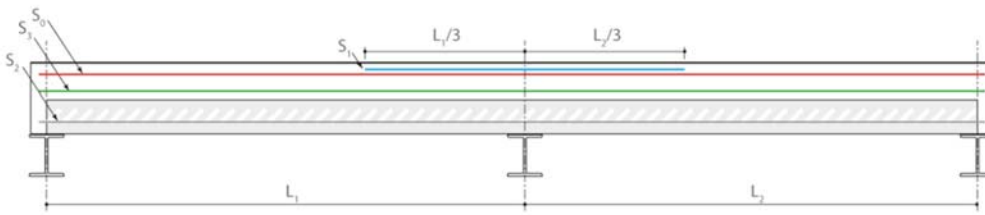
Cofraplus 60
0.75 mm
Non pré-percé



Caracteristiques profile

Epaisseur profil	0.75	mm
Poids profil	8.53	daN/m²
Limite d'élasticité	350	MPa
Hauteur profil	58	mm
Largeur utile	1035	mm
Epaisseur de la dalle	130	mm

Données du projet



Travée	L1	L2
Portée (m)	2.5	2.5
N° du profil	1	2
Nombre d'étais	1.0	1.0

Travée	L1	L2
Permanente (kN/m²)	1.3	1.3
Exploitation (kN/m²)	3.0	3.0

Ponctuelle : Q(kN); a x b(mm)

Essieu: Q(kN); L(m); a x b(mm) x coef dyn

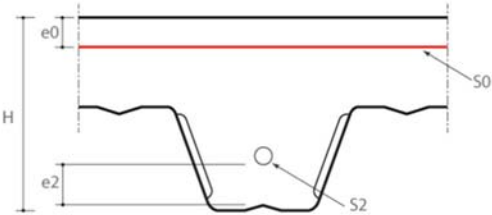
Coefficients de sécurité

Coeff. partiel profil γ_M	1
Coeff. béton γ_c	1.5
Pondération perm. γ_o	1.35
Pondération Surch. γ_o	1.5
Coeff. ψ_1	0.5

Paramètres de calcul

Distrib. moment sur appui	0.3
Résistance au feu : REI	60 min
Limite d'élasticité armature :	500 MPa
Flèche au coulage :	L / 180
Flèche en service:	L / 350
Largeur appui interm.	150 mm
Largeur d'étais :	80 mm

Matériaux rapportés



Quantités - Ratios

QUANTITATIF ramené au m² de plancher donné à titre indicatif :

BETONNAGE : La mise en place du béton par pompe est recommandée.

Attention !: Vérifier impérativement si les hypothèses de calcul sont conformes au Cahier des Charges et au plan du projet

Cette information doit être transmise à tous les intervenants participant à la réalisation au plancher collaborant.

Béton

Epaisseur de dalle	130	mm
Nuance béton	C25/30	
Chape	0	mm

Armatures complémentaires (c-dev : 10mm)

S0	Treillis général	ST25C	
	Calage: 33.0mm	e0	25 mm
S2	Renforts: feu+flexion	Ø 8 toutes les 2 ondes	
	o= toutes les deux	e2	25 mm

Poids total de la dalle	246.0	kg/m²
Litrage béton	95.0	l/m²
Treillis général	4.03	kg/m²
Chapeau *	0.0	kg/m²
TS répartition	0.0	kg/m²
Renfort feu + flexion	0.95	kg/m²

Laje mista [1]

Thursday 15 October 2020

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NOTE DE CALCUL DETAILLEE

Note: Dimensionnement du plancher collaborant selon DTA et CPT 3730_V2

Phase de construction

Γ_{δ}	=	0.048	<= 1.00	Flèche
$\Gamma_{M,+}$	=	0.197	<= 1.00	Moment de flexion positive
$\Gamma_{R,Ex}$	=	0.137	<= 1.00	Réaction sur appui d'extrémité
$\Gamma_{M,-}$	=	0.266	<= 1.00	Moment de flexion négative
$\Gamma_{R,C}$	=	0.378	<= 1.00	Réaction sur appui intermédiaire
Γ_{RM}	=	0.406	<= 1.00	Interaction moment-réaction sur appui intermédiaire

Dalle mixte

Γ_{M+}	=	0.160	<= 1.00	Moment de flexion positive
Γ_{M-}	=	0.794	<= 1.00	Moment de flexion négative
$\Gamma_{M-(L/3)}$	=	0.032	<= 1.00	Moment de flexion négative à L/3 de l'appui intermédiaire
Γ_{LR1}	=	0.260	<= 1.00	Cisaillement longitudinal (Tôle - béton)
Γ_{VR}	=	0.183	<= 1.00	Cisaillement vertical
Γ_{HR}	=	0.479	<= 1.00	Cisaillement horizontal des nervures
Γ_{FL}	=	0.052	<= 1.00	Contrôle de la flèche
Γ_{Vi}	=	0.152	<= 1.00	Contrôle de la vibration
Γ_{VP}	=	non concerné		Poinçonnement
Γ_{Fs}	=	non concerné		Contrôle de la fissuration

Résistance au feu

Γ_{IST}	=	0.885	<= 1.00	Critère d'isolation thermique
Γ_{RF}	=	0.677	<= 1.00	Critère de résistance
$\Gamma_{RF(L/3)}$	=	0.148	<= 1.00	Critère de résistance à L/3 de l'appui intermédiaire
$\Gamma_{RF\_recommandé}$	=	non concerné		Moment en travée - critère recommandé

Note: Vérifier impérativement si les hypothèses de calcul sont conformes au Cahier des Charges et au plan du projet.

1. Données du projet

a. Données du Cofraplus 60 / 0.75 mm / Non pré-percé

Caractéristiques	Valeur	Unité
Epaisseur du profil	0.75	mm
Poids du profil	8.53	daN/m ²
Hauteur du profil	58	mm
Largeur utile du profil	1035	mm
Aire de la section du profil	902	mm ² /m
Moment d'inertie du profil	44.57	cm ⁴ /m
Position de l'axe neutre	33.7	mm
Moment résistant positif	4.212	kNm/m
Réaction sur appui d'extrémité	22.184	kN/m
Largeurs de l'appui intermédiaire	60 / 160	mm
Moment résistant maximum sur appui intermédiaire	3.918 / 4.795	kNm/m
Réaction maximum sur appui intermédiaire	20.723 / 32.355	kN/m
Résistance en cisaillement longitudinal de la dalle $\tau_{u,Rk}$	0.1	N/mm ²

b. Dalle mixte

Portées:

Travée	L1	L2
Portée (m)	2.5	2.5

Schéma statique: hyperstatique

Epaisseur minimale demandée 130 (mm)

Epaisseur de la chape: 0 (mm)

c. Phase de construction

Nombre de travées par tôle:

Tôle d'acier	L1	L2
Nombre de travées	1	2

Nombre d'étais par travée:

Travée	L1	L2
Nombre d'étais	1.0	1.0

Pour N étais positionner chaque étai à $1/(N+1)$ mètres de l'appui

Largeur d'étais: 80 (mm)

Largeur d'appui interne définitif: 150 (mm)

d. Armatures maximales demandées par l'utilisateur

(Voir chapitre 2 pour les résultats définitifs)

Limite d'élasticité:	500	MPa
Classe de ductilité:	B	
Classe d'exposition:	XC1	
Classe structurelle:	S2	
Enrobage minimum:	25	(mm)
Calage:	15	(mm)
Treillis de chapeau retourne :	0	(mm)
Enrobage des barres de renfort min. :	25	
Enrobage du treillis de répartition :	0	(mm)
Tolérance d'enrobage ΔC_{dev} :	5	

Note: le treillis général doit être continu sur toute la surface

e. Béton: normal / C25/30

Poids volumique du béton frais	25	kN/m ³
Poids volumique du béton sec	24	kN/m ³
f_{ck}	25	MPa
f_{ctm}	2.6	MPa
E_{cm}	31000	MPa

f. Contrainte de calcul

Méthode de calcul au cisaillement longitudinal		partielle
Limite de flèche en construction	L /	180
Limite de flèche en service	L /	350
Facteur de redistribution du moment maximum souhaité		0.3
Facteur lié à la charge d'exploitation pour le calcul de la fréquence		0.5
Fréquence minimum		2.6
Exigence au feu	REI	60
Facteur de charge pour le calcul au feu	$\Psi_{f,i}$	0.5

g. Maîtrise de la fissuration

Méthode CPT

Maîtrise fissuration selon CPT :	Non
Flèche des solives :	Non renseigné
Moment en travée de la solive :	N/A

Méthode EC2

Maîtrise de la fissuration :	Non

h. Charges agissant sur la dalle

- Charges uniformément réparties

Travée →	L1	L2
Charge permanente *	1.3	1.3
Charge d'exploitation *	3.0	3.0

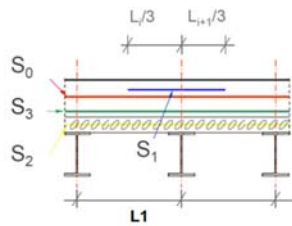
* unités : kN/m²

i. Coefficients de sécurité

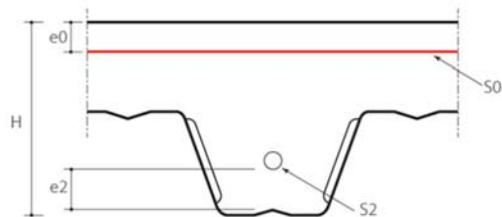
Matériaux			Actions		
Tôle d'acier	γ_M	1	Charges	γ_0	1.35
Armature	γ_{sb}	1.15	Charge	γ_q	1.5
Béton	γ_c	1.5			
Cisaillement	γ_{vs}	1.25			

2. Section longitudinale et coupe transversale

Section longitudinale



Coupe transversale



Profil: Cofraplus 60 / 0.75 mm / Non pré-percé

Epaisseur profil	0.75	mm	S0	Treillis général	ST25C		
Poids profil	8.53	daN/m²			e0	25	mm
Limite d'élasticité	350	MPa					
Hauteur profil	58	mm					
Largeur utile	1035	mm					
Epaisseur de la dalle	130	mm	S2	Renforts: feu+flexion toutes les 2 ondes	Ø 8 toutes les 2 ondes		
					e2	25	mm

3. Détails

MISE EN OEUVRE DE LA TÔLE : Appuis, étais, fixations, ouvertures etc... doivent être conformes aux règles de l'Art, aux conseils contenus dans des CPT et dans différents documents de ArcelorMittal Construction.

BETONNAGE : La mise en place du béton par pompe est recommandée. Si non le béton doit être versé sur les éléments porteurs sans accumulation excessive, et immédiatement arasé à l'épaisseur prévue

Poids total de la dalle	246.0	daN/m ²
Litrage béton	95.0	l/m ²
Treillis général	4.03	daN/m ²
Chapeau *	0.0	daN/m ²
TS répartition	0.0	daN/m ²
Renfort feu + flexion	0.95	daN/m ²

* treillis de chapeaux seulement sur partie du plancher - voir schéma sur 2.

Note: Les quantitatifs ci dessus sont donnés à titre indicatif, des valeurs plus précises pourront être calculées en tenant compte des considérations réelles de mise en oeuvre du chantier

4. Phase de construction

a. Actions

Poids de la tôle	8.53 daN/m ²
Poids de la dalle en béton	2.46 kN/m ²
Charge de construction (zone de travail 3mx3m)	1.5 kN/m ²
Charge de construction (hors zone de travail)	0.5 kN/m ²

b. Vérification de la flèche

- Flèche maximum sous poids propre de la tôle et du béton frais:

Tôle d'acier	1	2	3	4	5	6	7	8
f_0 (mm) (sans EdM)	0.3342	0.3342						
Poids additionnel (kN/m ²)	0.006	0.006						
Poids de la dalle (kN/m ²)	2.466	2.466						
f_{alw} (mm) (admissible)	6.9444	6.9444						
f_{max} (mm) (avec EdM si oui)	0.3350	0.3350						
f_{max} / f_{alw}	0.0482	0.0482						

$$\text{Ratio : } \frac{f}{f_{max}} = 0.048 \leq 1.00 \text{ Satisfaisant}$$

c. Vérification du moment positif

Tôle d'acier	1	2	3	4	5	6	7	8
Moment agissant max: M_{Edp} *	0.8307	0.8307						
Moment résistant: M_{Rdp} *	4.2120	4.2120						
M_{Edp} / M_{Rdp}	0.1972	0.1972						

* unités : kNm/ml

$$\text{Ratio : } \frac{M_{Edp}}{M_{Rdp}} = 0.197 \leq 1.00 \text{ Satisfaisant}$$

d. Réaction d'appui d'extrémité

Tôle d'acier	1	2	3	4	5	6	7	8
Réaction agissant max: $R_{Ed, En}$ *	3.0468	3.0468						
Réaction d'extrémité profil: $R_{Rd, En}$ *	22.184	22.184						
$R_{Ed, En} / R_{Rd, En}$	0.1373	0.1373						

* unités : kN/ml

$$\text{Ratio : } \frac{R_{Ed, En}}{R_{Rd, En}} = 0.137 \leq 1.00 \text{ Satisfaisant}$$

e. Vérification du moment négatif

Tôle d'acier	1	2	3	4	5	6	7	8
Moment agissant max: M_{Edn}^*	1.0900	1.0900						
Moment résistant: M_{Rdn}^*	4.0934	4.0934						
M_{Edn} / M_{Rdn}	0.2663	0.2663						

* unités : kNm/ml

$$\text{Ratio : } \frac{M_{Edn}}{M_{Rdn}} = 0.266 \leq 1.00 \text{ Satisfaisant}$$

f. Réaction de l'appui intermédiaire

Tôle d'acier	1	2	3	4	5	6	7	8
Réaction agissant max: $R_{Ed, In}^*$	8.7202	8.7202						
Résistance réaction appui: $R_{Rd, In}^*$	23.049	23.049						
$R_{Ed, In} / R_{Rd, In}$	0.3783	0.3783						

* unités : kN/ml

$$\text{Ratio : } \frac{R_{Ed, In}}{R_{Rd, In}} = 0.378 = 1.00 \text{ Satisfaisant}$$

g. Interaction moment - réaction d'appui

Tôle d'acier	1	2	3	4	5	6	7	8
Réaction agissant max: $R_{Ed, In}$	8.7202	8.7202						
Résistance réaction d'appui: R_0	23.049	23.049						
Moment agissant max: M_{Edn}	1.0900	1.0900						
Moment résistant: M_0	5.4793	5.4793						
$M_{Edn} / M_0 + R_{Ed, In} / R_0$	0.4061	0.4061						

$$\text{Ratio : } \frac{M_{Edn}}{M_0} + \frac{R_{Ed, In}}{R_0} = 0.406 \leq 1.00 \text{ Satisfaisant}$$

5. Dimensionnement en phase mixte

a. Actions

- Charges uniformément réparties

	Non pondérée (kN/m²)							
Travée →	1	2	3	4	5	6	7	8
Poids de la dalle mixte	2.466	2.466						
Charges permanentes	1.3	1.3						
Charge d'exploitation	3.0	3.0						

b. Moment de flexion positive

- Charges surfaciques et linéaires

Travée →	1	2	3	4	5	6	7	8
Moment agissant (kNm/m) M_{Edp}	4.897	4.897						
Moment résistant (kNm/m) M_{Rdp}	30.680	30.680						
M_{Edp} / M_{Rdp}	0.160	0.160						

$$\text{Ratio : } \frac{M_{Edp}}{M_{Rdp}} = 0.16 \leq 1.00 \text{ Satisfaisant}$$

c. Moment de flexion négative

- Charges surfaciques et linéaires

Appui →	1	2	3	4	5	6	7
Moment agissant (kNm/m) M_{Edn}	7.488						
Moment résistant (kNm/m) M_{Rdn}	9.428						
M_{Edn} / M_{Rdn}	0.794						

$$\text{Ratio : } \frac{M_{Edn}}{M_{Rdn}} = 0.794 \leq 1.00 \text{ Satisfaisant}$$

d. Moment de flexion négative à L/3 de l'appui intermédiaire

- Charges surfaciques et linéaires

Appui →	1	2	3	4	5	6	7	8
Moment agissant (kNm/m) M_{Edn}	0.298	0.298						
Moment résistant (kNm/m) M_{Rdn}	9.428							

$$\text{Ratio : } \frac{M_{Edn}}{M_{Rdn}} = 0.032 \leq 1.00 \text{ Satisfaisant}$$

e. Cisaillement longitudinal (taûle/béton)

Méthode de connexion partielle:

- Charges surfaciques et linéaires

Travée →	1	2	3	4	5	6	7	8
Moment agissant (kNm/m) M_{Ed}	4.808	4.808						
Moment résistant partiel (kNm/m) M_{Rd}	18.470	18.470						
Position (m)	0.875	1.625						
Ratio max M_{Ed} / M_{Rd}	0.260	0.260						

Ratio : $\frac{M_{Ed}}{M_{Rd}} = 0.260 \leq 1.00$ Satisfaisant

f. Cisaillement vertical

sections/project_da 0

- Charges surfaciques et linéaires

Effort tranchant max

Appui d'extrémité : $V_{Ed, En}$	9.688	kN/m
Appui intermédiaire : $V_{Ed, In}$	14.976	kN/m

Résistance de cisaillement vertical:

Appui d'extrémité : $V_{Rd, En}$	78.069	kN/m
Appui intermédiaire : $V_{Rd, In}$	81.895	kN/m

Ratio : $\frac{V_{Ed, En}}{V_{Rd, En} + V_{b, Rd}} = 0.124 \leq 1.00$ Satisfaisant

Ratio : $\frac{V_{Ed, In}}{V_{Rd, In} + V_{b, Rd}} = 0.183 \leq 1.00$ Satisfaisant

g. Cisaillement longitudinal (table-nervure)

- Charges surfaciques et linéaires

Effort tranchant max

Appui d'extrémité : $V_{Ed, En}$	9.357	kN/m
Appui intermédiaire : $V_{Ed, In}$	14.353	kN/m

Résistance de cisaillement longitudinal:

Appui d'extrémité : $V_{Rd, En}$	29.954	kN/m
Appui intermédiaire : $V_{Rd, In}$	29.954	kN/m

Ratio : $\frac{V_{Ed, En}}{V_{Rd, En}} = 0.312 \leq 1.00$ Satisfaisant

Ratio : $\frac{V_{Ed, In}}{V_{Rd, In}} = 0.479 \leq 1.00$ Satisfaisant

i. Vérification de la flèche

- Charges surfaciques et linéaires

Travée →	1	2	3	4	5	6	7	8
Flèche sous charges totales (mm) f	0.372	0.372						
Flèche admissible (mm) f_{max}	7.143	7.143						
Taux f/f_{max}	0.052	0.052						

Ratio : $\frac{f}{f_{max}} = 0.052 \leq 1.00$ Satisfaisant

k. Contrôle de la vibration

Coefficient de masse lié à la charge d'exploitation 0.50

Fréquence propre minimum: f_{min} 2.60 Hz

Estimation de la fréquence propre de la dalle 17.059 Hz

Ratio : $\frac{f_{min}}{f_0} = 0.152 \leq 1.00$ Satisfaisant

6. Résistance au feu

Durée de feu exigée: **60**

a. Actions

- Charges uniformément réparties:

Coefficient $\Psi_{1,1} = 0.5$

Travée →	1	2	3	4	5	6	7	8
Poids de la dalle mixte	2.466	2.466						
Charges permanentes	1.3	1.3						
Charge d'exploitation	3.0	3.0						

* unités : kN/m²

b. Critère d'isolation thermique

Epaisseur minimum nécessaire: 115.00 mm

Ratio : $\frac{h_{\min}}{h_t + h_{\text{screed}}} = 0.885 \leq 1.00$ Satisfaisant

c. Critère étanchéité

Pour les dalles mixtes, le critère étanchéité "E" est supposé satisfait (EN1994-1-2)

d. Critère de résistance

Travée →	1	2	3	4	5	6	7	8
Moment résistant négatif:	8.236							
Moment agissant en travée (kNm/m)	2.773	2.773						
Moment résistant en travée (kNm/m)	4.095	4.095						
Ratio max M_{Ed} / M_{Rd}	0.677	0.677						

Ratio : $\frac{M_{Ed,fi}}{M_{Rd,fi}} = 0.677 \leq 1.00$ Satisfaisant

Vérification complémentaire recommandée: 0.30 du moment agissant en travée

Travée →	1	2	3	4	5	6	7	8
0.30 moment agissant en travée	1.234	1.234						
Ratio max en travée	0.301	0.301						

Ratio : $\frac{0.30 M_{Ed, fi}}{M_{Rdp, fi}} = 0.301 \leq 1.00$ Satisfaisant