COMO CALCULAR MODULAÇÃO DE PISOS EM CHAPA XADREZ

Curso de Projeto e Cálculo de Estruturas Metálicas

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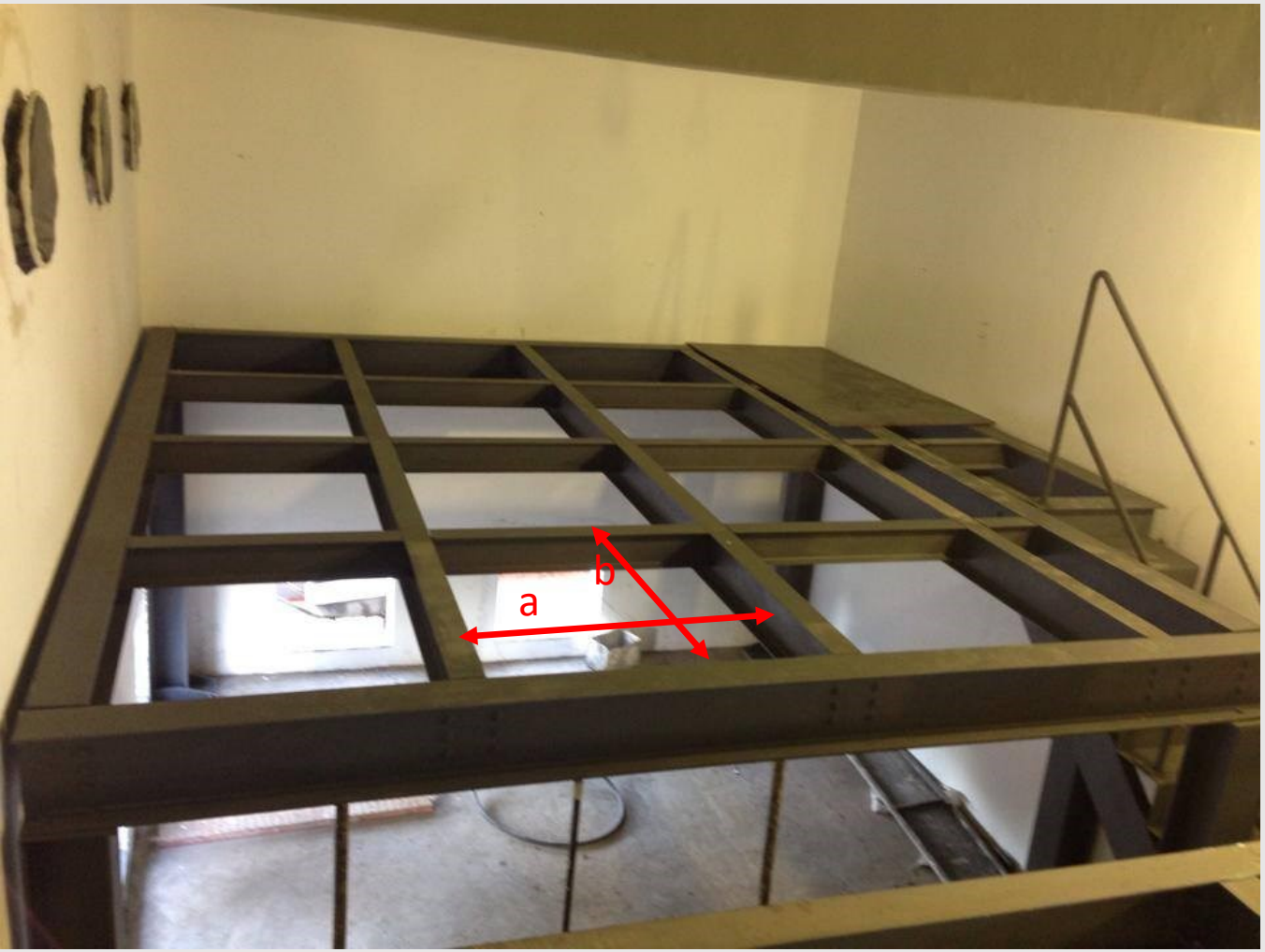


Como definir a modulação a e b?

Procedimento de Cálculo pelo Método dos Estados Limites

1- Verificação dos Estados Limites de Serviço (flecha limite)

2- Verificação dos Estados Limites últimos (resistência mecânica)

Qual a flecha limite para uma chapa de piso????

NBR8800/08 não estabelece esse limite específico

National Annex 1 do Eurocódigo menciona:

7.2 Serviceability limit states for buildings

7.2.1 Vertical deflections

(1)B With reference to EN 1990 – Annex A1.4 limits for vertical deflections according to Figure A1.1 should be specified for each project and agreed with the client.

NOTE B The National Annex may specify the limits.

7.2.2 Horizontal deflections

(1)B With reference to EN 1990 – Annex A1.4 limits for horizontal deflections according to Figure A1.2 should be specified for each project and agreed with the client.

NOTE B The National Annex may specify the limits.

7.2.3 Dynamic effects

(1)B With reference to EN 1990 – Annex A1.4.4 the vibrations of structures on which the public can walk should be limited to avoid significant discomfort to users, and limits should be specified for each project and agreed with the client.

Vertical deflections

	Vertical *total* deflection Calculated from dead + imposed loads
Member supporting partition walls	
• Brittle (not reinforced)	≤ L/500
• Reinforced	≤ L/300
• Removable	≤ L/300
Ceilings	
• Plastered	≤ L/300
• Suspended	≤ L/200
Roofing and Flooring	
• Rigid (e.g. ceramic tiles)	≤ L/500
• Flexible (e.g. flexible floor covering)	≤ L/250

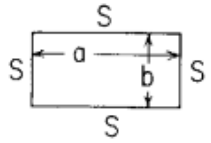
Table 2. ***Vertical deflections: Values from Table 8 of BS 5950-1: 2000***

	Vertical *imposed load* deflection
Cantilevers	≤ L/180
Beams carrying plaster or other brittle finish	≤ L/360
Other beams (except purlins and sheeting rails)	≤ L/200

Flecha máxima recomendada pelo NA1 do Eurocódigo 3:

fmax = L/250

1. Rectangular plate; all edges simply supported



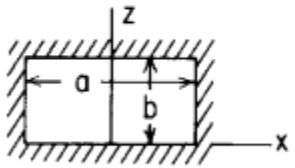
1a. Uniform over entire plate

(At center) $\sigma_{max} = \sigma_b = \frac{\beta q b^2}{t^2}$ and $y_{max} = \frac{-\alpha q b^4}{Et^3}$

(At center of long sides) $R_{max} = \gamma q b$

a/b	1.0	1.2	1.4	1.6	1.8	2.0	3.0	4.0	5.0	∞
β	0.2874	0.3762	0.4530	0.5172	0.5688	0.6102	0.7134	0.7410	0.7476	0.7500
α	0.0444	0.0616	0.0770	0.0906	0.1017	0.1110	0.1335	0.1400	0.1417	0.1421
γ	0.420	0.455	0.478	0.491	0.499	0.503	0.505	0.502	0.501	0.500

8. Rectangular plate, all edges fixed



8a. Uniform over entire plate

(At center of long edge) $\sigma_{max} = \frac{-\beta_1 q b^2}{t^2}$

(At center) $\sigma = \frac{\beta_2 q b^2}{t^2}$ and $y_{max} = \frac{\alpha q b^4}{Et^3}$

a/b	1.0	1.2	1.4	1.6	1.8	2.0	∞
β_1	0.3078	0.3834	0.4356	0.4680	0.4872	0.4974	0.5000
β_2	0.1386	0.1794	0.2094	0.2286	0.2406	0.2472	0.2500
α	0.0138	0.0188	0.0226	0.0251	0.0267	0.0277	0.0284

Critério 1

$$t = \sqrt[3]{\frac{250.\alpha.q.b^4}{E.a}}$$

Critério 2

$$t = b.\sqrt{\frac{\beta.\sigma_{sd}}{Fy}}$$

Exemplo: Calcular a espessura de chapa necessária para uma modulação de 50cm x 100cm – Considerar Material A36

Sobrecarga: 2kN/m²

Considerar apoio simples nas quadro arestas

$$\frac{a}{b} = \frac{100}{50} = 2$$

Espessura estimada inicial =3,18mm
P= 0,00318*7850=24,96kg/m²
P= 0,2496 kN/m²

$\alpha = 0{,}1110 \qquad \beta = 0{,}6102$

Critério 1

$$t = \sqrt[3]{\frac{250.\alpha.q.b^4}{E.a}}$$

$$t = \sqrt[3]{\frac{250.0{,}1110.(2.10^{-4} + 0{,}2496.10^{-4}).50^4}{20500.100}} = 0{,}266cm$$

Critério 2

$$t = b.\sqrt{\frac{\beta.\sigma_{sd}}{Fy}}$$

$$t = 50.\sqrt{\frac{0{,}6102.(1{,}5\,.2\,.10^{-4} + 1{,}25\,.0{,}2496\,.10^{-4})}{25}}$$

$t = 0{,}1421cm$

Ambos os critérios pedem chapas menores que 3,18mm, portanto modulação é adequada.