Steel Column Design

- Required steel area calculation

$$A_{req} = \frac{N_{ED}}{\frac{f_y}{\gamma_M}}$$

where: N_{ED} is the load action on the column
f_y is steel yield strength
γ_M is material safety factor

- Section selection from the universal steel column sheet

  The provided steel section have : Depth , width, flange thickness, web thickness, root radius and radius of gyration on both axis

- Identifying the class of the section
  Outstand flange

$$\frac{c}{t} = \frac{B - t_w - 2\,x\,r}{2t}$$

Internal compression part

$$\frac{c}{t} = \frac{D - 2t_f - 2\,x\,r}{t}$$

	Flange outstand limiting value, c/t_f	Web in bending limiting value, d/t_w
Class 1	9 ε	72 ε
Class 2	10 ε	83 ε
Class 3	14 ε	124 ε
Class 4	If it does not meet Class 3 requirements, the section is classified as Class 4	

where $\varepsilon = (275/f_y)^{0.5}$

- Compression resistance (clause 6.2.4 of EC3-1-1)

$$\frac{N_{ED}}{N_{c,Rd}} \leq 1.0$$

N_{Ed} is the design value of the axial compression;

$N_{c,Rd}$ is the design resistance to axial compression, given by the minimum of:

i) Plastic resistance

$N_{c,Rd} = A * f_y / \gamma_M$ (class 1,2 or 3)

$N_{c,Rd} = A_{eff} * f_y / \gamma_M$ (class 4)

ii) Buckling resistance - $N_{b,Rd}$, in general the flexural buckling resistance, which govern the design of a member in pure compression.

Buckling lengths – Assuming that the design forces were obtained by a second order structural analysis, the buckling lengths are considered (conservatively) equal to the real lengths (mid-distance between floors), given by:

Buckling in the plan x-z (around x) = L_{Ex}

Buckling in the plan y-z (around y) = L_{Ey}

Determination of the slenderness coefficient

$$\lambda_1 = \pi \sqrt{\frac{E}{f_y}}$$

where : E is elastic modulus of the steel

f_y is steel yield strength

$\lambda_x = L_{Ex} / i_x$ $\qquad$ $\lambda_x^* = \lambda_x / \lambda_1$

$\lambda_y = L_{Ey} / i_y$ $\qquad$ $\lambda_y^* = \lambda_y / \lambda_1$

where : λ_x^* and λ_y^* is slenderness coefficient which ever maximum is used to design

- Calculation of reduction factor χ_{min}

h/b ~1 and $t_f < 100$mm (Buckling curve can be used)

Flexural buckling around x curve b (α=0.34)

Flexural buckling around y curve c (α=0.49)

$$\lambda_y^* > \lambda_x^*$$

$$\alpha_{\text{curve c}} > \alpha_{\text{curve b}}$$

$$\chi_{min} \Rightarrow \chi z$$

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$$\Phi = 0.5[1 + \alpha(\lambda^* - 0.2) + \lambda^{*2}]$$

$$X_{min} \frac{1}{\Phi + \sqrt{\Phi^2 - \lambda *^2}}$$

$$N_{b,Rd} = \chi_z A f_y \gamma_M$$

$\frac{N_{ED}}{N_{b,RD}} \leq 1.0$, N_{Ed} is the design value of the axial compression; $N_{b,Rd}$ is the design buckling resistance.