WORKED EXAMPLE 7.1
Simple Column Base

Calculate the design resistance of the column base shown in Figure below. The column cross-section is HE200B, the base plate thickness is 30 mm, and the concrete foundation block dimensions are 850 x 850 x 900 mm. The steel is Grade S235 and the concrete is Grade C20/25. The material partial safety factors are $\gamma_M = 1.15$ and $\gamma_c = 1.50$.

![Figure 1 WE7-1](image)

For the effective cross section of the foundation block:

$$a_t = \min \begin{bmatrix} a + 2a_r = 340 + 2 \times 255 = 850 \\ 5a = 5 \times 340 = 1700 \\ a + h = 340 + 900 = 1240 \\ 5b_1 = 5 \times 850 = 4250 \end{bmatrix} = 850 \text{ mm},$$

and, from symmetry $b_1 = a_1$. The stress concentration factor is

$$k_j = \frac{a_1}{a} = \frac{850 \times 850}{340 \times 340} = 2.5.$$

The bearing strength of the concrete under the base-plate is

$$f_j = \frac{0.67 k_j f_{ck}}{\gamma_c} = \frac{0.67 \times 2.5 \times 20.0}{1.50} = 22.3 \text{ MPa}.$$

A rigid plate of effective width $c$, surrounding the column H-section, replaces the flexible base-plate:

$$c = t \sqrt{\frac{f_y}{3 f_j \gamma_{M0}}} = 30 \sqrt{\frac{235}{3 \times 22.3 \times 1.15}} = 52.4 \text{ mm}.$$

The effective area (see Fig. 5.11.2) is

$$A_{eff} = (200 + 2 \times 52.4) \times (200 + 2 \times 52.4) - (200 + 2 \times 52.4 - 9 - 2 \times 52.4) \times (200 - 2 \times 15 - 2 \times 52.4) = 80449 \text{ mm}^2.$$

The design resistance of the column base is

$$N_{Rd} = A_{eff} f_j = 80449 \times 22.3 = 1794 \times 10^3 \text{ N}.$$
Notes:

1) The design resistance of the column is lower than the resistance of the column base:
   \[ N_{pl,Rd} = A \frac{f_y}{\gamma_{Mo}} = \frac{7 \times 808 \times 235}{1,15} = 1,596 \times 10^3 N < N_{Rd} = 1,794 \text{ kN} \]
   where \( A \) is the column cross-sectional area.

2) The joint coefficient is taken as \( 2/3 \) provided that the characteristic strength of the grout is not less than \( 0,2 \times \text{characteristic strength of concrete foundation} \), and the grout thickness is less than \( 0,2 \times \min (a; b) = 0,2 \times 340 = 68 \text{ mm} \).
   
3) Packing plates (see Fig. 5.11.3) are used to level the base plate during erection.

Prepared based on [Wald et al, 2001].