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 $\gamma_{M0} = 1,15$ and $\gamma_c = 1,50$.

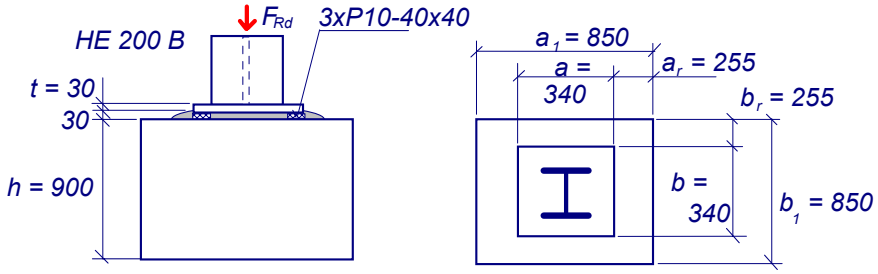

Figure 1 WE7-1

For the effective cross section of the foundation block:

$$a_1 = min\begin{Bmatrix} a + 2\ a_r = 340 + 2 * 255 = 850 \\ 5\ a = 5 * 340 = 1700 \\ a + h = 340 + 900 = 1240 \\ 5\ b_1 = 5 * 850 = 4250 \end{Bmatrix} = 850mm,$$

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

$$k_j = \sqrt{\frac{a_1\ b_1}{a\ b}} = \sqrt{\frac{850 * 850}{340 * 340}} = 2,5\ .$$

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

$$f_j = \frac{0,67 k_j\ f_{ck}}{\gamma_c} = \frac{0,67 * 2,5 * 20,0}{1,50} = 22,3\ MPa\ .$$

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

$$c = t\sqrt{\frac{f_y}{3 f_j \gamma_{M0}}} = 30 * \sqrt{\frac{235}{3 * 22,3 * 1,15}} = 52,4\ mm\ .$$

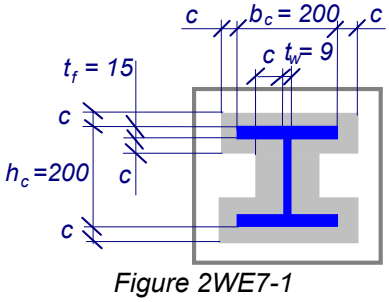

Figure 2WE7-1

The effective area (see Fig. 5.11.2) is

$$A_{eff} = (200 + 2 * 52,4) \times (200 + 2 * 52,4) - (200 + 2 * 52,4 - 9 - 2 * 52,4) \times (200 - 2 * 15 - 2 * 52,4)$$
$$= 80\ 449\ mm^2\ .$$

The design resistance of the column base is

$$N_{Rd} = A_{eff}\ f_j = 80\ 449 * 22,3 = 1\ 794 * 10^3\ N\ .$$

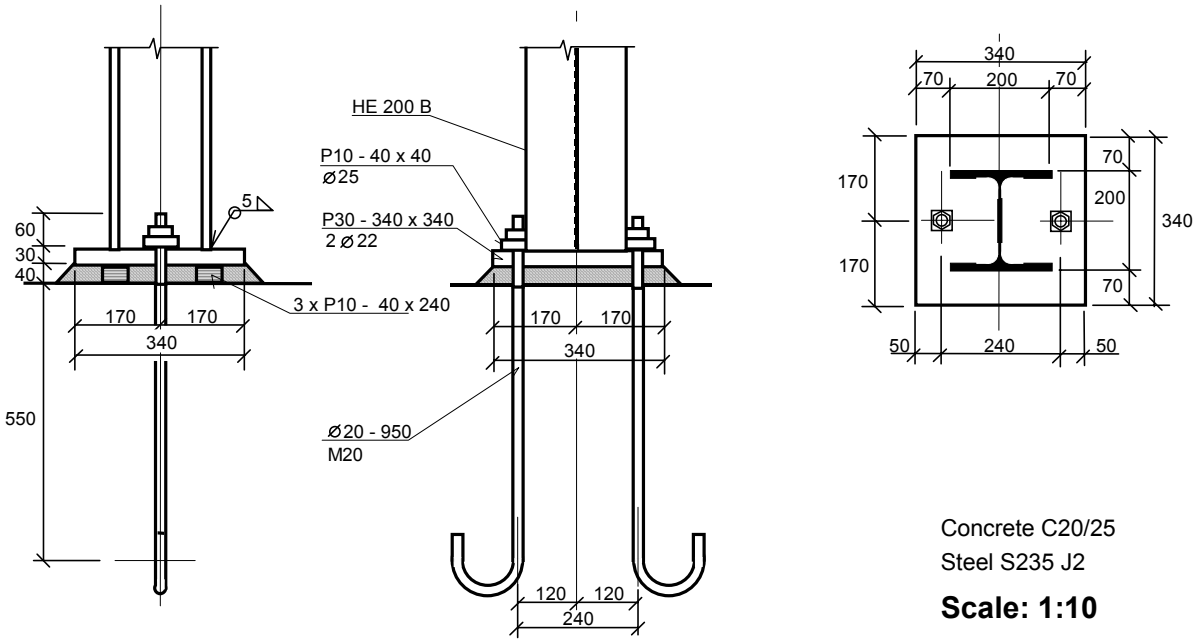

Figure 3WE7-1 Design drawing of the column base.
The anchor bolts are designed for structural integrity.

Notes:

1) The design resistance of the column is lower than the resistance of the column base: $N_{pl.Rd} = A\ f_y / \gamma_{M0} = 7\ 808 * 235 / 1{,}15 = 1\ 596 * 10^3\ N < N_{Rd} = 1\ 794\ kN$, 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 the characteristic strength of the concrete foundation, and the grout thickness is less than $0{,}2 * \min(a; b) = 0{,}2 * 340 = 68\ mm$.

3) Packing plates (see Fig. 5.11.3) are used to level the base plate during erection.

Prepared based on [Wald et al, 2001].