# EXERCISE BAT5: COMPOSITE COLUMN

## Data

Let us consider a composite column located in a bus parking lot located under a building, the section of which is shown below. It consists of a HEA 140 profile embedded in reinforced concrete.

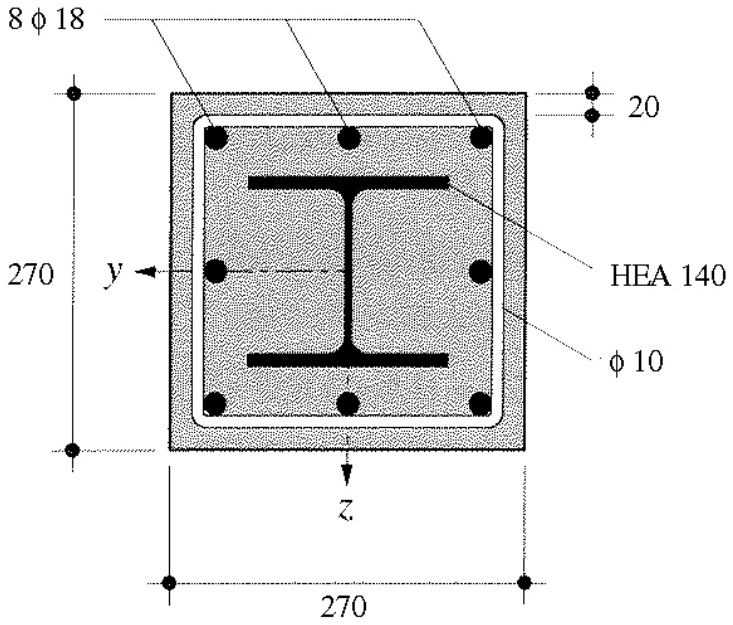


**Figure 1** - Composite Section

This column is loaded by a normal $N_{Ed}$ force of $1.5 \cdot 10^3$ kN and by a $Q_{shock,Ed}$ impact load of 60 kN applied at mid-height of the column and perpendicular to the weak axis of the section.

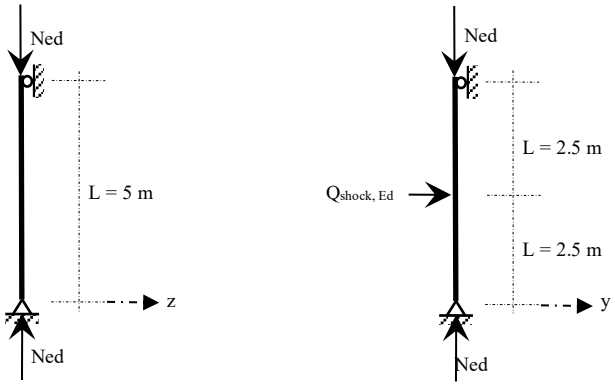


***Figure 2** – Static System and Loads*

The material properties are given in the following table:

| | | | |
|---|---|---|---|
| HEA 140 | S 235 | $f_y$ = 235 N/mm2 | $E_a$ = 210 • 103 N/mm$^2$ |
| Concrete ($\eta_{fc}$=1.0) | C 40/50 | $f_{ck}$ = 40 N/mm2 | $E_{cm}$ = 40 • 103 N/mm$^2$ |
| | | | $E_c$ = 20 • 103 N/mm$^2$ (see note) |
| Longitudinal reinforcing bars | B500B | $f_{sk}$ = 500 N/mm2 | $E_s$ = 210 • 103 N/mm$^2$ |

***Table 1 –*** *Material Properties*

# Questions

1.1 Determine the design resistance value of the composite column to normal force and verify the structural safety of it for the load case *live load* (without impact). Also check that the normal force can be be introduced at the column extremity.

1.2 Check this column with an M-N interaction for the accidental load case *shock,* $N_{Ed,\text{concomitant}}$ = 762 kN. Do not forget to check V and the introduction of the transverse load.

Note: for long-term effects, one can find a modulus more favorable than $Ec = E_{cm} / 2.5$ using the formula of SIA 264 § 5.3.2.9 with the following assumptions: $\varphi = 2$ and $N_{G,Ed}/N_{Ed} = 0.5$, which gives:

$E_c = E_{cm} / 2 = 20 \cdot 10^3$ N/mm$^2$