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 encased in reinforced concrete.

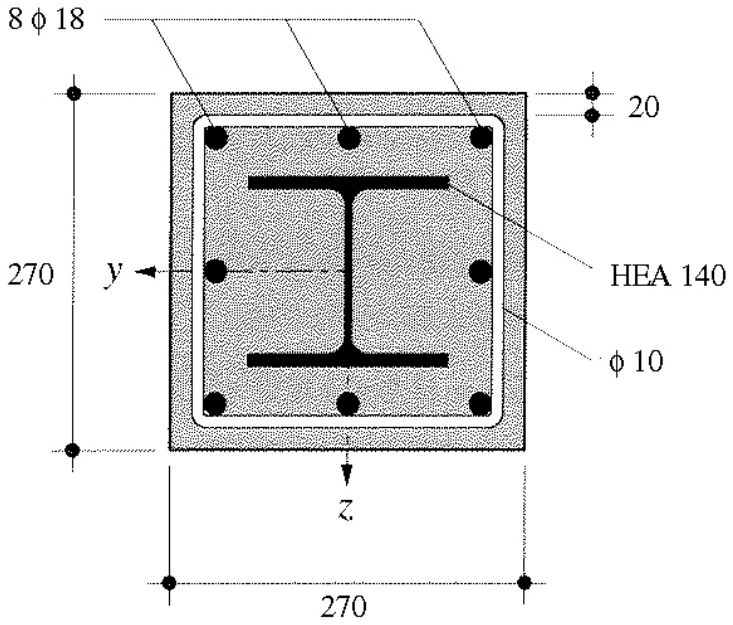

Figure 1 - Composite section of the column

This column is loaded by a normal N_{Ed} force of $1.5 \cdot 10^3$ kN and by a $Q_{impact,Ed}$ impact load of 60 kN applied at mid-height of the column and perpendicular to the weak axis of the section (worse case but can happen in the parking).

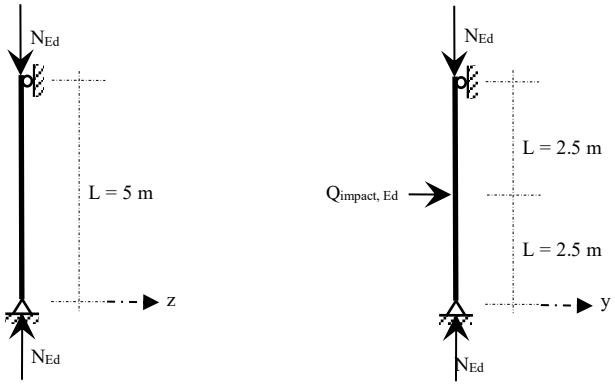

***Figure 2** – Static System and Loads*

The material properties are given in the following table:

HEA 140	S 235	$f_y = 235$ N/mm^2	$E_a = 210 \cdot 10^3$ N/mm^2
Concrete ($\eta_{fc} = 1.0$)	C 40/50	$f_{ck} = 40$ N/mm^2	$E_{cm} = 40 \cdot 10^3$ N/mm^2
			$E_c = 20 \cdot 10^3$ N/mm^2 (see note)
Longitudinal reinforcing bars	B500B	$f_{sk} = 500$ N/mm^2	$E_s = 210 \cdot 10^3$ N/mm^2

Table 1 – *Material Properties*

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 realistic assumptions: $\varphi = 2$ and $N_{G,Ed}/N_{Ed} = 0.5$, which leads to: $E_c = E_{cm} / 2 = 20 \cdot 10^3$ N/mm^2

Questions

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

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