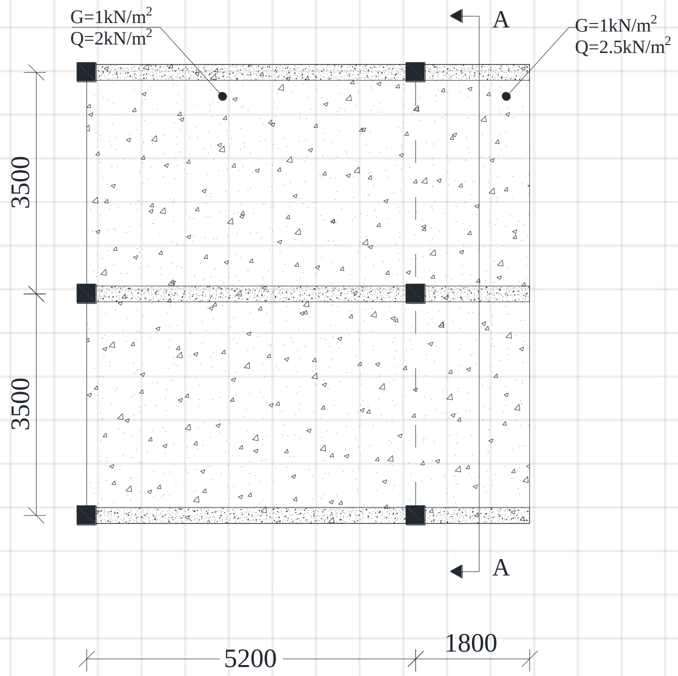
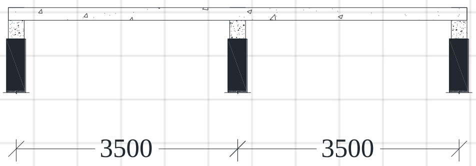
In the previous video, we determine the primary and secondary reinforcement for the slab. The slab transfers the loads toward the beams with a width of 250mm and a height of 500mm. In this video, we will determine the design bending moment on the critical beam which is in the middle of the slab. The effect of continuity and any fixity of the slab on the beams is neglected. Moreover, the meaning of the superior and inferior effect of the actions on the beams referring to the favorable and unfavorable actions are addressed.

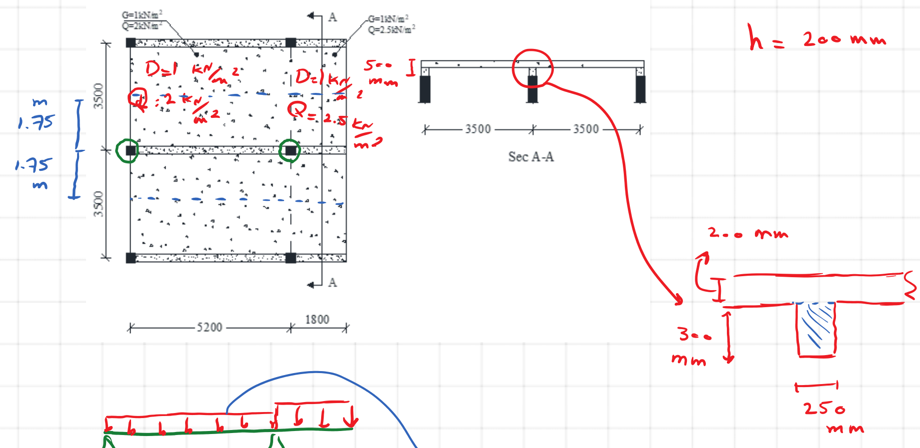
The slab thickness is 200mm as determined earlier in the previous video. The inside of the building is under a live load of $2kN/m^2$ and the balcony is under a live load of $2.5kN/m^2$.

Determine the design bending moment according to the Eurocode 1990 considering Finnish National Annex.

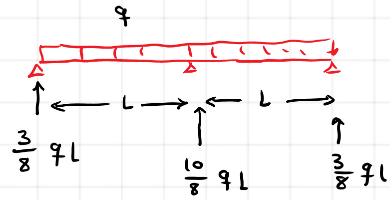


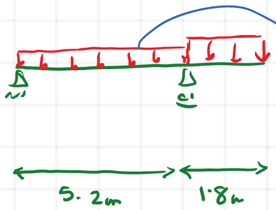


Sec A-A



h = 200 mm





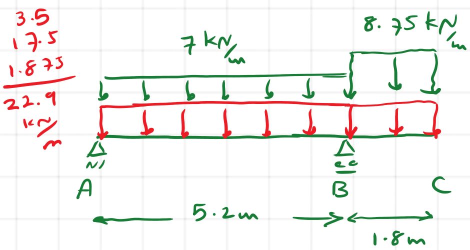
$D = 1\,kN/m^2 \times (1.75\,m + 1.75\,m) = 3.5\,kN/m$

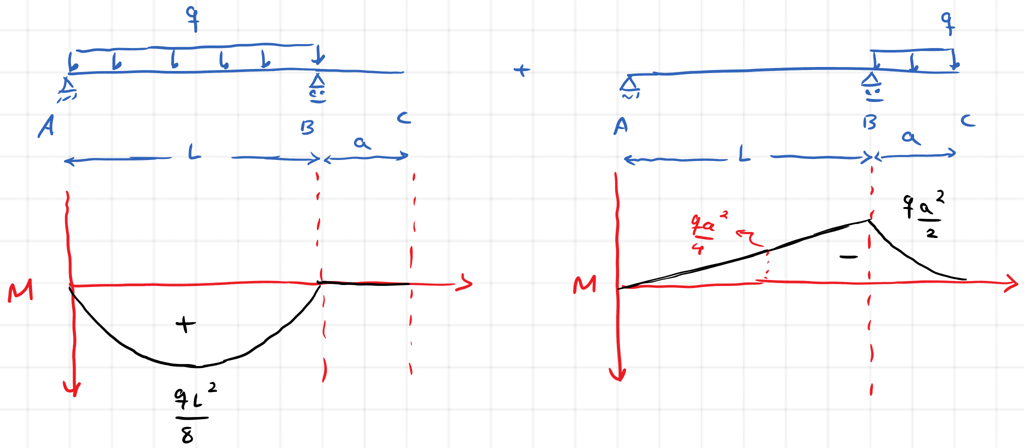
$D = 0.2\,m \times 25\,kN/m^3 \times 3.5\,m = 17.5\,kN/m$

$L = \begin{cases} 2.5\,kN/m^2 \times 3.5\,m = 8.75\,kN/m \\ 2\,kN/m^2 \times 3.5\,m = 7\,kN/m \end{cases}$

$Sw = 0.3\,m \times 0.25\,m \times 25\,kN/m^3 = 1.875\,kN/m$

3.5
17.5
1.875
22.9 kN/m





$M^+ = \frac{qL^2}{8} - \frac{qa^2}{4}$ (favorable action) , $M^- = \frac{qa^2}{2}$

SHAH

$q_D = 22.9\ kN/m$

$M^+_{AB} = \frac{qL^2}{8}, \quad M^-_{AB} = \frac{qa^2}{4}$

$q_L = \begin{cases} 7\ kN/m & (AB) \\ 8.75\ kN/m & (BC) \end{cases}$

$M^-_{BC} = \frac{qa^2}{8}$

$M_{AB}\ (G) \begin{cases} \frac{22.9\ kN/m \times (5.2m)^2}{8} = 77.4\ kN\cdot m \\ -\frac{22.9\ kN/m \times (1.8m)^2}{4} = -18.5\ kN\cdot m \end{cases}$

$Q \begin{cases} 7\ kN/m \times \frac{(5.2m)^2}{8} = 23.7\ kN\cdot m \\ -8.75\ kN/m \times \frac{(1.8\ m)^2}{4} = -7.1\ kN\cdot m \end{cases}$

$M_{ULS} : \max \begin{cases} 1.35\ K_{FI} \cdot G_{sup} + 0.9\ G_{inf} \\ 1.15\ K_{FI} \cdot G_{sup} + 0.9\ G_{inf} + 1.5\ K_{FI} \cdot Q \end{cases}$

$(K_{FI} = 1)$

$M_{ULS} : \max \begin{cases} 1.35 \times 77.4\ kN\cdot m + 0.9 \times (-18.5\ kN\cdot m) = 88\ kN\cdot m \\ 1.15 \times 77.4\ kN\cdot m + 0.9\ (-18.5\ kN\cdot m) + 1.5\ (23.7) = 107.5\ kN\cdot m \end{cases}$

$\boxed{M^+_{Ed} \simeq 108\ kN\cdot m}$

$M^- = \frac{qa^2}{2} \rightarrow$

$D: \frac{22.9\ kN/m \times (1.8m)^2}{2} = 37.1\ kN\cdot m$

$L: 8.75\ kN/m \times \frac{(1.8\ m)^2}{2} = 14.2\ kN\cdot m$

$M^-_{ULS} = \max \begin{cases} 1.35 \times 37.1\ kN\cdot m = 50.1\ kN\cdot m \\ 1.15 \times 37.1\ kN\cdot m + 1.5 \times 14.2\ kN\cdot m = 64\ kN\cdot m \end{cases} \rightarrow$

$\boxed{M^-_{Ed} = 64\ kN\cdot m}$