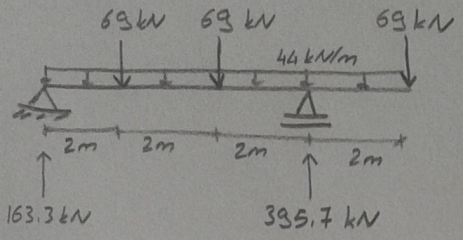
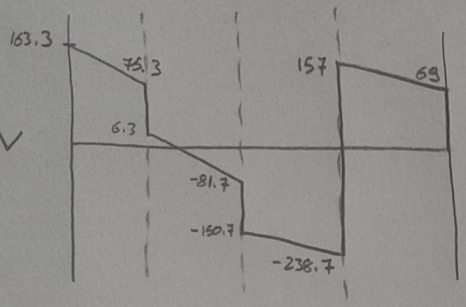
CE 382 - Reinforced Concrete Fundamentals

HOMEWORK 5

1)





$P = 1.4 \times 15 + 1.6 \times 30 = 69\ kN$

$q = 1.4 \times 20 + 1.6 \times 10 = 44\ kN/m$

$f_{cd} = 27\ MPa$, $f_{yd} = f_{ywd} = 365\ MPa$

$f_{ctd} = 1.47\ MPa$ (From Table 1.6, pg. 58)

Direct Support

$V_d = 163.3 - \left(44 \times \left(\frac{0.4}{2} + 0.46\right)\right) = 134.3\ kN$

Indirect Support

$V_d = 238.7 - \left(44 \times \frac{0.35}{2}\right) = 231\ kN$

Use $V_d = 231\ kN$

$V_{max} = 0.22 \times 27 \times 350 \times 500 = 1039.5\ kN$ $\quad V_d < V_{max}$ ✓ O.K.

$V_{cr} = 0.65 \times 1.47 \times 350 \times 460 = 154\ kN$

$V_{cr} < V_d$ need web reinforcement.

$$\min \frac{A_{sw}}{s} = 0.3 \times \frac{1.82}{365} \times 350 = 0.52$$

$V_d = V_c + V_w \qquad 231 = 0.8 \times 154 + V_w$

$$\rightarrow 107.8 \times 10^3 = \frac{A_{sw}}{s} \times 365 \times 460 \Rightarrow \frac{A_{sw}}{s} = 0.64 > \min \frac{A_{sw}}{s}$$ ✓

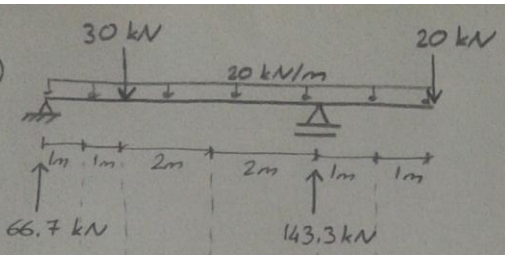
Use $\phi 8$ stirrups $\rightarrow A_o = 50\ mm^2 \rightarrow A_{sw} = 2 \times 50 = 100\ mm^2$

$$s = \frac{100}{0.64} = 156\ mm < d/2 = 230\ mm$$

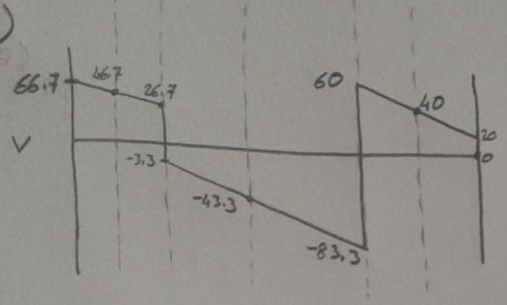
Use

$\phi 8/150\ mm$	at the span
$\phi 8/75\ mm$	near the supports.

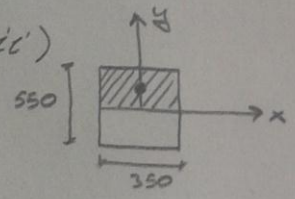
2)



i)



ii)



$$Q = 275 \times 350 \times \frac{275}{2} = 13.2 \times 10^6 \ mm^3 \quad \text{(for all A, B \& C)}$$

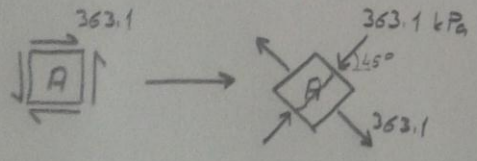
$$I_{x-x} = \frac{1}{12}(350)(550)^3 = 4.85 \times 10^9 \ mm^4$$

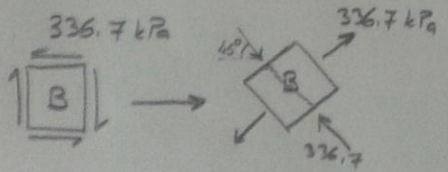
$$\tau = \frac{V \cdot Q}{I \cdot t}$$

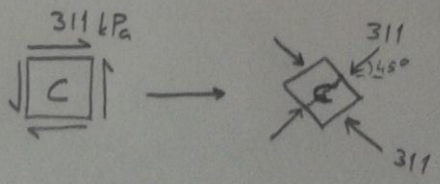
$$\tau_A = \frac{(46.7 \times 10^3) \times (13.2 \times 10^6)}{(4.85 \times 10^9) \times (0.35)} = 363.1 \ kPa$$

$$\tau_B = \frac{(-43.3 \times 10^3) \times (13.2 \times 10^6)}{(4.85 \times 10^9) \times (0.35)} = -336.7 \ kPa \qquad \tau_C = 311 \ kPa.$$

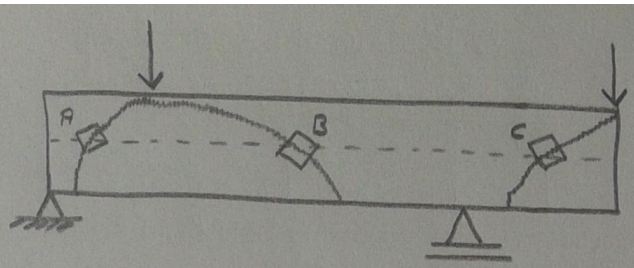
Since they all are located at the mid-depth $\sigma_{max} = \tau_{xy}$ & $\sigma_{min} = -\tau_{xy}$ and $\alpha = 45°$.







iii)



3) Column dimension is indicated different on the question and on the figure. I solve according to figure which is 350x400mm

$f_{cd} = 17\ MPa$ $\quad f_{ctd} = 1.2\ MPa$

$(U_p)_1 = 2\times(350+240) + 2\times(400+240) = 2460\ mm$

$(U_p)_2 = (350+240) + 2\times(400+120+250) = 2130\ mm \longrightarrow$ Critical

$V_{pc} = \gamma \times f_{ctd} \times U_p \times d = 1.0 \times 1.2 \times 2130 \times 240 = 613.4\ kN$

$V_d = 1200 - 800 - 15\times(0.77\times 0.59) = 393.2\ kN$

$V_{pc} > V_d \longrightarrow$ SAFE !!