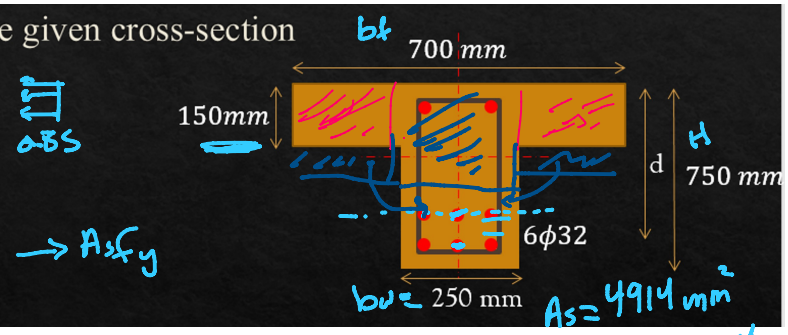
T sections

03 July 2020 04:20 PM

Example: Calculate the Moment capacity of the given cross-section

$f_y = 420\ MPa$ ..... $f'_c = 21\ MPa$



ABS

→ $A_s f_y$

assume rect.

$C = T$

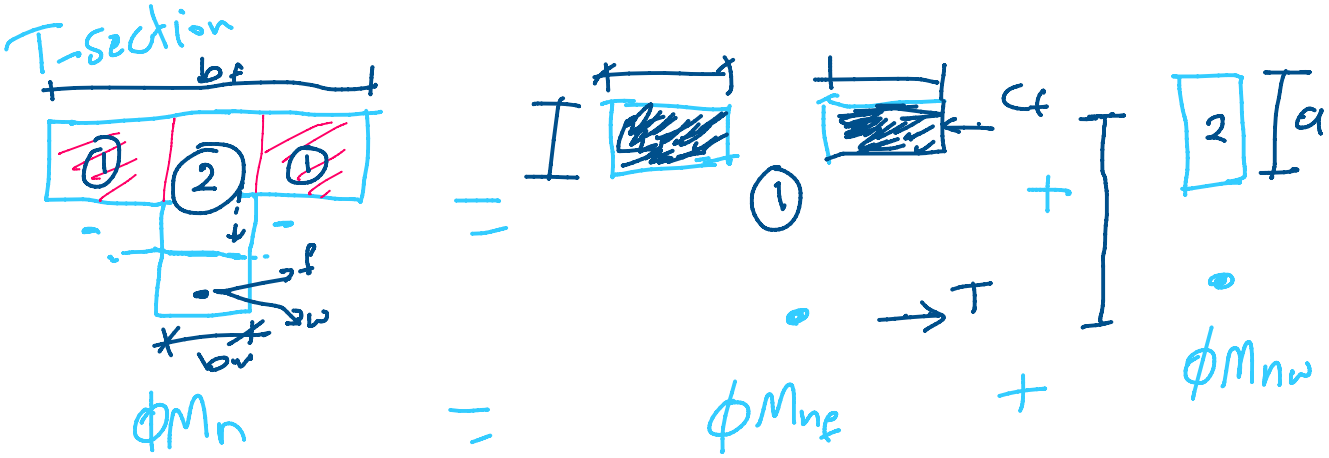
$0.85 f'_c\, a\, b_f = A_s f_y$ ←

$a = 165.2\ mm > h_f$

$d = H - 40 - 10 - \frac{32}{d_b} - \frac{32}{2} - \frac{h_f}{2}$

$d = 620\ mm$

T-section



for the flange ①

$T_1 = C_f$

$A_{sf} f_y = 0.85 f'_c\, h_f\, (b_f - b_w)$ → $A_{sf} = 2869\ mm^2$

$A_{sw} = 2045\ mm^2$ ... later

$\phi M_{nf} = \phi$ force × arm

$\phi M_{nf} = \phi\, A_{sf} f_y \left(d - \frac{h_f}{2}\right) = 591\ kN.m$

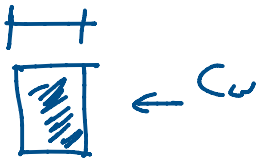
$\phi = 0.9$

for the web

$T_2 = C_w$

$A_{sw} f_y = 0.85 f_c' b_w a$

$a = 192.5\ mm$



$\phi M_{nw} = \phi f \times A$

$\phi A_{sw} f_y \left(d - \frac{a}{2}\right) = 404.9\ kN.m$

$\times 0.9$

check $\phi \rightarrow \epsilon_s$

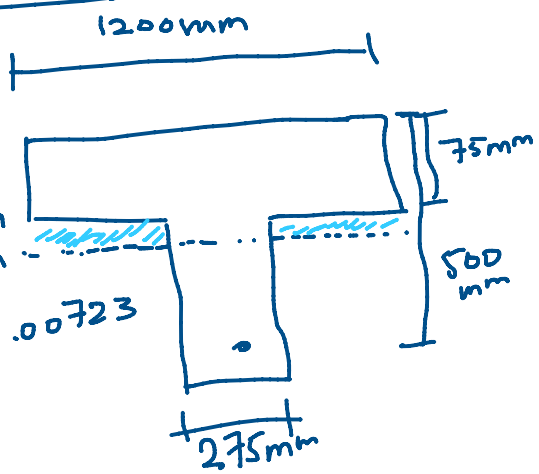
$\bar{y} = \frac{a}{\beta_1} \rightarrow \epsilon_s = 0.0052 > 0.005$

$\phi = 0.9$

$\phi M_n = 591 + 404.9\ kN.m = 995.9\ kN.m$

Design: $f_y = 420\ MPa$ $f_c' = 21\ MPa$

$+M_u = 750\ kNm$



Assume N.A(a) $< h_f \rightarrow$ rect. section $d = 500\ mm$ $b = 1200mm$

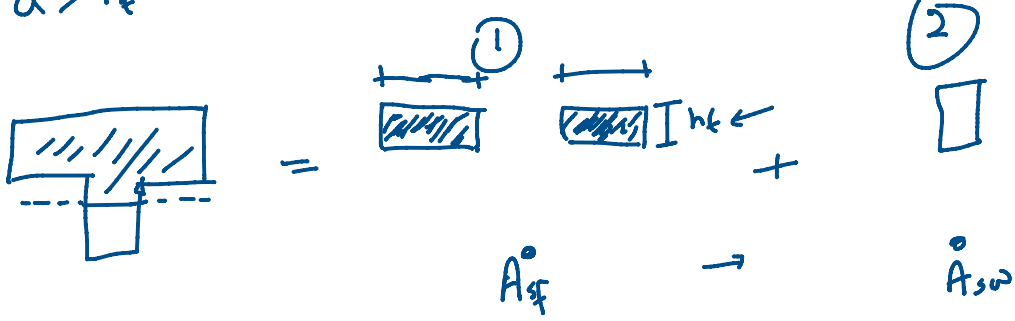
assume $\phi = 0.9$

$R = \frac{M_u}{\phi b d^2} = \frac{750 \times 10^6}{0.9 \times 1200 \times 500^2} = 2.78\ MPa \rightarrow \rho = 0.00723$

$A_s = \rho b d = 4338\ mm^2$

check $a \rightarrow T = C \rightarrow A_s f_y = 0.85 f_c' a b \rightarrow a = 85\ mm$

$a > h_f \rightarrow$ T-section



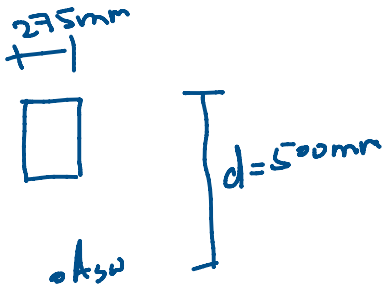
(1) $0.85 f_c' h_f (b_f - b_w) = A_{sf} f_y \rightarrow A_{sf} = 2948\ mm^2$

(1)

$\phi M_{nf} \rightarrow C_f = T_1 \Rightarrow 0.85 f_c' h_f (b_f - b_w) = A_{sf} f_y \rightarrow A_{sf} = 2948\ mm^2$

$\phi M_{nf} = \phi A_{sf} f_y \left(d - \frac{h_f}{2}\right) = 521.6\ kN.m$

(2) $\phi M_{nw} = 750 - 521.6 = 228.4\ kN.m$



option1:

$\phi M_{nw} = \phi A_{sw} f_y (d - \frac{a}{2})$ itr $\leftrightarrow$ $T = C$, $a = \frac{A_{sw} f_y}{0.85 f_c' b_w}$

A_{sw} , a

option2: $R = \frac{M_u}{\phi b d^2} = \frac{228.4 \times 10^6}{0.9 \times 275 \times 500^2}$ $\rightarrow$ $\rho \rightarrow A_{sw}$

$R = 3.69 \rightarrow \beta = 0.0099 \rightarrow A_{sw} = 1367\ mm^2$

$a = 117\ mm \rightarrow \bar{y} = 137.6\ mm$

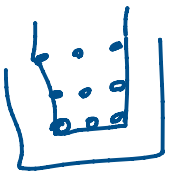
$\epsilon_s = 7.9 \times 10^{-3} > 0.005$

$\phi = 0.9$

$A_s = A_{sf} + A_{sw} = 4315\ mm^2$

Spacing , ϕM_n

#	A_s
$7\phi 29 \rightarrow$	4615
$9\phi 25 \rightarrow$	4590
$3\phi 43 \rightarrow$	4365
$6\phi 32 \rightarrow$	4914



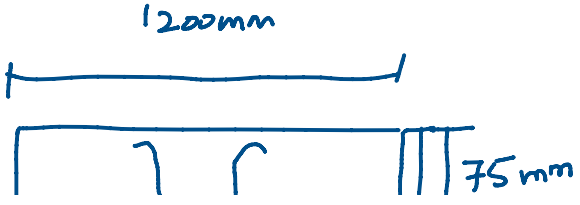
$b_w = 2(40) + 2(10) + 3(43) + 2S$

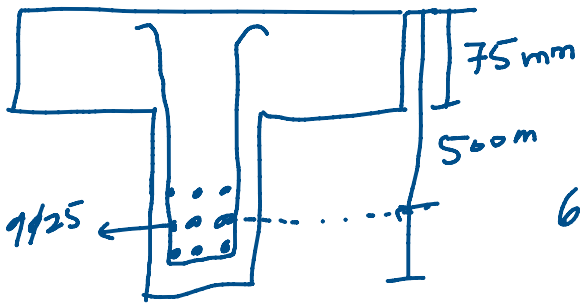
$S = 23\ mm$ <

$b_w = \text{- - - - - -} \rightarrow 3(25) + 2S$

$S = 62.5$ ok

$9\phi 25 \rightarrow 3$ layers





650 mm → d = ---

→ kaya