

Q.8

$$Q_y = 416.03 \text{ t}$$

$$\tau = \frac{Q S_f}{I_x}$$

$$S_f = b_e t_e + \frac{d_w + t_e}{2} = 100 * 5 + \frac{350 + 5}{2} = 88750 \text{ cm}^3$$

$$\tau = \frac{416.03 * 88750}{37939583.3} = 0.973 \text{ t/cm} = R \quad (\because \text{no direct effects})$$

$$R = 2 * 1 + q_w * S_w$$

$$0.973 = 2 * 1 + (0.2 + 5.2) * S_w \Rightarrow S_w = 0.47 \text{ cm}$$

where $S_{w1} = S_{w2} \therefore$ let $S_w = S_{w1}$

\Rightarrow Check for fatigue:

weld class D

$$N = 2 * 10^6 \Rightarrow \therefore P_{au} = 0.71 \text{ t/cm}^2$$

$$\tau = \frac{Q_{u+1} * S_f}{I_x} = \frac{(232.3 * 1.1) * 88750}{37939583.3} = 0.598 \text{ t/cm}$$

$$\text{let } 0.598 = 2 * 1 + 0.71 * S_w \text{ required. } \therefore \text{safe}$$

$$\rightarrow S_{w \text{ requ}} = 0.42 \text{ cm} < 0.8 \text{ cm used} \\ \therefore \text{safe.}$$

Ques 9

at location of cantilement at $\frac{L}{3} \Rightarrow 13.3 \text{ m}$

$$M_{DL} = (160.5 \times 13.3) - \left(\frac{8.025 \times 13.3^2}{2} \right) = 1424.9 \text{ mt}$$

$$M_{LL} = (191.6 \times 13.3) - (8 \times 10.9 \times 7.85) - (25 \times 1.6) + (20 \times 13.3) - \left(\frac{1 \times 13.3^2}{2} \right) = 2001.3 \text{ tm}$$

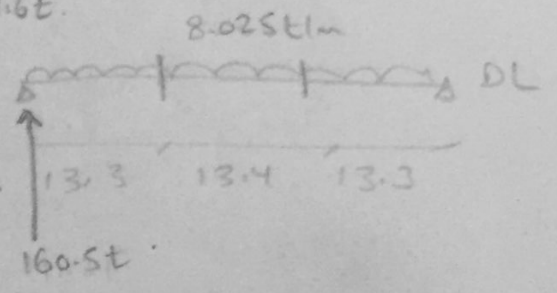
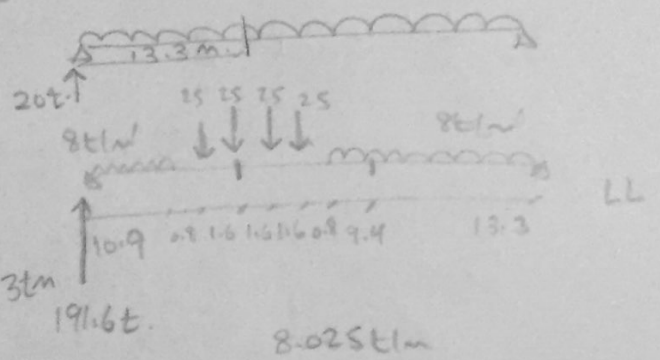
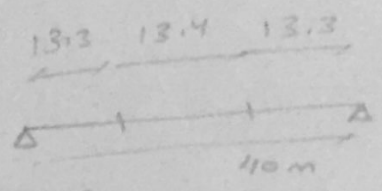
$$Q_{DL} = 160.5 - 13.3 \times 8.025 = 53.77 \text{ t}$$

$$Q_{LL} = 191.6 - 8 \times 10.9 - 25 - 25 + 20 - 13.3 \times 1 = 86.1 \text{ t}$$

or $191.6 - 8 \times 10.9 - 25 + 20 - 1 \times 13.3 = 86.1 \text{ t}$

$$M_T = M_{DL} + M_{LL} + I = 1424.9 + 1.1 \times 2001.3 = 3626.33 \text{ tm}$$

$$Q_T = Q_{DL} + Q_{LL} + I = 53.97 + 1.1 \times 86.1 = 148.48 \text{ t}$$



Design:

$$A_{req} = \frac{M}{\sigma_{bc} \times Z_p} - \frac{A_{web}}{6} = \frac{3626.33 \times 100}{350 \times 2.1} - \frac{1.8 \times 350}{6} = 388.4 \text{ cm}^2$$

use $t_f = 5 \text{ cm}$; $b_f = 80 \text{ cm}$

$$q_{fact} = \frac{Q}{A_{web}} = \frac{148.48}{350 \times 1.8} = 0.235 \text{ t/cm}^2 \quad \& \quad q_{all} = 0.68 \text{ t/cm}^2$$

$\frac{q_{fact}}{q_{all}} < 0.6$; no reduction in q_{all} .

$$I_x' = 31637916.67 \text{ cm}^4$$

$$Z_x' = 175766.2 \text{ cm}^3$$

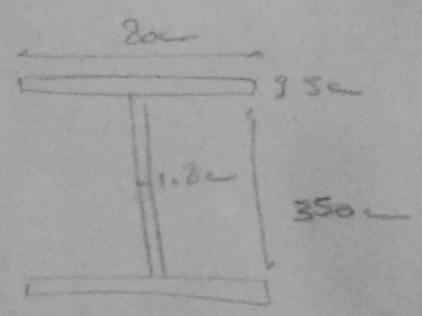
$$p_{fact} = \frac{M}{Z} = \frac{362633}{175766.2} = 2.06 \text{ t/cm}^2$$

$$L_{u1} = \frac{20 \times 80}{\sqrt{3.6}} = 843.3 \text{ cm}$$

$$L_{u2} = \frac{1380 \times 80 \times 5}{350 \times 5.6} = 438.1 \text{ cm}$$

$$\left. \begin{matrix} L_{u1} \\ L_{u2} \end{matrix} \right\} > L_u = 312.5 \text{ cm}$$

$p_{all} = 2.1 \text{ t/cm}^2 > p_{fact}$ - safe.



check deflection:

$$\text{let } M_u = \frac{w_{eq} L^2}{8}$$

$$\Rightarrow 2001.3 = \frac{w_{eq} \times 40^2}{8}$$

$$\Rightarrow w_{eq} = 90 \text{ kN/m}$$

$$\Delta_{act} = \frac{5 \times \frac{10}{100} \times 4000^4}{384 \times 2100 \times 31637916.67} = 5 \text{ cm}$$

$$\Delta_{all} = \frac{4000}{800} = 5 \text{ cm} \quad \text{safe.}$$