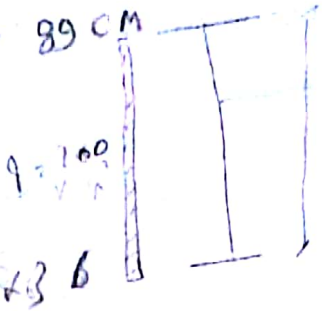
we may use different bracing systems. the optimum and economic one is consisting of intermedide and end brackets, another one is composed of ITZ L.W.B and end cross frame. for both we should use U.W.B temporarily during construction, It's worth to note that using cross frame in our case is not practically suggested for its angle of inclination.

System ① :-

using intermediate and end brackets :.
with temporarily U.W.B :-

→ UWB :- unloaded case is the critical one to RC slab.

$h_{m.a} = 250\ cm$, $h_{x.y} = 89\ cm$



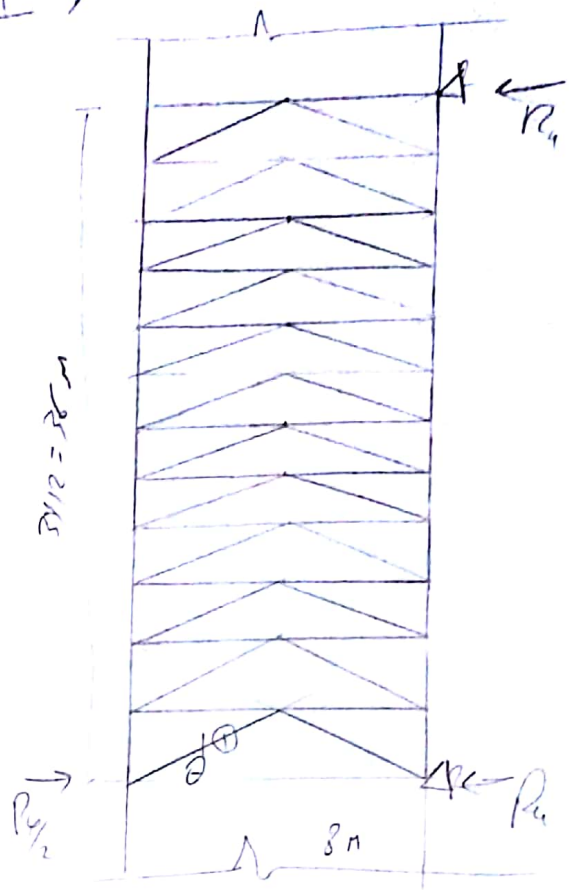
$P_{u\ tot} = 0.7 \times [2.5 + 0.25] \times 3.6$

$= 19.8\ t$

$P_4 = \frac{19.8}{12} = 1.65\ t$

$R_u = \frac{19.8}{2} = 9.9\ t$

$P_1 = \pm \frac{9.9 - \frac{1.65}{2}}{2 \times 0.8} = 5.68\ t$



$\theta = \tan^{-1} \frac{3}{4} = 36.86$

$L_x = 5\ M$, $L_y = 1.2 \times 5 = 6\ M$

assume using 2 L 120×12 BTB [St 37]

① compression

$\lambda_x = \frac{500}{0.3 \times 13} = 128.2 < 140$

$\lambda_1 = \frac{600}{0.45 \times 13} = 102.56 < 140$

O.K.

St 37

$\lambda_{max} = 128.2 > 100$

$f_{all} = \frac{7500}{128.2^2} = 0.456\ t/cm^2$

space action

$f_{act} = \frac{5.68}{2 \times 30} = 0.095\ t/cm^2 < 0.456 \times 0.85$

O.K.

② tension

M20

$A_{net} = 2(30 - 1.2(2+0.2)) = 54.72\ cm^2$

$f_{act} = \frac{5.68}{54.72} = 0.11\ t/cm^2 < 1.4 \times 0.85$

↳ space action

safe

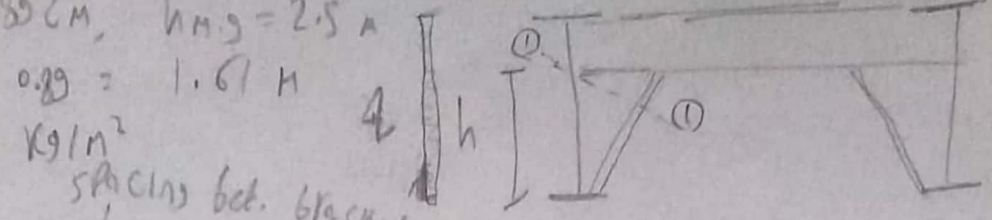
∴ use $2 < 13 \times 12$ bt6

→ Design of Intermediate bracket : [unloaded case is the critical case] (23)*

$x_{x.g} = 0.89$ cm, $h_{M.g} = 2.5$ m

$h = 2.5 - 0.89 = 1.61$ m

$q = 200$ kg/m²



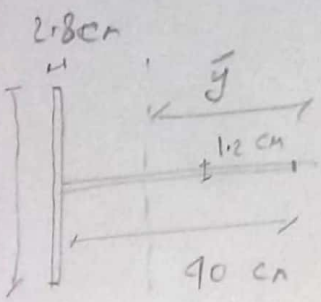
spacing bet. brackets

$w = 0.2 \times 3 = 0.6$ t/m

$M_b = \frac{0.6 \times 1.6^2}{2} = 0.768$ t.m [St.37]

$\bar{y} = \frac{40 \times 1.2 \times 20 + 30 \times 2.8 \times 41.4}{30 \times 2.8 + 40 \times 1.2}$

$= 33.62$ cm



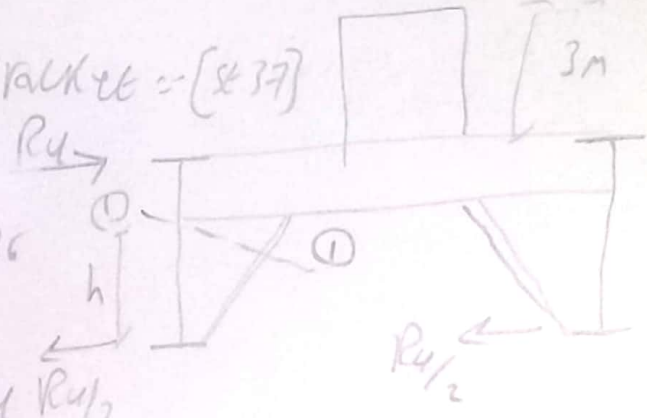
$I_x = \frac{1.2 \times 40^3}{12} + 1.2 \times 40 \times (20 - 33.62)^2 + \frac{30 \times 2.8^3}{12} + 30 \times 2.8 \times (41.4 - 33.62)^2$

$= 20493.42$ cm⁴

$f = \frac{0.768 \times 100 \times 33.62}{I} = 0.13$ t/cm²

< 1.4 t/cm² o.k

→ Design of end bracket : [St 37]



$Ru_{unloaded} = 9.9$ t

for loaded case

$Ru_{bt} = 0.1 \times [2.5 + 0.25 + 0.08 + 3] \times 36$

$= 21$ t

$Ru_{loaded} = \frac{21}{2} = 10.5$ t critical $Ru/2$

$M = \frac{10.5}{2} \times 1.61 = 8.46$ t.m

using the same dimensions as Int. bracket

$\therefore f = \frac{8.46 \times 100 \times 33.62}{I} = 1.39$ t/cm² < 1.4 t/cm²

o.k

System ② L.W.B + cross frame and temporaries U.W.B

→ U.W.B → the same as before but

$P_{tot} = 0.2\left[12.5 + \frac{12.5}{2}\right] + 0.25\} \times 36 = 10.8\ t$

→ L.W.B

$P_{tot} = 0.2 \times \frac{2.5}{2} + 36 = 9\ t$

$P_L = \frac{9}{12} = 0.75$

$R_L = 4.5\ t$

$f_1 = \pm \frac{4.5 - \frac{0.75}{2}}{2 \times 0.8} = 2.57\ t$

Use 2 C 130 x 12 at U.W.B with the same al

→ Vertical W.B ⇝ using end cross frame :-

to get the critical case ⇒

For unloaded case ..

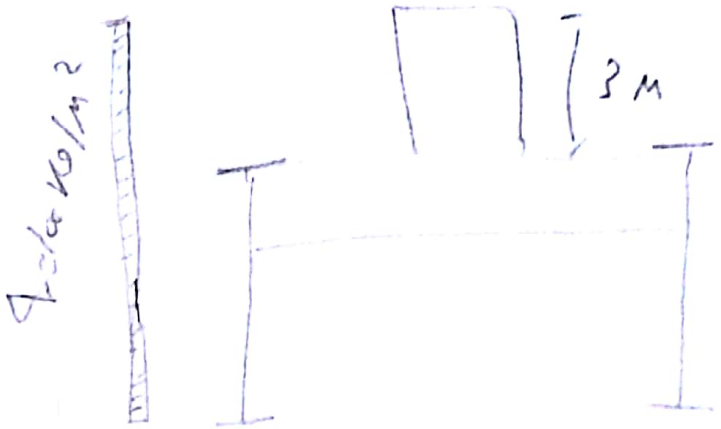
$P_{u\,tot} = 10.8\ t$ as before

$R_u = \frac{10.8}{2} = 5.4\ t$

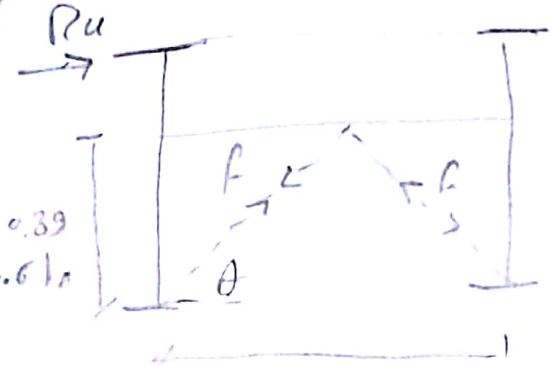
For loaded case

$P_{u\,tot} = 0.1\left(\frac{2.5}{2} + 0.25 + 0.08 + 3\right] \times 36$

$= 16.5\ t$



$R_u = \frac{16.5}{2} = 8.25\ t$ critical



$P = \pm \frac{8.25}{2\cos\theta} = 4.45\ t$

$\theta = 21.9°$

$L_x = 4.31\ m = L_{geo.}$

$L_y = 1.2 \times 4.31 = 5.17\ m$

(Compression)

assume using 2 ls 130 × 130 × 12 [SE 57]

$\lambda_x = \frac{431}{3.93} = 110.5 < 140$

$\lambda_y = \frac{5.172 \times 10}{.45 \times 13} = 88.41 < 140$

$f_{all} = \frac{750}{110.5^2} = 0.61\ t/cm^2$

SBC action

$f_{act} = \frac{4.45}{2 \times 30} = 0.075\ t/cm^2 < 0.61 \times 0.85\ t/cm^2$

Check as Tension member :-

$A_{net} = 2\{3.0 - 1.2 \times [2 + 0.2)\} = 59.72 \text{ cm}^2$

$f_{net} = \frac{4.45}{59.72} = 0.082 \text{ t/cm}^2 < 1.9 \times 0.85$ t/cm²

O.K

Q13

~ assume AADT 7,2500

$N = 2 \times 10^6$ cycles

~ assume Cont. welds

∴ Cat. B

~ assume 50 years ⇒ M = 1

∴ $f_{sr_{all}} = 1.26$ t/cm²

$$f_{sr_{act}} = \frac{0.5 M_{LL+I}}{Z_x} = \frac{0.5 \times 982.7 \times 10^2}{91667.21} = 0.54 \text{ t/cm}^2 < 1.26 \text{ t/cm}^2 \quad \text{OK}$$

for weld :- $f_{all} = 0.71$ t/cm²

$Q_{LL+I} = 122.5$ t , $S_x = 37367.1$ cm³

$I_x = 11343107.11$ cm⁴

$$\tau = \frac{0.5 \times 122.5 \times 37367.1}{I_x} = 0.2 \text{ t/cm}$$

∴ $\tau = 2 \times 1 \times f_{all} \times S_w$

∴ $0.2 = 2 \times 1 \times 0.71 \times S_w \Rightarrow S_w = 0.14$ cm

Use $S_{min} = 6$ mm

Q 19

Roller Design :-

$V = 236.8$ t , using f_{st} 56 , $t_p = 70$ cm , Concrete C_{35}

$V = 0.117 \cdot D \cdot L \rightsquigarrow L = 70 - 10 = 60$ cm

$\therefore 236.8 = 0.117 \cdot D \cdot 60 \rightsquigarrow D = 33.73$ cm

Let $D = 40$ cm

$b = 12/3 = 15$ cm

$f_{cmp} = \frac{236.8}{60 \times 15} = 0.263$ t/cm² < 2 t/cm² $\cdot V_s$

→ Base Plate :- (st 52)

$A_p = \frac{236.8}{110/1000} = 2152.73$ cm²

let $L = 60$ cm $\rightsquigarrow b_{Plate} = \frac{2152.73}{60} = 35.88$ cm

$\simeq b_{Plate} = 40$ cm

$f = \frac{236.8 \times 1000}{60 \times 40} = 98.67$ kg/cm² < 110 kg/cm²

$M = \frac{98.67 \times 20^2}{1000 \times 2} = 19.8$ t.cm/cm

$t_p = \sqrt{\frac{6 \times 19.8}{1000 \times 2.1 \times 3.6}} = 6.76$ cm $\simeq 6.8$ cm