Notes by-

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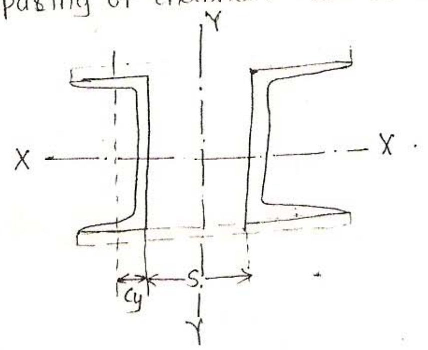
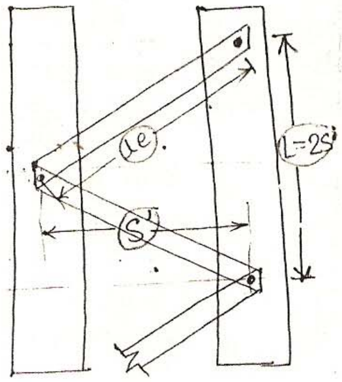
* Design of Built up column: carrying axial comp. load; using lacing

steps:-
① Assume $\sigma_{ac} = 110$ MPa
② ∴ $A_{reqd} = \frac{P}{\sigma_{ac}}$
③ From steel table, try a section.
④ Find $\lambda_{max} = \frac{le}{r_{min}}$ & hence σ_{acpro}
⑤ ∴ $A_{pro} = \frac{P}{\sigma_{acpro}} > A_{reqd}$ ∴ O.K.
⑥ Spacing of channel; Let $I_x = I_y$.





* Design of lacing:-
① Assume - single lacing system inclined at 45° with axis of colm. (0)
② Spacing of lacing bar = 2 (Dist. betn connection - rivet or weld).
$\Rightarrow L = 2S'$
③ $\lambda_{max} = \frac{L}{r_{min}} < 50$ ∴ O.K.
④ Effective length of lacing bar $= \sqrt{2} \times S' = le$
⑤ Min. thk. of lacing bar $= \frac{le}{40}$
⑥ Min. width of lacing bar for 20mm dia. pds rivet = 60 mm. → see Table.
⑦ ∴ $\lambda_{max} = \frac{le\sqrt{12}}{t} \not> 145$ → for lacing bar.
⑧ from Table 5.1, find σ_{ac}.
⑨ Transverse shear on lacing $= V = \frac{2.5P}{100}$ (kN)
⑩ ∴ Force in one lacing bar $= F = \frac{V}{2\sin\theta}$ → single lacing.
$= \frac{V}{4\sin\theta}$ → Double lacing.
⑪ Tensile stresses in each lacing bar $= \frac{F}{(b-d)\times t} \not> 150$ MPa. ∴ OK
⑫ Comp. stresses in each lacing bar $= \frac{F}{b\times t} \not> \sigma_{ac}$ cal. in step ⑧ ∴ O.K.
⑬ End connection.
strength of 20 mm dia pds rivets :-
① In single shear $= \frac{100 \times \frac{\pi}{4} \times 21.5^2}{1000} = 36.3$ kN
② In bearing lacing $= \frac{300}{1000} \times 21.5 \times (12) = 77.4$ kN — only t will change.
③ ∴ Rivet value = min. of two
④ ∴ No. of Rivets reqd $= \frac{2F\cos\theta}{\text{Rivet value}}$.

∴ Result :- Use ... X ... mm lacing inclined at 45° connected by 20 mm dia. pds rivet at each end.

Design of built up col^m using batten :-

1. Assume $\sigma_{ac} = 120$ MPa
2. $\therefore$ $A_{reqd} = \frac{P}{\sigma_{ac}}$
3. Try a section
4. $\lambda_{max} = \frac{l_e}{r_{min}} \rightarrow$ 10% increase due to battening.
5. from table 5.1, find $\sigma_{ac\,pro}$
6. $\therefore$ $A_{pro} = \frac{P}{\sigma_{ac\,pro}} > \sigma_{ac\,reqd}$ $\therefore$ O.K.
7. Design of Batten:-
8. (a) spacing of batten = C such that,

$$\frac{C}{r_{min}} \ngtr 50 \text{ or } 0.7 \times \sigma_{ac\,pro} \Big\} \text{ which ever is less}$$

~~or C ≯ 0.7~~

9. Thk. of batten $\Rightarrow$ $t > \frac{l_b}{50}$ → [fig]
10. Eff. depth of intermediate batten : $d > \frac{3}{4}a$ → (fig]
    & $d > 2b$.

$\therefore$ we have calculated D & t & spacing 'c'.

11. Transverse shear = $V = \frac{2.5P}{100}$ (kN)
12. Longitudinal shear = $V_1 = \frac{V \cdot C}{N \cdot S}$ (kN)
13. Moment = $M = \frac{V \cdot C}{2 \cdot N}$.

check

14. Longitudinal shear stress = $\frac{V_1}{D \times t} \ngtr 100$ MPa. $\therefore$ O.K.
15. Bending stress = $\frac{6M}{D \cdot t^2} \ngtr 165$ MPa. $\therefore$ O.K.

| Use ---x--- mm batten | → This sentence is "MUST".

End connection:-
find Rivet value by assuming 20 mm dia - pds rivet as -

1. In bearing = $\frac{300}{1000} \times d \times t$ (↓ σ_{tf})
2. In shearing - $\tau_{vf} \times \frac{\pi}{4} d^2$ (↓ $\frac{100}{}$)

d = Gross dia = 21.5 = 20+1.5

$\therefore$ Rivet value is least of ① & ②.

$\therefore$ Find No. of Rivets = $\frac{P}{RV}$.

Check :-

1. Direct force on each rivet = $F_a = \frac{V_1}{n}$
2. Force due to moment on each rivet = $\frac{M \cdot r}{\Sigma r^2}$
3. $\therefore$ Resultant force on each rivet = $\sqrt{F_a^2 + F_m^2} \ngtr$ Rivet value
   $\therefore$ O.K.