$$J_2 = \frac{7tB^3}{12} - \frac{t(B/2)^3}{12} \quad \left(\text{not } \frac{\pi D^4}{64}\right)$$

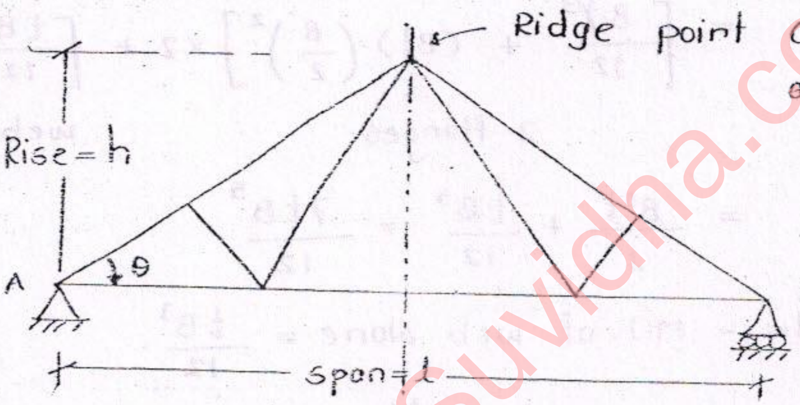
Solid c/s (M.I. of circular hole + projected area)

$$= \frac{55\,t B^3}{96}$$

$$\text{Loss of strength} = \frac{J_2}{J_1} = \frac{(55\,tB^3/96)}{(7tB^3/12)} = 0.98 \rightarrow 98\%$$

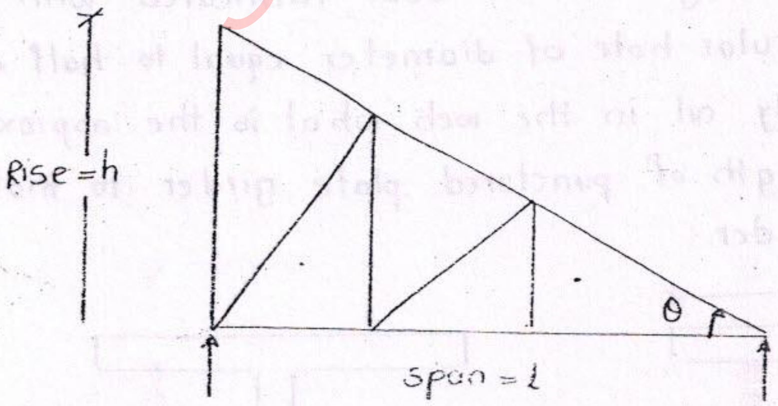
Design of Industrial roof trusses:

(i)



Slope of truss (θ) = $\tan\theta = \frac{h}{l/2} = \frac{\text{Rise}}{\text{half of span}}$

Pitch of truss (p) = $\frac{\text{Rise}}{\text{Span}} = \frac{h}{l}$

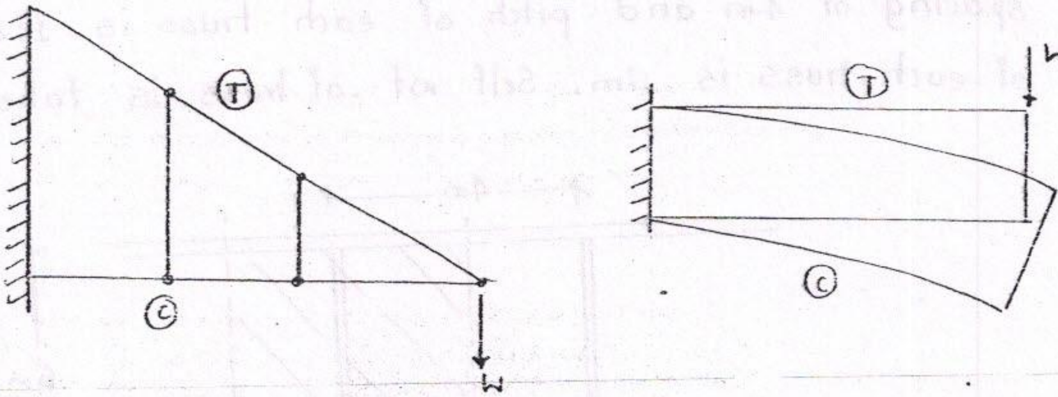


North light roof truss.

slope of truss (θ) = $\tan\theta = \frac{h}{l}$

pitch of truss (p) = $\frac{\text{Rise}}{\text{Span}} = \frac{h}{l}$

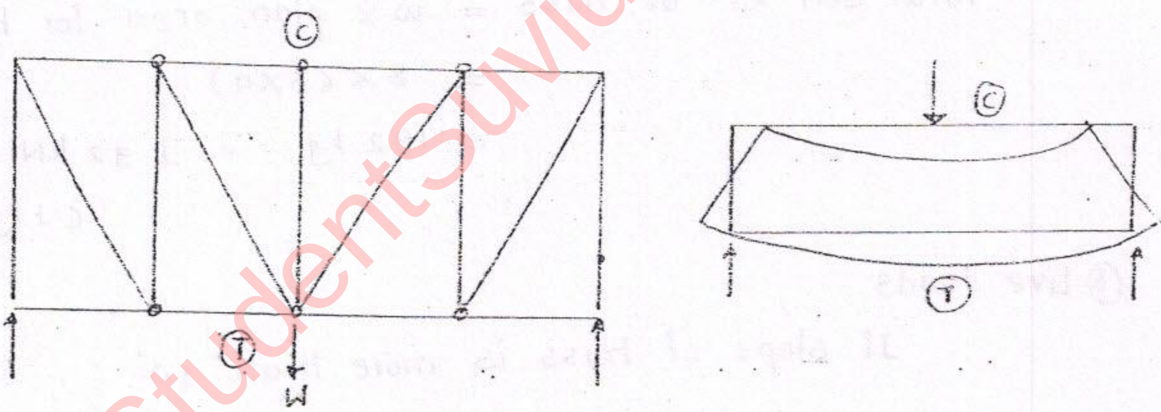
(ii)



Cantilever truss is idealised as cantilever beam. So all top members are subjected to tension and bottom members are subjected to compression.

Tension member is roof truss is called Tie and compression member is called 'strut'.

(iii)



Simply supported trusses are idealised as Simply supported beam. So all top members are subjected to compression and bottom members are subjected to tensio[n]

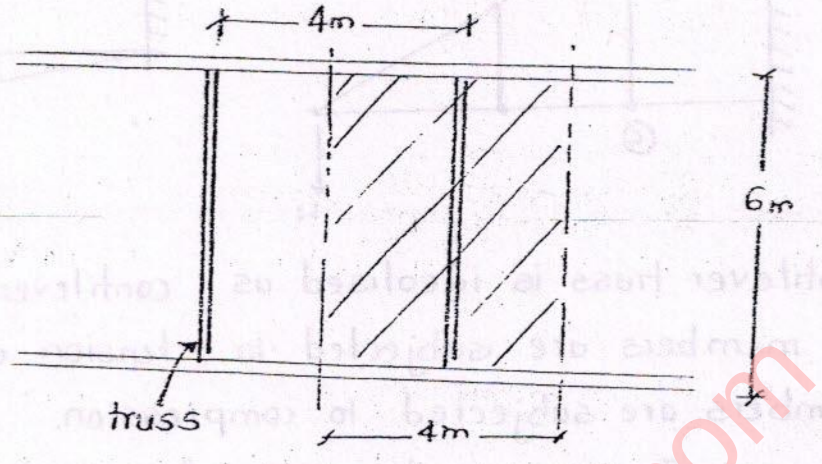
(iv) Loads on truss :

(a) Dead Loads :

If the spacing of truss is 4m and pitch of truss is 1:4 then self weight of truss may be taken as

$$W = \left(\frac{l}{3} + 6\right) \text{ kg/m}^2 \text{ of plan area.}$$

Q. In an industrial building, trusses are provided at a spacing of 4m and pitch of each truss is 1:4. The span of each truss is 6m. Self wt. of truss is taken as...



Plan

$$W = \frac{l}{3} + 6 = \frac{6}{3} + 6 = 8 \text{ kg (f)}/m^2$$

Total self wt. of truss = w × plan area for truss

$= 8 \times (6 \times 4)$

$= 192$ kg. $= 1.92$ kN

(1 kg (f) = 10N)

(b) Live loads.

If slope of truss is more than $10°$.

L.L. = 0.75 kN/m² − 0.02 kN/m² for every degree increase in slope above $10°$.

L.L. ≮ 0.4 kN/m²

Q. If slope of truss is $15°$, live load on truss is taken as.

$$L.L. = 0.75 - 0.02\,(15-10)$$
$$= 0.65 \text{ kN/m}^2.$$

© Snow- load:

2.5 N/m^2 for 1 mm depth of snow.

Note:

If the slope of truss is more than 50° ($\theta > 50°$) snow load need not be considered (because snow slips from roof surface)

(v) Economical spacing of trusses is the spacing that make overall cost of trusses, purlins, roof covering etc. to a minimum value. So for economic spacing of trusses

$$t = 2p + r$$

where,

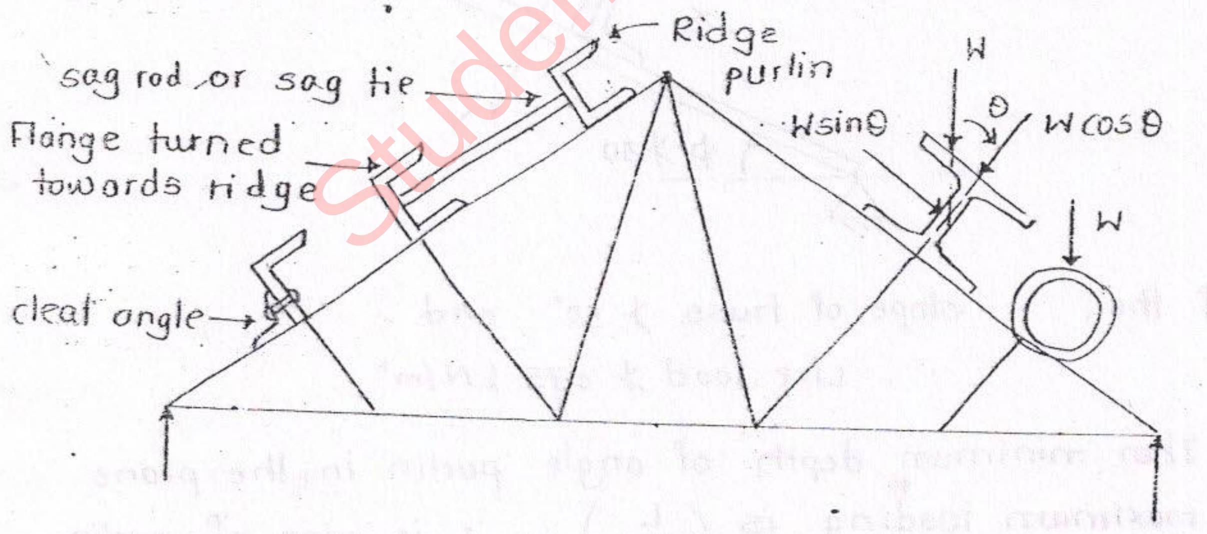
t - cost of trusses.

p - cost of purlins

r - cost of roof covering materials.

Design of purlins:

(Beams supporting roof covering material)



(i) Span of the purlin is equal to spacing of trusses.

(ii) Since purlins are continuous over more than two joints of trusses, they are designed as continuous beams.

(iii) Tubular sections are subjected to uniaxial bending and all other sections are subjected to bi-axial bending.

(iv) Purlins are interconnected by sag rods at the centre of span to reduce bending moment and deflections in the purlins.

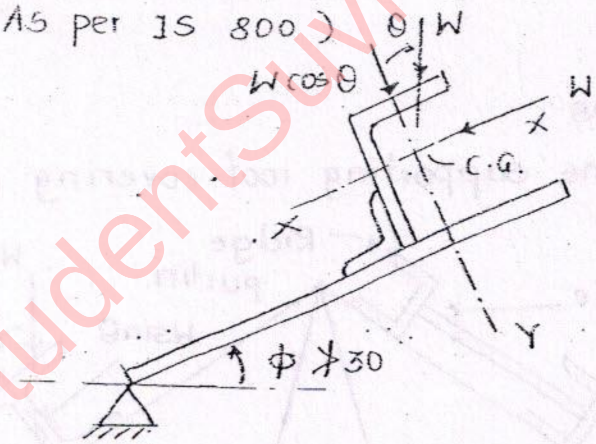
(v) Sag rods are provided in the plane of the roof. Sag rods reduce the span length of purlin so bending moment will be less.

(vi) The ridge purlins are subjected to vertical components of forces coming from sag rods.

(vii) The flange of section is turned towards the ridge to increase torsional stability of truss.

Simplified design of angle purlins:

(As per IS 800)



(i). If the slope of truss $\not> 30°$ and Live load $\not> 0.75\ kN/m^2$

Then minimum depth of angle purlin in the plane of maximum loading is $\left(\frac{L}{45}\right)$, L is span of purlin

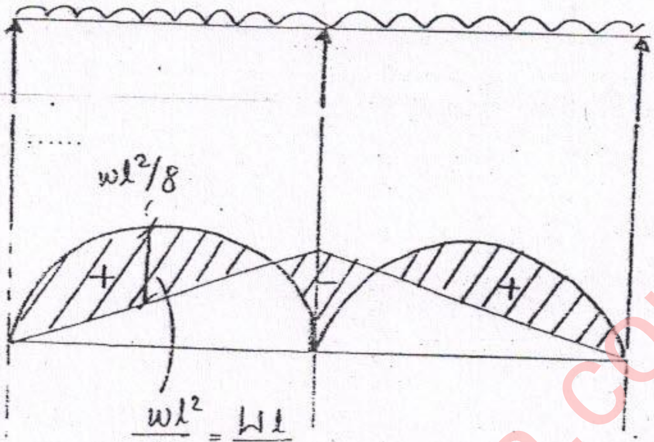
(ii) Minimum width of purlin $= \frac{L}{60}$

(iii) Max. B.M. in purlin $= M = \frac{WL}{10}$

W - total load on purlin (including wind load)

Note:

For simply supported purlins, max. B.M $= \frac{WL}{8}$. But since purlins are designed as continuous beams, max +ve B.M. is less. So $\frac{WL}{10}$ is taken as max. +ve B.M.



(iv) The loads are assumed to be acting normal to the roof surface. It means that $W \sin\theta$ is neglected i.e. the bending about minor axis Y-Y is neglected.

(v) $\sigma_{bc,cal} \not> \sigma_{bc}$.

$$\sigma_{bc} = (0.66 f_y) \times 1.33$$

(if wind load is considered)

(i.e. no reduction in permissible bending compressive stress)

(vi) $(y_{max})_{cal} \not> y_{max} = \frac{span}{325}$ (in WSM)

$= \frac{span}{300}$ (in LSM)

End