IMP

* Truss carries only axial forces. as Loading is done only on the joints.

* Frame carries all axial, torsion, bending forces as Loading is done anywhere on the members also.

⁂ TRUSS ⁂

Defination: A rigid structure composed of members which are fastened together by the smooth pins.

Purpose: To support a Heavy Load on Long span.

ASSUMPTION: Made in analysis of truss:-

(i) all joints are pin joints. (frictionless)

(ii) any Load act on the joint only not on the members because cross-sectional Area of members are too small. as compared to Length of members.

(iii) Weight of the members are negligible as compared to external applied Load, So they are neglected while analysis.

(iv) Temp. variation doesnot affect the stability of structure.

(v) All members are joined together by smooth pins.

(vi) All members carries only axial forces. may be tensile or compressive in nature.

METHODS TO FIND FORCES IN Members

1) Method of joints
2) Method of Sections
3) Graphical Method.

1) Method of joints

This method is based on the principle of concurrent force system.

So this method called as two force method.

FBD of each joint is necessary

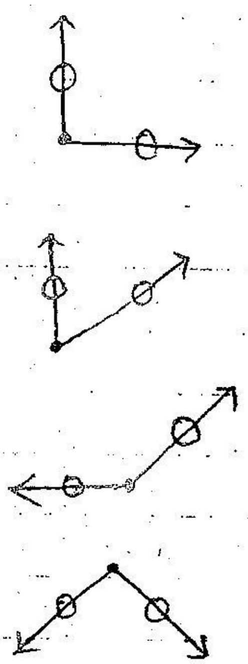
Direction of Force shows in all members which are intersect at joint while drawing FBD of joint.

- Apply only forces equilibrium condition, i.e $\Sigma Fx = 0$ and $\Sigma Fy = 0$. to Find Fesces in Members.
- So by this method, maxm two unknown forces can be determined in every analysis of FBD of joint.
- But this method is suitable when to find forces in all the members. or Corner members of the truss.

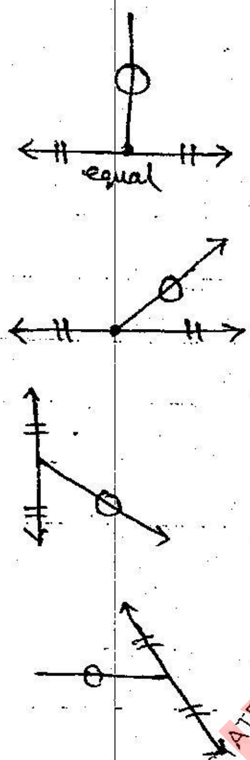
(2) SECTION METHOD

- This method is based on the principle of non-concurrent, non-parallel force System.
- So it is a 3 force method.
- FBD of section truss is necessary.
- Direction of force shows only in the cutting members which are cut by the section line. not in the complete member.
- Apply all the 3 equilibrium conditions i.e $\Sigma Fx = 0$, $\Sigma Fy = 0$ and $C = \Sigma M = 0$ to find forces in cutting members.
- So by this method Maxm 3 unknown force can be determined.
- But this method is suitable when to find forces in a particular member. or middle members of the truss.

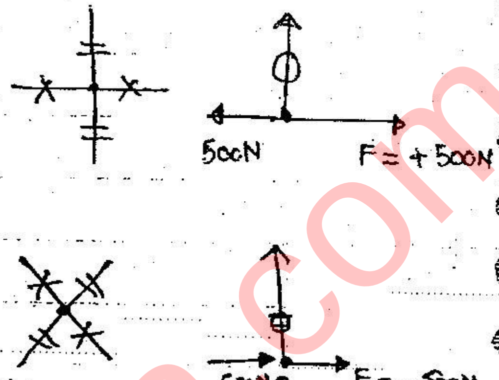
B.I Method (Simple without calc). To know forces in members



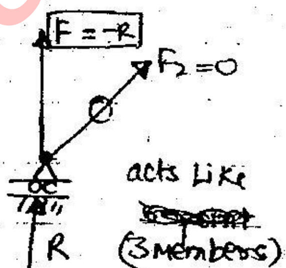
Only 2 Members are attached at a joint then forces in the 2 Members will be Zero.



At Joint 3 members are meeting.
The 2 Members which are co-Linear will have same Magnitude and sign.
and 3rd Member Making any angle will be Zero.

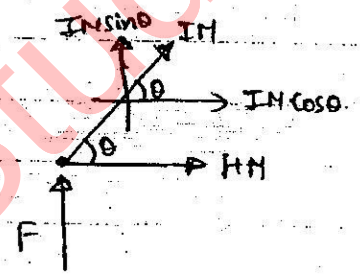


Co Linear Members will have Same Magnitude



acts Like (3 Members)

Force F and R will be collinear and the F_2 will be at an angle.
(Like 3 members and 1 Joint).



$\Sigma F_y = 0$

$F + IM \sin\theta = 0$

$$IM = -F/\sin\theta$$

Inclined Member.

$\Sigma F_x = 0$

$IM \cos\theta + HM = 0$

$-IM \cos\theta = HM$

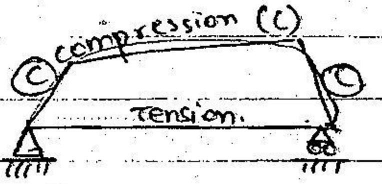
$$H_M = F/\tan\theta$$

Horizontal Member

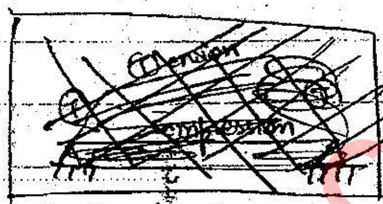
IMP: NOTE :- * If truss is simply supported truss and supports are at the extreme ends then top members starting from one support to second support always in compression and bottom members are in tension.

* While in cantilever truss, top members are in tension and bottom members are in compression.

TRICK



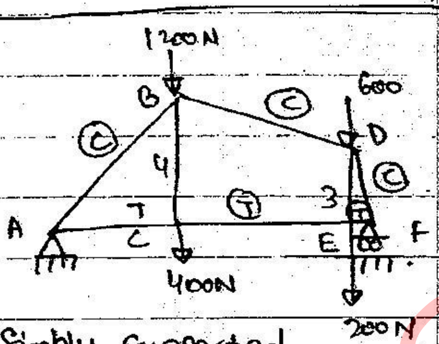
Simply supported has one ~~fixed~~ (hinged) support and one end roller support



Cantilever truss has both ends hinged.

always (vertically upside down)

Q.

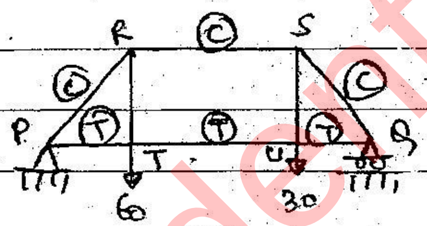


Simply supported

Match following Ⓐ Ⓑ Ⓒ Ⓓ

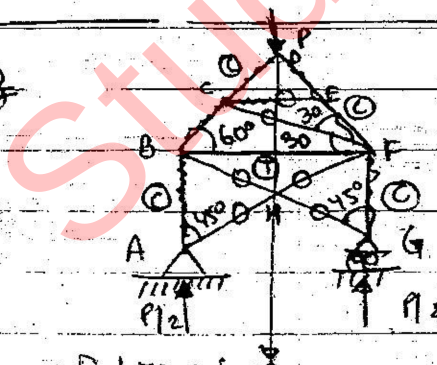
A) AB	i) 200 (T)	~~④~~	~~2~~	~~1~~	~~3~~
B) CE	ii) 948 (C) ✓	④	③	2	1
C) BD	iii) 800 (T)	~~3~~	~~4~~	~~1~~	~~2~~
D) DE	iv) 1800 (C)	~~1~~	~~3~~	~~4~~	~~2~~

Q



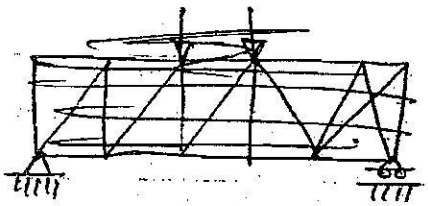
		Ⓐ	Ⓑ	Ⓒ	D
A) PR	1) 40 T	~~3~~	~~2~~	~~1~~	~~4~~
B) RS	2) 40 C	3	1	2	4
C) SU	3) 60 T	~~④~~	~~1~~	~~2~~	~~3~~
d) RT	4) 50√2 C	④	②	1	3

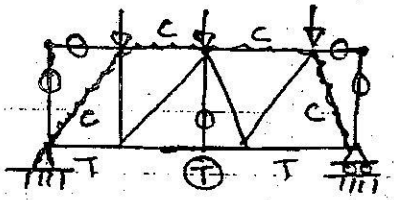
Q



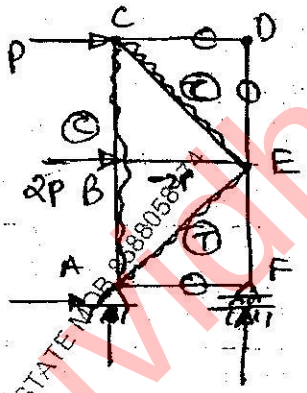
Find zero force Member

6 Members (Zero)

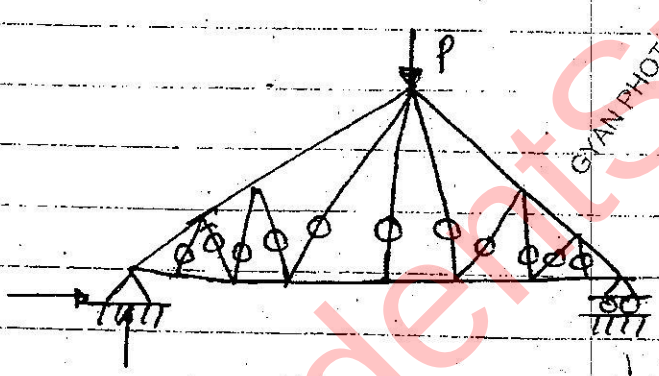


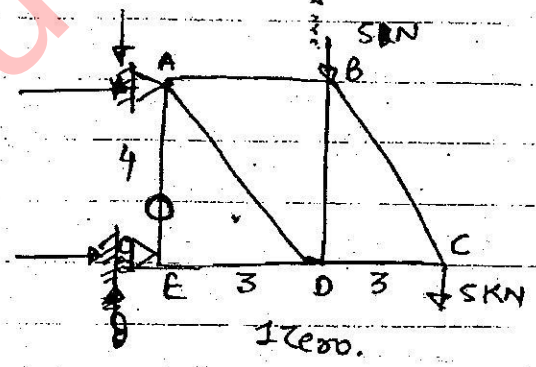


5 zeros

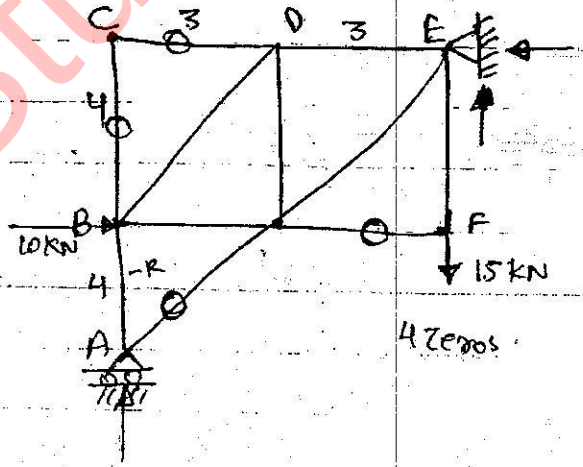


3 Zeros





1 Zero.



4 Zeros

Why zero force members are built up in the structure. Use scientific reason.

1) To increase Strength of structure.
2) To avoid the deformation of the structure
3) To increase the density of the structure
4) To transfer the Load from one member to another
5) To maintain the unity of the Structure.
6) To catch some Load when there is sudden application of Load, Vibrational Loads or earth quake Load.

Types of Truss

1) Perfect Truss / Stable Truss / determinent / just rigid truss

$M = 2j - R$

M = No. of Members
j = No. of Joints
R = Resistive reactions under supports.

2) Un-stable truss / Imperfect truss

$M < 2j - R$

3) Indeterminant / Redundant / Extra Rigid / over rigid truss

$M > 2j - R$

Ex:- SST (Simply supported truss) ⇒ R=3
(1 Hinge and 1 Roller)
(2 Reactions and 1 Reaction) ∴ R=3.

CST (Cantilever) ⇒ R=4 (2 Hinges) / (4 Reactions).

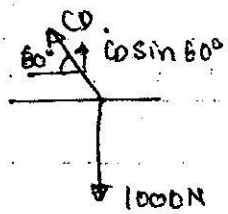
Every joint having 2 Resistive reactions (i.e Every joint forms concurrent force system) or Each member carries only axial forces
i.e we use $2j$. (2)

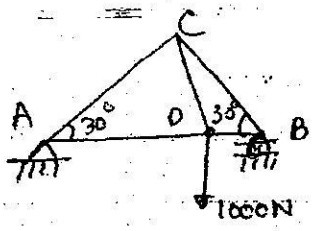
$x+y = PL$

$y(\frac{3L}{2}) = PL(\frac{3L}{2})$

Pg 56

→ Find CD



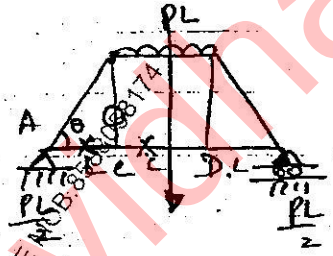


$CD \sin 60° = 1000$ $\quad CD = 1000 / \sin 60°$

Q5. $AC = \frac{PL/2}{\tan\theta}$

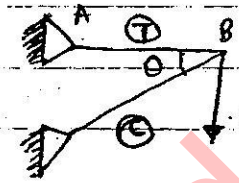
$AC = CD \quad \therefore \quad CD = \frac{PL/2}{\tan\theta}$

$CD = \frac{PL}{2}$



$\tan\theta = \frac{L}{L} = 1.$

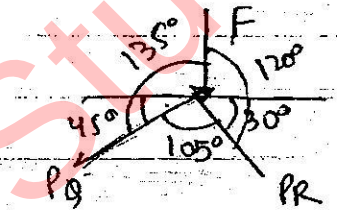
Q6

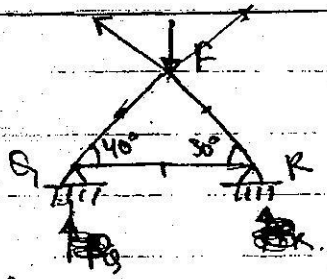


$AB = \frac{10}{\tan\theta} = 20KN$

$\tan\theta = \frac{0.5}{1}$

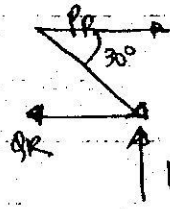
Q4





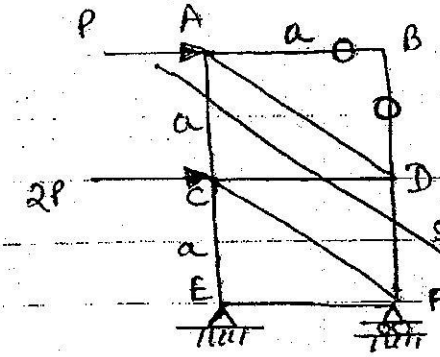
$\frac{F}{\sin 105°} = \frac{PR}{\sin 135°}$

$PR = \frac{F \sin 135°}{\sin 105°}$

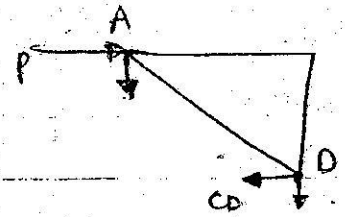


$PR\cos 30° = QR$

Find Force in CD



(We can find soln from either side)



$\Sigma F_x = 0$

$CD - P = 0$

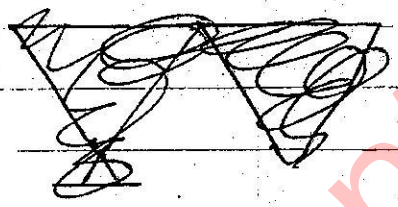
$\boxed{CD = P}$ Since we assumed CD to be tension and soln is +ve ∴ Tension in CD.

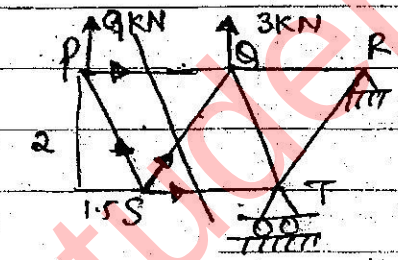
* Section Method Rules

(1) Section line must pass through atleast 3 members.

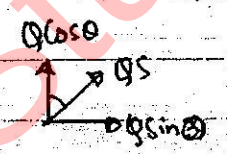
(2) All the cutting members should not be intersecting at the same common (single point) on either side of the Section line as it won't form Concurrent System.

(3) Section line must pass through req. member (if method is specified)





Force in QS.

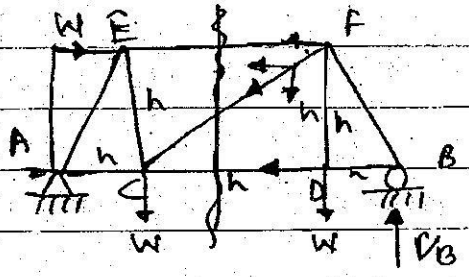


$QS \sin(\theta) = P = 9$

$QS = \frac{9}{\sin\theta}$

~~$\sin\theta = \frac{2}{2.5}$~~

$\left(\tan\theta = \frac{2}{1.5}\right)$



$M_A = 0$

$W \times h + W \times h + W \times 2h = V_B \times 3h$

$\boxed{V_B = \frac{4}{3} W}$

$-W - CF \sin 45° + \frac{4}{3} W = 0$

$\boxed{CF = 9}$

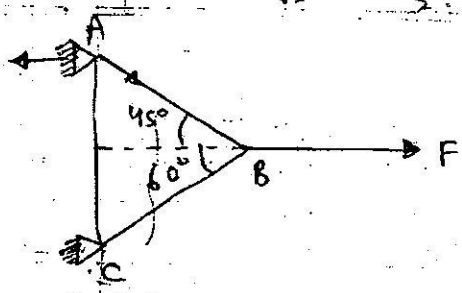
$T_{BC}\cos 60° + T_{AB}\cos 45° = F$

$T_{AB}\sin 45° = T_{BC}\sin 60°$

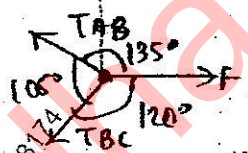
$\frac{T_{AB}}{\sqrt{2}} = \frac{T_{BC}\sqrt{3}}{2}$

1) If F = 1 KN, Find Vertical component at Hinge support C

2) Area of Each Members 100 mm^2, and Max^m permissible Stress 100 MPa should not be exceed in any member Find Safe Force F.



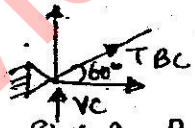
Soln $\frac{T_{AB}}{\sin 120°} = \frac{T_{BC}}{\sin 135°} = \frac{F}{\sin 105°}$.



if F = 1KN.

$T_{BC} = \frac{1 \times \sin 135°}{\sin 105°}$

$T_{BC} = 0.73\,N$



$T_{BC}\sin 60° = -R_{CV}$.

$[R_{CV} = -T_{BC}\sin 60°]$

(II) $A = 100mm^2$ $\sigma = 100MPa = 100N/mm^2$

Load = $\sigma \times A = 100 \times 100 = 10^4 N$. (Load in every member)

Let 10KN = AB (Load in AB) (T_{AB}) and Let (BC) = 10KN

$\frac{T_{AB}}{\sin 120°} = \frac{T_{BC}}{\sin 135°} = \frac{F}{\sin 105°}$

↓

Use T_{AB} first and find F
then use T_{BC}, find F.] Smallest of F will be answer.