EXAM:

MID TERM:

(STRUCTURE AANALYSIS)

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SECTION:

B

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20

SUBMITTED TO:

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QNo 1 :

Write a detail note in your own words on different types of loads the different types of structure are desigened to support through out its life. ELABORATE with examples.

Ans of Qno 1 :

The types of loads acting on structure for buildings and other structures can be classifed as.

1) Vertical loads
2) Horizontal loads
3) LonGitudnal loads

VERTICAL LOADS :

The vertical loads consist of dead load live load and impact load.

DEAD LOAD : (DL)

The first vertical load that is considered is dead load. Dead loads are Permanent or stationary loads which are transfered to structure through out the life span. Dead load is in many cases its own weight. like weight of walls, roofs etc.

EXAMPLE :

- → The load of the beams.
- → The load of the coloumn
- → The load of floor.

LIVE LOAD :

It is also known as imposed load.
The second vertical load that is considered in design of structure is imposed loads live load. Live loads are either movable loads without any acceleration or impact.
Live loads keep changing from

time to time. These loads are to be suitably ~~designed~~ assumed by the designer. It is one the major load in design.

EXAMPLE:

1. Educational buildings
2. Institutional, buildings
3. Assembly buildings.
4. Industrial buildings
5. storage rooms.

HORIZANTAL LOADS:

The horizantal load consist of wind load and earthquake load.

WIND LOADS:

The is horizantal load caused by the movement of air relative to earth. Wind load in structural design is to be considered in structural design specially.

For low rise building upto four or five wind load is not critical.
The horizontal forces exerted by the component of winds is to be kept in mind while designing the building.

EXAMPLE:

To design the wind velocity following expression is used.

$$V_z = K_1 . K_2 . K_3 . V_b$$

K_1 = Risk coefficient

K_2 = height or size.

K_3 = Topography factor.

Above 30m the wind pressure increces.

SNOW LOADS:

These type of loads are considerd only in the snow fall areas.
The minimum snow load on a roof area or any other area

above ground which is subjected to snow accumulation is obtaind by the expression.

$$S = \mu S_0$$

EARTH QUAKE LOAD :

Earthquake force constitute both vertical and horizantal on the building. The total vibration caused by the earthquake may be resolved into three mutually perpendicular direction.

Usually taken as one verticall and two horizontall directions.

ON STRUCTURE

The response of structure to the ground vibration is a function of foundation soil. size and mode of construction and the duration and intensity of ground motion.

HIGHWAY AND BRIDGE LOAD:

The Primary live load on Bridge spans are those due to traffic and heaviest loading encontered is that caused by the series of trucks.

The Bridge and highway are designed and than constructed by assuming the heaviest loads.

EXAMPLE:

The load imposed by the heavy running viechels on the highway. They are often designed for two axle truck plus one semi axle truck.

BUILDING LOADS:

The building floors are subjected to some uniform live loads for which the building is to be constructed. Each floor in the building is desinged for specific amount of load.

STRUCTURAL ELEMENTS:

The combination of structural elements or the elements which combines to make the structure. Different type of structure elements are as follow.

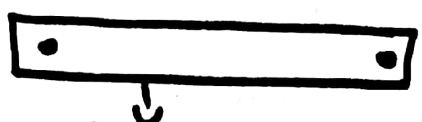
FRAMES:

The combination of beam and coloumn. which are fixed or pin joined. The frames are have rigid joints. This structure is intermediate.

TIE RODS:

The are generally selender shape membere and is used to carry tension.

O -> RoD



Tie Rod

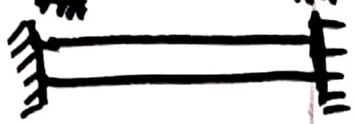
BEAM:

It is hobizantal member and support the vertical load. It generally

resist bending moment.
Beams are of many types some them are.

1, simply supported Beam.

2, Fixed supported BEAM.



COLOUMN:

The vertical member and generally resists compressive loads.

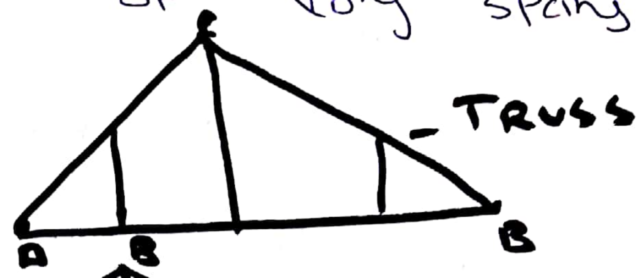
→ COLOUMN.

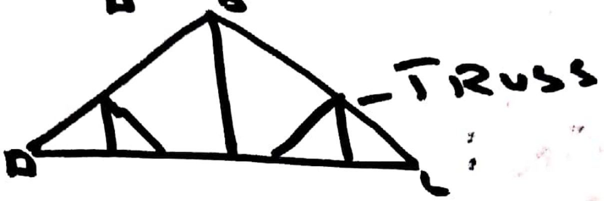
TRUSSES:

This consist of slender member joined in Triangular form. Due to its arrangement it generally carries Tensile and compoissive forces.

Space Trusse are used to cover

the areas of long spans.





CABLE AND ARCHES:

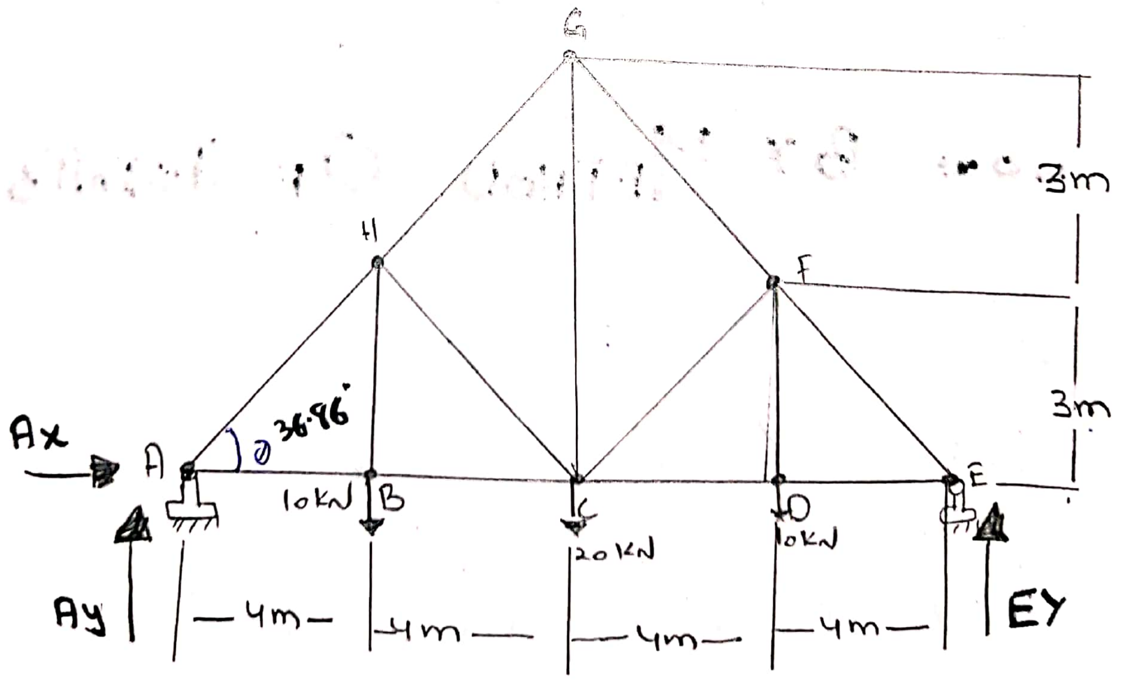
1, Cables are flexible and carry loads in Tension. They are commonly used in Bridges.

2, Arches are used to achive strength. They are generally rigid.

Q No 2:- Determine the forces in each member of truss. State if the member are in Tension or COMPRESION. Assume all members are Pin connected.

Ans OF Q No 2:

DIAGRAM:



$$\theta = \tan^{-1}\left[\frac{3}{4}\right]$$

$$\theta = 36.86°$$

SOLUTION:

$\Sigma F_y = 0$

$A_y + E_y = 40 \rightarrow ①$

$\Sigma F_x = 0 \qquad A_x = 0$

$\Sigma M_A = 0$ ↺

$(10 \times 4) + (20 \times 8) + (10 \times 12) - 16 E_y = 0$

$E_y = 20 \text{ kN}$

$E_y = 20 \text{ kN}$

~~Putting value of E_y in eq ①~~

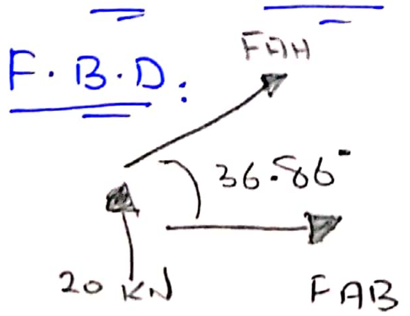
$A_y = 20 \text{kN}$

$A_y = 20 \text{kN}$

Now By Method Of Joints:

At Joint A:

F.B.D.:



$\Sigma F_y = 0 \quad \uparrow +$

$F_{AH} \sin(36.86°) + 20 = 0$

$F_{AH} = -25 \text{ kN}$

$(C) \rightarrow F_{AH} = 25 \text{ kN (COMPRESSION)}$

$\Sigma F_x = 0 \quad \overset{+}{\rightarrow}$

$F_{AH} \cos(36.86°) + F_{AB} = 0$

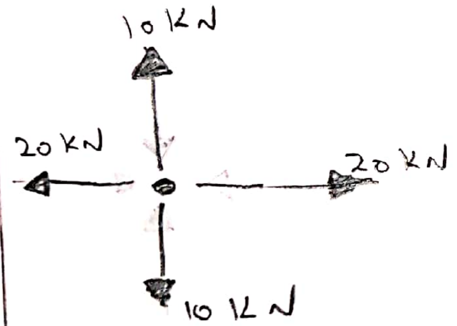
$(-25) \cos(36.86°) + F_{AB} = 0$

$F_{AB} = +20 \text{ KN}$

(T) → F_{AB} = 20 KN (TENSION)

→ **At Joint B :**

F.B.D :



$F_{BH} = 10 \text{ KN (T)}$

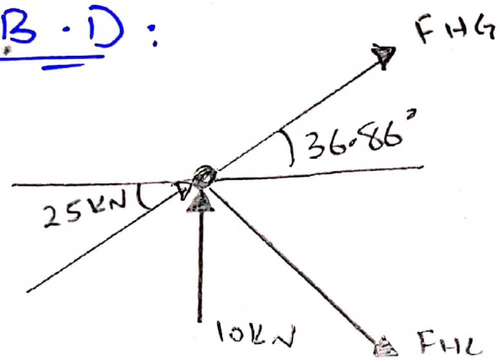
$F_{BC} = 10 \text{ KN (T)}$

F_{BH} = 10 KN (TENSION)

F_{BC} = 10 KN (TENSION)

→ **AT JOINT H :**

F.B.D :



$\Sigma F_y = 0 \uparrow +$

$0.6\, F_{HG} + 10 + 0.6(25) - 0.6\, F_{HC} = 0$

$0.6\, F_{HG} - 0.6 F_{HC} + 15 = 0$

$F_{HG} - F_{HC} = -25$

$F_{HG} - F_{HC} = -25$

$\Sigma F_x = 0 \quad \overset{+}{\rightarrow}$

$0.8\, F_{HG} + 0.8\, F_{HC} + (0.8)(25) = 0$

$F_{HG} + F_{HC} = -25 \longrightarrow (i)$

$F_{HG} - F_{HC} = -25$

$2\, F_{HG} = -50$

So

$F_{HG} = -25$

$F_{HG} = 25\ KN$ (COMPRESSIVE)

Putting it in eq (i)

$-25 - F_{HC} = -25$

$F_{HC} = 0$

$F_{HC} = 0$

By THE LOADING CONCLUSION:

$F_{CH} = F_{CA} = 0$

$F_{EF} = F_{AH} = -25\ KN$ (C)

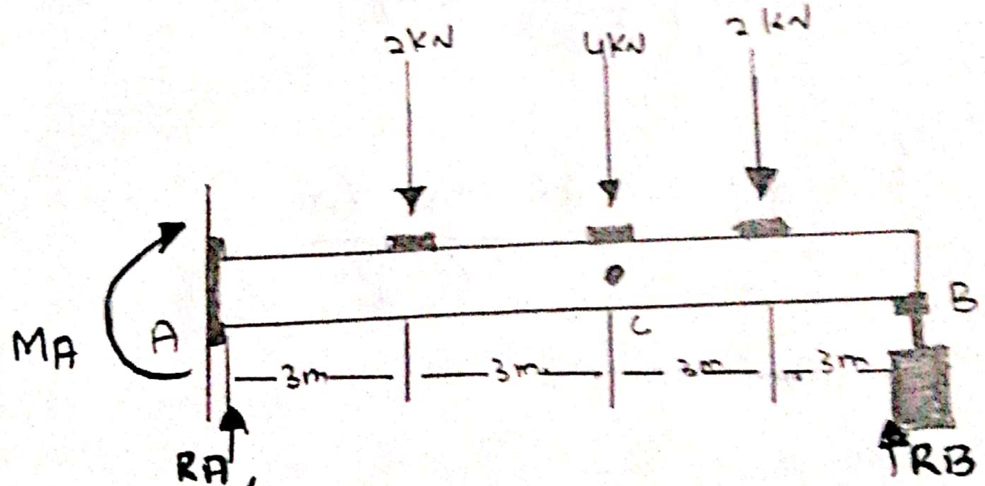
$F_{ED} = F_{AB} = 20\ KN$ (T)

$F_{FD} = F_{HB} = 10\ KN$ (T)

$F_{FG} = F_{HG} = 25\ KN$ (C)

Q No 3: Determine the SLOPE AT "A" and displacement At "C" of the Beam in the FIGURE a): By MOMENT-AREA THEOREM and Take $E = 200 GPa$
$I = 6(10^6)\ mm^4$

DIAGRAM:



SOLUTION:

$+\uparrow \quad \downarrow -$

$\Sigma F_y = 0$

$R_A + R_B = 2 + 4 + 2$

$R_A + R_B = 8\ kN$

Now As the beam is symetric in terms of Load.

So $R_A = R_B = 4\,KN$

$\curvearrowleft +\quad \Sigma M_A = 0$

$M_A + 2\times3 + 4\times6 + 2\times9 - 4\times12 = 0$

$M_A + 48 - 48 = 0$

$M_A = 0$

$M_A = 0$

$$t_{c/A} = \int_A^c \frac{M}{EI} \times (X) \, dx$$

$$\tan \theta_A = \frac{\Delta_c + t_{c/A}}{6}$$

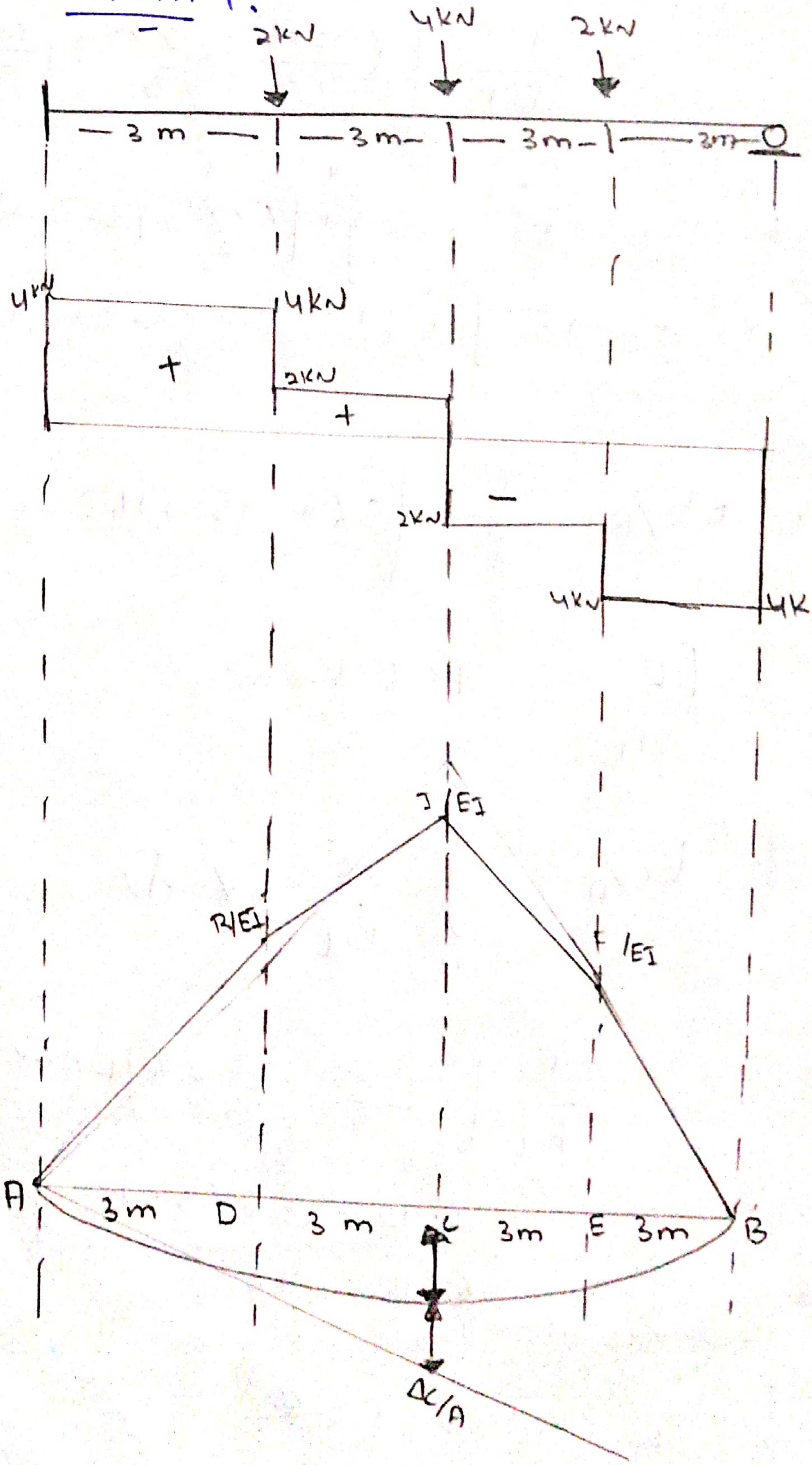
a ~~θ c~~

$\tan \theta_A \approx \theta_A$

$$\theta_A = \frac{\Delta_c + t_{/A}}{6} = \frac{t_{b/A}}{2}$$

$$\Delta_c = t_{B/A} - t_{c/A}$$

Shear Force And Bending Moment Diagram:



$$t_{B/A} = \int_A^B \frac{M}{EF} \times dx$$

$$= \frac{I}{EI}\left[\left(\frac{12\times3}{2}\right)\times\frac{2}{3}\times3 + \left(\frac{6\times3}{2}\times\left(3+\frac{2}{3}\times3\right.\right.\right.$$

$$\left. + (12\times3) + (3\times1.5)\right]^{*} + \left[\frac{6\times3}{2}\times\left(3+3+\frac{1}{3}\times3\right) + (12\times3\right.$$

$$\left.\times(3+3+1.5)\right] + \left(\frac{12\times3}{2}\times\left(3+3+3+\frac{1}{3}\times3\right)\right]$$

$$t_{B/A} = \frac{I}{EI}\left[36+45+162+63+270+180\right]$$

$$t_{B/A} = 756 \text{ KN-m}^3$$

$$t_{C/A} = \int_A^C \frac{M}{EI}\bar{x}\, dx$$

$$= \frac{I}{EI}\left[\left(\frac{12\times3}{2}\times\frac{2}{3}\times3\right] + \left(\frac{6\times3}{2}\right)\left(\frac{3+2\times3}{3}\right)\right.$$

$$\left. + (12\times3)\times(3+1.5)\right]$$

$$t_{C/A} = 36+45+162$$

$$t_{C/A} = 243 \text{ KNm}^3$$

For Slope At A:

θ_A = Area Under curve A to C

$\theta_A = \not{E}$

Method 1:

$$\theta = \frac{1}{EI}\left[\frac{12\times3}{2} + \left(\frac{6\times3}{2} + 12\times3\right]\right.$$

$$\theta = \frac{63}{EI} \rightarrow \theta = \frac{63}{EI}$$

Method 2:

$$\theta = \frac{66/2}{12}$$

$$\theta = \frac{756}{12\,EI}$$

$$\theta = \frac{63}{EI}$$

$$\theta = \frac{63}{EI}$$

FOR DISPLACEMENT AT "C":

As we know that

$$\theta_A = \frac{\Delta_C + \frac{+B}{A}}{6}$$

$$\Delta_C = \theta_A \times 6 - \frac{+B}{A}$$

$$\Delta_C = 0.052 \times 6 - \frac{243}{EI}$$

$$\Delta_C = 0.315 - \frac{243}{(200\times10^{6})(6\times10^{-6})}$$

$$\Delta_C = 0.315 - 0.2025$$

$$\Delta_C = 0.1125\ m$$