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SECTION :- "B"

DEPT. :- BE Civil

SUBJECT :- Structural Analysis.

IQRA NATIONAL UNIVERSITY:

Question #01:

=> Write a detail note in your own words on different types of loads that different types of structures are designed to support throughout its life. Elaborate with examples.

ANSWER:

=> LOADS:-

It is the dimensional requirement for a structure necessary to determine the loads, that the structure must support.

=> TYPES OF LOADS:

There are different types of loads which are as follows:-

1) Dead loads.
2) Live loads.

1. DEAD LOADS:-

Dead loads consist of the weights of the various structural members and the weights of any objects that are permanently attached to the structure.

Hence, for a building, the dead loads include the weights of

the columns, beams, and girders, the floor slab, roofing etc.

**Example:-**

1) Columns.
2) Beams.
3) Floor slab.
4) Roofing
5) walls.
6) Windows.
7) Plumbing.
8) Electrical fixtures.

## 2. Live Loads:-

"Live loads can vary both in magnitude and location".

They may be caused by the weights of objects temporarily placed on a structure, moving vehicles or natural forces.

**Example:-**

1) Weight of people on structure.
2) Things placed on structure
3) Winds. etc.

## ⇒TYPES OF Structures:-

⇒ The combination of structural elements and the materials which functions as a structural system. Each system consists of one or more of four types of structure.

⇒ Differents types of structures are as follows :-

1) Trusses.
2) Cables and Arches.
3) Frames.

## 1. TRUSSES:-

⇒ When the span of a structure is required to be large and its depth is not an important criterion for design, a truss may be selected.

" Trusses consist of slender elements, usually arranged in triangular fasion."

Due to the geometric arrangement of its members, loads that cause the entire truss to bend are converted into tensile or compressive forces in the members.

⇒ Planar trusses are composed of members that lie in the same

plane and are frequently used for bridge and roof support.

=> Space trusses have members extending in three dimensions and are suitable for towers and derricks.

## 2. CABLE AND ARCHES:-

=> "It is one of the types of structures that is used to span long distances".

=> Cables are flexible and carry the loads in tension. They are commonly used to support bridges, roofs.

=> Arches achieves strength in compression and has a reverse curvature to cable. It must be rigid to maintain its shape. Consists of shear and moment. They are used in bridge structures, dome roofs and openings.

## 3. Frames:

⇒ "One of the types of structures which are used in buildings and consists of beam and column", which are fixed or pinned connected.

The load on frames causes boudings of its members and has rigid joint connections. This structure is indeterminate.

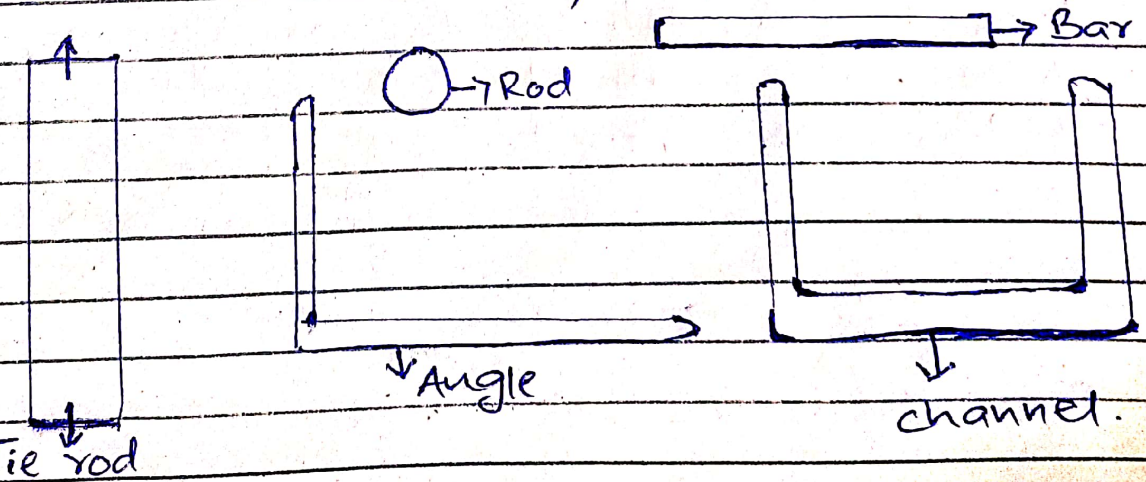
## ⇒ STRUCTURAL ELEMENTS:

Following are the elements of structure:-

1) Tie Rods.
2) Beams
3) Columns.

### 1. Tie Rods:-

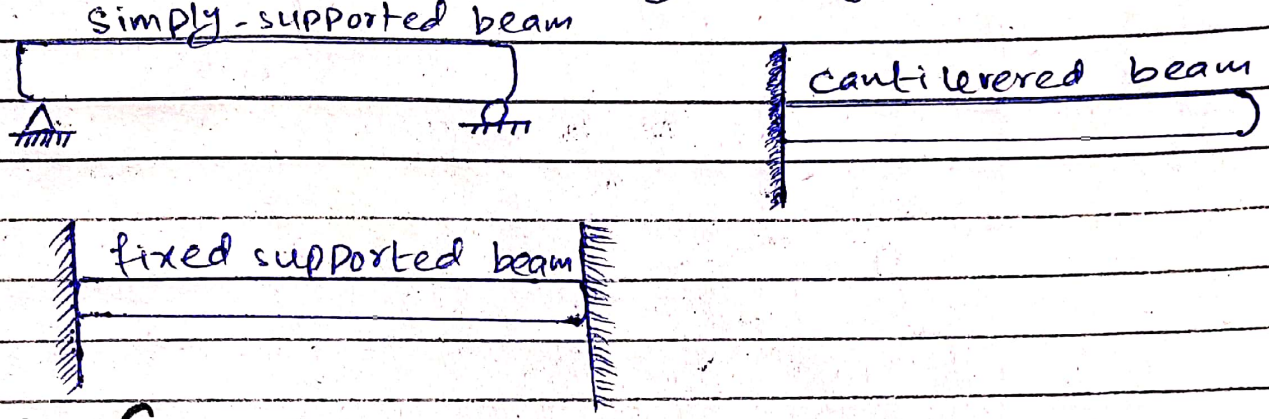
⇒ Consists of tensile force. These members are cleuders, bars or rods.



## 2. Beams:-

"Beams are horizontal members and supports vertical loads."

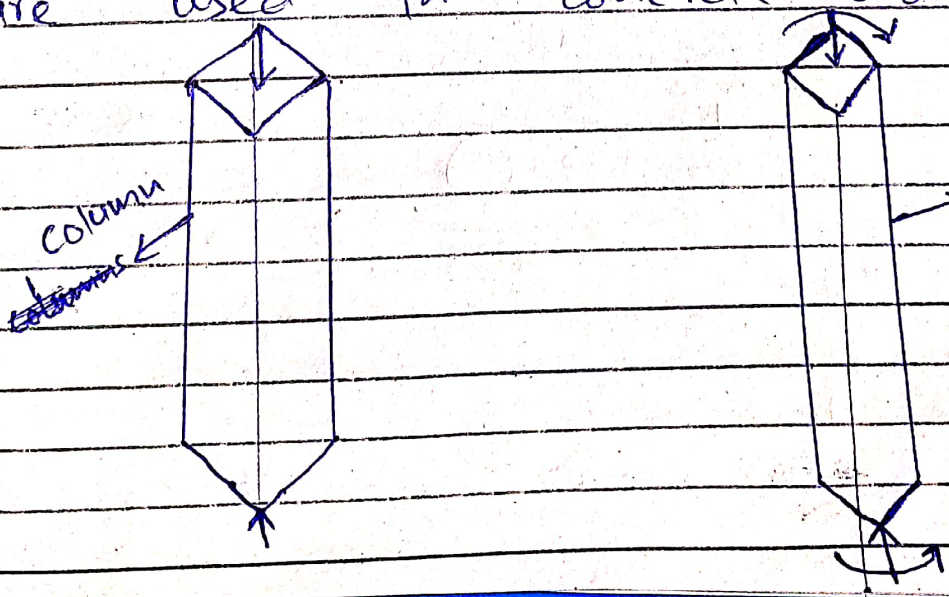
⇒ It resists bending moments, short every large loads.




## 3. Columns:-

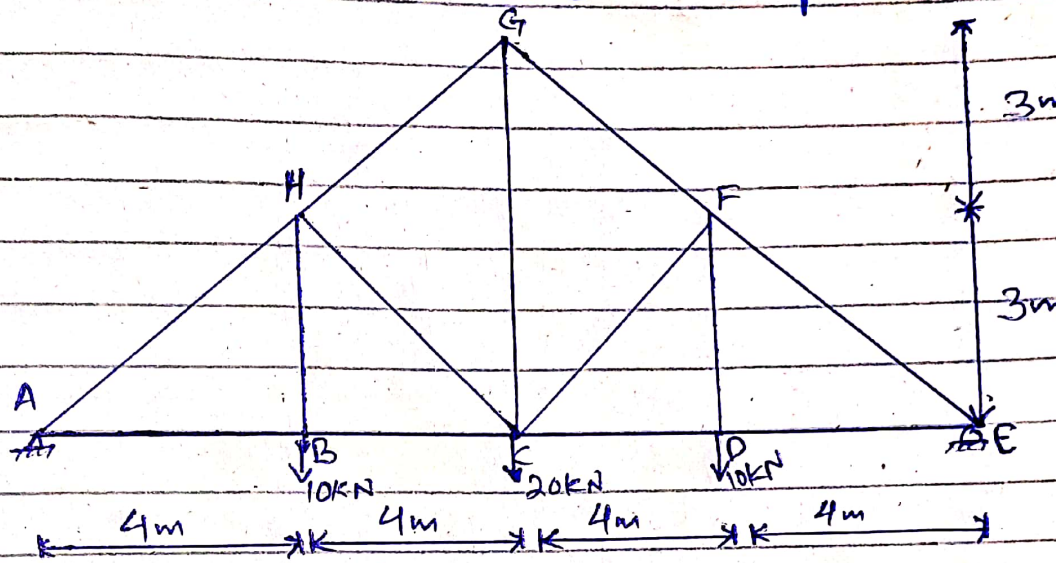
"They consists of vertical members and resists compressive loads".

⇒ Tubes and wide-flange across sections are used for metal columns. And square cross-section rods are used for concrete work.



Question # 02:-

Determine the force in each member of the truss. State if the members are in tension or compression. Assume all members are pin connected.




=> Solution:-

Support reactions:-

$\Sigma F_y = 0$

$\uparrow^{+} \downarrow^{-}$

$R_A + R_E = 40$ ——— (A)

$\Sigma M_A = 0 \; (\circlearrowright -)$

$R_E(16) + 10(12) + 20(8) + 10(4) = 0$

$R_E = \frac{320}{16} = 20KN$

putting $R_E = 20KN$ in (A)

$R_A = 20KN$

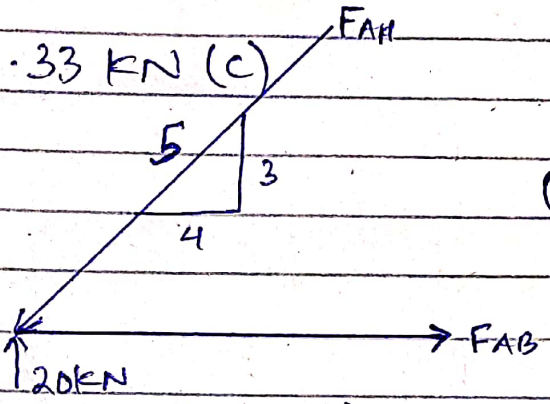
Now determining force in each member.

## JOINT A :-

$\Sigma F_y = 0$ ; $-3/5 (F_{AH}) + 20KN = 0$

$= -0.6 (F_{AH}) = -20KN$

$F_{AH} = 33.33 KN (C)$




(Joint - A).

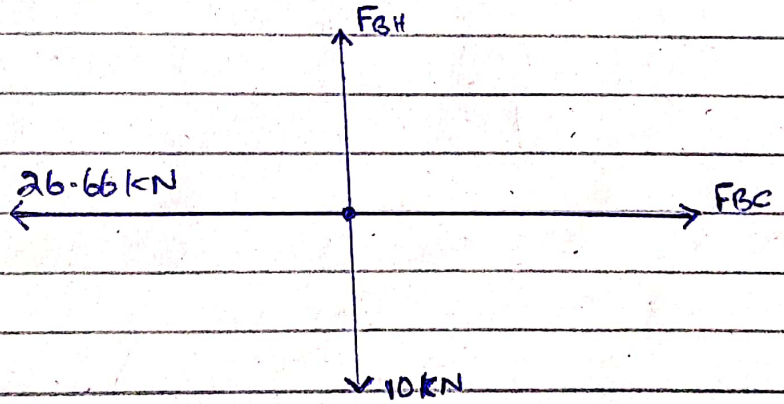
$\Sigma F_x = 0$ ; $-4/5 (33.33) + F_{AB} = 0$.

$\Rightarrow F_{AB} = 26.66KN$ (T)

## JOINT B :-

$\Sigma F_x = 0$ ; $F_{BC} = 26.66 KN$ (T)

$\Sigma F_y = 0$ ; $F_{BH} = 10 KN$ (T).




(Joint - B)

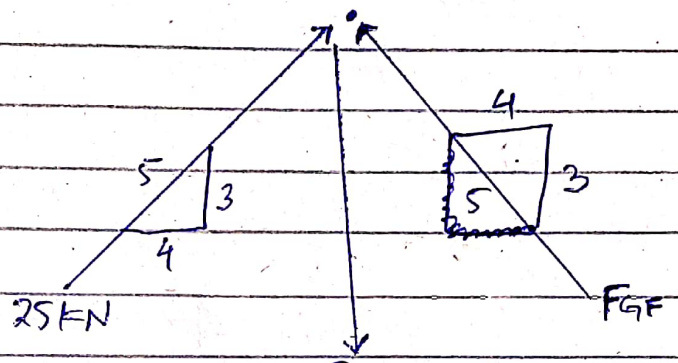
## JOINT G:-

$\Sigma F_x = 0$; $4/5\,(25) - 4/5\,(F_{GF}) = 0$

$F_{GF} = 25\,kN$ (C).

$\Sigma F_y = 0$ ; $3/5\,(25) + 3/5\,(25) - F_{GC} = 0$

$F_{GC} = 30\,kN$ (C).




(Joint G :).

## Joint H :-

$\Sigma F_y = 0$; $3/5\,(33.33) - 10kN + \frac{3}{5}(F_{HC}) - \frac{3}{5}(F_{HG})$ —*

$\Sigma F_x = 0$; $4/5\,(33.33kN) - 4/5\,(F_{HC}) - 4/5\,^{5}(F_{HG})$ $\frac{5}{}$ —⊛

Solving both equations.

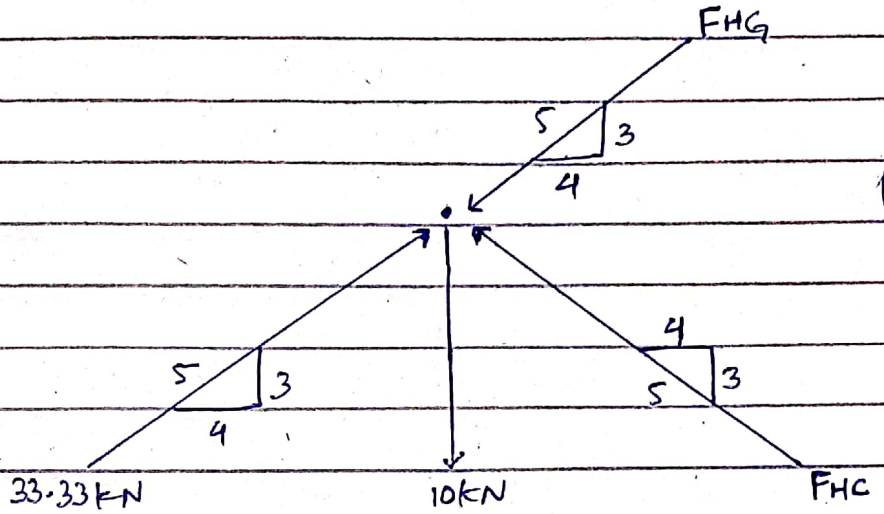
$19.98 - 10 + 0.6F_{HC} - 0.6F_{HG} = 0$ —— ①

$26.66 - 0.8F_{HC} - 0.8F_{HG} = 0$ —— ②

multiplying eq ① by 1.34 and then add with eq ② we get;

$F_{HG} = 25\,kN$ (C)

$F_{HC} = 8.34\,KN$ (C)




Due to symmetrical loading & Geometry.

$F_{AB} = F_{ED} = 26.66\ KN\ (T)$.

$F_{BC} = F_{DC} = 26.66\ KN\ (T)$.

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

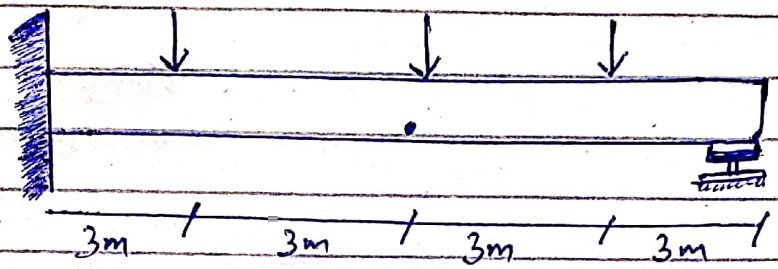
$F_{HG} = F_{FG} = 25\ KN\ (C)$.

$F_{HC} = F_{FC} = 8.34\ KN\ (C)$.

$F_{AH} = F_{CF} = 33.33\ KN\ (C)$.

**QUESTION. # 03 :-**

Determine the slope at A and displacement at C of the beam in the figure by a). Moment area Theorem and Take $E = 200\ GPa$, $I = 6(10^6)\ mm^4$




**Solution:-**

**Given data:-**

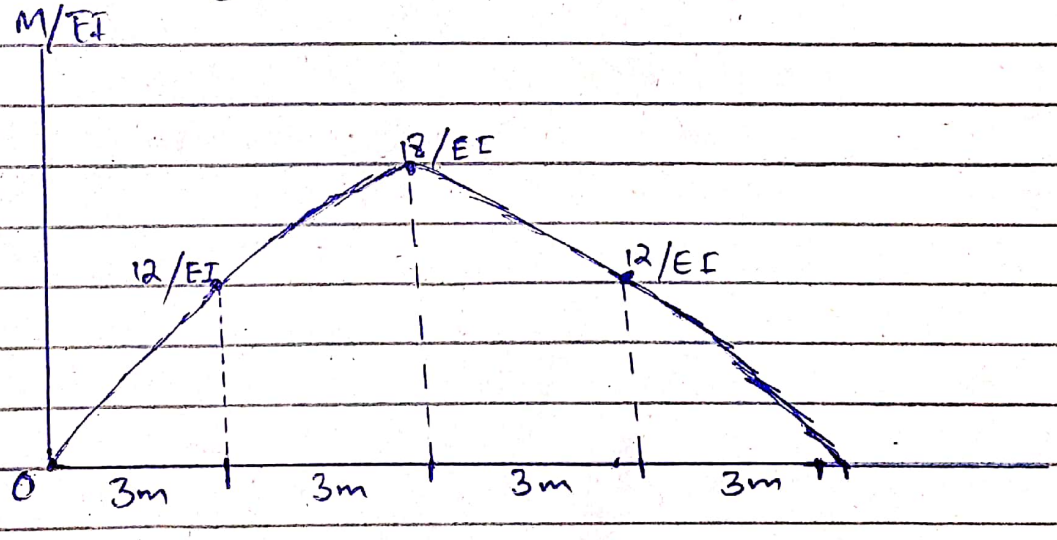
$E = 200\ GPa$

$I = 6 \times 10^6\ mm^4$

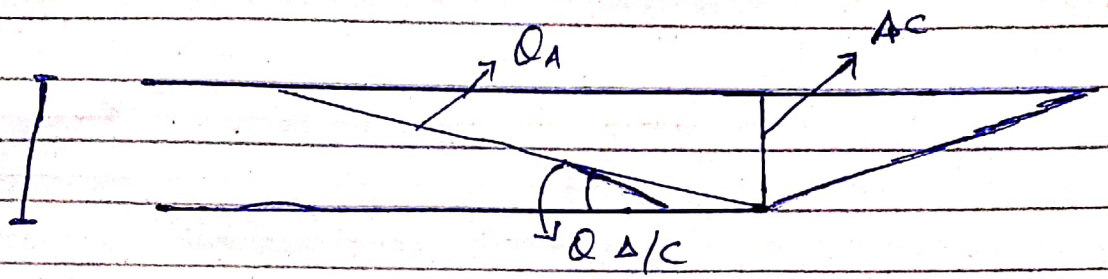
**Solution:-**

i) Finding the cut M/EI diagram of elastic curve.

**Moment diagram:-**



=> Elastic Curve:-




$$\theta_{A/C} = 1/2\,(12/EI)\,3 + (12/EI)\,3 + 1/2\,(6/EI)\,(3)$$

$$\theta_{A/C} = 18/EI + 36/EI + 9/EI.$$

$$\theta_{A/C} = 63/EI$$

Putting values of 'E' and 'I'

$$\theta_{A/C} = 63/(200\times10^6)(6\times10^6)(1000)^{-4}$$

$$\theta_{A/C} = 0.0525 \text{ rad.}$$

$\theta_A = 0.0525$ rad Ans.

$$t_{A/C} = \left[1/2\,(12/EI)\,(3)\right](2/3\,(3)) + \left[12/EI\,(3)\right]\left(\frac{3+1(3)}{2}\right) + \left[1/2\,(6/EI)\,(3)\right]\left(3+2/3\,(3)\right) = 0.202\text{m}$$

$\Delta_C = t_{A/C} = 0.202$m.

OR

$= 202$mm. Ans