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Sec- B.

Subject- Structural Analysis - I.

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Question No 1:-

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

Ans- LOADS:-

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

Types of Loads:-

There are different types of loads which are:

1) DEAD LOADS:-

It consists of structural members that are permanently attached to structure. Dead loads includes the

weights of columns, beams, girders, electrical fixtures and other attachments.

2) LIVE LOADS :-

Live load can vary both in their magnitude and location. These loads are caused by weights of temporary objects, moving vehicles, natural forces. Consists of additional protection against excess deflection and overload.

EXAMPLE :-

The live floor loading in classroom consists of desks, chairs and laboratory equipment.

Types of Structures:-

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

Different types of structures are:

1) TRUSSES:-

Trusses consists of slender elements in triangular form. Due to geometric arrangements of its members binds are converted into tensile or compressive forces in members.

→ Planar trusses are composed of members, lies in same plane and used for bridges and roof support.

→ Space trusses have members extending in three dimensions and used for derricks and towers.

2) CABLES AND ARCHES:

It is the types of structures used to span long distances.

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

→ Arches achieve 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:-

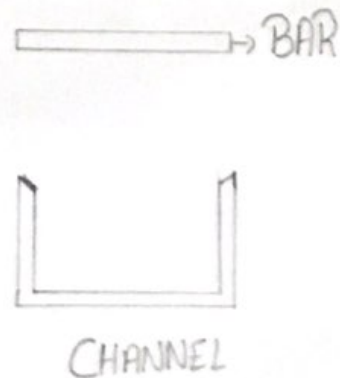
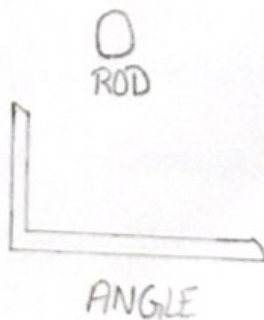
Types of structure which are used in buildings and consists of beam and column, which are fixed or pin connected. The load on frames causes bending of its members and has rigid joint connections. This structure is indeterminate.

STRUCTURAL ELEMENTS:-

Some of elements are.

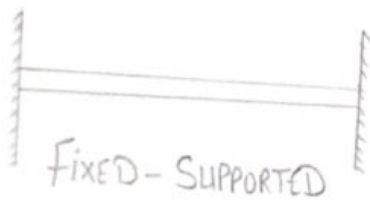
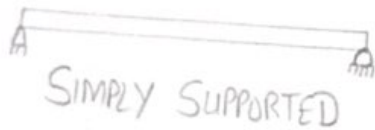
1) TIE RODS:-

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



2) BEAMS:-

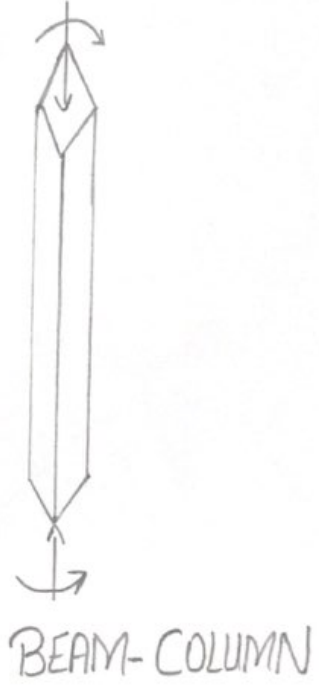
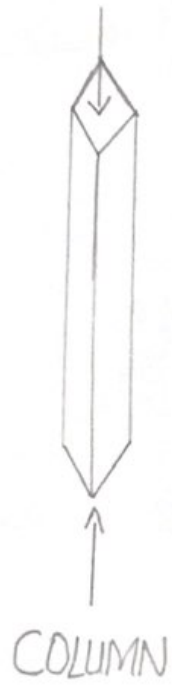
They are horizontal members and supports vertical loads. It resists bending moments, short carry large loads.



3) Columns:-

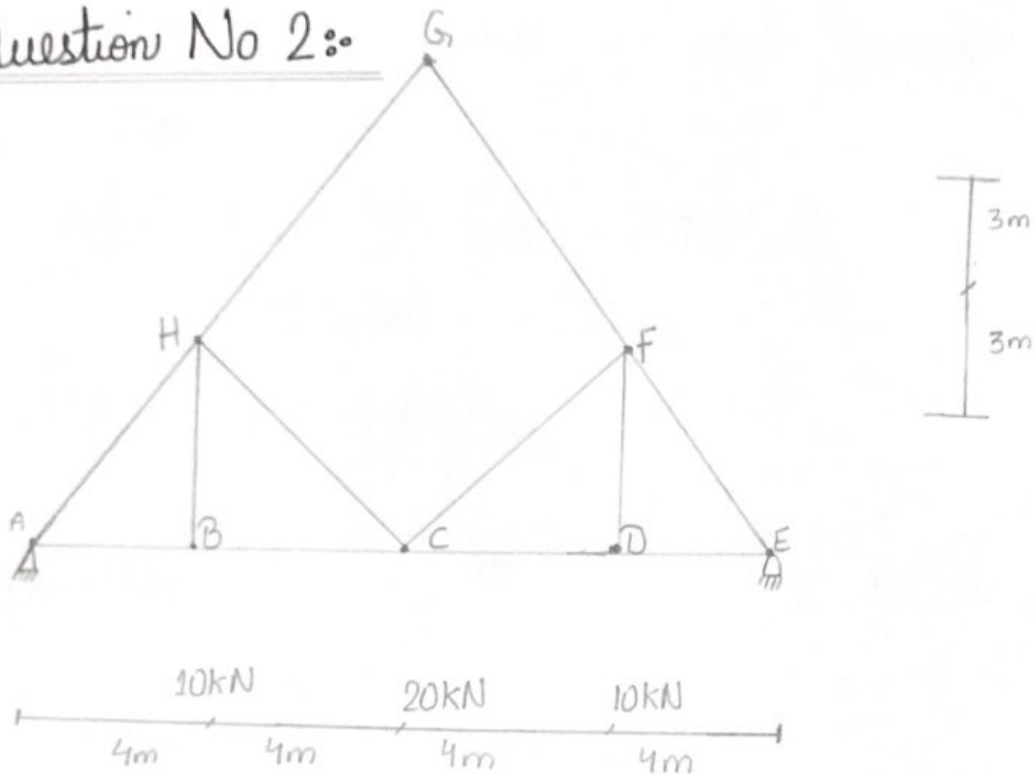
They consists of vertical members and resists compressive loads. Tubes and wide-flange across sections are used for metal columns and square cross sections rods are used for concrete work.

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Question No 2:-



Forces in each member = ?

Sol:-

Support reactions:

$$\sum F_y = 0 \uparrow \downarrow$$

$$R_A + R_E = 40 \text{ --- (A)}$$

$$\sum M_A = 0 \curvearrowright -$$

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

$$R_E = 320/16 = 20 \text{ kN}$$

$$\text{Put } R_E = 20 \Rightarrow R_A = 40 - 20 = 20 \text{ kN.}$$

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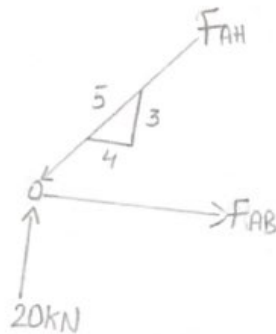
Now determining force in each member.

Joint A:-

$$\begin{aligned}\sum f_y &= 0; -3/5 (F_{AH}) + 20 \text{ kN} = 0 \\ &= -0.6 (F_{AH}) = -20 \text{ kN}\end{aligned}$$

$$F_{AH} = 33.33 \text{ kN (C)}$$

Joint A:

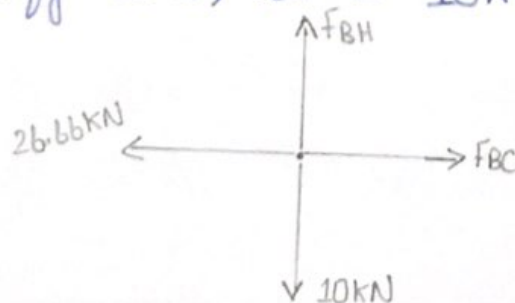


$$\begin{aligned}\sum f_x &= 0; -4/5 (33.33) + F_{AB} = 0 \\ &= F_{AB} = 26.66 \text{ kN (T)}\end{aligned}$$

Joint B:-

$$\sum f_x = 0; F_{BC} = 26.66 \text{ kN (T)}$$

$$\sum f_y = 0; F_{BH} = 10 \text{ kN (T)}$$



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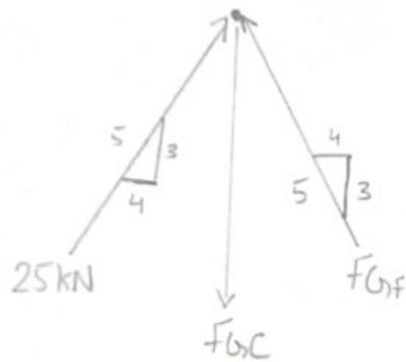
Joint G:-

$$\sum f_x = 0; \frac{4}{5}(25) - \frac{4}{5}(F_{GF}) = 0$$

$$F_{GF} = 25 \text{ KN (c)}$$

$$\sum f_y = 0; \frac{3}{5}(25) + \frac{3}{5}(25) - F_{GC} = 0$$

$$F_{GC} = 30 \text{ KN (c)}$$



Joint H:-

$$\sum f_y = 0; \frac{3}{5}(33.33) - 10 \text{ KN} + \frac{3}{5}(F_{HC}) - \frac{3}{5}(F_{HG}) = 0 \text{ --- (A)}$$

$$\sum f_x = 0; \frac{4}{5}(33.33 \text{ KN}) - \frac{4}{5}(F_{HC}) - \frac{4}{5}(F_{HG}) = 0 \text{ --- (B)}$$

Solving eq (1) and eq (2)

$$19.98 - 10 + 0.6 F_{HC} - 0.6 F_{HG} = 0 \text{ --- (A)}$$

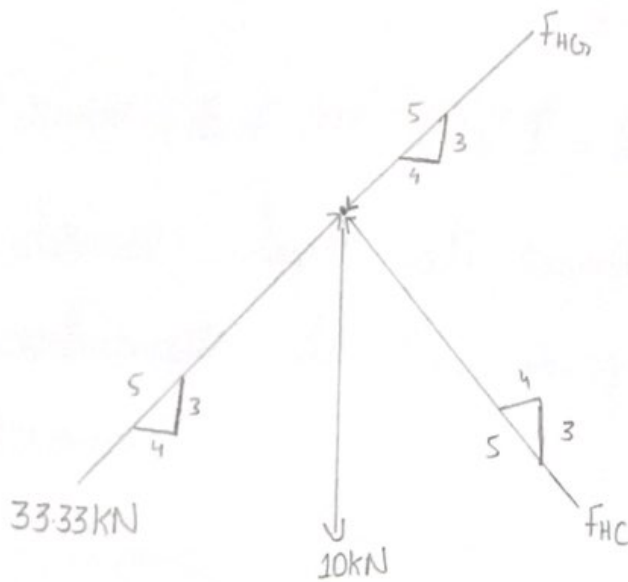
$$26.66 - 0.8 F_{HC} - 0.8 F_{HG} = 0 \text{ --- (B)}$$

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Multiplying eq (A) by 1.34 and then add with eq (B) we get.

$$F_{HG} = 25 \text{ KN (c)}$$

$$F_{HC} = 8.34 \text{ KN (c)}$$



Due to symmetrical loading and Geometry.

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

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

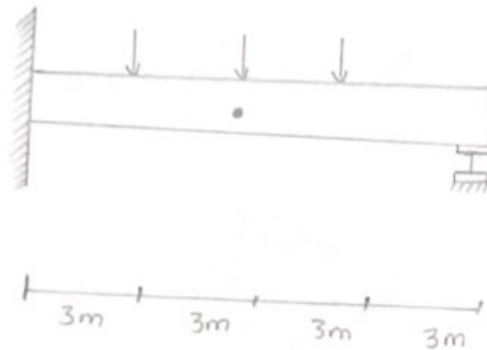
$$F_{BH} = F_{DF} = 10 \text{ KN (T)}$$

$$F_{HG} = F_{GL} = 25 \text{ KN (c)}$$

$$F_{HC} = F_{CH} = 8.34 \text{ KN (c)}$$

$$F_{AH} = F_{HL} = 33.33 \text{ KN (c)}$$

Question No 3 :-



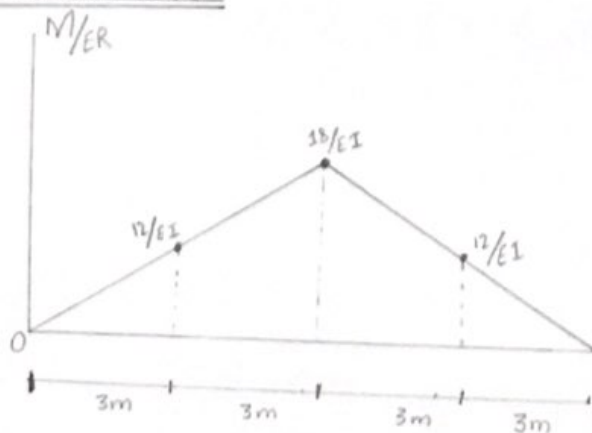
Given : $E = 200 \text{ Gpa}$, $I = 6 \times 10^6 \text{ mm}^4$

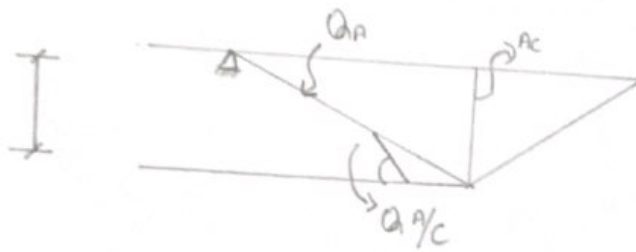
Determine slope at point 'D' and displacement at 'C' using Moment Area Theorem.

Solution :-

- (i) Finding out M/EI Diagram and elastic curve.

MOMENT DIAGRAM :-



ELASTIC CURVE::

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

$$\theta_{A/C} = \left(\frac{18}{EI} \right) + \left(\frac{36}{EI} \right) + \left(\frac{9}{EI} \right)$$

$$\theta_{A/C} = \frac{63}{EI} \Rightarrow \frac{63}{(200 \times 10^6) (6 \times 10^6) (1000)^{-4}}$$

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

$$\theta_A = 0.0525 \text{ rad Ans.}$$

$$\begin{aligned} \delta_{A/C} &= \left[\frac{1}{2} \left(\frac{6}{EI} \right) (3) \right] \left(\frac{2}{3} (3) \right) + \left[\frac{12}{EI} (3) \right] \left(3 + \frac{1}{2} (3) \right) + \\ &\quad \left[\frac{1}{2} \left(\frac{6}{EI} \right) (3) \right] \left(3 + \frac{2}{3} (3) \right) \\ &= 0.202 \text{ m} \end{aligned}$$

So

$$\Delta_C = \delta_{A/C} = 0.202 \text{ m}$$

$$= 202 \text{ mm Ans.}$$