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Section : A

Semester : 12 (Batch-14)

Paper : Structural Analysis - I

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"Iqra National University"

Q No 1:

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 load includes the weight of colums, 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 floor loading in classroom consists of disks, chairs and laboratory equipment.

Types of structures:

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

Different types of structure are;

1. Trusses:

Trusses consists of slender elements in Traingular 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 Towers.

2. Cables & Arches:

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

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

→ Arches archieves strength in compression and has a revers curvature to cable. It must be rigid to maintain its shape. consists of shear and moment. They are used in bridge structures, roofs and openings.

3. Frames:

Types of structure which are used in buildings and consists of beams and column which are fixed or Pin connected. The

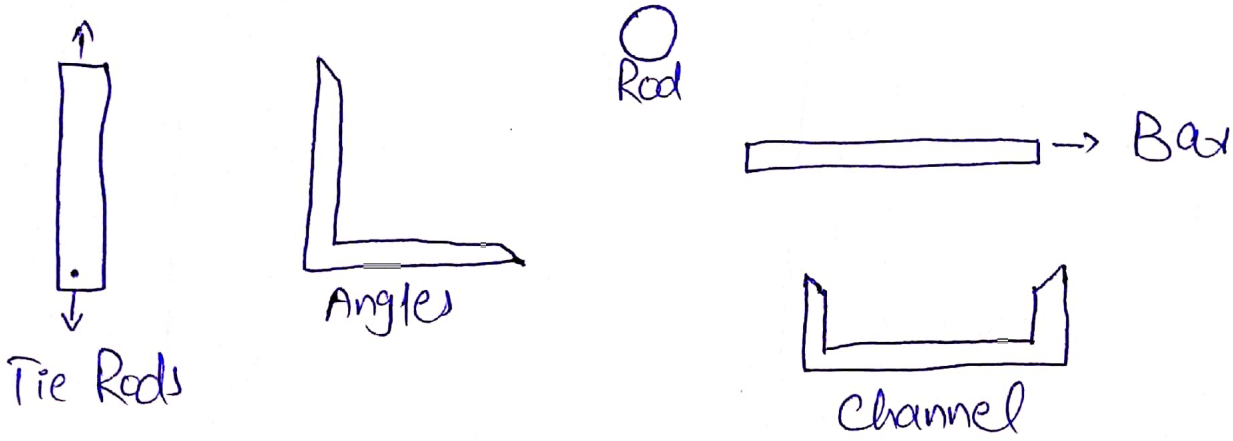
bad on causes bindings of its members and has rigid Joint connections. This structure is Indeterminate.

Structural Elements:

Some of elements are.

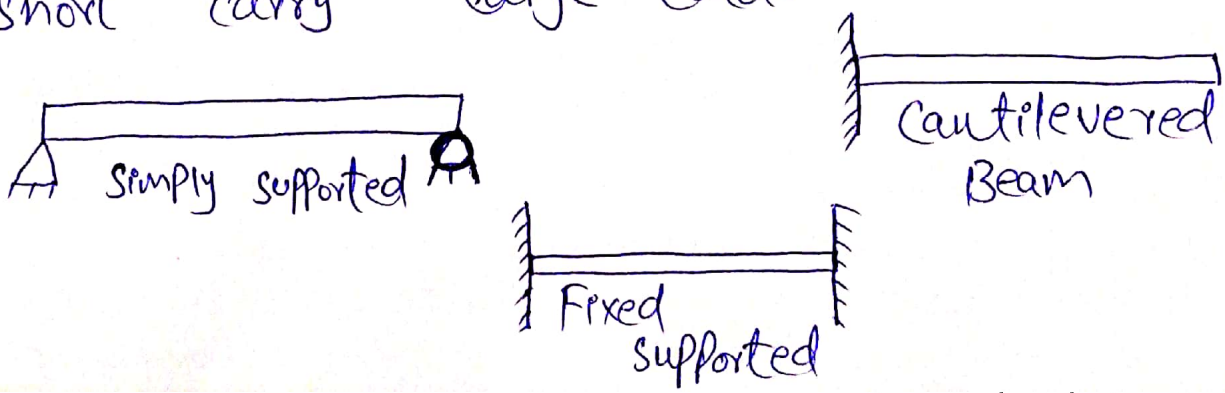
1) Tie Rods:

Consists of Tensile force. These members are bars or rods.



2) Beams:

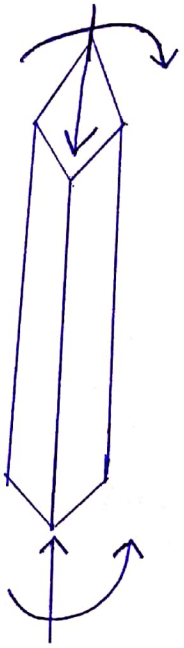
They are horizontal member and supports vertical loads. It resists bending moments short carry large loads.



3) Columns:

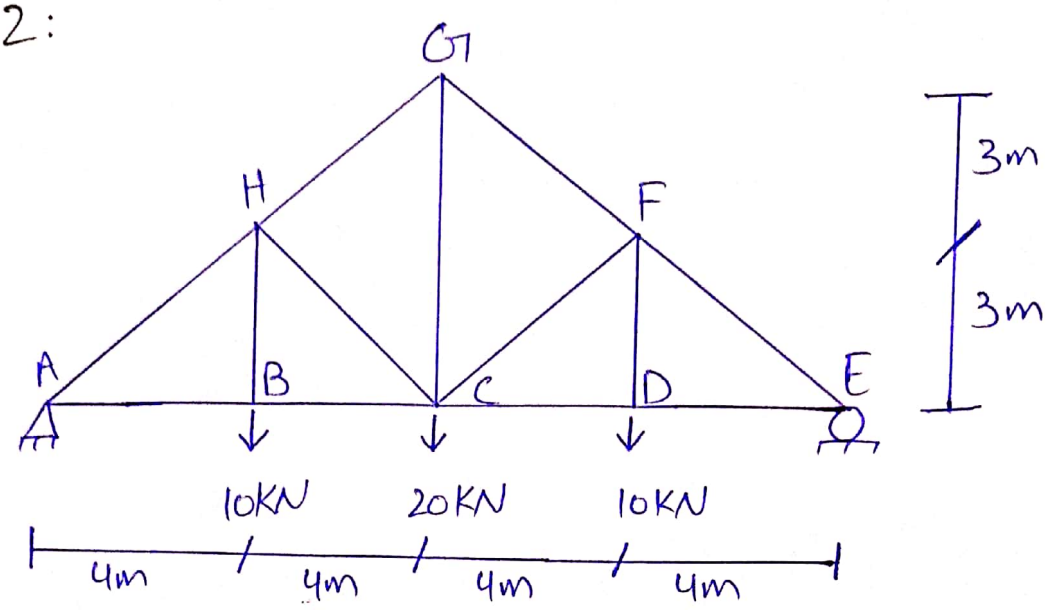
They are consists of vertical members and resist compressive loads. Tubes and wide-flange across sections are used for metal columns. and square cross sections reds are used for Concrete work.

Column



Beam-Column

Q No 2:



Force in each member = ?

Sol:-

Support Reaction:

$$\Sigma f_y = 0 \uparrow \downarrow$$

$$R_A + R_E = 40 \longrightarrow (A)$$

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

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

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

$$\text{Put} = 40 - 20 \Rightarrow R_A = 20 \text{ KN}$$

Now determining force in each member.

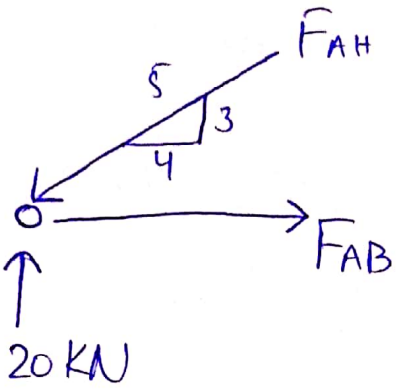
Joint A:

$$\Sigma f_y = 0; \quad -3/5\,(FAH) + 20\,KN = 0$$

$$= 0.6\,(FAH) = -20\,KN$$

$$FAH = 33.33\ KN\ (C)$$

Joint A:



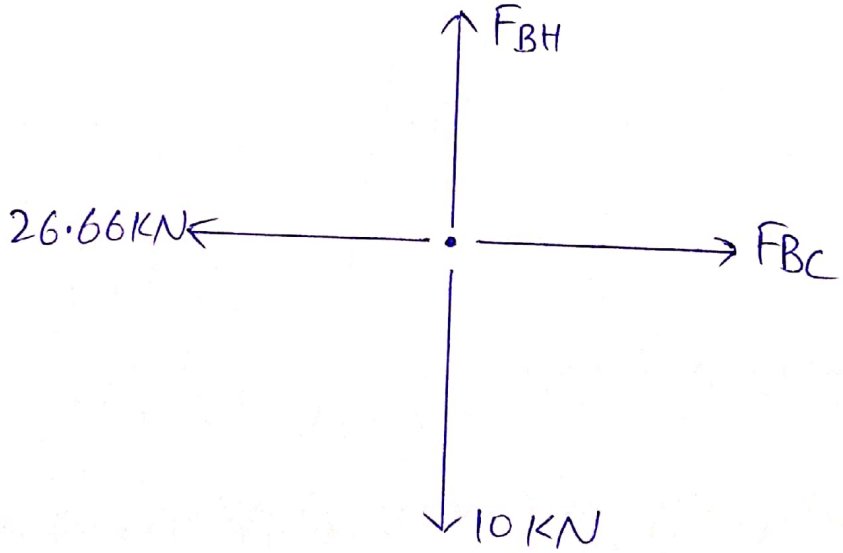
$\Sigma f_x = 0$; $-4/5\,(33.33) + F_{AB} = 0$

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

Joint B:

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

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



Joint B :

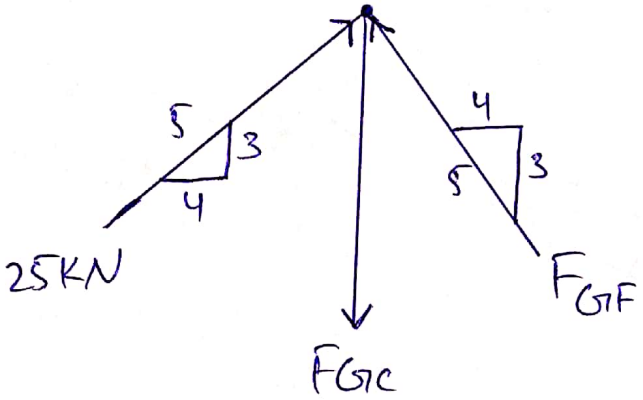
Joint G1:

$\Sigma f_x = 0;\ 4/5(25) - 4/5\ (F_{G1F}) = 0$

$F_{G1F} = 25\,KN\ (C)$

$\Sigma f_y = 0;\ 3/5\ (25) + 3/5\ (25) - F_{G1e} = 0$

$F_{G1e} = 30\ KN\ (C).$



Joint G1:

Joint H:

$\Sigma f_y = 0;\ 3/5\ (33.33) - 10\,KN + 3/5\ (F_{HC}) - 3/5\ (F_{HG1}) \rightarrow (A)$

$\Sigma f_x = 0;\ 4/5\ (33.33\,KN) - 4/5\ (F_{HC}) - 4/5\ (F_{HG1}) \longrightarrow (B)$

eq (1) & eq (2).

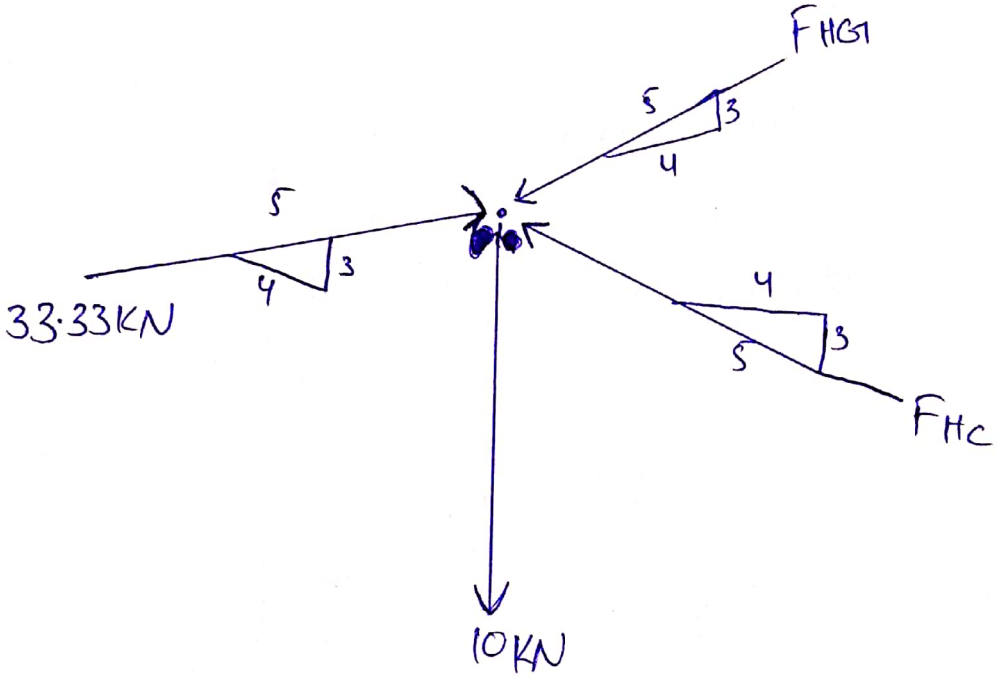
$19.98 - 10 + 0.6\ F_{HC} - 0.6\ F_{HG1} = 0 \longrightarrow (A)$

$26.66 - 0.8\ F_{HC} - 0.8\ F_{HG1} = 0 \longrightarrow (B)$

Multiplying eq A by 1.34 and Then add with eq B we get.

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

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



Joint H:

Due to Symmetrical loading & Geometry.

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

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

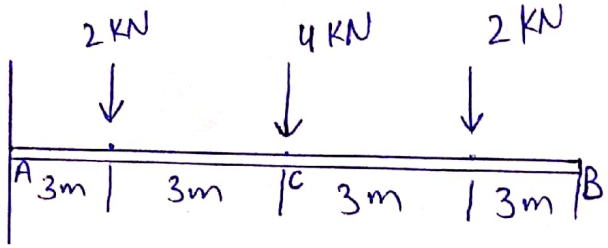
$F_{BH} = F_{DF} = 10\ KN\ (T)$

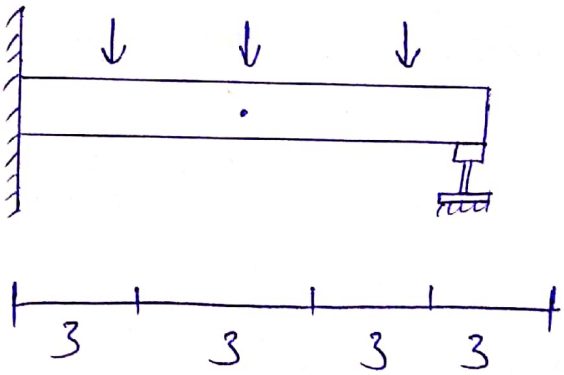
$F_{HG} = 25\ KN\ (C)$

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

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

Q No 3:





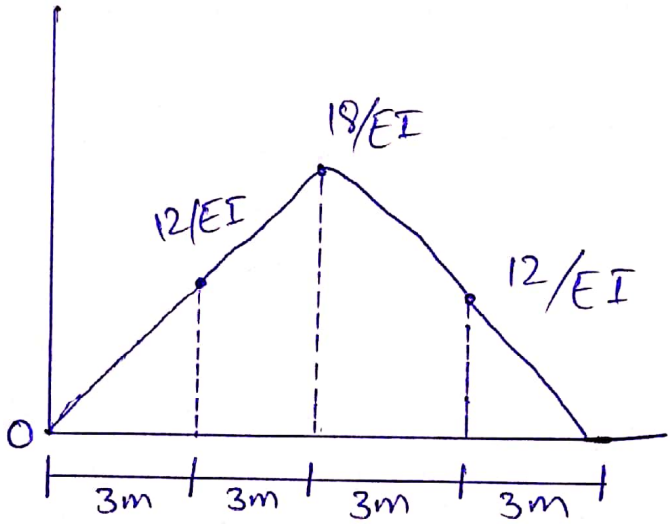
Given: $E = 200\ GPa$, $I = 6 \times 10^6\ mm$

Determine slope at Point 'A' and displacement at 'C' using Moment Area Theorm.

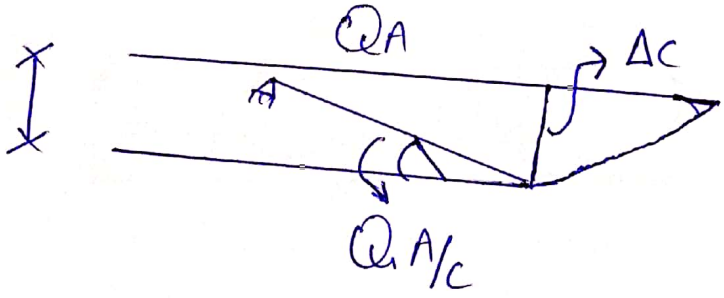
Sol:

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

Moment Diagram:



Elastic Curve :-



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

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

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

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

$$\theta_A = 0.0525$$

$$t_{A/C} = \left[\tfrac{1}{2}\left(\tfrac{12}{EI}\right)(3)\right]\left(\tfrac{2}{3}(3)\right) + \left[\tfrac{12}{EI}(3)\right]\left(3+\tfrac{1}{2}(3)\right) + \left[\tfrac{1}{2}\left(\tfrac{6}{EI}\right)(3)\right]\left(3+\tfrac{2}{3}(3)\right).$$

$$= 0.202\,m$$

So;

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

$$= 202mm$$

Ans

END PAPER