IQRA NATIONAL UNIVERSITY

STRUCTURE ANALYSIS 1

QUIZ

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Structure Analysis 1

Q # 01:

Write a 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:

The types of load acting on structure for building and other structure can be broadly classified as vertical load, horizontal load and longituding loads. The vertical loads consists of dead load, live load and impact load.

The horizontal loads comprises of wind load and earthquake load. And the longitudinal loads i.e. tractive and braking forces are considered in special case bridges, gantry girders etc.

Types of loads acting on a structure are:

1) Imposed Loads
2) Dead loads

3) Snow loads
4) Wind loads
5) Special loads
6) Earthquake loads.

Dead loads (DL)

The first vertical load that is considered is dead load. Dead loads are permanent.

The calculation of dead loads of each structure are calculated by the volume of each section.

Brick Masonry	w = Weight	= 18.8 kN/m³
Stone Masonry	weight =	20.4-26.5 kN/m³
PCC	" =	24 kN/m³
RCC	" =	24 kN/m³
Timber	" =	5-8 kN/m³.

Live Loads:

Live load consists of structural and vary both in their magnitude and location. These loads are caused by weights of object.

Examples:

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

Types of Structures:

The combination of structural elements and the material which functions as a structural system.

Types of structures are:

1) **Trusses:**

Trusses consists of slander the resulting figure is called a truss. No shear force and bending moment are produced.

2) **Cables:**

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

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

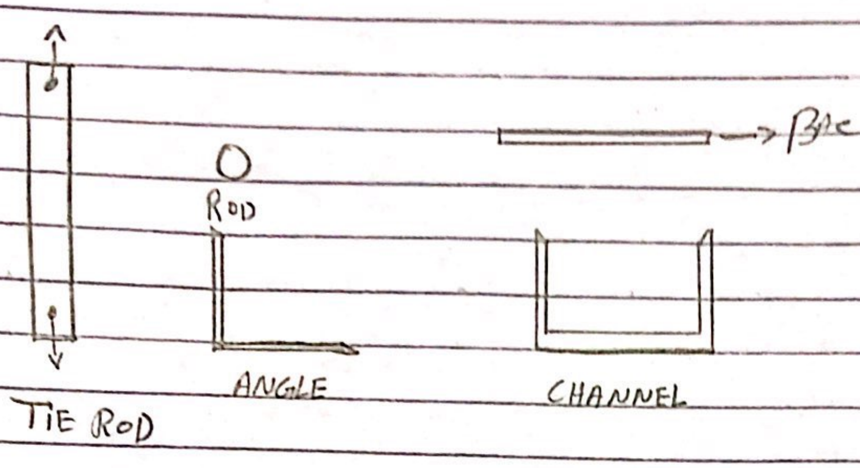
Frames:

Types of Structure which are used in buildings and consists of beam and column, which are fixed. The load on frames causes bendings of its members and has rigid joint connection.

→ Structural Elements:

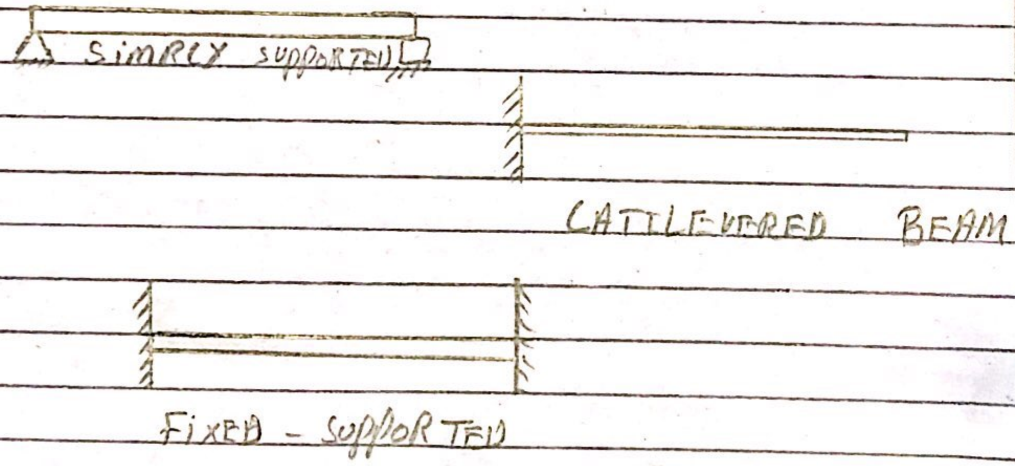
1) Tie Rods:

Consists of Inside 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.



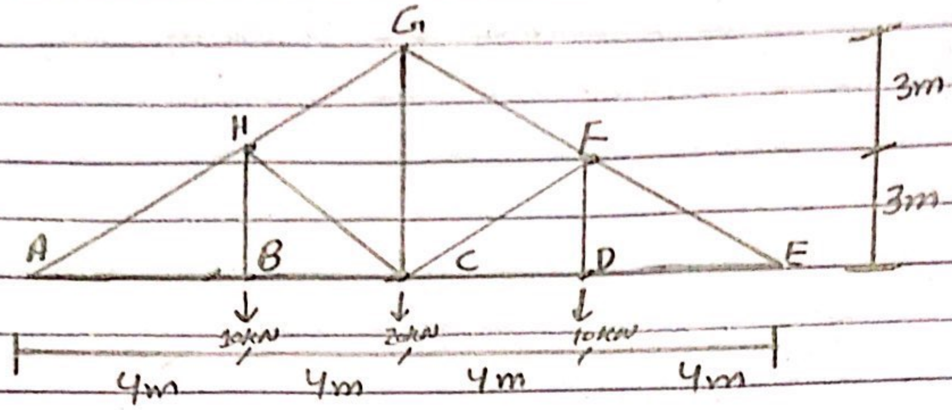
3) COLUMNS:

They consists of vertical members and resists compressive loads.

Tubes and wide-flang across sections are used for metal columns and square cross sections rods are used for concrete work.

Q # 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.



Forces in each member = ?

Sol:-

Support reactions.

$\Sigma fy = 0 \uparrow^{+} \downarrow$

$RA + RE = 40$ —— (A)

$\Sigma M_A = 0$

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

$RE = 320/16 = 20kN$

Put $= 40 - 20 \Rightarrow RA = 20kN$

Now determining force in each member.

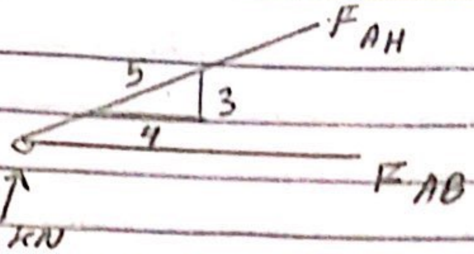
Joint A:

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

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

$FAH = 33.33\ kN\ (c)$

Joint A:



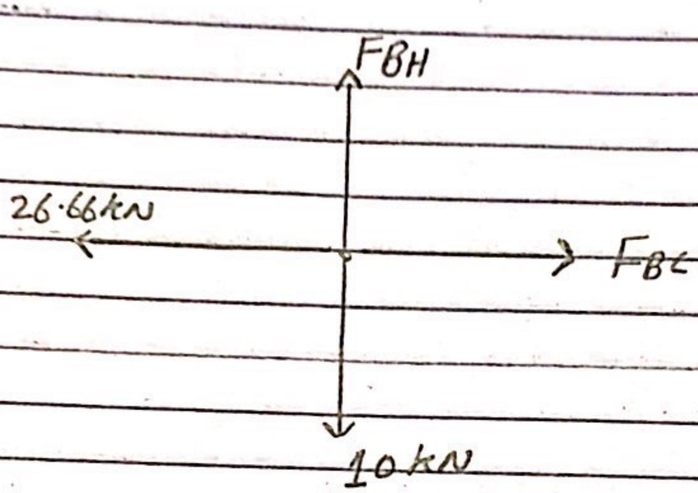
$\Sigma f_x = 0; \quad -4/5\,(33.33) + F_{AB} = 0$

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

JOINT B:

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

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



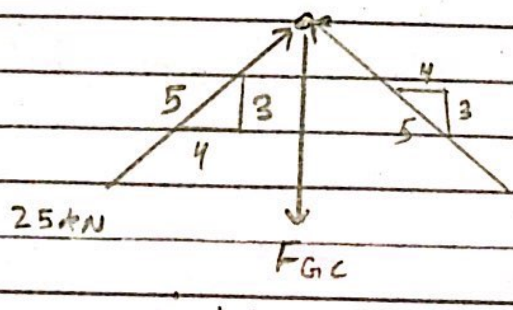
Joint B:

JOINT G:

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

$F_{GF} = 25\ kN\ (c)$

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



Joint G:

Joint H:

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

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

eq (1) and (2)

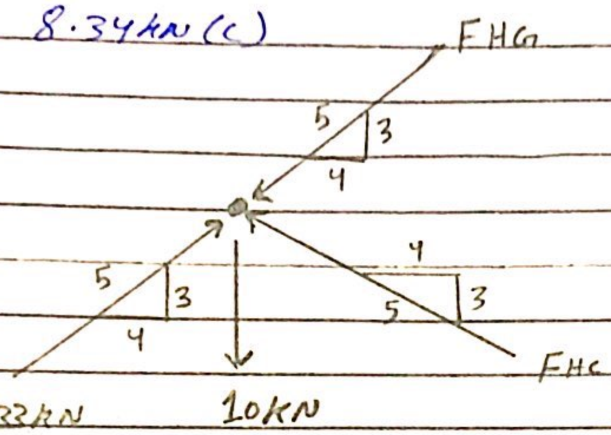
$19.98 - 10 + 0.6\,F_{HC} - 0.6\,F_{HG} = 0$ — (A)

$26.66 - 0.8\,F_{HC} - 0.8\,F_{HG} = 0$ — (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 and geometry

$F_{AB} = F_{ED} = 26.66\,kN\,(T)$

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

$F_{BM} = F_{DF} = 10\,kN\,(T)$

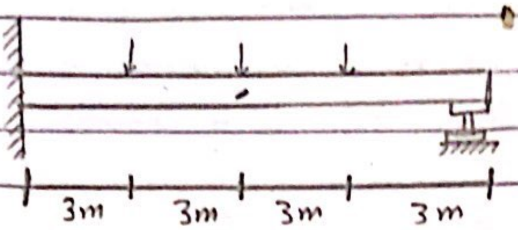
$F_{MG} = F_{FG} = 25\,kN\,(C)$.

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

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

Q#03:

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



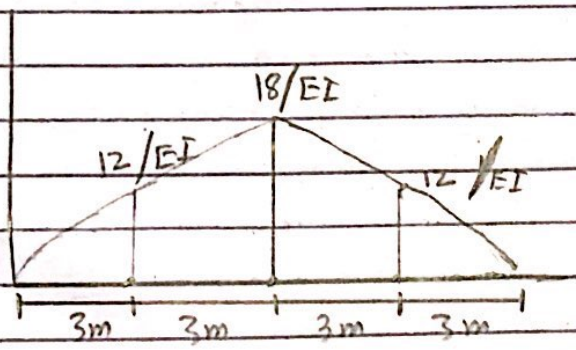
Given: $E = 200\ GPa$, $I = 6 \times 10^6\ mm$.
Determine slope at point "A" and displacement at "C" using moment area theorem..

Sol:-

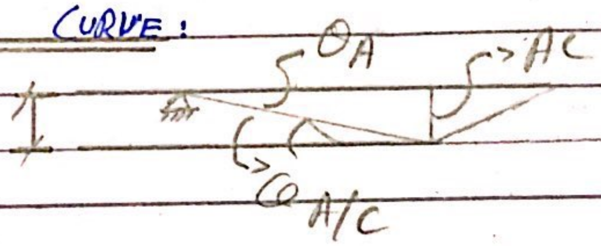
(i) Finding ~~ut~~ M/EI Diagram and elastic curve

Moment

DIAGRAM:



ELASTIC CURVE:



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

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

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

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

$$t_{AC} = \left[\frac{1}{2}\left(\frac{12}{EI}\right)(3)\right]\left(\frac{2}{3}(3)\right) + \left[\frac{12}{EI}(3)\right]\left(3+\frac{1}{2}(3)\right) + \left[\frac{1}{2}\left(\frac{6}{EI}\right)(3)\right]\left(3+\frac{2}{3}(3)\right).$$

$$= 0.202 \text{ m}$$

So

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

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