Subject:-

Steel Structures

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Question No-1

→ Write detail note on 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 consist of structural member that are permanently attached to structure. Dead load includes the weight of columns, beams, electrical fixtures and other attachments.

(2) **Line Loads:-**

Line load can vary both in their magnitude and location. These loads are caused by weights of temporily objects, moving vehicles, natural forces consists of additional protection against overload.

Example:-

The line 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 structure.

→ Different types of structures are:-

1) Trusses:-

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

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

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

(2) Cables & Arches:-

It is the type of structures used for long distances.

→ Cables are flexible and carry 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) FRAME :-

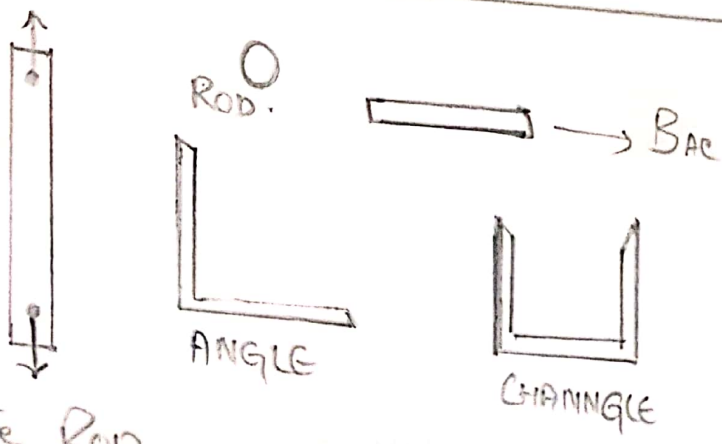
Type of structure which are used in buildings and consists of beam and column, which are fixed or pin connected. The load on frames causes bindings of its members and has rigid joints connections. This structure is indeterminante.

Structure Elements :-

Some of elements are :

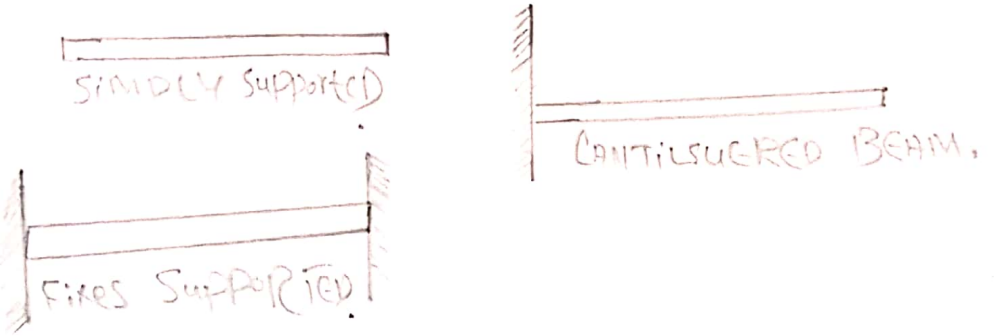
1) Tie Rods :-

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



(2) Beams :- (4)

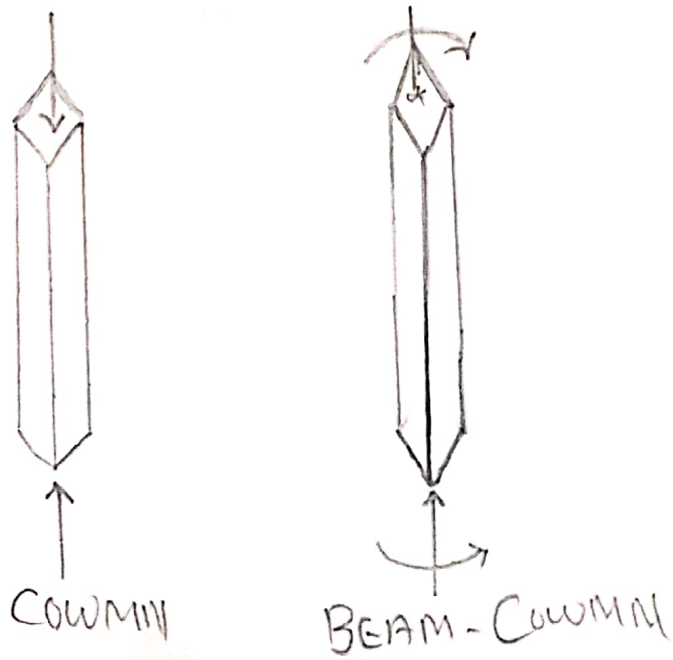
They are horizontal members and supports vertical loads. It resists bending moments, short carry large loads



(3) Columns :-

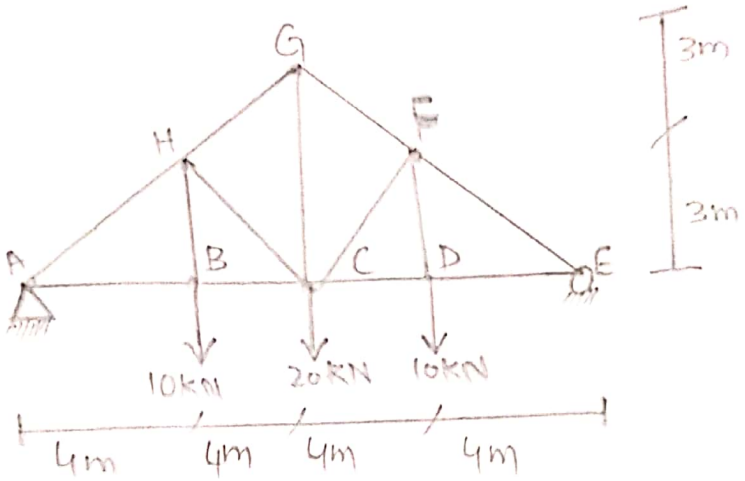
They consists of vertical member and resist compressive loads.

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



Question No-2

(1)



Required Data:-

→ Forces in each member?

Sol:-

Support reactions:-

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

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

$$\Sigma M_A = 0 \circlearrowright +$$

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

$$R_E = 320/16 = 20\,KN$$

$$Put = 40 - 20 \Rightarrow R_A = 20\,KN$$

Now determining force in each member.

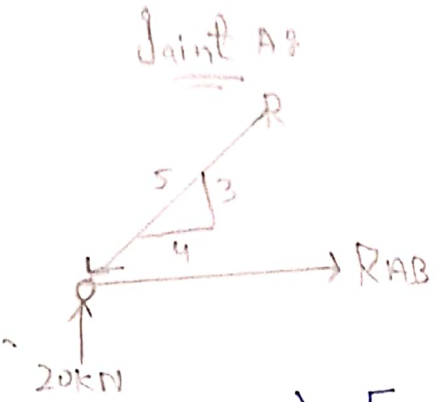
Joint A:

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

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

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

Joint A:-



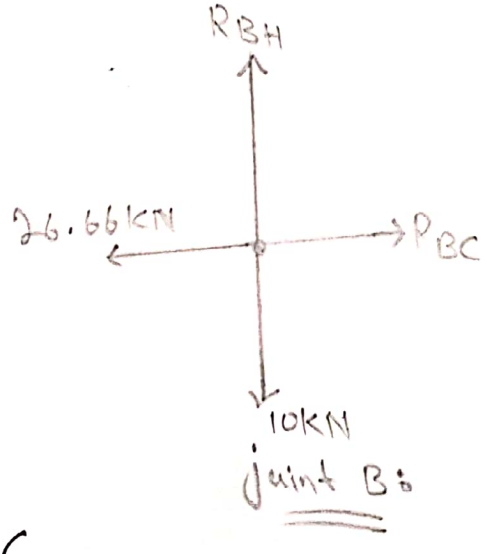
$\Sigma f_x = 0$; $-4/5\,(33.33) + F_{AB} = 0$

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

Joint B:-

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

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



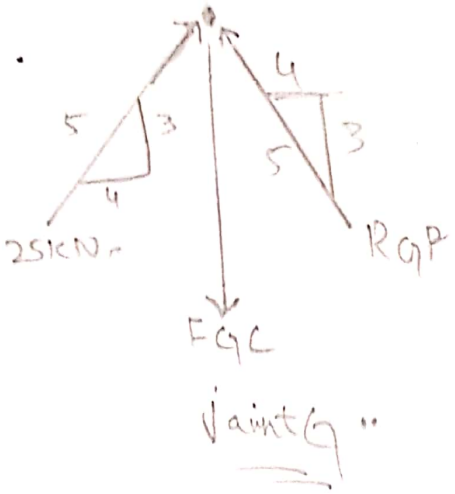
Joint G:-

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

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

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

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



Joint G :-

Joint H :-

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

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

eq (1) & eq (2)

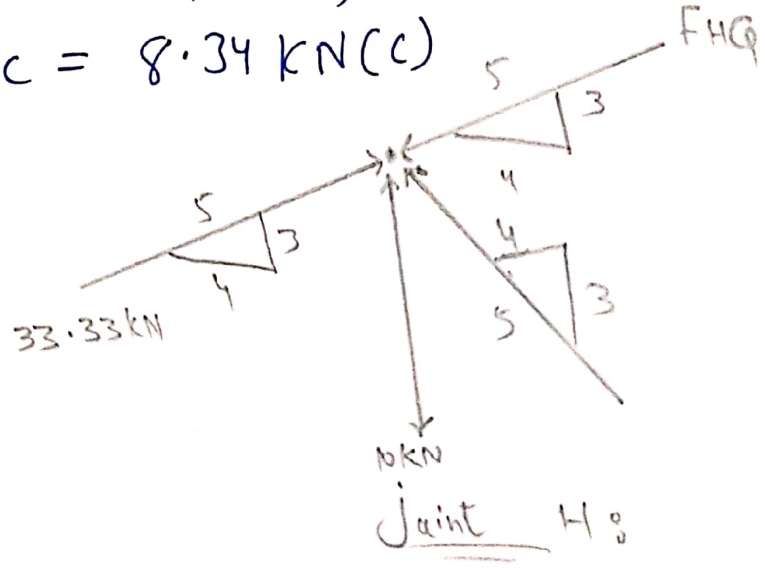
$19.98 - 10 + 0.6F_{HC} - 0.6F_{HG} = 0$ — (A)

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

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

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

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



Joint H :

Due to Symmetrical loading of Geometry

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

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

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

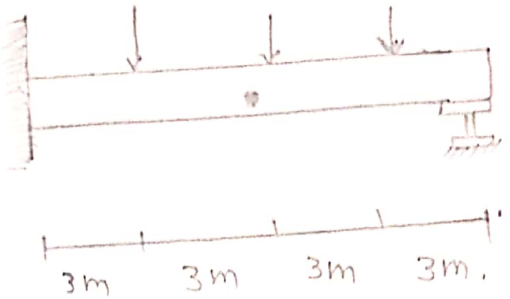
$F_{HG} = f_{FG} = 25\ KN\ (C)$

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

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

Question No-3:-

(9)



Given Data:-

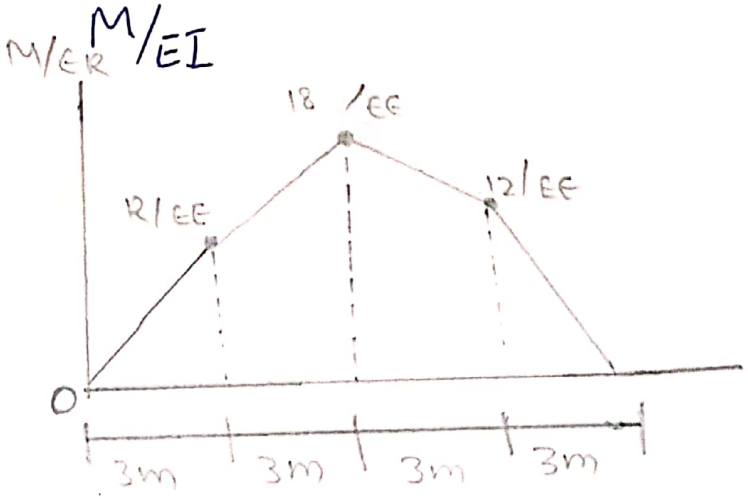
$E = 200\ GPa$, $I = 6 \times 10^6\ mm$.

Determine slope at point "A" and displacement at "C" using moment Area theorem.

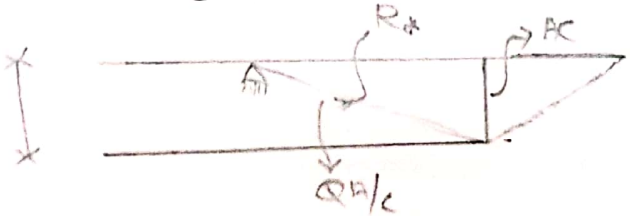
Sol:-

(i) finding out M/EI Diagram & elastic curve

Moment Diagram:-



Elastic Curve:-



(10)

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

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

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

$$\theta_{C} = 0.0525 \text{ rad}$$

$$\theta_{A} = 0.0525 \text{ rad Ans}$$

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

$$+\left[\frac{1}{2}\left(\frac{6}{EI}\right)(3)\right]\left(3+\frac{2}{3}(3)\right)$$

$$= 0.202 \text{ m}$$

So,

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

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