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Section:

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Deptt:

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Subject:

Structure Analysis

Submitted to:

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Question no 01:

Write a detail note in your own words on different types of load that different type of Structure are designed to support throughout its life. Elaborate with examples.

Load:

It becomes necessary to determine the loads the structures must Support often, it is anticipation of the various load that will be imposed on the structure that will be Chosen for design. for example high-rise structure must endure large latteral loading caused by wind or so Shear Walls and tubular fram System are Selected Whereas building located in area prone to earthquakes must be designed having ductile frames and Connection

Q3/4

Load are defined as, loads imposed on a Completed or temporary Structure during and as a result of the Construction process. Any external force or Couples moment is Said to be load when these are acting on the member during it functionality.

Types of load:

The types of load acting on structures for buildings and other Structures can be broadly Classified loads and longitudinal loads. The verticle loads Consist of dead load, live load and Impact load.

The Horizantal loads comprises of wind load and earthquake load. The longitudinal loads i.e tractive loads and braking forces are Considered in Special Case of designed ~~load~~ bridge, gantry girders etc.

In a Construction of building two major factors Considered are Safety and economy. The are adjudged and taken higher then economy is affected. If economy is Considered and loads are taken lesser than the safety is Compromised.

Types of loads action on a Structure are;

1) Dead loads
2) Imposed loads (Live loads)
3) Wind Loads
4) Snow Loads
5) Earthquake loads
6) Special Loads

1) Dead Loads (DL):

The First vertical load that is Considered is dead load. Dead load are permanent or Stationary loads which are transferred to structure throughout the life span. Dead load is primarily due to Self weight of structural members, parmanent partition walls, fixed permanet equipments and weight of different materials. It majorly Consists of the weights of roof, beams, walls and Column etc. Which are otherwise the Permanent parts of the buildings.

2) Imposed Loads or Live Loads:

The Second vertical load that is Considered design of a Structure is imposed load or live loads. Live loads are either movable or moving loads without any acceleration or impact. These loads are assumed to be Produced by the intended load use or occupancy of the building including weights of movable partitions or furniture etc.

Live Loads Keep on Changing from time to time. These loads are to be Suitable assumed by the designer. It is one of the major load in the design. The minimum values of live loads to be assumed are given in IS 875 (part 2) - 1987. It depend upon the intended use of the building.

3) Wind Loads:

Wind load is Primarily horizantal load Caused by the movement of air relative to earth. Wind load is required to be Considered in Structural design especially when the heart of the building exceeds two times the dimensions transverse to the exposed wind surface.

For low rise building say up to Four to Five Stories, the wind load is not Critical because the movment of resistance provided by the Continuity of floor System to Column Connection and wall provided between Column are Sufficient to accomodate the effect of these forces. Further in limit State method the factor for designed load is reduced to 1.2 (DL+LL+WL) when Wind is Considered as against the factor of 1.5 (DL+LL) when wind is not Considered.

4) Snow Loads:

Snow Loads Constitute to the verticle loads in the building. But these types of loads are considered

Only in the Snow fall places. The IS 875(part 4)-1987 deal with the Snow loads on roofs of the building.

The minimum Snow load on a roof area or any other area above ground which is Subjected to Snow accumulation is obtained by the expression

$$S = \mu S_0$$

Where S = Design load on plane area of the roof

μ = Shape Coefficient

S_0 = Ground Snow load

5) Earthquake Loads:

Earthquake forces Constitute to both vertical and horizontal forces on the building. The total vibration caused by earthquake may be resolved into three mutually perp direction, usually taken as vertical and two horizantal direction.

The movement in vertical direction do not Cause forces in Superstructure to any Significant extent. But the horizantal movment of the building at the time of earthquake is to be considered while designing.

6) Other loads and Effects acting on Structure:

As per the Clause 19.6 of IS 456-2000, in addition to above load load discussed, account shall be taken of the following forces and effects if they are liable to affect materially the safety and serviceability of the structure.

a) Foundation movement (IS 904)

b) Soil and fluid pressure (IS 1904) (875)

c) Elastic & Shortening

d) Vibration

e) Fatigue

f) Impact (IS 875)

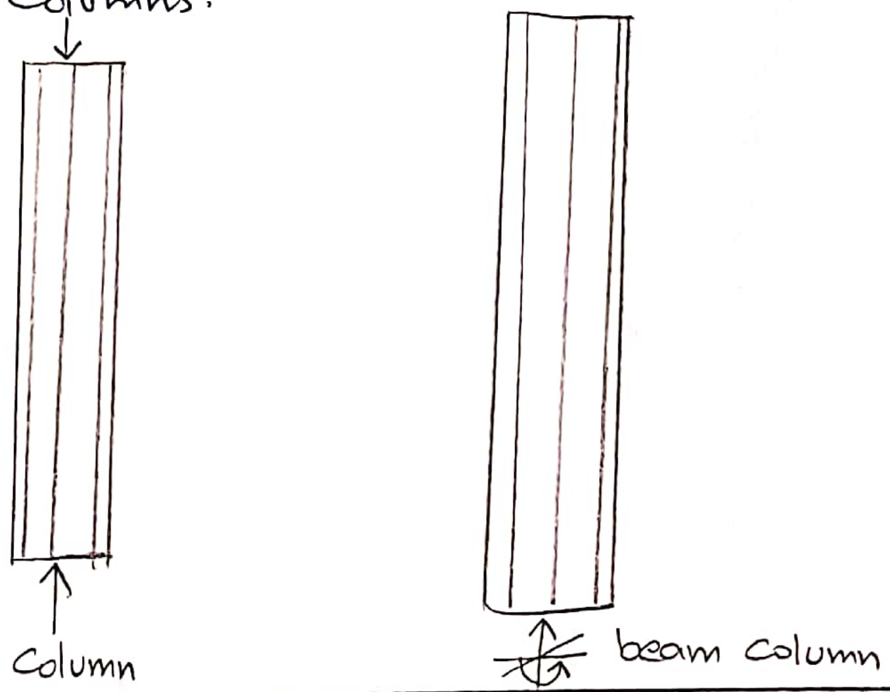
g) Erection loads (IS 875)

h) Stress Concentration effect due to point load and the like.

Different types of Structures are designed to Support load:

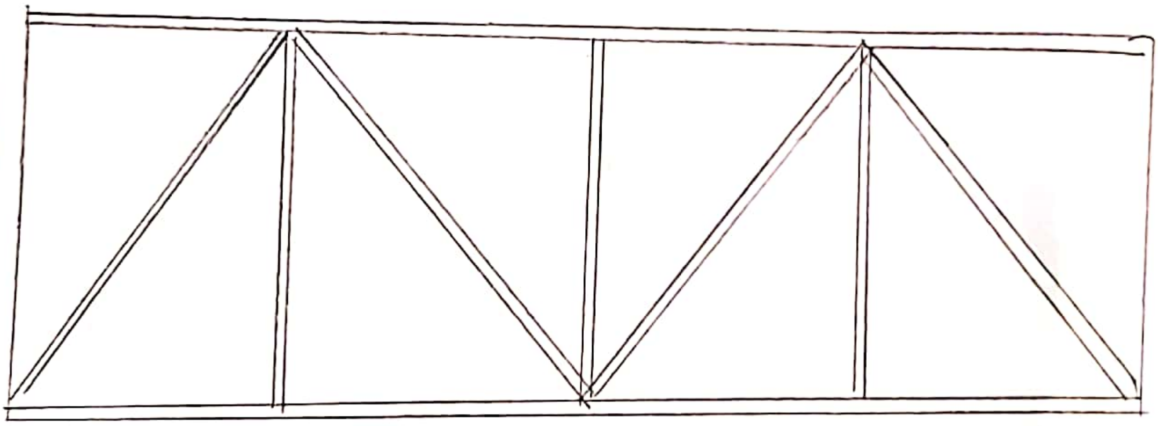
Column:

Members that are generally Vertical and resist axial Compression load are referred to as Columns. Tubes and wide-flange Cross-Section are often Used for metal Columns, and Circular and Square Cross Sections With reinforcing rods are used for those made of Concrete. Occasionally Columns are Subjected to both an axial load and a bending moment. These members are refferred to as beam Columns.



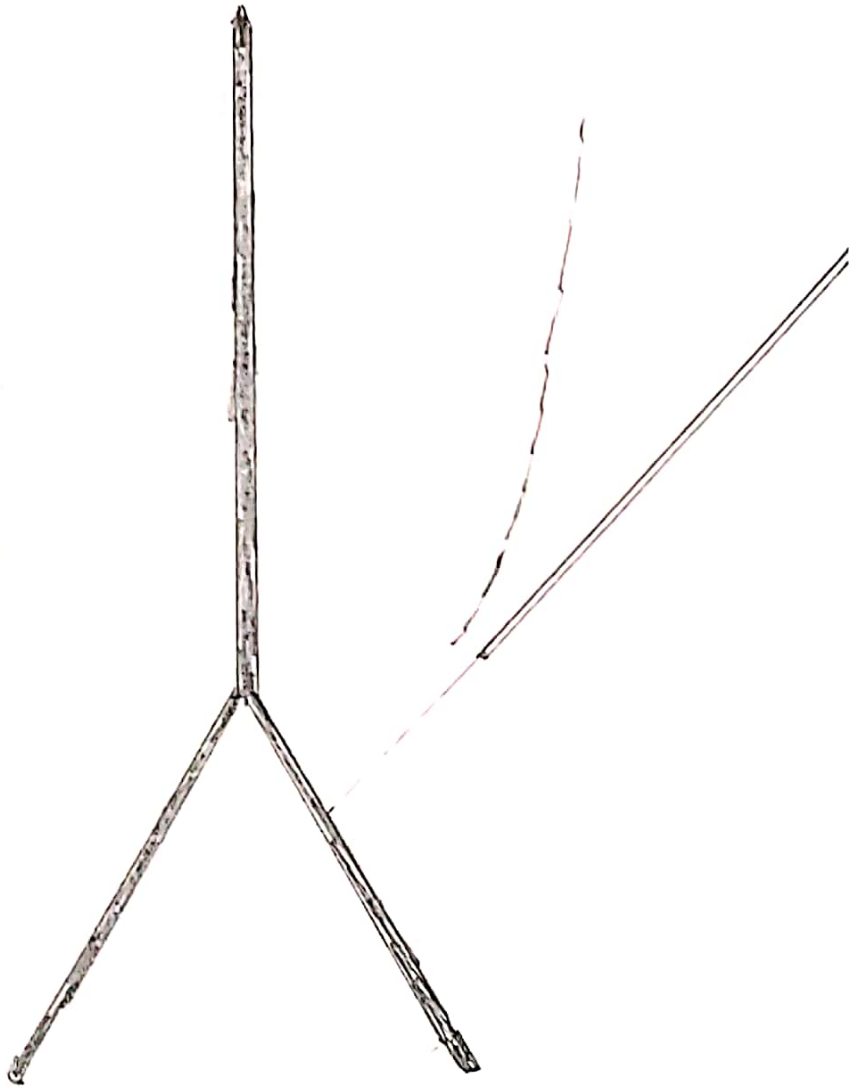
Trusses:

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 fashion. Planner trusses are Composed of members that lie in the Same plane and are frequently Used for bridge and roof Support whereas space trusses have members extending in Three dimensional and are Suitable for derricks and towers.



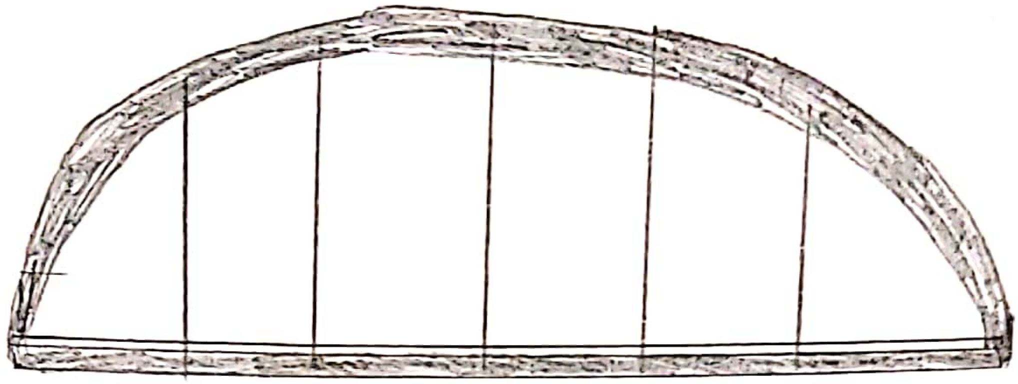
Cables:

Cables are Usually flexible and carry their load in tension. They are Commonly Used to Support bridge, and building roofs. When used for these purposes, the Cable has an advantages over the beam and the truss, especially Spans that are greater than 150ft (46m).



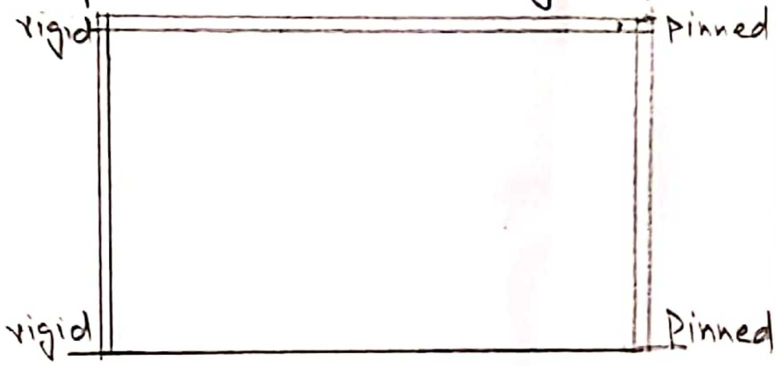
Arch:

Arch archieves its strength in compression, since it has a reverse curvature to that of the cable. The arch must be rigid, however, in order to maintain its shapes and this results in secondary loadings involving shear and moment, which must be considered in it design. Arch are frequent used in bridge structures, dome roofs, and for opening in masonary walls.



Frames:-

Frames are often used in building and are composed of beam and columns that are either pin or fixed connected. Like frame exten in two or three dimension. The loading on a frame cause bending of its members and if it is a rigid joint connection.



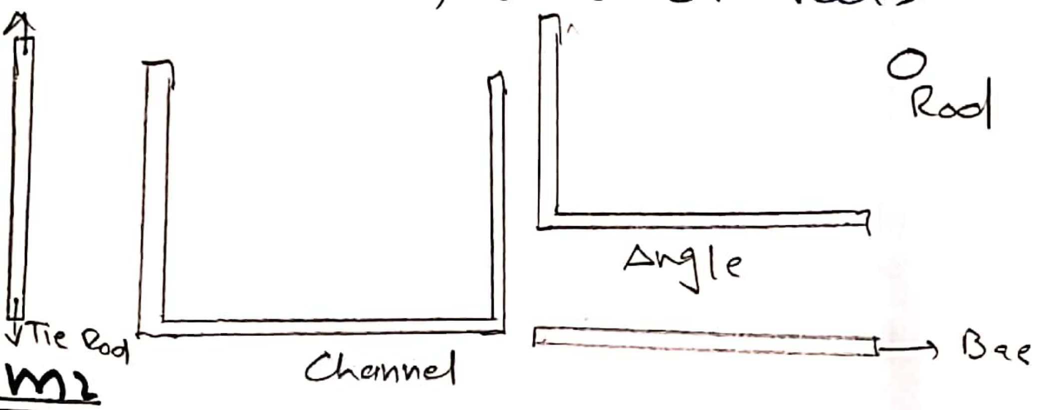
Surface Structure:-

A surface structure is made from a material having a very small thickness compared to its other dimensions. Sometime this material is

Very flexible and can take the form of a tent or air-inflated structure. In both cases the material act as a membrance that is subjected to pure tension.

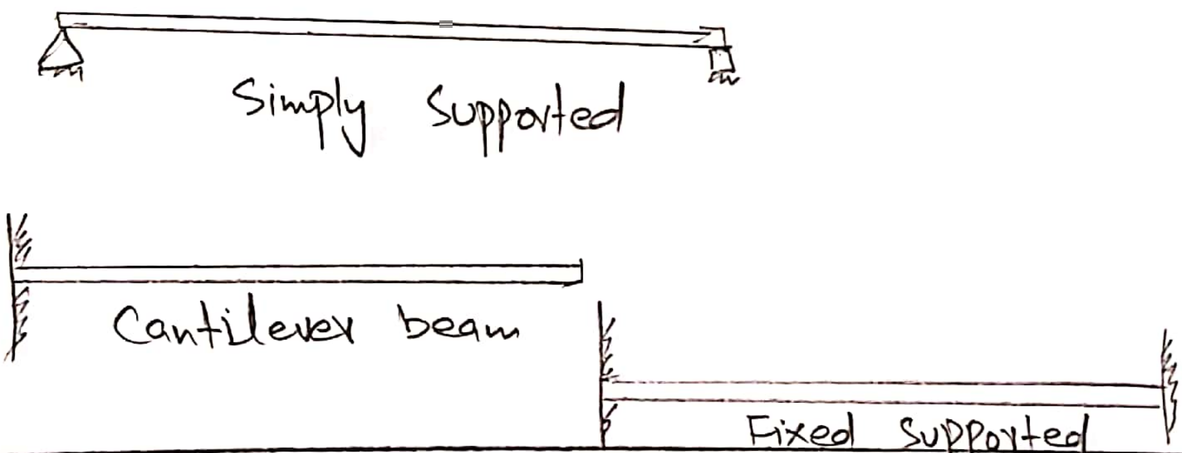
Tie rods:

Consist of tensile force. These members derder, bars or rods.



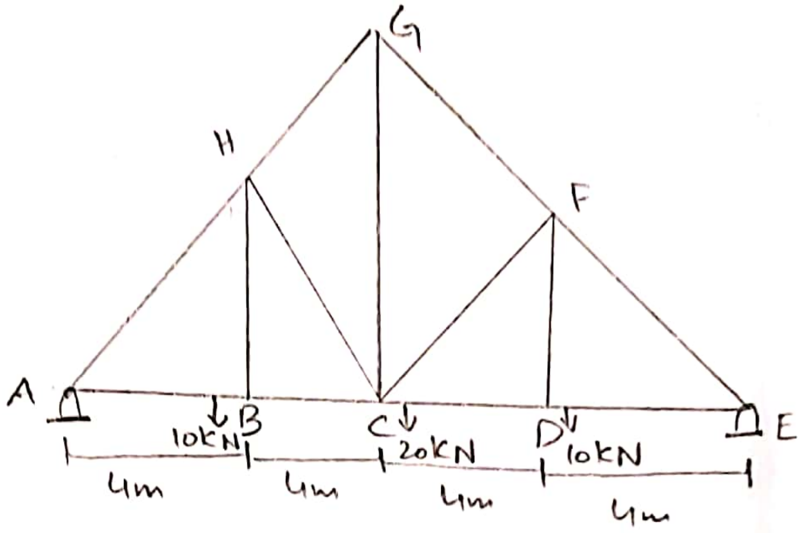
Beam:

They are horizontal members and supports vertical loads. It resist bending moment, short carry large loads.



Question No 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?



Required:

Force in each members = ?

Solution:

$$\Sigma F_y = 0 \quad \uparrow + \downarrow -$$

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

$$\Sigma M_A = 0 \quad \circlearrowright -$$

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

$$R_E = \frac{320}{16} = 20kN \longrightarrow (B)$$

Put equ B value in equ A

$$R_A = 40-20$$

$$R_A = 20kN$$

Now determine force in each members.

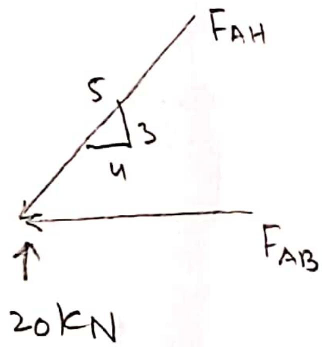
Joint A:

$\Sigma F_y = 0;$

$-\frac{3}{5}(F_{AH}) + 20kN = 0$

$\Rightarrow -0.6(F_{AH}) = -20kN$

$F_{AH} = 33.33 kN$ (3)



$\Sigma f_x = 0;$

$-\frac{4}{5}(33.33) + F_{AB} = 0$

$F_{AB} = 26.66 kN$ (4)

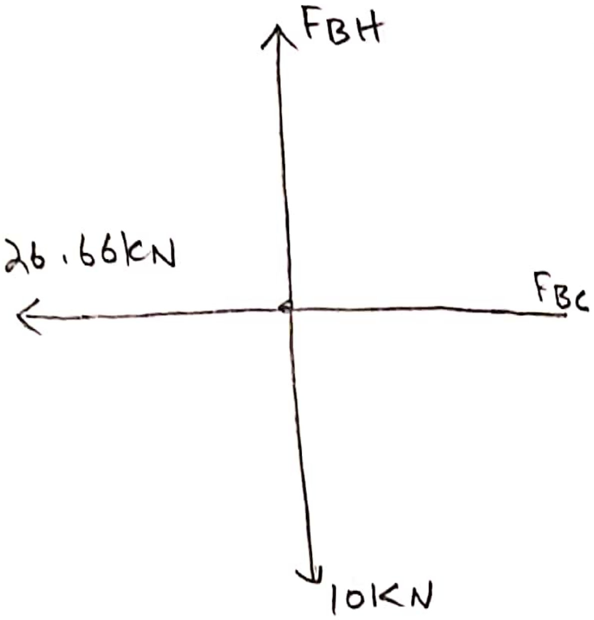
Joint B:

$\Sigma f(x) = 0;$

$F_{BC} = 26.66\ KN (Y)$

$\Sigma fy = 0;$

$F_{BH} = 10KN (Y)$



Joint H:

$\Sigma Fy = 0;$

$3/5(33.33) - 10KN + 3/5(F_{HC}) - 3/5(F_{HG}) \rightarrow (a)$

$\Sigma Fx = 0;$

$4/5(33.33) - 4/5(F_{HC}) - 4/5(F_{HG}) \rightarrow (b)$

So now solving eq (a) & (b)

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

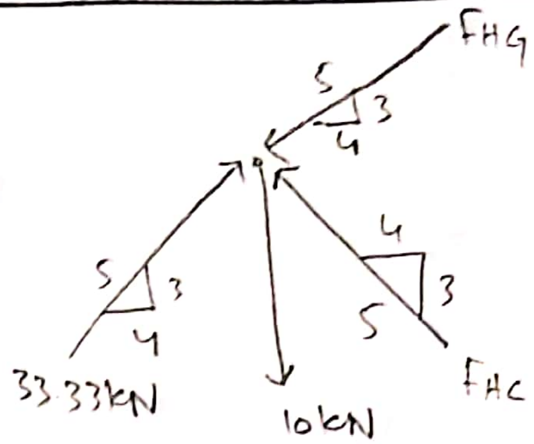
$26.66 - 0.8F_{HC} - 0.8F_{HG} = 0 \rightarrow (d)$

Now,

Moltiplying equ (c) by 1.34 and then add with equ (d) we get;

$F_{HG} = 25\,KN\ (3)$

$F_{HC} = 8.34\,KN\ (3)$



Joint G:

$\Sigma F_x = 0;$

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

$F_{GF} = 25\,KN\ (3)$

$\Sigma F_y = 0;$

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

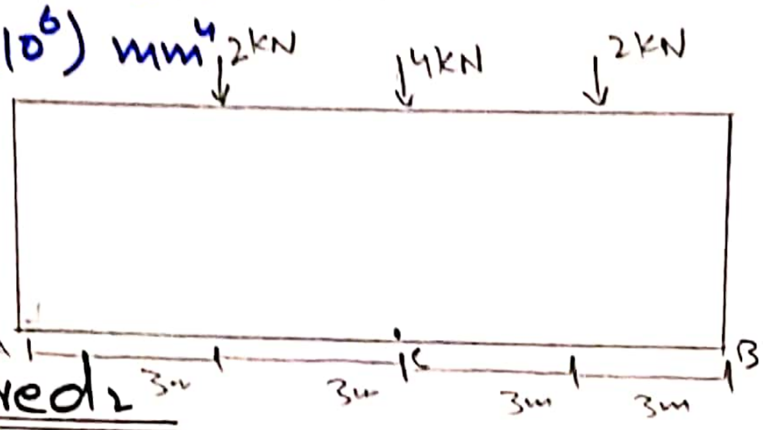
$F_{GC} = 30\,KN\ (3)$

Due to symmetrical loading of structure we get,

F_{AB} =	F_{ED} =	26.66 KN	(4)
F_{BC} =	F_{DC} =	26.66 KN	(4)
F_{BH} =	F_{DF} =	10 KN	(4)
F_{HG} =	F_{FG} =	25 KN	(3)
F_{HC} =	F_{FC} =	8.34 KN	(3)
F_{AH} =	F_{EF} =	33.34 KN	(3)

Question No 03:

Determine the Slop at A and displacement at C of the beam in the figure by a) Moment of theorem and Take $E = 200 Gpa$, $I = 6(10^6)\ mm^4$



Required:

Determine Slope at point 'A' and displacement at C using moment Area Theorem.

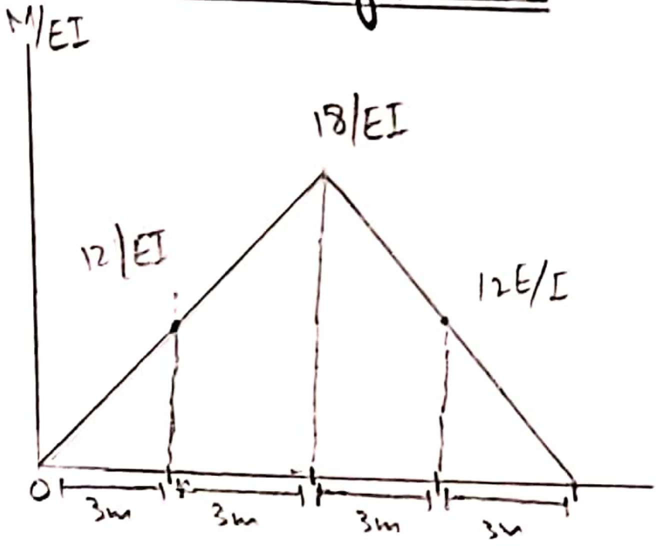
Given Data:

$E = 200 Gpa$

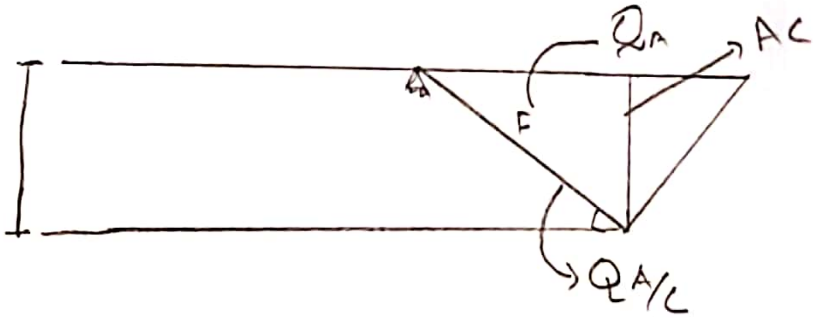
$I = 6 \times 10^6\ mm^4$

Finding out M/EI diagram of elastic curve

Moment Diagram:



Elastic Curve:



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

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

$$\theta_{A/C} = \left(\frac{63}{EI}\right)$$

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

$$\theta_{A/C} = 0.0525 \text{ radian}$$

$$\boxed{\theta_{A} = 0.0525 \text{ radian}}$$

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

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

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

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

So, we get,

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

$$\boxed{\Delta_C = 202\text{mm}}$$