QNo (01). Write a detail note in your own words on different types of loads that different types of structures are designed to support throughout its life. Elaborate with examples.

ANSWER.

Load.

load is a weight or source of of pressure borne by something or someone.

OR

A heavy or bulky thing that is being carried or is about to be carried.

Load is calculated at the time of any structure designing. It plays an important role in structure for the life time.

Types:

There are three types of loads acting on the structure, which are given below.

(i) Vertical loads (ii) horizontal loads.
(iii) longitudinal loads.

(i) Vertical loadin

Vertical loads are also known as gravity loads. loads which are applied perpendicular to the roof or floor System are called Vertical loads. Vertical loads are of two types (a) Dead load and (b) Live load.

(a) Dead load:-

Loads which are Permanent and stationary throughout the life Span of Structure are called Dead loads. Dead load is due to the Self weight of Structural members, Permanent partition walls, Permanent equipments and weight of different materials. It majorily Consists of weight of roofs, beams, walls and Columns; which are permanent Parts of building.

(b) Live load:

loads which are movable without any acceleration. loads are Produced due to the use or occupancy of the building. These loads includes weights of moveable partition, furniture or human bengs weight.
live load keeps changing from time to time.
The Value of live load depends upon type of building. Different type of buildings have different Values for live load.

(ii) Horizontal load:

loads which are applied parallel to the ground are called horizontal loads. There are two types of horizontal loads.

ⓐ Wind load

ⓑ Earthquake load.

a) **Wind load:**

The load which is Cause by the movement of air relative to the earth. It should be considered in structural design, when the heath of bulling exceeds two times the dimensions traverse to the exposed wind surface.
For low rise buildings say upto five stories, the wind load is not critical. Calculation of wind loads depends on velocity of wind and size of building.

(b) **Earthquake load:**

This type of load comes in the form of waves. It contributes to the vertical and horizontal forces. Earthquake may be resolved into three mutual perpendicular directions. The horizontal movement of the building at the time of earthquake should be considered at the time of designing. The response of structure to ground vibration is a function of nature of fundation. Soil, size and mode of construction and intensity of ground motion.

(iii) Longitudinal load:

The load which acts along the length of member is called longitudinal load. longitudinal loads acts along lengthwise.

Structure:-

A Combination of members Connected together in Such a way to serve a useful Purpose is called structure.

Types:-

Some of types of Structure are given below.

Rigid Frame:-

A type of structure in which the members are joined together by rigid joints ~~are~~ is called rigid frame.

Trusses:-

A type of structure formed by members in triangular form, The resultant figure is called truss. In Trusses the joints are pin Connected and loads are applied at joints. No Shear force or bending moment are Produced. Only axial Compression and axial tension is to be determined while analyzing a truss

Cables and Arches:-

These type of Structure are used to Span long distances are the Cable and the arch. Cables are usually flexible and Carry the load in tension. Cables are usually Suspended at their ends and are allowed to Sag. These forces are directed along the axis of Cable. Arches are Similar to Cables but they are inverted They Carry Compressive load that are directed along axis of arch.

Plates and Slabs:-

Plates are three dimensional flat structural Components usually made of metal that are often found in floors and roofs of structures. Slabs are similar to plates except that they are usually made of Concrete

Structural members:-

Members which are interconnected in such a way so as to Constitute a structure are called structural members.

Beam:-

Beam is flexure member of Structure. It is subjected to vertical loads and gravity loads. These loads create shear and ~~moment~~ bending in the beam.

Column:-

A long vertical member subjected to Compressive loads mostly is called Column. It transfer the load to the soil.

Strut:-

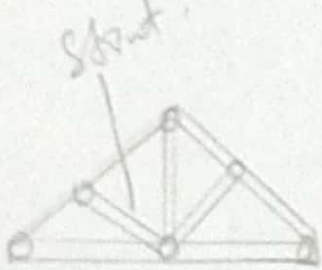
A Compressive member of a Structure is called Strut.

Beam-Column:-

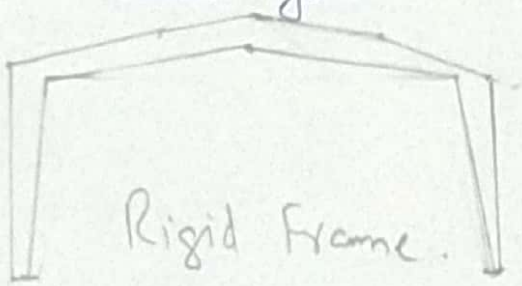
A Structural member subjected to Compression as well as flexure is called beam Column.

Grid:-

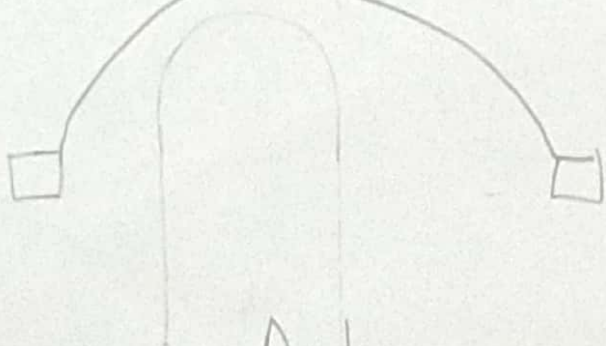
A network of beam intersecting each other at right angles and subjected to vertical loads is called grid.



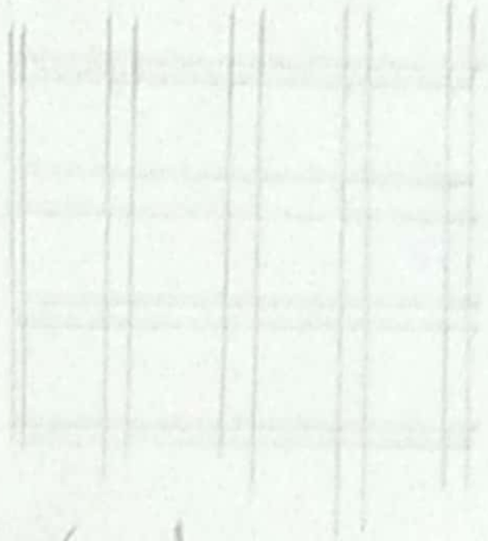
Trusses



Cables



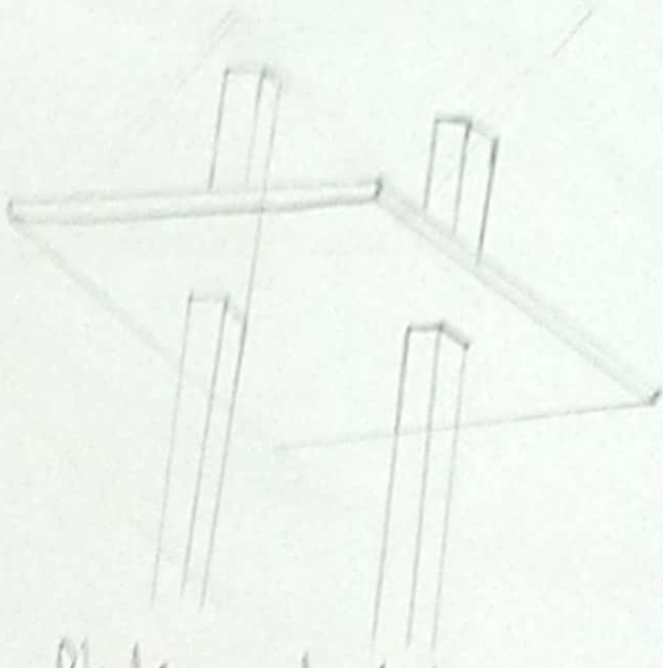
Arches.



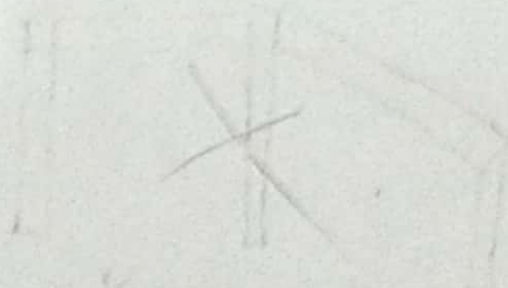
Grid.

beam

Column.

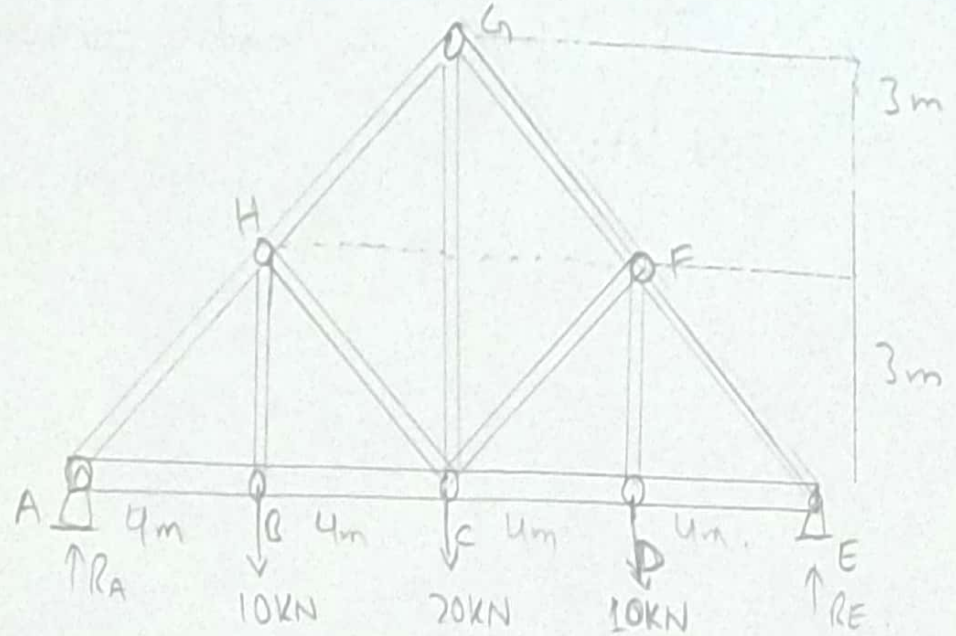


Plates and slabs.



Q(2): Determine the force in each member of the truss. State if the member are in tension or compression. Assume all members are pin connected.

ANSWER



Required:

Force in each member = ?

Solution:

We know that

$\sum F_y = 0$ ↑(+ve) ↓(-ve)

$R_A + R_E = 40KN$.

Now Moments along A.

$\sum M_A = 0$ (clockwise is Positive)

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

$-(R_E \times 16) + 120 + 160 + 40 = 0$

$R_E \times 16 = 320$

$R_E = \frac{320}{16}$

$R_E = 20KN$

Now

$R_A + R_E = 40KN$

$R_A = 40 - 20$

$R_A = 20KN$.

Now for forces in each member

Joint "A":-

$\Sigma F_y = 0$ ↑(+ve) ↓(-ve)

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

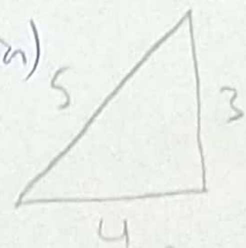
$-0.6 \times F_{AH} = -20$

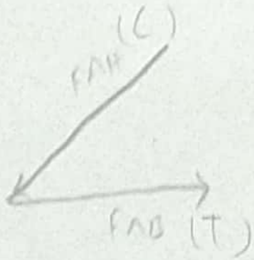
$F_{AH} = \frac{-20}{-0.6} = 33.33KN$ (Compression)

$\Sigma F_x = 0$

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

$+F_{AB} = 26.664 KN$ (Tension)



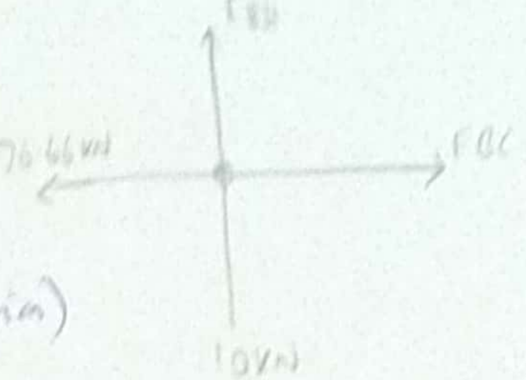


By Pythagoras theorem

Joint B:

$\Sigma F_y = 0$

$F_{BH} = 10\,kN$ (Tension)



$\Sigma F_x = 0$

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

Joint H:

$\Sigma F_y = 0$

$\frac{3}{5} \times (33.33) - 10kN + \left(\frac{3}{5}\right)(F_{HC}) - \left(\frac{3}{5}\right)(F_{HG}) = 0$ — (a)

$\Sigma F_x = 0$

$\frac{4}{5}(33.33) - \frac{4}{5}(F_{HC}) - \frac{4}{5}(F_{HG}) = 0$ — (b)

Solving the above equations (a) and (b)

$19.998 - 10 + 0.6 F_{HC} - 0.6 F_{HG} = 0$ — (a)

$26.664 - 0.8 F_{HC} - 0.8 F_{HG} = 0$ — (b)

Multiplying eq (a) by 1.33 then eq (a) becomes

Note: 0.792 rounded off to 0.80

$13.297 + 0.80 F_{HC} - 0.80 F_{HG} = 0$ — (a)

Now adding eq (a) and eq (b)

$13.297 + 0.80 F_{HC} - 0.80 F_{HG} = 0$

$26.664 - 0.80 F_{HC} - 0.80 F_{HG} = 0$

$39.961 - 1.60 F_{HG} = 0$

$1.60 F_{HG} = 39.961$

$F_{HG} = \frac{39.961}{1.60}$

(Compression)

$F_{HG} = 24.975\ KN$ — (c)

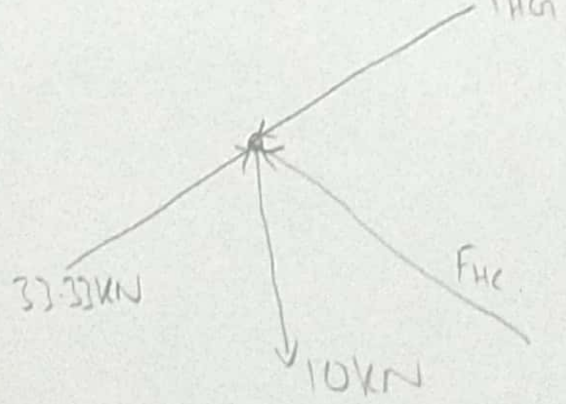
Putting the Value of F_{HG} in eq (b)

$26.664 - 0.8(F_{HC}) - 0.8(29.975) = 0$

$26.664 - 0.8(24.975) = 0.8\ F_{HC}$

$\frac{26.664 - 19.9805}{0.8} = F_{HC}$

$\therefore F_{HC} = 8.354\ KN$ (Compression)



Joint G:

$\Sigma F_x = 0$

$$\frac{4}{5}(24.975) - \left(\frac{4}{5}\right)(F_{GF}) = 0$$

$$19.98 - 0.8(F_{GF}) = 0$$

$$F_{GF} = \frac{19.98}{0.8}$$

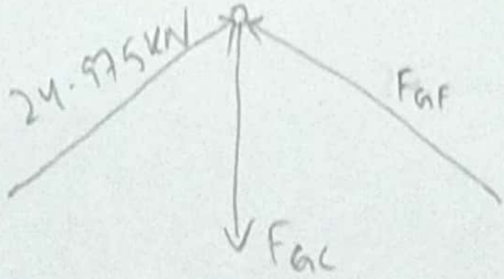
$F_{GF} = 24.975\ KN.$ ((Compression)

$\Sigma F_y = 0$

$$\frac{3}{5}(24.975) + \frac{3}{5}(24.975) - F_{GC} = 0$$

$$29.97 - F_{GC} = 0$$

$F_{GC} = 29.97\ KN.$ (Compression)



Joint

~~ΣFx = 0~~

Symetric loading and Geometry.

$F_{AB} = F_{ED} = 26.664\,kN$ (Tension)

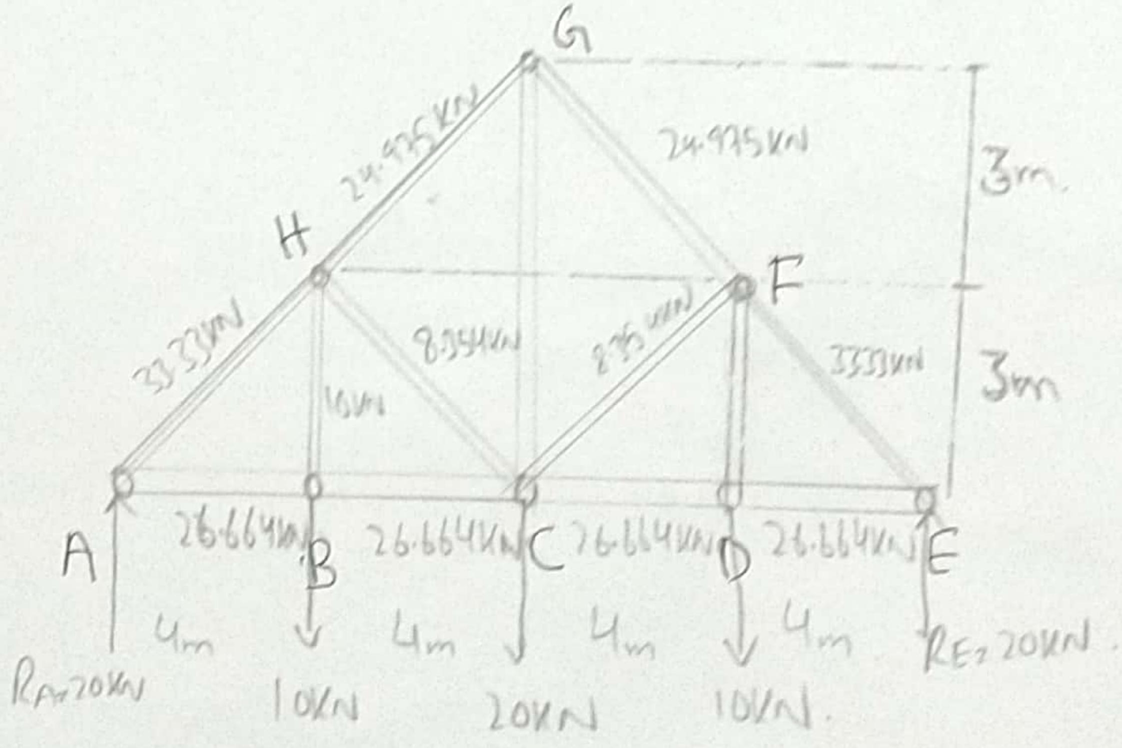
$F_{BC} = F_{DC} = 26.664\,kN$ (Tension)

$F_{BH} = F_{DF} = 10\,kN$ (Tension)

$F_{HG} = F_{GF} = 24.975\,kN$ (Compression)

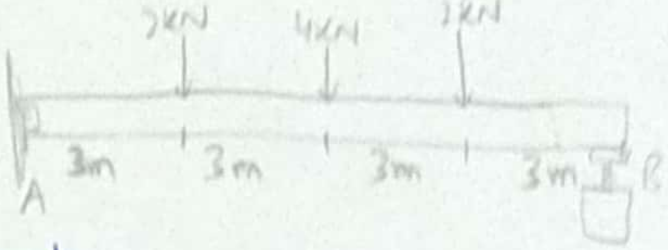
$F_{HC} = F_{FC} = 8.354\,kN$ Compression

$F_{AH} = F_{EF} = 33.33\,kN$ (Compression)



Q No (3)..

Determine the slope at A and displacement at C of the beam in the figure by Moment-Area theorem and take $E = 200\ GPa$, $I = 6 \times 10^6\ mm^4$



Given Data..

$E = 200\ GPa$

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

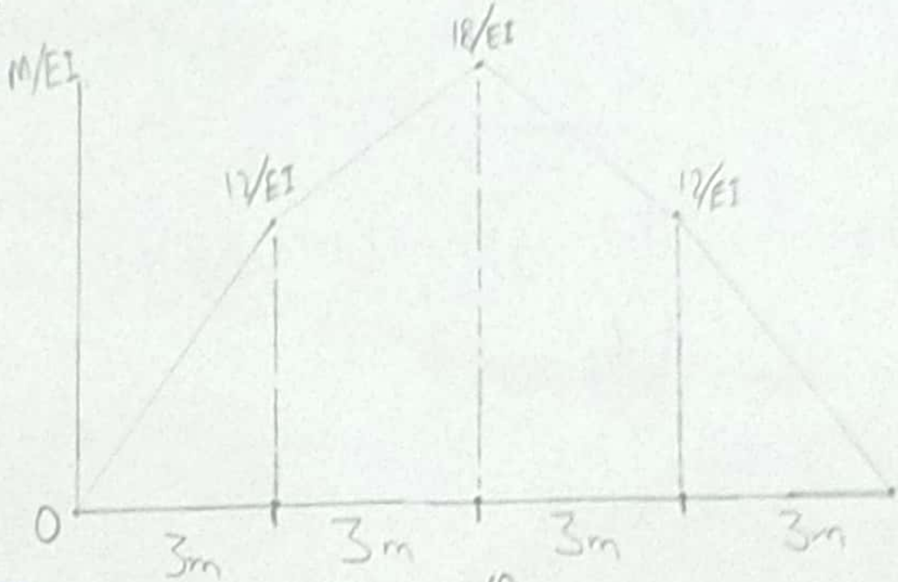
Required..

Slope at A = ?

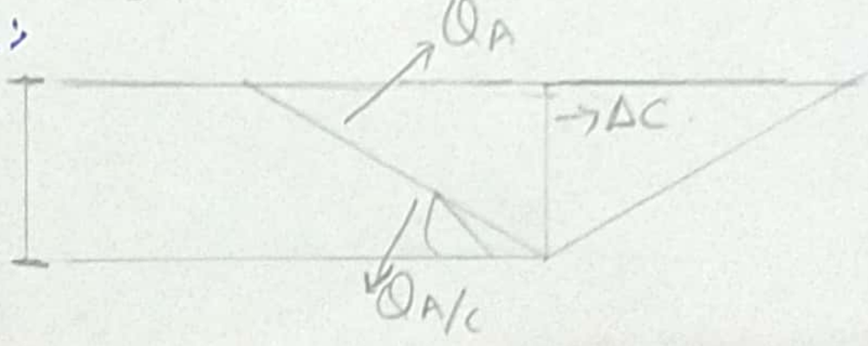
Displacement at C = ?

Solution..

Moment Diagram..



Elastic Curve:



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

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

$\theta_{A/C} = \frac{18}{EI} + \frac{36}{EI} + \frac{9}{EI}$

$\theta_{A/C} = \frac{63}{EI}$

Putting the Values of E and I.

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

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

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

$t_{A/C} = 0.202m$

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