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Section 'B"

Fourth Semester

Subject: Structure Analysis.

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QNO#01 Ans:

Load:→

Anything which exerts pressure OR thrust on a structure is termed as load. The basic requirement of any structural component of a building is that it should be strong enough to carry OR support all possible types of load to which it is likly to be subjected. The loads coming on building foundations are genrally divided into the following types.

Different Types of Loads that Acting on Different Structure.

* Dead loads.
* Live loads.
* Highway Bridge loads
* Railroad Bridge loads.
* Impact loads
* Snow loads
* Earthquack loads
* wind loads

* DEAD Load:-

It is permanent, Immovable & untransferable load of a structure. This is the load used for the various component of a building such as walls, floors, roof, partitions, ceillings, water tanks and shall include the weight of all other permanant construction OR structure and finture. All permanent loads are thus included in the dead load. Include equipment, materials, constructione or othe element of weight supported in on OR By a building, including its own weight, that are supposedly to remain permanent in place. The load of the structure itself is dead loads. The load of the structure system (Example) walls, columns, beams frame, cladding material (interior and enterior) slabes, portition walls and weight of other parmanent service equpment HVAC system. The dead loads are easy to calculate weight of evaluted by consulting bables of unit weights of structural material.

* Live Load :-

All other loads Acting on a structure other then dead loads of the structure is called live load. They include all the movable weight that include human, furniture and fixtures and other non structural elements such as rain, snow, ice. The wind pressure, water pressure or push of earth are also included in live load. The live load are assumed to be acting uniformly over the whole floor Area and the total live load is proportionalty distributed on the wall foundation for the purpose of design. The live load is assumed to act on all the floor of building. in the case of multistory building, some reduction is allowed in different floors as it is assumed that all the floor of a building are not simultaneously loaded. A percentage reduction is applied in the design of piers, (Example columns, walls and foundation of a multi-story Buildings.

⇒ The examples of live loads are the occupants, equipments, constructions or other element of weight supposed in on OR by building and that are likiy to be relocated during the expected building life. Weight of persons, movable partitions, Dust, load, weight of furniture.

* Snow load :-

Snow load acts on roofs. Actual load due to snow will depend upon the shape of the roof and its capacity to retain the snow. Roof should be designted for Actual loads due to snow or for the imposed loads, whichever is more severe. Mountainous region in northern parts of india are subjected to snow fall. load of snow baybe taken as 2.5 kg/m^2 per centimeter depth of snow. In case of roofs with slopes greater then 50° snow load may be disregarded.

⇒ Exampl of the snow loads on the building such as Residential Building multi story Building etc. To accumulated snow over roofs.

The empirical formula $P_f = 0.7 C_e C_t I_s P_g$

* Wind Loads

When structure block the flow of wind, The winds kinetic energy is converted into potential energy of pressure. Which causes causes a wind loading. The effect of wind on a structure depends upon the density and velocity of the air, The Angle of incidenke of the wind. The Shape of the Stiffness of the structure, and roughness of its surface.

⇒ For design purposes, wind loadings can be treated using either a static or dynamic Approach.

⇒ Example : wind loads thrust of wind on high-rise structure etc.

Wind Pressure

$$P = KV^2$$

Wher P = wind pressure in kg/m^2
V = velocity of wind in k/hr
K = Coeffcient whose value depends on various factors shuch as wind speed, temperature of air, shape of structure etc.
= 0.0006 (as per building code)

If the height of the building is less then twice its effective width, The wind pressure may be neglected. In Case of tall building the effect due to wind should be Considered. Tall Building are subjected to wind pressure on thier enposed faces and inclind or slopy roof surface The effect of wind pressure on the foundation on the windword side and to increase the pressure on the foundation on the leewards side For Purpose of design its assumed that the wind loading is acting horizontally at a uniform rate over the entire enpoed surface on the windward side.

* Earthquacke Force (Load)

Earthquacke causes shaking of the ground. So a building resting on it will experience motion at its base. The random earthquacke ground motions, which causes the structure to vibrate. Can be resolved, in any three mutually perpendicular directions. The Prominent direction of ground vibration is usually Horizontal. The engineering entention is to make buid building earthquacke resistance, Such building resist the effect of ground shaking, Although they may get damaged but would not Collapse during the strong earthquack. Thus, safety of people and content is assured in earthquake resistant buildings.

⇒ **Example** of the earthquack load on Building that forces caused due to Horizontal/vertical moment of Building etc.

* Impact loads:

Impact Load is caused by vibration or impact or Acceleration. thus impact load is equal to imposed load incremented by Som percentage called impact factor or impact allowance depending upon the intensity of impact. Impact loads are forces that need a structure or its components to absorb energy in a very short interval of time

An Example is dropping a heavy weight on a floor slab, or the shoke wave from an explosion strinking the walls and roof of a building.

External forces might also be classified as distributed and concentrated.

* Building Loads: (design loads)

The floor of building are Assumed to be subjected to uniform live loads. which depand upon the purpose for which the building is designted. These loading are ganrally tubulated in local state or nation codes.

It Should be realized Howeve, that codes provide only a genral guide for design. The ultimate responsibility for the design lies with the structural engineering. for Example Building load renfocement, roof slabe etc.

* Bridge Load:

Design live loading for Highway bridges are specified in the code of the American Association of State Highway and Transportation official (AASHTO)
H series truck weight very form 10 to 20 tons. However, bridges located on major Highways, which carry a great deal of traffic, are aften designed for two axle trucks plus a one axle Semitrailer as.
These are designated as HS loadings.
In genral, a truck loading selected for design depends upon the type of bridge. Its location, and type of traffic Anticipated.

* Railroad Bridge Load:

The loadings on railroad bridges:
Are specified in the specifications for Steel Railway Bridges published by the American Railroad Engineeres Association (AREA)
Normally E loads, as orignally devised by Theodor Coopers load distribution and has devised a series of M loadings, which are currently Acceptable for design. Since train loading involve a complicated series of concentrated forces, to simplify hand calculations table to obtain and graphes are sometimes used in conjunction with influence lines to obtain the critical load. Also computer programs are used for this purpose.

* Other Natural Load:

Several othe types of live loads may Also have to be conseclered in the design of a structural, depending on its location or use. Theos include the effect of blast. temperature changes, and differential settlement of foundation.

* HYDROSTATIC AND SOIL PRESSURE.

When building a wall, whether it is a basement wall, or in outeloor retaining wall, it is neccesary to make it strong enough to resist the pressure differential from the soil side to the open side.

This pressure will consist of two elements.

Soil pressure, which is a function of the soil depth and type.

Hydrostatic pressure, which will be simply the depth of the wall time the density of the water.

Structural elements:

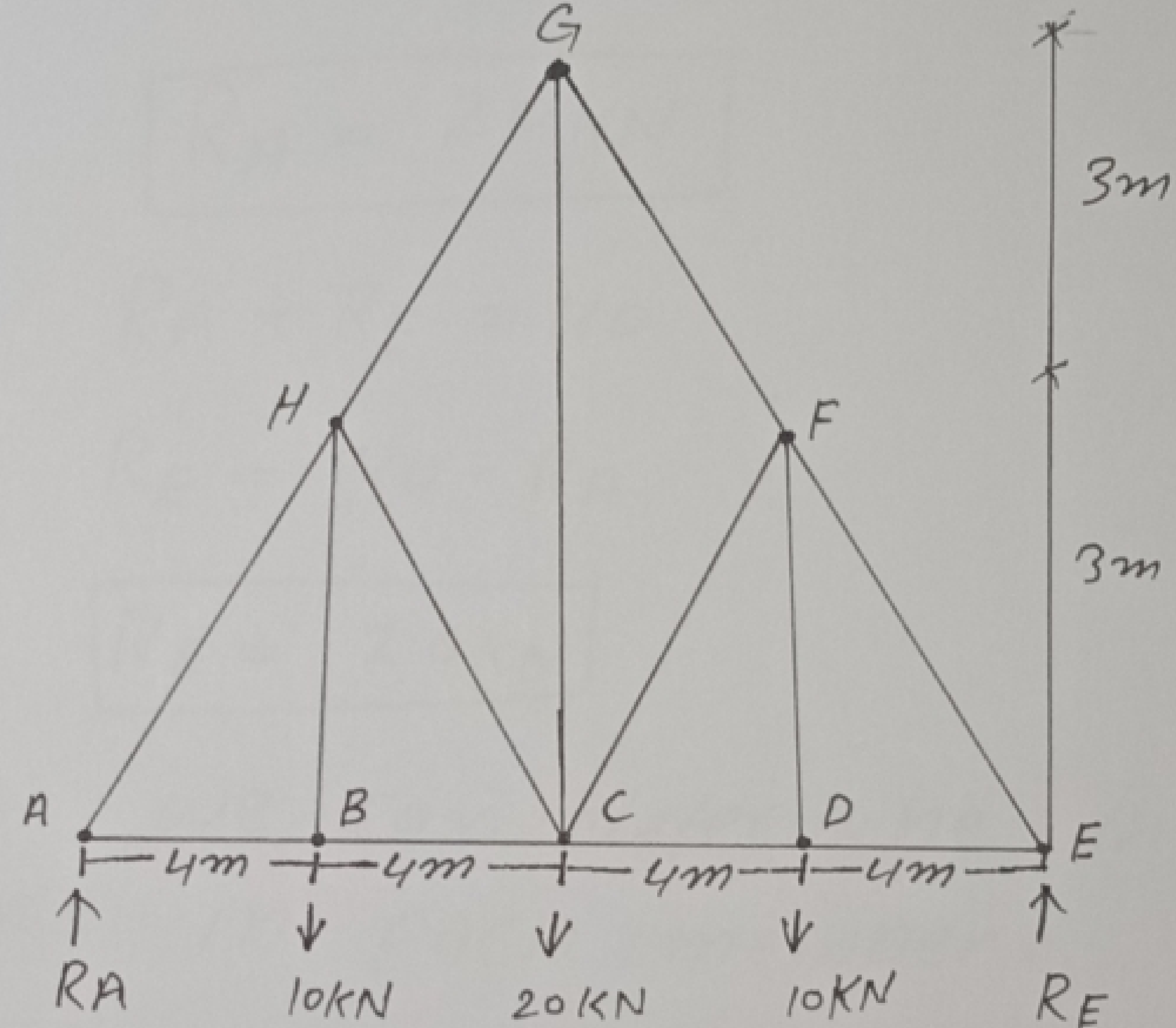
Tie road: Structural element subjected to a tensile load. Are often referred to as Tie road or brace struts. due to the nature of this load.

Beam :-> Beam are primarily designted to resist the bending moment. If they are short carry large loads. the internal shear force may beom quite large and this force may govern thiere design.

Column :-> Column are vertical membe to resist the compression load.

QNO#02

Determine the force in each member of the truss. State if the member are in tension OR Compression. Assume Assume all member are pin connected.



Solution:-

Required:- Force in Each members.

First of all we find the support Reaction.

$\Sigma F_y = 0$ $\quad R_A + R_E - 10 - 20 - 10 = 0$

$$R_A + R_E = 40KN$$

$\Sigma M \text{ at } E = 0$ (↺ −)

$R_A * 16 - 10*12 - 20*8 - 10*4 = 0$

$$R_A = \frac{10*12 + 20*8 + 10*4}{16}$$

$$\boxed{R_A = 20\,KN}$$

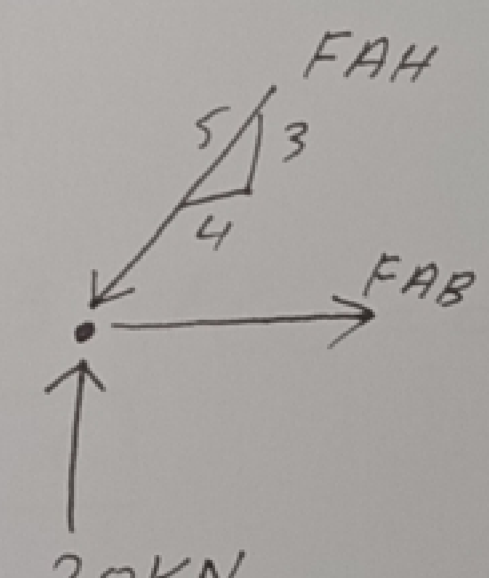
$R_A + R_E = 40$

$R_E = 40 - R_A$

$$\boxed{R_E = 20\,KN}$$

Now we can determine The force in Each member.

Joint "A"



$\uparrow + \Sigma F_y = 0$

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

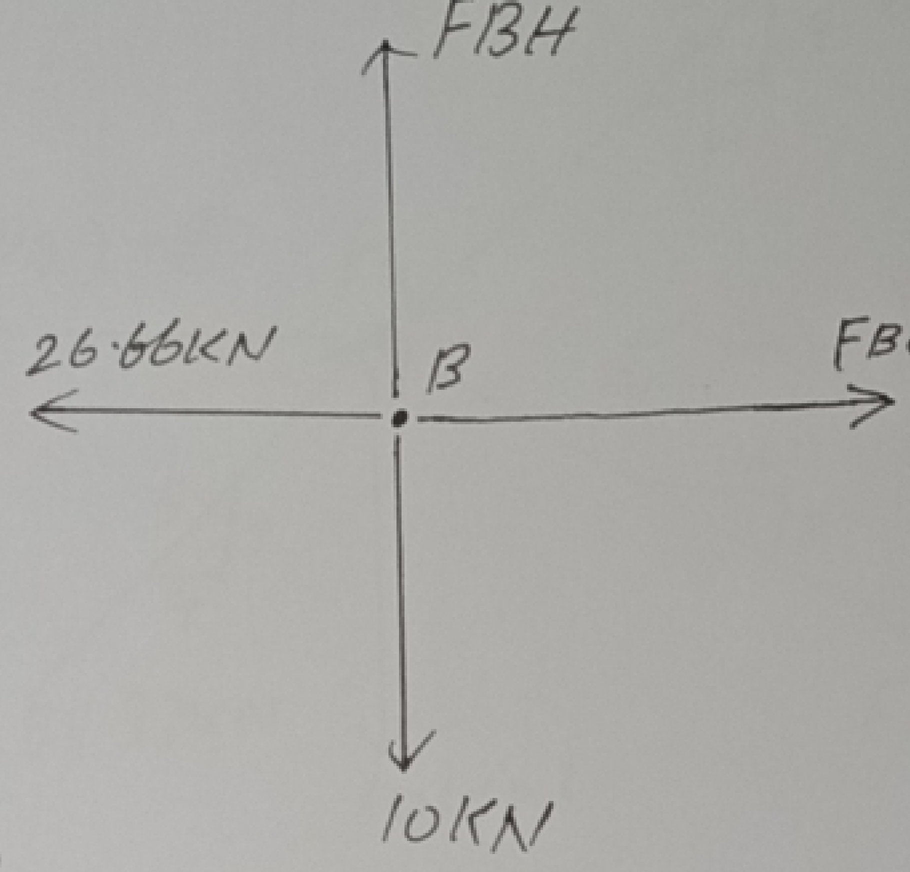
$\Rightarrow -0.6\,F_{AH} = -20\,KN$

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

$+\rightarrow \Sigma F_x = 0 \quad -\frac{4}{5}(33.33 + F_{AB} = 0$

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

Joint "B"



$+\uparrow \Sigma F_y = 0$

$F_{BH} - 10\,KN = 0$

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

$+\rightarrow \Sigma F_x = 0$

$-26.66\,KN + F_{BC} = 0$

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

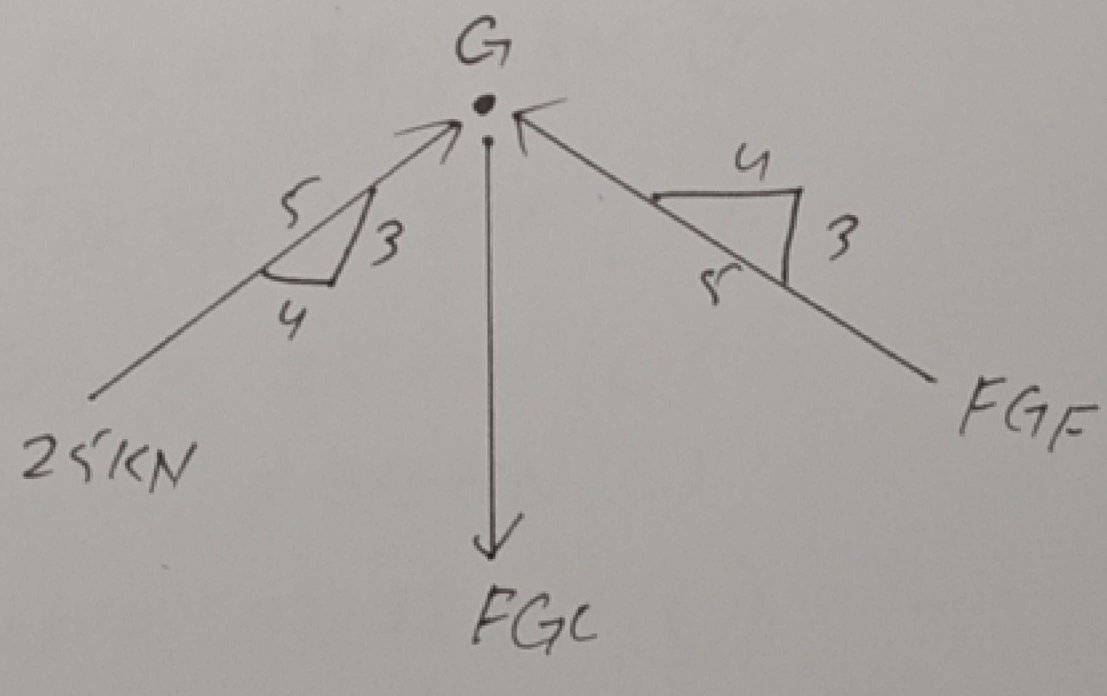
Joint "G"

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

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

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

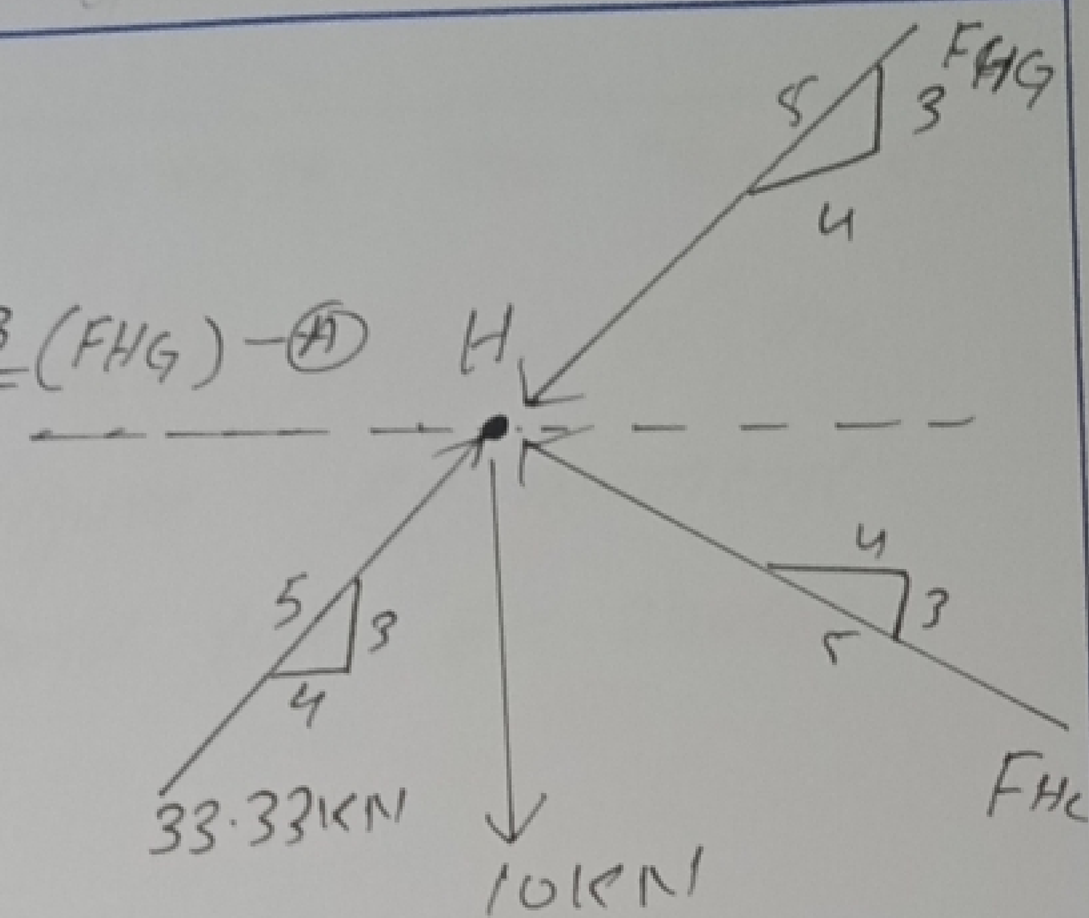
$\boxed{F_{GC} = 30\,KN\ \ C}$



Joint "H"

$\Sigma F_y = 0$

$\frac{3}{5}(33.33) - 10 + \frac{3}{5}(F_{HC})$ $-\frac{3}{5}(F_{HG})$ — (A)



$\Sigma F_x = 0$

$4/5(33.33) - 4/5(F_{HC}) - 4/5(F_{HG})$ --- (B)

$19.98 - 10 + 0.6 F_{HC} - 0.6 F_{HG} = 0$ --- (1)

$26.66 - 0.88 F_{HC} - 0.8 F_{HG} = 0$ — (2)

By the solution of equation (1) & (2)

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

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

Due to Symmetrical Loading & Geometry.

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

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

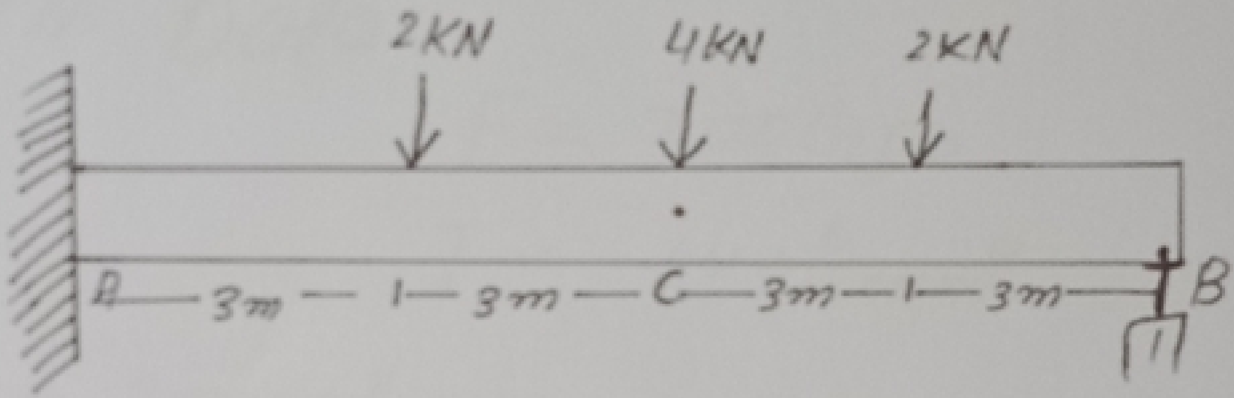
$F_{BH} = F_{DF} = 10\,KN$ (T)

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

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

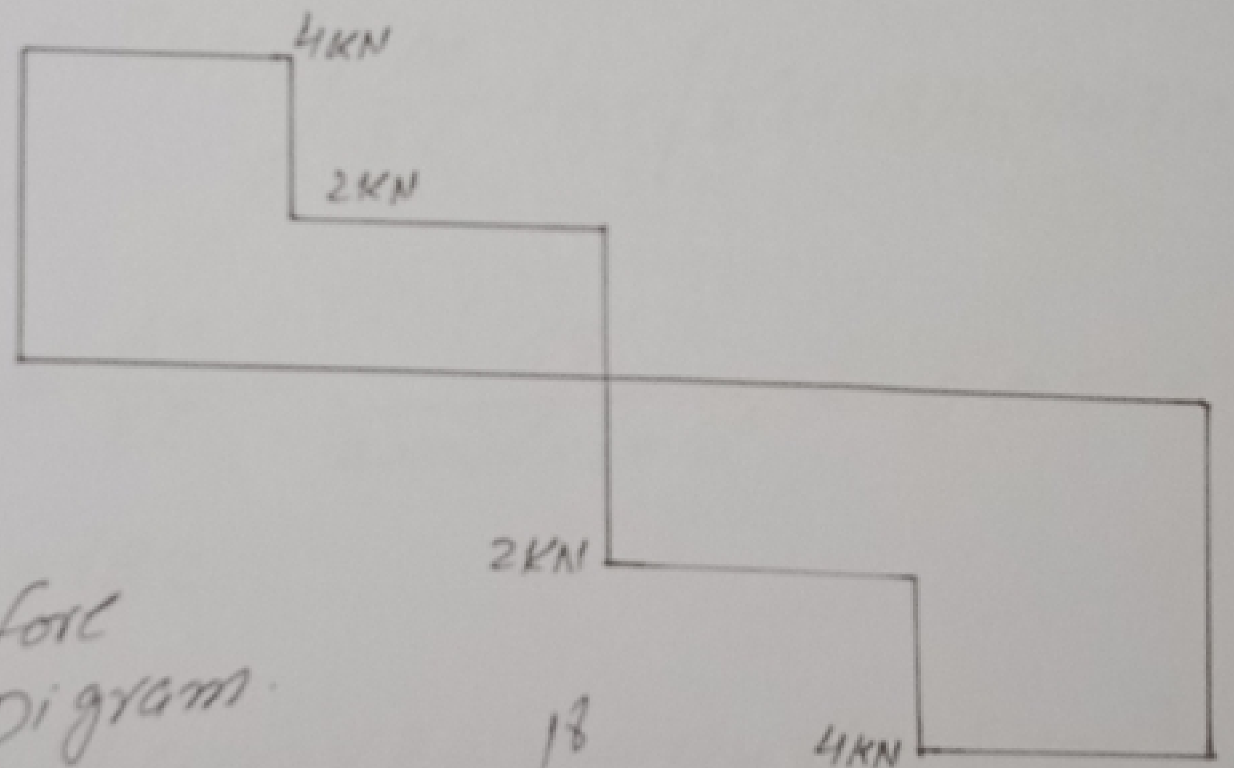
$F_{AH} = F_{EF} = 33.33\,KN$ (C)

Q No #03 Determine the Slope at A and displacement at C of the Beam in the figure. By moment Area theorm and take $E = 200 GPa$ $I = 6(10)^6 mm^4$.

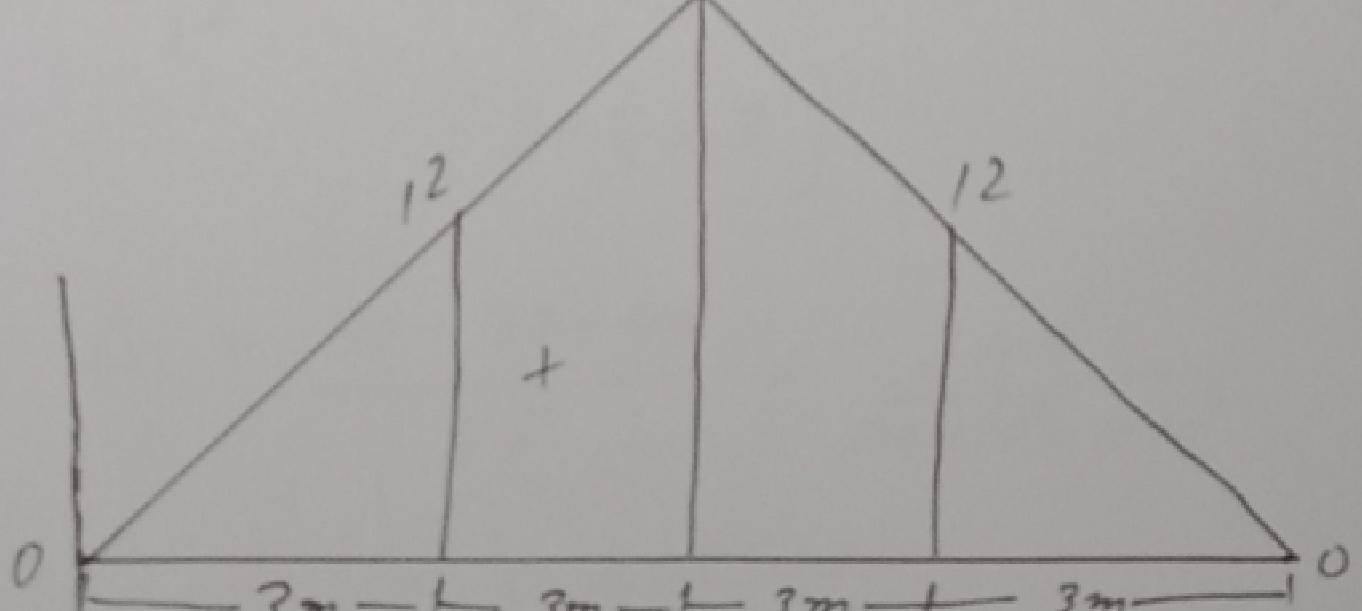


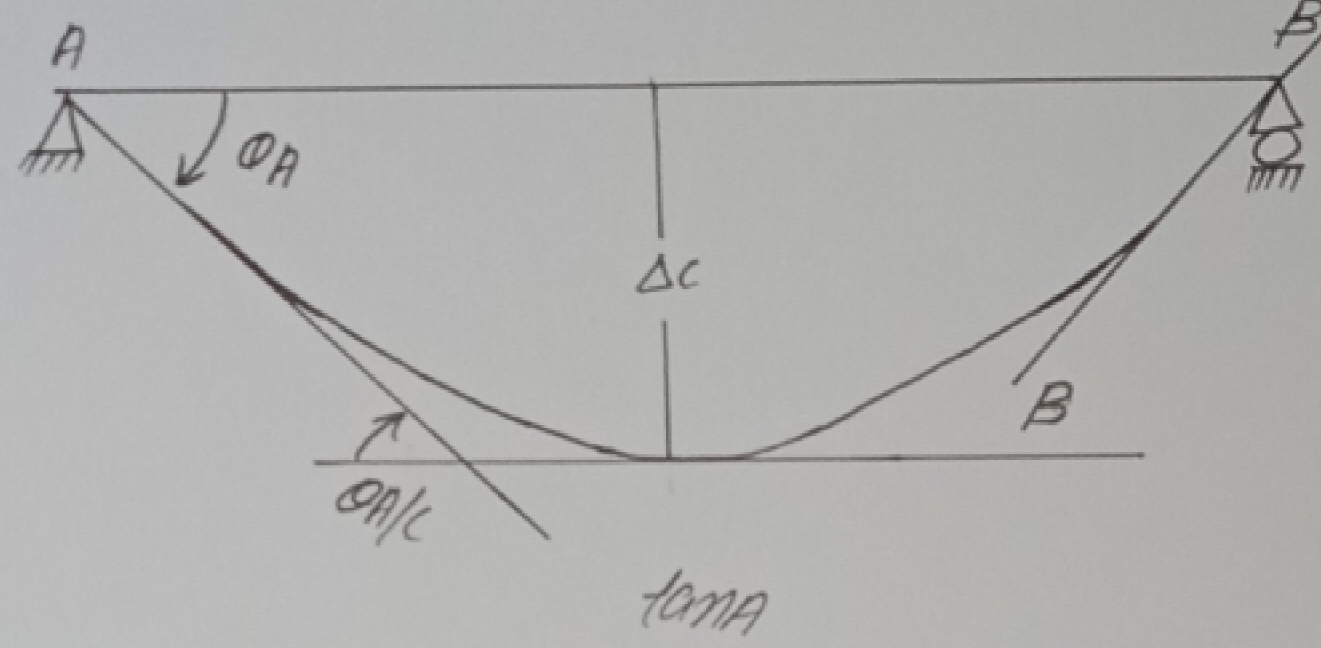
Solution :-

SFD



Shear forc Digram.





Given Data:

$$E = 200\,Gpa$$

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

So $E = 200 * 10^3 = 200000\ kN/m = 200 \times 10^6\ kN/m^2$

$$\theta_{A/C} = \theta_A = \int_C^A \frac{M}{EI}\,dx = \left[\frac{1}{2}(12*3) + (12*3) + \frac{1}{2}*6*3\right]\frac{1}{EI}$$

$$= \frac{63}{EI} = \frac{63}{200*10^6 \times 6*10^{-6}} = 0.0525\ rad$$

$$\Delta c = t_{B/C}$$

$$AC = \left[\frac{1}{2}(12\times3)\left(\frac{2}{3}*3\right) + 12*3\left(3+\frac{1}{2}(3)\right)\right] + \frac{1}{2}(6\times3)\left(3+\frac{2}{3}*3\right)$$

$$\Delta_c = \frac{36+162+45}{EI} = \frac{243}{200*10^6 \times 6\times10^{-6}}$$

$$= 0.2025\,m$$