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Name : Fahad M. Irshad
I.D :- 7379
Subject :- Structural Analysis
Instructor :- Sir Amjad Islam.

Q1 :- 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.

Ans :- The types of loads acting on structures for different buildings and other structures can be broadly classified as vertical loads, horizontal loads and longitudinal loads.

→ The vertical loads consists of dead load, live load and impact load.

→ The horizontal loads comprises of wind load and earthquake loads.

→ The longitudinal loads i.e and breaking forces are considered in special cases of designs of bridges, gantry girders etc.

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* Types of loads on different structures :-

1. Dead Loads.
2. Imposed loads.
3. Wind Loads.
4. Snow loads.
5. Earthquake loads.
6. Special loads.

1. Dead Loads :-

The first vertied load that is considered in dead load. Dead load are permanent or stationary loads which are transferred to structure throughout the life span. The calculation of dead loads of each structure are calculated by the volume of each section and multiply with the unit of weight.

2. Imposed Loads or Live Loads :-

It is considered in design of a structure in imposed Loads or Live loads, live loads are assumed to be produced by the intended use or occupancy of the building including weights of movable partitions or furniture etc. Live loads keeps on changing from time to time.

3- Wind Loads :-

Wind load is horizontal load caused by the movement of all relative to earth. Wind load is required to be considered in structural design especially when the health of building exceeds two times the dimensions transverse to the exposed wind surface for low rise building ray upto 4 to 5 stories, the wind load is not critical.

4- Snow Loads :-

Snow Loads constitude to the vertical loads in the building. But these type of loads are considered only in the snowfall places. The minimum snow loads on a roof area or any other area above the ground which is subjected to snow accumulation is obtained by the expression $S = \mu S_0$

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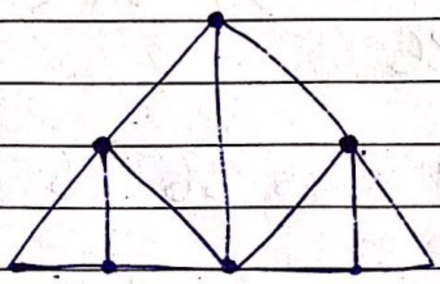
5- Earth Quake Loads :-

Earth quake forces constitude to both vertical and horizontal forces on the building. The total vibration caused by earthquake may be resolved into three mutually perpendicular directions, usually taken as vertical and two horizontal directions. The movement in vertical directions do not causes forces in superstructure to any significant extent. But the horizontal movement of the building at the time of earthquake is to be considered while designing.

6- OTHER LOADS & EFFECTS ACTING ON STRUCTURE :-

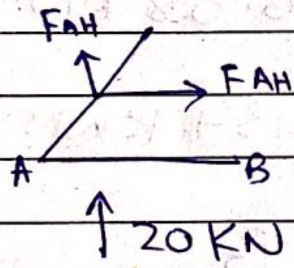
1- Foundation movement.
2. Elastic and shortning.
3- Vibration.
4. Impact.
5. Erection load.
6- Stress concentration effect due to point load.

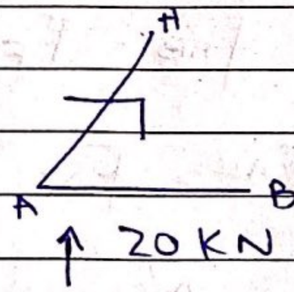
Q2 Determine the force in each member of the truss. State if the members are in tension or compression. Assume all members are pin connected.



Sol:-

Joint A.





$\Sigma F_x = 0.$

$F_{AB} - F_{AH} \cos Q = 0.$ $\overrightarrow{+ve}$ $\overleftarrow{-ve}$

as for $Q \Rightarrow \tan Q = \frac{P}{B} = \frac{3}{4}$

or $Q = \tan^{-1}\left(\frac{3}{4}\right) \Rightarrow Q = 36.86°$

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$F_{AB} - F_{AH} \cos 36.86 \longrightarrow$ ⓐ

$\Sigma F_y = 0$ ↑ +ve ↓ -ve

$20 = F_{AH} \sin 36.86 = 0$

$F_{AH} = \frac{20}{\sin 36.86} = 33.34$ KN. (C) P.T.V in eq — a

$F_{AB} - 33.34 \cos 36.86 = 0$

or $F_{AB} = 33.34 \cos(36.86)$

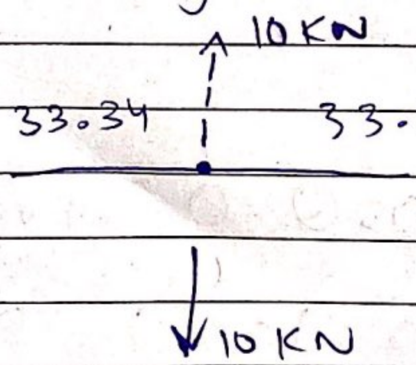
$F_{AB} = 26.68$ KN (T)

Same in for Joint D

as $F_{AB} = F_{ED} = 26.68$ KN (T)

& $F_{AH} = F_{DC} = 33.34$ KN

Now Joint B.



As for $F_{BH} = F_{CE} = 10$ KN. (T)

$F_{BC} = F_{CD} = 33.34$ KN. (T)

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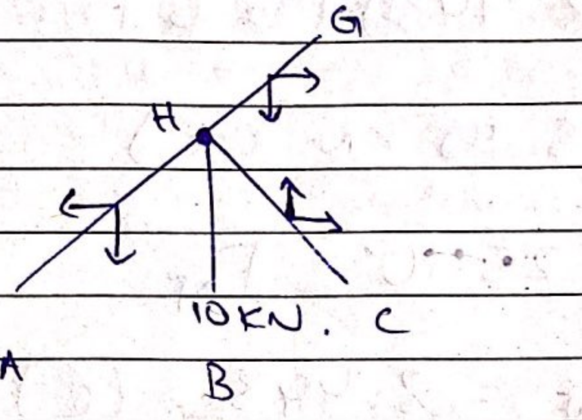
Now Joint H



$\Sigma F_x = 0$ $\overset{-ve}{\leftarrow}$ $\longrightarrow +ve$

$-33.34 \cos 36.87 + F_{HG} \cos 36.87 + F_{HC} \cos 36.87 = 0$

$-26.67 + 0.8 F_{HG} + 0.8 F_{HC} = 0 \rightarrow$ (b)

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

$10 - 33.33 \sin 36.87 - 0.6 F_{HG} + 0.6 F_{HC} = 0$

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

for $F_{HC} \Rightarrow F_{HC} = \left(\frac{10 + 0.6 F_{HG}}{0.6}\right)$ P.T.V in eq

$-26.67 + 0.8 F_{HG} + 0.8\left(\frac{10 + 0.6 F_{HG}}{0.6}\right) = 0$

$-26.67 + 0.8 F_{HG} + 13.33 + 0.78 F_{HG} = 0$

or $F_{HG} = 8.443$ KN

P.T.V in eq — (c)

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$$-10 - 0.6\,F_{HG} + 0.6\,F_{HC} = 0$$

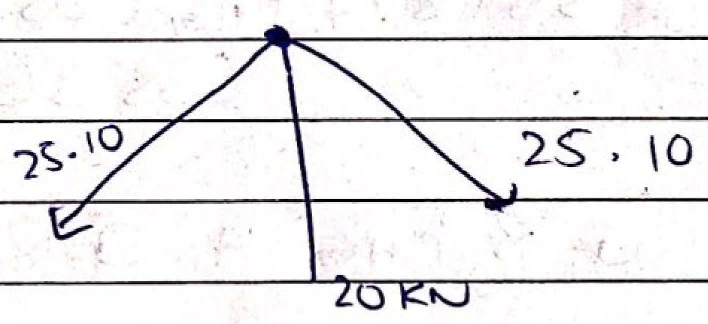
$$-10 - 0.6(8.443) + 0.6\,F_{HC} = 0.$$

$F_{HC} = 25.10$ KN (C)

So $F_{HC} = 25.10 = F_{DF}$

ϕ $F_{HG} = F_{GF} = 8.443$. (C)

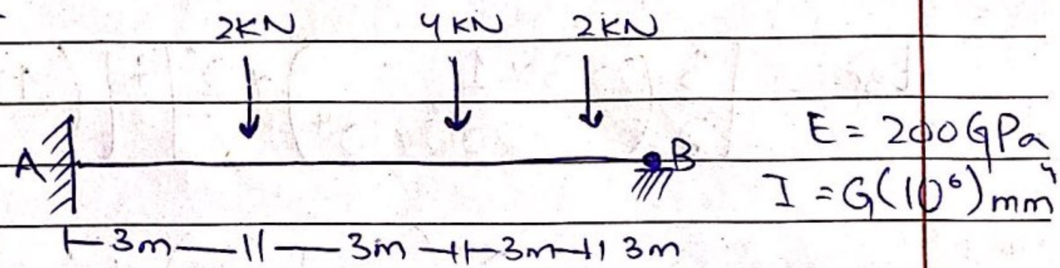
Now Joint G



$F_{GC} = 20$ KN . (T)

Q3 Determine the slope at A & displacement at C of the beam in the figure by a) Moment - Area Theorem and Take $E = 200$ GPa, $I = 6(10^6)\,mm^4$.

Sol :-



$\frac{1}{2}\left(\frac{Pa}{EI}\right)$ Slope (A) displacement (C)

$\phi_{AC} = \frac{1}{2}\left(\frac{Pa}{EI}\right)a + \left(\frac{Pa}{EI}\right)a + \frac{1}{2}\left(\frac{Pa}{2EI}\right)a$

$\phi_{AC} = \frac{1}{2}\left(\frac{4\times3}{200\times10^6\times6\times10^{-5}}\right)^3 + \left(\frac{4\times3}{200\times10^6\times6\times10^3}\right)$

$\times 3 + \frac{1}{2}\left(\frac{2\times3}{2\times200\times10^6\times6\times10^3}\right) \times 3$

$\phi_{AC} = \frac{1}{200\times10^9\times6^{-5}}\left(\frac{3}{2}(4\times3) + (12\times3) + \frac{3}{2}\left(\frac{6}{2}\right)\right)$

$\phi_{AC} = \frac{1}{200\times10^4}(18 + 36 + 4.5)$

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$\phi_{AC} = 0.00002925\ m.$

$$t_{BC} = \left[\frac{1}{2}\left(\frac{Pa}{EI}\right)a\right]\left(\frac{2}{3}a\right) + \left[\frac{Pa(a)}{EI}\right]\left(a + \frac{1}{2}a\right)$$

$$+ \left[\frac{1}{2}\left(\frac{Pa}{2EI}\right)a\right]$$

$$\left[a + \frac{2}{3}a\right]$$

$$t_{BC} = \left[\frac{3}{2}\left(\frac{2 \times 3 \times 1}{200 \times 10^4}\right) \times 2\right] + \left[\left(\frac{4 \times 3 \times 3 \times 1}{200 \times 10^4}\right)\right.$$

$$\left. \times \left(3 + \frac{3}{2}\right)\right] + \frac{3}{2}\left(\frac{2 \times 3}{2}\right.$$

$$\left.\frac{\times 1}{200 \times 10^4}\right) \times (3 + 2)$$

$t_{BC} = 9 \times 10^{-6} + 8.1 \times 10^{-5} + 1.125 \times 10^{-5}$

$t_{BC} = 1.0125 \times 10^{-4}$ or 0.00010125.