Paper .: Structure analysis

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Q1 Write a detail note on different types of loads that different type of structure are desgned to support throughout its life.

Ans/ The types of loads acting on structure for different bulding and structures be broadly classified as vertical loads, horizontal loads and longitudinal loads. The vertical loads consist of dead load. live load and impact load.

The horizontal loads comprises of wind load and earthquake load. The longitudinal load ie. tractive and braking forces are considerd in especial

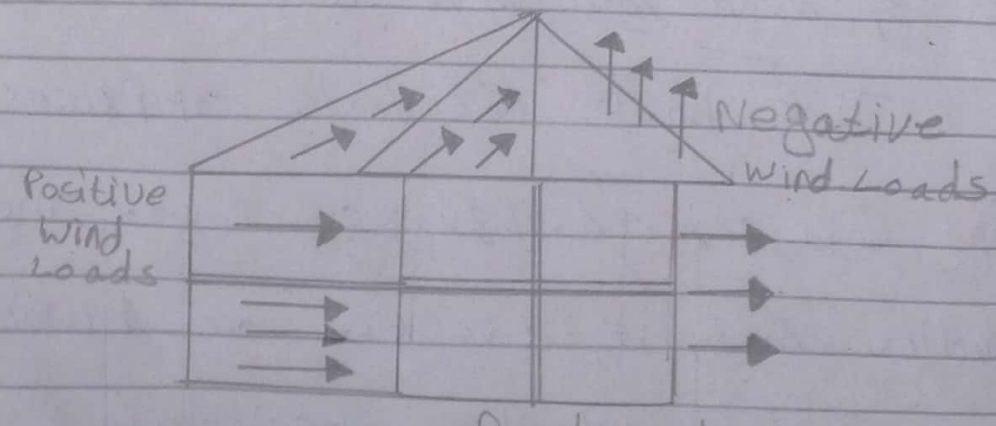
case of design of bridges, gantry girders etc

Types of Loads on different structures :

On a construction of building two Major factors considered are safety and economy. If the loads are adjudged and taken higher then economy is affected. If economy is considered and load are taken lesser then the safety is compromised.

Minimum design Loads for Building and other Structures specifies various loads for building and structures.

~~Types of loads acting on a structure are~~



Types of Loads on structure

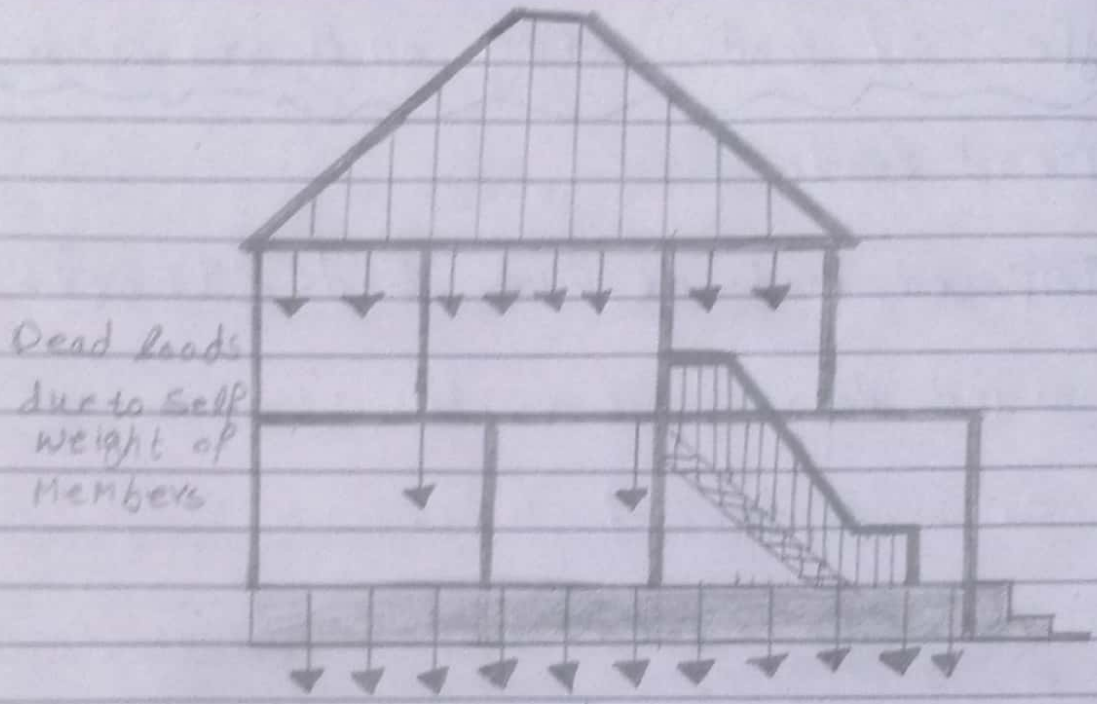
Types of loads acting on a structure are:

1) Dead loads
2) Imposed loads or live loads (IL or LL)
3) wind loads
4) snow loads
5) Earth quake loads
6) special loads.

1/ Dead Loads.: These loads are Permanent loads which are carried to the structure throughout their lifespan. Dead loads are also called as stationary loads. These loads occur mainly due to the self-weight of the structural Members, fittings, fixed Partition fixed equipment etc.

For suppose, to build a column we need steel bars concrete shuttering etc.

Dead Loads on a structure

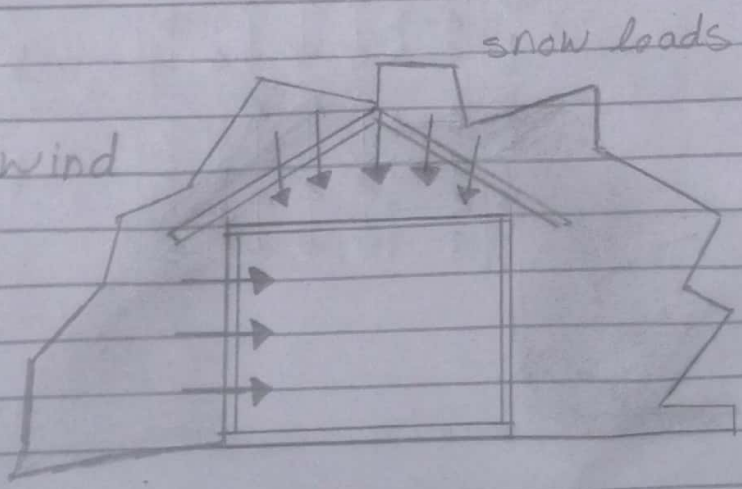


Live Loads:- As the name itself resembling that these type of loads are real-time loads. Live loads are also called as imposed or sudden loads. Live loads changes with respect to time. This type of loading may come and go. For example, At one moment the room may be empty hence the live load is zero. If the same room is packed with the people then the live load includes the weight of furniture, people accupying the floor, etc.

(5)

Snow loads:

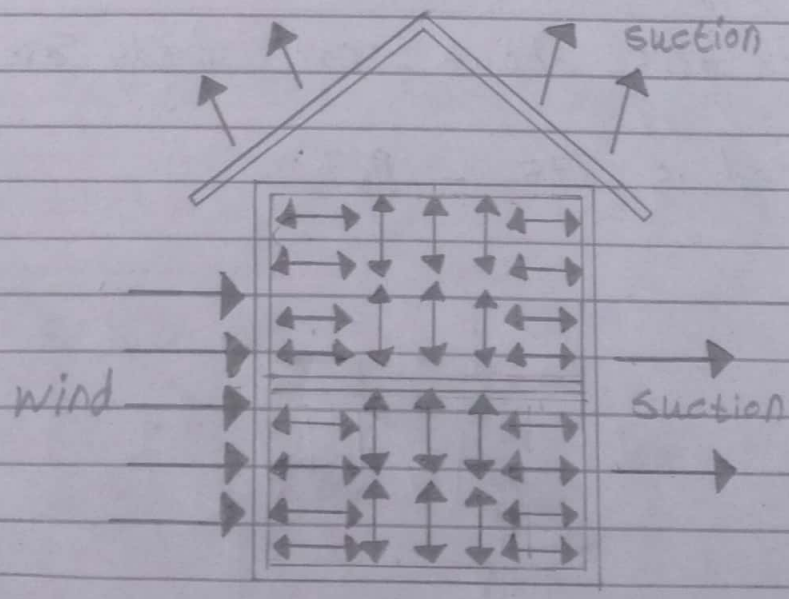
This type of loads is considered only on the structure which receives snowfall during Monsoon. Snow loads are calculated by the projections made by snow at different parts of the structure, The amount of snow load depends on the height of building, size and shape of the roof, the location of building whether its on the slope or not, the frequency of snow etc. The more details about snow loads are clearly mentioned is 875 – 1987.



Snow Loads on a Structre

Wind loads:

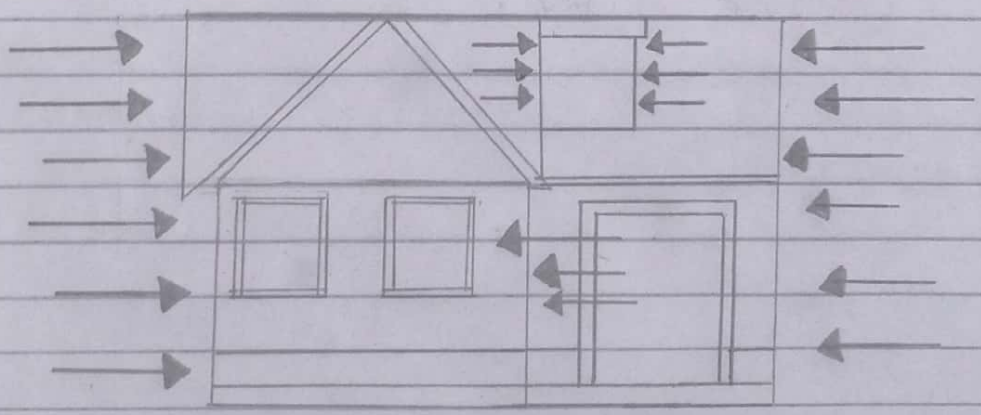
The types of loads are considered in design if the height of the building is More than 15m. Wind loads are occurred due to the horizontal load caused by the wind. As an construction. The structure should be strong enough with the heavy dead weights and anchored to the ground to resist this wind load. if not the building may blow away. wind load acts horizontally towards roofs, walls and create.



Wind Loads on a Structre

Earthquake loads :

These types of loads causes Movement of the foundation of structures. Earthquake force are internal force that developed on the structure because of the ground Movements.



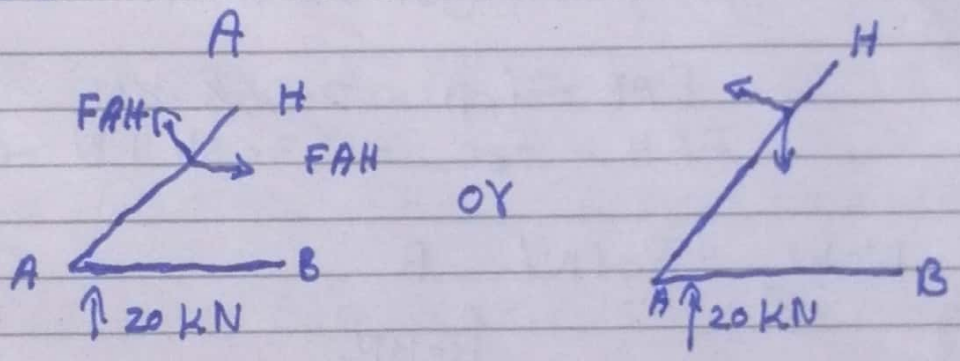
Earthquake loads on a structure.

Some other types of loads:

- Foundation Movement (IS 1904)
- Erection load (IS 875-)
- Vibration, Fatigue
- Soil and fluid pressures
- Stress concentration effect due to
- Point application of load and the like.

Q2/ Determine the force in each Member of the truss. State if the Members are in tension or compression. Assume all Members are connected.

Joint



$\Sigma F_x = 0$

$F_{AB} - F_{AH} \cos\theta = 0$ $\rightarrow$ +ve $\leftarrow$ -ve

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

or

$\theta = \tan^{-1}\left(\frac{3}{4}\right) \Rightarrow \theta = 36.86^\circ$

$F_{AB} - F_{AH} \cos 36.86$ ⟶ (2)

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

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

$F_{AH} = \frac{20}{\sin 36.86} = 33.34$ kN (C) P.T. Vin eq (2)

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

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

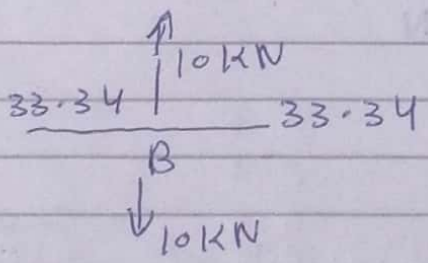
$F_{AB} = 26.68$ KN (T)

Same is for Joint D

$\therefore F_{AB} = F_{CD} = 26.68$ KN (T)

$\therefore F_{AH} = F_{CE} = 33.34$ KN (C)

Now Joint B

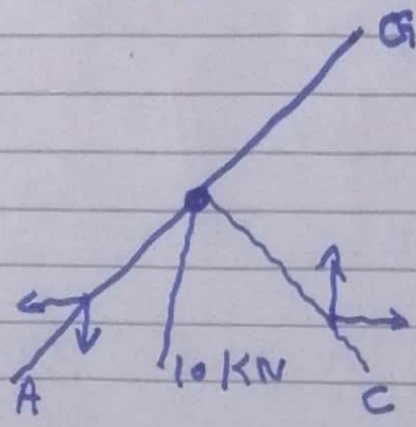


As for

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

~~As for~~ $F_{BC} = F_{CD} = 33.34$ KN (T)

Now Joint H



$\Sigma F_x = 0$ $\quad$ -ve $\longleftarrow$ $\longrightarrow$ +ve

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

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

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

$10 - 33.33 \sin 36.87 \; 0.6 F_{HG} + 0.6 F_{HC} = 0 \longrightarrow (c)$

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

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

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

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

or

$F_{HG} = 8.443 \text{ KN}$

PTV in eq (c)

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

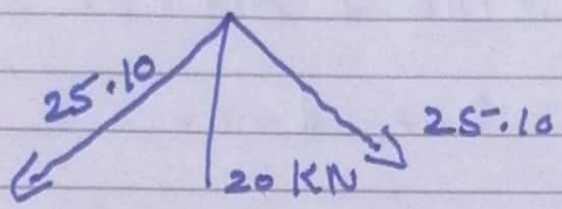
$-10 - 0.6 (8.443) + 0.6 F_{HC} = 0$

$F_{HC} = 25.10 \text{ KN} \quad (C)$

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

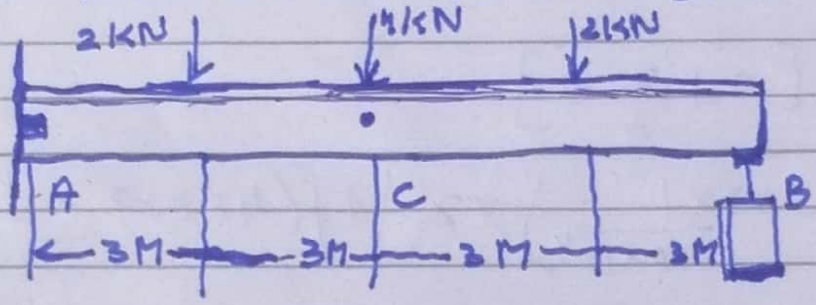
& $F_{HC} = F_{GF} = 8.443 \; (C)$

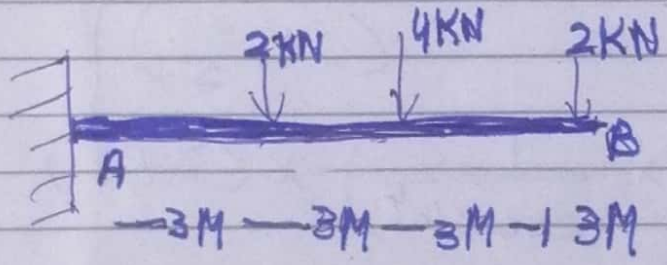
Now Joint G



$F_{GC} = 20\,KN\ (CT)$

Q3/ Determine the slope at A and 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





E x 200 GPa
I = 6 (10^6) MM^4

$\frac{1}{2}\left(\frac{Pa}{EI}\right)$

slope @

displament ©

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

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

$$+\frac{1}{2}\left(\frac{2\times3}{2\times200\times10^9\times6\times10^{-3}}\right)\times3$$

$$\theta_{AC} = \frac{1}{200\times10^9\times6\times10^{-5}}\left(\frac{3}{2}(4\times3) + (12\times13) + \frac{3}{2}\left(\frac{6}{2}\right)\right)$$

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

@AC = 0.0002925 M

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

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

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

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

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

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