PAPER

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- Subject. Structure Analysis
- Section. A

4 semester

Q1) write a detail note in your own words on different types of loads that different type of structures are designed to support throughout its life?

Ans **Loads**

In a construction of building two major factors considered are safetly and economy. if the loads are adjudged and taken higher than economy is affected if economy is considered and loads are taken lesser then the safetly is compromised.

Types of loads.

1) **Dead Load**

The first load is vertical load that is considered dead load. Dead loads are permanent or stationary loads which are transferred to structure loads which are transfered to structure throughout the life span. Dead load is primarily due to self weight of structral members, permanent partition walls fixed permanent equipment and weight of different materials. It majority consists of the weight of roofs, beams walls and columns etc.

2) **Live Load**

The second vertical load that is consider in design of a structure is imposed loads or live loads. Live loads are either movable or moving loads without any acceleration or impact. These load are

assumed to be produced by the intended use or occupancy of the building including weights of movable partitions or furniture etc.

3) Wind loads :-

wind load is primarily horizontal load caused by the movement of air relative to earth. wind load is required to be considered in structural design especially when the height of the building exceeds two times the dimensions transverse to the exposed wind surface.

4) Snow load :-

snow loads constitute to the vertical loads in the building. But these types of loads are considered only in the snow fall places. The IS 875 (part 4) - 1987 deals with snow loads on roof of the building.

5) Earth Quake load

Earth quake forces constitute to both vertical and horizontal forces on the building. The total vibration caused by earth quake may be resolved into three mutually perpendicular directions usually taken as vertical and two horizontal direction.

The movement in vertical direction do not cause forces in superstructure to any significant extent. But the horizontal movement of the building at the time of earth quakes it is to considered while designing.

6). Other loads and effects acting on structures

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

Types of structures

The combination of elements and the material which functions as a structural system. Each system consists of one or more of four types of structures.

1) Trusses :-

Trusses consists of slender element in triangular form. Due to geometric arrangement of its members loads are converted into Tensile or compressive forces in members.

→ Planar Trusses are comprise of members, lies in same plane and used for bridge and roof supports

→ Space Trusses have member extending in three dimensions and used for derrick and Trusses.

2) Cables & Arches :-

It is the types of structure used to span long distance.

→ cables are flexible and carry loads in Tensions They are commonly used to efficient support bridges roofs

→ Arches achieves strength in compressions and has a severe curvature to cable must be rigid to maintain its shape - consists of shear and moment. They are used in bridge structures dome roofs and openings

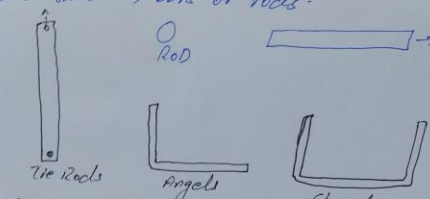
3) Frame structure.

Type of structure which is used in building and consists of beam and column. which are fixed or pin connected. The load on frames causes bendings of its members and has rigid joint connections. This structure is indeterminate.

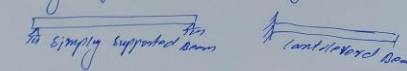
→ structure Elements.

Some of element are :-

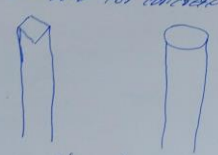
1) TIE Rods :-
consists of Tensile force. These members are slender, bars or rods.



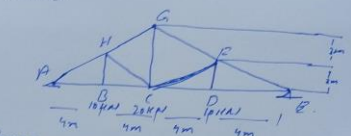
2) Beams :-
They are horizontal members and supports vertical loads. It resists bending moments exert easy large loads.



3) Columns
They consists of vertical member and resists compressive loads.
Tubes and wide flange across section are used for metal columns and square cross sections rod are used for concrete work.



(2) Determin the forces in each member of the truss. State if the members are in tension or compression. Assume all member are pin connected.



Forces on each member = ?

Sol:-

Support reaction

$\Sigma F_y = 0$ ↑↓

$R_A + R_E = 40$ → (1)

$\Sigma M_A = 0$ ↻

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

$R_E = 320/16 = 20KN$.

$R_A + 40 - 20 \Rightarrow R_A = 20KN$

Now determing force in each member

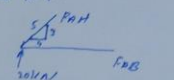
Joint A:

$\Sigma F_y = 0$; $-3/5\,(F_{AH}) + 20KN = 0$.

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

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

Joint A:-



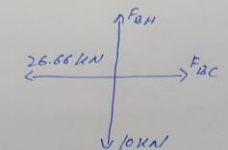
$\Sigma F_H = 0$; $-4/5\,(33.33) + F_{AB} = 0$

$= F_{AB} = 26.66KN$

Joint B:

$\Sigma F_H = 0$; $F_{BC} = 26.66KN\,(T)$

$\Sigma F_y = 0$; $F_{BH} = 10kN$ (T)



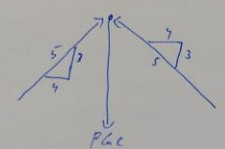
Joint B:

Joint G: $\Sigma F_x = 0$; $4/5 \cdot (25) - 4/5 (F_{GH}) = 0$

$F_G = 25kN$ (C)

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

$F_{GC} = 30kN$ (C)



Joint G:

Joint H:

$\Sigma F_y = 0$; $3/5 \cdot (33.33) - 10kN - 3/5 (F_{HC}) - 3/5 (F_{HG})$ ①

$\Sigma F_x = 0$; $4/5 (33.33kN) - 4/5 (F_{HC}) - 4/5 (F_{HG})$ ②

solving eq ① & eq ②

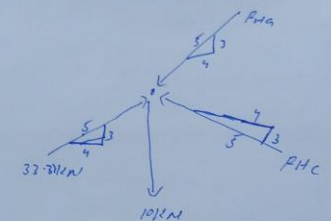
$19.99 - 10 + 0.6 F_{HC} - 0.6 F_{HG}$.

$26.66 - 0.8 F_{HC} - 0.8 F_{HG}$.

multiplying eq A by 1.34 and then added with eq B) we got.

$F_{HG} = 28kN$ (C).

$F_{HC} = 8.34kN$ (C)



Joint H:

Due to symmetrical loading & Geometry.

$F_{AB} = F_{BD} = 26.66kN$ (T)

$F_{BC} = F_{DC} = 26.66kN$ (T)

$F_{BE} = F_{DE} = 10kN$ (T)

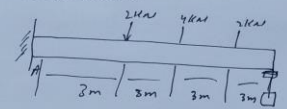
$F_{HG} = F_{FG} = 25kN$ (C)

$F_{HC} = F_{FC} = 8.34kN$ (C)

$F_{AH} = F_{GF} = 33.33kN$ (C)

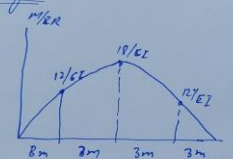
(Q3) Determine the slope at A and displacement at C of the beam in the figure by a) moment - A Theorem and Table $E = 200\,GPa$.

$I = 6(10^6)\,mm^4$

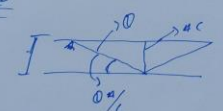


(i) Finding out M/EI Diagram & elastic curve.

Moment Diagram



Elastic curve



$\theta_{B/C} = \frac{1}{2}(12/EI)(3) + (\frac{18}{EI})(3) + \frac{1}{2}(6/EI)(3)$

$\theta_{B/C} = (18/EI) + (36/EI) + (9/EI)$

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

$\theta_{B/C} = 0.0525\,rad.$

$t_{B/C} = [\frac{1}{2}(18/EI)(3)][\frac{2}{3}(2)] + [12/EI(3)][(3)+\frac{1}{2}(3)] + [\frac{1}{2}(6/EI)(3)][(3)+\frac{2}{3}(3)]$

$= 0.203\,m$

$\therefore \Delta_C = t_{B/C} = 0.203\,m.$

$= 203\,mm$