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SUBJECT Structural Analysis

Semester 4th

Program BE Civil

ID # 7925

Section A

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Di Q#1

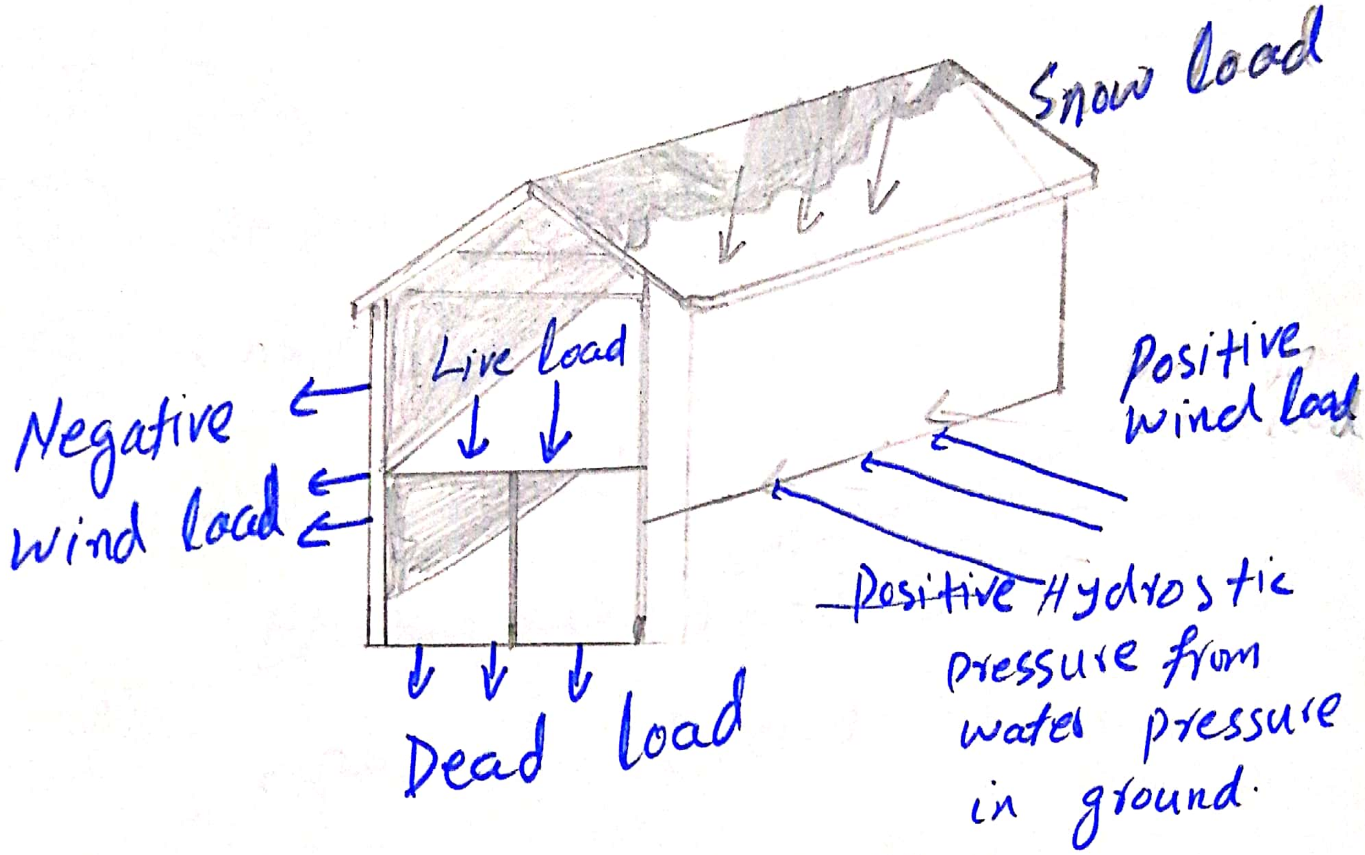
Different Types of Load:

The types of load acting on structure for building and other structure can be broadly classified as vertical load, horizental load and longitudinal loads,
hrizental load and longitudinal load.

The vertical load consist of dead load, live load and Impact load.

The horizental load comprise of Wind load and earthquake load.

The longitudinal load i.e tractive and braking force are considered in special case of design of bridges, gantry griders etc



→ In a construction of building two major factors considered are safety and economy. if the load are adjudged and taken higher then economy is effected. If economy is considered and loads are taken lesser then the safety is compromised.

→ Types of load acting on Structure are

1) Dead Load
2) Imposed Load OR Live load.
3) Wind Load
4) Snow load
5) Earthquake Load
6) special Load.

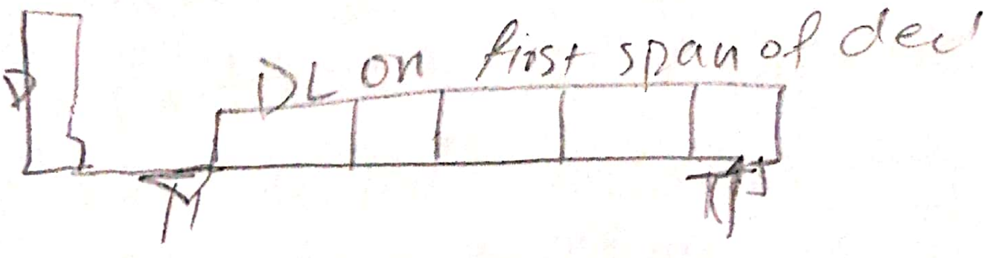
1) Dead Load (D.L)

The first vertical load that is considered is dead load. Dead load are pelmanent or stationary load which transfered to structure throught out the life span.

Dead load is primarily due to self weight of structural member, permanent partition wall, fixed permenent equipment and weight weight of different material. It majorly consist of the weight of roofs, beams, wall and column etc.

Which are otherwise the permenent parts of building.

F.B.D



(2) Imposed load or Live load (IL or LL)

: The second vertical load that is considered in design of structure is imposed load or live load. Live load are ~~eign~~ either movable or moving loads with out any acceleration or Impact. These load are assumed to be produced by the Intended use or occupancy of the building including weight of movable partitions or funiture etc

-> Residential buildings.
-> Education buildings.
-> Institutional buildings.
-> Assembly buildings.
-> Industrial buildings.

wind Load:-

wind load is primarily horizental load caused by the movement of air relative to earth. wind load is required to be considered in ~~structu~~ structural design especially when the heath of the building exceeds the two time dimensions transverse to the exposed wind surface.

Snow load:- Snow load constitute to the vertical load in the building But these types of load are considered only in ~~an~~ the ~~Snow fall~~ Snow fall places. The minimum snow load on a roof area or any other area above ground which is subjected to Snow ~~accumat~~ accumalation is Obtained by the expression -

$S = \mu S_0$

where S = Design Snow load on plan area of roof

μ = shape coefficient an

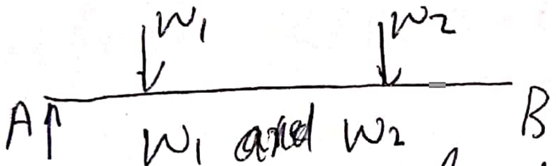
S_0 = Ground Snow load

(5) Earth Quake Load (EL)

Earthquake force constitute to both vertical and horizental force on building. The total Vibration caused by earthquake may be resolved into three mutually perpendicular direction usually taken as vertical and two horizental direction

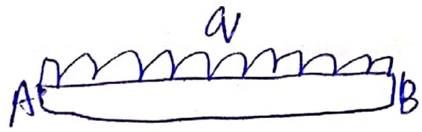
Point load OR concentrated load
The load concentrated at one point is called point load

→ Unit of point load is N or K.N



w_1 and w_2 are point load.

Uniformaly distributed load:-



Load uniformly distributed on certain length of a beam is called Unifomly distributed Load.

It is writen Udl

It is Shown by w

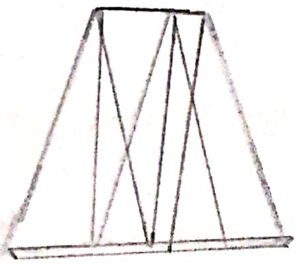
Unit KN/m or N/m

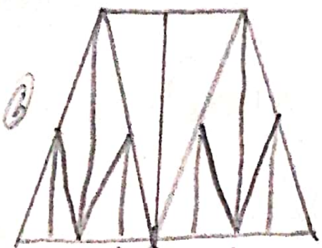
Types of Structure:

1. Trusses
2. Cables and Arches.
3. frame
4. Surface structure

1) Trusses. As a spans increase the use of beams becomes Unecnomical. For moderatly long span trusses are commonly used. Trusses Consist of Slender element connected at either ends (Joint) by hinged connection arranged in ~~traingular~~ triangular fashion to form of stable Configuration. when the load are applied Joints, ideal Trusses are always either in uniform tension cause

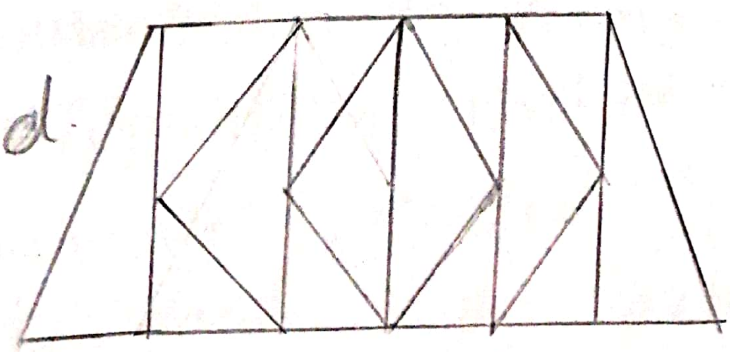
membe elongate or in uniform compression cause member shorten.
Trusses are commonly used in bridge and roof structure
Based on these shape, trusses are classified in to ~~setral~~ several types shown in

(a)

Pratt trusses

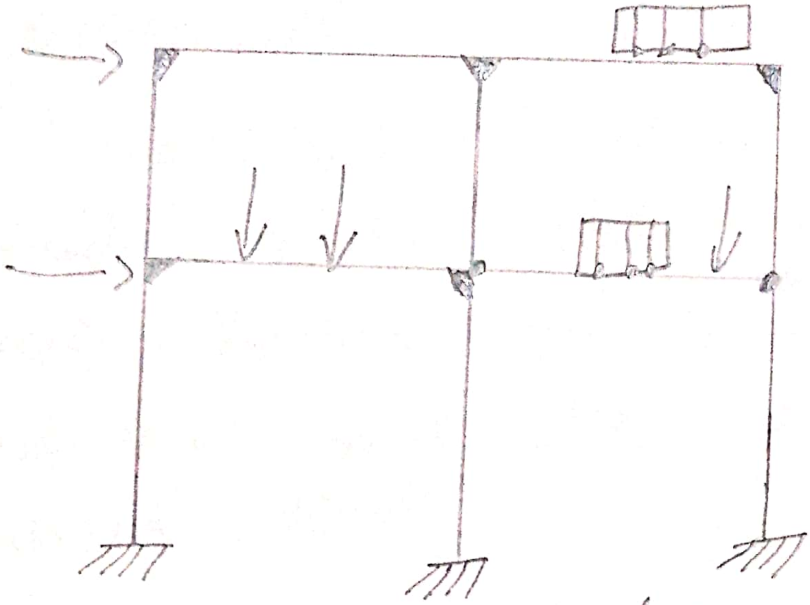
(b)

Baltimore trusses

(c)

Fink truss

d.

K Truss

frame structure



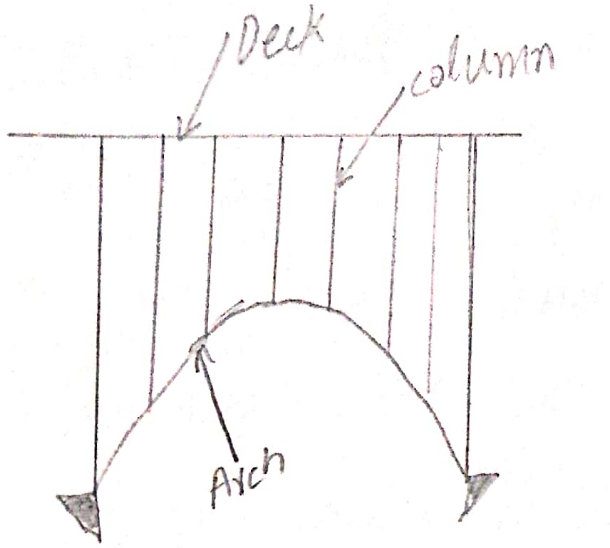
frame structure

frame structure : frame are comosed of beams and column that are either rigid (moment-resisting) connection or by ~~hang~~ hinged connection to frame stable configurations, Unlike trusses which are subjected only to joint load. the external loads on. frame may be applied ~~Gr~~of frame subjected to bending momement

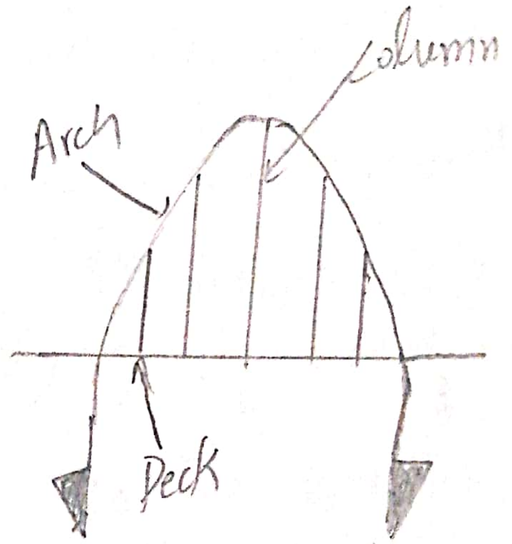
Shear, axial (compression, or tension) ~~tor~~ is torsion (For space trusses) Under the action of external loads. structural ~~a~~ steel and reinforced concrete frames are commonly used in multistory building and Industrial plants.

Arches:· The use of trusses to support bridge deck becomes impracticable for longer than moderate spans. In this situation arches are are commonly used. an arch in which the bridge deck is carried by columns supported in turn by the arches. ~~Alten~~ Alternatively the bridge deck may be ~~sup~~ suspended from the Arch by hanger is. Arch carry most

Arches are ~~co~~ frequently used in bridge structure dome roof and for opening in masonary wall. most there loads by developing compressive stresses within the arch itself.



Arch structure Bridge Deck supported by column



Arch structure Bridge Deck supporte by hanger.

Cables:: Other structure than arches to support long-span bridge are cables. because of there flexibility Cable have ~~negla~~ negligible bending stiffness can develope only tension. Thus under external load a cable adopts a shape that enables it to support the load by tensile force alone

Shape of a cable change as the load acting on change.

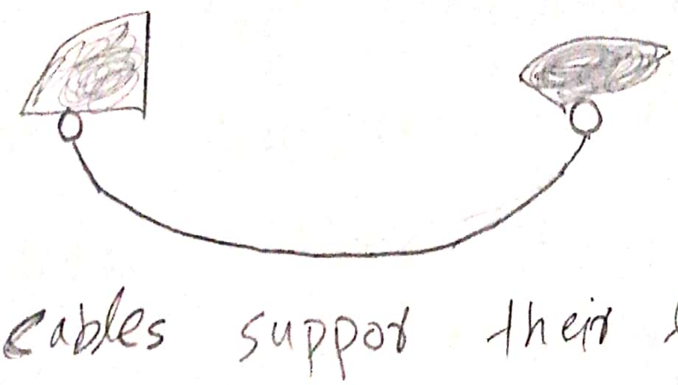
One of the popular cable structure is suspension bridge. In suspension bridge, the roadway suspended from two main cables means of vertical hangers.

The cable pass over saddles on the top of tower and are fixed at each ~~and~~ end within the ground by massive anchor blocks.

The weakness of suspension bridge and other cable structure is lack stiffness in laterial direction, they are ~~suspension~~

susceptible to wind-induced oscillations. Bracing of stiffening system are therefore provided to reduced such oscillation.

Cable are commonly used to support bridge and building roof when used for these purposes the cable has an advantage over the beam truss, ~~espisally~~ especially for span that are greater than 150 ft (40m).



cables suppor their load and tension

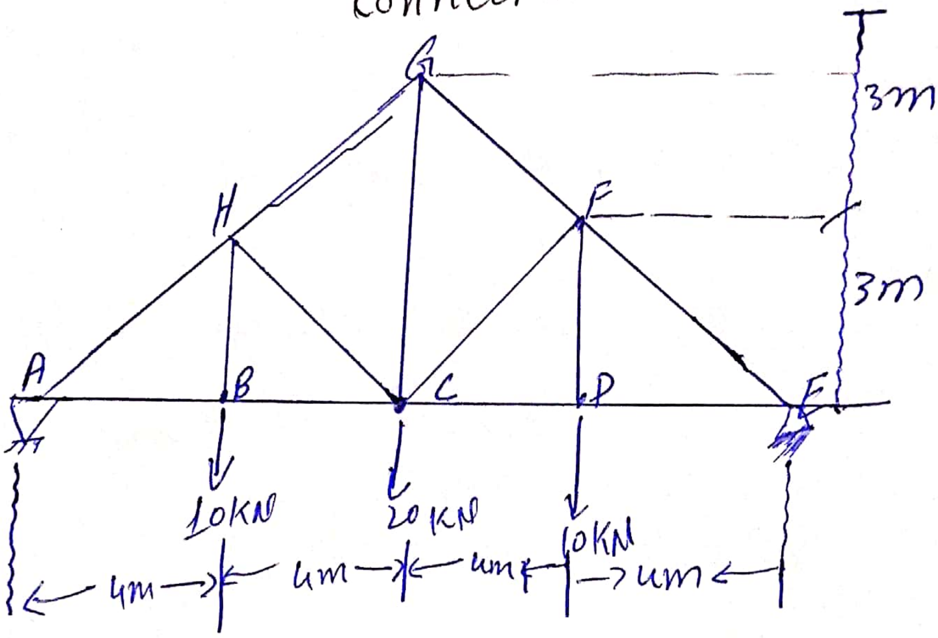
Surface Structure: A surface structure is made from a material ~~heaving~~ having a very small thickness compared to its other dimension p. Some time this material is very ~~flex flexiable~~ flexible and can take the form of a tent ~~and~~ or air-inflated structure. As such they may ~~be~~ ~~a~~ also be made rigid material such as reinforced concrete.

As such the may be shape as folded plates, or shells.

These structure act like cable ~~are~~ or arches since they support loads primarily in tension or compression with very little bending.

Q#2: Determine the force in each member of the truss, state if the member are in tension or compression.

Assume all member are point connected.



Solution:

Support reaction:

$\sum fy = 0$ ↑ ↓

$R_A + R_E = 40 \rightarrow$ (A)

$\sum M_A = 0$ Anticlockwise

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

$$RE = \frac{320}{16} = 20\ KN$$

RE = 20 in put in equation (A)

$RA + RE = 40$

$RA + 20 = 40$

$RA = 40 - 20 = 20 \Rightarrow RA = 20KN$

Now determine foce in each ~~moment~~ member

=> **Joint A**

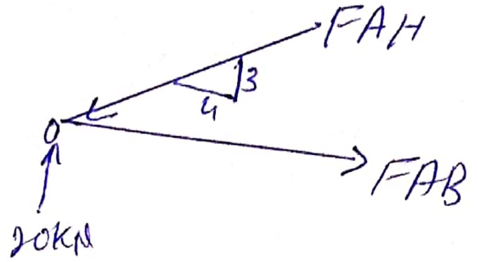
$\Sigma fy = 0, \; -3/5\,(FAH) + 20KN = 0$

$= -0.6\,(FAH) = -20KN$

$FAH = 33.33\ KN$ (compressive)

Scanned with CamScanner

Joint A :-



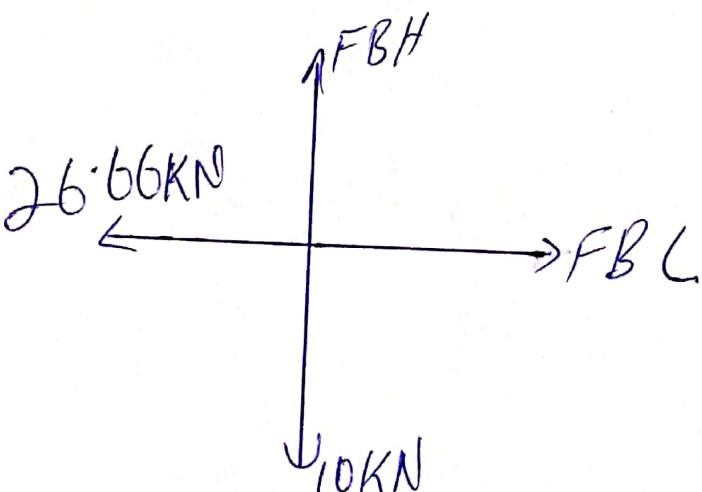
$\sum fx = 0;$ $-\frac{4}{5}(33.33) + FAB = 0$

$\Rightarrow FAB = 26.66$ KN (Tensill

Joint B)

$\Rightarrow \sum fx = 0;$ $FBC = 26.66$ KN (Tensile)

$\sum fy = 0;$ $FBH = 10$ KN (Tensile)



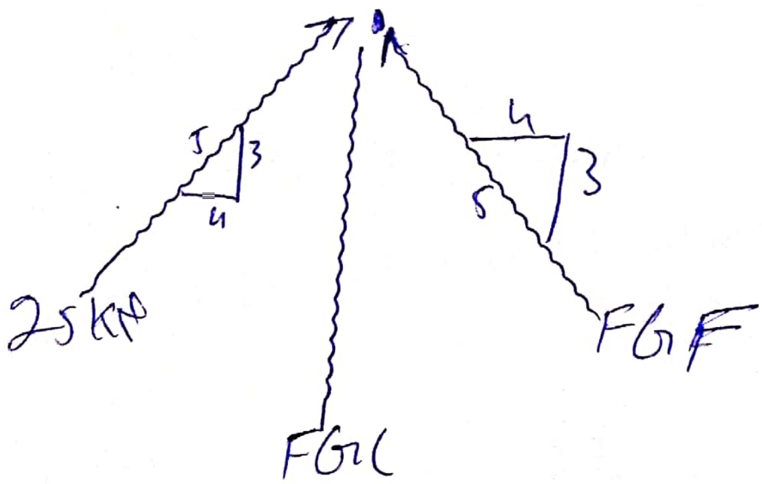
Joint G:

$\Rightarrow \sum F_x = 0; \quad 4/5\,(25) - 4/5\,(F_{GF}) = 0$

$F_{GF} = 25\,kN$ (compressive)

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

$F_{GC} = 30\,kN$ (compressive)



Joint G

Joint H:

$\Rightarrow \Sigma F_y = 0$

$3/5\,(33.33) - 10\,KN + 3/5\,(FHC) - 3/5\,(FHG \rightarrow (A)$

$\Rightarrow \Sigma F_x = 0;\ 4/5(33.33) - 4/5\,(FHC) - 4/5(FHG) \rightarrow B$

Solving eq (1) and eq (2)

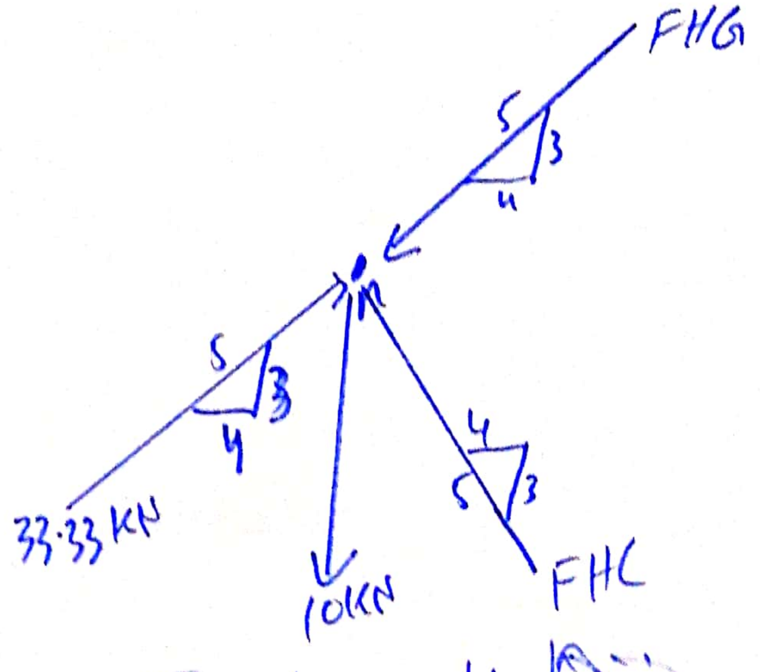
$\Rightarrow 19.98 - 10 + 0.6\,FHC - 0.6\,FHG = 0 \rightarrow (A_c)$

$\Rightarrow 26.66 - 0.8\,FHC - 0.8\,FHG = 0 \rightarrow (B_c)$

xing eq (A_c) by 1.34 and then add with eq (B_c) we get

FHG = 25 KN (compressive)

FHC = 8.34 KN (compressive)



Joint H

Due to Symmetrical loading And 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)

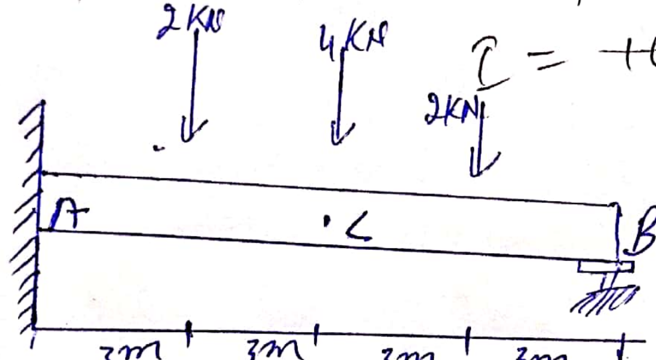
$F_{HC} = F_{FC} = 8.34$ KN (C)

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

Q# 3 Determine the slope at A and displacement at C of the beam in figure by a (Moment-Area Theorem and. Take E = 200 Gpa I = ~~10~~ 6 (10)^6 mm^4

Ans:.

Sol.



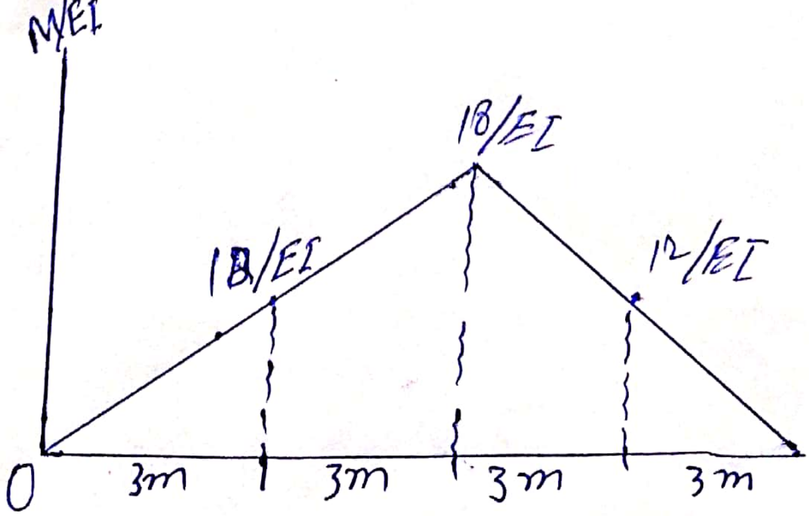
Given $E = 200$ Gpa , $I = 6 \times 10^6$ mm

Required data: (1) Determine the slope at point A ?

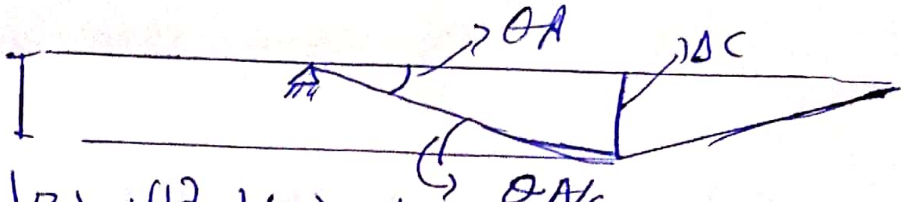
displacepent at point C = ?

Use Moment Area theorem = ?

Solution



Elastic curve:



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

$$\theta_{A/C} = \left(\frac{18}{EI}\right) + \left(\frac{36}{EI}\right) + \left(\frac{9}{EI}\right)$$

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

$$\theta_{A/C} = 0.0525 \text{ rad}$$

$$\theta_A = 0.0525 \text{ ~~road~~ rad.}$$

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

$$= 0.202 \text{ m}$$

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

$= 202$ mm ← Ans