BE(C) 4th Semester (mid-exam)

Name :- Ibrar Ahmad

ID No; 7914

Section :- A

Subject :- Structural Analysis-I

Instructor :- Sir Amjad Ashlam

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Question No. 01

Write a detail note in your own words on different types of loads and different types of structures. Explain with examples.

Ans:- Loads:-

A load is a force that is acting on a structure. for dimensional requirments of structures, it is necessory to determine the loads acting on it.

Types of loads

① Dead load:-

A type of load which does not vary in both in magnitude and location. It consists of loads due to self weight of structure or furniture above it. It can be easily calculated as compared to live loads.

Live loads:-

These loads vary in both in magnitude and ~~direction~~ location.

These are caused by moving objects, vehicales etc.

Types of structure:-

A combination of structural elements which is designed to support loads and is balanced is called a structure.

Generally two types of structures.

(i) Determinate → which can be balanced by 3-eqs of equalibrium

(ii) Indeterminate → which cannot be balanced by 3-eqs of equalibrium

Other types are given;

1) Trusses:-

Trusses consists of slendered elements in triangular form.

They are designed mainly to supported compressive loads.

2) cables and Arches:-

These structures are used for long span distances. it supports both →

Compressive and tensile loads.

- Cables are flexible and is good in tension.
- While Arches provides strength in compression.

(3) Beams:-

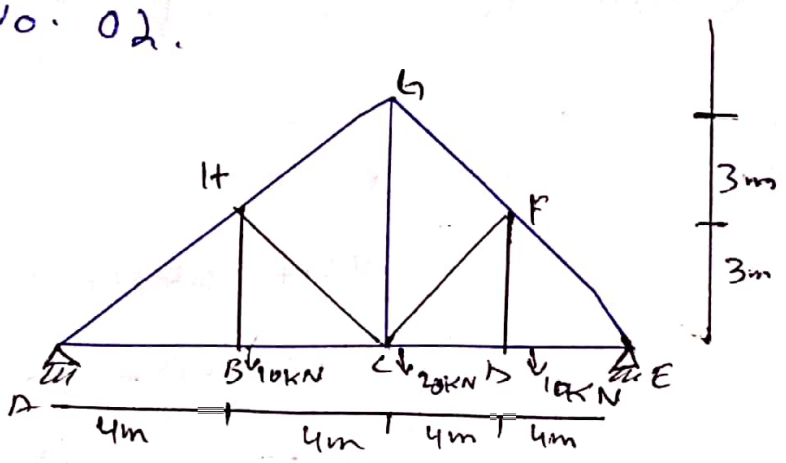
Its length is greater compared to other dimensions and is used to transfer load through compression.

It can be of timbers, steel, R.C.C or Concrete, etc.

(4) Columns:-

Vertical structures which transfer axial load through compression to the ground or other part of the structures.

Question No. 02.



forces in each member = ?

Sol:- Support reactions:

$$\Sigma f_y = 0 \quad (\uparrow +, \downarrow -)$$

$$R_A + R_E = 40 \rightarrow (1)$$

as $\Sigma f_y = 0$ ↺

so; $\Sigma m_A = 0 \quad (\circlearrowleft +, \circlearrowright -)$

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

$$R_E = \frac{320}{16} = 20\,kN$$

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

$$\Rightarrow R_A + R_B = 40\,kN$$

$$\Rightarrow \boxed{R_A = 20\,kN}$$

→

Now determining force at each member.

Joint 'A':

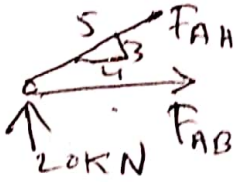
$\Sigma F_y = 0$

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

$\Rightarrow -0.6(F_{AH}) = -20kN$

$\boxed{F_{AH} = 33.33kN}$ (Compression)

Joint A



$\Sigma F_x = 0$

$\Rightarrow -\frac{4}{5}(33.33) + F_{AB} = 0$

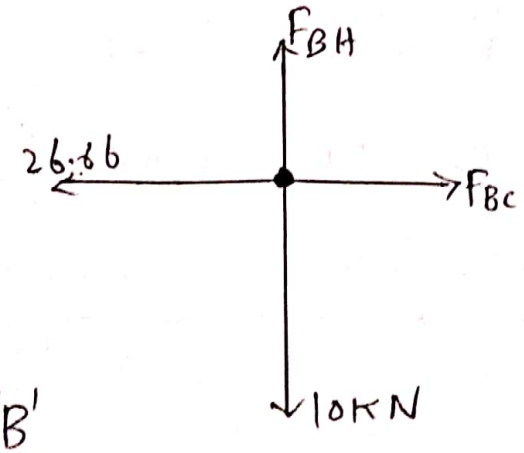
$\Rightarrow \boxed{F_{AB} = 26.66kN}$ (Compression)

$\Rightarrow \boxed{\begin{aligned} F_{AH} &= 33.33kN \\ F_{AB} &= 26.66kN \end{aligned}}$

Joint 'B':

$\Sigma F_x = 0$; $F_{BC} = 26.66kN$ (Tension)

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



'B'

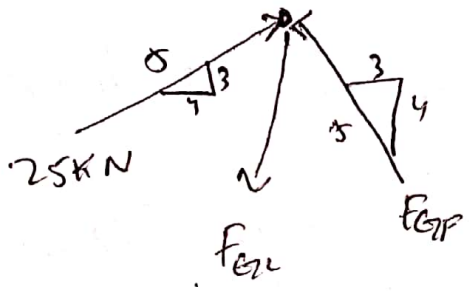
Joint 'G' :-

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

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

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

$\Rightarrow \boxed{F_{GC} = 30kN}$ (compression)



'G'

Joint 'H'.

$\Sigma F_y = 0$

$\Rightarrow \frac{3}{5}(33.33) - 10kN + \frac{3}{5}(F_{HC}) - \frac{3}{5}(F_{HG}) = 0 \rightarrow (1)$

$\Sigma F_y = 0$

$\Rightarrow \frac{4}{5}(33.33) - \frac{4}{5}(F_{HC}) - \frac{4}{5}(F_{GH}) = 0 \rightarrow (2)$

Solving eq(1) and eq(2)

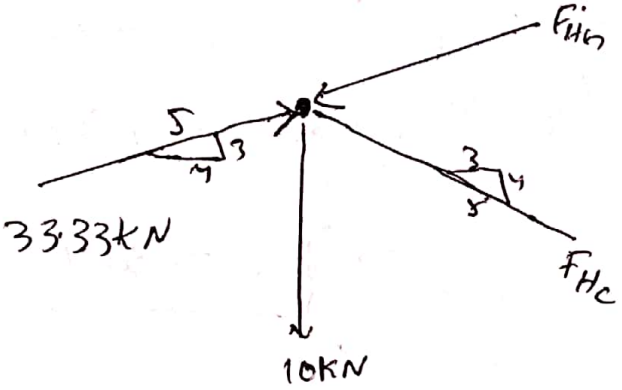
$19.98 - 10 + 0.6F_{HC} - 0.6F_{HG} = 0 \rightarrow (a)$

$26.66 - 0.8F_{HC} - 0.8F_{HG} = 0 \rightarrow (b)$

multiplying eq A by 1.34 and add with eq B.

$F_{HG} = 25kN$ (Compression)

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



Due to Symmetrical loading and geometry.

$F_{AB} = F_{ED} = 26.66kN$ (Tension)

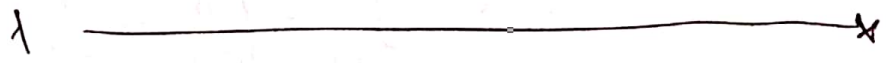
$F_{BC} = F_{DC} = 26.66kN$ (Tension)

$F_{BH} = F_{DE} = 10kN$ (Tension)

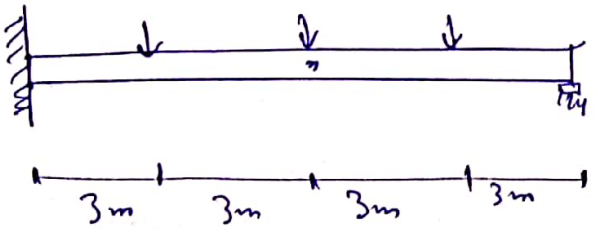
$F_{HG} = F_{FG} = 25kN$ (Compression)

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

$F_{AH} = F_{CF} = 33.33kN$ (Compression)



Question No. 03



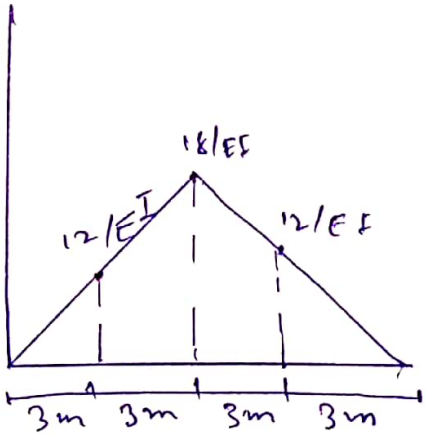
Given that $E = 200\ GPa$, $I = 6 \times 10^6\ mm$

Determine slope at point 'A' and displacement at 'C' using moment area theorem.

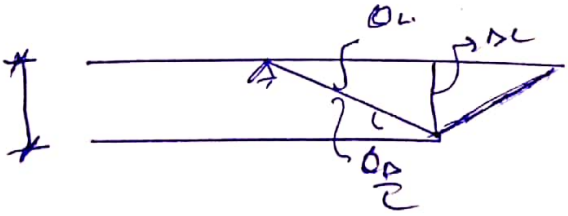
Solution.

: finding out M/EI Diagram of elastic curve.

moment diagram:



Elastic Curve:



→

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

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

$$\theta_{\frac{A}{C}} = \frac{63}{EI} \Rightarrow \frac{63}{(200\times10^6)(6\times10^6)(10000)^{-4}}$$

$$\theta_{\frac{A}{C}} = 0.0525 \text{ rad.}$$

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

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

$$= 0.202 \text{ m}$$

So, $\Delta_C = \Delta_{\frac{A}{T}} + \Delta_{\frac{A}{C}} = 0.202 \text{ m}$

$$\Rightarrow \boxed{\Delta_C = 202 \text{ mm}} \text{ Ans}$$

THE END