SUBJECT: STRUCTURE

NAME: ASFANDYAR KHAN

ROLL NO: 7399

Ans(1) LOADS:

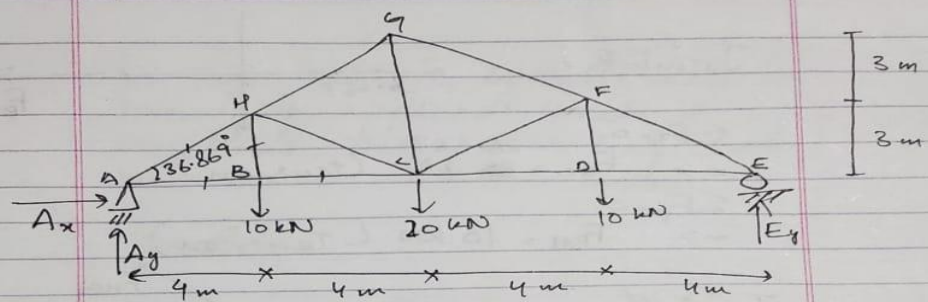
The different type of loads that the civil structures take during their life are as follows

1. **DEAD LOAD:** the permanent and stationary load which are transferred to the structure through out the life span is called dead load.
   Example: this load is mainly due to weight of the structure's own components like weight of roof, columns, beam and it also contains partition walls or fixed permanent equipment.
2. **LIVE LOAD:** all the movable loads that occur on the structure through out the life span are called live loads
   Example: all the movable things in the structure such as cupboards, people, desks and movable partitions etc. these loads may come and go with different intensity like a high live load of people in a party.
3. **WIND LOAD:** this load caused by the air and it is horizontal load which is relative to earth. These loads are more critical for high rise buildings and not so critical for low rise structures
   Example: a modern light gauge frame structure may easily be affected by wind, so the structure must be braced to resist the load
4. **SNOW LOAD:** these types of loads are the vertical loads on the building due to snow, and these depend on the longitude and latitude i.e. location of the structure. The shape of the roof of a structure also play role in the loads, the steeper the pitch, lesser the snow and hence low load
   Example: all the snow loads on the roofs of the structures on the northern side
5. **EARTHQUAKE LOAD:** these are both vertical and horizontal loads and these are dynamic loading. The response of structure against these loading depend on different factors such as soil type, construction method and duration and magnitude of earthquake.

ANS(2)

Solved by hand , pictures attached are below,

* Question #02:



Reactions:

$\Sigma M_E = 0$

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

$40 + 160 + 120 = 16 A_y$

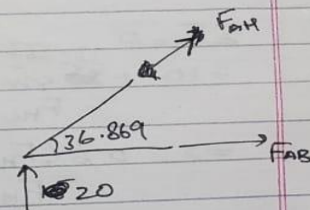
$A_y = 20$ kN

$\Sigma F_y = 0$

$\Rightarrow \quad E_y = 20$ kN

→ Method of Joints:

Joint A:



$\Sigma F_y = 0$

$20 + F_{AH} \sin 36.869 = 0$

$F_{AH} = \dfrac{-20}{\sin 36.869}$

$F_{AH} = -33.333$ kN

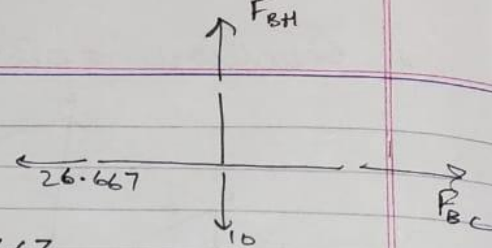
$F_{AH} = 33.333$ kN (compression)

$\Sigma F_x = 0$

$F_{AB} - F_{AH} \cos 36.869 = 0$

$F_{AB} = 26.667$ kN (tension)

Joint B:



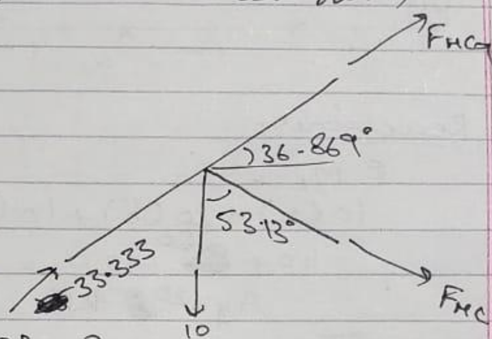
$\Sigma F_x = 0$

$\Rightarrow \quad F_{BC} = 26.667$ kN (tension)

$\Sigma F_y = 0$

$\Rightarrow \quad F_{BH} = 10$ kN (Tension)

Joint H:



$\Sigma F_x = 0$

$33.333 \cos 36.869°$

$+ F_{HG} \cos 36.869°$

$+ F_{HC} \sin 53.13° = 0$

$\Rightarrow \quad 0.8 F_{HG} + 0.8 F_{HC} = -26.667$

$F_{HG} + F_{HC} = -33.333 \longrightarrow (i)$

$\Sigma F_y = 0$

$-10 + 33.333 \sin 36.869 + F_{HG} \sin 36.869$

$- F_{HC} \cos 53.13 = 0$

$\Rightarrow \quad 0.6 (F_{HG} - F_{HC}) = -10$

$F_{HG} - F_{HC} = -16.667 \longrightarrow (ii)$

Solving (i) & (ii) simultaneously,

~~F_{HG} = -8.333 kN = 8.333 kN (comp)~~

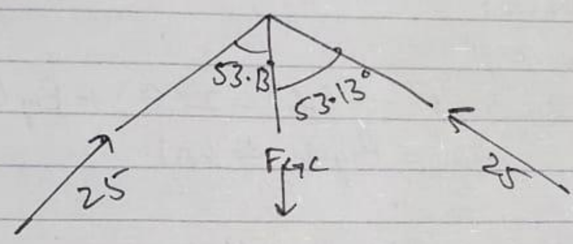
~~F_{HC} = -16.6667 kN = 16.6667 kN (comp)~~

$F_{HG} = -25$ kN $= 25$ kN (compression)

$F_{HC} = -8.333 = 8.333$ kN (compression)

As the truss is symmetrical in geometry, applied loads & reactions, the other half has the same internal forces.

Joint G:

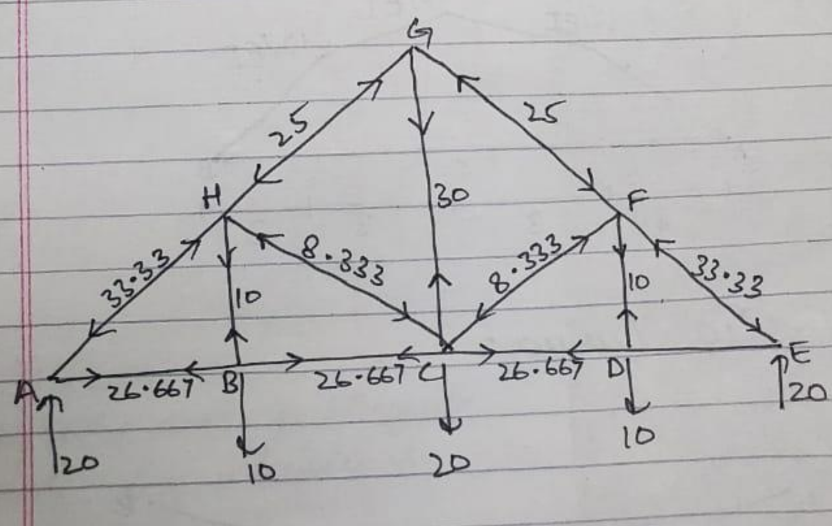


$\Sigma F_y = 0$

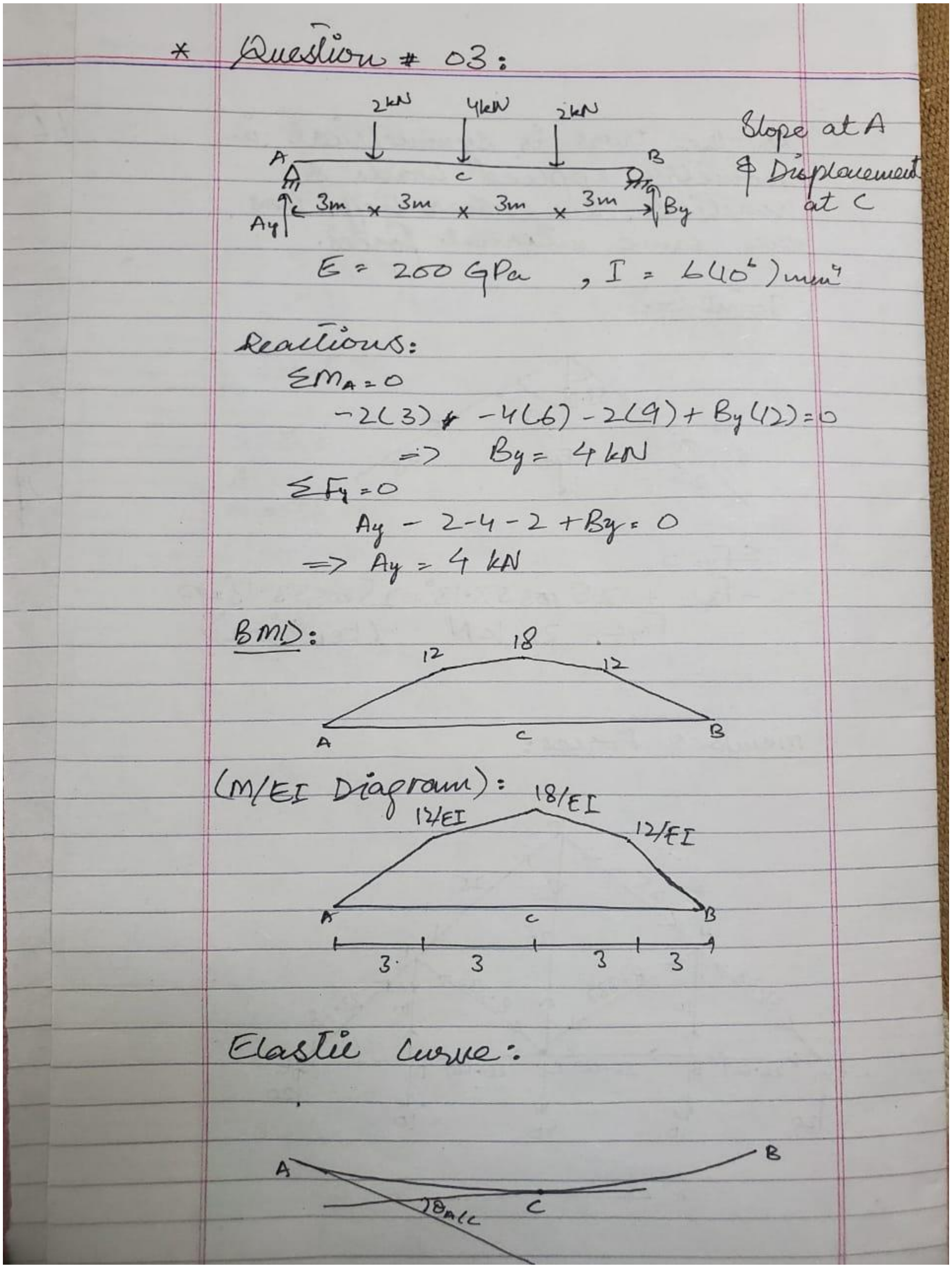
$-F_{GC} + 25\cos 53.13° + 25\cos 53.13° = 0$

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

Member Forces:



ANS(3) solved by hands, pictures attached below



* Question # 03:

Slope at A & Displacement at C

$E = 200\ GPa$, $I = 6(10^6)\ mm^4$

Reactions:

$\Sigma M_A = 0$

$-2(3) - 4(6) - 2(9) + B_y(12) = 0$

$\Rightarrow B_y = 4\ kN$

$\Sigma F_y = 0$

$A_y - 2 - 4 - 2 + B_y = 0$

$\Rightarrow A_y = 4\ kN$

BMD:

(M/EI Diagram):

Elastic Curve:

→ As the loading is applied symmetrically, the tangent at C is horizontal.

So,

$$\theta_A = \theta_{A/C}$$

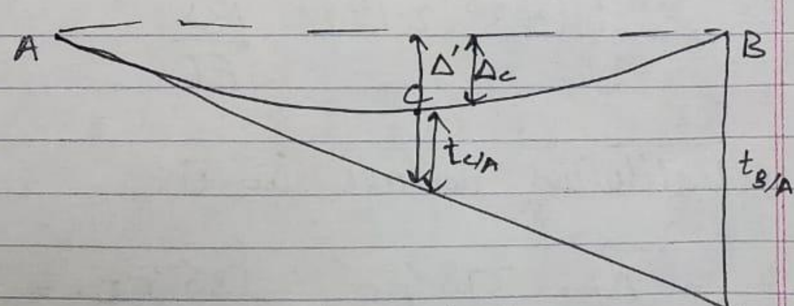
$\theta_{A/C}$ is the area of M/EI diagram b/w points A & C.

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

$$\theta_A = \frac{1}{EI}(18 + 36 + 9) = \frac{63}{250 \times 6 \times 10^6}$$

$$\boxed{\theta_A = 5.25 \times 10^{-8} \text{ rad}}$$ Slope at A

→ Displacement at C:



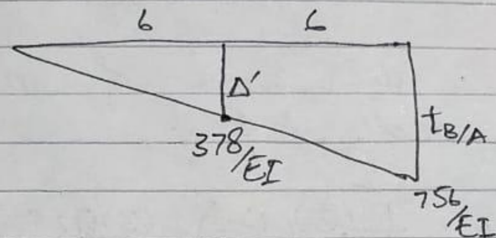
We can compute Δ' from $t_{B/A}$ using similar triangles and subtract $t_{C/A}$ from Δ' to get Δ_C which is the deflection at C:

$$\Delta_C = \Delta' - t_{C/A} \longrightarrow (i)$$

(moment of area b/w A & B about B)

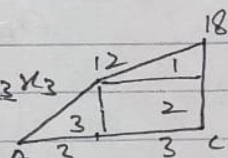
$$t_{B/A} = 2\left[\left(\frac{1}{2}\right)(3)\left(\frac{12}{EI}\right) + (3)\left(\frac{12}{EI}\right) + \frac{1}{2}(3)\left(\frac{6}{EI}\right)\right](6)$$

$$t_{B/A} = \frac{756}{EI}$$



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

centroid: $x = \dfrac{A_1x_1 + A_2x_2 + A_3x_3}{A_1 + A_2 + A_3}$



$$x = \frac{(9)(1) + (36)(1.5) + (18)(4)}{9 + 36 + 18}$$

$$x = \frac{135}{63} \quad 2.14\ m$$

$$t_{C/A} = \frac{1}{EI}(63)(2.14) = \frac{135}{EI}$$

Substituting values in (i),

$$\Delta_C = 378/EI - 135/EI = \frac{243}{EI}$$

Deflection at C: $\boxed{\Delta_C = \dfrac{243}{200 \times 6 \times 10^6} = 2.025 \times 10^{-7}\ m}$

THE END