

Q5

$$T_{CD} = T_D = 1000 \text{ N-m.}$$

Since the tangential force is equal at the contact of gear C & B, hence we have,

$$\frac{T_C}{40} = \frac{T_B}{100} \Rightarrow T_B = \frac{10 T_C}{4} = 2500 \text{ N-m.}$$

Now for the angle of rotation of gear B,

$$\frac{d\phi}{dx} = \frac{T_B}{GJ} \Rightarrow \phi_B - \phi_A = \frac{T_B L_{AB}}{GJ} = \frac{1000}{GJ}$$

taking $\phi_A = 0$ (fixed)

$$\phi_B = \frac{1000}{GJ}$$

Now the arc-length of contact are same for gear B & C,

hence we have,

$$\phi_B \times 100 = \phi_C \times 40 \Rightarrow \phi_C = \frac{100}{40} \phi_B = \frac{2500}{GJ}$$

again for the rotation of section at D,

$$\phi_D - \phi_C = \frac{T_{CD} L_{CD}}{GJ} = \frac{600}{GJ} \Rightarrow \phi_D = \frac{600 + 2500}{GJ} = \frac{3100}{GJ}$$

Now for design for τ_{max} using

① larger internal torque, $T_{AB} = T_B = 2500 \text{ N-m}$

$$\frac{T r}{J} < 60 \text{ MPa} \Rightarrow r > 29.82 \text{ mm}$$

② we choose larger radius of the two $r = 31.43 \text{ mm}$
 $d = 62.86 \text{ mm}$

design for θ_{max} ,

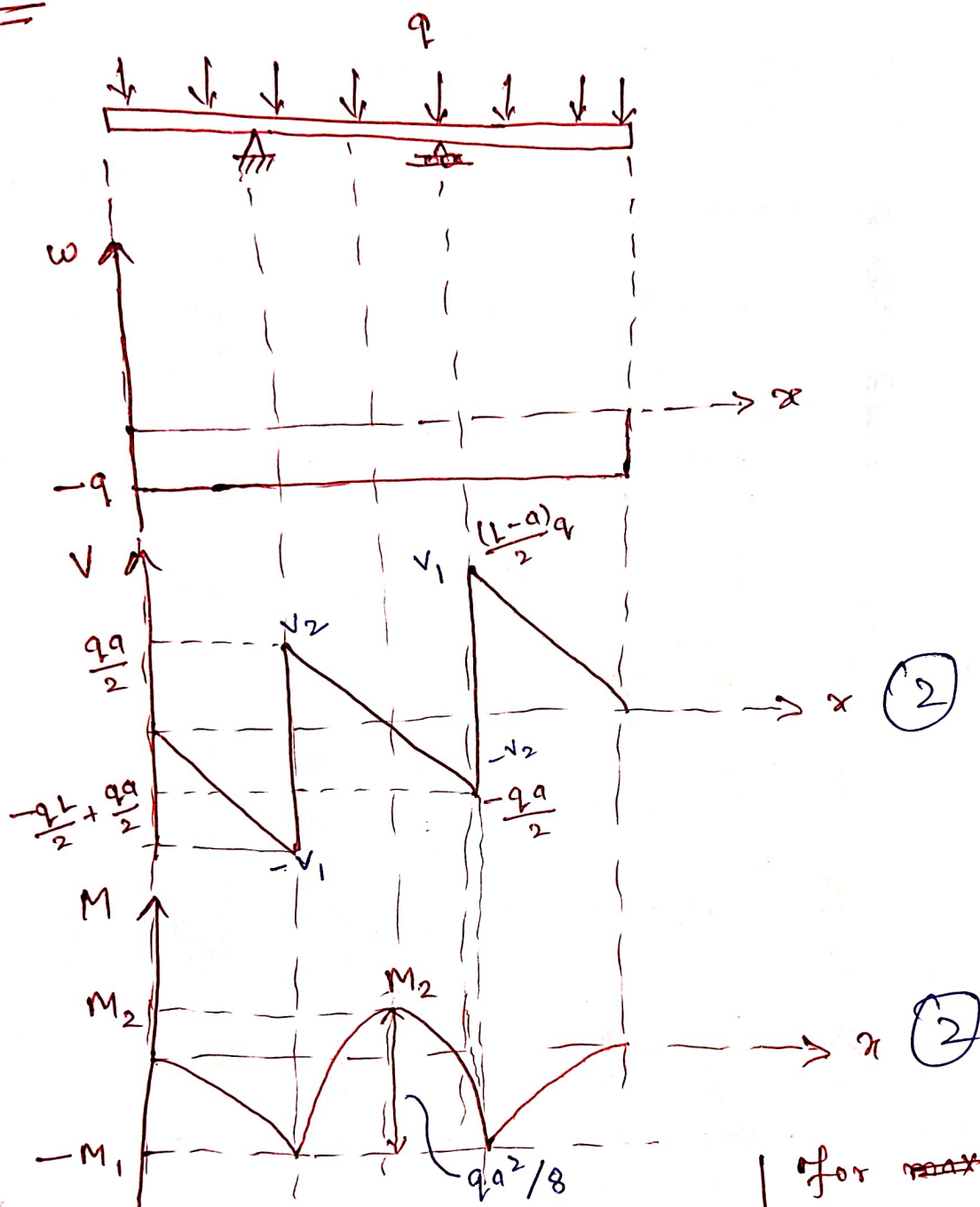
$$\phi_D < 1.5^\circ$$

(4)

$$\Rightarrow \frac{3100}{GJ} < \frac{1.5 \times \pi}{180}$$

$$\Rightarrow r > 31.43 \text{ mm.}$$

6.



$$M_1 = \frac{q(L-a)^2}{8} \quad (3)$$

$$M_2 = \frac{qL}{8}(2a-L)$$

For min magnitude of max B.M,

$$M_1 = M_2$$

$$\Rightarrow (L-a)^2 = L(2a-L)$$

$$\Rightarrow a = (2-\sqrt{2})L = 0.5858L$$

for ~~max~~ $a = 0.5858L$

$$M_1 = 0.02145 qL^2 \quad (1)$$

$$M_2 = 0.2145 qL^2$$

ϕ

$$V_1 = 0.207 qL \quad (1)$$

$$V_2 = 0.2929 qL$$

$$V_{\max} = \frac{P}{2} = 6 \text{ kN}$$

Second moment of area;

$$I = \frac{1}{12} (0.1 \times 0.25^3 - 0.075 \times 0.2^3) \text{ m}^4$$

$$= 8.02 \times 10^{-5} \text{ m}^4 \quad \text{--- } (2.5)$$

Q for the shaded area,

$$Q = A y_{c.m} = 100 \times 25 \times 10^{-6} \times \frac{112.5}{1000}$$

$$= 281.25 \times 10^{-6} \text{ m}^3 \quad \text{--- } (2.5) \text{ shear force}$$

hence the shear flow $q = \frac{VQ}{I} = \frac{f}{s} \rightarrow \text{spacing,}$

$$s = \frac{fI}{VQ_{\max}} = \frac{1.5 \times 10^3 \times 8.02 \times 10^{-5}}{6 \times 281.25 \times 10^{-6}} \text{ m,}$$

$$= 71.3 \text{ mm,} \quad \text{--- } (3)$$

