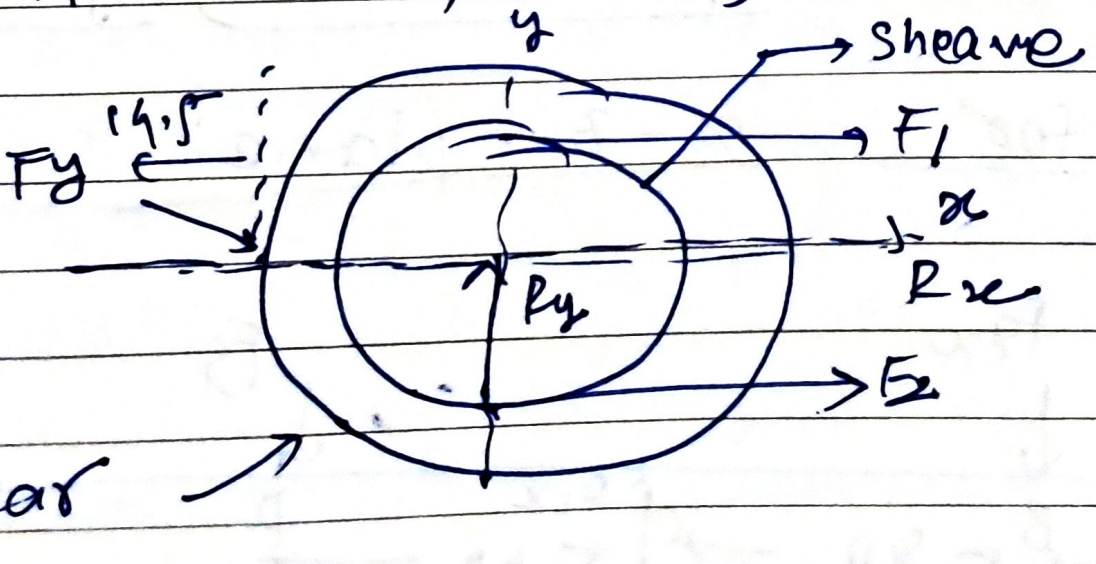
* Design of Machine-Elements: Lab 6:

Given: 2.5hp at 1800rpm. -Rutam S Rajhans
Nf = 2.4. B22ME055

$$(\text{Torque})_m = \frac{P \times 60}{2\pi N} = \frac{2.5 \times 60 \times 746}{2\pi \times 1800} = 9.89 \text{ Nm.}$$

$F_n = F_1 - F_2$, $F_s = F_1 + F_2$, $F_1 = 51^{\circ}$



$F_n = 412$

Calculating the value of F_g, F_1 and F_2 we get

$F_2 = 32.96N$ | $F_1 = 164.82N$ | $F_S = 197.78N$

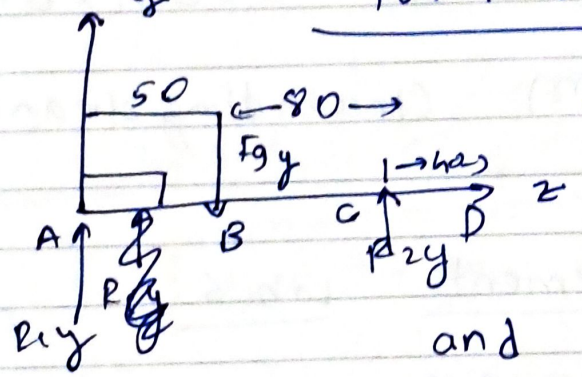
$$(F_g)_T)_y = \frac{T}{r_{gear}} = \frac{9.89}{75 \times 10^{-3}} = 131.86N.$$

$F_{gy} \times \tan 14.5 = F_{gx} = 31.10N.$

$I_x = 9.89 = T_q$ $\quad \therefore T_{min} = 0$

Also $T_{max} = 19.78 Nm$

For Y-Z-Plane:



$\Rightarrow \Sigma F_y = 0.$

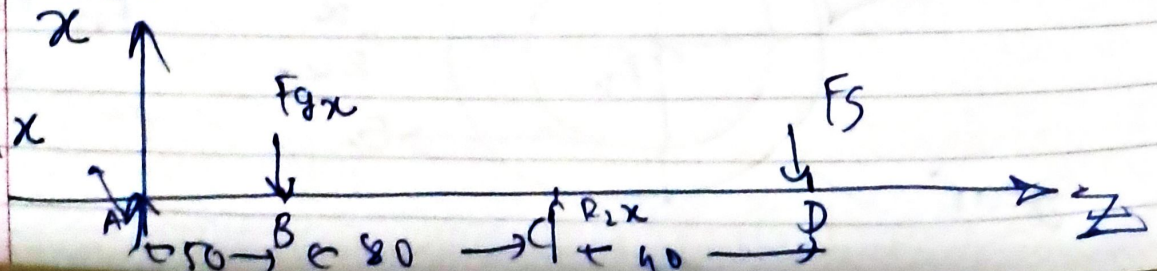
$R_{1y} + R_{2y} = 131.86N$

and $\Sigma M_A = 0$

$\therefore -F_{gy} \times 50 + R_{2y} \times 130 = 0$

calculating $R_{1y} = 81.14N$ | $R_{2y} = 50.71N$

* Now for x-z-plane:



Again: $\Sigma F_y = 0$.

$R_{1x} + R_{2x} = F_g x + F_s = 197.78 + 51.1$.

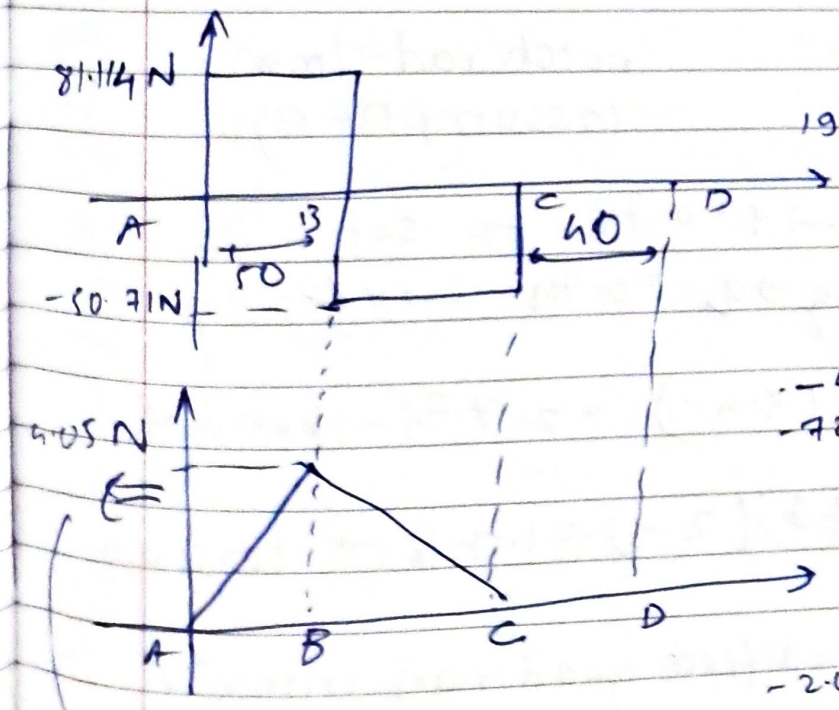
$\Rightarrow$ $\boxed{R_{1x} + R_{2x} = 228.88N}$

$\Sigma M_A = 0$. $-F_g \times 30 + F_{2x} \times 30 - F_s(170) = 0$.

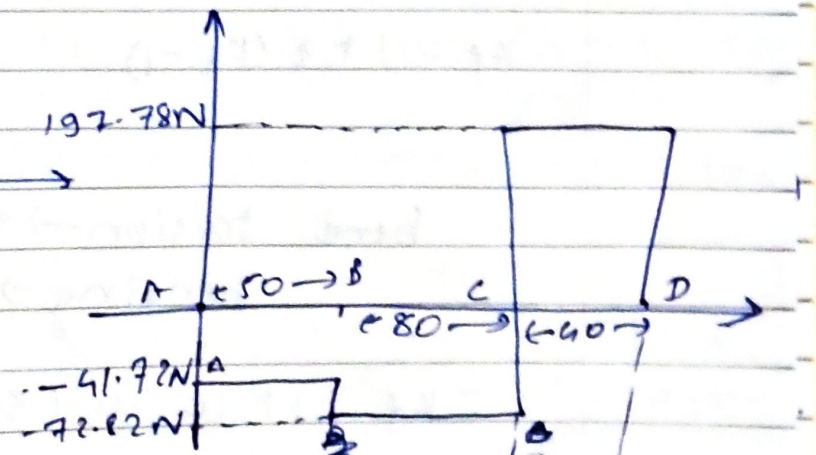
$\therefore$ Calculating $\boxed{\begin{aligned} R_{1x} &= -41.72N \\ R_{2x} &= 270.59N \end{aligned}}$

Now drawing their SFDs and BMDs.

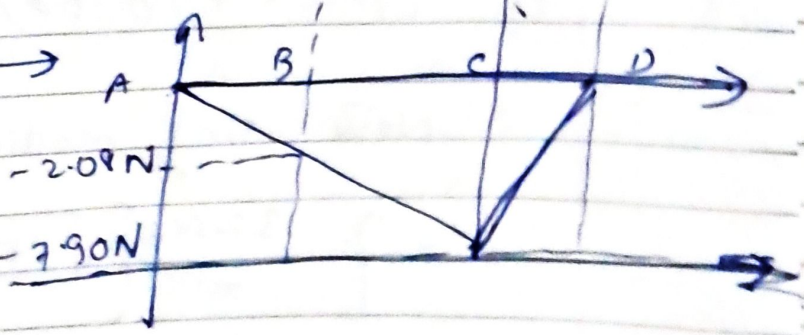
SFD y-z plane:



SFD x-z plane:



BMD x-z plane



Material: → AISI/045 steel (cold-drawn):

$S_{ut} = 585\ MPa$ $\quad S_y = 30\ MPa$

$S_n' = 0.5 S_{ut} = 292.5\ MPa.$

→ Corrected Endurance-Limit

$S_n = S_n' C_L C_G C_S C_T C_R$

$C_L = 1 \quad C_G = 1, \quad C_S = 0.77, \quad C_T = 1, \quad C_R = 0.814$ (99% reliable)

$S_n = 292.5 \times 0.77 \times 0.814$

$S_n = 183.33\ MPa$

$K_f = 1 + q(K_t - 1)$ notch rad = 1mm (assumption)

torsion → $q = 0.78$ → $scf = 2$

bending → $q = 0.74$ → $scf = 3.4$

$K_f = 1 + (0.74)(3.4 - 1) = 2.776$ → bending

$\eta_f = 1 + (0.78)(2 - 1) = 1.78$ → torsion

Now using modified goodman criteria:

$$d = \left\{ \frac{32 N_f}{\pi} \left[\sqrt{\frac{(K_f m_a)^2 + 3/4 (K_{fs} T_a)^2}{S_e}} + \sqrt{\frac{(K_f m_m)^2 + 3/4 (K_{fs} T_m)^2}{S_{ut}}} \right] \right\}$$

→ at c $M_a = M_m = 7.90 \text{ N-m}$ $T_a = T_m = 9.89 \text{ N-m}$

Substituting.

$$d_1 = \left[\frac{32 \times 2.4}{\pi} \sqrt{\frac{(2.776 \times 7.90)^2 + (3/4)(1.78 \times 9.89)^2}{183.33}} \right]^{1/3}$$

$$\pi \sqrt{\frac{(2.77 \times 7.90)^2 + 3/4 (1.78 \times 9.89)^2}{585}}$$

$$\therefore d_1 = [24.44 [0.1456 + 0.047]]^{1/3} = 16.26 \text{ mm}$$

at point D → $M_a = M_m = 0$, $T_a = T_m = 9.89 \text{ N-m}$.

$$\therefore d_3 = [24.44 [83.159 + 26.06]]^{1/3} = 13.87 \text{ mm}$$

At pt. B: $M_a = M_m = 4.55 \text{ N-m}$. $T_a = T_m = 9.89 \text{ N-m}$.

$$d_0 = [24.446 (146.85 + 46.02)]^{1/3} = 16.77 \text{ mm}$$

At pt A: $M_A = M_m = 0$. $T_a = T_m$

$$d_2 = [24.446 (29.69 + 40.64)]^{1/3} = 16.08 \text{ mm}$$

→ $d_0 = 16.77 \text{ mm}$ → B

$d_1 = 16.28 \text{ mm}$ → C

$d_2 = 16.08$ → A

$d_3 = 13.87 \text{ mm}$ → D.

1/3.