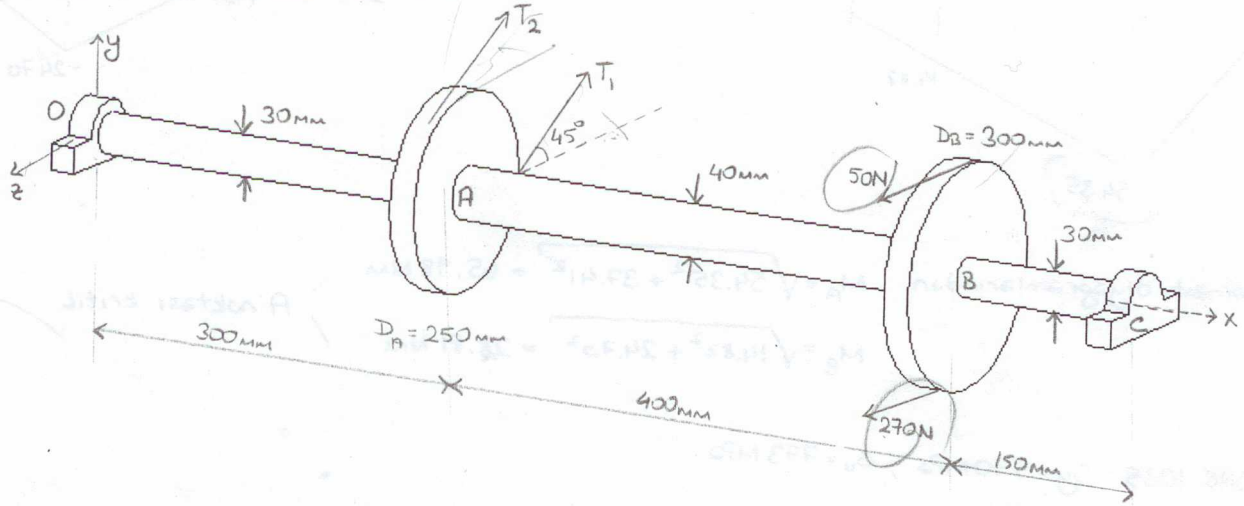


PROBLEM 2

Şekildeki mil SAE1035CD çeliğinden imal edilmiş ve yüzeyi taşlanmıştır. Çapın değiştiği yerlerdeki yuvarlatma yarıçapı 3mm dir. A ve B noktalarındaki makaralar mile kamalar yardımıyla sabitlenmiştir ($K_t=1.79$, $q=0.8$). A noktasındaki makaranın gevşek tarafındaki gerilme sıkı tarafın %20'sidir ($T_2=0.2T_1$). Buna göre %99 güvenilirlik için kritik noktadaki emniyet katsayısını bulunuz.



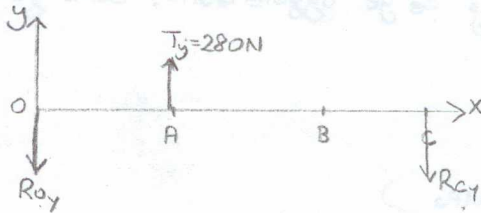
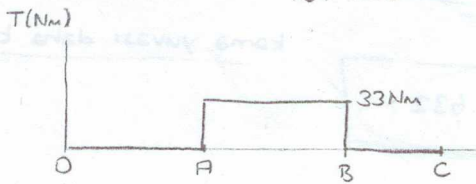
$$\text{denge koşulu} \Rightarrow (T_1 - T_2) \frac{D_A}{2} = (270 - 50) \frac{D_B}{2} \Rightarrow (T_1 - T_2) \cdot 125 = 220 \cdot 150 \quad \text{--- (1)}$$

$$T_2 = 0.2T_1 \quad \text{--- (2)}$$

$$T_1 = 330 \text{ N}, T_2 = 66 \text{ N}$$

$$\text{A noktasında } T_y = (330 + 66) \sin 45 = 280 \text{ N}, T_z = (330 + 66) \cos 45 = 280 \text{ N}$$

$$\text{net tork } T = (330 - 66) \frac{250}{2} = 33000 \text{ Nmm} = 33 \text{ Nm}$$

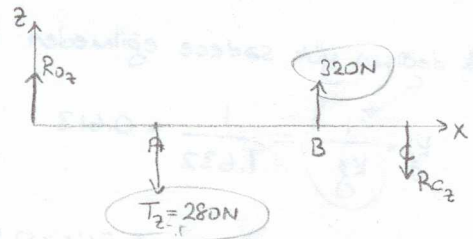


$$\sum M_B = 0 \quad 280 \times 0.3 - R_{cy} \times 0.85 = 0$$

$$R_{cy} = 98.82 \text{ N}$$

$$\sum F_y = 0 \quad 280 - 98.82 - R_{oy} = 0$$

$$R_{oy} = 181.18 \text{ N}$$

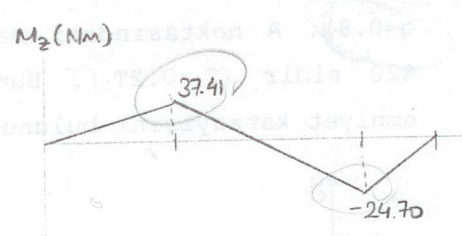
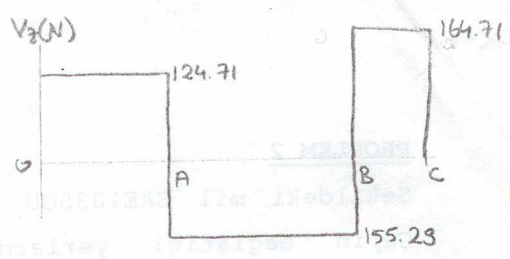
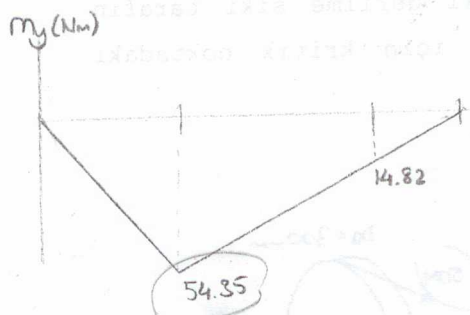
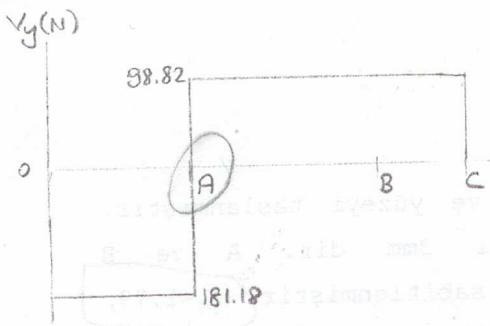


$$\sum M_B = 0 \quad 280 \times 0.3 - 320 \times 0.7 + R_{cz} \times 0.85 = 0$$

$$R_{cz} = 164.71 \text{ N}$$

$$\sum F_z = 0 \quad R_{o2} - 280 + 320 - 164.71 = 0$$

$$R_{o2} = 124.71 \text{ N}$$



moment diyagramlarından $M_A = \sqrt{54.35^2 + 37.41^2} = 65.98 \text{ Nm}$
 $M_B = \sqrt{14.82^2 + 24.70^2} = 28.81 \text{ Nm}$ } A noktası kritik ✓

SAE 1035 $S_y = 570 \text{ MPa}$, $S_u = 773 \text{ MPa}$

$S_e' = 0.5 S_u = 386.5 \text{ MPa}$

$k_d = 0.89$ (taşınmır), $k_b = 0.85$ ($8 < d \leq 50 \text{ mm}$), $k_e = 0.814$ (99% güvenilirlik)

* çap değişiminde $\left. \begin{array}{l} \frac{D}{d} = \frac{40}{30} = 1.3 \\ \frac{r}{d} = \frac{3}{30} = 0.1 \end{array} \right\} \text{ eğilme için } K_t \approx 1.6$ $\left. \begin{array}{l} r = 3 \text{ mm} \\ S_u = 773 \text{ MPa} \end{array} \right\} q \approx 0.84$

$K_f = 1 + q(K_t - 1) \Rightarrow K_f = 1 + 0.84(1.6 - 1) \Rightarrow K_f = 1.504$

* kama yuvasında $K_t = 1.79$, $q = 0.8 \Rightarrow K_f = 1 + 0.8(1.79 - 1) \Rightarrow K_f = 1.632$

kama yuvası daha kritik ✓

* değişen yük sadece eğilmeye kaynaklandığı için K_f S_e' 'ye uygulanabilir. Buna göre:

$k_f = \frac{1}{K_f} = \frac{1}{1.632} = 0.613$

$S_e = 0.89 \times 0.85 \times 0.814 \times 0.613 \times 386.5 = 145.9 \text{ MPa}$

$\sigma_{\max} = \frac{32 M_A}{\pi d^3} = \frac{32 \times 65.98}{\pi \times 0.03^3} = 24.89 \text{ MPa}$ $\sigma_{\min} = -\sigma_{\max} = -24.89 \text{ MPa}$

$\sigma_m = \frac{1}{2}(\sigma_{\max} + \sigma_{\min}) = 0 \text{ MPa}$ $\sigma_a = \frac{1}{2}(\sigma_{\max} - \sigma_{\min}) = 24.89 \text{ MPa}$

$$\tau_{\max} = \frac{16T}{\pi d^3} = \frac{16 \times 33}{\pi \times 0.03^3} = 6.22 \text{ MPa} \quad \tau_{\min} = \tau_{\max} = 6.22 \text{ MPa}$$

$$\tau_M = \frac{1}{2} (\tau_{\max} + \tau_{\min}) = 6.22 \text{ MPa} \quad \tau_0 = \frac{1}{2} (\tau_{\max} - \tau_{\min}) = 0 \text{ MPa}$$

$$\sigma'_m = \sqrt{\sigma_m^2 + 3\tau_m^2} = \sqrt{3} \tau_m = \sqrt{3} \times 6.22 = 10.77 \text{ MPa}$$

$$\sigma'_0 = \sqrt{\sigma_0^2 + 3\tau_0^2} = \sigma_0 = 24.89 \text{ MPa}$$

Goodman hipotezine göre :

$$\frac{\sigma'_0}{\sigma_e} + \frac{\sigma'_m}{\sigma_u} = \frac{1}{n} \quad \Rightarrow \quad \frac{24.89}{145.9} + \frac{10.77}{773} = \frac{1}{n} \quad \Rightarrow \quad n = 5.419$$