أسئلة سابقة ..

تصميم ميكانيكي 2

FOLLOW US :

Mech.MuslimEngineer.Net

FB.com/Groups/Mid.Group

0789434018 MechFet

youtube.com/MechanicalFet

لجنة الميكانيك Polytechnic

Mechanical Engineering Department
Mechanical DesignII
First examination

Name:… ………… Date: 9/11/2015

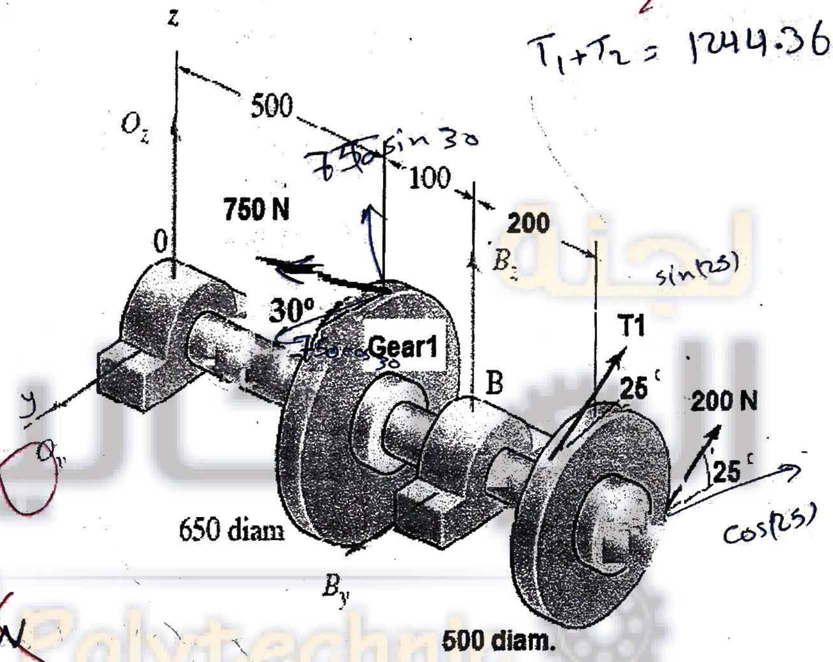
Q1 The figure shows a steel countershaft that supports Gear1 and pulleys. Gear1 receives power from a motor producing the belt tensions shown. Pulley *A* transmits this power to another machine through the belt tensions

The shaft and gear1 are made of **cold-drawn low carbon steel alloys** . The shaft is solid and of constant **diameter 75 mm. The safety factor is 2.5**

1- Calculate the reaction at bearing O and B (6 points)

Reaction	Value
Oy	484.175 N
Oz	112.793 N
By	-962.435 N
Bz	1013.67 N

$T_1 + T_2 = 1244.36$

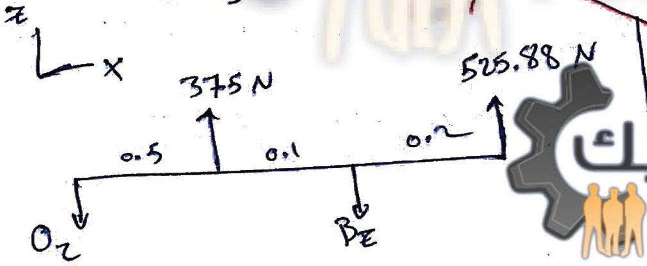


$\Sigma T = 0$

$750 \cos 30 (0.325) - T_1 (0.25) + 200 (0.25) = 0$

$211.09 - T_1 (0.25) + 50 = 0$

$T_1 = \frac{50 + 211.09}{0.25} = 1044.36$ N



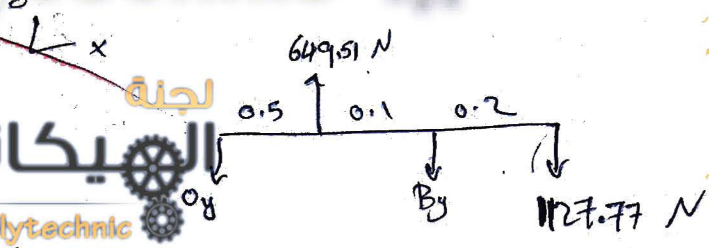
$\Sigma M_o = 0$

$375 (0.5) - B_z (0.6) + 525.88 (0.8) = 0$

$B_z = 1013.67$ N

$\Sigma F_y = 0$

$O_z = 112.793$ N



$\Sigma M_o = 0$

$649.51 (0.5) - B_y (0.6) - 1127.77 (0.8)$

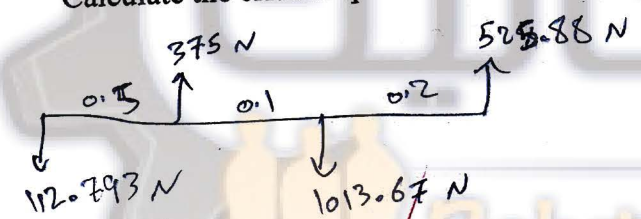
$B_y = -962.435$ N لأنه عكس المفروض

$\Sigma F_y = 0$

$O_y = 484.175$ N

B) if the weight of gear1 and Pulley equal to the load applied on each one in the z-**direction.**

Calculate the critical speed for the shaft in **zx** plan using rayleight method **(8 points)**



$$q(x) = -112.793\langle x-0\rangle^{-1} + 375\langle x-0.5\rangle^{-1} - 1013.67\langle x-0.6\rangle^{-1} + 525.88\langle x-0.8\rangle^{-1}$$

$$V(x) = -\left[-112.793\langle x-0\rangle^{0} + 375\langle x-0.5\rangle^{0} - 1013.67\langle x-0.6\rangle^{0} + 525.88\langle x-0.8\rangle^{0}\right]$$

$$M(x) = \left[-112.793\langle x\rangle^{1} + 375\langle x-0.5\rangle^{1} - 1013.67\langle x-0.6\rangle^{1} + 525.88\langle x-0.8\rangle^{1}\right]$$

$$EI\frac{d^2y}{dx^2} = M(x)$$

$$EI\frac{dy}{dx} = \frac{-112.793}{2}\langle x\rangle^2 + \frac{375}{2}\langle x-0.5\rangle^2 - \frac{1013.67}{2}\langle x-0.6\rangle^2 + \frac{525.88}{2}\langle x-0.8\rangle^2$$

$$EI\,y = \frac{-112.793}{6}\langle x\rangle^3 + \frac{375}{6}\langle x-0.5\rangle^3 - \frac{1013.67}{6}\langle x-0.6\rangle^3 + \frac{525.88}{6}\langle x-0.8\rangle^3 + C_1x + C_2$$

w = 0.02 m
h = 0.01 m

$n_s = 2.5$ $d = 0.075$ m $T_{max} = 555$ N.m

C) Gear1 is fixed with the shaft by flat parallel key made of aluminum with width 20mm and height of 10 mm the max torque should never go above 555 N.m

Calculate critical length of key considering shear. **(6 points)**

$S_y = 17$ MPa

$$L_{cr} = \frac{2 T_{max}}{d w \cdot \tau_{design}}$$

$$S_{sy} = 0.4 S_y = 0.4(17 \times 10^6) = 6800000$$

$$= \frac{2(555)}{(0.075)(0.02)(2720000)}$$

$$\tau_{design} = \frac{S_{sy}}{n_s} = \frac{6800000}{2.5} = 2720000$$

$$= 0.27205 \text{ m}$$

Mechanical Engineering Department
Mechanical DesignI
First examination

Name Date: 28/6/2015

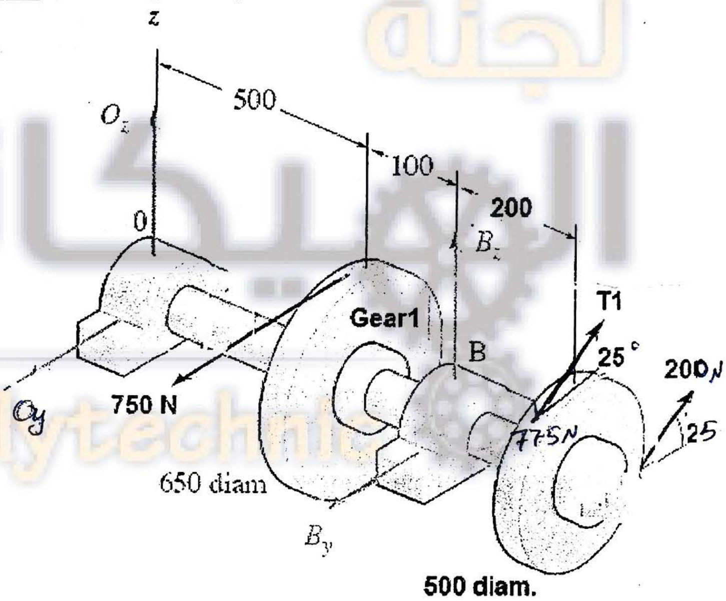
Q1 The figure shows a steel countershaft that supports Gear1 and pulleys. Gear1 receives power from a motor producing the belt tensions shown. Pulley *A* transmits this power to another machine through the belt tensions

ρ = 7860 Kg/m³ / Sy = 295 MPa, Su = 395 MPa

The shaft and gear1 are made of **cold-drawn low carbon steel alloys** . The shaft is solid and of constant **diameter 70 mm. The safety factor is 3.5.**

1- Calculate the reaction at bearing O and B (6 points)

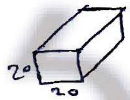
Reaction	Value
Oy	
Oz	
By	
Bz	



B) if the weight of gear1 and Pulley equal to the load applied on each one in **the y-direction.**
Calculate the critical speed for the shaft in xy plan using rayleight method

(8 points)

$T_{max} = \frac{\tau_d J}{c} = $ ~~[illegible]~~ 500 N.m Not exceeded



$S_y = 69$ MPa

C) <u>Gear1 is fixed with</u> the shaft by square key made of copper with width and height of 20 mm the max torque should never go above 500 N.m
Calculate critical length of key considering compression. **(6 points)**

$T_{max} = 500$ N.m

$\sigma_d = \frac{0.9 S_y}{n.s} = \frac{0.9 (69 \times 10^6)}{3.5}$

$\sigma_{design} = \frac{4 T_{max}}{d L_{cr} h}$

$\sigma_{design} = 17.74 \times 10^6$ pa

$L_{cr} = \frac{4 \times 500}{17.74 \times 10^6 \times 0.07 \times 0.02} = 0.0805$ m $= 80.53$ mm

6

Mechanical Engineering Department
Mechanical DesignII
First examination

/20

Name: Date: 5/11/2014

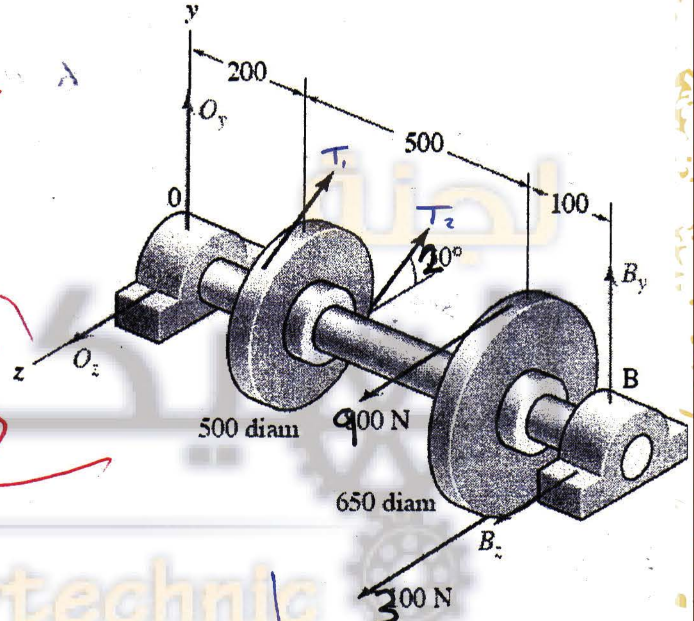
Instructors: Dr. Khaleel Abu shgair

Q1 In Fig. 1 the tension on the slack side of the left pulley is 20% of that on the tight side. The shaft Rotates at 270 rpm. The shaft is made by hot rolling process from aluminum alloy. The shaft is solid and of constant diameter 24 mm. Assume **the DET throughout**. Also, **for fatigue loading conditions** assume completely reversed bending with a bending moment amplitude equal to 29% of that used for static conditions. The alternating torque is zero.

1- Calculate the reaction at bearing O and A (4 points)

$T_1 = 0.2 T_2$

Reaction	Value
~~Oz~~ Oy	300 N
~~Oy~~ Oz	-974.25 N
~~Ax~~ By	100 N
~~Ay~~ ~~Bz~~ Bz	-1324.75N



Oy 400 By

x-y ⇒

$\Sigma M_o = 0.0 \Rightarrow B_y(0.8) - 400(0.2) = 0.0$

$B_y = 100N$

$\Sigma F_y = 0.0 \Rightarrow 100 - 400 + O_y = 0.0$

$O_y = 300N$

3

$\Sigma T = 0.0$

$(900-300)(0.65) - (T_1 - T_2)(0.5) = 0.0$

$\Rightarrow 390 - (0.2T_2 - T_2)0.5 = 0$

$390 - (0.2T_2 - T_1)(0.5) = 0.0$

$0.2T_2 - T_2 = 780$

$T_2(0.2-1) = 780$

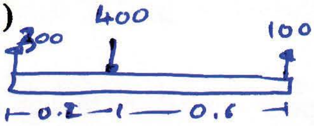
$T_2 = -975N$

$T_1 = -195N$

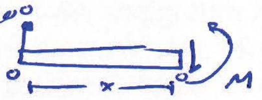
<u>2-Show moment diagrams in the various planes</u>. and torque diagram
(3 points)

Max. moment at xy plane at	X=	0.2 m
Max. moment at xz plane at	X=	0.2 m
X critical		0.2 m

x-y ⇒



$0 \le x \le 0.2 \Rightarrow$



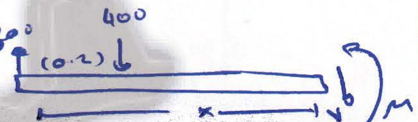
~~$\Sigma M_0 = 0$~~

$\Sigma F_y = 0.0 \rightarrow V(x) = 300$

$\Sigma M = 0.0 \rightarrow -300(x) + M = 0.0$

$M = 300x$ — @ $x = 0. \rightarrow M = 0.0$
@ $x = 0.2 \Rightarrow M = 60\ N.m$

$0.2 \le x \le 0.8$



$\Sigma F_y = 0.0 \quad 300 - 400 - V = 0.0$

$V = -100\ N$

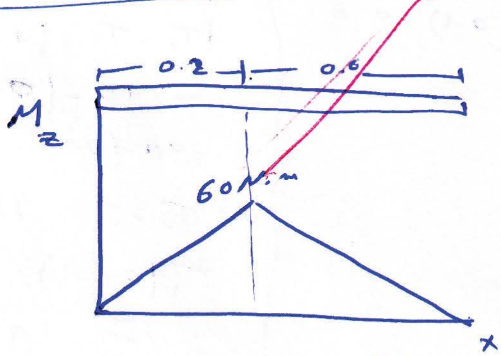
$\Sigma M = 0.0$

$-300x + 400(x - 0.2) + M = 0.0$

$M = 300x - 400x + 80$

@ $x = 0.2 \Rightarrow M = 60\ N.m$

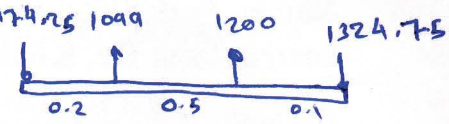
@ $x = 0.8 \Rightarrow M = 0.0\ N.m$



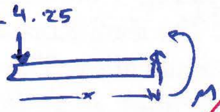
$M_{max} = \sqrt{}$

$\boxed{M_{max} = 203.9\ N.m}$

x - z ⇒



$0 \le x \le 0.2$



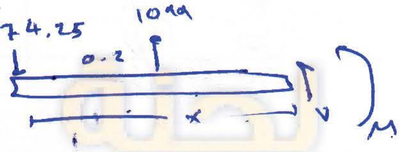
$V = 974.25$

$M = 974.25x$

@ $x = 0 \rightarrow M = 0.0$

@ $x = 0.2 \rightarrow M = \boxed{194.85\ N.m}$

$0.2 \le x \le 0.7$



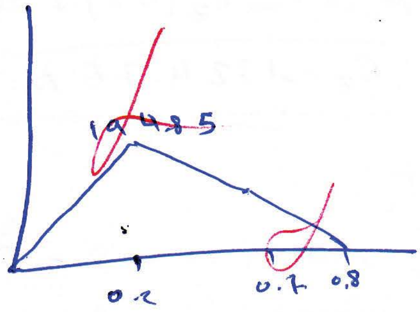
$V = 124.75$

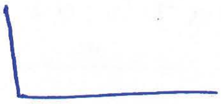
$974.25(x) - 1099(x - 0.2) + M = 0.0$

$M = 1099x - 974$

@ $x = 0.2 \rightarrow M = 194.85\ N.m$

$x = 0.7 \rightarrow M = \boxed{132.472\ N}$





$T_{cor} = 390\ N.m$

Determine the safe factor due to fatigue loading. **(8 points)**

M ( ) moment	59.131
T ( ) torsion	113.1
Kf	1.354
Se'	93 × 10^6 Pa
Kf	~~1.6~~ 1.35
Ks	1.697
Kt	1
Kr	1
Km	1
Se	213.7 MPa
n.s.	1

$S_y =$

$d = 24 \times 10^{-3}$ m

$M_m = 0.0$

$M_a = 0.29\, M_{max}$

$T_a = 0.0$

$S_y = 97$ MPa

$S_{ub} = 186$ MPa

$b = 0.718$

$e = 57.7$

$S_e = k_f\, k_s\, k_r\, k_t\, k_m\, S_e'$

$k_f = e\, S_{ut}^{b}$

$= e$

$k_s = 1.189 \times (24 \times 10^{-3})^{0.112}$

$S_e' = 0.5 \times 186 \times 10^6$

$S_e = 1.35 \times 1.189 \times (24)^{0.112} \times 1 \times 1 \times 1 \times 0.5 \times 186 \times 10^6$

$= 213.7$ MPa

$$n_s = \frac{\pi \times 24^3 \times 97 \times 10^6}{32 \sqrt{\left(\frac{97}{213.7}(1.35) \times 59.131\right)^2 + \frac{3}{4}\left(T_m + \frac{97}{213.7}\right)}}$$

$n_s = 1$

B) if the weight of gear1 and gear2 equal to the load applied on each one in **the y-direction**
Calculate the critical speed for the shaft in xy plan using rayleight method

(7 points)

Mechanical Engineering Department
Mechanical Design
First examination

Name:. | Time : 50 minutes
ID No. | Date: 25/6/2013

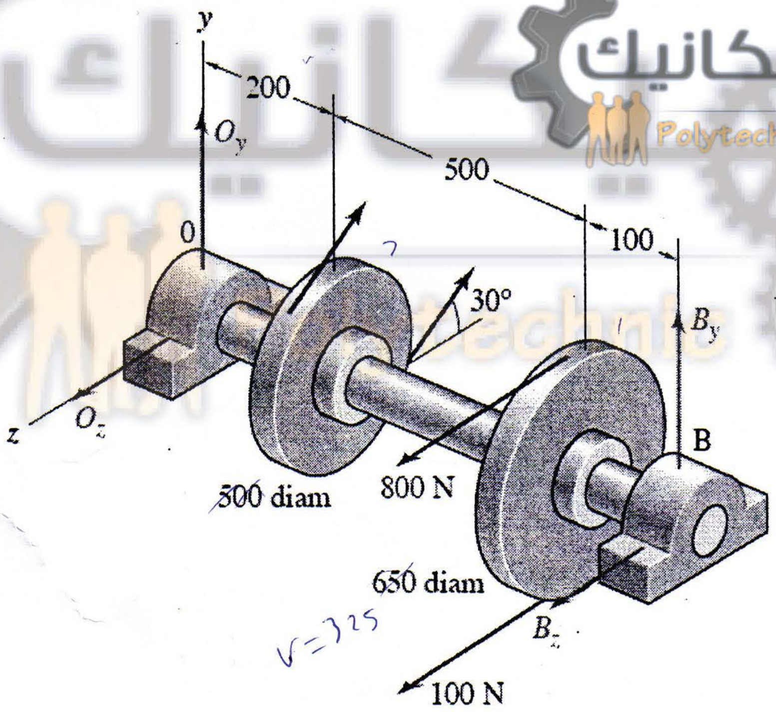
Instructors: Dr. Khaleel Abu shgair

<u>Q1</u> In Fig. 1 the tension on the slack side of the left pulley is 20% of that on the tight side. The shaft Rotates at 720 rpm. The shaft is made of **titanium.** The shaft is solid and of constant diameter. **The safety factor is 0.6.** Assume **the DET throughout**. Also, **for fatigue loading conditions** assume completely reversed bending with a bending moment amplitude equal to that used for static conditions. The alternating torque is zero.

Determine the safe shaft diameter due to

1- Static loading
2- fatigue loading.

Show shear and moment diagrams in the various planes.



B) Calculate the critical speed for the shaft in xy plan

(8 marks)

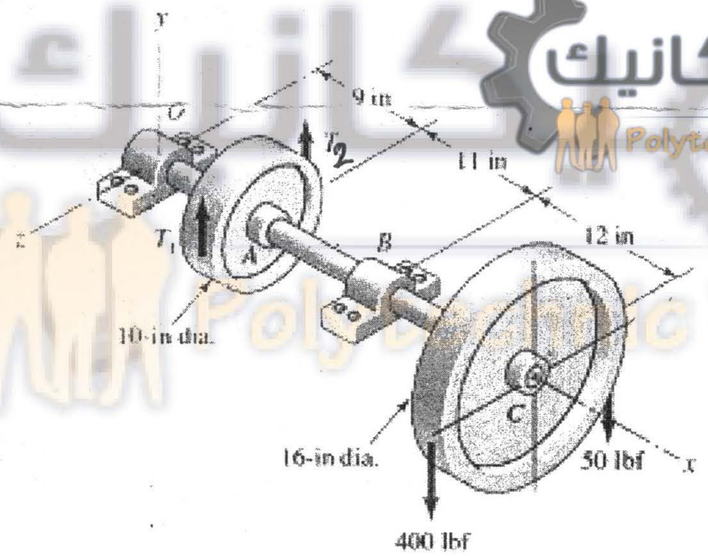
Al- Balqa' Applied University
Mechanical Engineering Department
Mechanical DesignII
First examination

Name:.... Time : 50 minutes
ID No.: .... Date: 30/10/2012
Instructors: Dr. Khaleel Abu shgair

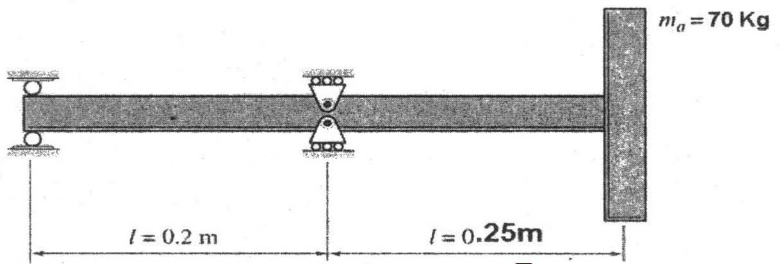
Q1 The figure shows a steel countershaft that supports two pulleys. Pulley *C* receives power from a motor producing the belt tensions shown. Pulley *A* transmits this power to another machine through the belt tensions T_1 and T_2 such that $T_1 = 8\ T_2$
The yield stress for the shaft, which is made of **cold-drawn steel, is 71,000 psi and the ultimate stress is 85,000 psi**. The shaft is solid and of constant diameter. **The safety factor is 2.6.** Assume **the DET throughout**. Also, **for fatigue loading conditions** assume completely reversed bending with a bending moment amplitude equal to that used for static conditions. The alternating torque is zero. **Determine the safe shaft diameter due to**

1- Static loading
2- fatigue loading.

Show shear and moment diagrams in the various planes **(15 marks)**



Q2. Calculate the critical speed for a rotor shown in sketch j that has two moment-free bearings. The shaft has a diameter of 20mm and is made of steel with E=206GPa.
(5 marks)

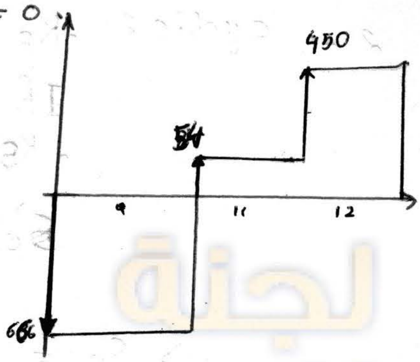


* Design II

1st exam

Q(1): cold drawn steel , $S_y = 71,1000$ psi ,
$S_{ut} = 85000$ psi , constant diameter means "$K_f = 1$",
$n.s = 2.6$, DET :-

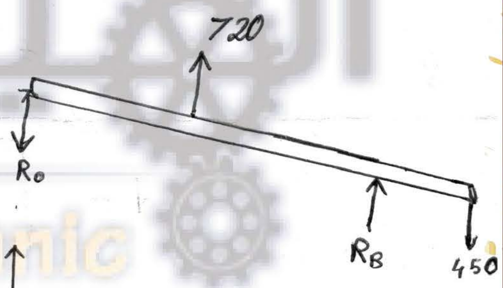
1 - static + DET : Moment + Torsion.
2 - fatique + DET : $M_m = 0$, $T_a = 0$.



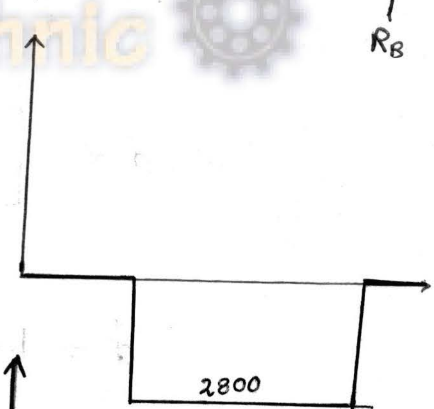
Soln :-

$\sum T_o = 0$.
$(400 - 50)\,8 - (T_1 - T_2)\,5 = 0$
$350 * 8 - 7 T_2 * 5 = 0$

$T_1 =$ ~~560 lbf~~	640 lbf
$T_2 =$ 80 lbf	

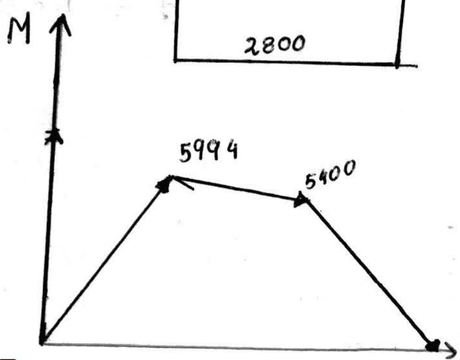


Torqe (A) $= (640 - 80) * 5$
$= 2800$ lbf.in.



$\sum M_o = 0$
$720\,(9) + R_B\,(20) - 450\,(32) = 0$
$R_B = 396$ lbf

$\sum F_y = 0$
$-R_o + 720 + 396 - 450 = 0$
$R_o = 666$ lbf



$T_M = T_{Max} = 2800$ lbf.in.
$M_a = M_{max} = 5994$ lbf in.

1- static:

$$d = \left(\frac{32\, n.s.}{\pi S_y} \sqrt{M^2 + \frac{3}{4} T^2} \right)^{1/3}.$$

$$= \left(\frac{32 * 2.6}{\pi * 71000} \sqrt{5994^2 + \frac{3}{4} * 2800^2} \right)^{1/3}$$

$$= 1.34 \text{ in}$$

2 - cyclic: $\cdot K_f = 0.76$ from fig 7.10.

If $d = 1.5$in then:

$\cdot K_S = 0.869\, d^{-0.112} = 0.83.$ eq 7.22.

$S_e' = 0.5\, S_{ut} = 0.5 * 85000 = 42500$ psi.

$$\Rightarrow S_e = K_f K_s S_e'$$

$$= 0.76 * 0.83 * 42500$$

$$= 26809 \text{ psi}.$$

$$d = \left[\frac{32\, n.s}{\pi\, S_y} \sqrt{\left(M_m + \frac{S_y}{S_e} K_f M_a\right)^2 + \frac{3}{4}\left(\frac{S_y}{S_e} K_{fs} T_a + T_m\right)^2} \right]^{1/3}$$

$$d = \left[\frac{32 * 2.6}{\pi * 71000} \sqrt{\left(\frac{71000}{26809} * 1 * 5994\right)^2 + 0.75\,(2800)^2} \right]^{1/3}$$

$$d = 1.82 \text{in}.$$