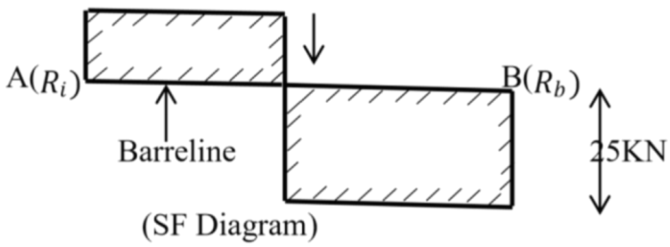
Name

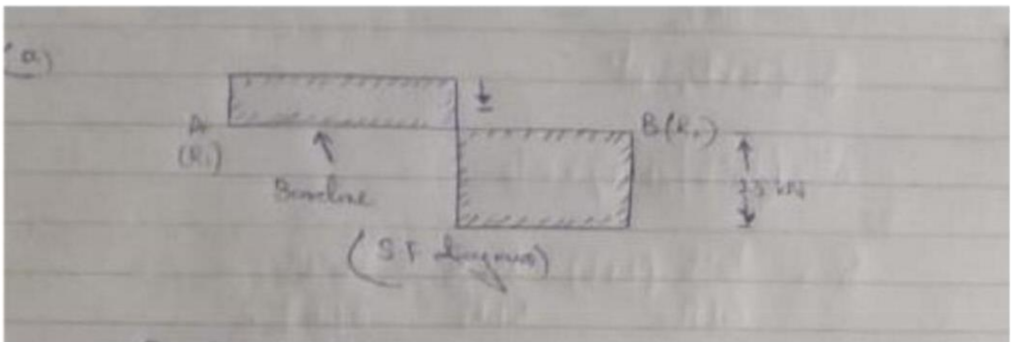
Assignment

Institute

Question 1

(a)





$R_1 + R_b = 25kN$

Taking moments of force about $R_{(A)}A$

$R_b \times 25 = 25*4*x*6$

$R_b = 15kN$, $R_a = 10kN$

Shear force Diagram;

At A;

$F_A = R_A = 10kN$

Shear force between $A \in D$ is

(b)

constant and equal to +10kN

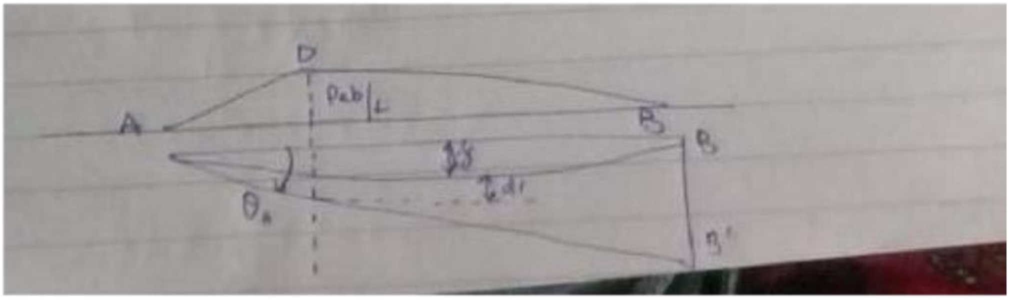
Shear force between $D \in R2(B)$ is constant equal to +25kN

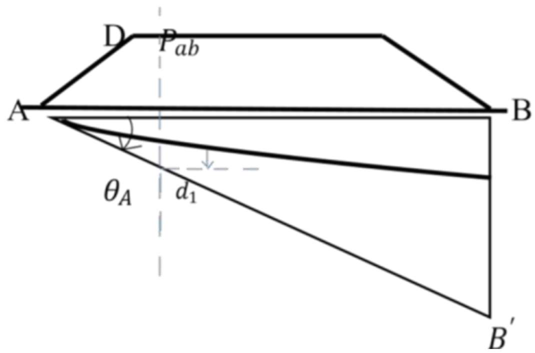
Bending Moment Diagram;

$$BM\ at\ A \rightarrow M_A \times 0$$

$$BMatD \Rightarrow M_0 = R_A \times 15 - 25 \times U = 25 - x - 25\,.\,10 = 10kN$$

BM at B_2 $M_b = 0$





(c)

Bending Moment Diagram;

$$BM\ at\ A \rightarrow M_A \times 0$$

$$BMatD \Rightarrow M_0 = R_A \times 15 - 25 \times U = 25 - x - 25 \quad 10 = 10kN$$

BM at B_2 $M_b = 0$

(d)

$$BB' = 2\_\_\_\_ \quad \_\_\_\_pE^{ab}{}_1\,(L + 3\ b)$$

$$\theta_A = \frac{p_{ab}}{\_\_\_\_}\,(L + b) \ \ 6E12$$

$$8 = (a \times \theta_A) - d'$$

$$d' = (p_a 2b\ /\ 22E_1)^x a|3$$

So,

$$8 = \underset{6EIL}{p_a 2b}\,(\cancel{L+}b) - \underset{62EI}{} \ \underset{3LEI}{p\_\_\_\_} \quad \_\_\_\_a_3 b = p a_2 b_2$$

(e)

Building codes specify the maximum deflection limitations that can be used. When a fraction is used, it is stated as a clear span measured in inches (L) over a particular integer. For example, a floor joist with an L/360 limit that is adequately selected to span 10 feet will deflect no more than

120″/360 = 1/3 inches under maximum design loads when properly installed.

Whenever possible, beam design is carried out in conformity with the principles established in the relevant codes of practice. In most cases, the maximum deflection is limited to the span length of the beam multiplied by 250, which is the span length of the beam multiplied by 250.

The deflection range of an optical beam with a 5m spread is thus 20mm without causing harm. So, the maximum deflection is located at point Pab,

Question 2

(a)

P = 3MW

N = 200 rpm

Di (internal) = 0.75xd2

D2 ≤ 270mm

D2 = 270mm J =

55 MN/m2

Solution:

$$2x\ NT$$

$P =$

60

$$3\infty = \frac{2\pi \times 200 \times T}{60}$$

T = 180000/1256 = 14.33 kNm

T = 14.33 x 10^3 Nm

T = 14.33 x 10^6 Nmm

We know the equation,

$\pi \qquad D_0^4 - D_i^4$

$T = 10 \qquad \times J \times (\; D_0 \qquad)$

$^6 = \pi \times 55 \times (270^4 - D_i^4)$

$14.33 \quad 10$

x

$10 \qquad 270$

$^6 = 0.196 \times 55 \times (270^4 - D_i^4)$

$14.33\ x\ 10$

270

$$3869\ x\ 10^6 = 10.78 \times 5314x10^6 \times D_i^4$$

4

$$\overline{10.78 \times 5314x10} = D_i$$

$$i^4 = (60.458 * 10^6)\ ^\wedge\ ^1/4$$

$3869\ x\ 10_6 \quad 6$

$D \quad D_i = 278mm * 0.75$

$D_i = 208.5mm$

(b)

Consider a shaft is fixed at one end and another end is subjected to the torque as shown in the figure. As a result, each and every cross section of the shaft is subjected to the Torsional shear

stress.

Due to the Circular section of the shaft, It has been considered that the shear stress at the centre axis will be zero and it is maximum at the outer surface of the shaft. From the Torsion equation for a circular member is

$$\frac{\tau}{r} = \frac{T}{J} = \frac{C.\theta}{l}$$

Where τ = Torsional stress induced at the outer surface of the shaft (Maximum Shear stress)

r =

Radius of the shaft

T = Twisting Moment or Torque

J = Polar moment of inertia

C = Modulus of rigidity for the shaft material. l = Length of the shaft θ

= Angle of twist in radians on a length "l".

Torsion is used frequently in engineering design, and one of the most obvious instances is the power provided by transmission shafts. By performing a basic dimensional analysis, we can immediately see how twist creates power and how it works. Watts [W] are the units of measurement for power, and 1 W equals 1 N m s-1. To begin, we noticed that torque is a twisting pair, which implies that it has units of force times distance, or [N m], as previously said. In order to create power with a torque, we need something that occurs at a specific frequency f, which is measured in Hertz [Hz] or seconds (1 s-1], respectively. **(c)**

D = 270mm

P = 300kW

N = 200 rpm

C = 55000

L = 4000 mm

$$\frac{T}{J_p} = \frac{G\theta}{l}$$

$$\frac{14.33 * 10^{\wedge}6}{J_p} = \frac{55000 * 2.20}{4000}$$

$$J_p = 4737101$$

Question 3

(a & b)

Solutions:

Equations of Motions are:

Satellite;

I$\ddot{\theta}$(t)=x(t)+ω(L)

x= $ssu+u'/'c2)$

$$x' = \frac{}{1+(} \quad \frac{}{1+(\ \ c} ssu+u'/'\,2) = 1+(00..100100cc)+(00..100100cc)/c2 = 0.198c$$

Earth, $x' = 0.198c$

So $t = \overline{ud'} = \overline{x_0 u + 'ut}$

Now $u't = x_0 + vt\varepsilon$

$$t = \frac{x_0}{u' - v} = \frac{12 \times 10^9 ly}{0.198c - 0.198c} \frac{(1y)c}{\cdot y}$$

$= 1.2064 \times 10^4 y$

$$t' = \frac{d}{c} = \frac{x_0 + vt}{c}$$

$= \frac{1.20 \times 10^{15} ly + (0.198c) 1.2064 \times 10^4 y}{c} = 1.2058 \times 10^{11} y$

(c)

Since the gravitational field is "conservative" an object moving under the influence of the gravitational field alone does not lose or gain total mechanical energy. Although mechanical energy remains constant, it exchanges one form, "kinetic energy" for another, "potential energy." The total mechanical energy (E) is often used in orbital mechanics with a constant mass, so we usually use a simplified term, the total mechanical energy per unit mass called the total specific mechanical energy:

$$\varepsilon = \frac{E}{m}$$

But the total mechanical energy is the sum of the kinetic and potential energy, so we can express the specific mechanical energy in the form:

$$\varepsilon = \frac{v2}{} - \frac{\mu}{} \quad \text{per unit mass}$$

$2 \qquad r$

Where $\frac{v^2}{2}$ is the specific kinetic Energy (sKE)

And, $\frac{\mu}{r}$ is the specific potential energy (sPE)

$$\varepsilon = \frac{v^2}{2} - \frac{\mu}{r}$$

CONSTANT

This equation is known as the Vis-Viva Equation and is one of the most important equations in orbital mechanics. The Vis-Viva Equation shows the total mechanical energy per unit mass of the satellite converses. The specific potential energy is also equal to the gravitational potential function (V) per unit mass. One thing to note is that potential energy (PE) is zero at an altitude of infinity, and is increasingly negative between zero and the origin at r=0, i.e.,

PE<<0.

Question 4

(a)

Powe = P =90kW

Speed = N = 150 rpm
J = 55MN/m^2

Modules of rigidity = 80 GN/m^2 Dia

= ? ɵ = ?

$$P = \frac{2\pi NT}{60}$$

$$90 = \frac{2\pi 150 T}{60}$$

$$T = \frac{90 * 60}{2\pi 150}$$

= 5.73kNm = 5.73x10^6 Nmm

Torque for solid Shaft (considering shear stress)

$$T = \frac{\Pi}{16} \times J \times D^3$$

$$5.73x10^6 = \frac{\Pi}{16} \times 55 \times D^3$$

$$D = 17.44mm$$

(b)

$D = 17.44mm$

$P = 90kw$

$N = 150rpm$ $C = 80$

GN/m^2 $\lambda = 3m =$

$3000mm$

$C = 80000\ {}^{N}/mm_2$

So,

$T \quad G_3\theta$

$=$

$J_p \quad l$

$5.73x10^6 \quad 8000 \times \theta$

$\frac{\pi}{}_4 = 3000$

$32 \times d$

$5.73x10^6 \quad 8000 \quad \times \quad \theta$

$=$

$0.009077x10^6 \quad 3000$

$631.26 = 26.66_y\theta$

$\theta = 23.69 radius$