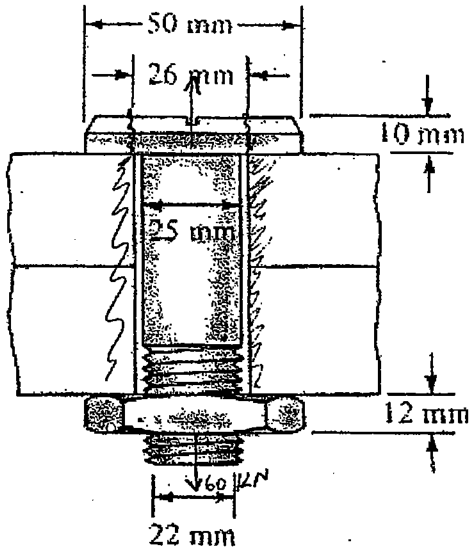
CIE202/SP10 Mechanics Of Materials **TEST#1** **NAME** [redacted]

PROB-1 (35)



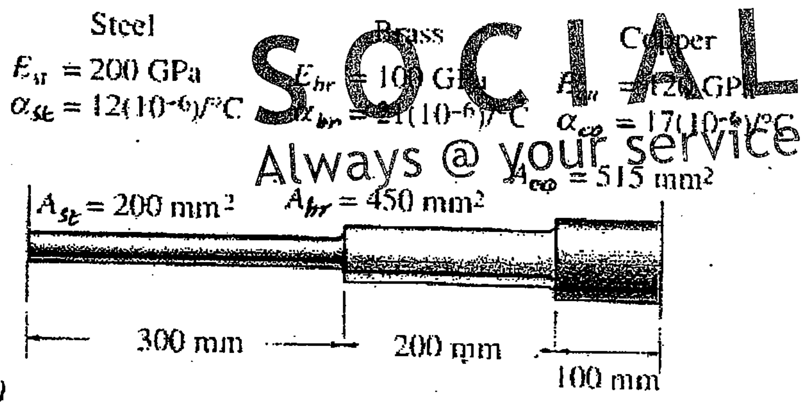
Two plates are fastened by a bolt as shown in the Figure. The nut is tightened to cause a tensile load in the shank (unthreaded part) of the bolt of 60 kN. Determine *(a)* the shearing stress in the threads; *(b)* the shearing stress in the head of the bolt; *(c)* the bearing stress between the head of the bolt and the plate; and *(d)* the normal stress in the bolt shank.

b) $\tau = \frac{60\times10^3}{\pi(26)(10)} = 73.46\ MPa$ (fail here before) (ultimate stress)

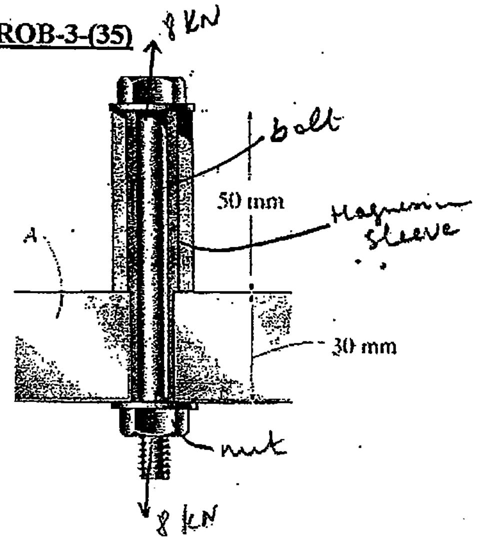
$\tau = \frac{60\times10^3}{\pi(25)(10)} = 76.39\ MPa$

PROB-2-(30)

Three bars each made of different materials are connected together and placed between two walls when the temperature is $T_1 = 12°C$. Determine the force exerted on the (rigid) supports when the temperature becomes $T_2 = 18°C$. The material properties and cross-sectional area of each bar are given in the Figure below.



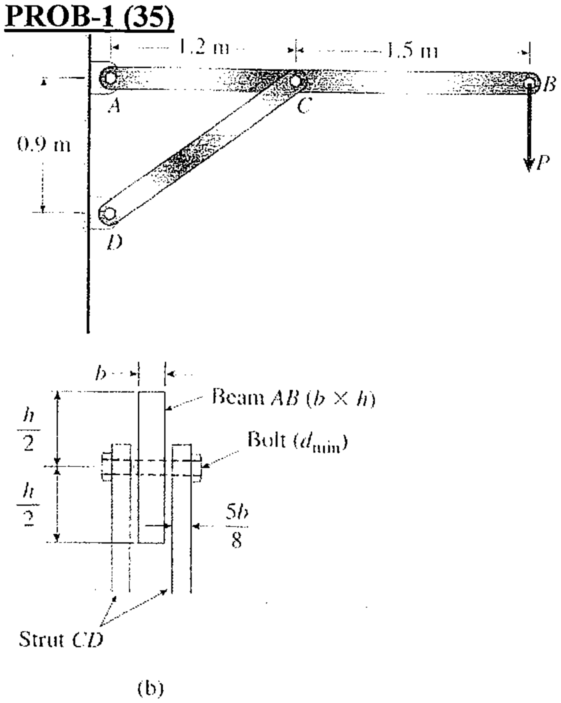
PROB-3-(35)



The 8-mm-diameter bolt is made of an aluminum alloy. It fits through a magnesium sleeve that has an inner diameter of 12 mm and an outer diameter of 20 mm. If the original lengths of the bolt and sleeve are 80 mm and 50 mm, respectively, determine the strains in the sleeve and the bolt if the nut on the bolt is tightened so that the tension in the bolt is 8 kN. Assume the material at *A* is rigid. $E_{al} = 70$ GPa, $E_{mg} = 45$ GPa.

CIE202/SP11 Mechanics Of Materials **TEST#1** **NAME** [redacted]

PROB-1 (35)

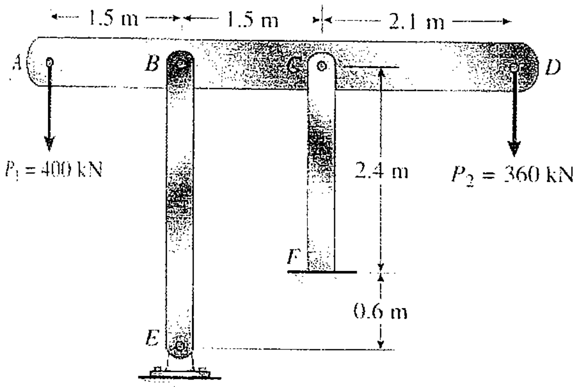


A horizontal beam *AB* with cross-sectional dimension (b = 19 mm) X (h = 200 mm) is supported by an inclined strut *CD* and carries a load P = 12 kN at joint *B* (see Figure). The strut, which consists of two bars each of thickness $5b/8$, is connected to the beam by a bolt passing through the three bars meeting at joint *C* [see figure part (b)].

(a) If the allowable shear stress in the bolt is 90 MPa, what is the minimum required diameter d_{min} of the bolt at *C*.

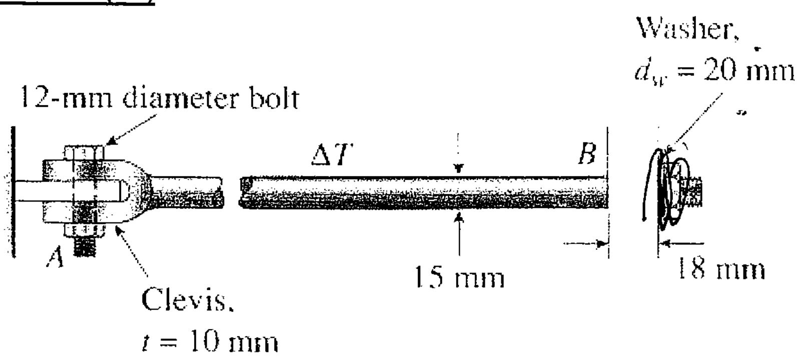
(b) If the allowable bearing stress in the bolt is 130 MPa, what is the minimum required diameter d_{min} of the bolt at *C*.

PROB-2 (35)



The horizontal rigid beam *ABCD* is supported by vertical bars *BE* and *CF* and is loaded by two vertical forces acting at points *A* and *D*, respectively (see figure). Bars *BE* and *CF* are made of steel (E = 200 GPa) and have cross-sectional areas A_{BE} = 11,100 mm^2 and A_{CF} = 9,280 mm^2. The distances between various points on the bars are shown in the figure. Determine the vertical displacements of points *A* and D.

PROB-3- (30)



A steel rod of 15-mm diameter is held snugly (but without any initial stresses) between rigid walls by the arrangement shown in the figure. (For the steel rod, use (α = 12 X 10^{-6}/°C and E = 200 GPa.)

(a) Calculate the temperature drop ΔT (degrees Celsius) at which the average shear stress in the 12-mm diameter bolt becomes 45 MPa.

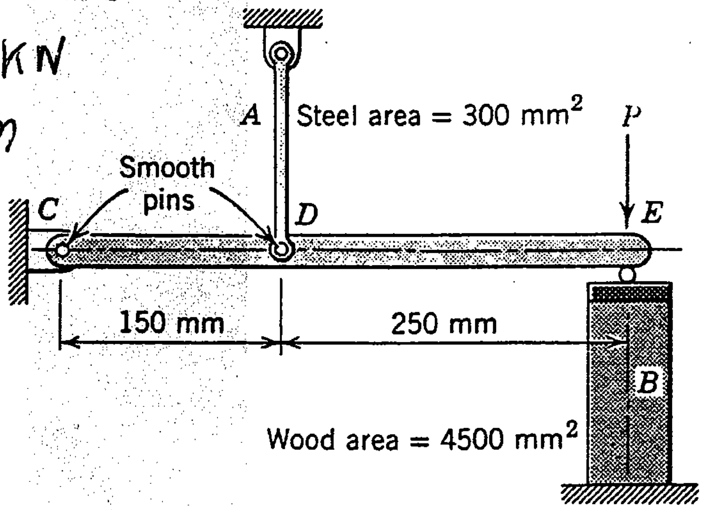
(b) Determine the average bearing stresses in the bolt and clevis at *A* and the washer (d_w = 20 mm) and wall (t = 18mm) at *B*.

CIE301 Strength of Materials/SP98 **Test#1** **Name**________________

PROB-1-(35)

The axial stresses are 12 M Pa in the wood post B and 150 M Pa in the steel bar A. Determine (a) The load P; (b) The minimum diameter for pin C if it is in single shear and the shearing stress is limited to 70 M Pa; (c) The minimum diameter for pin D if it is in double shear and the shearing stress is limited to 50 M Pa.

P= 70.875 KN
d_C=22.62 mm
d_D= 23.94 mm



a) F_{AD} = 45 KN
F_B = 54 KN
$\Sigma M_c = 0$
⇒ P = 70.875

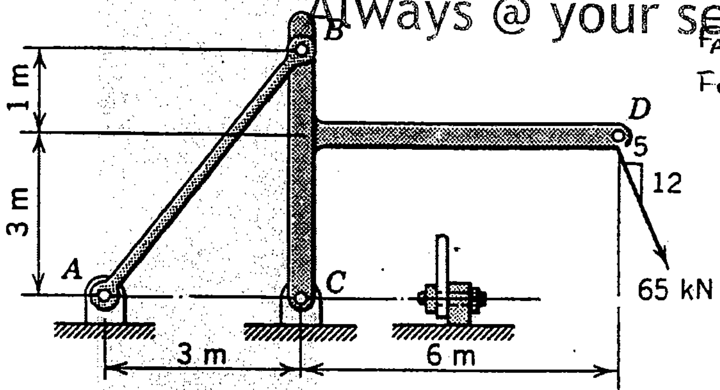
b) C_y = 28.125 ↓
$A_V = \frac{\pi}{4} D^2$. τ = 70
⇒ D = 22.62

c) $\tau = \frac{F_{AD}}{2A_V}$
$A_V = \frac{\pi}{4} D^2$
D = 23.93 mm

PROB-2-(30)

The tie rod AB has a cross-sectional area of 950 mm^2. The cross-sectional area of pin C is 1850 mm^2. Both the tie rod and the pin are made of steel for which the ultimate normal stress is 450 M Pa and ultimate shearing stress is 270 M Pa. Determine (a) The factor of safety in rod AB; (b) The factor of safety in pin C.

a) FS= 2.36
b) FS=2.26

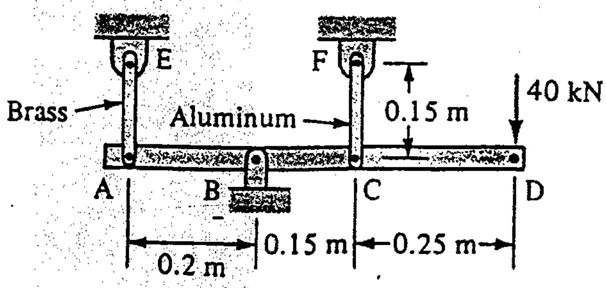


F_{AB} = 191.25 KN
F_C = 205 KN
σ_{AU} = 190.78
⇒ F.S = 2.36
τ_{AU} = 110.81
⇒ F.S = 2.4

PROB-3-(35)

In the assembly shown below, brass rod AE (E_b = 105 G Pa) and aluminum rod CF (E_a = 70 G Pa) each have a cross-sectional area of 500 mm^2. Determine the displacement of end D of the rigid member ABCD that would be caused by a 40 kN load.

δ_D=0.332 mm

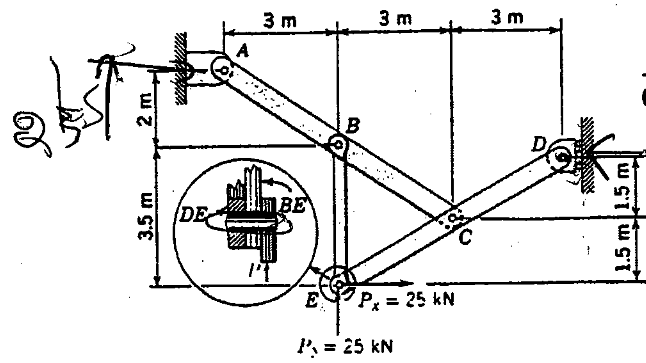


$-0.2F_E + 0.15F_C = 16$

CIE301 Strength of Materials/SP00 TEST#1 NAME________________

PROB-1-(30)

Member BE of the pin-connected structure shown below is a 25 X 8 mm rectangular bar. The load P is applied to the pin at E as shown below. The pin at E has a diameter of 30mm. Determine a) the axial stress in BE, and b) the shearing stress in the pin at E.



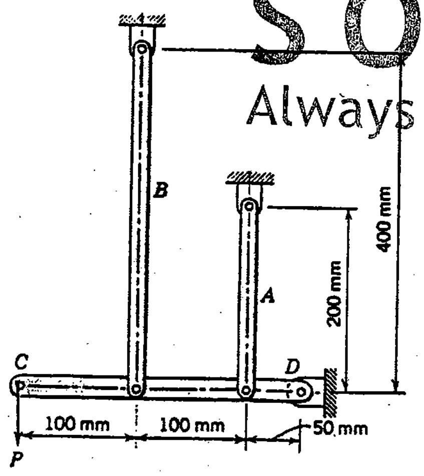
$\sigma = 150$ MPa

$\tau_E = 21.22$ MPa.

$\tau_E = 50.02$ MPa

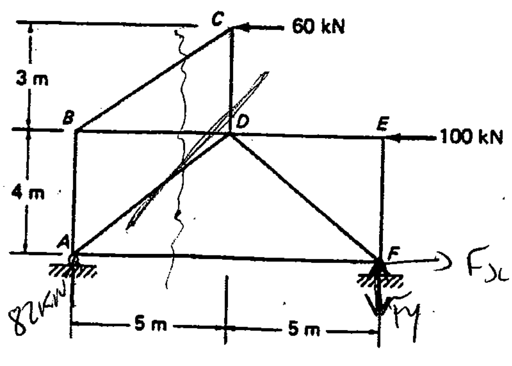
PROB-2-(40)

Bar CD of the pin-connected structure shown below is to be considered rigid. If temperature in bar A (E= 200 G Pa, A= 150 mm², $\alpha = 11.9 \times 10^{-6}/°C$) increases by 100 °C and the temperature in bar B (E= 100 G Pa, A= 200 mm², $\alpha = 17.6 \times 10^{-6}/°C$) increases by 50 °C after the 24 KN load P is applied. Determine the vertical displacement of point C.



PROB-3-(30)

For the truss shown below, determine the stresses in members AD and CD. Given $A_{CD} = 200$ mm² and $A_{AD} = 150$ mm².



$\sigma_{AD} = -490.91$ MPa

$\sigma_{CD} = 180$ MPa.

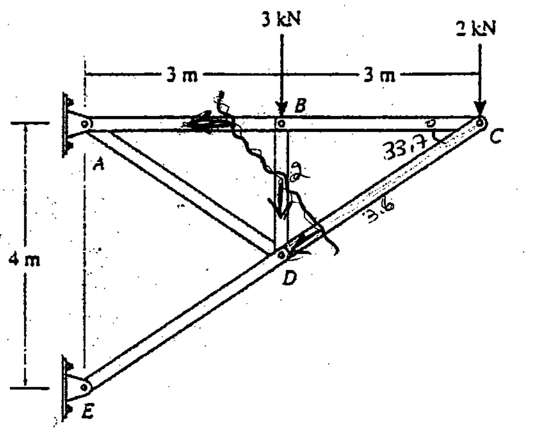
$F_x = 160$

CIE301 Strength of Materials/SP02 TEST#1 NAME Dr. Issa

PROB-1-(25)

For the truss shown below, determine the stresses in members AB, BD, and CD. Given $A_{AB} = 200$ mm^2, $A_{CD} = 150$ mm^2, and $A_{BD} = 125$ mm^2.

$\sigma_{BD} = -24$ MPa
$\sigma_{CD} = -24.04$ MPa
$\sigma_{AB} = +15.0$ MPa



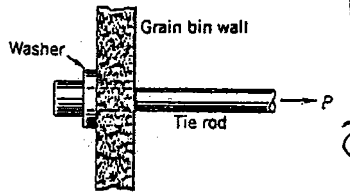
$F_{AB} = 3$ kN
$F_{CD} = -3.605$ kN
$F_{BD} = -3$ kN

PROB-2-(40)

The tie rod shown below has a diameter of 40 mm and is used to resist the lateral pressure against the walls of a grain bin. If the tensile stress in the rod is 70 M Pa, determine: a) The diameter of the washer that must be used if the bearing stress on the wall is not to exceed 3.0 M Pa. b) The average shearing stress in the head of the rod if the head has a diameter of 80 mm and a thickness of 60 mm.

$D = 197.32$ mm $\quad A_b = \frac{\pi}{4}D^2$

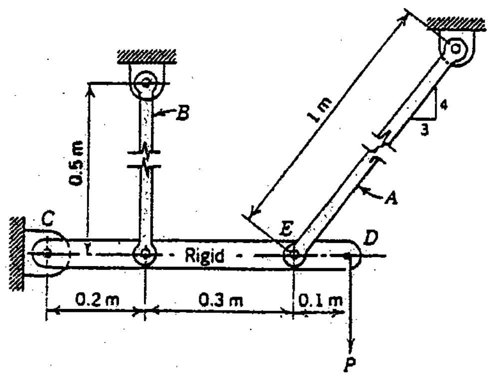
$P = (70)(\frac{\pi}{4})(40^2)$
$= 87.96$ kN



$\tau = 11.67$ MPa $\quad A_v = \pi(R)(t)$

PROB-3-(35)

Bar A is made of aluminum with a modulus of elasticity of 10.5 x10^3 ksi and Bar B is made of steel with a modulus of elasticity of 29x 10^3 ksi. All bars have a rectangular cross section of 2.5 by 1.0 inches and are unstressed when P is zero. When load P is applied, the strain in A is found to be 0.0010. Determine the axial stresses and load P.

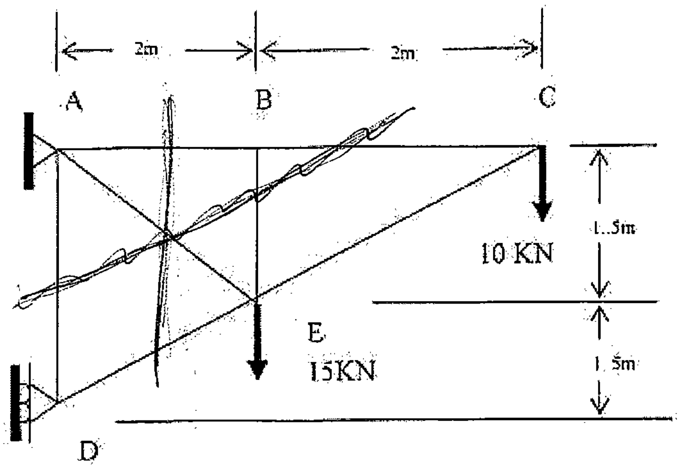


$\sigma_A = 10.5$ KSI
$\sigma_B = 18.56$ KSI
$P = 32.97$ N

CIE301 Mechanics of Materials/SP03 Test#1 Name:______________________

PROB-1- (30)

In the truss shown below, determine the stress in members AE, BE, and BC. Given that the members are 50 mm in diameter.



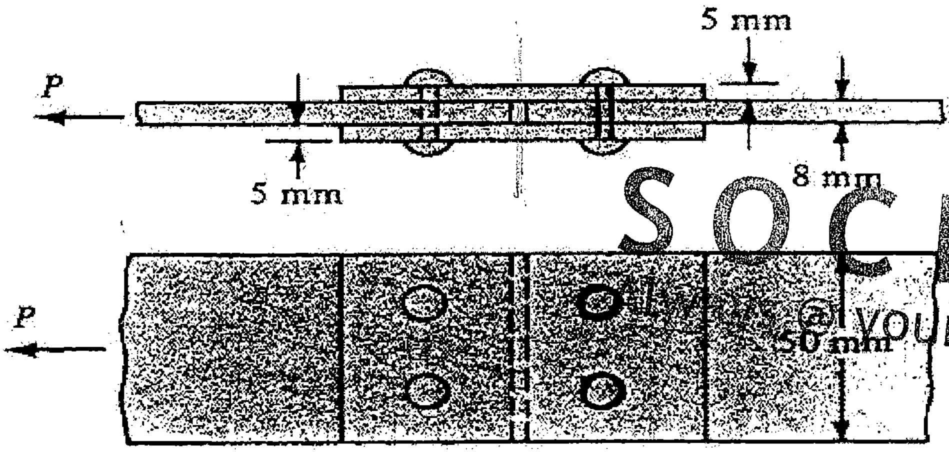
$\sigma_{AE} = 6.37\ MPa$

$\sigma_{BE} = 0$ ✓

$\sigma_{BC} = 6.79\ MPa$ ✓

PROB-2- (35)

The but joint shown below is fastened by four 15 mm diameter rivets. Determine the maximum load P if the maximum stresses are not to exceed 100 MPa in shear, 140 MPa in tension, and 210 MPa in bearing. Assume that the load is equally divided among the rivets.



$P_{\sigma} = 22.4\ KN$

$P_{\tau} = 70.69\ KN$

$P_b = 113.4\ KN$

Use $P = 22.40\ KN$

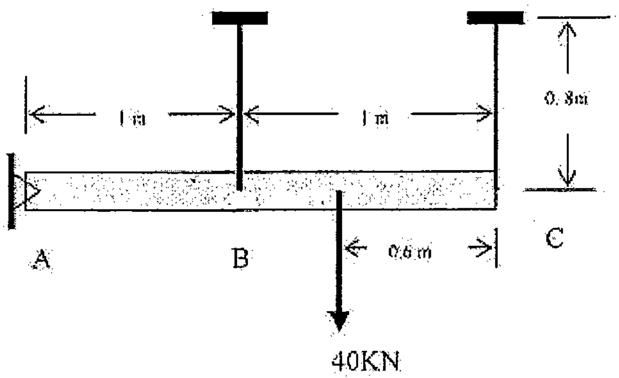
$\tau = \frac{P}{4A_V}$ $(A_V = \frac{\pi}{4}15^2)$

$A_t = (50-30)(8)$

$A_b = 2\times(5+5+8)(15)$

PROB-3- (35)

A rigid horizontal bar ABC is supported by a hinge at A and by two steel cables at B and C, which are of equal length L = 0.8 m., and area A = 140 mm^2. Given E = 200 GPa and a load of 40 KN is applied as shown. Determine the stress in each cable.



$\sigma_B = 80\ MPa$ ✓

$\sigma_C = 160\ MPa$ ✓

$F_B + 2F_C = 56$

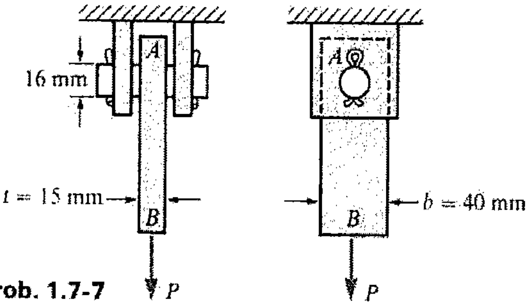
$\delta_C = 2\delta_B \Rightarrow F_C = 2F_B$

$F_B = 11.2\ KN$

$F_C = 22.4\ KN$

CIE202/SP05 Mechanics Of Materials **TEST#1** **NAME**____________________

PROB-1 (35)



rob. 1.7-7

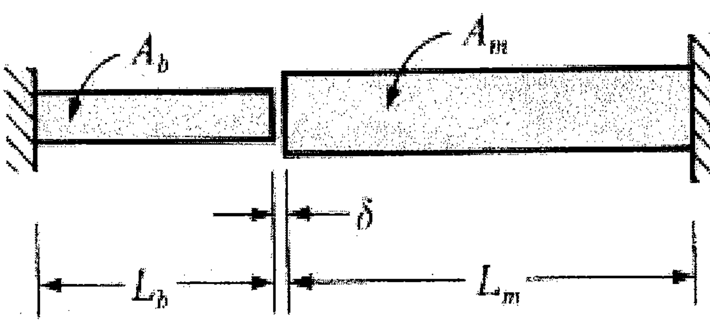
An aluminum bar *AB* is attached to its support by a 16 mm diameter pin at *A* (see figure). The thickness *t* of the bar is 15 mm, and its width *b* is 40 mm. If the allowable tensile stress in the bar is 150 M Pa and the allowable shear stress in the pin is 85 M Pa, find the allowable load *P*.

$P_\sigma = 54$ KN

$P_\tau = 34.18$ KN

PROB-2-(40)

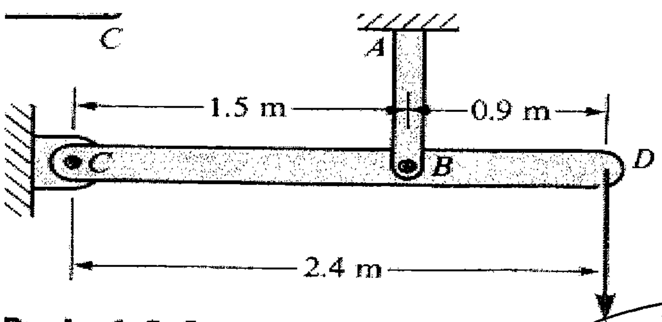
The bimetallic thermal control shown in the figure is made of a brass bar (length L_b = 0.75 in. and cross-sectional area A_b = 0.10 in.^{2}) and a magnesium bar (length L_m = 1.30 in. and cross-sectional area A_m = 0.20 in.^{2}). The two bars are arranged so that the gap between their free ends is δ = 0.0040 in. at room temperature. Calculate the following quantities: (a) the temperature increase ΔT (above room temperature) at which the two bars come into contact, and (b) the stress σ in the magnesium bar when the temperature increase ΔT is 300 °F. (Use the following material properties: $\alpha_b = 10 \times 10^{-6}$/ °F , $\alpha_m = 14.5 \times 10^{-6}$ / °F, $E_b = 15 \times 10^6$ psi, and $E_m = 6.5 \times 10^6$ psi.)



$0.004 = \alpha_b \Delta T L_b + \alpha_m \Delta T L_m$

PROB-3-(25)

A horizontal bar *CBD* having a length of 2.4 m is supported and loaded as shown in the figure. The vertical member *AB* has a cross-sectional area of 550 mm^2. Determine the magnitude of the load *P* so that it produces a normal stress equal to 40 M Pa in member *AB*.

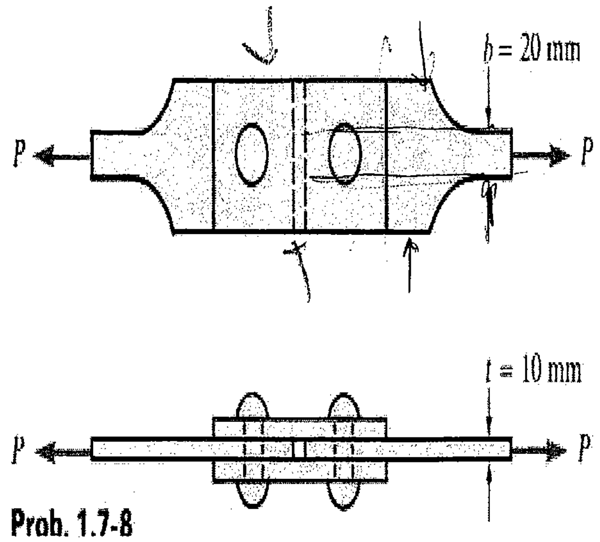


Prob. 1.2-2

P = 13.75 KN

CIE202/SP06 Mechanics Of Materials **TEST#1** **NAME**____________________

PROB-1 (35)



Prob. 1.7-8

Two flat bars loaded by a tensile force P are spliced using two 15 mm diameter rivets (see figure). The bars have width b = 20 mm and thickness t = 10 mm. The bars are made of steel having an ultimate stress equal to 400 M Pa. The ultimate shear stress for the rivet steel is 180 M Pa. Determine the allowable load P if a safety factor of 3.0 is desired with respect to the ultimate load that the connection can carry. (Assume that the bars do not fail in tension at a cross section through a rivet, and disregard friction between the

$P_T = 6.66$ kN

$P_G = 21.205$ kN

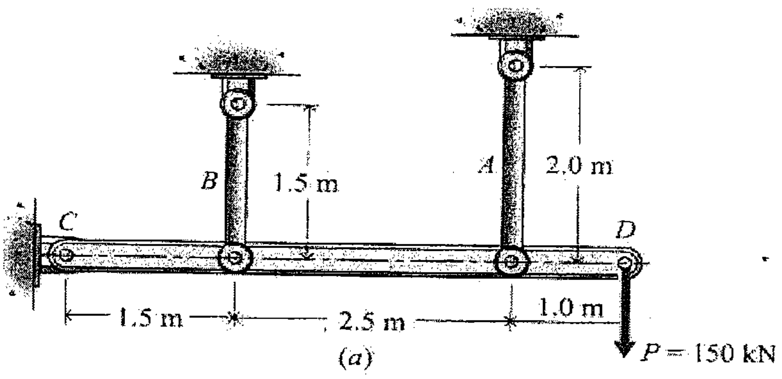
PROB-2-(40)

After a load P = 150 kN is applied to the pin-connected structure shown in figure below, the temperature increases 100 °C. The thermal coefficients of expansion are 22×10^{-6}/ °C for the aluminum alloy rod A and 12×10^{-6}/ °C for the steel rod B. The moduli of elasticity of aluminum and steel are 75 G Pa and 200 G Pa, respectively. The cross-sectional area of members A and B are 1000 mm² and 500 mm², respectively. If member CD is rigid, determine (a) The normal stresses in bars A and B. (b) The vertical component of the displacement of point D.

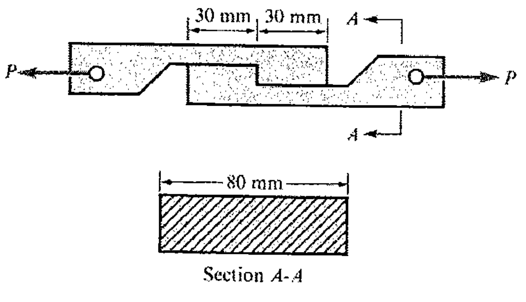
a) σ_A = 210 MPa

σ_B = 120 MPa

b) δ_D = 15.15 mm



PROB-3-(25)

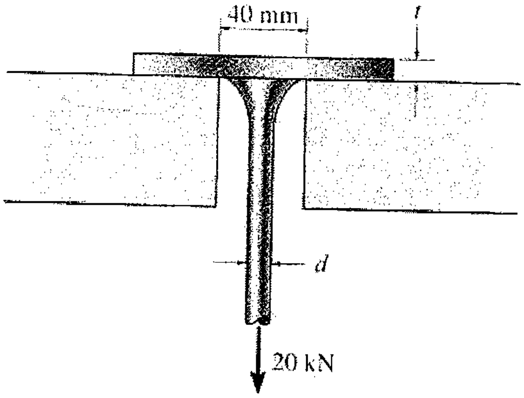


Two pieces of material are interlocked as shown in the figure and are pulled by forces P. If the ultimate stress in shear for the material is 38 M Pa, what force P is required to fracture the piece in shear.

P = 182.4 kN

CIE202/SP07 Mechanics Of Materials **TEST#1** **NAME**____________________

PROB-1 (30)

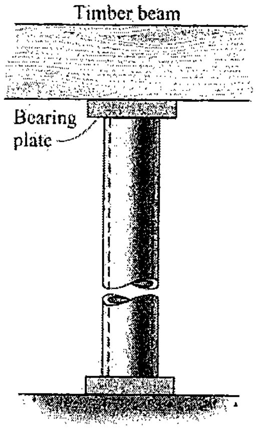


The suspended rod is supported at its end by a fixed-connected circular disk as shown in Figure. If the rod passes through a 40-mm-diameter hole, determine the minimum required diameter of the rod and the minimum thickness of the disk needed to support the 20-kN load. The allowable normal stress for the rod is σ_{allow} = 60 MPa, and the allowable shear stress for the disk is τ_{allow} = 35 MPa.

d = 20.60 mm **t = 4.55 mm**

$\sigma = \frac{P}{A_t}$ $A_t = \pi R^2$ or $\frac{\pi D^2}{4}$ $\tau = \frac{P}{A_v}$ $A_v = (\pi)(R)(t)$

PROB-2 (40)



The steel (E_s = 200 GPa) pipe column shown in Figure has an outside diameter of 150 mm and a wall thickness of 15 mm. The load imposed on the column by the timber beam is 150 KN. Determine

(a) The average bearing stress at the surface between the column and the steel bearing plate. σ_b= 23.58 MPa

$A_b = \frac{\pi}{4}(D_o^2 - D_i^2)$

(b) The diameter of a circular bearing plate if the average bearing stress between the steel plate and the wood beam is not to exceed 3.25 MPa.

D = 242.41 mm $A = \pi R^2$

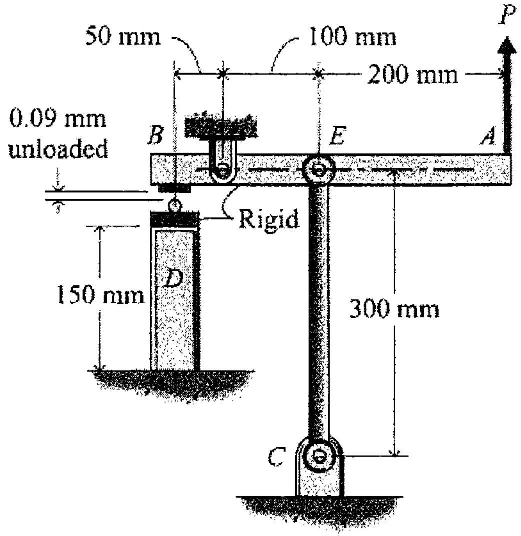
(c) The change in the pipe thickness if υ = 0.3. δt = 0.000531 mm

$\upsilon = -\frac{\epsilon_{LAT}}{\epsilon_{AX}}$ $\epsilon_{AX} = \frac{\delta D}{D} = \frac{PD}{DAE} = 0.000117$

$\epsilon_{LAT} = 3.5\times10^{-5} = \frac{\delta t}{t}$ $\Rightarrow \delta t = 0.0000531$

where did the (-) go??

PROB-3- (30)

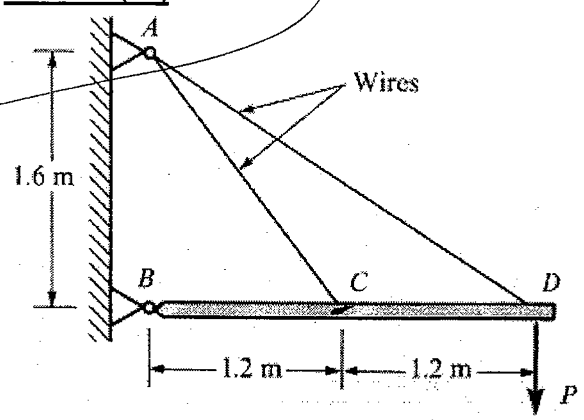


The load *P* produces an axial strain of 0.0075 m/m in the steel post *D* in the Figure; Determine the axial strain in the aluminum rod *CE* if there is a 0.09 mm clearance between B and D before the load P is applied.

ε_{CE} = 0.0081

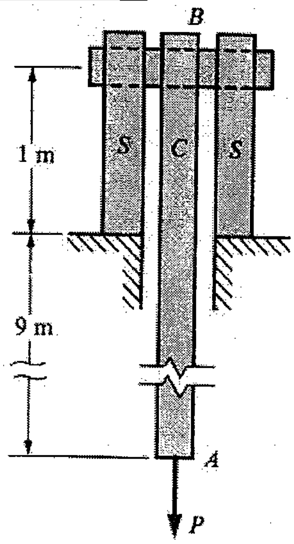
CIE202/SP08 Mechanics Of Materials **TEST#1** **NAME**____________________

PROB-1 (35)



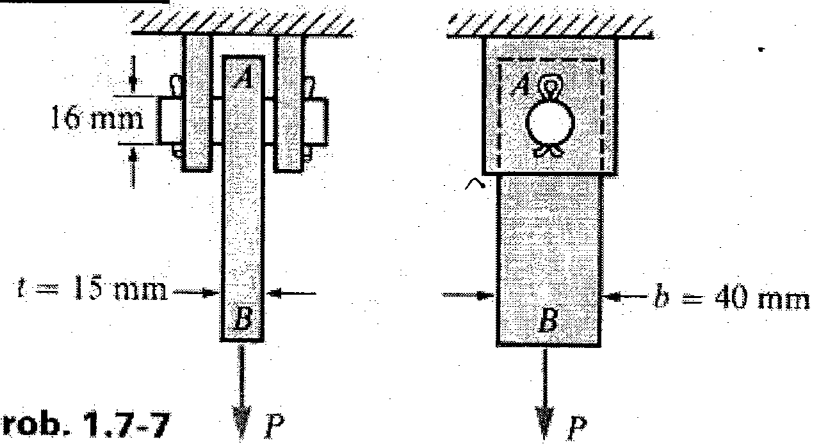
A rigid bar *BD* is supported by a pin support at *B* and by two wires attached at C and *D* (see figure). The wires are identical except for length and are just taut (but free from stress) before the load *P* is applied. Find the tensile forces produced in the wires by a load *P* = 5000 N.

PROB-2 (35)



A copper bar *AB* under a tensile load *P* = 500 KN hangs from a pin supported by two steel pillars (see figure). The copper bar has length 10 m, cross-sectional area 8100 mm^2, and modulus of elasticity E_c = 103 GPa. Each steel pillar has height 1 m, cross-sectional area 7500 mm^2, and modulus of elasticity E_s = 200 GPa. Determine the displacement of point *A*.

PROB-3- (30)

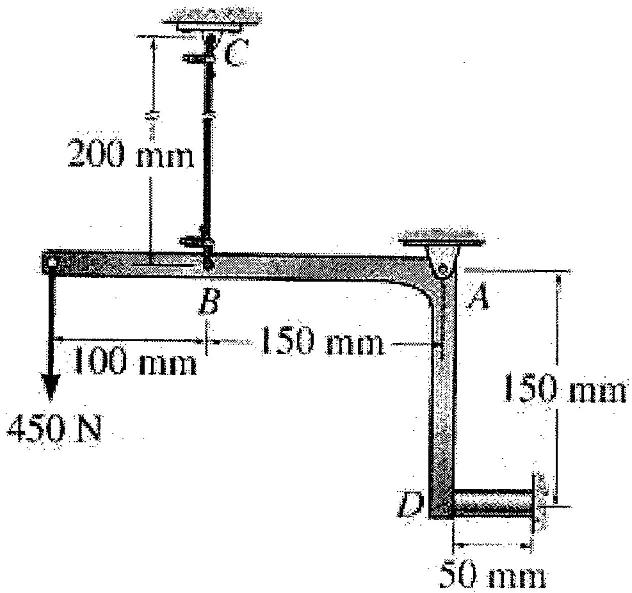


rob. 1.7-7

An aluminum bar *AB* is attached to its support by a 16 mm diameter pin at *A* (see figure). The thickness *t* of the bar is 15 mm, and its width *b* is 40 mm. If the allowable tensile stress in the bar is 150 MPa and the allowable shear stress in the pin is 85 MPa, and allowable bearing stress is 75 MPa, find the allowable load *P*.

CIE202/SP09 Mechanics Of Materials **TEST#1** **NAME**____________________

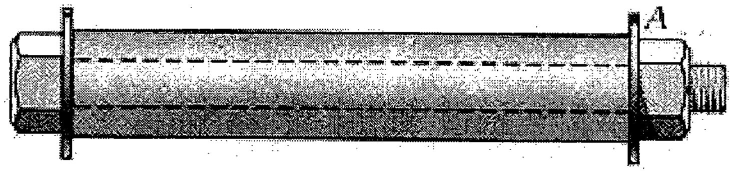
PROB-1 (35)



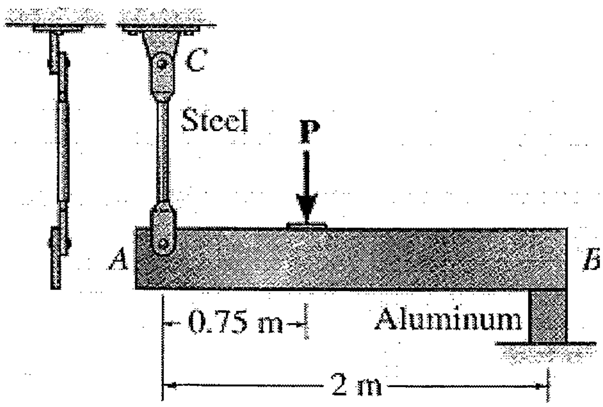
The rigid link is supported by a pin at A, a steel wire BC having an un-stretched length of 200 mm and cross-sectional area of 22.5 mm^2, and a short aluminum block having ~~an unloaded~~ length of 50 m m and cross-sectional area of 40 mm^2. If the link is subjected to the vertical load shown, determine the rotation of the link about the pin A. Report the answer in radians. Given that E_{st} = 200 GPa and E_{al} = 70 GPa.

PROB-2-(30)

The steel bolt has a diameter of 7 mm and fits through an aluminum sleeve as shown. The sleeve has an inner diameter of 8 mm and an outer diameter of 10 mm. The nut at A is adjusted so that it just presses up against the sleeve. If the assembly is originally at a temperature of T_1 = 20°C and then is heated to a temperature of T_2 = 100°C, determine the average normal stress in the bolt and the sleeve. E_{st} = 200 GPa, E_{al} = 70 GPa, α_{st} =14 x 10^{-6}/ °C, α_{al} = 23 x 10^{-6}/ °C



PROB-3-(35)

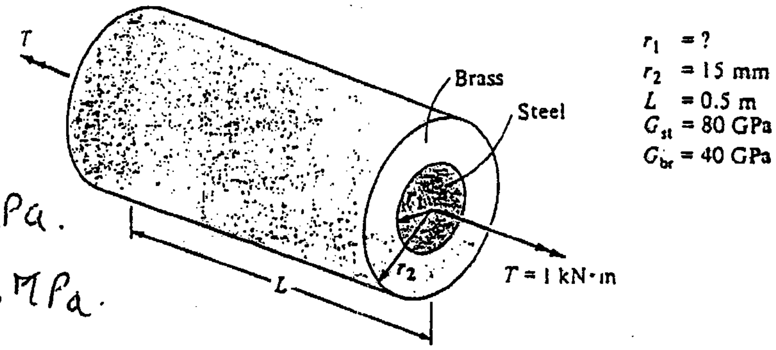


The rigid bar AB shown is supported by a steel rod AC having a diameter of 20 mm and an aluminum block having a cross- sectional area of 1800 mm^2. Pins at A and C are 18-mm diameter pins. If the failure stress for the steel and aluminum is $\sigma_{st(fail)}$ = 680 MPa and $\sigma_{AL\ (fail)}$ = 70 MPa, respectively, and the failure shear stress for each pin is τ_{fail} = 900 MPa, determine the largest load P that can be applied to the bar. Apply a factor of safety of F.S. = 2.

CIE301Strength of Materials/SP98 Test#2 Name_______________________

PROB-1- (30)

A composite bar consists of a steel core and a brass shell as indicated in the figure. Determine: a) The radius of the interface in order that each component carry half the torque. b) The maximum shear stresses in the steel and brass portions.



$r_1 = 11.40 mm$

$\tau_1 = 214.85 MPa.$

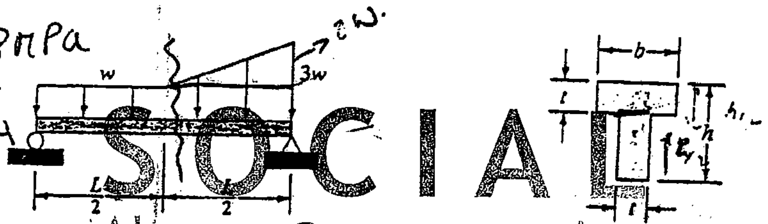
$\tau_2 = 141.53 MPa.$

PROB-2-(35)

The T-beam section is subjected to the loading as shown below. Determine at midspan: a) The maximum compressive stress. b) The maximum tensile stress. Take L = 3 m, b = 0.15 m, h = 0.2 m, t = 0.05 m, and W = 1.5 k N/m .

$\sigma_{comp} = 3.18 MPa$

$\sigma_{TEN} = 5.29 MPa$



I am Not Sure

$M = 5.625 kN \cdot m$

$\bar{y} = 0.15 m.$

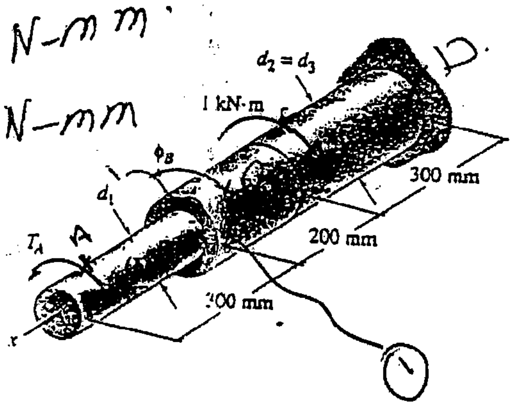
$I = 6.15 \times 10^{-5} m^4$

PROB-3-(35)

The solid steel shaft AD shown below is subjected to applied torques at sections A and C. The shear modulus of elasticity G = 80 G Pa and the diameters of the shaft d_1 = 25mm and $d_2 = d_3$ = 40 mm. If the angle of rotation at A is not to exceed $|\phi_A|_{allow}$ = 0.0125 radians in either direction, and the magnitude of the shear stress is not to exceed τ_{allow} = 70 M Pa anywhere in the shaft. Determine: a)The minimum torque T_A that must be applied at end A. b) The maximum torque T_A that may be applied at end A.

MAX $T_A = 2.24 \times 10^5$ N-mm

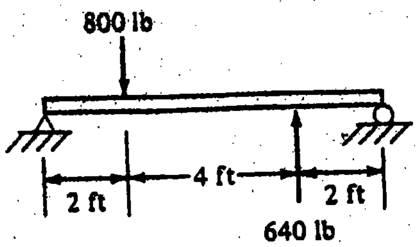
MIN $T_A = 1.20 \times 10^5$ N-mm

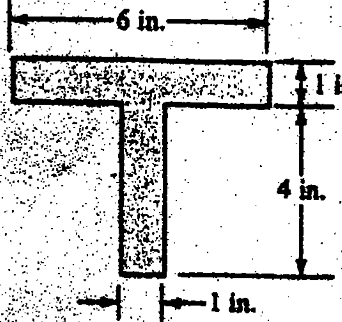


CIE301 Mechanics of Materials/SP02 TEST # 2 NAME Dr. [illegible]

PROB-1-(40)

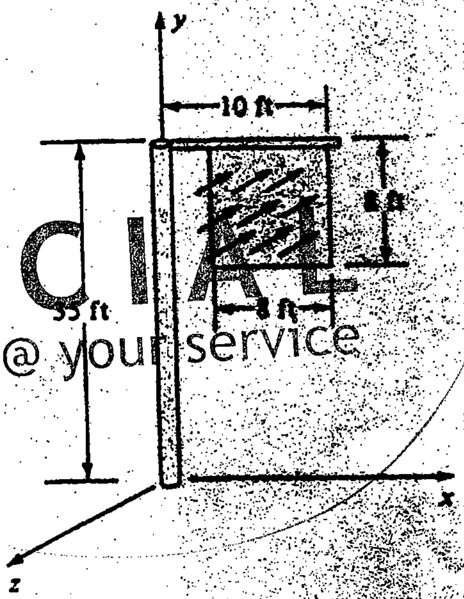
For the beam and loading shown below, calculate at midspan: i) The maximum compressive stress; and ii) The maximum tensile stress. $\sigma_{TOP} = -138.24$ PSI ; $\sigma_{BOT} = 32265$ PSI





PROB-2-(35)

The circular steel column shown below supports a sign board 8 ft by 8 ft that is subjected to a uniform loading of 30 lb/ft^2. Determine the required diameter of the column if the allowable shear stress due to torsional loading is limited to 10 ksi.

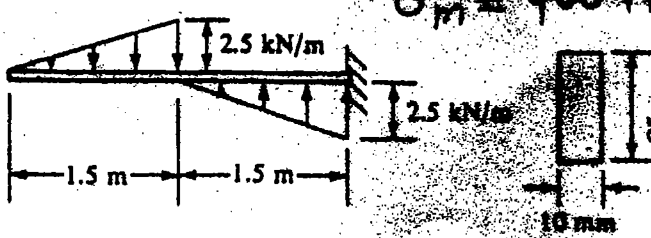


$d = 4.13''$

PROB-3-(25)

For the beam shown below, compute at midspan, the maximum bending stress.

$\sigma_m = 900$ MPa



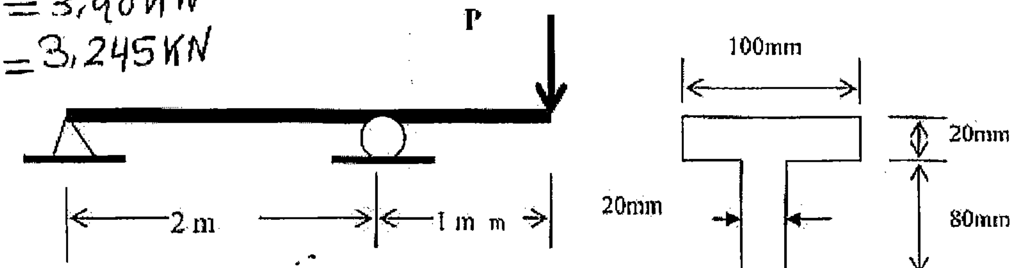
CIE301 Mechanics of Materials/SP03 **TEST # 2** **NAME**__________________

PROB-1-(35)

For the beam and cross-section shown below, calculate the load P based on an allowable stress of 40 MPa in tension and 70 MPa in compression.

$P_T = 3{,}90\ kN$

$P_C = 3{,}245\ kN$

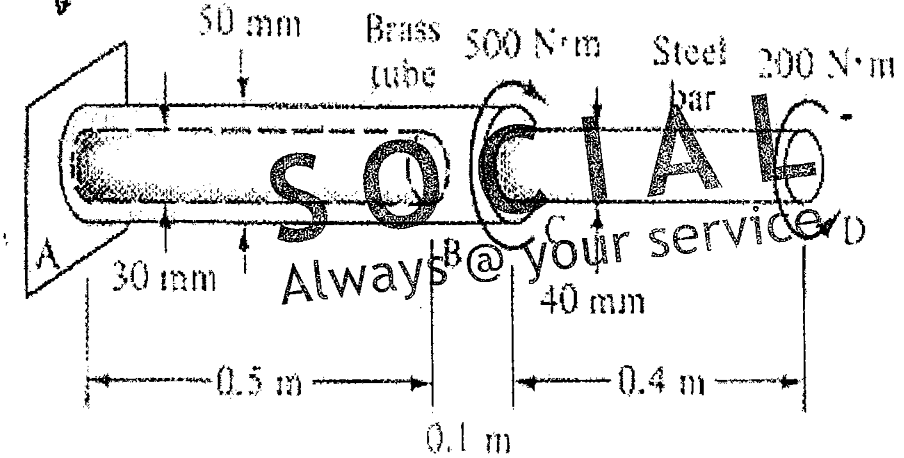


USE $P = 3{,}245\ kN$

PROB-2-(30)

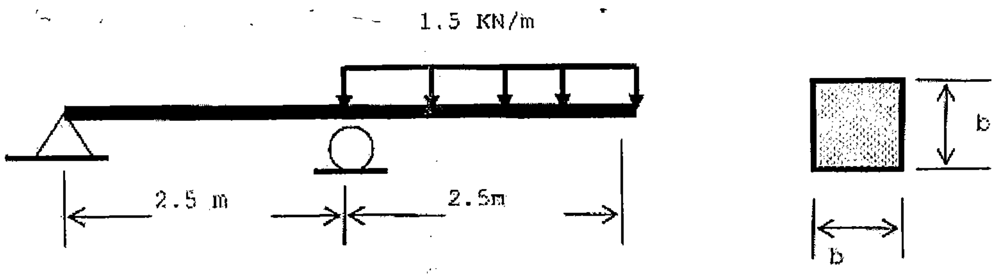
The circular shaft shown below is subjected to torques at C and D. Given that $G_{Brass} = 40$ GPa and $G_{Steel} = 80$ GPa, determine the angle of twist at D and the maximum shearing stress in the shaft.

$\phi_D = 0{,}244°$ $\tau_{max} = 15.92$ MPa .



PROB-3-(35)

The beam shown below has a square cross-section and carries the loading as shown. Calculate the required side dimension b of the square cross-section if the allowable bending stress is 12 MPa.



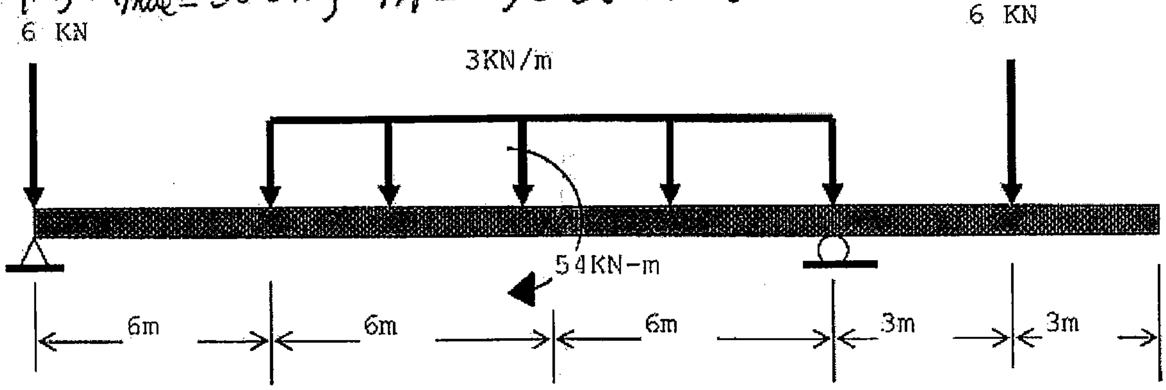
$b = 132.83\ mm$

CIE301 Mechanics of Materials/SP04 TEST#2 NAME___________________

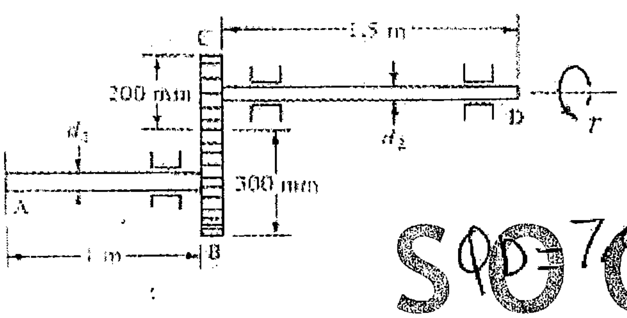
PROB-1-(30)

The cross section of the beam below is square of dimension 50x 50 mm. Determine the maximum stress at 9 m from the left hand pin support.

X=9m, M_{max}= 58.5KN-m σ_m = 2,808 MPa



PROB-2(30)



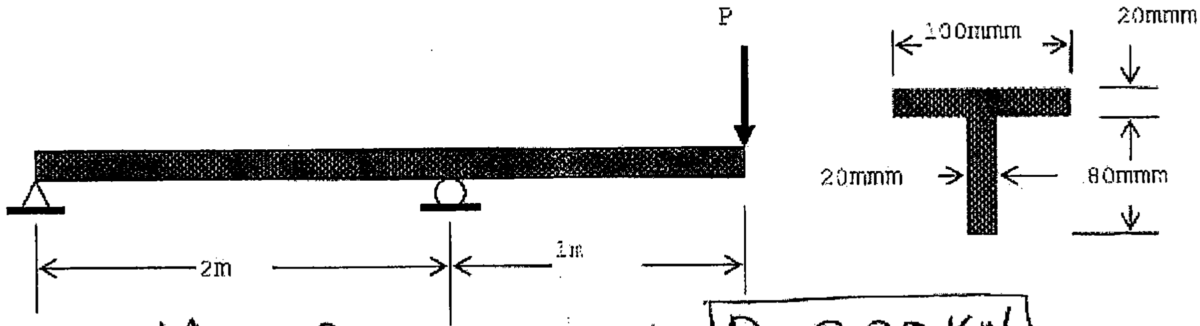
The two steel shafts (G = 80 G Pa) are connected by gears and subjected to a torque of 400 N-m. Given that d_1 = 40 mm and d_2 = 30 mm, determine (a) the angle of rotation in degrees at D and (b) the maximum shearing stress in each shaft.

ϕ_D = 7.97° $\tau_{AB\,max}$ = 47,75 MPa

$\tau_{CD\,max}$ = 75,45 MPa

PROB-3-(40)

Determine the value of load P so that the maximum allowable stresses at the roller support does not exceed 40 M Pa in tension and 70 M Pa in compression.



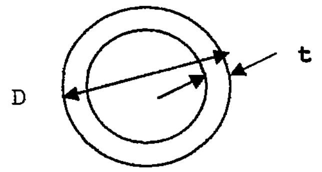
M = − P KN-m ⇒ P = 3,25 KN

CIE202 Mechanics of Materials/SP05 TEST # 2 NAME________________

PROB-1-(30)

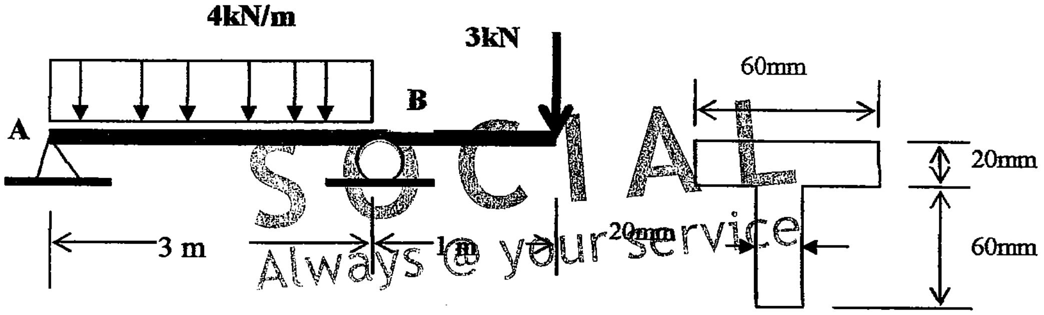
A 2 m long circular steel shaft must transmit a torque of 800 N-m. If the shaft is to be lightweight, it must be hollow. Assume the wall thickness is 0.1 times the diameter (see figure). If the maximum allowable shear stress in the shaft is 150 M Pa; Determine:

a) The required diameter in mm. b) The total angle of twist of one end of the shaft relative to the other.



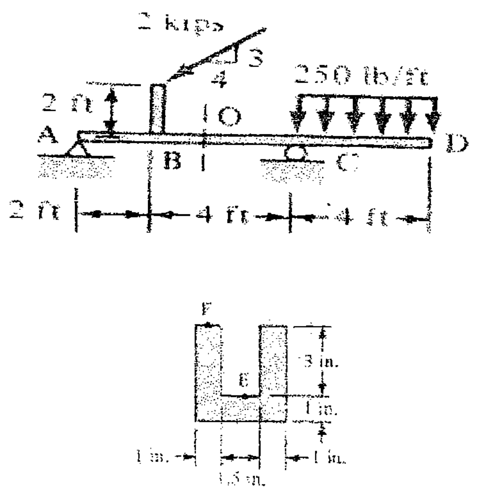
PROB-2-(35)

For the beam and cross-section shown below, calculate the maximum compressive and tensile stress at the midpoint between A and B.



PROB-3-(35)

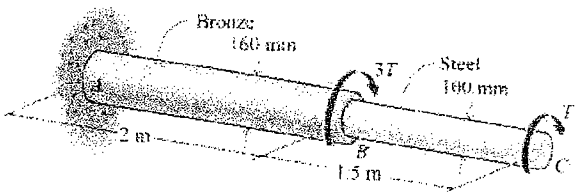
For the beam and cross-section shown below, calculate the stress at point E and F of the cross section based on the moment value at the midpoint between B and C of the beam.



CIE202 Mechanics of Materials/SP06 [redacted]# 2 NAME_______________

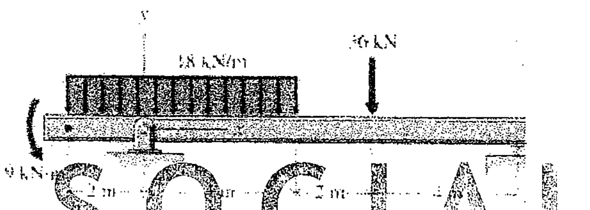
PROB-1-(30)

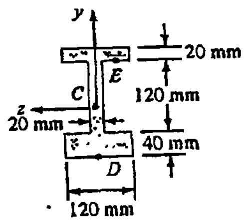
A solid circular structural steel (G = 77 G Pa) shaft is securely fastened to a solid cold-rolled bronze shaft (G = 39 G Pa). For the steel, the allowable shearing stress is 75 M Pa; for the bronze, the allowable shearing stress is 150 M Pa. The allowable angle of twist in the 3.5-m length is 2.5°. Determine the maximum permissible value of the torque *T*.



PROB-2-(40)

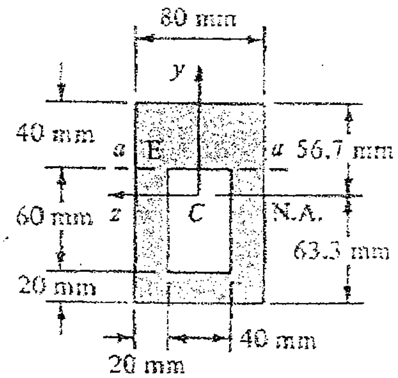
For the beam and cross-section shown below, for the moment value at midpoint between the supports, calculate the stresses at points D and E of the cross section.

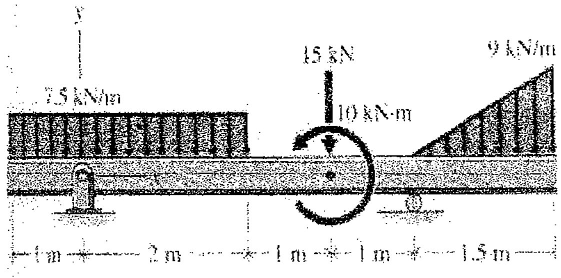




PROB-3-(30)

For the beam and cross-section shown below, calculate the maximum compressive and tensile stress on the cross section based on the moment value at the midpoint between the two supports. Given I = 10.5×10^6 mm^4.





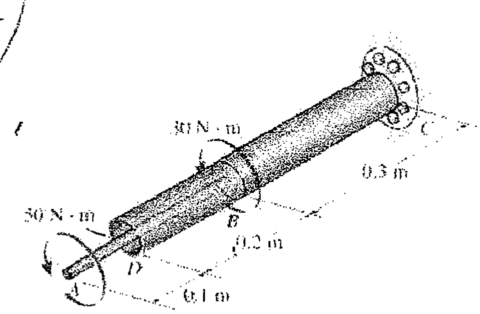
CIE202 Mechanics of Materials/SP07 **TEST # 2** **NAME**________________

PROB-1-(30)

The shaft assembly shown below is made of A-36 steel (G = 77 G Pa) and consists of a solid rod AB of 15 mm in diameter connected to the inside of a tube DBC using a rigid disk at *B*. Determine the angle of twist at *A*. The tube has an outer diameter of 30 mm and wall thickness of 3 mm.

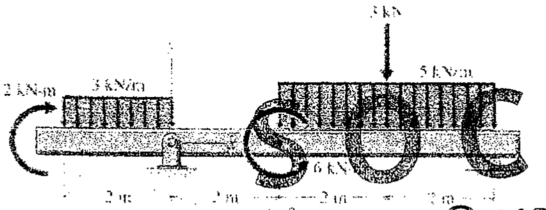
$\phi_{in} = \phi_{out}$

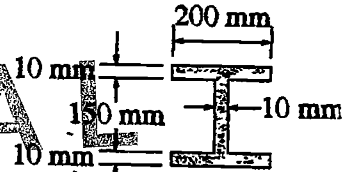
$T_{in} + T_{out} = T$



PROB-2-(30)

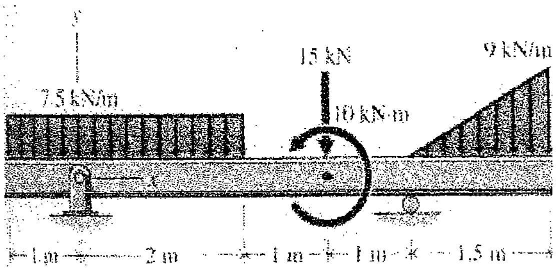
For the beam and cross-section shown below, for the moment value at midpoint between the supports, calculate the maximum compressive and tensile stresses.

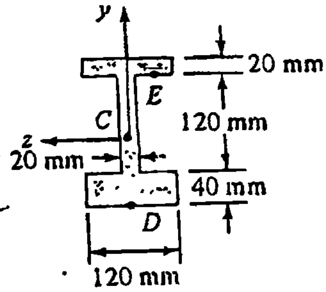




PROB-3-(40)

For the beam and cross-section shown below, for the moment value at midpoint between the supports, calculate the stresses at points D and E of the cross section.

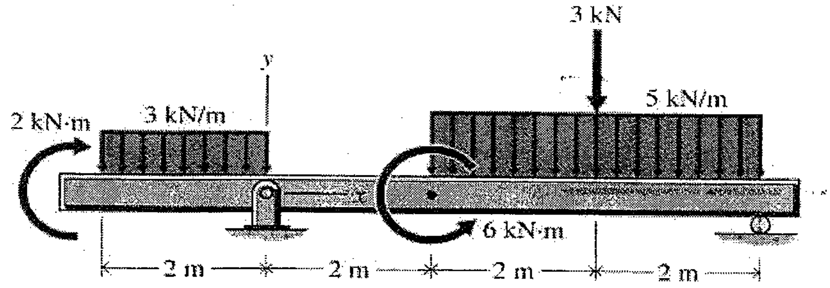




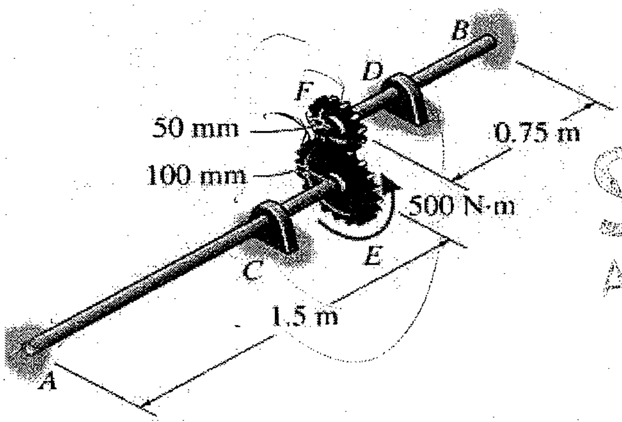
CIE202 Mechanics of Materials/SP08 **TEST#2** **NAME**____________________

PROB-1-(30)

Draw the moment and shear diagrams for the beam shown below.



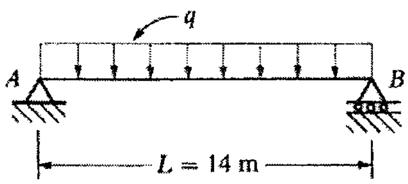
PROB-2(30)

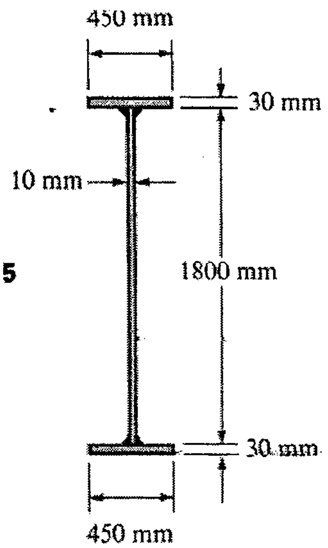


The two shafts are made of steel (G = 80 G Pa). Each has a diameter of 25 mm and they are connected using the gears fixed to their ends. Their other ends are attached to fixed supports at *A* and *B*. They are also supported by journal bearings at C and *D*, which allow free rotation of the shafts along their axes. If a torque of 500 N-m is applied to the gear at *E* as shown, determine the reactions at *A* and *B*.

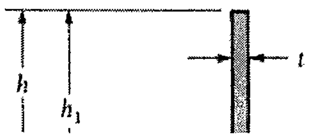
PROB-3-(40)

A simple beam *AB* with span length L = 14 m supports a uniform load *q* that includes the weight of the beam. The beam is constructed of three plates welded together to form the cross section shown. Determine the maximum permissible load *q* based upon bending and shear if the allowable stresses are σ_{all} = 110 MPa and τ_{all} = 70 MPa.





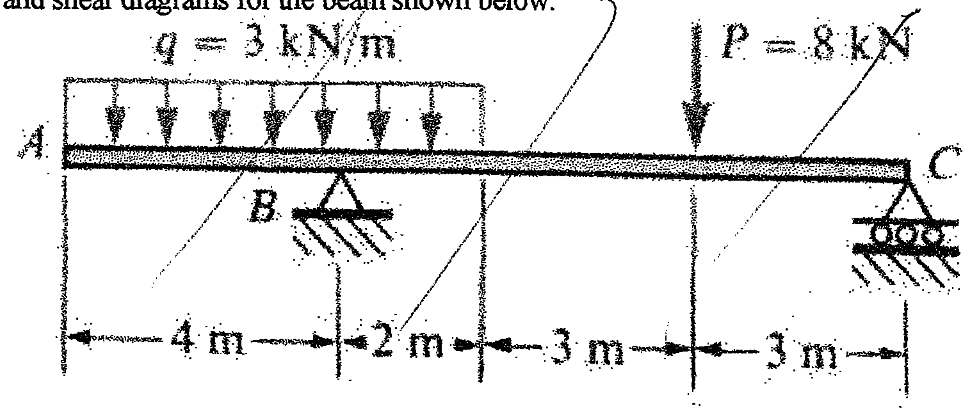
Prob. 5.6-5



CIE202 Mechanics of Materials/SP09 **TEST#2** **NAME**________________

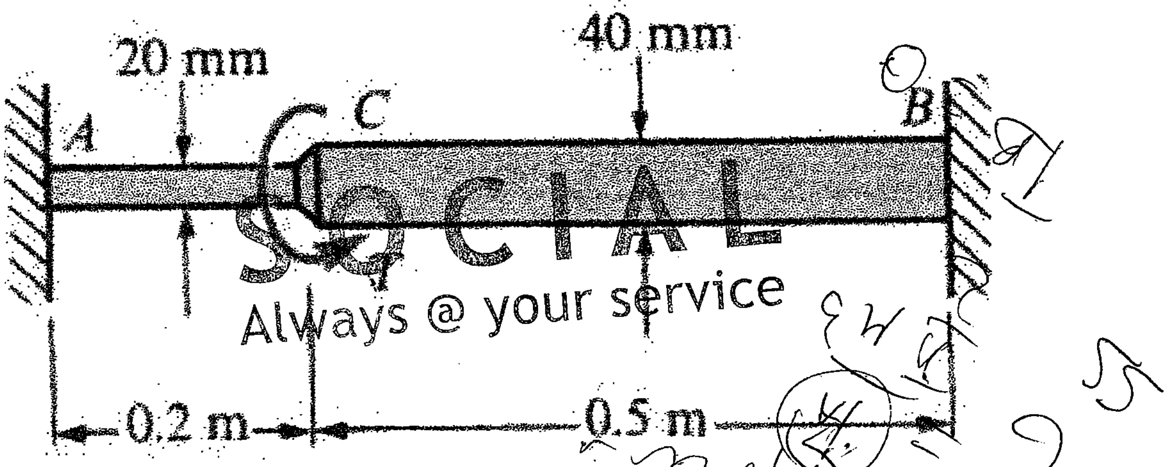
PROB-1-(30)

Draw the moment and shear diagrams for the beam shown below.



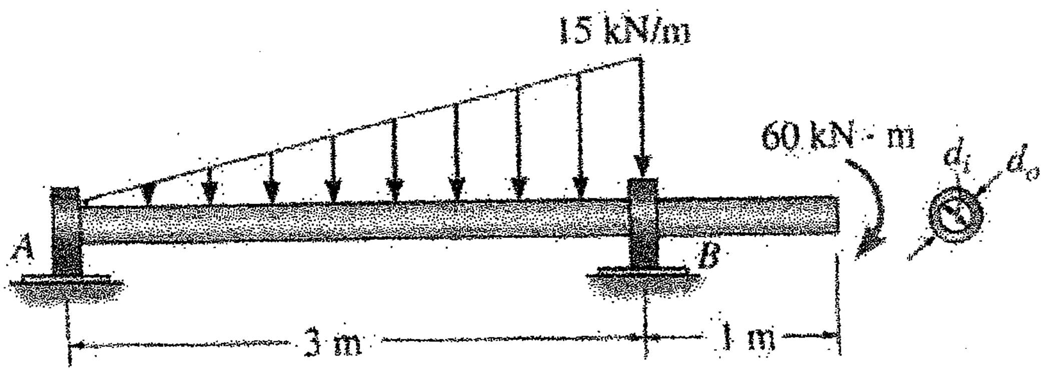
PROB-2(35)

The stepped shaft shown is made of solid circular cross section (see figure) and is held against rotation at the ends. If the allowable stress in shear is 55 M Pa, what is the allowable torque *T* that may be applied to the shaft at C?



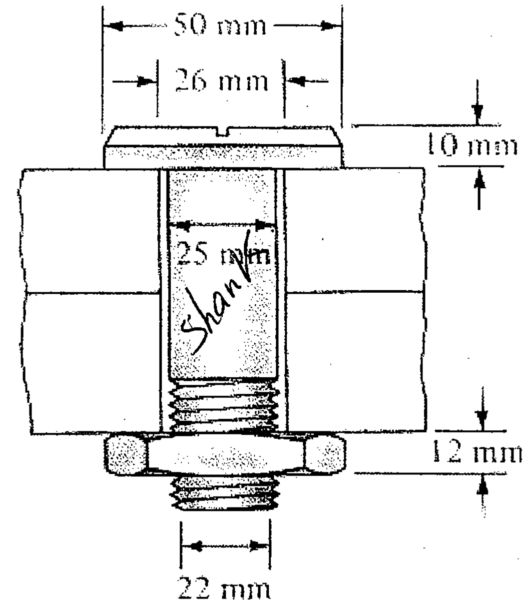
PROB-3-(35)

The tubular shaft is to have a cross section such that its inner diameter and outer diameter are related by $d_i = 0.8\, d_o$. Support at A is considered as a pin and at B as a roller. Determine these required dimensions if the allowable bending stress is $\sigma_{all} = 155$ M Pa.



CIE202/SP10 Mechanics Of Materials **TEST#1** **NAME** [redacted]

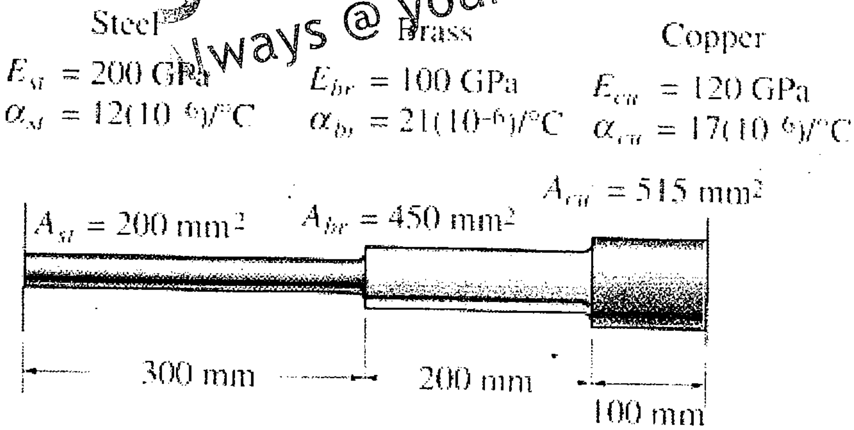
PROB-1 (35)



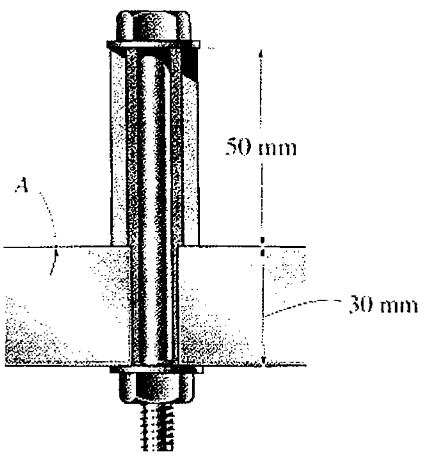
Two plates are fastened by a bolt as shown in the Figure. The nut is tightened to cause a tensile load in the shank (unthreaded part) of the bolt of 60 kN. Determine *(a)* the shearing stress in the threads; *(b)* the shearing stress in the head of the bolt; *(c)* the bearing stress between the head of the bolt and the plate; and *(d)* the normal stress in the bolt shank.

PROB-2-(30)

Three bars each made of different materials are connected together and placed between two walls when the temperature is $T_1 = 12°C$. Determine the force exerted on the (rigid) supports when the temperature becomes $T_2 = 18°C$. The material properties and cross-sectional area of each bar are given in the Figure below.



PROB-3-(35)

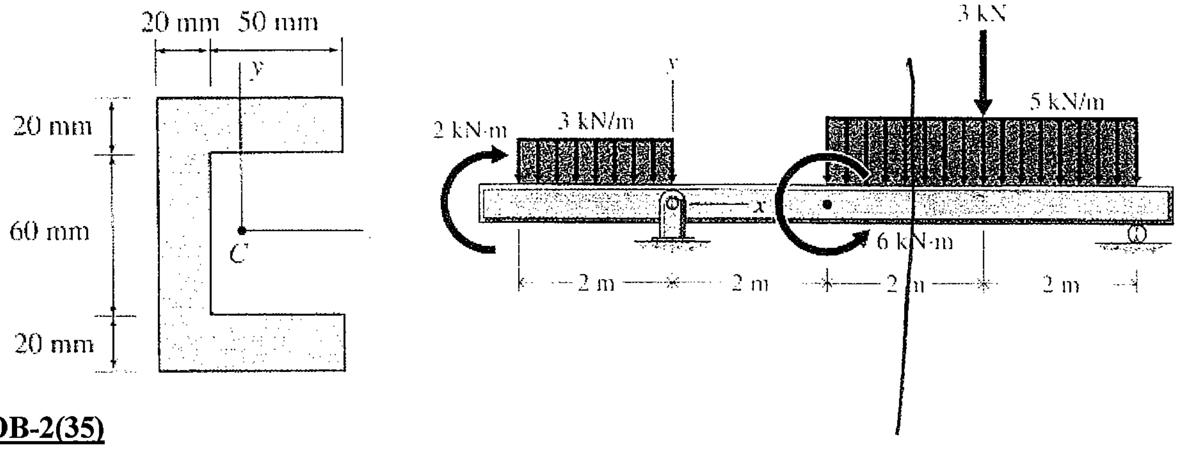


The 8-mm-diameter bolt is made of an aluminum alloy. It fits through a magnesium sleeve that has an inner diameter of 12 mm and an outer diameter of 20 mm. If the original lengths of the bolt and sleeve are 80 mm and 50 mm, respectively, determine the strains in the sleeve and the bolt if the nut on the bolt is tightened so that the tension in the bolt is 8 kN. Assume the material at A is rigid. $E_{al} = 70$ GPa, $E_{mg} = 45$ GPa.

CIE202 Mechanics of Materials/SP11 **TEST#2** **NAME**____________________

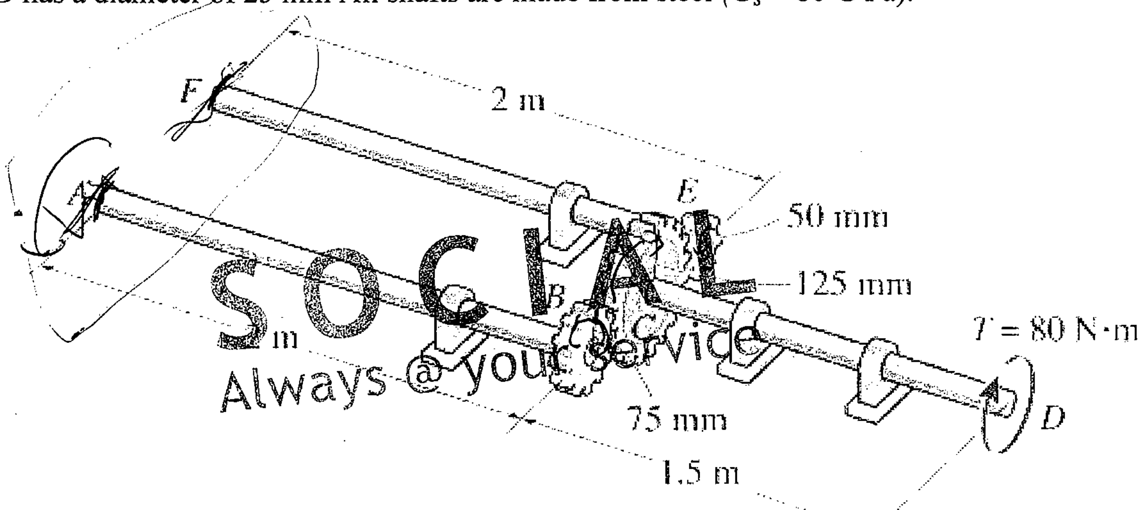
PROB-1-(40)

For the beam shown below determine the force acting on the top flange (70x20 mm) based on the value of the bending moment at mid span between the supports, The cross-section of the beam is shown to the right.



PROB-2(35)

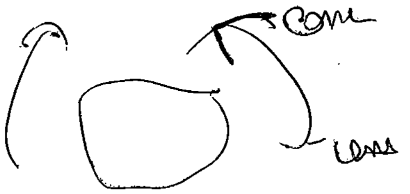
The two shafts *AB* and *EF* are fixed at their ends and fixed connected to gears that are in mesh with a common gear at C, which is fixed connected to shaft *CD*. If a torque of $T = 80$ N. m is applied to end *D*, determine a) the torque at *A* and *F* and .b) the angle of twist of end *D*. Shaft AB has a diameter of 20 mm. Shaft FE has a diameter of 30 mm. Shaft CD has a diameter of 25 mm All shafts are made from steel ($G_s = 80$ G Pa).

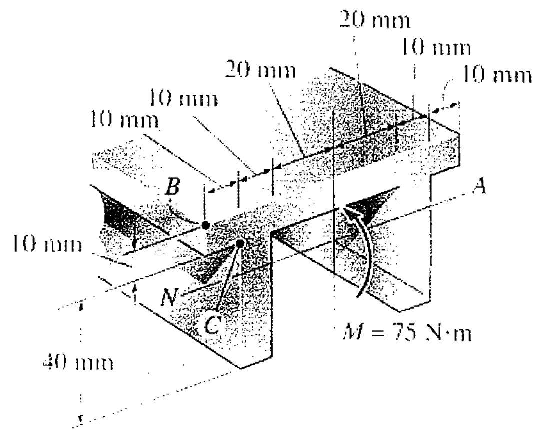


Probs. 5–81/82

PROB-3-(25)

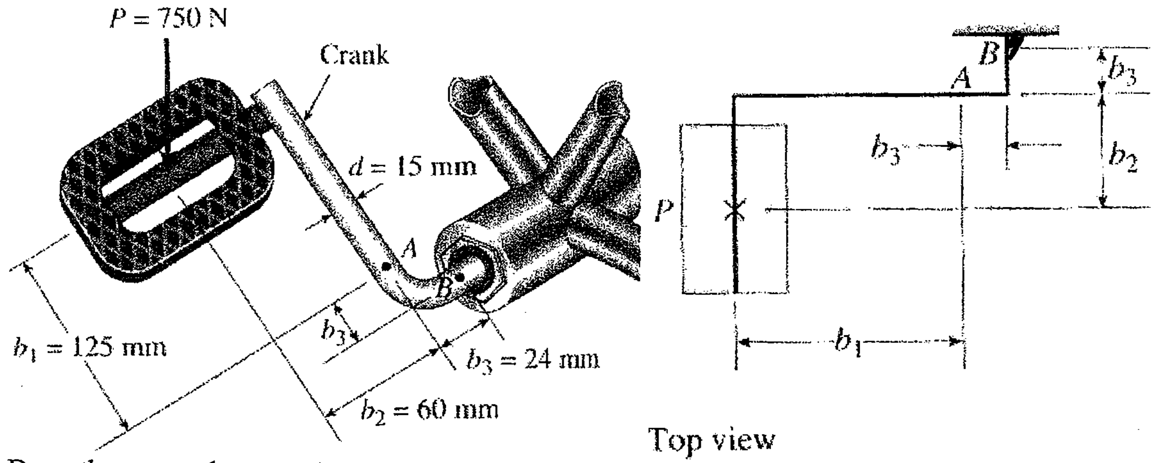
The aluminum machine part is subjected to a moment of $M = 75$ N-m. Determine : a) the maximum tensile, b) the maximum compressive stress, and c) the stress at point C of the part.





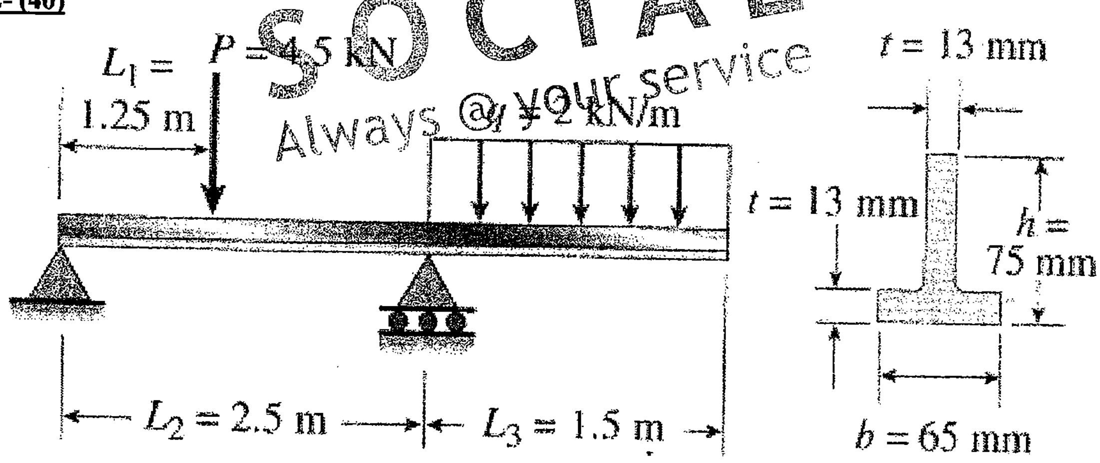
CIE202Mechanis of Materials /SP11 **Test #3** **NAME**________________

PROB-1-(35)



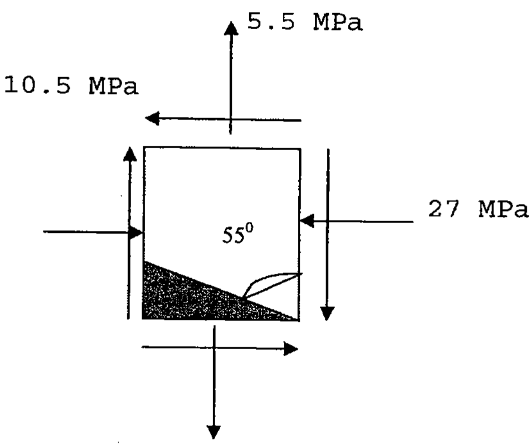
Draw the stress elements showing stresses at points A and B on the bicycle pedal crank shown in the figure. The pedal and crank are in a horizontal plane and points A and B are located on the top of the crank. The load $P = 750$ N acts in the vertical direction and the distances (in the horizontal plane) between the line of action of the load and points A and $B$are $b_1 = 125$ mm, $b_2 = 60$ mm and $b_3 = 24$ mm. Assume that the crank has a solid circular cross section with diameter $d = 15$ mm.

PROB-2- (40)



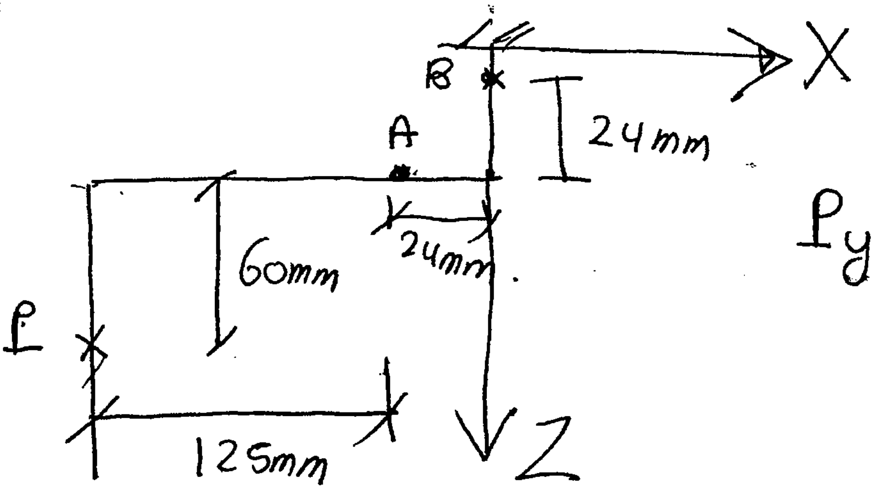
For the beam and cross section shown, determine the maximum tensile, compressive, and shearing stresses.

PROB-3-(25)



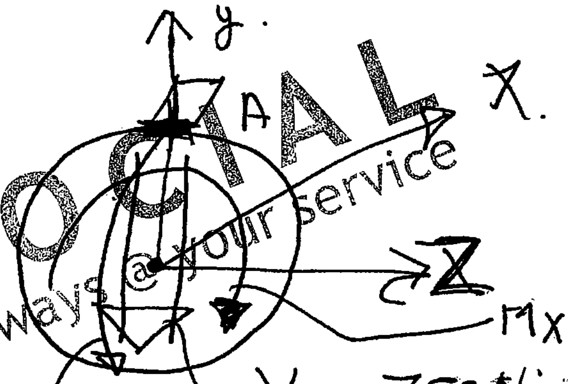
For the stress state shown to the left, determine: a) the normal and shearing stresses for the shaded area using the method of equilibrium; b) Draw the stress elements showing the principal stresses and maximum shearing stress.

1) $D = 15\,mm \Rightarrow R = 7.5\,mm$



$P_y = (-750\vec{j})\,N$

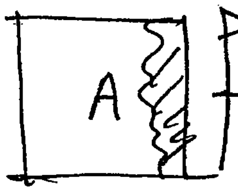
POINT A



$M_x = T = (750)(60) = 45{,}000\ N\text{-}mm$

$V_y = 750\,N$

$M_z = (750)(125) = 93{,}750\ N\text{-}mm$

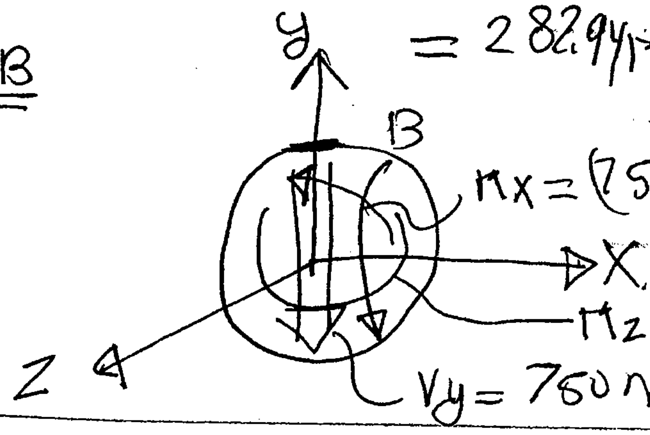


$\tau = \frac{TR}{J} = \frac{2T}{\pi R^3} = \frac{2(45{,}000)}{\pi (7.5)^3} = 67.91\ MPa$

$\sigma = \frac{M_z R}{\frac{\pi}{4} R^3} = \frac{4 M_z}{\pi R^3} = \frac{4(93{,}750)}{\pi (7.5)^3}$

$= 282.94\ MPa$

POINT B

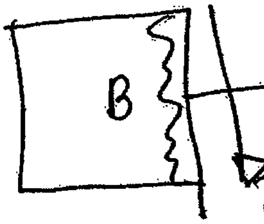


$M_x = (750)(60+24) = 63{,}000\ N\text{-}mm$

$M_z = (750)(125+24) = 111{,}750\ N\text{-}mm$

$V_y = 750\,N$

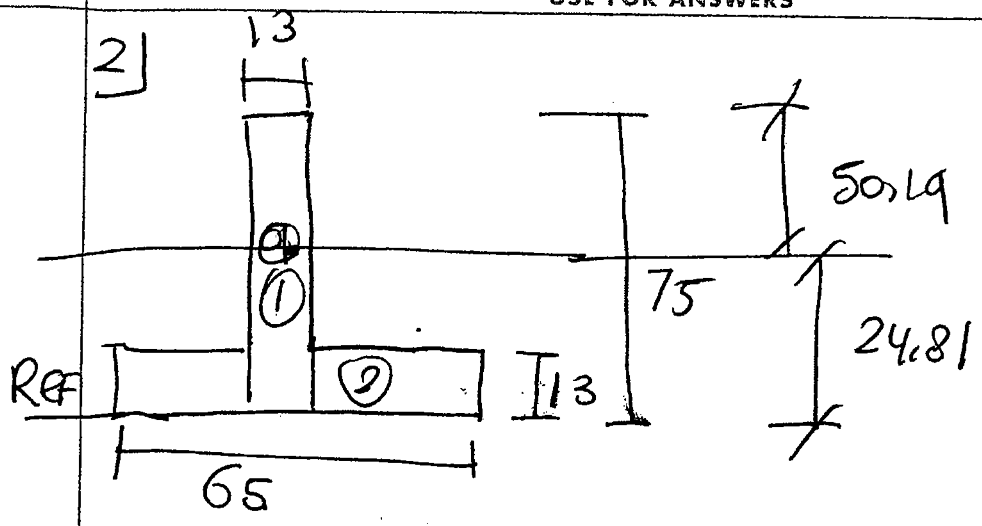
3/12



$$\sigma = \frac{M_x R}{\frac{\pi}{4} R^4} = \frac{4 M_x}{\pi R^3} = \frac{4(63{,}000)}{\pi (7.5)^3} = 190.14\ \text{MPa}$$

$$\tau = \frac{M_z R}{\frac{\pi}{2} R^4} = \frac{2 M_z}{\pi R^3} = \frac{2(11{,}750)}{\pi (7.5)^3} = 168.63\ \text{MPa}$$

2]



$$\bar{y} = \frac{(75)(13)(75/2) + (13)(65-13)(13/2)}{(75)(13) + (13)(65-13)} = 24.81\,mm.$$

$y_{TOP} = 75 - 24.81 = 50.19\,mm$, $y_{BOT} = 24.81\,mm$

$$I = \frac{1}{12}(13)(75)^3 + (13)(75)\left(\frac{75}{2} - 24.81\right)^2$$

$$+ \frac{1}{12}(65-13)(13)^3 + (65-13)(13)(13/2 - 24.81)^2$$

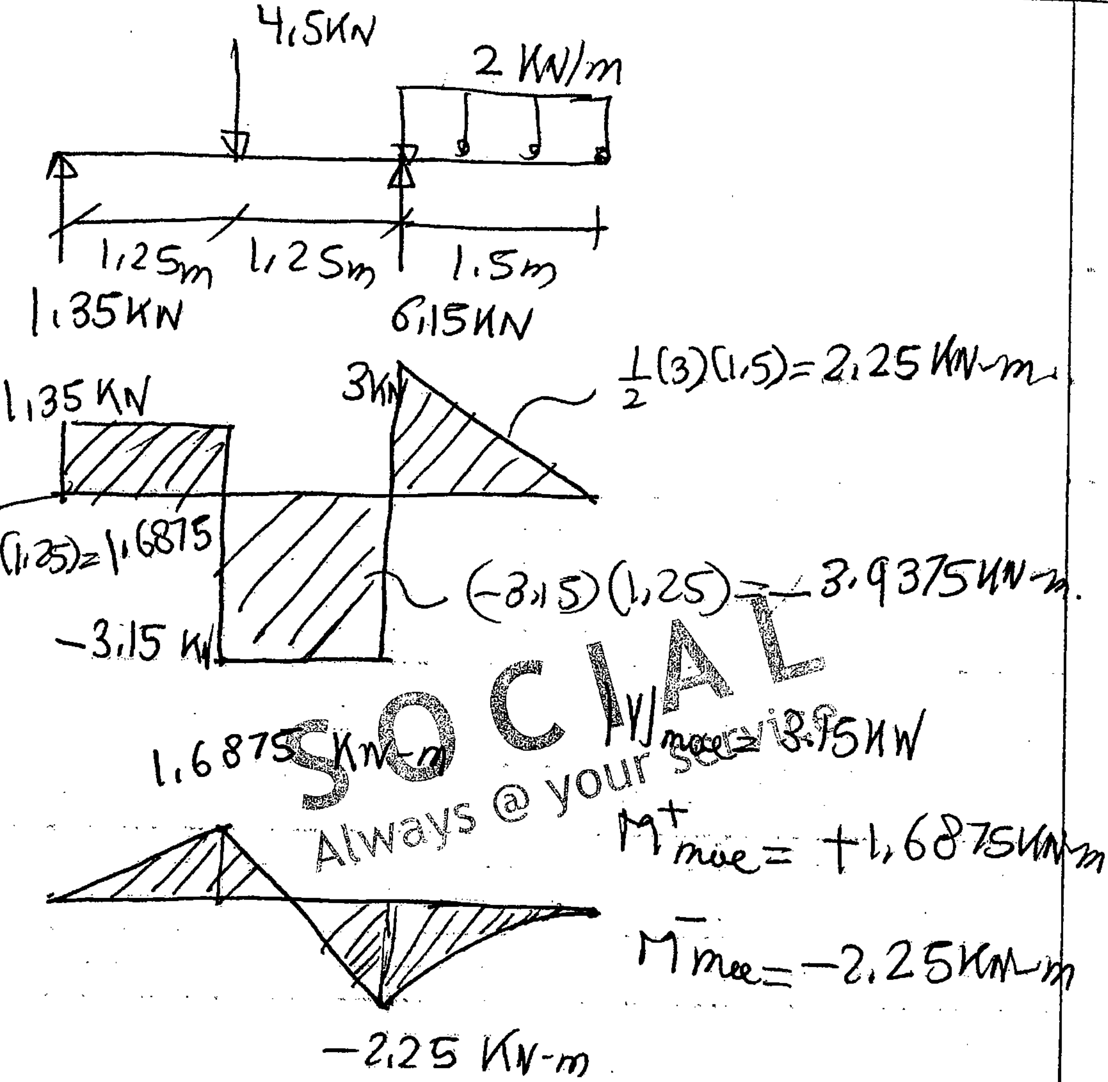
$$= 850{,}194.90\ mm^4$$

$t_m = 13\,mm$

$$Q_m = (50.19)(13)\left(\frac{50.19}{2}\right) = 16{,}373.73\,mm^3$$

$$R_R = \{(4.5)(1.25) + (2)(1.5)[2.5 + (1.5/2)]\}/2.5 = 6.15\,kN$$

$$V_L = [(4.5)(1.25) - (2)(1.5)(1.5/2)]/2.5 = 1.35\,kN$$



$$\tau_m = \frac{|V|_{max} Q_m}{I\, t_m} = \frac{(3.15\times10^3)(16{,}373.73)}{(850{,}194.90)(13)} = \boxed{4.67\ MPa}$$

M^+

$$\sigma_{TOP} = -\frac{M\, y_{TOP}}{I} = -\frac{(1.6875\times10^6)(50.19)}{850{,}194.90} = \boxed{-99.62\ MPa} = \sigma^{COMP}_{MAX}$$

$$\sigma_{BOT} = -\frac{M\, y_{BOT}}{I} = -\frac{(1.6875\times10^6)(-24.81)}{850{,}194.90} = +49.24\ MPa$$

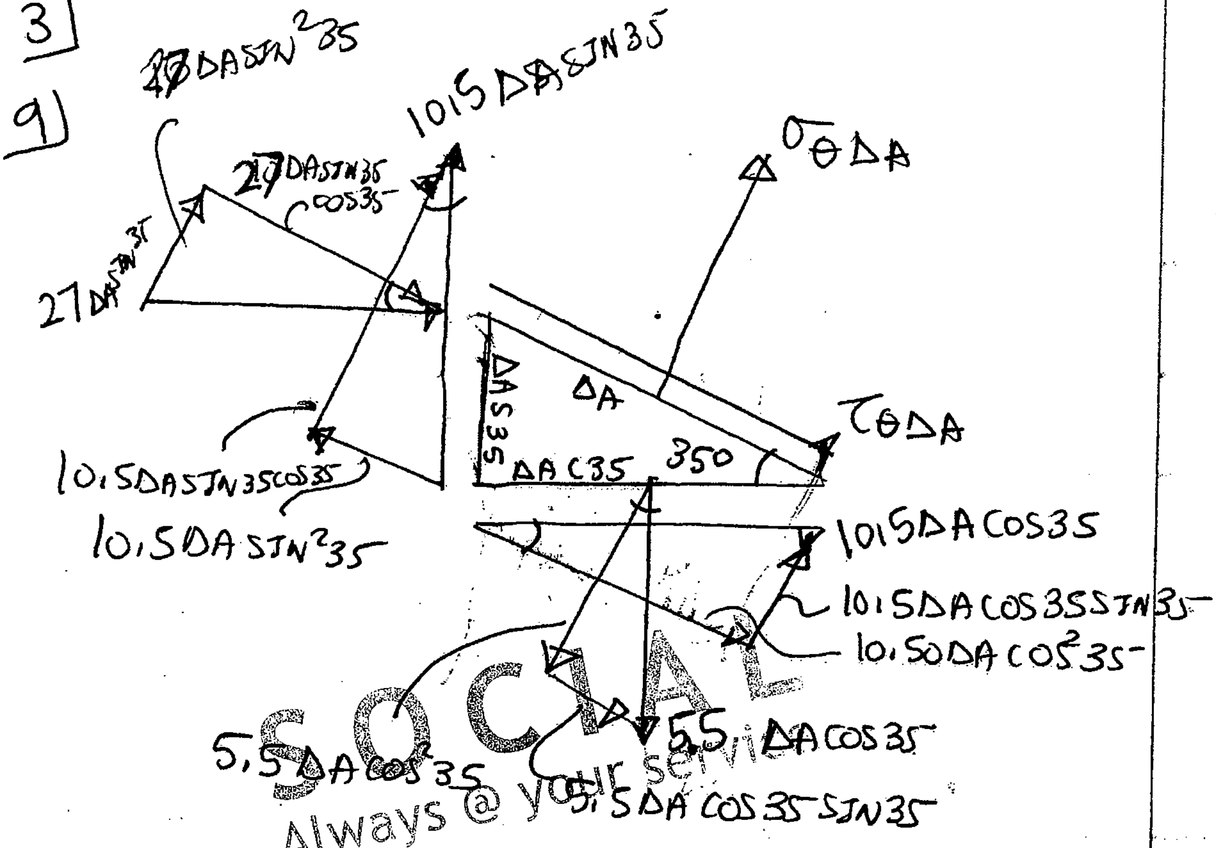
M^-

$$\sigma_{TOP} = -\frac{(-2.25\times10^6)(50.19)}{850{,}194.90} = \boxed{+132.83\ MPa} = \sigma^{MAX}_{TEN}$$

$$\sigma_{BOT} = -\frac{(-2.25\times10^6)(-24.81)}{850{,}194.90} = -65.66\ MPa$$

3)

9)



$$\Sigma F \nearrow = 0 = \sigma_\theta \Delta A + 10.5 \Delta A \sin 35 \cos 35 + 27 \Delta A \sin^2 35 + 10.5 \Delta A \sin 35 \cos 35 - 5.5 \Delta A \cos^2 35$$

$$\Rightarrow \sigma_\theta = -21 \sin 35 \cos 35 + 5.5 \cos^2 35 - 27 \sin^2 35$$

$$\boxed{\sigma_\theta = -15.06 \text{ MPa}}$$

$$\Sigma F \nwarrow = 0 = \tau_\theta \Delta A - 10.5 \Delta A \sin^2 35 + 27 \Delta A \sin 35 \cos 35 + 10.5 \Delta A \cos^2 35 + 5.5 \Delta A \cos 35 \sin 35$$

$$\Rightarrow \tau_\theta = 10.5 (\sin^2 35 - \cos^2 35) - 32.5 \cos 35 \sin 35$$

$$\Rightarrow \boxed{\tau_\theta = -18.86 \text{ MPa}}$$

b) $\sigma_x = -27\,MPa$, $\sigma_y = +5.5\,MPa$, $\tau_{xy} = -10.5\,MPa$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\tau_{max} = \sqrt{\left(\frac{-27-5.5}{2}\right)^2 + (-10.5)^2} = 19.35\,MPa$$

$$\sigma_{ave} = \frac{\sigma_x + \sigma_y}{2} = \frac{-27+5.5}{2} = -10.75\,MPa$$

$$\sigma_{max,min} = \sigma_{ave} \pm \tau_{max}$$

$$= -10.75 \pm 19.35$$

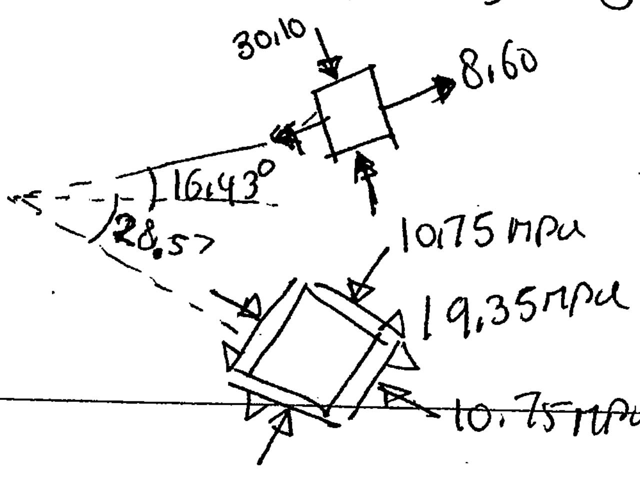
$$= 8.60, -30.10\,MPa$$

$$\theta_p = \frac{1}{2}\left(\tan^{-1}\left[\frac{2\tau_{xy}}{\sigma_x - \sigma_y}\right]\right)$$

$$= \frac{1}{2}\left\{\tan^{-1}\left[\frac{2(-10.50)}{-27-5.5}\right]\right\} = 16.43^\circ$$

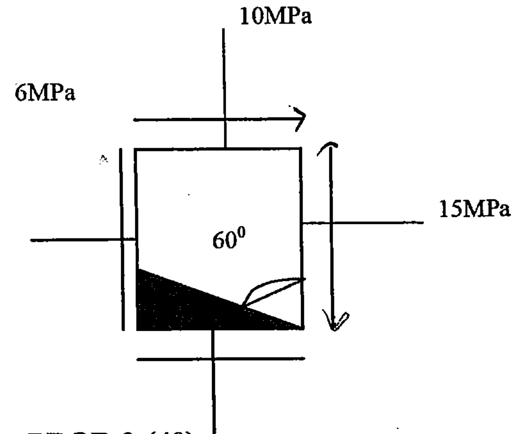
$$\theta_s = \frac{1}{2}\left\{\tan^{-1}\left[\frac{\sigma_x - \sigma_y}{-2\tau_{xy}}\right]\right\}$$

$$= \frac{1}{2}\left\{\tan^{-1}\left[\frac{-27-5.5}{-2(-10.50)}\right]\right\} = -28.57^\circ$$



CIE202 Mechanics of Materials/SP09 **Test#3** **NAME:** ____________________

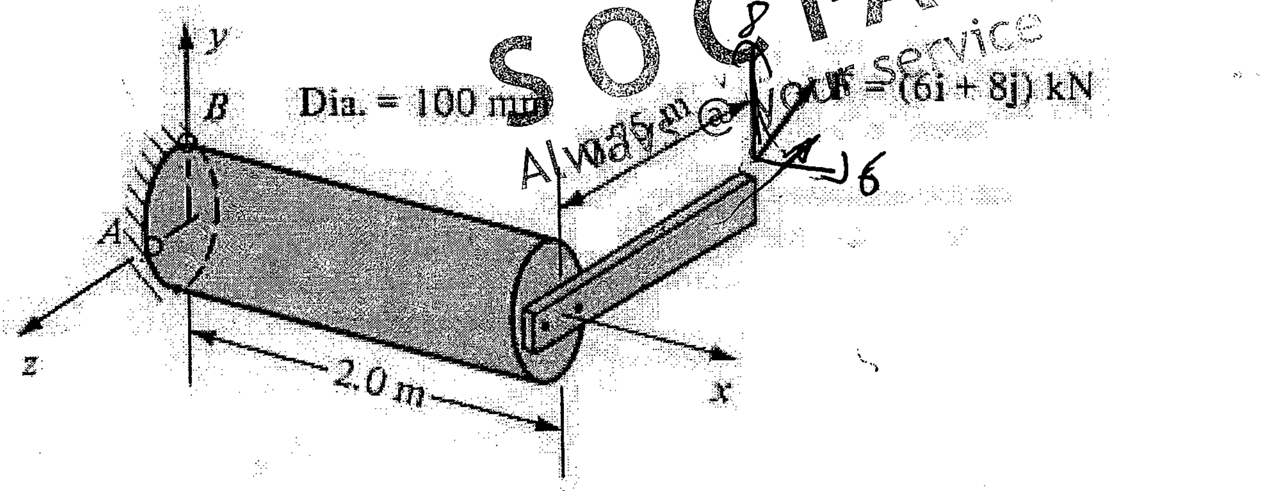
PROB-1-(25)



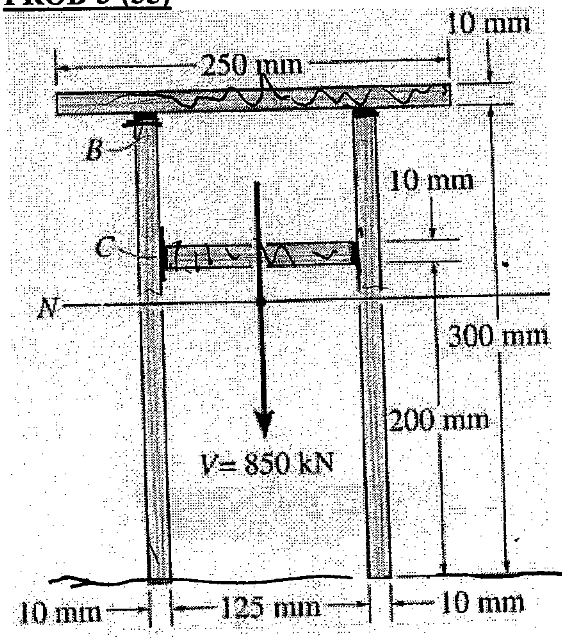
For the stress state shown to the right: a) Determine the normal and shearing stresses for the shaded area using the method of equilibrium; b) Determine the principal stresses and the maximum shearing stress.

PROB-2-(40)

A circular hollow shaft 100 mm in outer diameter and wall thickness of 10 mm is fixed at one end and loaded as shown below Compute the state of stress at points *A* and *B* located at the fixed end. Present your analysis and the state of stress acting on an element.



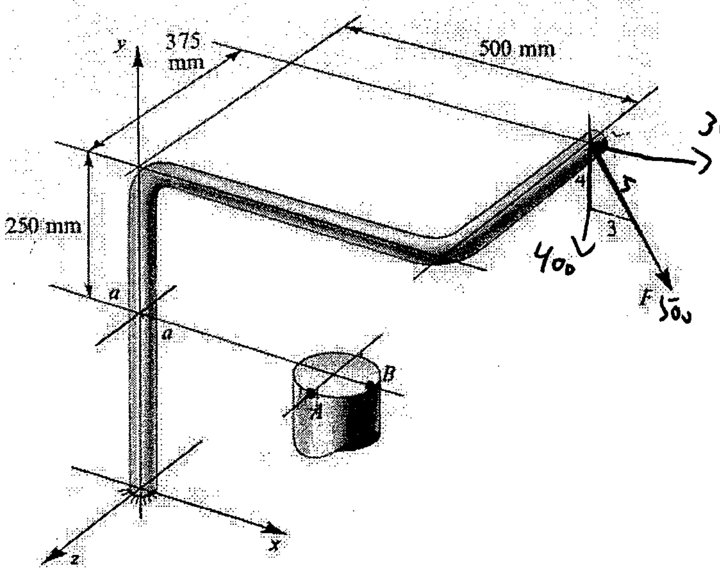
PROB-3-(35)



The beam is constructed from four boards glued together as shown to the left. If it is subjected to a shear of $V = 850$ kN, determine a) the shear flow at B and C that must be resisted by the glue; b) the maximum shearing stress in the composite section.

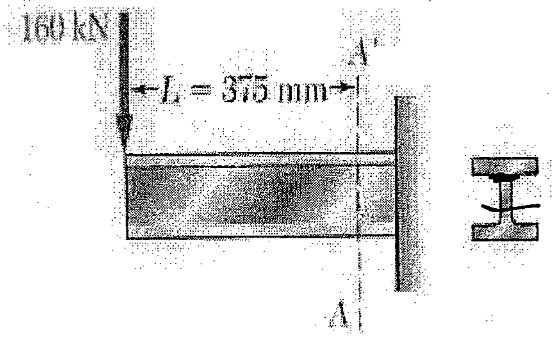
CIE202Mechanis of Materials /SP08 **Test #3** **NAME**____________________

PROB-1-(35)



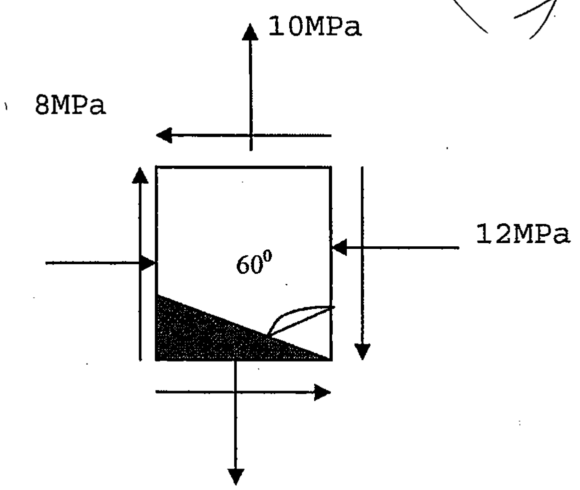
A 30 mm diameter rod is subjected at its free end to an inclined force F = 500 N as in the figure. (The force F in plan view acts in the direction of the x axis and has an x and y component.) Determine the magnitude and directions of the stresses due to F on the elements A and B at section *a-a.* Show the results on elements clearly related to the points on the rod.

PROB-2- (30)



A 160-kN force is applied as shown at the end of a W200 X 52 rolled-steel beam. Determine whether the normal stresses in the beam satisfy a design specification that they should be equal to or less than 155 MPa at section *A-A by* looking at *(a)* the maximum value of the normal stress in the beam, and *(b)* the maximum value of the principal stress at the junction of the flange and the web.

PROB-3-(30)

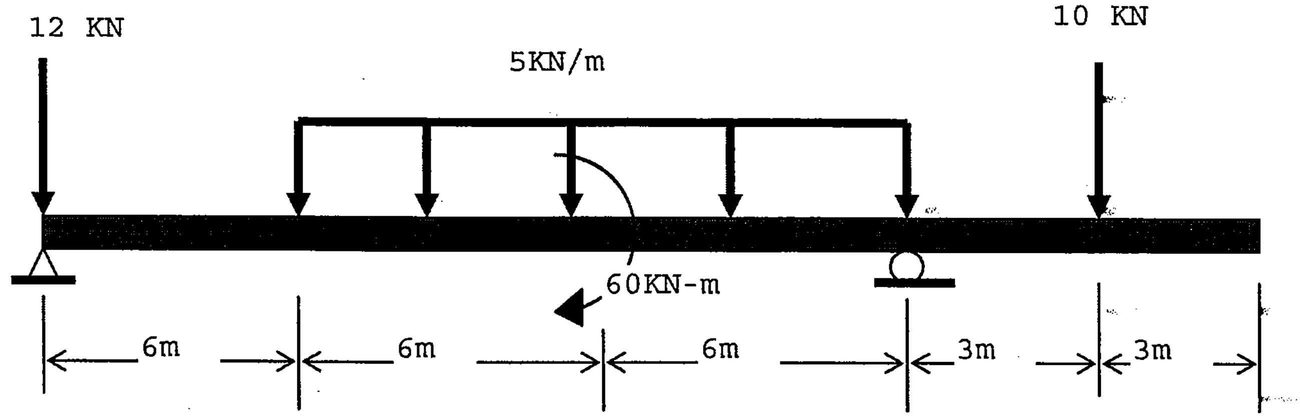


For the stress state shown to the left, determine: a) the normal and shearing stresses for the shaded area using the method of equilibrium; b) The principal stresses and maximum shearing stress.

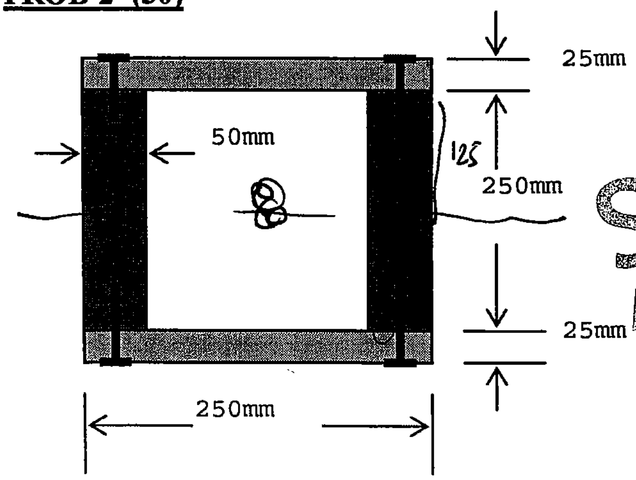
E202Mechanis of Materials /SP07 **Test #3** **NAME**__________________

PROB-1-(40)

Draw the moment and shear diagrams for the beam shown below.

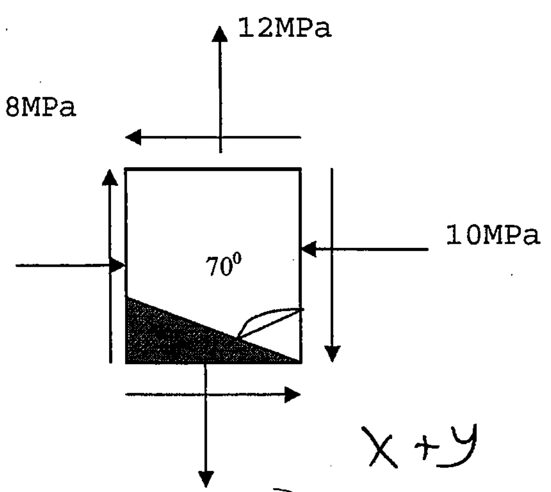


PROB-2- (30)



A wood beam is constructed of two members 50 mm X 250mm in a cross section that are attached by two 25mm X 250mm boards as shown in figure. The boards are nailed to the beams at a longitudinal spacing of 100 mm. The allowable force per nail is 1300 N. a) Determine the maximum vertical shear force that could be handle by the section. b) Determine the maximum shearing stress if the vertical shear force is 12 KN.

PROB-3-(30)



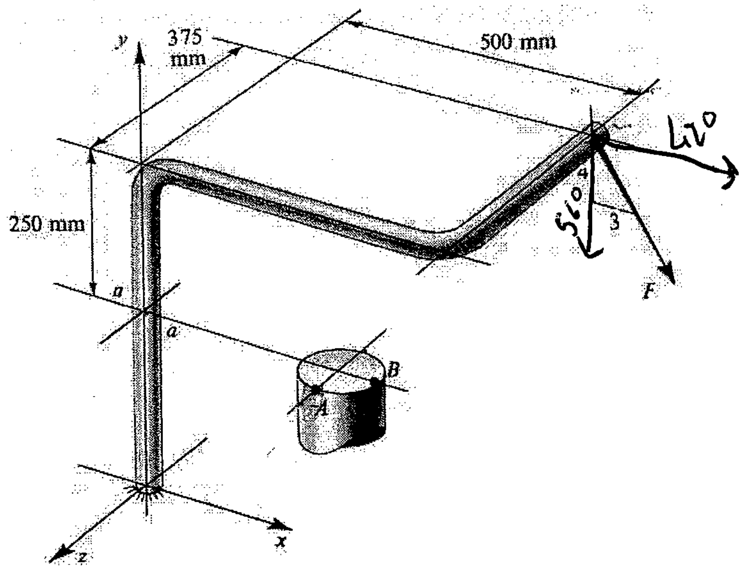
For the stress state shown to the left, determine: a) the normal and shearing stresses for the shaded area using the method of equilibrium; b) The principal stresses and maximum shearing stress.

X + y

−10 + 12 = 2/2 = 1.

CIE202 Mechanics of Materials/SP06 **TEST # 3** **NAME**________________

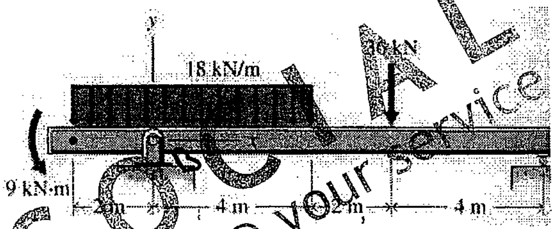
PROB-1-(35)



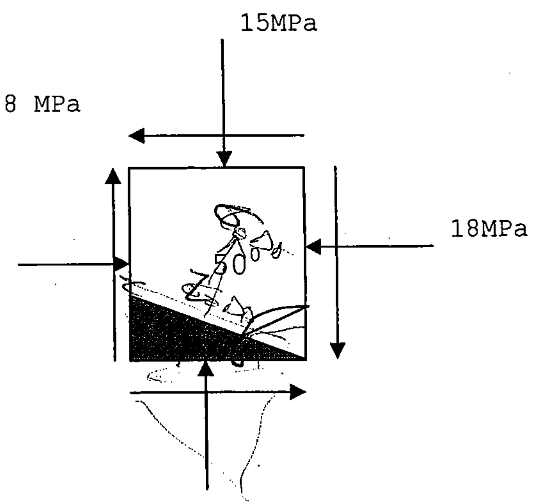
A 50 mm diameter rod is subjected at its free end to an inclined force F = ~~700 N as in the figure.~~ (The force F in plan view acts in the direction of the x axis and has an x and y component.) ~~Determine the magnitude~~ and directions of the stresses due to F on the elements A and B at section a-a. Show the results on elements clearly related to the points on the rod.

PROB-2-(35)

For the beam shown below, draw the moment and shear diagrams.



PROB-3-(30)

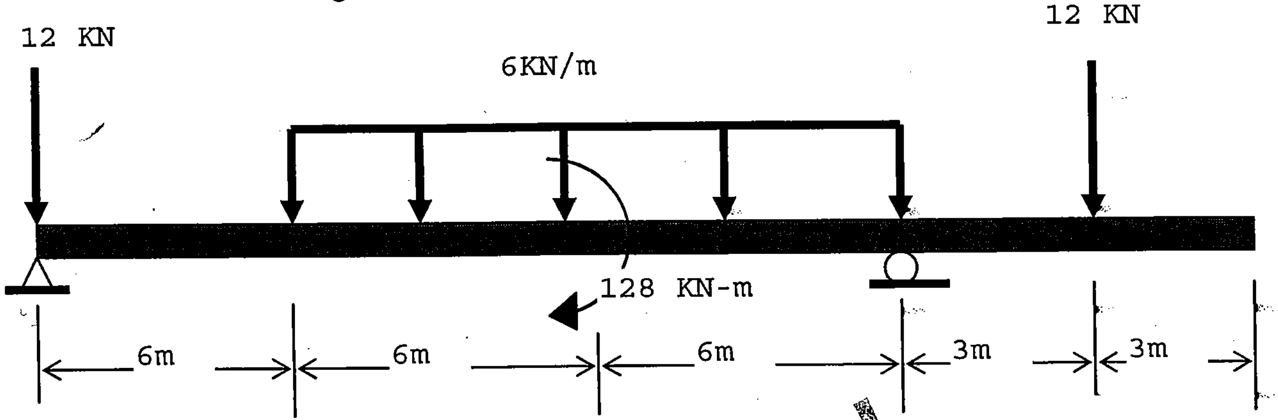


For the stress state shown to the left, determine: a) the normal and shearing stresses for the shaded area using the method of equilibrium; b) The principal stresses and maximum shearing stress.

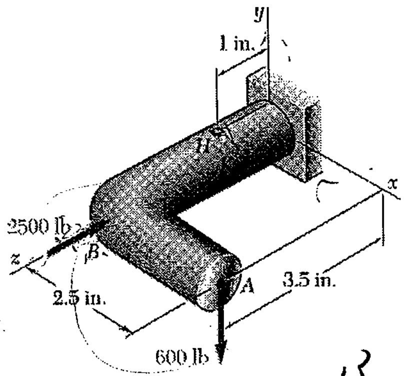
E202 Mechanis of Materials /SP05 **Test #3** **NAME____________________**

PROB-1-(35)

Draw the moment and shear diagrams for the beam shown below.

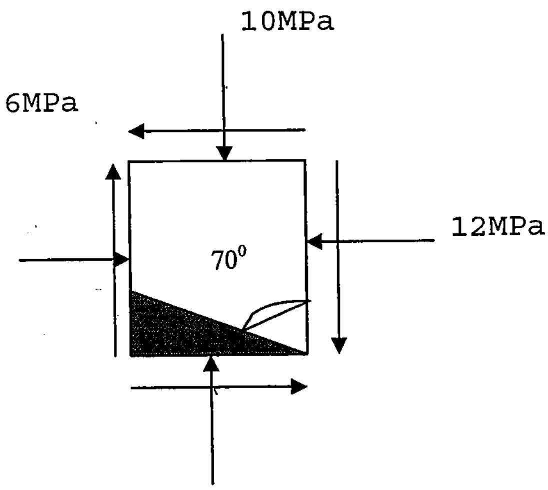


PROB-2- (35)



Forces are applied at points *A* and *B* of the solid cast-iron bracket shown. Knowing that the bracket has a diameter of 0.8 in., Determine and draw the stress element at point *H*.

PROB-3-(30)

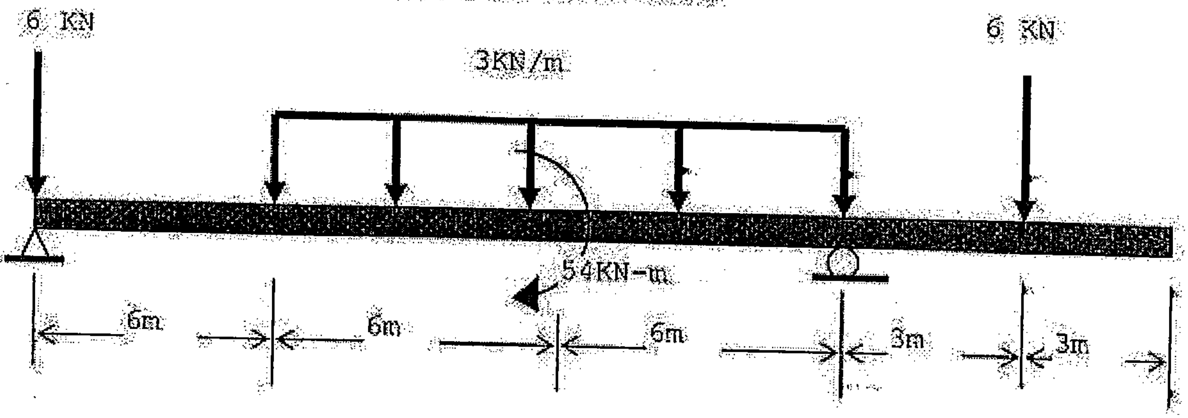


For the stress state shown to the left, determine: a) the normal and shearing stresses for the shaded area using the method of equilibrium; b) The principal stresses and maximum shearing stress.

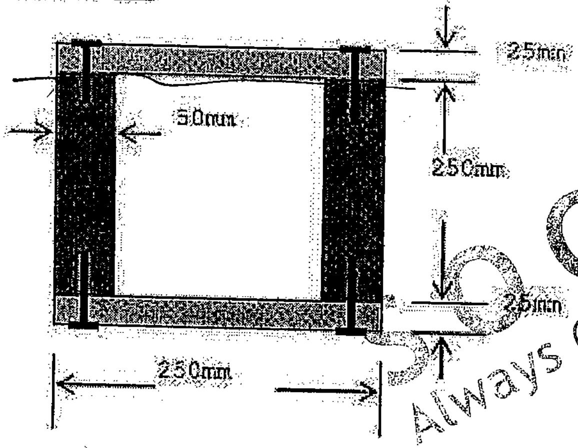
CIE301Mechanis of Materials /SP04 Test #3 NAME [illegible]

PROB-1-(40)

Draw the moment and shear diagrams for the beam shown below.



PROB-2- (30)

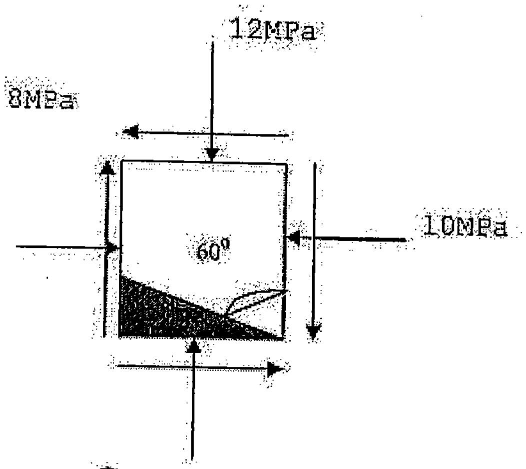


A wood beam is constructed of two members 50 mm X 250mm in a cross section that are attached by two 25mm X 250mm boards as shown in figure. The boards are nailed to the beams at a longitudinal spacing of 100 mm. The allowable force per nail is 1300 N. a) Determine the maximum vertical shear force that could be handle by the section. b) Determine the maximum shearing stress if the vertical shear force is 10 KN.

a) $V = 11.10$ KN

b) $\tau_m = 0.45$ MPa

PROB-3-(30)



For the stress state shown to the left, determine: a) the normal and shearing stresses for the shaded area using the method of equilibrium; b) The principal stresses and maximum shearing stress.

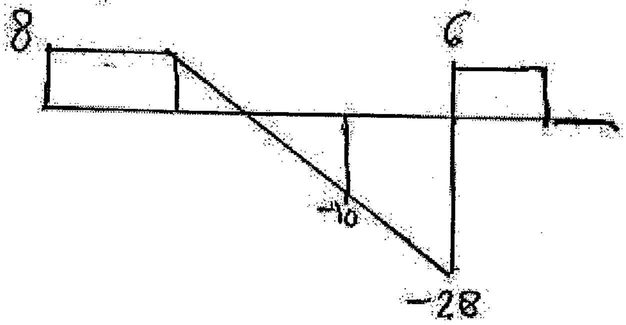
a) $\tau_\theta = 3.13$ MPa

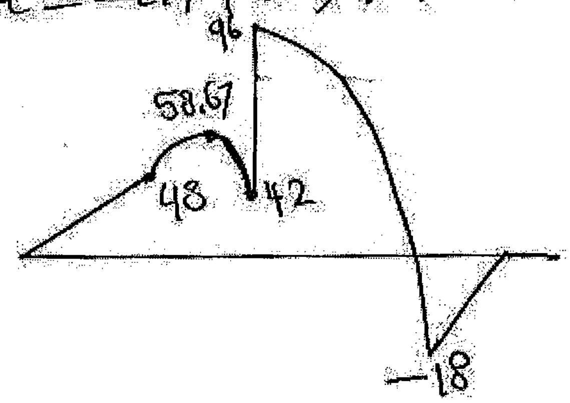
$\sigma_\theta = 18.43$ MPa

b) $\tau_{max} = 8.06$ MPa

$\sigma_{max} = -2.94$ MPa, $\sigma_{min} = -19.06$ MPa

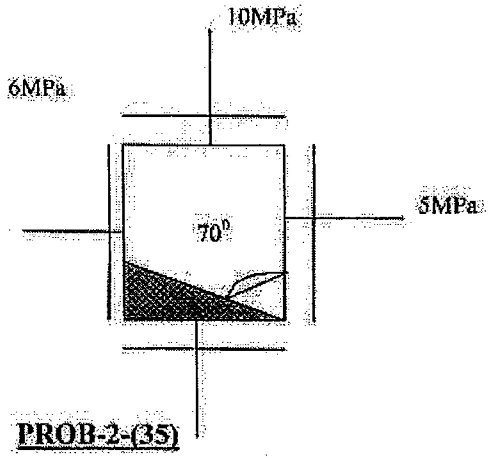
1)





CIE301 Mechanics of Materials/SP03 Test#3 NAME: ____________________

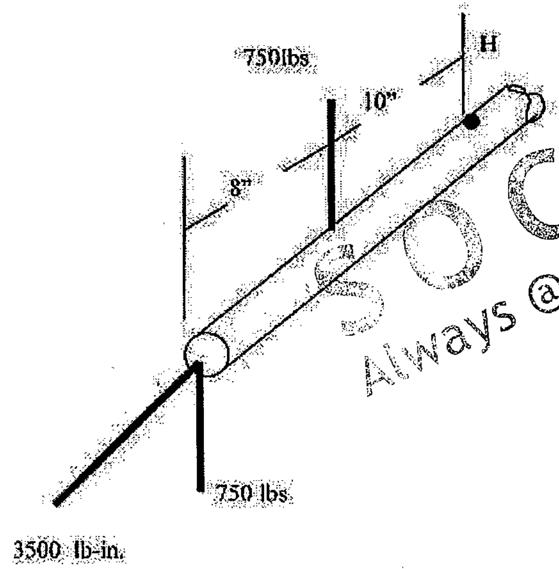
PROB-1-(25)



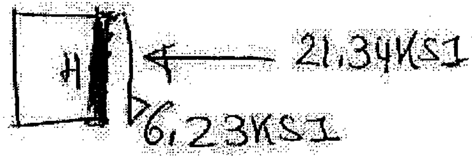
For the stress state shown to the right: a) Determine the normal and shearing stresses for the shaded area using the method of equilibrium; b) Determine the principal stresses and the maximum shearing stress.

$\tau_\theta = -9.42$ MPa
$\sigma_\theta = 4.89$ MPa
$\tau_{max} = 9.60$ MPa
$\sigma_{max,min} = 12.10; -7.10$ MPa

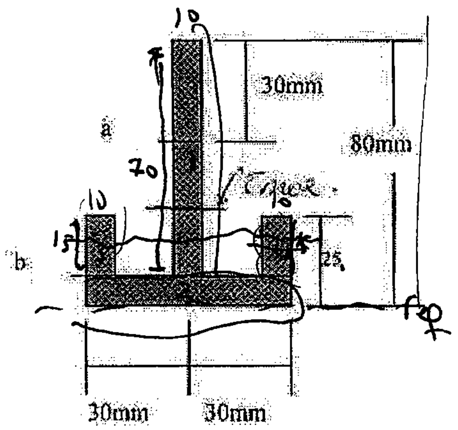
PROB-2-(35)



The axle of a small truck is acted upon by the forces and couple shown. Knowing that the diameter of the axle is 1.42 inches, determine the stress state at point H located on the top of the axle.



PROB-3-(40)



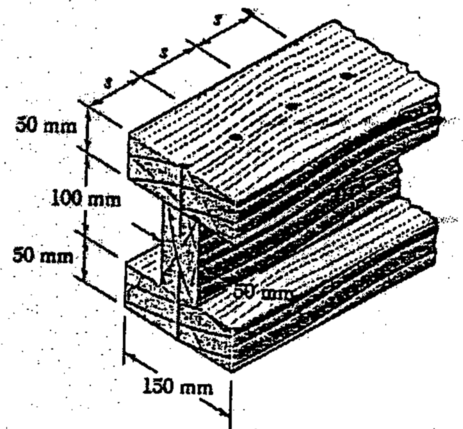
The cross section of the beam shown to the right is 10 mm thick and is acted upon by a shear force of 20 KN. Determine: a) The shearing stress at point a; b) The shearing stress at point b; and c) The maximum shearing stress in the beam.

$\tau_a = 28.91$ MPa
$\tau_b = 9.53$ MPa
$\tau_{max} = 12.17$ MPa
$\tau_{max} = 36.51$ MPa ← CONTROLS

CIE301 Strength of Materials/SP02 TEST # 3 NAME Dr. ISSA

PROB-1-(30)

Three boards, each 50 mm thick, are nailed together to form a beam that is subjected to a 1200 n vertical shear. Knowing that the allowable shearing force in each nail is 300 N, determine the largest permissible spacing s between nails.



S = 40.74 mm

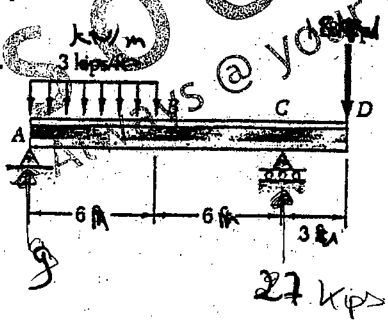
PROB-2-(35)

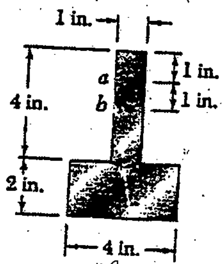
For the beam and loading shown, consider a section at point B of the beam and determine i) the shearing stress at point a, ii) the shearing stress at point b, iii) the maximum shearing stress.

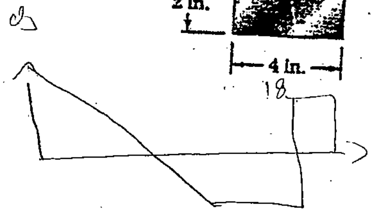
$\tau_a = 0.984$ ksi

$\tau_b = 1.6875$ ksi

$\tau_c = 2.25$ ksi

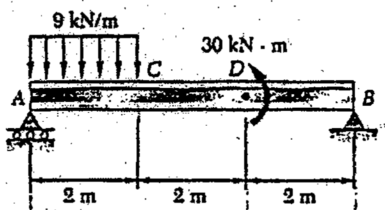


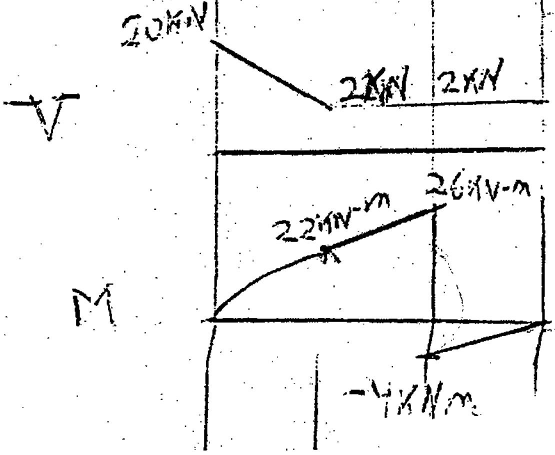




PROB-3-(35)

Draw the moment and shear diagrams for the beam shown below.

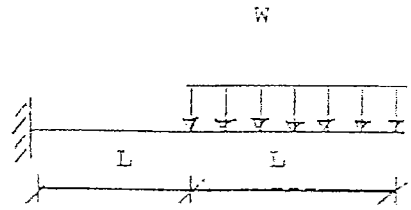




CIE301/SP97 FINAL EXAM NAME Dr. ISSA

PROB-1

For the beam and loading shown below, determine the equation of the deflection.



$0 \le X \le L$

$V = wl, \quad M = wLx - \frac{3}{2}wl^2$

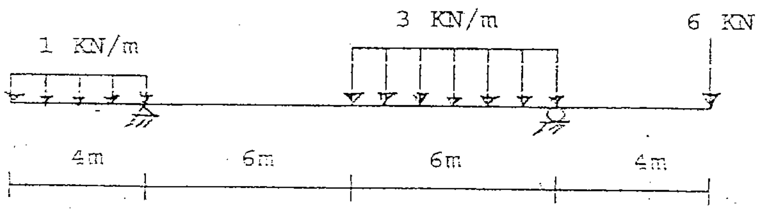
$y = \frac{1}{EI}\left(\frac{wLx^3}{6} - \frac{3wL^2x^2}{4}\right)$

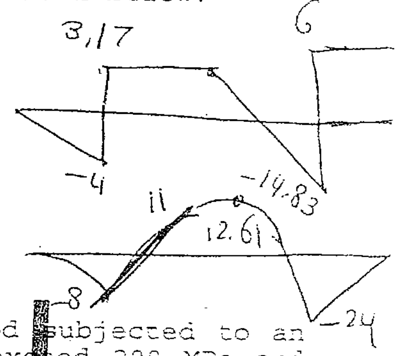
$L \le X \le 2L$

$y = \frac{1}{EI}\left[-wL^2x^2 - \frac{wx^4}{24} + \frac{wx^3L}{3} + \frac{wL^3x}{3} - \frac{wL^4}{24}\right]$

PROB-2

Draw the moment and shear diagrams for the beam shown below.





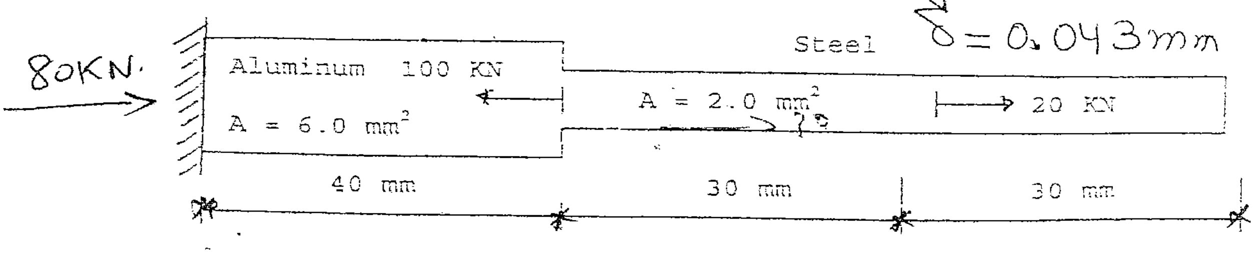
PROB-3 Chp. 1+2

Find the required cross sectional area of a rod subjected to an axial load of 35 KN, if the stress is not to exceed 200 MPa and the elongation is not exceed 0.10 mm. The rod is 1.5 m long and is made of steel (E = 30E06 MPa) A = 175 mm²

PROB-4

The bar shown below is made from aluminum (E = 10E06 MPa) and steel (E = 30E06 MPa) and is loaded with two axial loads. Determine the net movement of the free end.

$\delta = 0.043\,mm$



PROB-5

The cross section shown on next page is subjected to a constant shear of 750 N. Compute the required spacing of the nails along the beam, if the allowable shear force is 75 N/nail. Given I_c = 892 mm⁴.

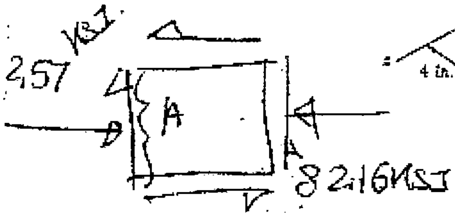
PROB-9

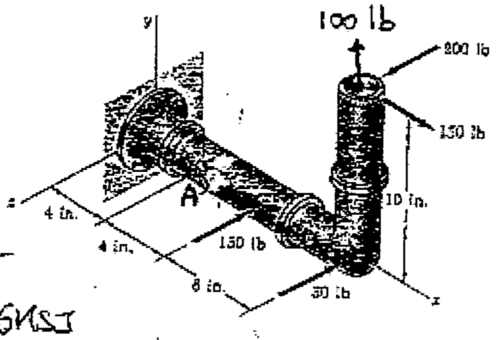
A 12 m long by 12.5 mm diameter steel rod is subjected to an axial tensile load of 25 KN. The total elongation is 0.07 mm. Calculate the: a) axial stress ; b) axial strain.

$\sigma = 203.72\ MPa$ $\epsilon = 0.583 \times 10^{-5}$

PROB-10

The solid shaft shown below is 0.5" in diameter and is acted upon by the forces as shown. Determine the stress state at point A and draw the stress element. Solve the problem by looking at point A from the left hand side.





EQUATIONS:

$\varepsilon = \delta/L$; $\sigma = P/A$; $\sigma = E\varepsilon$; $\delta = \Sigma\ (P_iL_i)/(A_iE_i)$; $\tau = (VQ)/(It)$;

$q = (VQ)/I$; $\sigma = -(My)/I$; $Fn = qs$; $\tau = (Tr)/J$; $A = bh$; $A = bh/2$

; $A = \pi R^2$; $I = bh^3/12$; $J = \pi/2\ (R_o^4 - R_i^4)$; $I = \pi/4\ (R_o^4 - R_i^4)$;

$\varepsilon = \alpha\ \Delta T$; $Q = \Sigma A_i y_i$; $\bar{y} = (\Sigma A_i y_i)/(\Sigma A_i)$

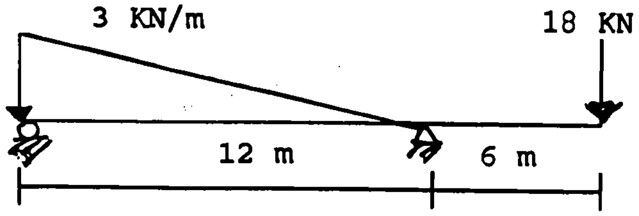
; $\phi = \Sigma\ (T_iL_i)/(J_iG_i)$; $I_c = \Sigma\ (I_{ci} + A_i d_i^2)$; $dV/dx = -w(x)$;

$dM/dx = V$; $d^2y/dx^2 = M/EI$

CIE301/SP00 **FINAL EXAM** **NAME**____________________

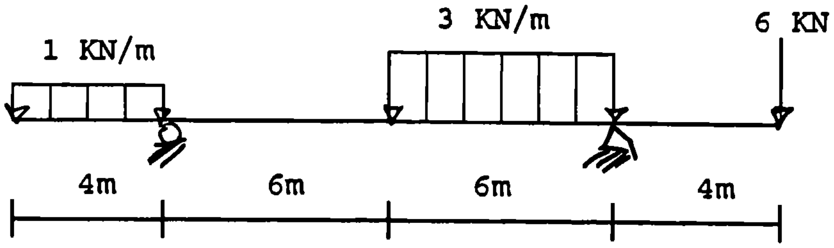
PROB-1

For the beam shown below determine the equation of deflection



PROB-2

Draw the moment and shear diagrams for the beam shown below.

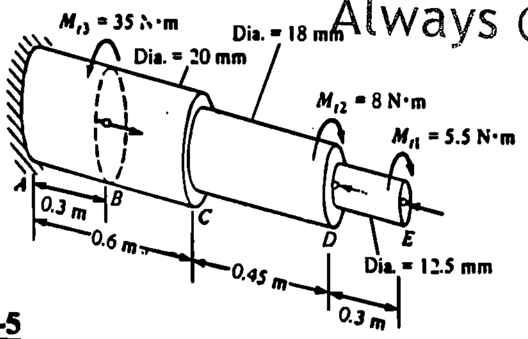


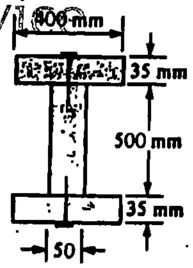
PROB-3

Find the required cross sectional area of a rod subjected to an axial load of 35 KN, if the stress is not to exceed 200 MPa and the elongation is not exceed 0.10 mm. The rod is 1.5 m long and is made of steel (E = 30E06 MPa).

PROB-4

The shaft shown below is made from aluminum (G = 85 GPa) . Determine the rotation of the free end, and the maximum shearing stress in the shaft.



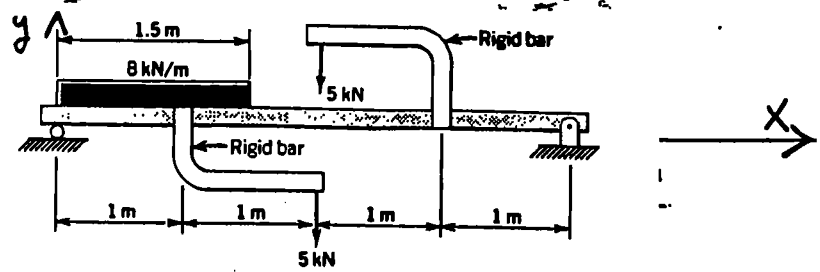


PROB-5

The I cross section shown above is subjected to a constant shear of 8 KN. Compute the required spacing of the nails along the beam, if the allowable shear force is 800 N/nail.

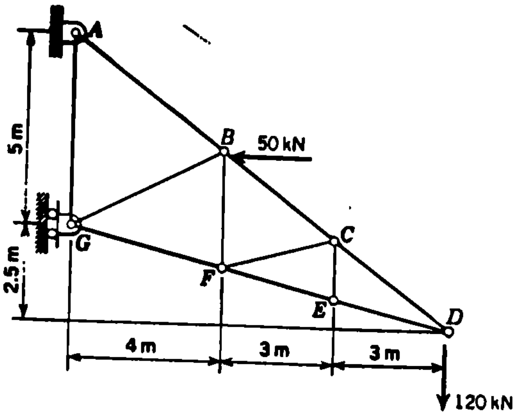
PROB-6

Write the moment and shear equations for the beam shown below.



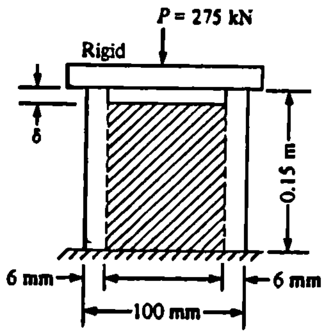
PROB-7

Determine the stress in members GF of the truss shown below. Given: $A_{GF} = 4500\ mm^2$.



PROB-8

A square steel (E = 200 GPa) container with outside dimensions 100 mm by 100mm and sides of 6 mm thickness. The container is filled with a material of E = 30 G Pa and leaving a gap of 0.025 mm at the top of the container as shown below. A force of 275 KN is applied on the container, determine the stress on the material inside the container.

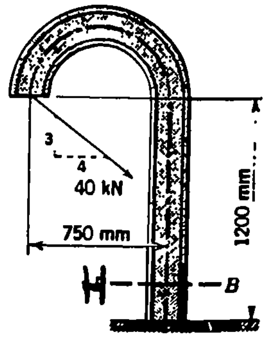


PROB-9

A 12 m long by 12.5 mm diameter steel rod is subjected to an axial tensile load of 25 KN. The total elongation is 0.07 mm. Calculate the: a) axial stress ; b) axial strain.

PROB-10

The solid rod shown below is 30 mm in diameter and is acted upon by the forces as shown. Determine the stress state at point H and draw the stress element. Solve the problem by looking at point H from the top side.



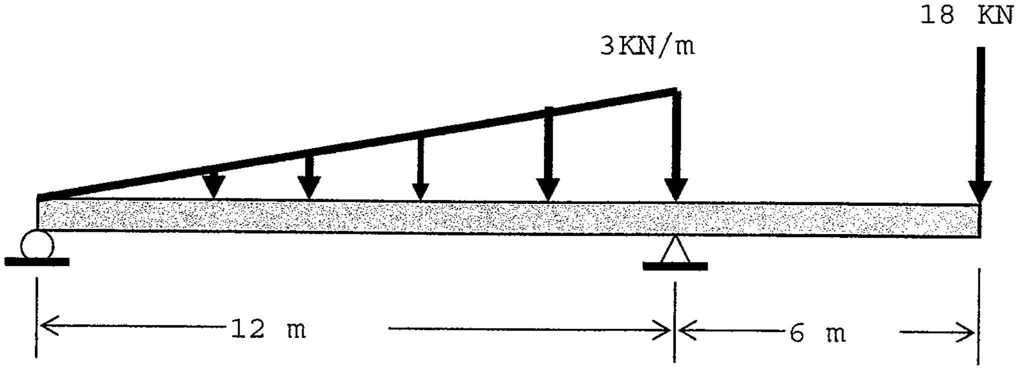
EQUATIONS:

$\varepsilon = \delta/L$; $\sigma = P/A$; $\sigma = E\varepsilon$; $\delta = \Sigma\ (P_iL_i)/(A_iE_i)$; $\tau = (VQ)/(It)$; $q = (VQ)/I$; $\sigma = -(My)/I$; $Fn = qs$; $\tau = (Tr)/J$; $A = bh$; $A = bh/2$; $A = \pi R^2$; $I = bh^3/12$; $J = \pi/2\,(R_o^4 - R_i^4)$; $I = \pi/4\ (R_o^4 - R_i^4)$; $\varepsilon = \alpha\ \Delta T$; $Q = \Sigma\ A_i\ d_i$; $d_i = |y_i - y_c|$; $y_c = (\Sigma\ A_i\ y_i)/(\Sigma\ A_i)$; $\phi = \Sigma\ (T_iL_i)/(J_iG_i)$; $I_c = \Sigma\ (\ I_{oi} + A_i\ d_i^2\ )$; $dV/dx = -w(x)$; $dM/dx = V$; $d^2y/dx^2 = M/EI$

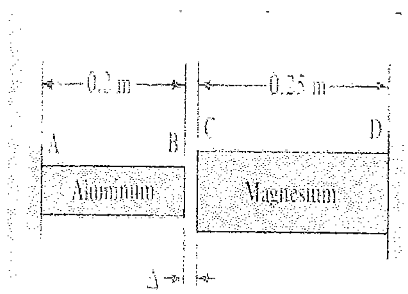
CIE202/SP05 **FINAL EXAM** **NAME**____________________

PROB-1

For the beam shown below, draw the moment and shear diagrams.

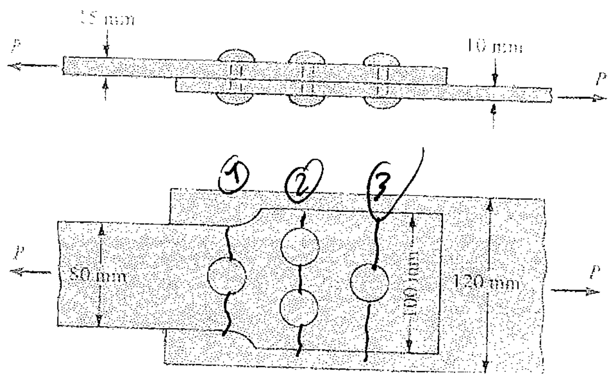


PROB-2



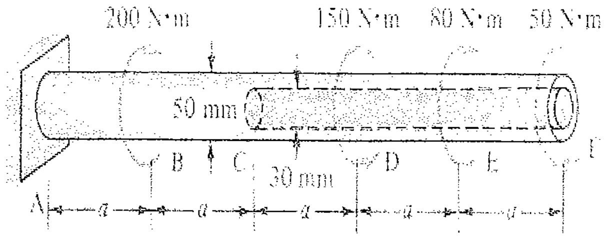
At 20°C there is a gap $\Delta = 0.4$ mm between the ends of the aluminum and magnesium bars shown in Figure. Use $E_a = 70$ GPa. $\alpha_a = 23 \times 10^{-6}/°C$, $A_a = 500\ mm^2$, $E_m = 45$ GPa, $\alpha_m = 26 \times 10^{-6}/°C$ and $A_m = 1200\ mm^2$. Determine *(a)* the compressive stress in each rod when the temperature rises to 120°C and *(b)* the change in length of the magnesium bar.

PROB-3



Two plates are joined by four rivets of 20-mm diameter, as shown in Figure. Determine the maximum load *P* if the shearing, tensile, and bearing stresses are limited to 80, 100, and 140 MPa, respectively. Assume that the load is equally divided among the rivets.

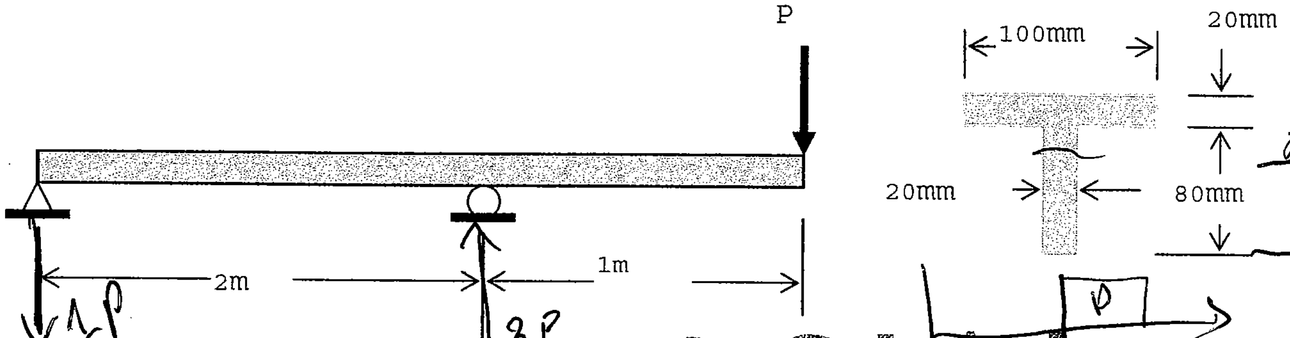
PROB-4



Determine: a) the largest shearing stress in the shaft. b) the angle of rotation in degrees at F. Given G = 80 G Pa

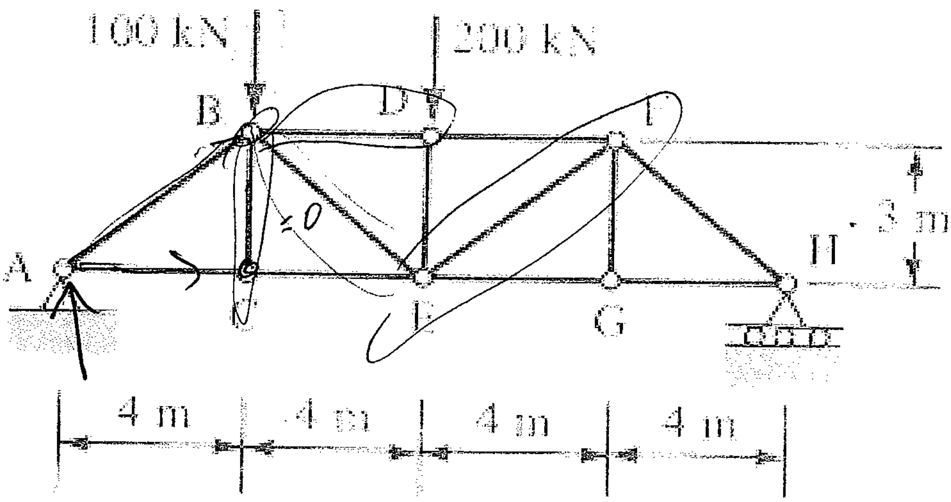
PROB-5-

Determine the value of load P so that the maximum allowable stresses does not exceed 40 M Pa in tension, 70 M Pa in compression, and 12 M Pa in shear.



PROB-6-

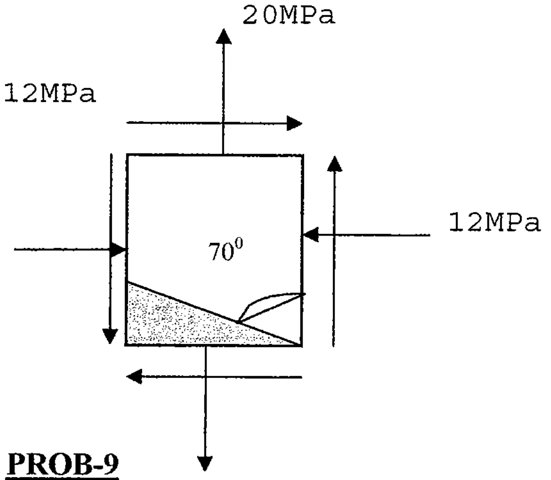
Determine the stress in members FE, BD, and BC of the truss shown below. Given: A = 5000 mm^2.



PROB-7-

A 2 inch diameter and 4 inch long solid cylinder is subjected to uniform axial stress of 7.2 Ksi. Use E = 30x10^3 Ksi and $\upsilon = \frac{1}{3}$. Calculate: a) the change in length, b) the change in diameter.

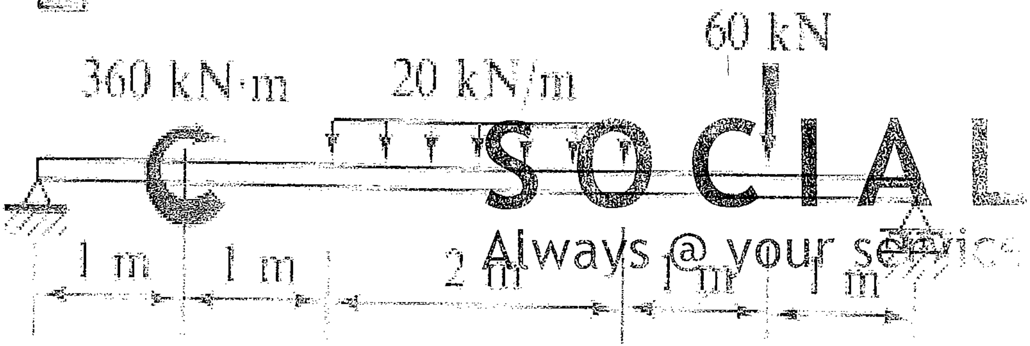
PROB-8



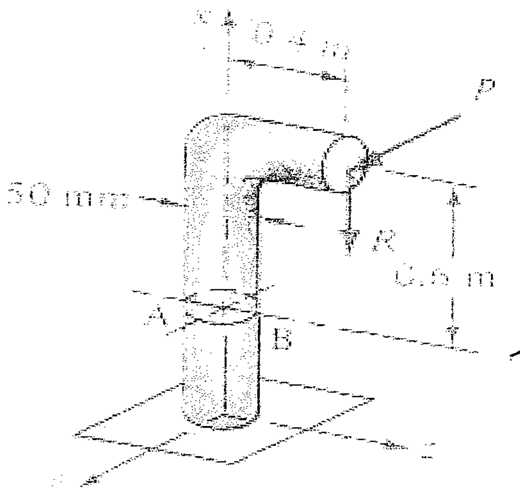
For the stress state shown to the left, determine the normal and shearing stresses for the shaded area using the method of equilibrium.

PROB-9

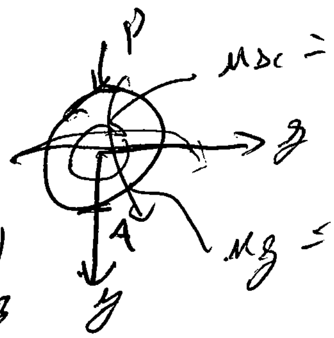
Draw the moment and shear diagrams for the beam shown below.



PROB-10



Loads P = 1200 N and R = 2400 N are applied at the free end of the 50 mm diameter post shown. Determine the stress state at point A and draw the stress element. Solve the problem by looking at point A from the top side



$M_{xc} = 1200\,(400)$ N.mm

$M_z = 1200\,(600)$ N.m

$\tau_x = 0$

$\tau_m = \frac{1200(600)}{\frac{\pi}{2}R^3}$

$\tau_m = 29{,}33$

$\sigma_f = \frac{-2400}{\frac{\pi}{4}50^2}$

$\sigma_m = \frac{Mc}{I} =$

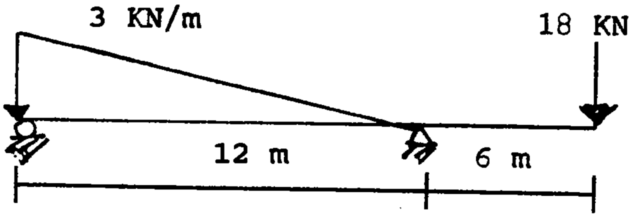
EQUATIONS:

$\varepsilon = \delta/L$; $\sigma = P/A$; $\sigma = E\varepsilon$; $\delta = \Sigma\ (P_iL_i)/(A_iE_i)$; $\tau = (VQ)/(It)$; $\bar{y} = \frac{4R}{3\pi}$; $I = \frac{\pi R^4}{4}$;
$q = (VQ)/I$; $\sigma = -(My)/I$; $Fn = qs$; $\tau = (Tr)/J$; $A = bh$; $A = bh/2$; $A = \pi R^2$;
$I = bh^3/12$; $J = \pi/2\,(R_o^4 - R_i^4)$; $I = \pi/4\ (R_o^4 - R_i^4)$; $\varepsilon = \alpha\ \Delta T$; $Q = \Sigma\ A_i\ d_i$;
$d_i = |y_i - y_c|$; $y_c = (\Sigma\ A_i\ y_i)/(\Sigma\ A_i)$; $\phi = \Sigma\ (T_iL_i)/(J_iG_i)$;

CIE301/SP00 **FINAL EXAM** **NAME____________________**

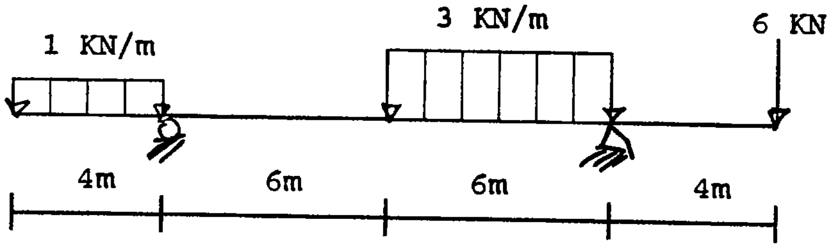
PROB-1

For the beam shown below determine the equation of deflection



PROB-2

Draw the moment and shear diagrams for the beam shown below.

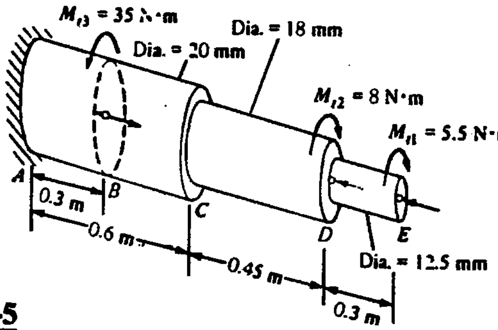


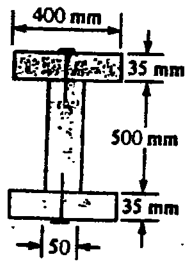
PROB-3

Find the required cross sectional area of a rod subjected to an axial load of 35 KN, if the stress is not to exceed 200 MPa and the elongation is not exceed 0.10 mm. The rod is 1.5 m long and is made of steel (E = 30E06 MPa).

PROB-4

The shaft shown below is made from aluminum (G = 85 GPa) . Determine the rotation of the free end, and the maximum shearing stress in the shaft.



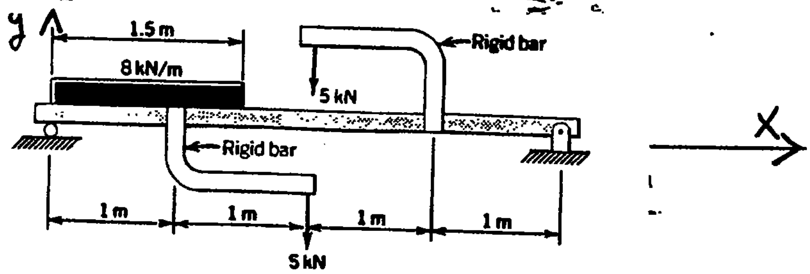


PROB-5

The I cross section shown above is subjected to a constant shear of 8 KN. Compute the required spacing of the nails along the beam, if the allowable shear force is 800 N/nail.

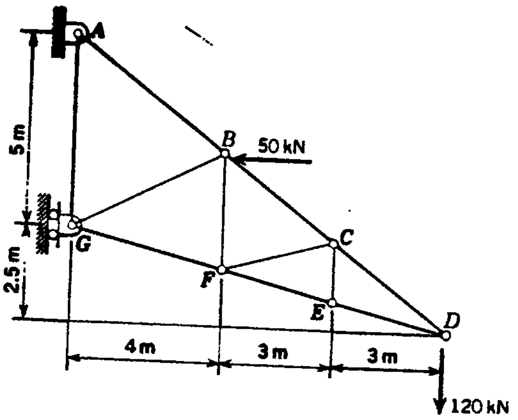
PROB-6

Write the moment and shear equations for the beam shown below.



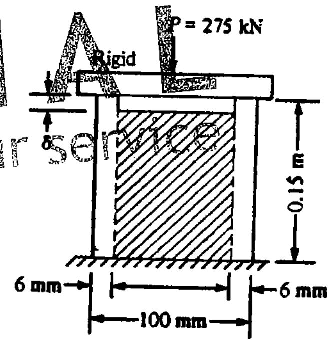
PROB-7

Determine the stress in members GF of the truss shown below. Given: $A_{GF} = 4500\ mm^2$.



PROB-8

A square steel ($E = 200$ GPa) container with outside dimensions 100 mm by 100mm and sides of 6 mm thickness. The container is filled with a material of $E = 30$ G Pa and leaving a gap of 0.025 mm at the top of the container as shown below. A force of 275 KN is applied on the container, determine the stress on the material inside the container.

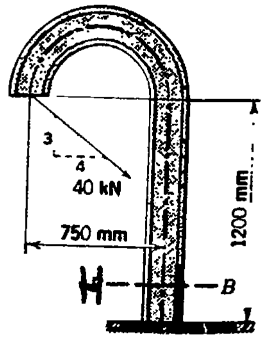


PROB-9

A 12 m long by 12.5 mm diameter steel rod is subjected to an axial tensile load of 25 KN. The total elongation is 0.07 mm. Calculate the: a) axial stress ; b) axial strain.

PROB-10

The solid rod shown below is 30 mm in diameter and is acted upon by the forces as shown. Determine the stress state at point H and draw the stress element. Solve the problem by looking at point H from the top side.



EQUATIONS:

$\varepsilon = \delta/L$; $\sigma = P/A$; $\sigma = E\varepsilon$; $\delta = \Sigma\,(P_iL_i)/(A_iE_i)$; $\tau = (VQ)/(It)$; $q = (VQ)/I$; $\sigma = -(My)/I$; $Fn = qs$; $\tau = (Tr)/J$; $A = bh$; $A = bh/2$; $A = \pi R^2$; $I = bh^3/12$; $J = \pi/2\,(R_o^4 - R_i^4)$; $I = \pi/4\,(R_o^4 - R_i^4)$; $\varepsilon = \alpha\,\Delta T$; $Q = \Sigma\,A_i\,d_i$; $d_i = |y_i - y_c|$; $y_c = (\Sigma\,A_i\,y_i)/(\Sigma\,A_i)$; $\phi = \Sigma\,(T_iL_i)/(J_iG_i)$; $I_c = \Sigma\,(I_{oi} + A_i\,d_i^2)$; $dV/dx = -w(x)$; $dM/dx = V$; $d^2y/dx^2 = M/EI$