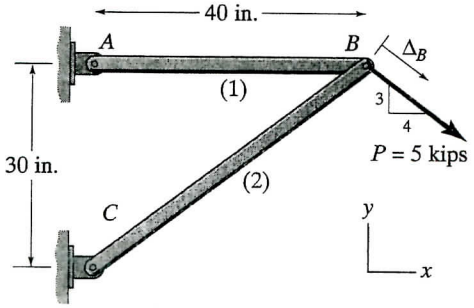
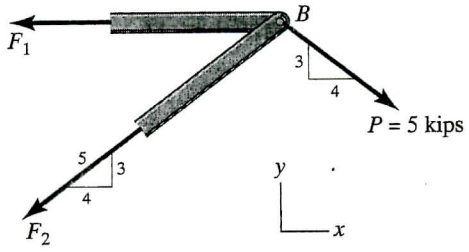
NAME:_____ SID #_____

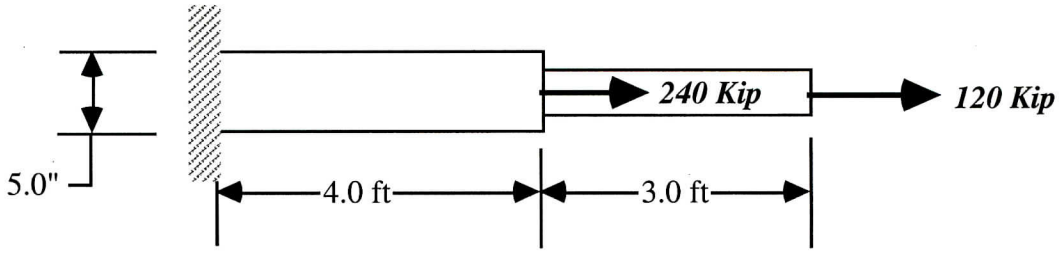
Question 1:
For the two member truss with $A_1 = A_2 = 1.20\text{-in}^2$ and $E_1 = E_2 = 10\text{x}10^6\text{-psi}$::
a- find the total strain energy in the truss.
b- use **work-energy** method to find the displacement at point B in the direction of the load.

Answers:
U = 0.1588 kip-in
Δ_B = 0.0635-in



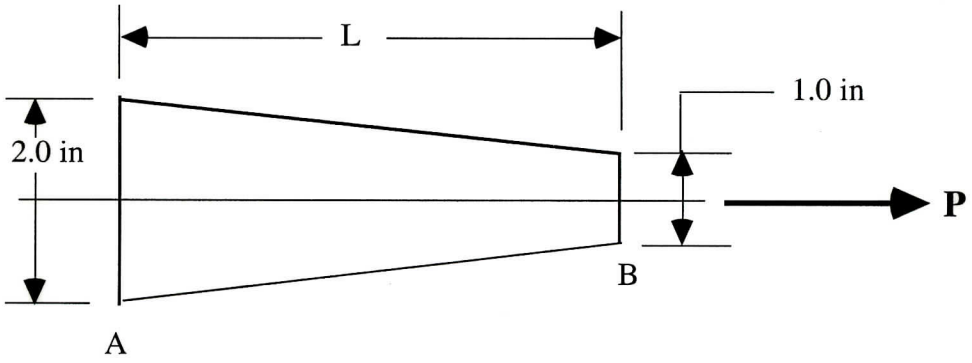


Question 2:
For the two member circular aluminum rod with diameters of 5-in and 4-in and $E = 10.1\text{x}10^6$-psi:
a- find the total strain energy in the rod.
b- can you use **work-energy** method to find the displacement at the end of the rod? Explain.



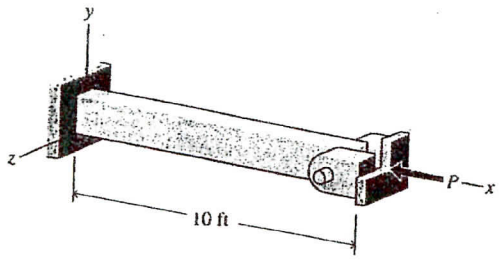
Question 3:
For the aluminum tapered circular rod with diameters of 2-in and 1-in at its end:
a- find the total strain energy in the rod and the displacement at end B.
b- find the total strain energy in the rod if instead of P a torque T is applied. Also find the relative angular deformation at end B.

Answers:
$U = P^2 L / \pi E$ $\Delta_B = 2 P L / \pi E$
$U = 14 T^2 L / 3\pi G$ $\varphi_B = 7 T L / 3\pi G$

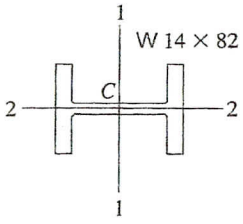


NAME:_____ SID #_____

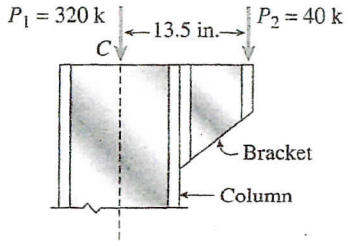
Question 1:
A 10-ft long bar with cross sectional area of 2"x1" must support an axial load P. One end of the bar is fixed to the wall and the other end is pin-bracket as shown. Knowing that E = 29,000-ksi and σ_{yd} = 36-ksi, determine the safe value of axial load P with a safety factor of 2.



Question 2:
A steel wide-flange column of W14x82 shape is pin supported at it's ends and has a length of 25-ft. The column supports a centric load of 320-kips and an eccentric load of 40-kips on the 2-2 axis as shown.
a- Using the secant formula and E = 30,000-ksi, find the maximum compressive stress in the column.
b- If the yield stress for the steel is σ_{yd} = 42-ksi, what is the factor of safety with respect to yielding?

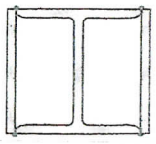


(a)



(b)

Question 3:
A compression member of 9-m effective length is obtained by welding two 10-mm steel plates to a W250x80 rolled-steel wide flange shape as shown. Knowing that σ_{yd} = 345-MPa and E = 200-GPa, by using allowable stress AISC design determine:
a- The allowable centric load for this compressive member.
b- If the load is applied on the web but 40-mm off center, determine the allowable load P using both allowable stress method and the interaction formula.



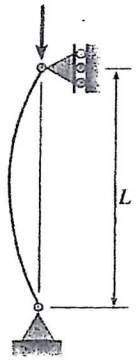
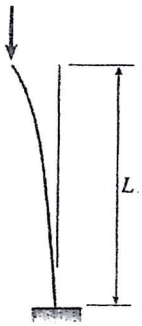
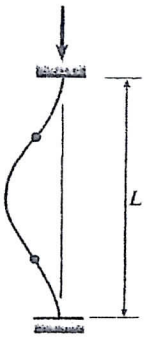
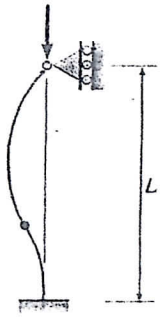
(a) Pinned - pinned column	(b) Fixed - free column	(c) Fixed - fixed column	(d) Fixed - pinned column
$P_{cr} = \frac{\pi^2 EI}{L^2}$	$P_{cr} = \frac{\pi^2 EI}{4L^2}$	$P_{cr} = \frac{4\pi^2 EI}{L^2}$	$P_{cr} = \frac{2.046\,\pi^2 EI}{L^2}$
			
$L_e = L$	$L_e = 2L$	$L_e = 0.5L$	$L_e = 0.699L$
$K = 1$	$K = 2$	$K = 0.5$	$K = 0.699$

Fig. 11-19 Critical loads, effective lengths, and effective-length factors for ideal columns

Minimum AISC Recommendation $L_e = L$ $L_e = 2.1L$ $L_e = 0.65L$ $L_e = 0.8L$

Desin under a centric load
Steel: Allowable stress design

$C_c = 4.71\sqrt{E/\sigma_{yd}}$ and $\sigma_e = \pi^2 E / (L_e/r)^2$

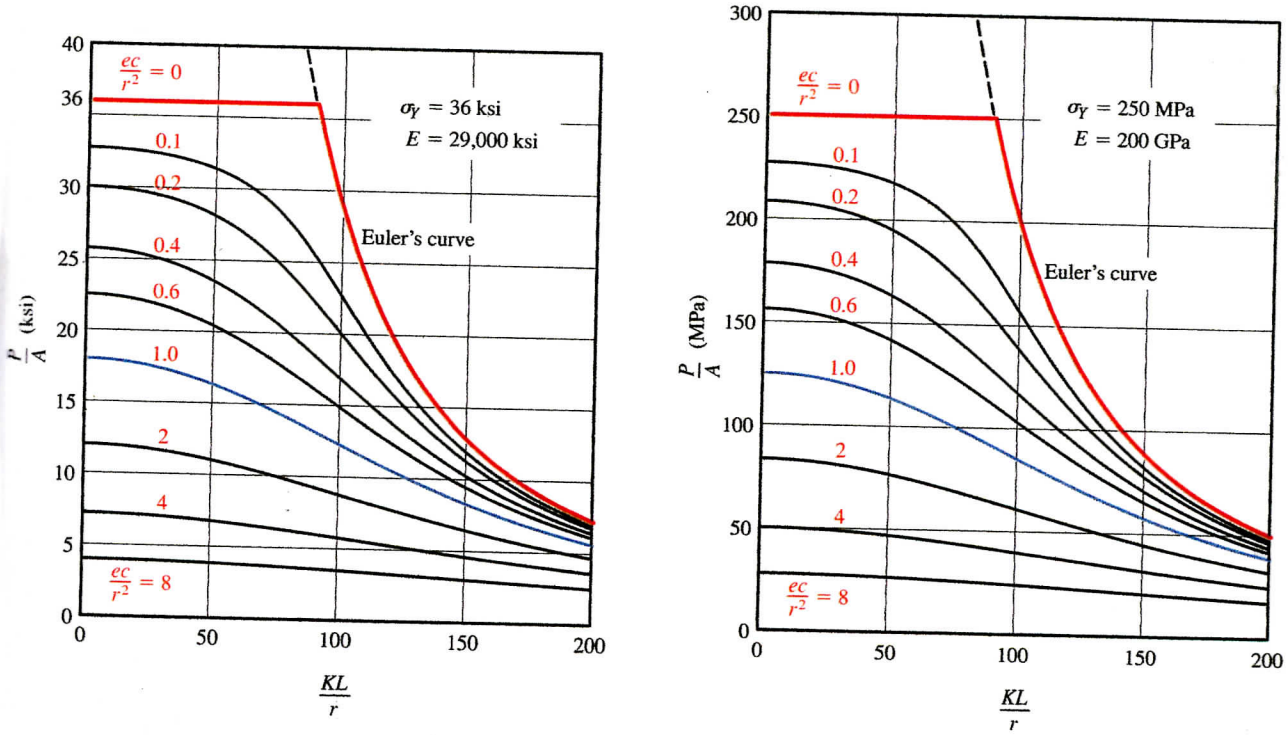
If $(L_e/r) > C_c$ $\sigma_{cr} = 0.877\,\sigma_e$
and F.S.= 1.67

If $(L_e/r) < C_c$ $\sigma_{cr} = [0.658^{(\sigma_{yd}/\sigma_e)}]\,\sigma_{yd}$
and F.S.= 1.67

Design of columns under an eccentric load:

Allowable stress design: $\frac{P}{A} + \frac{Mc}{I} \le \sigma_{all}$

Interaction method: $\frac{P/A}{(\sigma_{all})_{centric}} + \frac{Mc/I}{(\sigma_{all})_{bending}} \le 1$



Average compression stress versus slenderness ratio based on the secant formula.

$$\sigma_{max} = \frac{P}{A}\left[1 + \frac{ec}{r^2}\sec\left(\frac{KL}{2r}\sqrt{\frac{P}{EA}}\right)\right]$$