UNIVERSITY OF CALIFORNIA AT BERKELEY

Department of Civil and Environmental Engineering

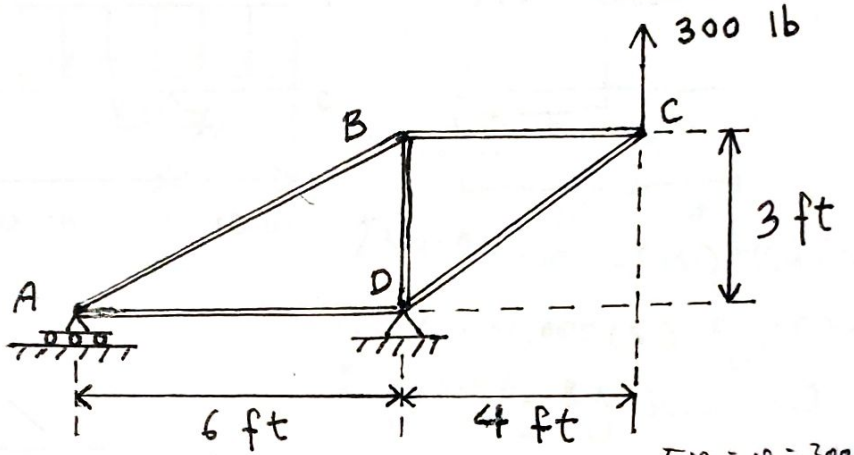
CE C30/ME C85, Section 2, Fall 2019

Instructor: A. Imam

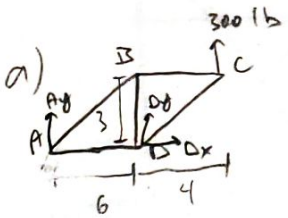
80/100

MIDTERM EXAM

6 1- (35 pts.) For the truss below which is supported by a joint at D and a roller at A and is acted on by a 300 lb force, find (a) the reactions at points A and D, (b) forces in each member of the truss.



a)



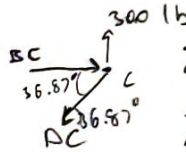
$\Sigma F_x = 0 = D_x \Rightarrow$ **$D_x = 0$**

$\Sigma M_D = 0 = 300(4) - A_y(6) \rightarrow$ **$A_y = 200$ lb**

$\Sigma F_y = 0 = 300 + A_y + D_y = 0 \rightarrow$ **$D_y = -500$ lb**

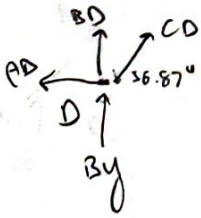
$\Sigma M_A = 0 = 300(10) + D_y(6) \rightarrow D_y = -500$ ✓

b)



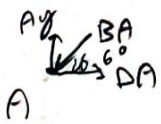
$\Sigma F_{cy} = 0 = 300 - DC\sin(36.87) \rightarrow$ **$DC = 500$ lb (T)** ✓ ✓

$\Sigma F_{cx} = 0 = BC - DC\cos(36.87) \rightarrow$ **$BC = 400$ lb (C)** ✓ ✓



$\Sigma F_y = 0 = B_y + BD + CD\sin(36.87) \rightarrow$ **$BD = 200$ lb (T)** ✓

$\Sigma F_x = 0 = CD\cos 36.87 - AD \rightarrow$ **$AD = 400$ lb (T)** ✓



$\Sigma F_y = 0 = A_y - BA\sin(26.6) \rightarrow$ **$BA = 446.7$ lb (C)** ✓

$\Sigma F_x = 0 = DA - BA\cos(26.6) = 0$ ✓

35

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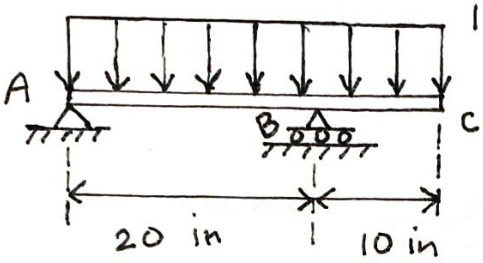
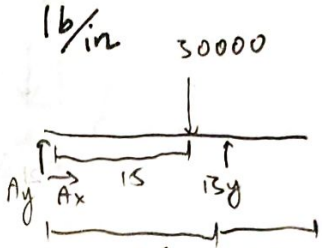
2- (35 pts.) (a) Draw the shear and bending moment diagrams for the beam and loading shown below. (b) Determine the maximum value of the absolute value of shear force and the bending moment.



1000 lb/in



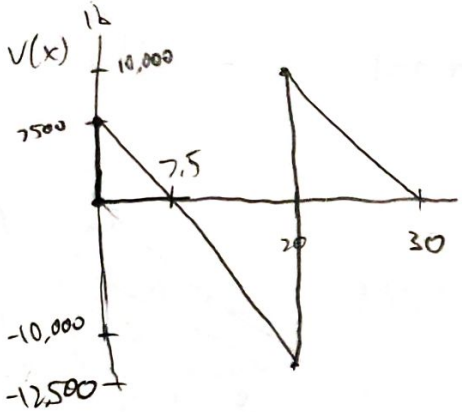
$A_x = 0$

$\Sigma M_A = 0 = -30{,}000(15) + B_y(20) \rightarrow B_y = 22{,}500$ lb

$\Sigma M_B = 0 = 30{,}000(5) - A_y(20) \rightarrow A_y = 7500$ lb

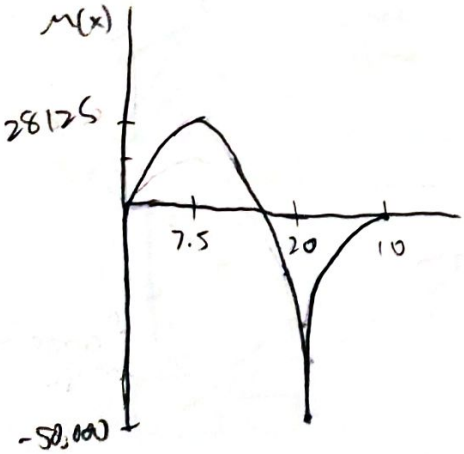
$\Sigma F_y = 0 = A_y + B_y - 30000 = 0$ ✓

a) V(x) lb



b) max absolute value of shear is 12500 lb

M(x)



max absolute moment is 50,000 lb/in ✓

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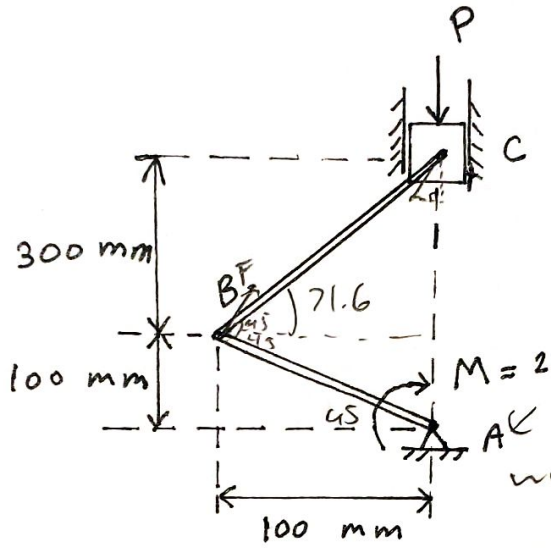
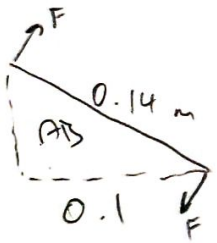
3- (30 pts.) A couple **M** of magnitude 2000 N-m is applied to member AB of the mechanism shown below. For this position find (a) the force **P** required to hold the mechanism in equilibrium. (b) The average normal stress in member BC which has a uniform cross sectional area A = 500 mm^2.



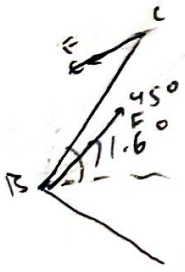
A couple can be replaced with force vector

a)



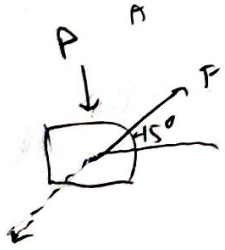
$M = r \times F = 2000 = 0.14 \times F \rightarrow F = 14142$ N

0.1



Since BC acts like a 2-force member, C has force of F acting in that angle

$\Sigma F_{yc} = \sin 45 (F) - P \rightarrow P = 10{,}000$ N



10

b) $\sigma_{avg} = P/A = \dfrac{P \cos(71.6 - 45)}{500 \text{ mm}^2} = 17.88 \text{ N/mm}^2$