Boston Architectural Center
TM-321 Structures-II
Exam #1 – October 11, 2005

First and Last Name: ME 1

Note: Please write your answers clearly in the bluebook provided, make sure to show all your work. Thank you!

1. For the simply supported beam shown, determine the reaction at the supports A and B.

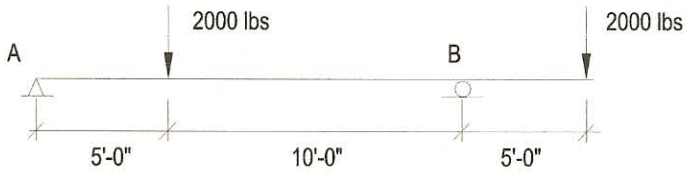


Figure-1

2. For the simply supported beam shown below: a) Find the reactions b) Determine the magnitude and location of maximum shear and bending moment. c) Draw the diagrams.

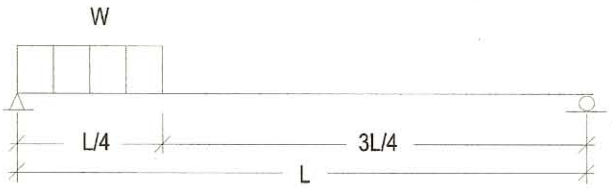


Figure-2

3. Given a square member 10"x10" with length L= 20'-0" loaded in tension with 200,000 lbs, determine:
a) The Tensile stress in the member.
b) Determine the strain and extension.

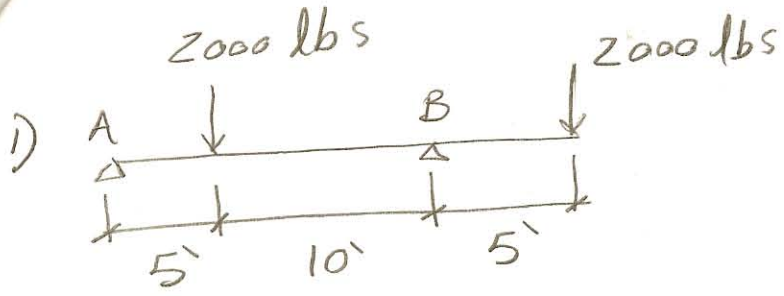
Given: A36 Steel with Fy = 36000 psi
Modulus of Elasticity E = 29000000 psi
Following formulas given for information and use:

$\sigma = F/A$ $\varepsilon = \Delta L/L$ $\sigma = E \cdot \varepsilon$ $\Delta L = PL/AE$

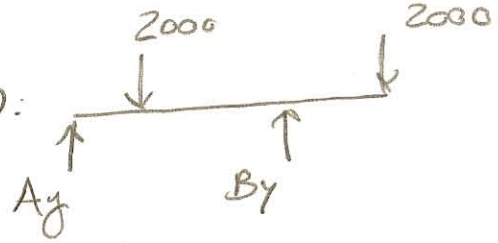
Figure-3

AC EXAM #1 FALL 2005 SOLUTION:

1)



FBD:



$\Sigma F_x = 0$

$\uparrow \Sigma F_y = 0 \Rightarrow A_y + B_y - 4000 = 0 \quad (1)$

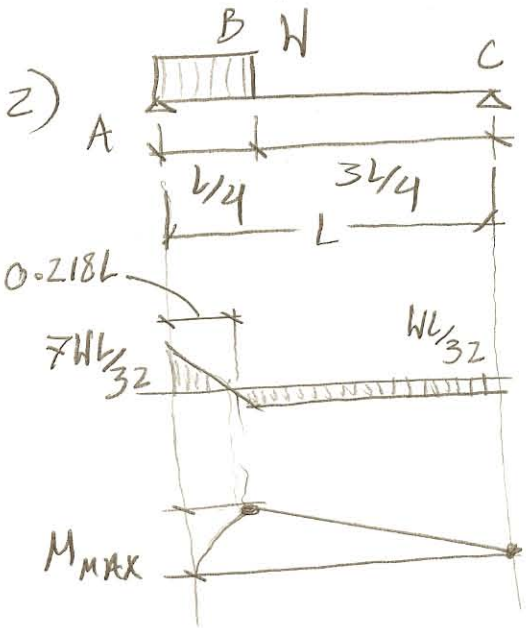
$\circlearrowleft \Sigma M_A = 0 \Rightarrow -2000\ \text{lbs}(5') + B_y(15') - 2000\ \text{lbs}(20') = 0 \quad (2)$

$\Rightarrow -10000\ \text{lbft} + B_y(15') - 40000\ \text{lbs.ft} = 0$

$\Rightarrow B_y(15') = 50000 \Rightarrow B_y = 3333.33\ \text{lbs}\uparrow$

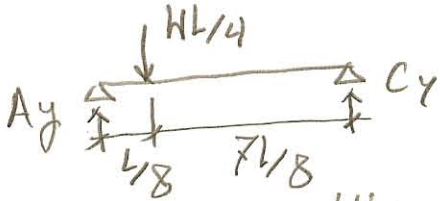
$\Rightarrow A_y + 3333.33 - 4000 = 0 \Rightarrow A_y = 666.67\ \text{lbs}\uparrow$

2)



$\Sigma F_x = 0$

$\Sigma F_y = 0$



$\Rightarrow A_y + C_y - WL/4 = 0 \Rightarrow A_y + C_y = WL/4 \quad (1)$

$\circlearrowleft \Sigma M_A = 0 \Rightarrow WL/4\,(L/8) + C_y L = 0 \Rightarrow$

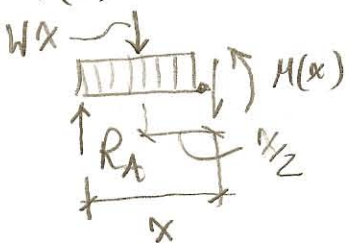
$C_y = WL/32$

$(1) \Rightarrow A_y = WL/4 - WL/32 = 8WL/32 - WL/32 = \underline{7WL/32}$

$V(x) = R_A - Wx = A_y - Wx$

$V(x) = 7WL/32 - Wx \quad \text{SET} = 0$

$V(x) = 0 \ @ \ x = \frac{7L}{32} = 0.218L$



$M(x) = R_A x - Wx^2/2$

$M(x) = A_y \cdot x - Wx^2/2$

$M(x) = 7WL/32 \cdot x - \frac{W}{2}x^2 \Rightarrow M_{MAX} \ @ \ V=0 \Rightarrow M_{MAX} = M(7L/32)$

$M_{MAX} = 7WL/32 \cdot 7L/32 - \frac{W}{2}(7L/32)^2 = \frac{49WL^2}{1024} - \frac{49WL^2}{2048} = \frac{49WL^2}{2048}$

a) $A = 10" \times 10" = 100\ in^2$, $P = 200000\ lbs$

$$\sigma_T = P/A = \frac{200000}{100} = 2000\ Psi$$

b) STRAIN $\varepsilon = \sigma/E = \frac{2000}{29 \times 10^6} = 0.000069\ in/in$

EXTENSION $\frac{\Delta l}{l} = \varepsilon \Rightarrow \Delta l = 0.000069 \times (20' \times 12\ in/ft) = 0.1656\ in$