Name: _____
Group members: _____ _____ _____

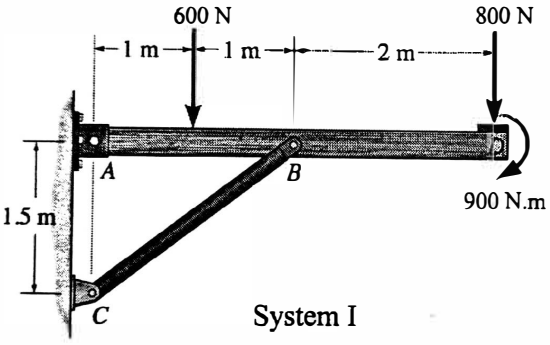
TAM 210/211 - Worksheet 6

Objectives:

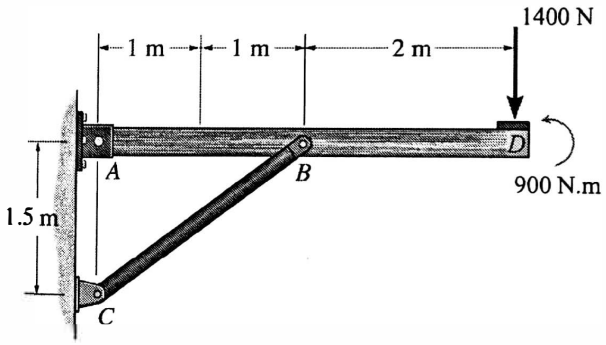
- Obtain resultant forces and moments for equivalent systems.
- Evaluate distributed loadings intensities.

Equivalent systems

1) The overhanging beam is supported by a pin at A and the strut BC. Show that the loading conditions below are equivalent by replacing the loadings by a single resultant force and a moment at A.



System I



$\Sigma F_R = -600\hat{j} - 800\hat{j}$

$= (-1400\hat{j})$ N

$\Sigma M_R = -900\hat{k} - 600(1)\hat{k}$

$-800(4)\hat{k}$

$= (-4700\hat{k})$ N-m

$\vec{M}_{RA} = d(-1400)\hat{k} = -4700\hat{k}$

$\Rightarrow d = 3.36$m

$F_R = -1400\hat{j}$ N @ $d = 3.36$m

$M_R = (-4700\hat{k})$ N-m

$\Sigma F_R = -1400\hat{j}$ N

$\Sigma M_R = -1400(4) + 900$

$= -4700$ N-m

$M_{RA} \Rightarrow d(-1400) = -4700\hat{k}$

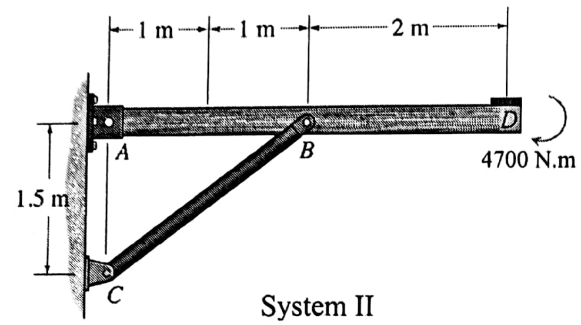
$d = 3.36$m

$F_R = -1400\hat{j}$ N @ $d = 3.36$m

$M_R = (-4700)\hat{k}$ N-m

As both F_R & M_R are equal, the systems are equivalent

2) Is the loading condition in System II equivalent to the ones above? Explain.

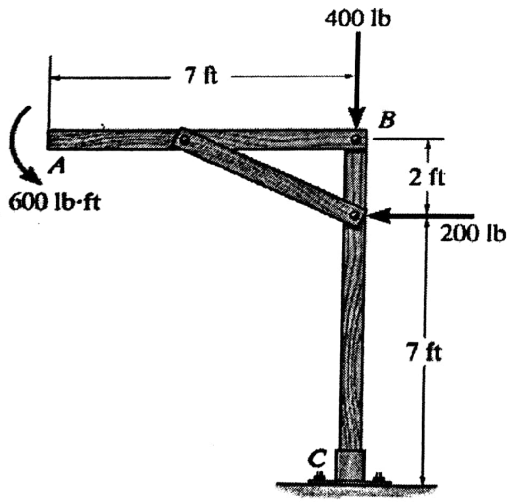


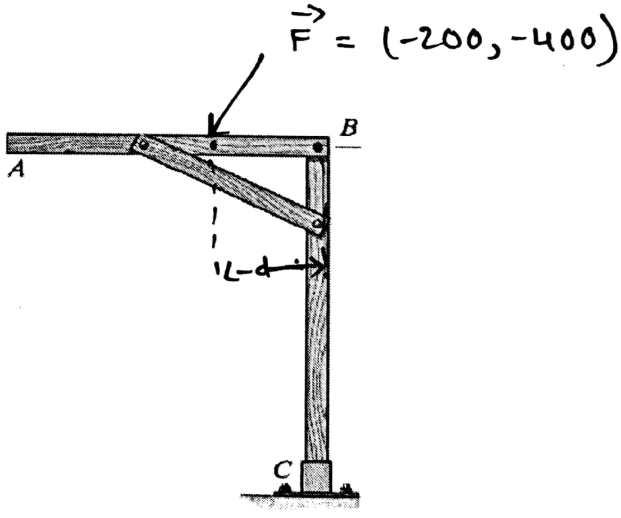
System II

NO

Reason: though moment about A is the same for both the case F_R is not.

3) Replace the force system acting on the left frame below by a single resultant force acting on member AB. Sketch your equivalent system on the right frame.





$F_R = \langle -200, 400 \rangle$ lb

$M_R = 600 + (200)(7)$

$= 2000$ lbft

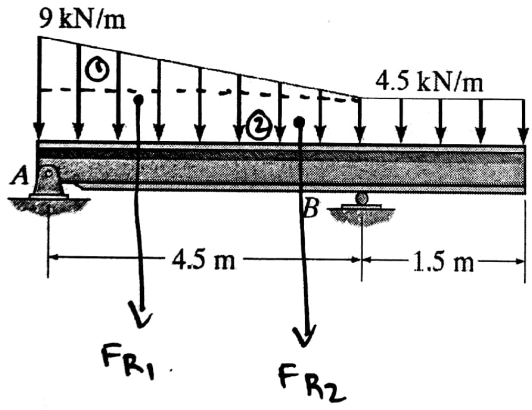
$M_C = 200(9) + 400(d) = 2000$ lb-ft

$d = 0.5$ ft

Work space for Problem 3.

Reduction of distributed loads

4) Determine the resultant force and specify where it acts on the beam measured from end A.



$\vec{F_R} = \vec{F_{R_1}} + \vec{F_{R_2}} = -\frac{1}{2}(4.5)(4.5) - 6(4.5) = -37.125\,\hat{j}$ KN

$\vec{M_A} = -F_{R_1}\left(\frac{4.5}{3}\right) - F_{R_2}\left(\frac{6}{2}\right) = -10.125(1.5) - 27(3)$

$\vec{M_A} = -96.1875$ KN-m $= d(F_R) = d(-37.125)$

$\Rightarrow d = 2.59$ m

$\vec{F_R} = -37.125\,\hat{j}$ KN @ $d = 2.59$ m

d = distance from (A).