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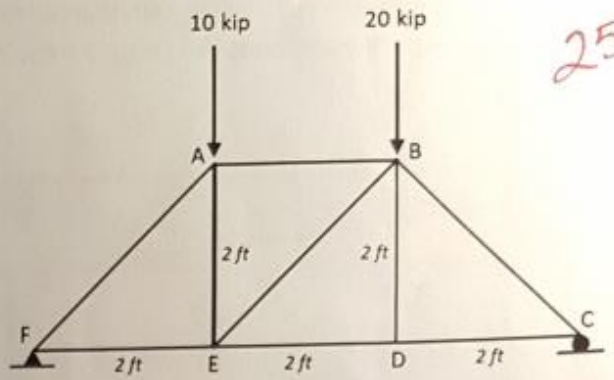
1. The truss is supported by a pin at *F* and a roller at *C*.
   (a) Draw a free-body diagram of the truss
   (b) Determine the support reaction at roller *C*
   (c) Draw relevant free-body diagrams, and determine the force in member *AB*, the force in member *BE*, and the force in member *BD*. Report whether each is in tension or compression. *Solution without supporting free-body diagrams will receive zero credit.*



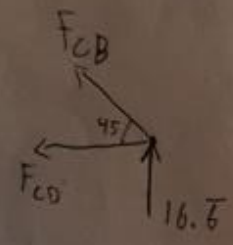
$\Sigma F_y = 0$: $F_y + C = 30$ $\quad F_x = 0$

$\Sigma M_F = 0$: $10(2) + 20(4) = 6C$

$C = 16.6\overline{6}$

F_{BD} is zero force member

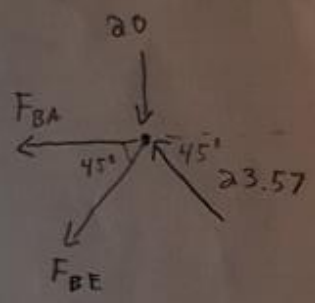
pin C:



$16.6 + F_{CB}\sin 45^\circ = 0$

$F_{CB} = -23.57$

pin B:



$\Sigma F_x = 0$: $23.57\cos 45^\circ + F_{BA} + F_{BE}\cos 45^\circ = 0$

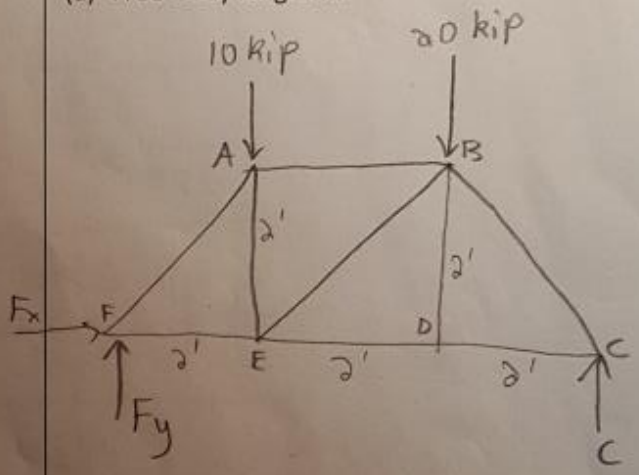
$\Sigma F_y = 0$: $23.57\sin 45^\circ = F_{BE}\sin 45^\circ + 20$

$F_{BE} = -4.71$ kip

$F_{BA} = 4.04\cos 45^\circ - 23.57\cos 45^\circ$

$= -13.33$ kip

(a) Free-body diagram:



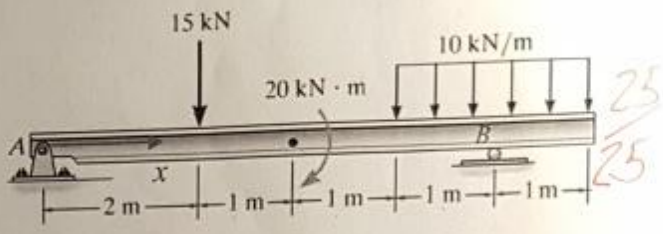
(b) C_y = 16.67

(c) F_{AB} = 13.33 kip (C)

F_{BE} = 4.71 kip (C)

F_{BD} = 0

3. A simply-supported beam is loaded as shown.
   (a) Draw a free-body diagram of the beam.
   (b) Draw the shear force diagram of the beam. Label all values, and indicate whether the variation is 1st, 2nd, or 3rd-order in each region, as applicable.
   (c) Draw the bending moment diagram of the beam. Label all values, and indicate whether the variation is 1st, 2nd, or 3rd-order in each region, as applicable.



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$A_x = 0$

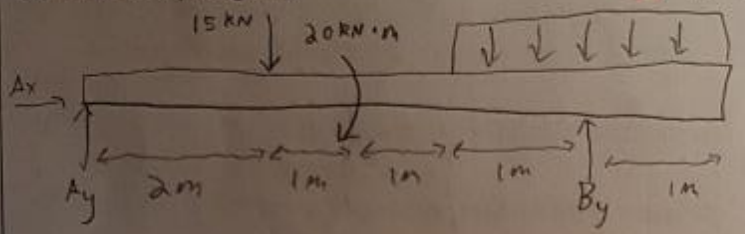
$\Sigma F_y = 0$: $A_y + B_y = 15 + 20$

$\Sigma M_A = 0$: $15(2) + 20(5) + 20 = 5B_y$ +1

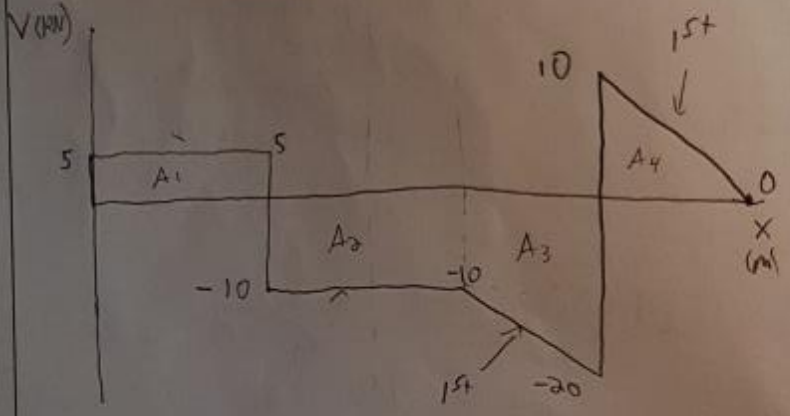
$B_y = 30$ kN

$A_y = 5$ kN +1

(a) Free-body diagram: +3



(b) Shear force diagram: +4



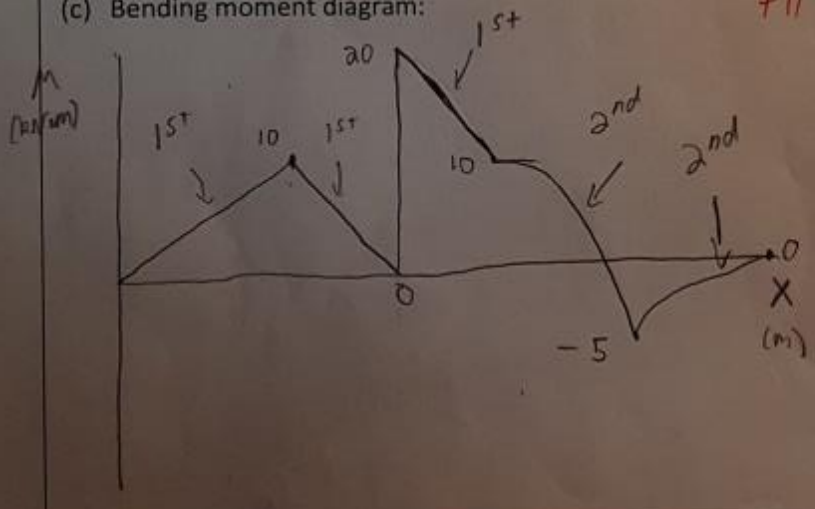
$A_1 = 10$

$A_2 = -20$

$A_3 = -10 - \frac{1}{2}(10) = -15$

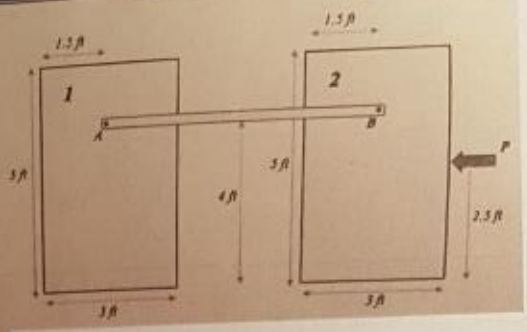
$A_4 = 5$

(c) Bending moment diagram: +11

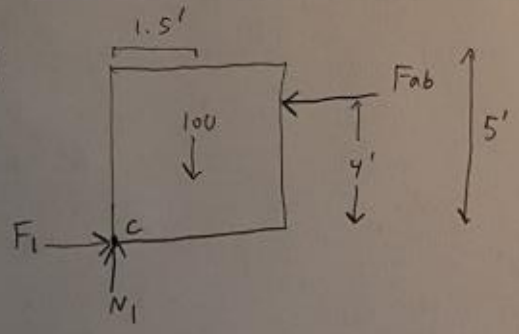


Show all of your work.

4. Identical, homogeneous blocks 1 and 2 weigh 100 pounds each. They are linked with a horizontal bar pinned at A and B. Force P is applied to block 2 as shown. The coefficient of static friction between the floor and each block is 0.4
   (a) For the condition of impending motion for the system, block 1 tips. Draw the free-body diagram of block 1
   (b) Determine the magnitude and direction of the friction force acting on block 1
   (c) Draw the free-body diagram of block 2
   (d) For the condition of impending motion for the system, determine whether block 2 slips or tips. Circle "slips" or "tips".
   (e) Determine the magnitude and direction of the friction force acting on block 2
   (f) For the condition of impending motion for the system, determine the value of P



a)



b) $\Sigma F_x = 0$: $F_1 = F_{ab}$

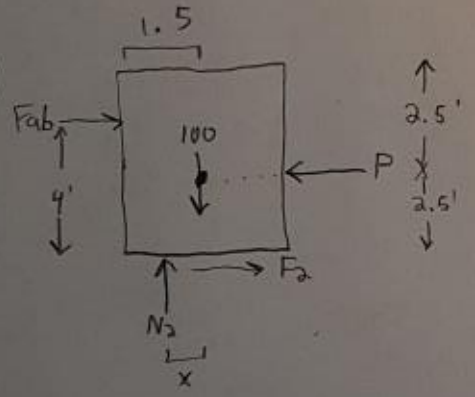
$\Sigma F_y = 0$: $N_1 = 100$

$\Sigma M_C = 0$: $4F_{ab} = 100(1.5)$

$F_{ab} = 37.5$ lb

$F_1 = 37.5$ lb →

c)



d) 2 ways to do it:

(1) compare P: slip: $\Sigma F_x = 0$: $F_{ab} + F_2 = P$

$\Sigma F_y = 0$: $N_2 = 100$

$F_2 = \mu N_2 = .4(100) = 40$

$P = 37.5 + 40$

$= 77.5$

(2) OR Find X

$\Sigma M_{center} = 0 = F_2(2.5) - F_{ab}(4-2.5) - N_2 X$

$\Sigma F_y = 0$: $N_2 = 100$

$F_2 = \mu N_2 = 40$

$X = \frac{40(2.5) - 37.5(1.5)}{100}$

$= .4375 < 1.5$

⇒ slips

tip: $\Sigma M_{corner} = 0 = 2.5P - 37.5(4) - 100(1.5)$

$P = 120$

limiting factor: 77.5 < 120 ⇒ slips

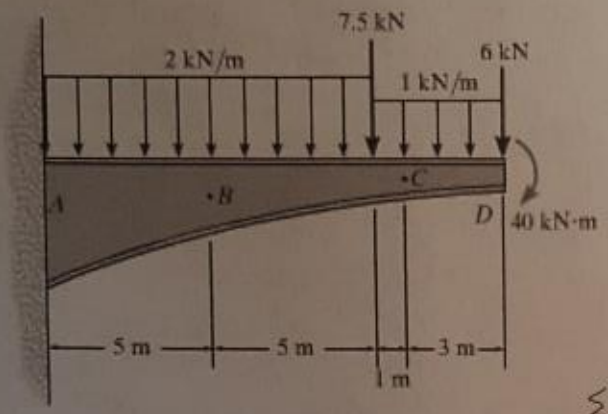
e) from above (slip)

f)

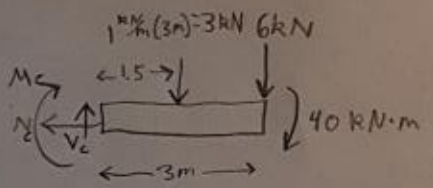
$F_2 = 40$ lb

$P = 77.5$ lb

R7–2. Determine the normal force, shear force, and moment at points B and C of the beam.



pt C)



$\rightarrow \Sigma F_x = 0 = N_C$

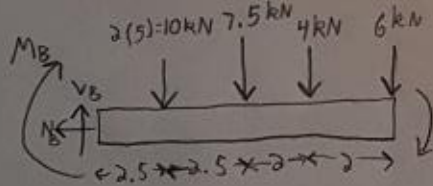
$\uparrow \Sigma F_y = 0 = V_c - 3 - 6 \quad \rightarrow \Sigma F_x = 0 = N_c$

$V_c = 9 \text{ kN}$

$\circlearrowleft + \Sigma M_{cut} = 0 = -M_c - 3(1.5) - 6(3) - 40$

$M_c = -62.5 \text{ kN.m}$

pt B)



$\rightarrow \Sigma F_x = 0 = N_B$

$\uparrow \Sigma F_y = 0 = V_B - 10 - 7.5 - 4 - 6$

$V_B = 27.5 \text{ kN}$

$\circlearrowleft + \Sigma M_{cut} = 0 = -10(2.5) - 7.5(5) - 4(7) - 6(9) - 40 - M_B$

$M_B = -184.5 \text{ kN.m}$