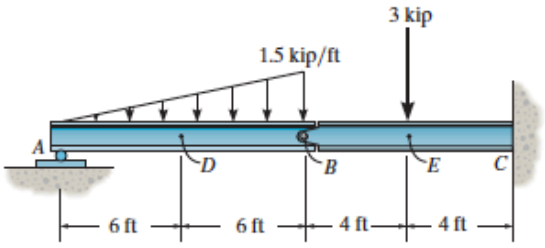
CE 270
Fall 2011
Solutions – Problem Set 1

•1–5. Determine the resultant internal loadings in the beam at cross sections through points D and E. Point E is just to the right of the 3-kip load.



Support Reactions: For member AB

$\zeta + \Sigma M_B = 0; \quad 9.00(4) - A_y(12) = 0 \quad A_y = 3.00 \text{ kip}$

$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad B_x = 0$

$+\uparrow \Sigma F_y = 0; \quad B_y + 3.00 - 9.00 = 0 \quad B_y = 6.00 \text{ kip}$

Equations of Equilibrium: For point D

$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad N_D = 0$ **Ans.**

$+\uparrow \Sigma F_y = 0; \quad 3.00 - 2.25 - V_D = 0$

$V_D = 0.750 \text{ kip}$ **Ans.**

$\zeta + \Sigma M_D = 0; \quad M_D + 2.25(2) - 3.00(6) = 0$

$M_D = 13.5 \text{ kip} \cdot \text{ft}$ **Ans.**

Equations of Equilibrium: For point E

$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad N_E = 0$ **Ans.**

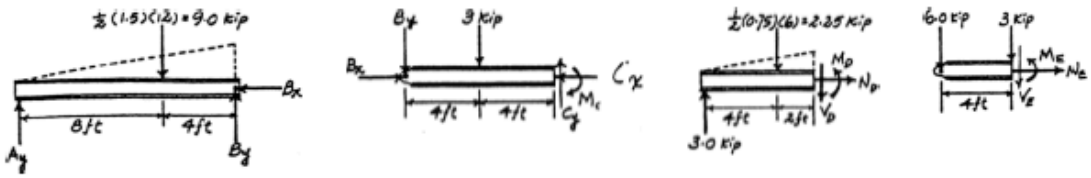
$+\uparrow \Sigma F_y = 0; \quad -6.00 - 3 - V_E = 0$

$V_E = -9.00 \text{ kip}$ **Ans.**

$\zeta + \Sigma M_E = 0; \quad M_E + 6.00(4) = 0$

$M_E = -24.0 \text{ kip} \cdot \text{ft}$ **Ans.**

Negative signs indicate that M_E and V_E act in the opposite direction to that shown on FBD.



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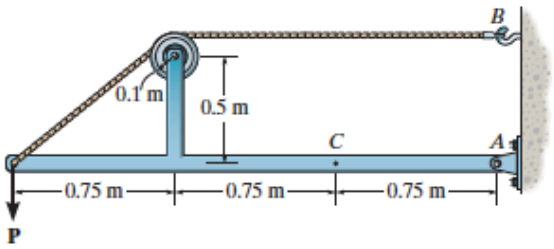
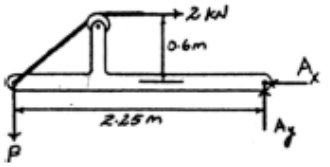
1–7. The cable will fail when subjected to a tension of 2 kN. Determine the largest vertical load P the frame will support and calculate the internal normal force, shear force, and moment at the cross section through point C for this loading.



Support Reactions:

$\zeta + \Sigma M_A = 0; \quad P(2.25) - 2(0.6) = 0$

$P = 0.5333 \text{ kN} = 0.533 \text{ kN}$ **Ans.**



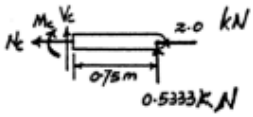
$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad 2 - A_x = 0 \quad A_x = 2.00 \text{ kN}$

$+\uparrow \Sigma F_y = 0; \quad A_y - 0.5333 = 0 \quad A_y = 0.5333 \text{ kN}$

Equations of Equilibrium: For point C

$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad -N_C - 2.00 = 0$

$N_C = -2.00 \text{ kN}$ **Ans.**



$+\uparrow \Sigma F_y = 0; \quad V_C + 0.5333 = 0$

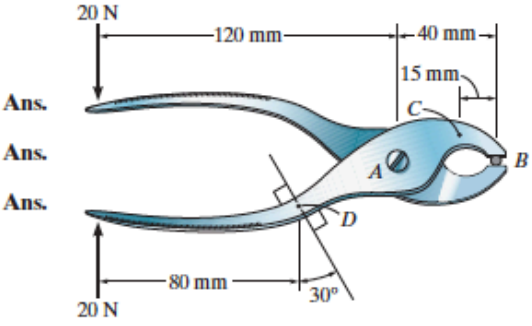
$V_C = -0.533 \text{ kN}$ **Ans.**

$\zeta + \Sigma M_C = 0; \quad 0.5333(0.75) - M_C = 0$

$M_C = 0.400 \text{ kN} \cdot \text{m}$ **Ans.**

Negative signs indicate that N_C and V_C act in the opposite direction to that shown on FBD.

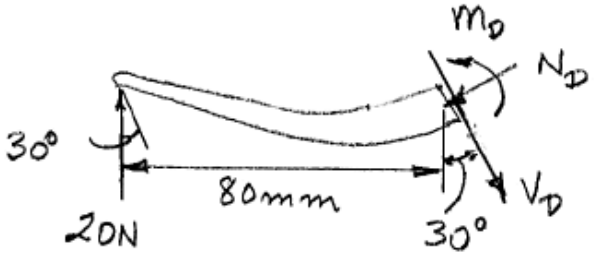
***1–16.** Determine the resultant internal loading on the cross section through point D of the pliers.



$\searrow + \Sigma F_y = 0; \quad V_D - 20 \cos 30° = 0; \quad V_D = 17.3 \text{ N}$ **Ans.**

$+\swarrow \Sigma F_x = 0; \quad N_D - 20 \sin 30° = 0; \quad N_D = 10 \text{ N}$ **Ans.**

$+\circlearrowleft \Sigma M_D = 0; \quad M_D - 20(0.08) = 0; \quad M_D = 1.60 \text{ N.m}$ **Ans.**



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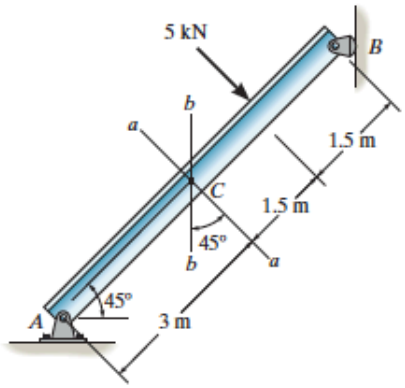
•1–17. Determine resultant internal loadings acting on section *a–a* and section *b–b*. Each section passes through the centerline at point *C*.



Referring to the FBD of the entire beam, Fig. *a*,

$\zeta + \Sigma M_A = 0; \quad N_B \sin 45°(6) - 5(4.5) = 0 \quad N_B = 5.303 \text{ kN}$

Referring to the FBD of this segment (section *a–a*), Fig. *b*,

$+\swarrow \Sigma F_{x'} = 0; \quad N_{a-a} + 5.303 \cos 45° = 0 \quad N_{a-a} = -3.75 \text{ kN}$ **Ans.**

$+\nwarrow \Sigma F_{y'} = 0; \quad V_{a-a} + 5.303 \sin 45° - 5 = 0 \quad V_{a-a} = 1.25 \text{ kN}$ **Ans.**

$\zeta + \Sigma M_C = 0; \quad 5.303 \sin 45°(3) - 5(1.5) - M_{a-a} = 0 \quad M_{a-a} = 3.75 \text{ kN} \cdot \text{m}$ **Ans.**

Referring to the FBD (section *b–b*) in Fig. *c*,

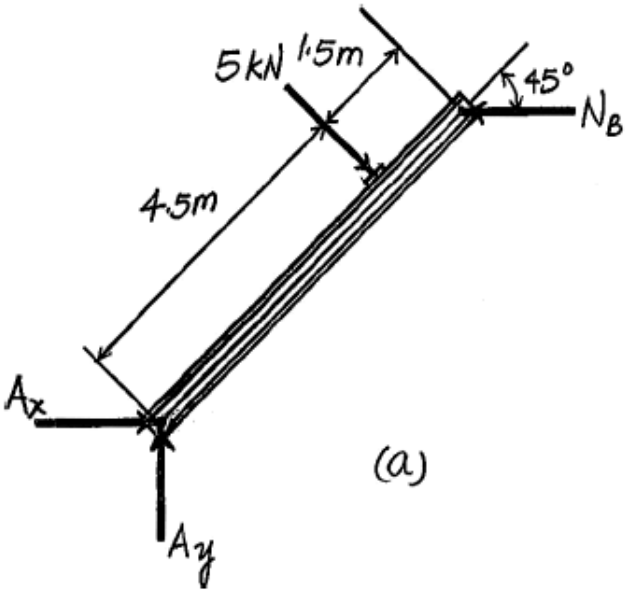
$\overset{+}{\leftarrow} \Sigma F_x = 0; \quad N_{b-b} - 5 \cos 45° + 5.303 = 0 \quad N_{b-b} = -1.768 \text{ kN}$

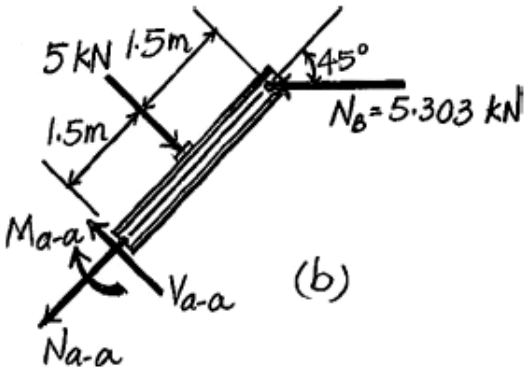
$= -1.77 \text{ kN}$ **Ans.**

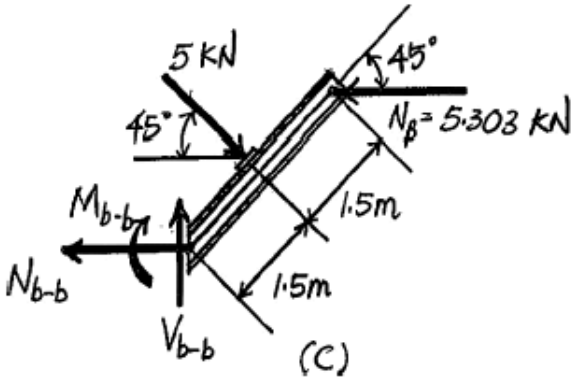
$+\uparrow \Sigma F_y = 0; \quad V_{b-b} - 5 \sin 45° = 0 \quad V_{b-b} = 3.536 \text{ kN} = 3.54 \text{ kN}$ **Ans.**

$\zeta + \Sigma M_C = 0; \quad 5.303 \sin 45°(3) - 5(1.5) - M_{b-b} = 0$

$M_{b-b} = 3.75 \text{ kN} \cdot \text{m}$ **Ans.**







(For fundamental problem solutions please see the back of your course textbook)