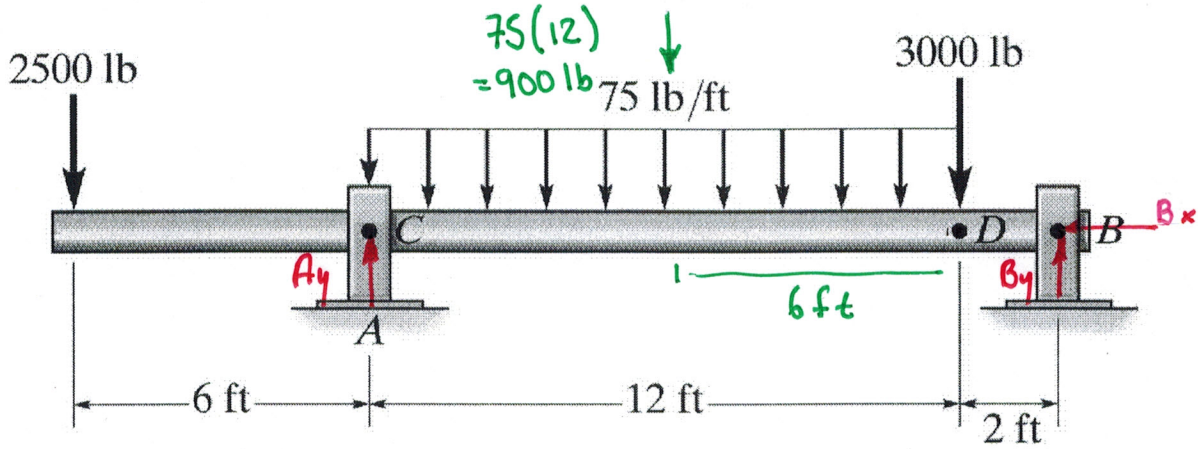
The shaft is supported by a journal bearing at A and a thrust bearing at B. Determine the normal force, shear force, and moment at a section passing through

a) point C, which is just to the right of the bearing at A

b) point D, which is just to the left of the 3000-lb force.



Support Reactions

$\Sigma M_B = 0 \qquad 2500(20) - A_y(14) + 900(8) + 3000(2) = 0$

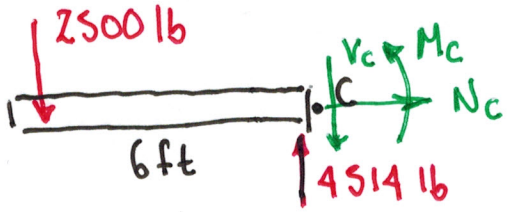
$A_y = 4514 \text{ lb}$

$\Sigma F_x = 0 \qquad B_x = 0$

$\Sigma F_y = 0 \qquad -2500 + 4514 - 900 - 3000 + B_y = 0$

$B_y = 1886 \text{ lb}$

a)



$\Sigma F_x = 0 \qquad N_C = 0$

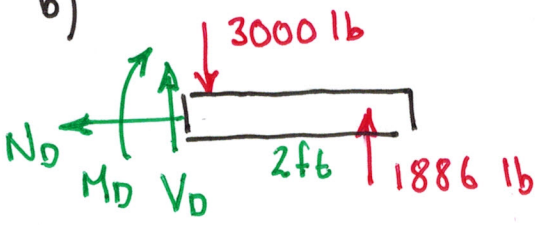
$\Sigma F_y = 0 \qquad -2500 + 4514 - V_C = 0$

$V_C = 2014 \text{ lb} = 2.01 \text{ kip}$

$\Sigma M_C = 0 \qquad M_C + 2500(6) = 0 \qquad M_C = -15{,}000 \text{ lb}\cdot\text{ft}$

$= -15 \text{ kip}\cdot\text{ft}$

b)



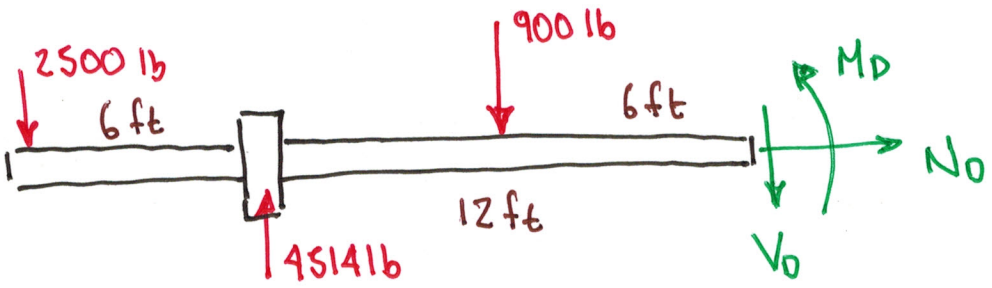
$\Sigma F_x = 0 \qquad N_D = 0$

$\Sigma F_y = 0 \qquad V_D - 3000 + 1886 = 0$

$V_D = 1114\ lb$ or $1.114\ k_{ip}$

$\Sigma M_D = 0 \qquad -M_D + 1886(2) = 0 \qquad M_D = 3771\ lb \cdot ft$

$= 3.77\ k_{ip} \cdot ft$



$\Sigma F_x = 0 \qquad N_D = 0$

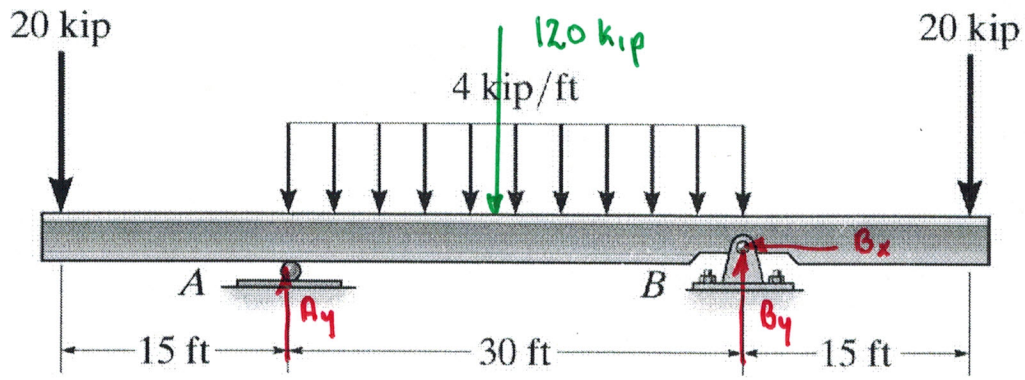
$\Sigma F_y = 0 \qquad -2500 + 4514 - 900 - V_D = 0$

$V_D = 1114\ lb$

$\Sigma M_D = 0 \qquad M_D + 2500(18) - 4514(12) + 900(6) = 0$

$M_D = 3771\ lb \cdot ft$

Draw the shear and moment diagrams for the beam.



Support Reactions

$\Sigma M_B = 0$

$20(45) - A_y(30) + 120(15) - 20(15) = 0$

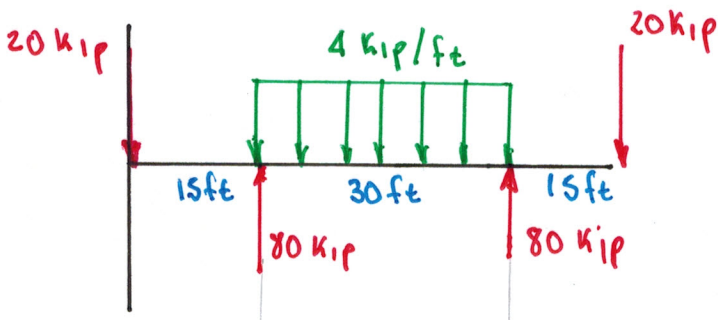
$A_y = 80$ kip

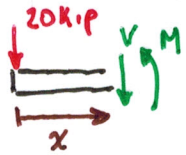
$\Sigma F_y = 0$

$B_y = 80$ kip

$\Sigma F_x = 0$

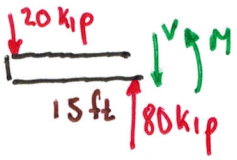
$B_x = 0$ kip





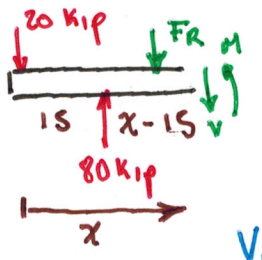
$\Sigma F_y = 0 \quad -20 - V = 0 \quad V = -20$ k

$\Sigma M = 0 \quad M + 20x = 0 \quad M = -20x$



$\Sigma F_y = 0 \quad -20 + 80 - V = 0 \quad V = 60$

$\Sigma M = 0 \quad 20(15) + M = 0 \quad M = -300$



$F_R = (x-15)4$

$\Sigma F_y = 0 \quad -20 + 80 - (x-15)4 - V = 0$

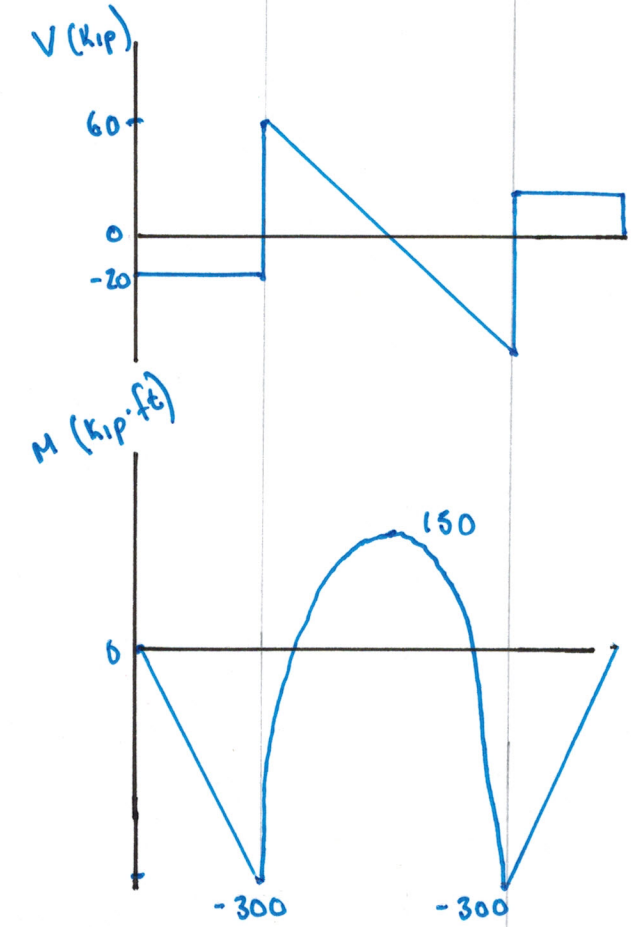
$V = 120 - 4x$

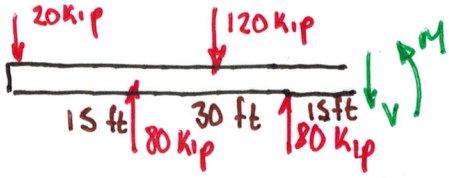
$V_{15} = 60 \quad V_{30} = 0 \quad V_{45} = -60$

$\Sigma M = 0 \quad M + 20(x) - 80(x-15) + (x-15)4\left(\frac{x-15}{2}\right) = 0$

$M - 60x + 1200 + 2(x-15)^2 = 0$

$M_{15} = -300 \quad M_{30} = 150 \quad M_{45} = -300$





$\Sigma F_y = 0 \quad -20 + 80 - 120 + 80 - V = 0 \quad V = 20$

$\Sigma M = 0 \quad 20(60) - 80(45) + 120(30) - 80(15) + M = 0$

$M = 0$

max M occurs when $V = 0$, in this case $x = 15$ or $x = 45$.