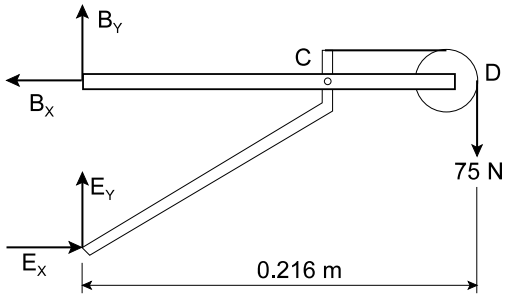
GNG 1105 Problem Set 9 - 8th edition Beer and Johnston

6.163 Freebody = whole frame, find reactions

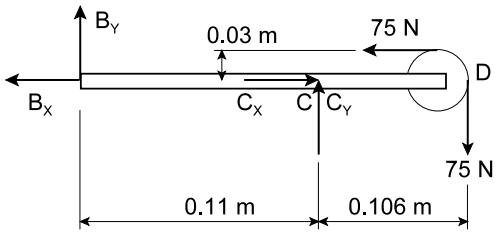


$\Sigma M_B = 0 = 0.095\text{m}\ E_X - 0.216\ \text{m} \times 75\ \text{N}$
$\Sigma F_X = 0 = E_X - B_X$
$\Sigma F_Y = 0 = B_Y + E_Y - 75\ \text{N}$

then $E_X = B_X = 170.5$ N

This is a "collapsible" frame, hence we can't find E_Y and B_Y at this stage, and will only be able to calculate them after we have dismantled the structure.

FB = BD:



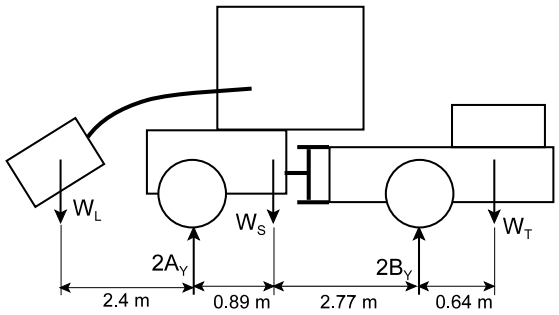
$\Sigma M_C = 0 = -\ 0.11\text{m}\ B_Y - 0.106\text{m} \times 75\ \text{N} +$
$+\ 0.030\text{m} \times 75\ \text{N}$

then **B_Y = -51.8 N** (wrong direction assumed on FBD)

and from the earlier ΣF_Y we have **E_Y = 126.8 N.**

Note: textbook answers wrong.

6.96 (a) Free-body = whole unit, find reactions. Note that we have written $2A_Y$, etc. because there are two wheels on each axle.

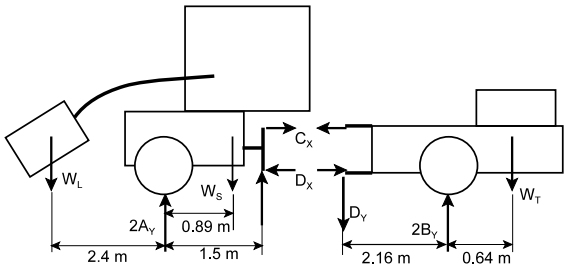


$\Sigma M_A = 0 = 2.4\text{m}\ W_L - 0.89\ \text{m}\ W_S$
$+\ 3.66\ \text{m} \times 2B_Y - 4.3\text{m}\ W$

$\Sigma F_Y = 0 = 2A_Y + 2B_Y - W_L - W_S - W$

which gives **A_Y =15.7 kN, B_Y = 26.3 kN.**

6.96 (b) FB = rear half. Forces at C and D are like those on two bearings. Note that if D_Y acts down on rear half, the load will rest on D; if it acts up, the load will bear on C.



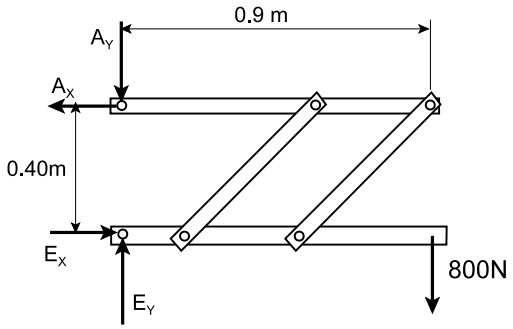
$\Sigma M_D = 0 = 0.61\text{m}\ W_S + 3.9\text{m}\ W_L - 1.5\text{m} \times 2A_Y + 0.75\text{m}\ C_X$

$\Sigma F_X = 0 = -C_X + D_X$

$\Sigma F_Y = 0 = 2A_Y - W_L - W_S + D_Y$

which gives $\mathbf{C_X = D_X = 35.1\ kN,\ D_Y = 2.63\ kN.}$ Answers in the text are not very accurate.

6.109 Free-body = whole frame, find reactions. Note that this is a "collapsible" frame, hence there are four reaction components. FC and GD are 2-force members.



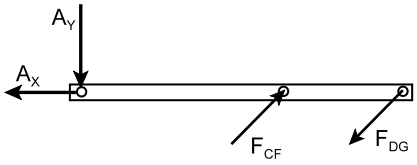
$\Sigma M_E = 0 = 0.4\ \text{m}\ A_X - 0.9\ \text{m} \times 800\ \text{N}$

$\Sigma F_Y = 0 = -A_Y + E_Y - 800\ \text{N}$

$\Sigma F_X = 0 = E_X - A_X$

then $\mathbf{A_X = E_X = 1.80\ kN}$

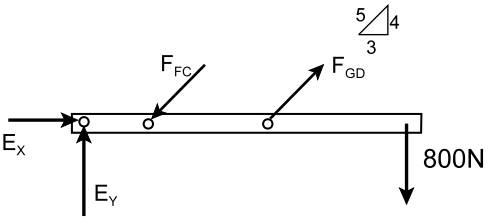
FB = AD:



$\Sigma M_A = 0 = -0.9 \times 4/5\ F_{DG} + 0.6 \times 4/5\ F_{CF}$

$\Sigma F_X = 0 = -A_X + 3/5\ F_{CF} - 3/5\ F_{DG}$

$\Sigma F_Y = 0 = -A_Y + 4/5\ F_{CF} - 4/5\ F_{DG}$

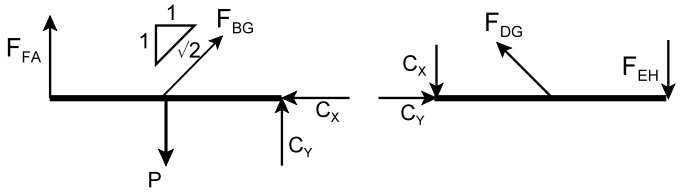


then $\mathbf{A_Y = 2.40\ kN,\ E_Y = 10.4\ kN}$

$\mathbf{F_{CF} = 9.0\ kN\ compression}$

$\mathbf{F_{DG} = 6.0\ kN\ tension}$

6.112 Dismantle, take parts as FB's. (Taking whole thing as FB does not help solution.)
AF, BG, DG and EH are two-force.



FB = AC:
$\Sigma F_X = 0$ gives $C_X = F_{BG} / \sqrt{2}$

FB = CE:

$\Sigma F_X = 0$ gives $C_X = F_{DG} / \sqrt{2}$,
and therefore $F_{DG} = F_{BG}$

$\Sigma M_C = 0 = (a/\sqrt{2}) F_{DG} - 2a F_{EH}$

$\Sigma F_Y = 0 = -C_Y - F_{EH} + F_{DG} / \sqrt{2}$

from which $C_Y = F_{EH} = F_{BG} / 2\sqrt{2}$

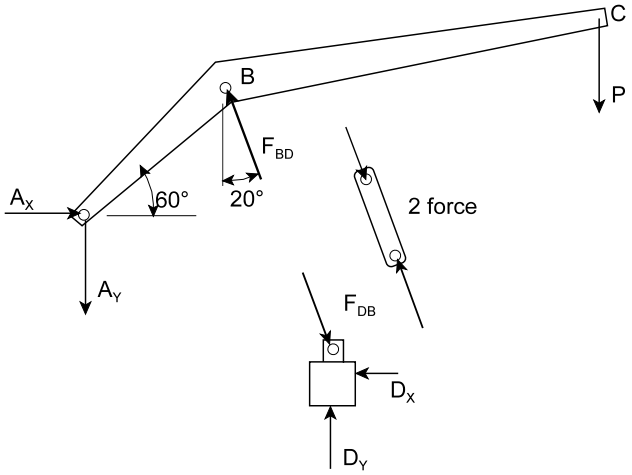
FB = AC:

$\Sigma M_B = 0 = - a F_{FA} + a C_Y$

$\Sigma F_Y = 0 = F_{FA} + C_Y - P + F_{BG}/\sqrt{2}$

from which $\mathbf{F_{BG} = F_{DG} = P/\sqrt{2}}$, both in tension;
$\mathbf{C_Y = F_{FA}}$ **(tension)** $\mathbf{= F_{EH}}$ **(compression)** $\mathbf{= P/4}$

6.121 Dismantle, take parts as FB's. BC is two-force.



FB = stamp D:

$\Sigma F_Y = 0 = D - F_{DC} \cos 20°$

then $\mathbf{F_{DC} = 958\ N}$

FB = arm ABC:

$\Sigma M_A = 0 = 0.20\ m\ F_{BD} \sin (20° + 30°)$
$- (0.2\ m \cos 60° + 0.4\ m \cos 15°) P$

then $\mathbf{P = 302\ N}$