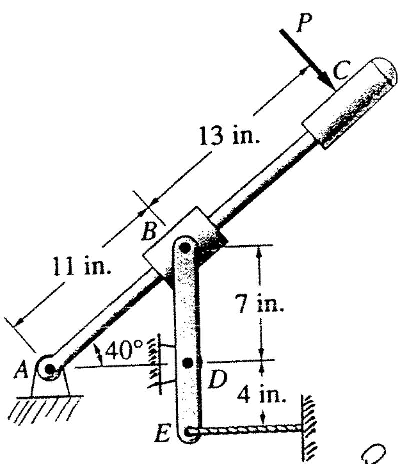
Determine the force **P** that would produce a tensile force of 25 lb in the cable at E. Also determine the pin reaction at D. Neglect the weight of the members. The sliding bushing at B is frictionless.

Given: $T_E = 25$ lb, slider is frictionless
neglect weights

FIND: P, reaction at D



Plan

unknowns = 6 ($A_x, A_y, D_x, D_y, P, N_B$)

independent eqs available = 6

∴ sol^n is possible

Strategy

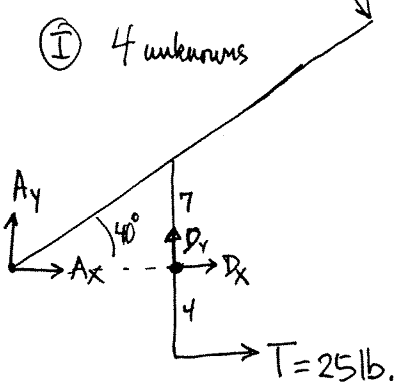
III $\sum M_D = 0 \Rightarrow N_B$

III $\sum F_x = 0 \Rightarrow N_B, D_x$

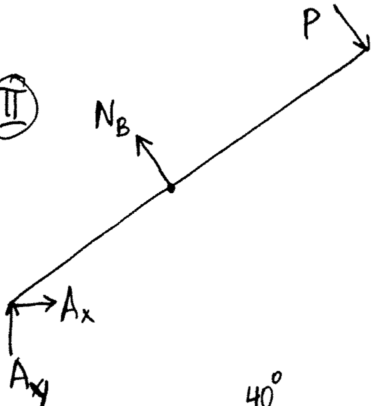
III $\sum F_y = 0 \Rightarrow N_B, D_y$

II $\sum M_A = 0 \Rightarrow N_B, P$

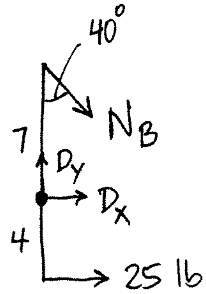
I 4 unknowns



II



III



Analysis

III $\circlearrowleft + \ \sum M_D = 0 = -(N_B \sin 40°)(7) + 25(4) = -4.5N_B + 100$

$\boxed{N_B = 22.22 \text{ lb}}$

III $\overset{+}{\rightarrow} \sum F_x = 0 = 25 + D_x + 22.22 \sin 40° = 25 + D_x + 14.28$

$\boxed{D_x = -39.28 \text{ lb}}$

III $+\uparrow \sum F_y = 0 = D_y - N_B(\cos 40°) = D_y - 17.02$

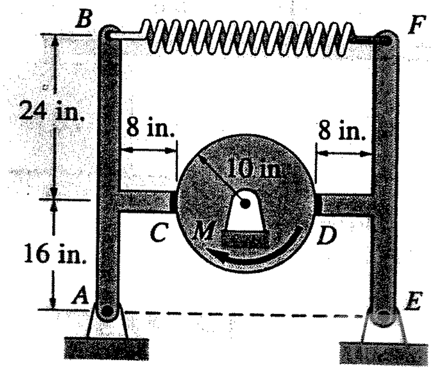
$\boxed{D_y = 17.02 \text{ lb}}$

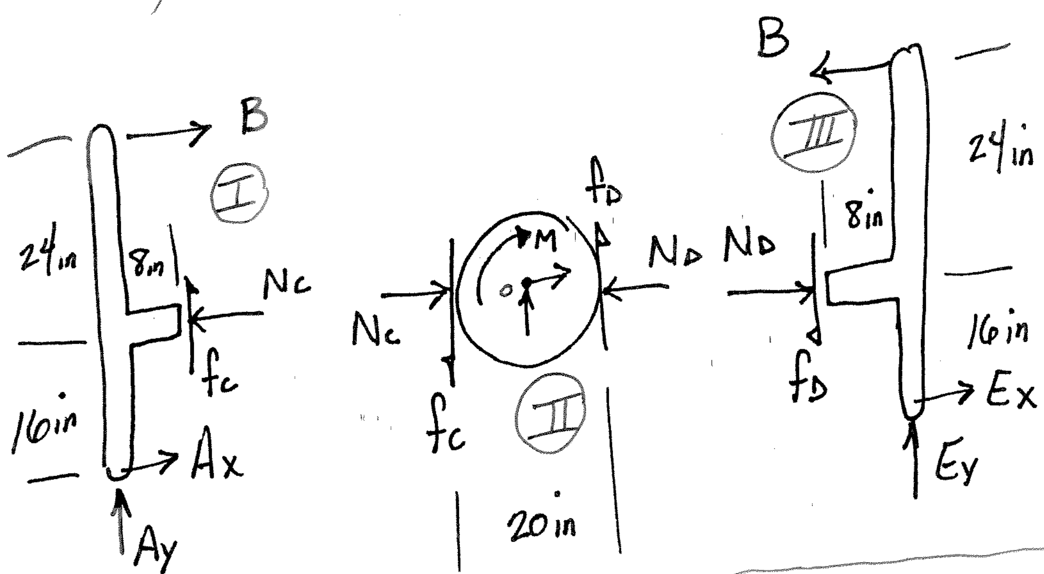
II $\circlearrowleft + \ \sum M_A = 0 = N_B(11) - P(24) = 244.444 - 24P$

$\boxed{P = 10.18 \text{ lb}}$

The brake pads at C and D are pressed against the cylinder by the spring BF. The coefficient of static friction between the pads and the cylinder is 0.2. Find the smallest tension in the spring that would prevent the cylinder from rotating when the clockwise couple $M = 3000$ lb · in. is applied. Neglect the weights of the members.

Given: $\mu = 0.2$, $M = 3000$ lb·in FIND F_{spring}





Note:
You CAN NOT assume $f_c = f_D$ or $N_c = N_D$ (there are pin reactions at the center of the cylinder)

PLAN

I $\Sigma M_A \rightarrow N_c, f_c, B$

II $\Sigma M_o \rightarrow f_D, f_c$

III $\Sigma M_E \rightarrow N_D, f_D, B$

Slips at C and D at the same time so both friction forces will reach their max. values just as equilibrium is disturbed

$f_c = 0.2\,N_c$, $f_D = 0.2\,N_D$

5 equations - 5 unknowns - solvable!

II ΣM_o: $f_D(10) + f_c(10) - 3000 = 0$ $.2N_c + .2N_D = 300$

$N_D = 1500 - N_c$

I $\Sigma M_A = -B(40) + N_c(16) + (.2N_c)(8) = 0$

$B = 0.44\,N_c$ $N_c = 2.27\,B$ $N_D = 1500 - 2.27\,B$

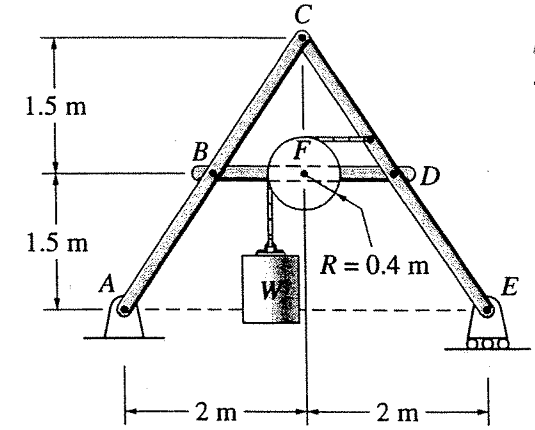
III $\Sigma M_E = B(40) - N_D(16) + (.2N_D)(8) = 0$

$40B - 14.4(1500 - 2.27B) = 0$

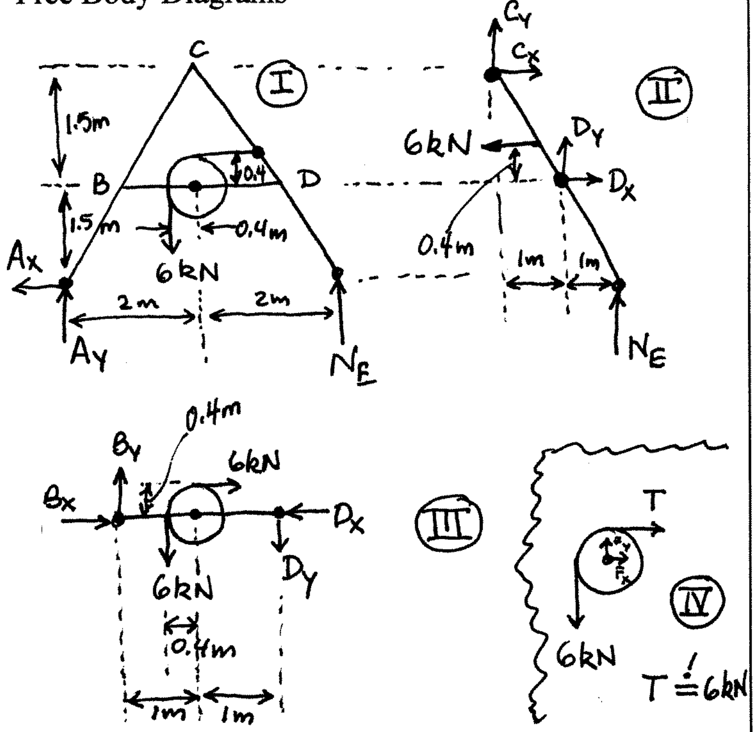
$72.69\,B = 21600$ $\boxed{B = 297 \text{ lb}}$

The weight W = 6 kN hangs from the cable, which passes over a frictionless pulley at F. Neglecting the weights of the bars and the pulley, determine the magnitude of the pin reaction at D.

FIND: $|D|$



Free Body Diagrams



Plan

(I) $\Sigma M_A = 0 \Rightarrow N_E$

(III) $\Sigma M_B = 0 \Rightarrow D_y$

(II) $\Sigma M_C = 0 \Rightarrow D_x, D_y, N_E$

$\therefore$ 3 unknowns $\Rightarrow N_E, D_x, D_y$ and 3 independent equations

Solution for D_x & D_y

Analysis

(I) $\circlearrowleft + \ \Sigma M_A = 0 = -6(1.6\text{m}) + N_E(4)$

$$N_E = \frac{9.6}{4} = 2.4\text{ kN}$$

$$\boxed{N_E = 2.4\text{ kN}}$$

(III) $\circlearrowleft + \ \Sigma M_B = 0 = -6(0.6) - 6(0.4) - D_y(2)$

$$D_y = -\frac{3.6 + 2.4}{2} = -3\text{ kN}$$

$$\boxed{D_y = -3\text{ kN}}$$

(II) $\circlearrowleft + \ \Sigma M_C = 0 = -6(1.1) + D_y(1) + D_x(1.5) + N_E(2)$

$$D_x = \frac{6(1.1) - (-3)(1) - 2.4(2)}{1.5} = \frac{6.6 + 3 - 4.8}{1.5}$$

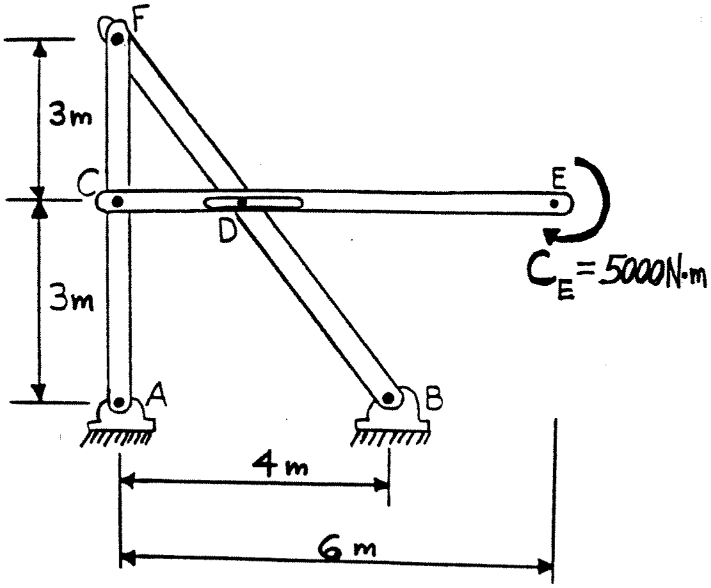
$$\boxed{D_x = 3.2\text{ kN}}$$

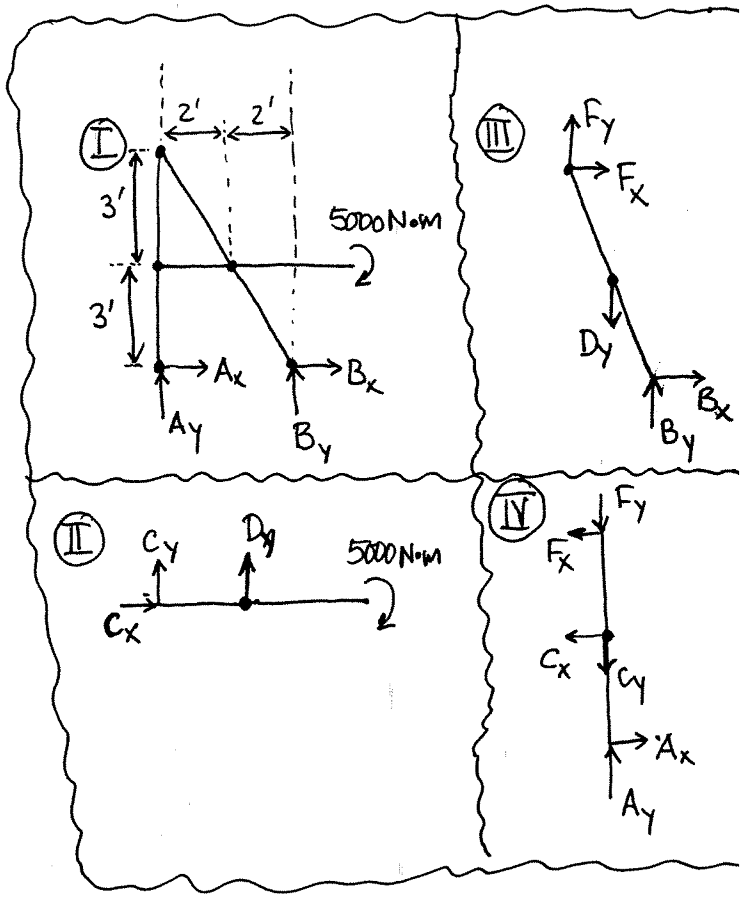
$|D| =$ 4.39 kN

The frame shown is in equilibrium. Neglecting the weights of the members and assuming that all pins and the horizontal "slot" are frictionless, then determine the pin forces at pins B, C, and D.

Given: frictionless slot at D

Find: Reactions at B, C, and D





Plan/Strategy

I $\Sigma M_A = 0 \Rightarrow B_y$

II $\Sigma M_C = 0 \Rightarrow D_y$

II $\Sigma F_x = 0 \Rightarrow C_x$

II $\Sigma F_y = 0 \Rightarrow C_y, D_y$

III $\Sigma M_F = 0 \Rightarrow B_x, B_y, D_y$

Analysis

I $\Sigma M_A = 0 = B_y(4) - 5000$ N·m

$\boxed{B_y = 1250 \text{ N} \uparrow}$

II $\Sigma M_C = 0 = D_y(2) - 5000$

$\boxed{D_y = 2500 \text{ N} \uparrow}$

II $\overset{+}{\rightarrow} \Sigma F_x = \boxed{0 = C_x}$

II $+\uparrow \Sigma F_y = 0 = D_y + C_y$

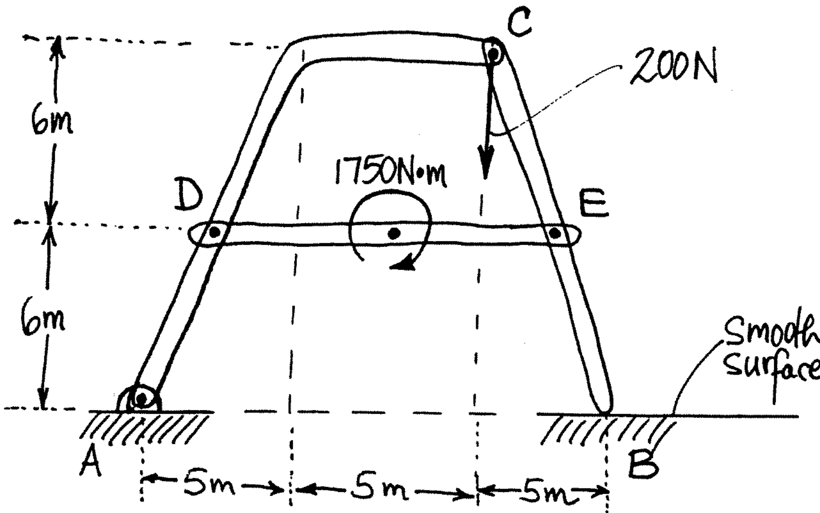
$\boxed{C_y = -D_y = 2500 \text{ N} \downarrow}$

III $\Sigma M_F = 0 = -D_y(2) + B_x(6) + B_y(4)$

$= -2500(2) + 6B_x + 1250(4) \Rightarrow \boxed{B_x = C}$

For the 3-member body loaded with the applied force and couple, as shown in the figure, determine the reactions at A, B, and C. The horizontal surface upon which B rests is smooth.

Given ↴ Find: Reactions at A, B, and C



Strategy / Plan

I $\Sigma M_A = 0 \Rightarrow B_y$

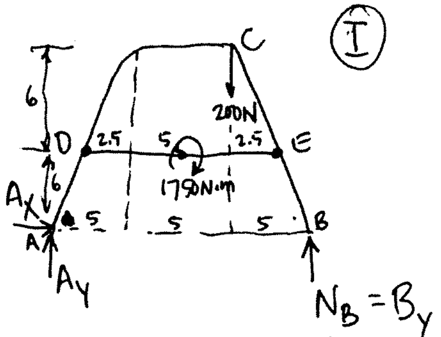
I $\Sigma F_y = 0 \Rightarrow A_y, B_y$

I $\Sigma F_x = 0 \Rightarrow A_x = 0$

II $\Sigma M_D = 0 \Rightarrow A_x, A_y, C_x, C$

III $\Sigma M_E = 0 \Rightarrow B_y, C_x, C_y$

5 unknowns $\Rightarrow A_x, A_y, B_y, C_x, C$
5 eqs.



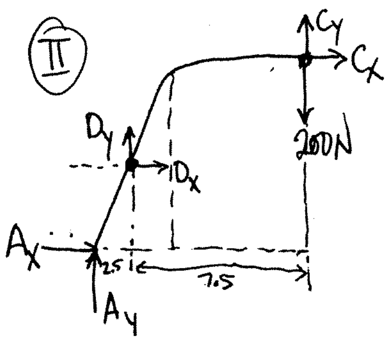
$\boxed{1}$ I $\circlearrowleft_+ \ \Sigma M_A = 0 = +1750 - 200(10) + B_y(15)$

$$\boxed{B_y = \frac{3750}{15} = 250\,N}$$

$\boxed{2}$ I $+\uparrow \Sigma F_y = 0 = A_y - 200 + 250$

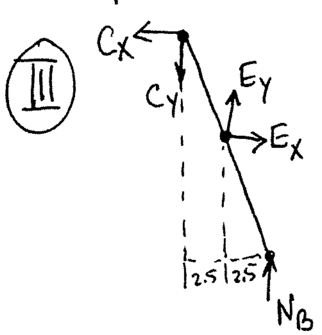
$$\boxed{A_y = -50N}$$

$\boxed{3}$ I $\underset{+}{\rightarrow} \Sigma F_x = 0 \Rightarrow \boxed{A_x = 0}$



$\boxed{4}$ II $\circlearrowleft_+ \ \Sigma M_D = 0 = -200(7.5) - (-50)(2.5) - C_x(6) + C_y(7.5)$

$$6\,C_x - 7.5\,C_y = -1500 + 125 = -1375$$



$\boxed{5}$ III $\circlearrowleft_+ \ \Sigma M_E = 0 = 250(2.5) + C_x(6) + C_y(2.5) \cancel{+6C_x}$

$$6\,C_x + 2.5\,C_y = -625$$

Solve last 2 eqs. simultaneously

Subtract $\boxed{5}$ from $\boxed{4}$

$$-10\,C_y = -750$$

$$\boxed{C_y = 75N}$$

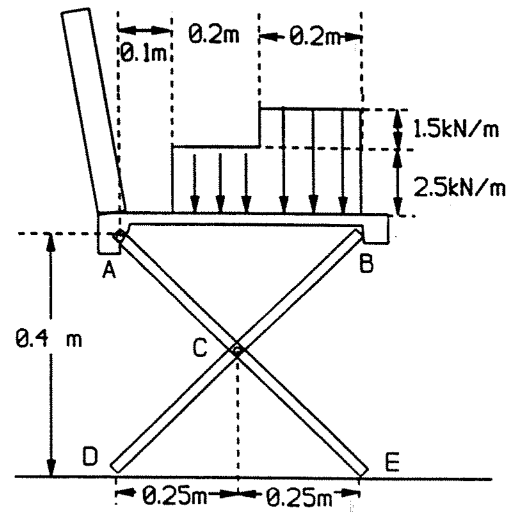
substitute into $\boxed{4}$

$$6C_x = +7.5(75) - 1375 = 562.5 - 1375$$

$$\boxed{C_x = \frac{-812.5}{6} = -135.4\,N}$$

A folding chair pinned at points A and C rests on a smooth surface. A child and an adult sitting on the chair exert a distributed load over the front 0.4 m of the chair, as shown. Neglecting the weight of the members, calculate the magnitudes of the reactions at points D, C, and B.

Given ↓ Find B_x, B_y, C_x, C_y, N_D



Plan/Strategy

(I) $\Sigma M_E = 0 \Rightarrow N_D$

(II) $\Sigma M_A = 0 \Rightarrow B_y$

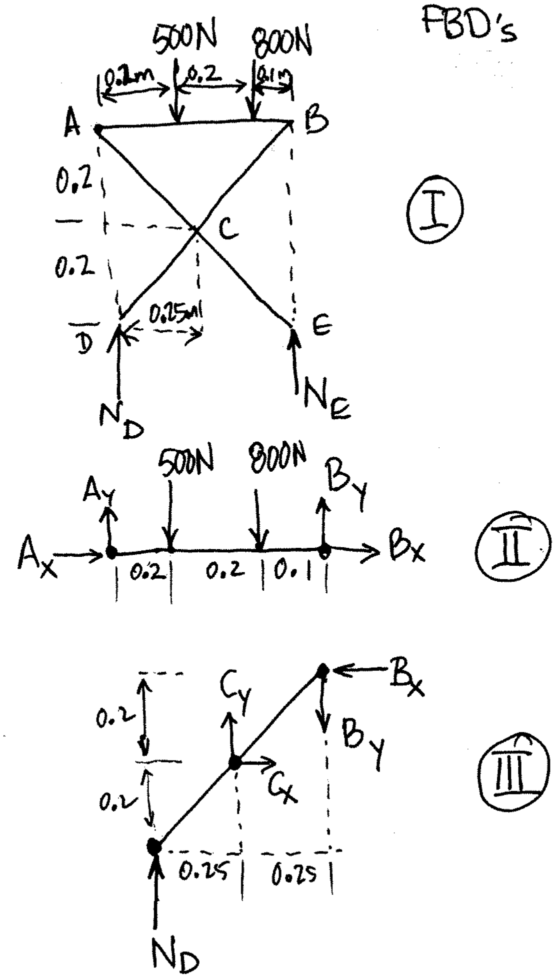
(III) $\Sigma M_C = 0 \Rightarrow N_D, B_y, B_x$

(III) $\Sigma F_x = 0 \Rightarrow C_x, B_x$

(III) $\Sigma F_y = 0 \Rightarrow C_y, B_y, N_D$

∴ 5 unknowns and 5 equations

FBD's



(I)

$$\circlearrowleft + \; \Sigma M_E = 0 = 800(0.1) + 500(0.3) - N_D(0.5)$$

$$\boxed{N_D = \frac{80+150}{0.5} = 460\,N}$$

(II)

$$\circlearrowleft + \; \Sigma M_A = 0 = -500(0.2) - 800(0.4) + B_y(0.5)$$

$$\boxed{B_y = \frac{100+320}{0.5} = \frac{420}{0.5} = 840\,N}$$

(III)

$$\circlearrowleft + \; \Sigma M_C = 0 = -N_D(0.25) + B_x(0.2) - B_y(0.25)$$

$$\boxed{B_x = \frac{+460(0.25) + 840(0.25)}{0.2} = \frac{210+115}{0.2} = 1625\,N}$$

(III)

$$\overset{+}{\rightarrow} \Sigma F_x = 0 = C_x - B_x$$

$$\boxed{C_x = B_x = 1625\,N}$$

(III)

$$+\uparrow \Sigma F_y = 0 = N_D + C_y - B_y$$

$$\boxed{C_y = B_y - N_D = 840 - 460 = 380\,N}$$