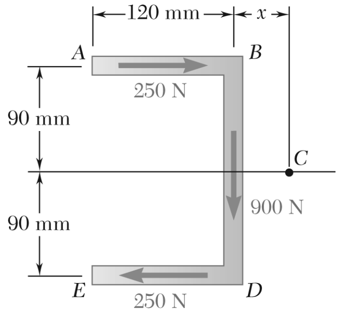
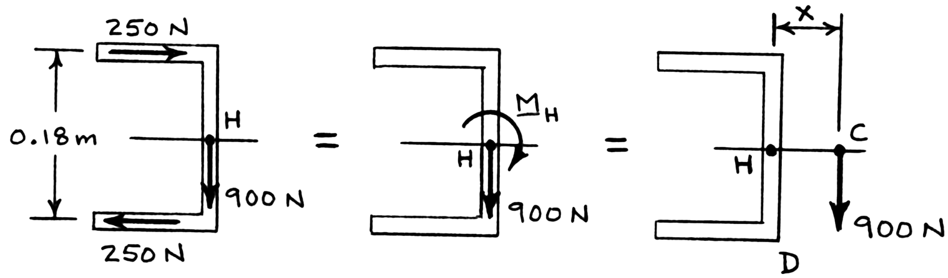


PROBLEM 3.91

The shearing forces exerted on the cross section of a steel channel can be represented by a 900-N vertical force and two 250-N horizontal forces as shown. Replace this force and couple with a single force **F** applied at Point *C*, and determine the distance *x* from *C* to line *BD*. (Point *C* is defined as the *shear center* of the section.)

SOLUTION

Replace the 250-N forces with a couple and move the 900-N force to Point *C* such that its moment about *H* is equal to the moment of the couple



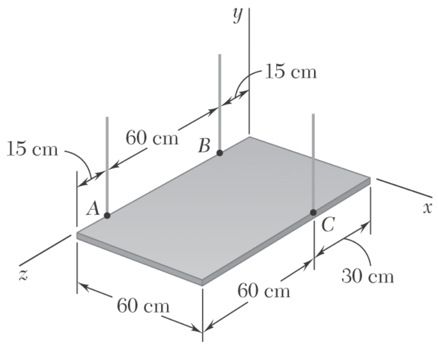
$$M_H = (0.18)(250\text{ N})$$
$$= 45\text{ N}\cdot\text{m}$$

Then $$M_H = x(900\text{ N})$$

or $$45\text{ N}\cdot\text{m} = x(900\text{ N})$$
$$x = 0.05\text{ m}$$

$\mathbf{F} = 900\text{ N}\downarrow \quad x = 50.0\text{ mm}$ ◀

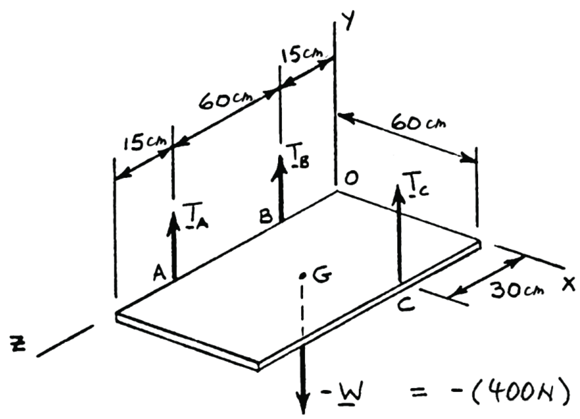
PROBLEM 4.103



The rectangular plate shown weighs 400 N and is supported by three vertical wires. Determine the tension in each wire.

SOLUTION

Free-Body Diagram:



$$\Sigma \mathbf{M}_B = 0: \quad \mathbf{r}_{A/B} \times T_A\mathbf{j} + \mathbf{r}_{C/B} \times T_C\mathbf{j} + r_{G/B} \times (-400 \text{ N})\mathbf{j} = 0$$

$$(60 \text{ cm})\mathbf{k} \times T_A\mathbf{j} + [(60 \text{ cm})\mathbf{i} + (15 \text{ cm})\mathbf{k}] \times T_C\mathbf{j} + [(30 \text{ cm})\mathbf{i} + (30 \text{ cm})\mathbf{k}] \times (-400 \text{ N})\mathbf{j} = 0$$

$$-60T_A\mathbf{i} + 60T_C\mathbf{k} - 15T_C\mathbf{i} - 12000\mathbf{k} + 12000\mathbf{i} = 0$$

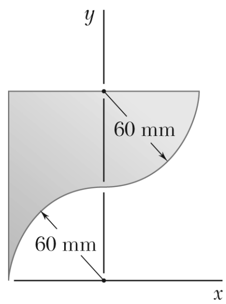
Equating to zero the coefficients of the unit vectors:

$$\mathbf{k}: \quad -60T_A - 15(200) + 12000 = 0 \qquad T_A = 150 \text{ N} \blacktriangleleft$$

$$\mathbf{i}: \quad 60T_C - 12000 = 0 \qquad T_C = 200 \text{ N} \blacktriangleleft$$

$$\Sigma F_y = 0: \quad T_A + T_B + T_C - 400 \text{ N} = 0$$

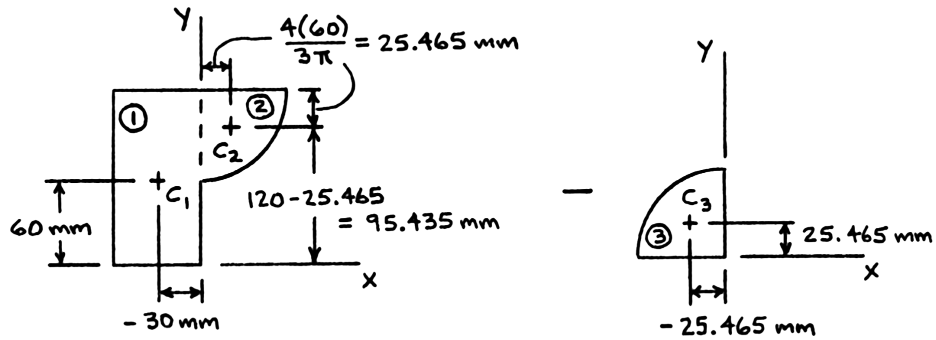
$$150 \text{ N} + T_B + 200 \text{ N} - 400 \text{ N} = 0 \qquad T_B = 50 \text{ N} \blacktriangleleft$$



PROBLEM 5.8

Locate the centroid of the plane area shown.

SOLUTION



	A, mm^2	$\bar{x}$, mm	$\bar{y}$, mm	$\bar{x}A$, mm^3	$\bar{y}A$, mm^3
1	$(60)(120) = 7200$	-30	60	-216×10^3	432×10^3
2	$\frac{\pi}{4}(60)^2 = 2827.4$	25.465	95.435	72.000×10^3	269.83×10^3
3	$-\frac{\pi}{4}(60)^2 = -2827.4$	-25.465	25.465	72.000×10^3	-72.000×10^3
Σ	7200			-72.000×10^3	629.83×10^3

Then $\bar{X}A = \Sigma\bar{x}A$ $\quad \bar{X}(7200) = -72.000\times10^3$ $\quad \bar{X} = -10.00$ mm ◀

$\bar{Y}A = \Sigma\bar{y}A$ $\quad \bar{Y}(7200) = 629.83\times10^3$ $\quad \bar{Y} = 87.5$ mm ◀