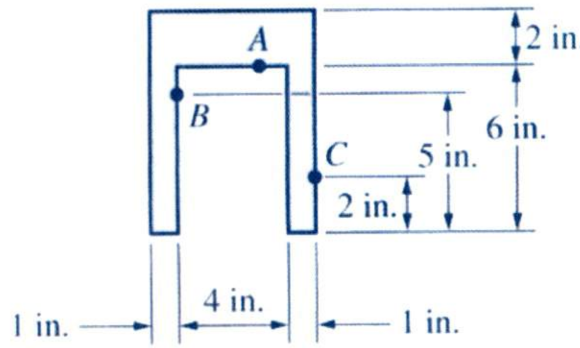
14-23

A beam having the channel section shown in Fig. P14-23 is subjected to a maximum shear force of 10 kips. Determine the shear stresses at points A, B, and C.

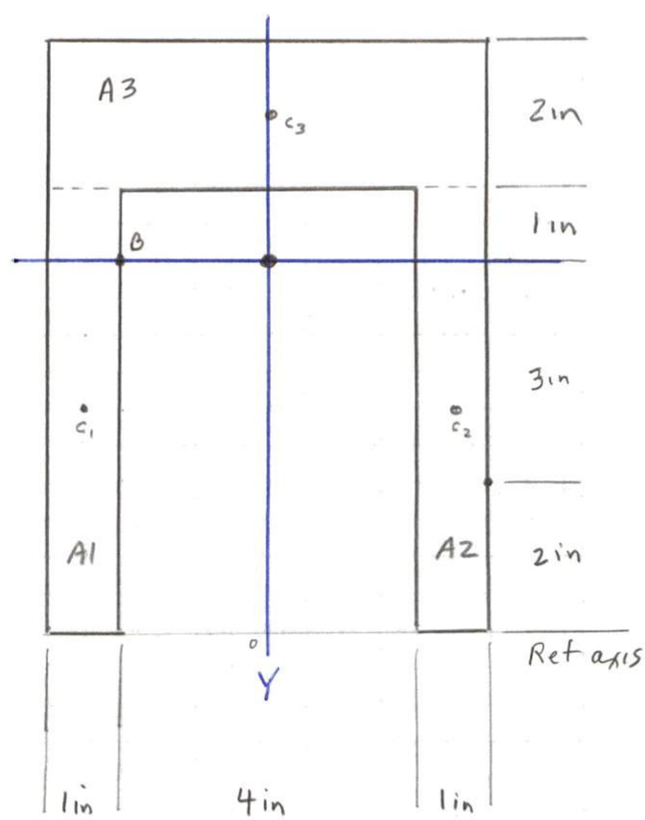
Solution.



Review – locate the centroidal x-x axis and determine the moment of Inertia, I_x.

Shape	Area	y	Ay	$\bar{y}-y$	$A(\bar{y}-y)^2$	I $(bh^3/12)$
A1	$1\times6=6$	3	18	2	24	18
A2	$1\times6=6$	3	18	2	24	18
A3	$6\times2=12$	7	84	-2	48	4
	24		120		96	40

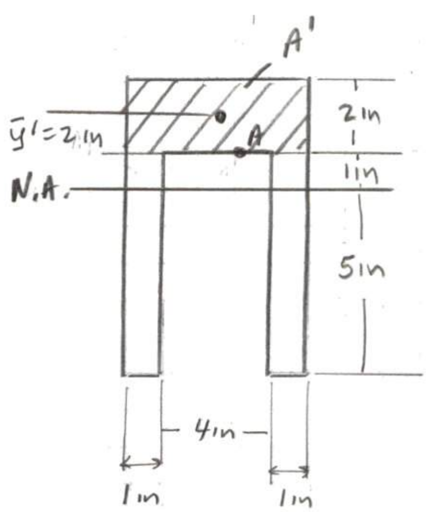
N.A.



$$\bar{y}=\frac{120}{24}=5 \text{ in}$$

$$\bar{I}=\Sigma\left[I+A(\bar{y}-y)^2\right]=40+96=136 \text{ in}^4$$

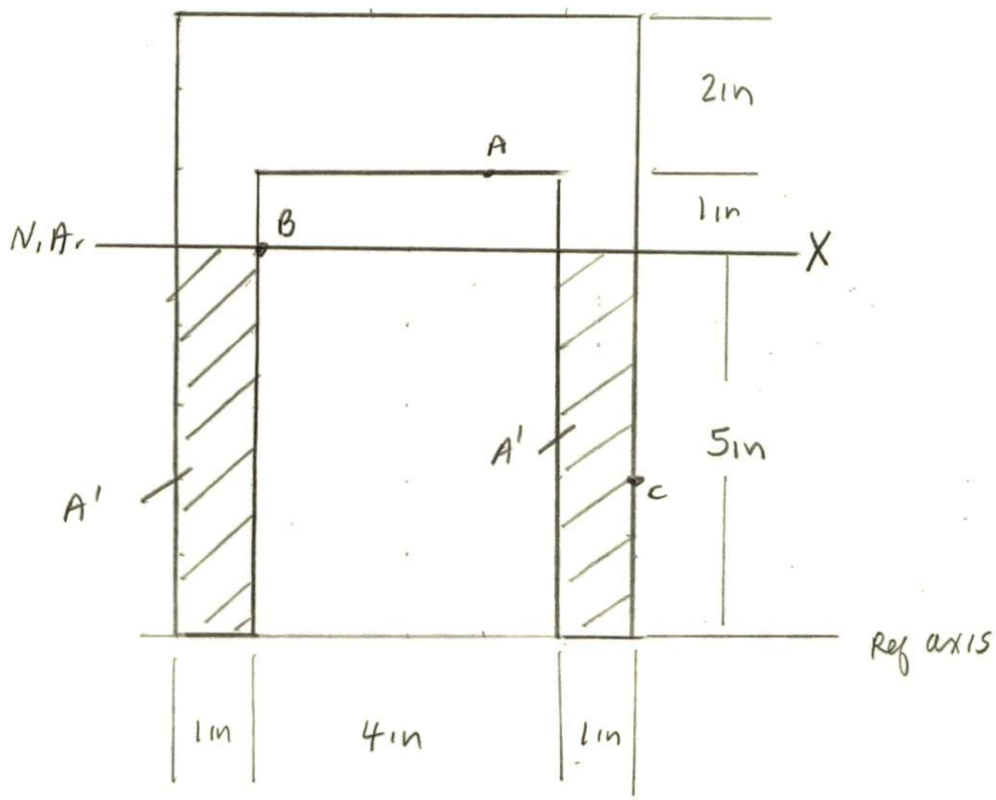
(a) Shear stress at point A



$$Q=6\text{in}(2\text{in})(2\text{in})=24 \text{ in.}^3$$

$$\tau_A=\frac{VQ}{It}=\frac{10\text{ kips}(24\text{ in.}^3)}{136\text{ in}^4(6\text{in})}=0.294\text{ ksi}=294\text{ psi}$$

(b) Shear stress at point B



$$Q = A'\bar{y}' = 2(1\times5)(2.5) = 25\ in.^3$$

$$\tau_B = \frac{VQ}{It} = \frac{10{,}000\ lb\ (25\ in.^3)}{136\ in^4\ (2\ in)} = \underline{\underline{919}}\ psi$$

(c) Shear stress at point c

$$Q = A'\bar{y}' = 2(1in)(2in)(4in) = 16\ in^3$$

$$\tau_c = \frac{VQ}{It} = \frac{10{,}000\ lb\ (16\ in^3)}{136\ in^4\ (2in)} = \underline{\underline{588}}\ psi$$