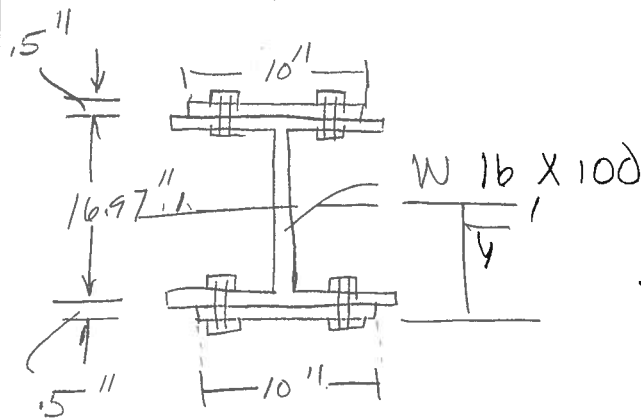


A steel beam is built up from a W16 X 100 wide flange beam with two 10 in x 1/2 in. cover plates as shown. The cover plates are attached with 2 bolts on the top flange and 2 bolts on the bottom flange as shown. The allowable shear load for each bolt is 3 K. What is the required bolt spacing s along the length of the beam if the shear force in the beam is $V = 35$ K.



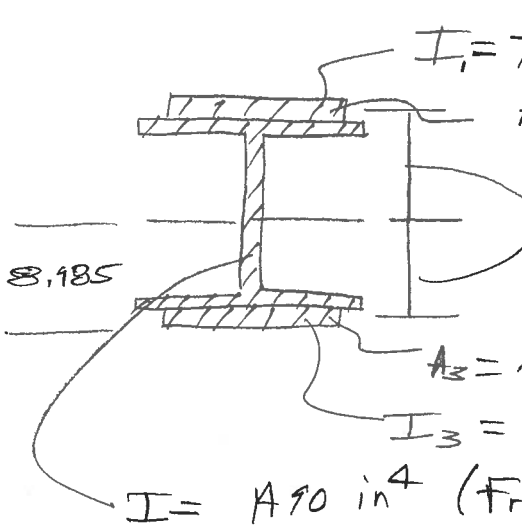
From Table
 $I_{x-x} = 1490 \text{ in}^4$

The construction of this beam is symmetric

so

$$(1) \quad \bar{y} = \frac{16.97}{2} + 0.5$$

$$(2) \quad \bar{y} = 8.985 \text{ in}$$



$$I_1 = \frac{1}{12} (10)(.5)^3 = .104 \text{ in}^4$$

$$A_1 = (10)(.5) = 5 \text{ in}^2$$

$$8.985 - .25 = 8.735 \text{ in}$$

$$A_3 = 10(.5) = 5 \text{ in}^2$$

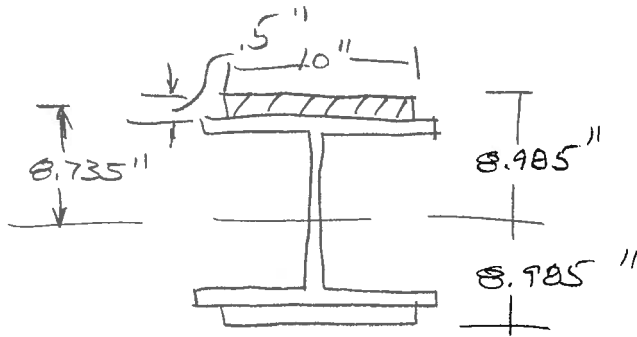
$$I_3 = \frac{1}{12} (10)(.5)^3 = .104 \text{ in}^4$$

$$I = 1490 \text{ in}^4 \text{ (From Table)}$$

$$\begin{aligned} \cong I &= .104 + 5(8.735)^2 \\ &\quad + 1490 \\ &\quad + .104 + 5(8.735)^2 \end{aligned}$$

$$\text{A) } \underline{I = 1819.1 \text{ in}^4}$$

Two bolts connect the upper cover plate to the W16x100 and two bolts connect the lower cover plate to the W16x100. Because of symmetry the shear flows for the upper and the lower cover plates will be the same. We will analyze the upper cover plate.



$$(5) \quad Q_{\text{Top Plate}} = (10)(.5)(8.735)$$

$$(6) \quad Q_{\text{Top Plate}} = \underline{43.675 \text{ in}^3}$$

The shear flow is then given as follows

$$(7) \quad q = \frac{VQ}{I}$$

$$(8) \quad q_{\text{rad}} = \frac{(35000 \text{ lb})(43.675 \text{ in}^3)}{1819.1 \text{ in}^4}$$

$$(9) \quad \underline{q_{\text{rad}} = 840.3 \frac{\text{lb}}{\text{in}}}$$

$$(10) \quad q_{\text{avail}} = \frac{(2)(3000 \text{ lb})}{S}$$

$$(11) \quad q_{\text{rad}} = 840.3 \frac{\text{lb}}{\text{in}} = \frac{2(3000 \text{ lb})}{S} = q_{\text{avail}}$$

$$(12) \quad \underline{S = 7.14 \text{ in}}$$