$$\therefore \sigma = \frac{M}{I} \times y$$

$$= \frac{12000000}{3142222.4} \times 32.23$$

$$= 123.08 \text{ N/mm}^2.$$

Shear Centre:

→ Shear Centre is also known as 'Centre of Twist'.

→ The Shear Centre (for any transverse Section of the beam) is the point of intersection of the bending axis & the plane of transverse Section.

Principle of Shear Centre

The Principle involved in Locating the Shear Centre for a Cross-Section of beam is that the Loads acting on the beam must lie in plane which contains the resultant shear force on each Cross-Section of the beam as computed from the shear stresses produced in the beam when it is loaded So, that it does not twist at its ends.

Shear Centre for channel Section :

$$e = \frac{3b}{6 + \frac{A_w}{A_f}}$$

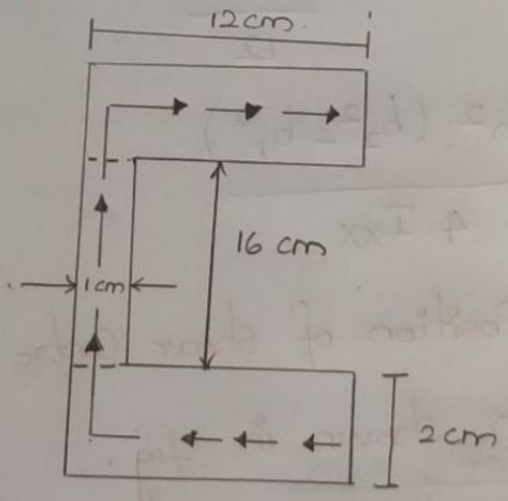
A_f (Area of flange) $= b \times t_1$.

A_w (Area of Web) $= h \times t_2$.

$$e = \frac{b^2 h^2 t_1}{4 I_{xx}}.$$

$$I_{xx} = \frac{h^2}{12}(t_2 h + 6 b t_1)$$

1) A channel Section has flanges 12 cm x 2cm & Web 16cm x 1cm. Determine the shear Centre of the channel



Here $b = 12 - 0.5 = 11.5$ cm.

$t_1 = 2$ cm, $t_2 = 1$ cm, $h = 18$ cm.

$A_w = h t_2 = 18 \times 1 = 18\ cm^2$

$A_f = b t_1 = 11.5 \times 2 = 23\ cm^2$

W.K.T, $e = \dfrac{3b}{6 + \dfrac{A_w}{A_f}} = \dfrac{3 \times 11.5}{6 + \dfrac{18}{23}}$

$= 5.086\ cm.$

Hence, the position of shear centre = 5.086 cm.

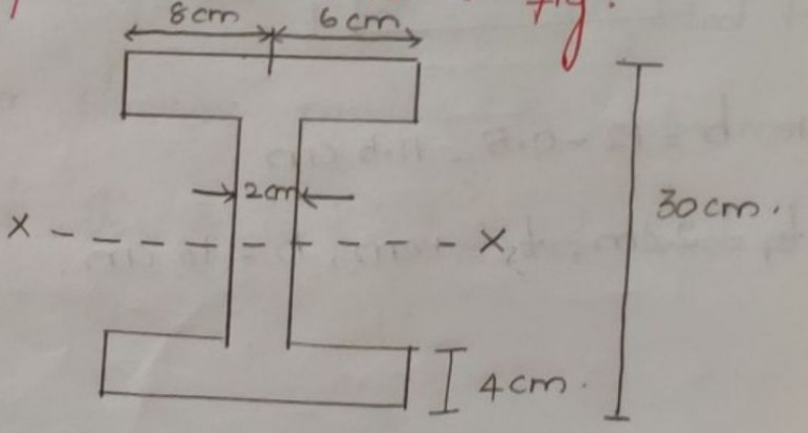
Shear Centre for Unequal I-Section.

Shear stress in any Layer $\tau = \dfrac{S A \bar{y}}{I t}$

$$I_{xx} = 2\left[(b_1+b_2)\frac{t_1^3}{12} + (b_1+b_2)t_1 \times \frac{h^2}{4}\right] + \frac{t_2 h^3}{12}$$

$$e = \frac{t_1 h^2 (b_2^2 - b_1^2)}{4 I_{xx}}$$

1) Determine the Position of shear centre of the Section of Beam shown in fig.



$t_1 = 4\,cm$

$b_1 = 6\,cm$

$b_2 = 8\,cm.$

$h = 30 - 4 = 26\,cm$

$$I_{xx} = 2\left[\frac{14\times4^3}{12} + 14\times4\times13^2\right] + \frac{2\times22^3}{12}$$

$$= 2(74.67 + 9464) + 1774.67$$

$$= 20852\ cm^4.$$

W.K.T, $$e = \frac{t_1 h^2 (b_2^2 - b_1^2)}{4\, I_{xx}}.$$

$e \rightarrow$ Distance of shear centre from the centre of Web.

$$e = \frac{4\times26^2(8^2 - 6^2)}{4\times20852} = 0.9077\ cm.$$