



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

DEPARTMENT OF AEROSPACE ENGINEERING



Subject Code & Name: 19AST203 Aircraft Structural Mechanics

TOPIC: Shear flow in open sections with one axis of symmetry

6-07-24

1) Sketch the shear flow pattern when thin wall angle section in fig is subjected to 50 kN load inclined 50° to horizontal. wall thickness is 1.6 mm through out.

$t = 1.6 \text{ mm}$

20 cm

50°

20

Soln:-

| Element | A | x | y | Ax | Ay | Ax ² | Ay ² | Axy | I _{cx} | I _{cy} |
|---------|-----|----|----|----|----|-----------------|-----------------|-----|--|--|
| 1 | 3.2 | 0 | 10 | 0 | 32 | 0 | 320 | 0 | 13.31×10^3 106.66 | 13.31×10^3 6.8×10^3 |
| 2 | 3.2 | 10 | 0 | 32 | 0 | 320 | 0 | 0 | 13.31×10^3 6.8×10^3 | 13.31×10^3 106.66 |
| 3 | 6.4 | 10 | 10 | 64 | 32 | 320 | 320 | 0 | 106.66 26.6×10^3 | 106.66 26.6×10^3 |

$$\bar{x} = \frac{\sum Ax}{\sum A} = \frac{32}{6.4}$$

$$\bar{x} = 5 \text{ cm}$$

$$\bar{y} = \frac{\sum Ay}{\sum A}$$

$$\bar{y} = \frac{32}{6.4}$$

$$I_{xx} = \sum I_{cx} + \sum AY^2 - \sum A\bar{Y}^2$$

$$I_{xx} = 106.66 + 320 - 6.4(5)^2$$

$$I_{xx} = 266.66 \text{ cm}^4$$

$$I_{yy} = \sum I_{cy} + \sum AX^2 - \sum A\bar{X}^2$$

$$I_{yy} = 106.66 + 320 - 6.4(5)^2$$

$$I_{yy} = 266.66 \text{ cm}^4$$

$$I_{xy} = \sum Axy - \sum A\bar{x}\bar{y}$$

$$I_{xy} = 0 - 6.4(5)(5)$$

$$I_{xy} = -160 \text{ cm}^4$$

$$S_x = 50 \times \cos 50^\circ$$

$$S_x = 32.13 \times 10^3 \text{ N}$$

$$S_y = 50 \times \sin 50^\circ$$

$$S_y = 38.30 \text{ N}$$

$$q = -\frac{\bar{S}_y}{I_{xx}} \int yt \, ds - \frac{\bar{S}_x}{I_{yy}} \int xt \, ds$$

$$q = -\frac{38.30 \times 10^3}{266.67} \int y(0.16) \, ds - \frac{32.13 \times 10^3}{266.67} \int x(0.16) \, ds$$

$$\bar{S}_x = \frac{S_x - S_y \frac{I_{xy}}{I_{yy}}}{1 - \frac{I_{xy}^2}{I_{xx} I_{yy}}} = \frac{32.13 \times 10^3 - 38.30 \times \frac{(-160)}{266.66}}{1 - \frac{(-160)^2}{266.66 \times 266.66}}$$

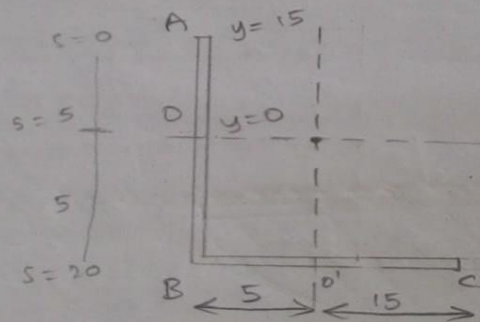
$$\bar{S}_x = 86.12 \times 10^3$$

$$\bar{S}_y = \frac{S_y - s_x \frac{I_{xy}}{I_{yy}}}{1 - \frac{I_{xy}^2}{I_{xx} I_{yy}}}$$

$$\bar{S}_y = \frac{38.20 - 32.13 \times 10^3 \times \frac{(-160)}{266.66}}{1 - \frac{(-160)^2}{266.66 \times 266.66}}$$

$$\bar{S}_y = 89.96 \times 10^3$$

$$q = -53.97 \int y ds - 51.66 \int x ds$$



q_{ab}

$$q = -53.97 \int (15.5) ds - 51.66 (-5) \int ds$$

$$q = -5397 \left(15s - \frac{s^2}{2} \right) + 258.3s$$

| | | |
|-----------|----------------------------|-------------------------|
| $s=0$ | $s=15$ | $s=20$ |
| $q_0 = 0$ | $q_0 = 2.19 \text{ kN/cm}$ | $q_B = -0.24 \text{ k}$ |

$$q_{bc} = -53.97 \int y ds - 51.66 \int x ds + q_b$$

$$y = -5 \text{ cm} \quad x = s - 5$$

$$q = -53.97(-5)s - 51.66\left(\frac{s^2}{2} - 5s\right) + q_b$$

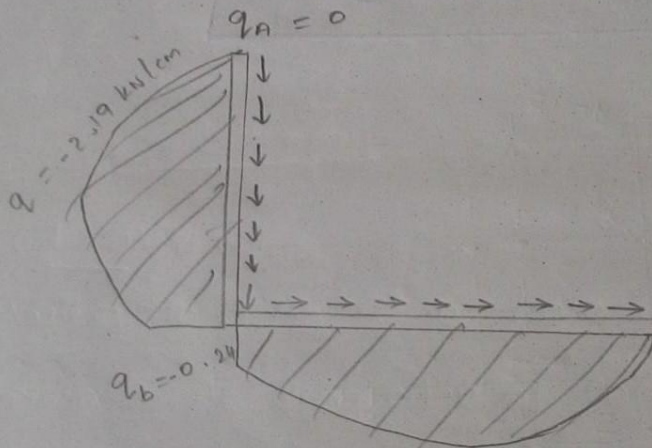
$$s = 0$$

$$s = 5$$

$$s = 20$$

$$q_c = 0.2 = 0.$$

$$q_b = -0.24 \text{ KN/cm} \left\{ \begin{array}{l} q_{01} = 1349.25 \\ q_{10} = -2 \text{ KN/cm} \end{array} \right.$$



07-14

One axis Symmetry
(Wall ineffective in bending)

- Plot the shear flow for a given cross section also find out distance of shear centre. given $A = B = C = 2 \text{ cm}^2$ (boom area).

