SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

DEPARTMENT OF AEROSPACE ENGINEERING

Subject Code & Name**: 23AST205 AEROSPACE STRUCTURES**

UNIT: **3. SHEAR FLOW IN CLOSED SECTIONS**

TOPIC: **5. Shear flow in single & multicell structures under torsion**

To prove:-

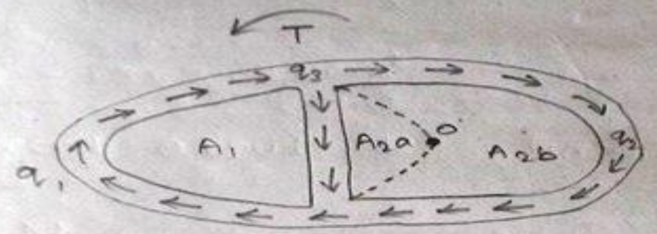
for multicell,

$T = 2A_1q_1 + 2A_2q_2$

for equilibirium,

$q_1 = q_2 + q_3$

$q_3 = q_1 - q_2$



Moment about O

$-T + 2(A_1 + A_{2a})q_1 + 2A_{2b}q_2 - 2A_{2a}q_3 = 0$

$-T + 2A_1q_1 + 2A_{2a}q_1 + 2A_{2b}q_2 - 2A_{2a}q_1 + 2A_{2a}q_2 = 0$

$-T + 2A_1q_1 + 2q_2(A_{2a} + A_{2b}) = 0$

$$\boxed{T = 2A_1q_1 + 2A_2q_2}$$

Angle of twist

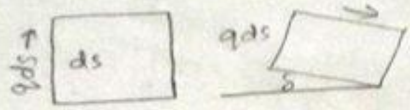
$$\boxed{\theta = \frac{1}{2AG} q \int \frac{ds}{t}}$$

$$T = 2Aq$$

$$q = \frac{T}{2A}$$

$$\tau = \frac{q}{t} = \frac{T}{2At}$$

consider small element



Shear modulus

$$G = \frac{\tau}{\gamma}$$

$$\gamma = \frac{\tau}{G}$$

$$\gamma = \frac{T}{2AGt}$$

Small change in strain energy

$$du = q.ds \ \gamma/2$$

$$= \frac{T}{2A} \cdot \frac{T}{2AGt} \frac{ds}{2}$$

$$du = \frac{T^2}{8A^2Gt} ds$$

According to castigliano's theorem

$$\frac{du}{dT} = d\theta$$

$$du = \frac{T^2}{8A^2Gt} ds \quad \Bigg| \quad \frac{du}{dT} = \frac{2T}{8A^2Gt} ds = \frac{T}{4A^2G}$$

$$\frac{du}{dT} = d\theta$$

$$d\theta = \frac{T}{4A^2Gt}\, ds$$

On integration

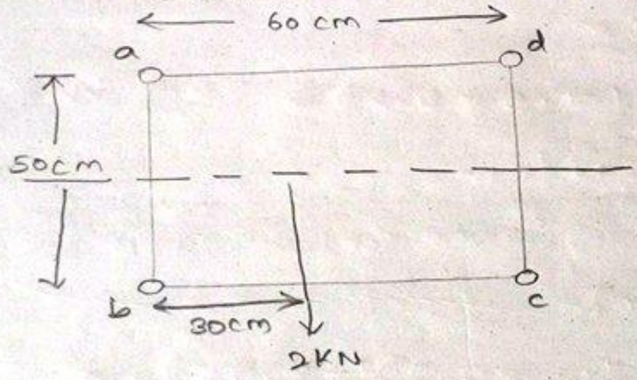
$$\theta = \frac{1}{2AG}\int \frac{T}{2A}\,\frac{ds}{t}$$

$$\boxed{\theta = \frac{1}{2AG}\, q \int \frac{ds}{t}}$$

1) Plot shearflow distribution for given section

$a = b = 3\,cm^2$

$c = d = 2\,cm^2$



soln:

Boom	A	y	Ay^2
a	3	25	1875
b	3	-25	1875
c	2	-25	1250
d	2	25	1250
Σ	10	0	6250


SEE YOU NEXT
CLASS!