$$\tau = \frac{F\int_{0.1}^{y} (dy/t)y}{tI}$$

$$= \frac{F}{I}\left[\frac{y^2}{2}\right]_{0.1}^{y}$$

$$\tau = \frac{F}{I}(y^2/2 - 5E\text{-}3)$$

BC

@ B, $\tau_B = 0.015F/I$

@ C, $\tau_c = 0.015F/I + 0.2 \times \frac{t \times 0.2 \times F}{tI}$

$\tau_c = 0.055F/I$

$$F_{BC} = \left(0.015\frac{F}{I} + 0.055\ \frac{F}{I}\right) * ½ * 0.2\ t$$

$$= 7E\text{-}3\ Ft/I$$

$$= \frac{7E\text{-}3\ Ft}{0.0333t} = \underline{0.21\ F}$$

CD

$$\tau = \frac{0.055F}{I} + \frac{F}{tI}\int(0.2d\phi.t) * 0.2\cos\phi$$

$$= \frac{0.055F}{I} + \frac{F}{I} * 0.04\ [\sin\phi]_0^{\phi}$$

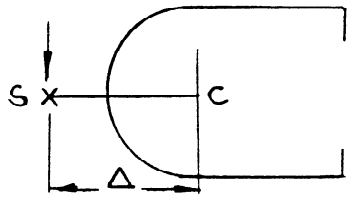
$$F_{CD} = \frac{F}{I} \int [0.055 + 0.04\sin\phi]\ 0.2\ d\phi * t$$

$$= \frac{0.2Ft}{I} [0.055\phi - 0.04\cos\phi]_0^{\pi}$$

$$= \frac{0.2Ft}{0.0333t} \{(0.055\pi + 0.04) = (0 - 0.04)\}$$

F_{CD} = 0.0506 Ft/I = 1.518 F

Moms abt 0



$F\Delta = (0.02F * 0.2 + 0.21\ F * 0.2) * 2 + 1.518F * 0.2$

Δ = 0.396

7b. $I_{NA} = 0.016t + 1.667E\text{-}4t + 0.1t \times 0.25^2 \times 2 + 0.01257t$

$I_{NA} = 0.0412\ t$

AB

$$\int ydA = \int_{0.2}^{y} tdy.y$$

$$= t\left[\frac{y^2}{2}\right]_{0.3}^{y} = \frac{t}{2}\,[y^2 - 0.09]$$

$$\tau = \frac{F\int y\,dA}{tI} = \frac{0.5\ Ft}{tI}\,(y^2 - 0.09)$$

$$F_{AB} = \int \tau.tdy = \frac{0.5Ft}{I}\left[\frac{y^3}{3} - 0.09y\right]_{0.3}^{0.2}$$

$$= \frac{0.5Ft}{I}\,[(-1.53E\text{-}2) - (-1.8E\text{-}2)]$$

$$F_{AB} = \underline{1.35E\text{-}3\ Ft/I}$$

@ B, $\int ydA = 0.1t \times 0.25 = \underline{0.025t}$

@ C, $\int ydA = 0.025t + 0.04t = \underline{0.065t}$

$\tau_B = \underline{0.025F/I}$

$\tau_C = \underline{0.065F/I}$

$\underline{F_{BC} = 9E\text{-}3Ft/I}$

CB

$$\int ydA = 0.065t + 0.04t\sin\phi$$

$$\tau_\phi = \frac{F}{I}(0.065 + 0.04\sin\phi)$$

$$F_{CD} = \int_0^\pi \tau_\phi \cdot 0.2d\phi t$$

$$= \frac{0.2Ft}{I}[0.065\phi - 0.04\cos\phi]_0^\pi$$

$$= \frac{0.2Ft}{I}[(0.065\pi + 0.04) - (0 - 0.04)]$$

$$F_{CD} = 0.0568\ Ft/I$$

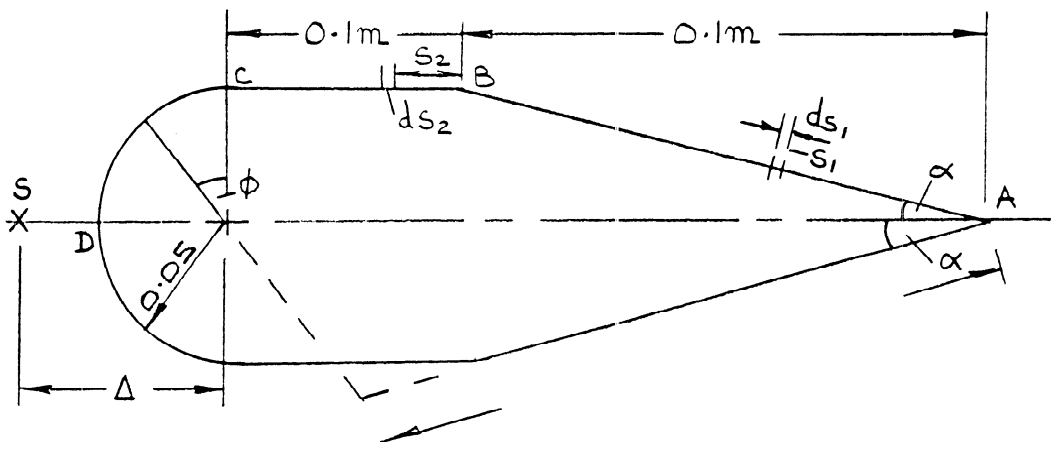
Moms abot 0

$$F\Delta = \frac{Ft}{I}[-1.35E{-}3 \times 0.2 \times 2 + 9E{-}3 \times 0.2 \times 2 + 0.0568 \times 0.2]$$

$$= \frac{Ft}{0.0412t}[-5.4E{-}4 + 3.6E{-}3 + 0.01136]$$

$$\Delta = \underline{0.352\ m}$$

8.



$\alpha = \tan^{-1}(0.05/0.2) = 14.04°$

$$I = 2x \int_0^{0.206} t.ds_1 (s_1 \sin\alpha)^2 + 0.1 \times t \times 0.05^2 \times 2 + \int_0^{\pi} (t.Rd\phi)\, R\cos\phi)^2$$

$$= 0.1176t \left[\frac{s_1^3}{3}\right]_0^{0.206} + 5E\text{-}4t + tR^3 \int_0^{\pi} \cos^2\phi \, d\phi$$

$$= (3.427E\text{-}4 + 5E\text{-}4 + R^3 \int_0^{\pi} \frac{[1 + \cos 2\phi]}{2} \, d\phi)t$$

$$= \left(8.427E\text{-}4 + \frac{0.05^3}{2}\left[\phi + \frac{\sin 2\phi}{2}\right]\right)t$$

$I = \underline{1.039E\text{-}3t}$

AB

$$\tau_{s1} = \frac{F}{tI} \int (tds_1)\, s_1 \sin\alpha$$

$$= \frac{F}{1.039E\text{-}3t} \times 0.2426 \left[\frac{s_1^2}{2}\right] = \underline{116.75Fs_1^2.t}$$

$\tau_B = \underline{4.95F/t}$

BC

as 't' is uniform

$$\tau_{s2} = \frac{4.95F}{t} + \frac{F}{tI}\int_0^{s_2} (t.ds_2) * 0.05$$

$$t_{s2} = \frac{4.95F}{t} + \frac{48.12Fs_2}{t}$$

$$\tau_c = \underline{9.76F/t}$$

<u>CD</u> as 't' is uniform

$$\tau_\phi = \frac{9.76F}{t} + \frac{F}{tI}\int_0^{\phi} (t.R.d\phi)\ R\cos\phi$$

$$= \frac{9.76F}{t} + \frac{F.R^2}{1.04E-3t}\ [\sin\phi]_0^{\pi}$$

$$\tau_\phi = \underline{\frac{9.76F}{t} + 2.404\sin\phi.\frac{F}{t}}$$

$$\tau_0 = \frac{\oint \tau.ds}{\oint ds}$$

but,

$\oint$ ds = 0.206 x 2 + 0.1 x 0.2 + π x 0.05 = <u>0.769 m</u>

$$\oint \tau.ds = 2x \int_0^{0.206} \frac{116.8Fs_1^2}{t} \cdot ds_1$$

$$+ 2 \times \int_0^{0.1} \left(\frac{4.95F}{t} + \frac{48.12Fs_2}{r} \right) .ds_2$$

$$+ \int_0^{\pi} \left(\frac{9.76F}{t} + 2.4\sin\phi \frac{F}{t} \right) 0.05 * d\phi$$

$$= \frac{233.6F}{t} \left[\frac{s_1^3}{3} \right]_0^{0.206} + \left(9.9F \frac{s_2}{t} + \frac{48.12Fs_2^2}{t} \right)_0^{0.1}$$

$$= \left[\frac{0.488F\phi}{t} - \frac{0.12F\cos\phi}{t} \right]_0^{\pi}$$

$$= \frac{F}{t} (0.681 + 0.99 + 0.481 + 1.533 + 0.24)$$

$$= 3.925F/t$$

$$\tau_0 = \frac{-3.925F}{t} \times \frac{1}{0.769}$$

$$\tau_0 = \underline{-5.104F/t}$$

Moms abot "0"

$$F(\Delta + R) = 2 \times \int_0^{0.206} [\tau_0 + 116.8\, Fs_1^2/t] * t\, ds_1 * 0.3$$

$\cos\alpha * \tan\alpha$

$$+ 2 \int_0^{0.1} \left[\tau_0 + \left(\frac{4.95F}{t} + \frac{48.12FS_2}{t} \right) \right] t.ds_2 * 0.05$$

$$= \int_0^{\pi} \left[\tau_0 + \left(\frac{9.76F}{t} + 2.4 \frac{F}{t} \sin\phi \right) \right] 0.05^2.d\phi.t$$

or

$$F(\Delta) = 0.6F\left[-5.104s_1 + \frac{116.8s_1^3}{3}\right]_0^{0.206} \times 0.243$$

$$+ 0.1\ F\left[-5.104s_2 + 4.95s_2 + 48.12\ \frac{s_2^2}{2}\right]_0^{0.1}$$

$$\Delta = 0.05^2\ F\ [-5.1041 + 9.76\phi - 2.4\cos\phi]_0^{\pi}$$

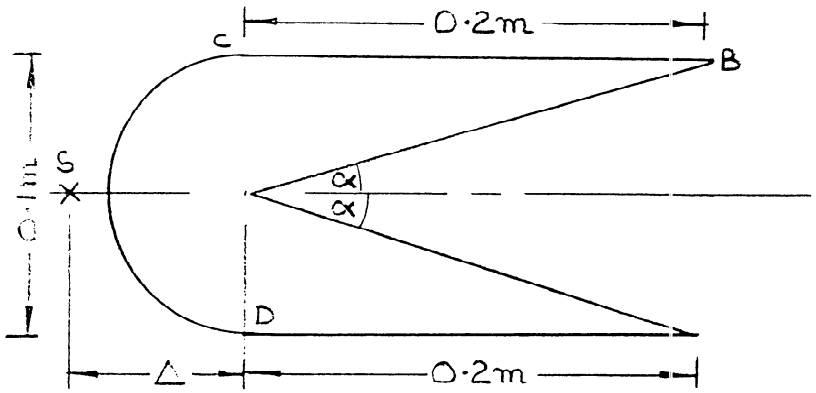
$$= 0.146(-1.051 + 0.34) + 0.1[-0.51 + 0.495 + 0.241]$$

$$+ 0.05^2[-16.03 + 30.66 + 4.8]$$

$$= -0.104 + 0.023 + 0.049 = -0.032\ \text{m}$$

$$\Delta = \underline{-0.032\ \text{m}}$$

9.



OB

$\alpha = \tan^{-1}(0.05/0.2) = 14.04°$

$$I = 2\int_0^{0.206} (t.ds_1) \cdot (s_1\sin\alpha)^2 \, ds_1$$

$$+ 2 \times 0.2 \times t \times 0.05^2 + \int_0^{\pi} t.R.d\phi \, (R\cos\phi)^2$$

$$= \frac{2}{3} \times 0.05886 \left[\frac{s_1^3}{3}\right]_0^{0.206} t + 1.963E\text{-}4t$$

$I = 3.43E\text{-}4t + 1E\text{-}3t + 1.963E\text{-}4t$

$I = \underline{1.539E\text{-}3t}$

$$\tau_{s1} = \frac{F}{tI}\int_0^{s_1} (s_1.\sin\alpha).tds_1 = \frac{F}{I}\left[\frac{s_1^2}{2}\right]_0^{s_1} \sin\alpha$$

$\underline{\tau_{s1} = 78.82\, Fs_1^2/t}$

$\underline{\tau_B = 3.345F/t}$

BC

As "t" is constant

$$\tau_{s2} = \frac{3.345F}{t} + \frac{F}{tI}\int_0^{s_2} t.ds_2 * 0.05$$

$$\tau_{s2} = \frac{3.345F}{t} + 32.49Fs_2/t$$

$\tau_c = \underline{9.84F/t}$

CD

$$\tau_\phi = \frac{9.84F}{t} + \frac{F}{tI}\int_0^{\phi} (R.d\phi.t)\ R\cos\phi$$

$$\tau_\phi = \frac{9.84F}{t} + \frac{1.62}{t} F\sin\phi$$

$$\tau = \frac{-\int \tau ds}{\int ds}$$

$$\oint ds = 0.206 \times 2 + 0.2 \times 2 + \pi \times 0.05$$

$$= 0.969 \text{ m}$$

$$\int \tau_s.ds = 2\int_0^{0.206} 78.82 \frac{Fs_1^2}{t} . ds_1$$

$$+ \frac{2F}{t}\int_0^{0.2} (3.345 + 32.49s_2)\, ds_2 + \frac{F}{t}\int_0^{\pi} (9.84 + 1.62\sin\phi) * 0.05d\phi$$

$$= 157.64 \frac{F}{t}\left[s_1^3\right]_0^{0.206} + \frac{2F}{t}\left[3.345s_2 + \frac{32.49s_2^2}{2}\right]_0^{0.2}$$

$$+ 0.05 \frac{F}{t}\left[9.84\phi - 1.62\cos\phi\right]_0^{\pi}$$

$$= \frac{F}{t}(0.46 + 2.636 + 1.71) = 4.8F/t$$

$$\tau_0 = -4.8 \frac{F}{t} * \frac{1}{0.969}$$

$$\tau_0 = \underline{-4.96\ F/t}$$