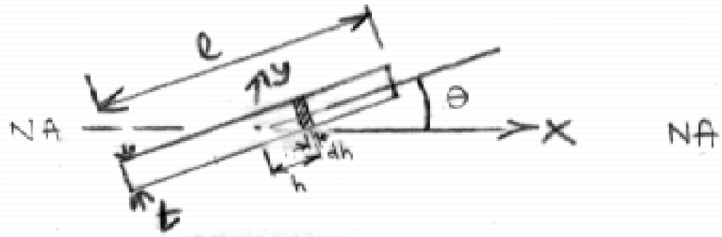
BAS008 SECTION PROPS, FLAT PLATE ASSY METHOD

R.F.



$$I_{NA} = \int y^2 \, dA$$

$$dA = t.dh$$

$$y = h.\sin\theta$$

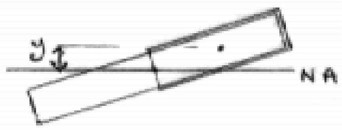
$$I_{NA}/2 = \int_0^{l/2} (h.\sin\theta)^2 . t . dh$$

$$I_{NA}/2 = \left[\sin^2\theta . h^3 . t \,/ 3 \right]_0^{l/2}$$

$$I_{NA}/2 = \sin^2\theta . l^3 . t \,/ 24$$

$$\boxed{I_{NA} = \frac{\sin^2\theta . l^3 . t}{12}} + \underbrace{\frac{\cos^2\theta . l . t^3}{12}}_{\text{minor axis contrib.}}$$

PLASTIC



Area above NA $= l.t \,/2$

$y = l.\sin\theta \,/4$

Force $= f_c . \, l.t \,/2$

Moment $= f_c . \dfrac{l.t.}{2} \dfrac{l.\sin\theta}{4}$

Total Moment, $M_p = \dfrac{f_c . l^2 . t . \sin\theta}{4}$

Principal and MOA's.

Ref. Duncan: page 260.

I_1 is rotated θ_{12} from I_z
I_2 " " " " I_y.

$$r - p_1 = p_t \tan\theta \qquad (1)$$
$$r - p_2 = p_t \cdot \cot\theta.$$

Where r = principal stress σ_1 or σ_2
p_1 p_2 = stresses parallel to z & y axes.
p_t = shear stress.

Assume

I_1 I_2 $\equiv$ r
I_z I_y $\equiv$ p_1 p_2
H_{zy} $\equiv$ p_t

substituting in eqn (1) gives,

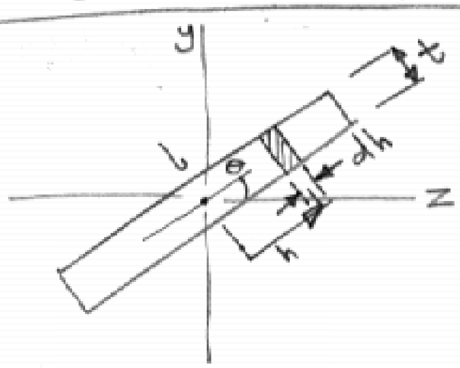
$$I_{1 or 2} - I_z = H_{zy} \cdot \tan\theta_{12} \qquad (2)$$

Program Lines:-

$\theta = \theta_{12}$ or $\theta_{12} + PI/2$

$I_{1 or 2} = -H_{zy} * TAN(\theta) + I_z$

Product Moment of Area

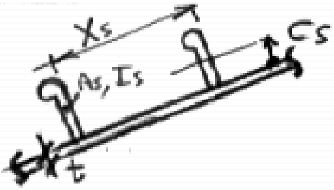


$$H_{zy} = \int_{-l/2}^{l/2} z \, . \, y \, . \, dA$$
$$= \int \sin\theta \, . \, h \, . \cos\theta \, . \, h \, . \, t \, . \, dh$$
$$= \left[\sin\theta . \cos\theta . (h^3/3) . t \right]_{-l/2}^{l/2}$$
$$= (\sin\theta . \cos\theta . t/3) . (l^3/8 - - l^3/8)$$
$$= \underline{\sin\theta . \cos\theta . t . l^3 / 12}$$

Including minor axis contribution,

$$H_{zy} = \frac{\sin\theta . \cos\theta}{12} (t . l^3 + t^3 . l)$$
$$= \frac{t . l . \sin\theta . \cos\theta}{12} (l^2 + t^2)$$

SSO1 , bas008 mod



008.4

Input Data :

No. , Item. , X1 , Y1 , X2 , Y2 , t, Ns, As, Is, Cs

Calculation

No., L, Ap+Ns.As, yp, ys, A.y, A.y², Io, As.yo

where $y_s = y_p + C_s.(X_2 - X_1)/L$ 562

$A.y = A_p.y_p + N_s.A_s.y_s$ 580

$A.y^2 = A_p.y_p^2 + N_s.A_s.y_s^2$ 590

$I_o = ((y_2-y_1)/L)^2.(t.L^3/12)$

$+ ((x_2-x_1)/L)^2.N_s.I_s + A_s.y_o^2$. 600

and for even no. stiffeners,

$A_s.y_o^2 = ((y_2-y_1)/L)^2 \times 2 \times A_s.(L/(N_s+1))^2.((N_s/2)^3/3)$

565

and for odd no. stiffeners,

$A_s.y_o^2 = ((y_2-y_1)/L)^2 \times 2 \times A_s.(L/(N_s+1))^2.$

$(((N_s-1)/2)^3/3 + ((N_s-1)/2)^2/2 + ((N_s-1)/2)/4))$

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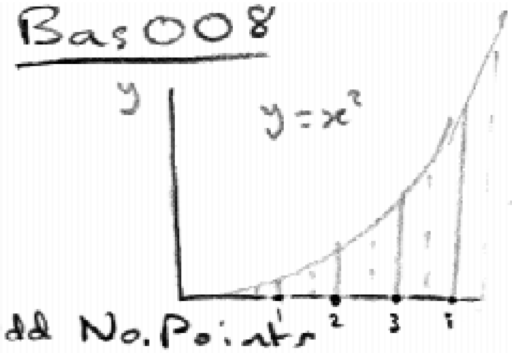
Bas008



Stiffener Contribution

different function for even or odd

① is for odd.

Odd No. Points

$$y = (x + .5)^2$$
$$= x^2 + 2 \times .5 \times x + .5^2$$
$$= x^2 + x + .25$$
$$\Phi = x^3/3 + x^2/2 + x/4 \quad —①$$

$(x = 0,\ y = 0)$

x =	1	2	3	4	5	6	7	8
Φ =	1.083	5.167	14.25	30.33	55.42	91.5	140.58	204.67
Σi^2 =	1.	5.	14.	30.	55.	91.	140.	204.

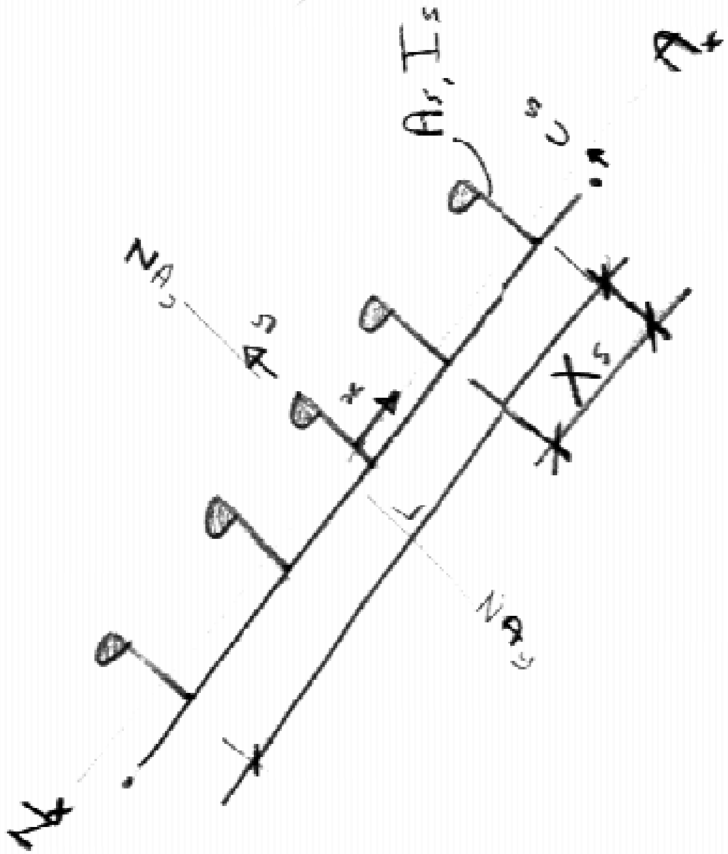
error → reducing

Even No. Points

$$y = x^2$$
$$\Phi = x^3/3 \quad —②$$

x =	1	2	3	4	5	6	7	8
Φ =	.28	2.67	9.	21.33	41.67	72.	114.33	170.67
$\Sigma(i-.5)^2$ =	.25	2.5	8.75	21.	41.25	71.5	113.75	170.

error → reducing



$X_s = L/(N_s+1)$

$I_y = 2.A_s.\sum(i.x_s)^2$

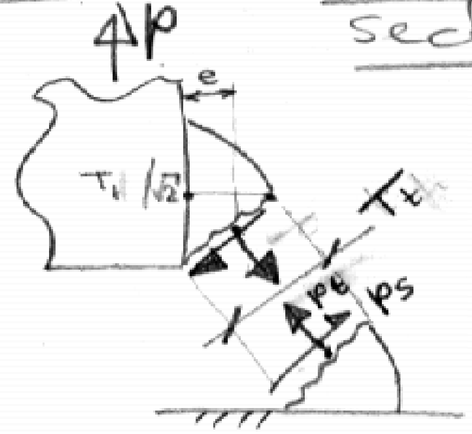
$= 2.A_s.X_s^2.\sum(i^2)$ — 3

Odd, Sum from 1 to $(N_s-1)/2$

Even, Sum from 1 to $N_s/2$

N_s, no. stiffeners on panel

Bas 008 — Strength of Fillet Welded Sections.



Allow mix of fillet FW & Full Pen FP to obtain total section.

Line force P acts on weld.

Direct & Shear line forces in weld,

$$p_s = p_t = p\sqrt{2}/2$$

Stress thru weld throat,

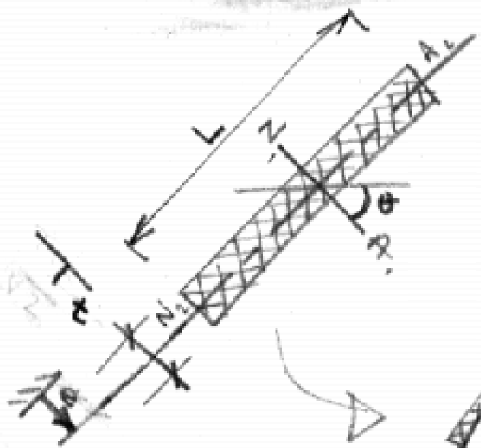
$$\sigma_s = \sigma_t = p/(\sqrt{2}.T_t)$$

Then allowable shear stress, $Fd/\sqrt{3}$.

Equiv. Weld Stress,

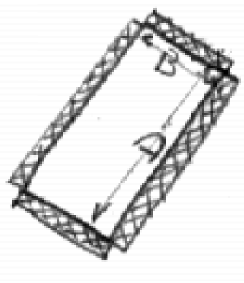
$$f_e = \sqrt{(fd^2 + 3(\tau_\perp^2 + \tau_\parallel^2))}$$

Fillet Weld Section Props,

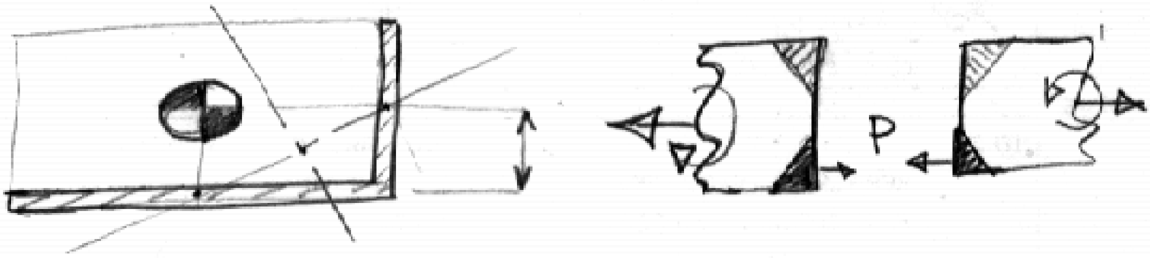


$$I_h = \frac{T_t.L}{12}(T_t.\sin^2\theta + L.\cos^2\theta)$$

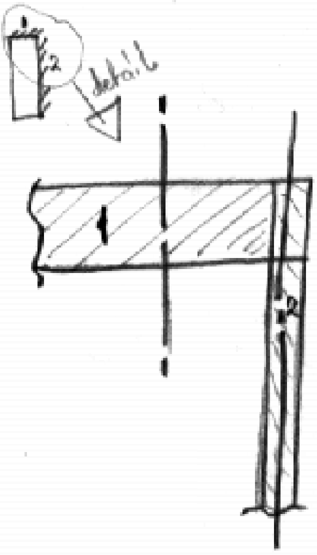
$$I_v = \frac{T_t.L}{12}(T_t.\cos^2\theta + L.\sin^2\theta)$$



Offset, $e = T_t/(\sqrt{2}.2)$

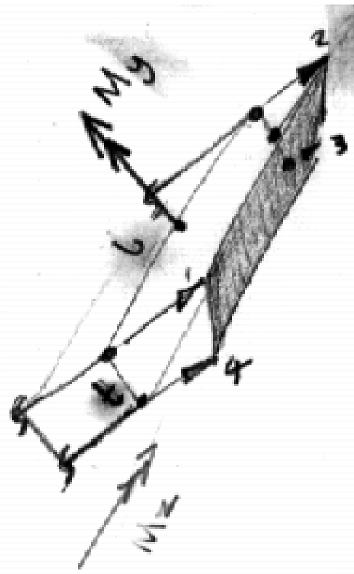


- Two or more sided welds can be balanced
- Single Cannot ... other than by putting BM thru weld
- this is only easy soln.
- Not too bad idealisation as it discriminates heavily against single sided welds



- Distribute moment between adjacent sides (two welds 'L') according to rel. stiffness I_1/I_2.

SimpleCalcReports	OK	OK	OK	NOT	OK	outlaw: weld 2 adj. sides only	OK

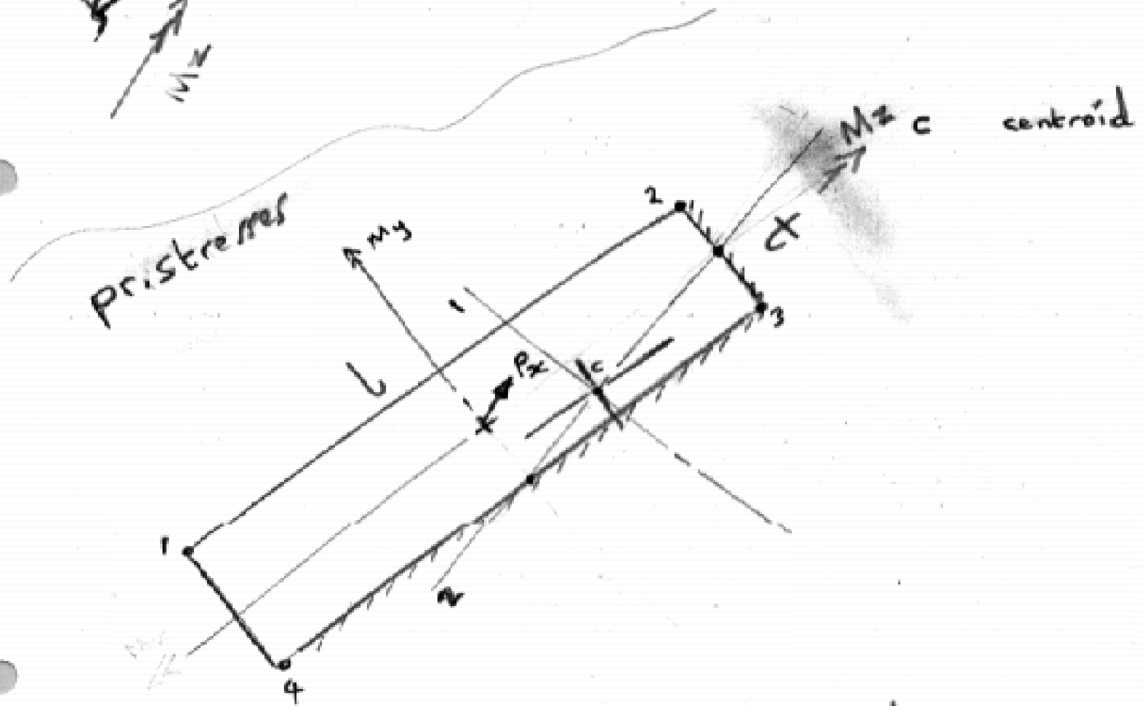


$$P_{ave} = (\sigma_1+\sigma_2+\sigma_3+\sigma_4)\,Lt/4 \quad -①$$

$$\sigma = M(6/(b\,d^2)) \quad \text{then,}$$

$$M_x = -((\sigma_1-\sigma_4)+(\sigma_2-\sigma_3))(L\,t^2/(4\times6)) \quad -②$$

$$M_y = ((\sigma_1-\sigma_2)+(\sigma_4-\sigma_3))(t\,L^2/(4\times6)) \quad -③$$



- Not quite so good as it does not simulate the general continuity of stress thru the total cross-section, although it is good for element in isolation. In this sense not worth pursuing pr. plane analysis for elements.