11 $\sigma_i/S_u + n\sigma_a(1/S_u + 1/S_e) = 1$

where $\sigma_a = CP/2A_s$.

$\therefore n CP(S_e/S_u + 1)/2A_s S_e = 1 - \sigma_i/S_u$

Define $\beta = \frac{1}{2}(1 + S_e/S_u)/(1 - \sigma_i/S_u)$

and $A_s = \beta n CP/S_e$ — QED.

This will define our approx. requirement for bolting — which must also satisfy spacing limitations around p.c.d.

MATERIAL $S_u = 900MPa$ $S_y = 650MPa$

$S_e' = (0.55 - 0.088 \times 0.9) \times 0.9 = 424$ MPa

$S_e = 424/3.0$ (rolled threads) $= 141$ MPa.

BOLTING Let there be z bolts of size d.

External load on joint per bolt

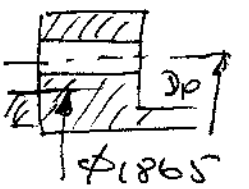
$P = \frac{\pi}{z} \times 1840^2 \times 0.15/z = 430/z$ kN.

From above equation developed, assuming joint factor of 0.5 and $\beta = 1.8$ say:

$A_s = 1.8 \times 5 \times 0.5 \times 430/z \times 141$

(i) $\therefore A_s = 12800$ mm²

Considering spacing



Say $D_p = 1865 + 30$

$= 1900$ mm as trial

$\therefore$ Spacing requirement is

$5 \le 1900\pi/zd \le 10$

(ii) i.e. $600 \le zd \le 1200$

Eliminate z from (i) & (ii)

$600 \le 12800\, d/A_s \le 1200$ mm

$11 \le A_s/d \le 21$

Trial d mm	16	20	24	30	36
A_s mm² (Table 1)	157	245	353	561	817
A_s/d. mm	10	12	15	19	23
	X	✓	✓	✓	X

Select middle-of-road $d = 24$

$\therefore z = 12800/353$ from (i)

$= 36$ nice round no!

Check spacing ratio:

$D_p \ge 1865 + 24 + 10$ clearance

i.e. 1900 choice above is O.K.

$\therefore$ spacing $= 1900\pi/36 \times 24 = 6.9$

— OK

Whilst it would be advisable to try 20 & 30 sizes, we'll consider only 24 mm for ex.

cont'd....