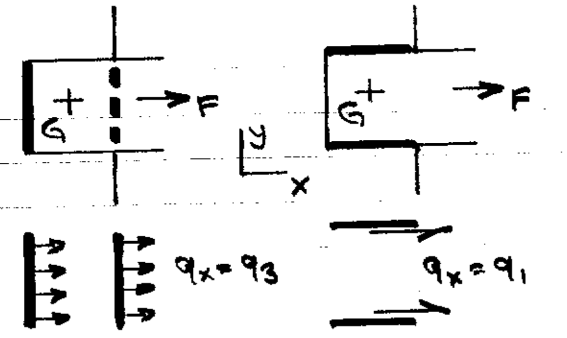
1



Both joints are subjected to primary (force) loading only – there is no centroidal moment or secondary intensity i.e. $q = [q_x \; 0 \; 0]$, $q_x = F/L$. The difference between the joints, for same F, L is that q_x is a q_3 (or q_2) intensity on the transverse joint (i.e. ⊥ fillet leg) whereas it is a longitudinal shear – q_1 type – in the longitudinal joint. So applying eq (1)

Transverse: $q_E = q_3 = F/L \quad \therefore F = wL\sigma_E/2$

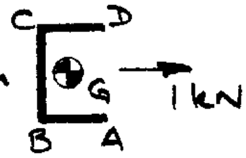
Longitudinal: $q_E = \sqrt{3/2}\, q_1 = \sqrt{3/2}\, F/L \quad \therefore F = wL\sigma_E/\sqrt{6}$

That is, for the same strength and safety factor (i.e. σ_E), the same length and the same size, the transverse joint can withstand $\sqrt{6}/2 = 1.22$ times the load on the longitudinal joint.

Experiment however indicates a larger difference than this – usually reckoned as 30–40%. There are a number of reasons for this – the 22% was based on uniform throat stresses. The longitudinal joint is also subject to shear lag with increased stress concentration at the run ends (see Appendix)

2 Assume a dummy load of say 1 kN then proportion stresses to find maximum load.

a) No centroidal moments so primary intensity only $q = F/L = 10^3/170 = 5.88$ N/mm which makes itself felt as q_1 loading in AB & CD, and as q_3 in BC. Bearing in mind the conclusions of the previous problem the legs AB and CD will be subject to max. q_E – i.e.



$\hat{q}_E = \sqrt{1.5} \times 5.88 = 7.20$ N/mm in AB, CD.

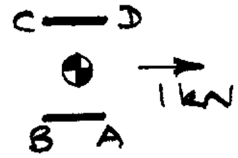
Applying the design equation (1)

$\hat{\sigma}_E = 2\hat{q}_E/w = 2 \times 7.20/6 = 2.40$ MPa.

So, if 1 kN → 2.40 MPa, then 100 kN → 240 MPa.

The load capacity is thus 100 kN.

b) The same approach as in (a), as AB and CD are both subject to



$q_1 = F/L = 10^3/60 = 13.3$ N/mm

$\therefore q_E$ (uniform) $= \sqrt{3/2} \times 13.3 = 20.4$ N/mm

$\therefore \sigma_E = 2q_E/w = 2 \times 20.4/6 = 6.80$ MPa

Therefore the load capacity (necessary to give 240 MPa) is $240/6.80 = 35.3$ kN