

AVERAGE AND EDGE STRESSES FOR THIN FLAT ALUMINIUM ALLOY PLATES IN COMPRESSION

1. NOTATION

b	plate width (between rivet lines of plate)	m	in
E	modulus of elasticity of plate material	N/m ²	lbf/in ²
f_a	average stress in plate = $\frac{\text{total load on plate}}{t \times b}$	N/m ²	lbf/in ²
f_e	stress at edges of plate, parallel to direction of applied load	N/m ²	lbf/in ²
t	plate thickness	m	in
ν	Poisson's ratio for plate material		

Both SI and British units are quoted but any coherent system of units may be used.

2. NOTES

Figure 1 gives the average plate stress plotted against the edge stress for various ratios of b/t for aluminium alloy plates in compression.

The plates are assumed to be thin ($b/t > 60$) and attached to sturdy stiffeners. The curves are based on the empirically derived equations given in the Derivation with E taken to be 70 000 MN/m² and $\nu = 0.3$. The indicated buckling stress and the slope after buckling correspond to a slight degree of lateral and rotational restraint, see Items Nos 72019 and Struct 02.01.23. Those Items may also be consulted for a more accurate estimate of the buckling stress and of the slope immediately after buckling.

The downward curvature of the post-buckling curve is due to changes in the wave form and, for higher values of f_e , to partial yielding in the plates.

No allowance has been made for the effect of small initial irregularities; this will be small in the post-buckling range but may cause an appreciable rounding of the curve close to the buckling point (see Items Nos Struct 02.01.11 to 14).

3. DERIVATION

The curves are based on the formulae

$$f_a = 0.81 \left[\frac{\pi^2 E}{3(1 - \nu^2)} \left(\frac{t}{b} \right)^2 f_e \right]^{1/2} + 0.19 f_e \quad (3.1)$$

and

$$f_a = \left[\frac{\pi^2 E}{3(1 - \nu^2)} \left(\frac{t}{b} \right)^2 f_e^2 \right]^{1/3} . \quad (3.2)$$

The lower of the two values given by these formulae has been plotted.

4. EXAMPLE

It is required to find the average stress in a flat aluminium alloy plate for which $t = 1.2$ mm, $b = 135$ mm and $f_e = 120$ MN/m².

Then, $b/t = 135/1.2 = 112.5$.

From Figure 1, $f_a = 62$ MN/m².