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Average and edge stresses for long flat plates in compression for different edge conditions

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1. NOTATION

a	plate length	m	in
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
N	elastic stiffness per unit length against lateral movement of edges parallel to applied load	(N/m)/m	(lbf/in)/in
t	plate thickness	m	in
μ_L	elastic edge lateral restraint coefficient defined by $\mu_L = \frac{Nb}{Et}$		

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

2. NOTES

In Figure 1 the ratio $f_a / \{ E(t/b)^2 \}$ is plotted against the ratio $f_e / \{ E(t/b)^2 \}$. The data provide an estimate of the limits within which the load carried by a long plate ($a/b > 2.5$) of any isotropic material may vary. The straight lines corresponding to post-buckling conditions are represented in a different manner in the lower diagram in ESDU Struct 02.01.23.

In general, the wave form of a buckled plate changes as f_e is increased, and in consequence the slope of f_a/f_e will be reduced. Changes of wave form depend on all the conditions of loading and restraint. The effects of these changes are not represented by the data given because the experimental evidence suggests that they are generally unimportant for edge stresses up to about three times the buckling stress. The assumption that the wave form does not change leads to the straight line relationship between f_a and f_e . For higher values of edge stress for thin aluminium alloy plates some further information is given in ESDU Struct 02.01.03.

The curves are drawn on the assumption that Poisson's ratio is 0.3 and that the limit of proportionality of the sheet material is not exceeded over any appreciable area.