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The buckling of flat plates under non-uniform compression. Symmetric distributions due to initial or thermal stress

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THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item was monitored and guided by the Aerospace Structures Committee. This Committee first met in 1940 and now has the following membership:

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THE BUCKLING OF FLAT PLATES UNDER NON-UNIFORM COMPRESSION
SYMMETRIC DISTRIBUTIONS DUE TO INITIAL OR THERMAL STRESS

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THE BUCKLING OF FLAT PLATES UNDER NON-UNIFORM COMPRESSION SYMMETRIC DISTRIBUTIONS DUE TO INITIAL OR THERMAL STRESS

1. NOTATION

a	plate length	m	in
b	plate width	m	in
E	Young's modulus	N/m ²	lbf/in ²
f_b	elastic buckling stress of plate under uniform compression	N/m ²	lbf/in ²
f_c	value of f_x at plate centre-line	N/m ²	lbf/in ²
f_{cb}	value of f_c at which plate first buckles	N/m ²	lbf/in ²
f_e	value of f_x at plate edge	N/m ²	lbf/in ²
f_x	axial stress on plate at distance y from plate edge, positive in compression	N/m ²	lbf/in ²
K	elastic buckling stress coefficient for uniform loading defined by $f_b = KE\left(\frac{t}{b}\right)^2$		
t	plate thickness	m	in
x, y	reference axes of plate		
ν	Poisson's ratio		

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

2. NOTES

This Data provides a method of checking the elastic stability of rectangular plates subject to stresses that are compressive at the centre-line and distributed parabolically across the width. The data are valid only for distributions, such as those arising from initial or thermal strain, that do not vary along the length of the plate. This is not therefore applicable to external load distributions that diffuse rapidly into the plate.

Figure 1 gives values of K plotted against a/b for various edge conditions, assuming $\nu = 0.3$. For values of ν that are appreciably different, K should be multiplied by $0.91/(1-\nu^2)$.

Figure 2 shows the variation of f_{cb}/f_b with f_e/f_c for the same range of edge conditions.

Figure 3 presents the family of parabolas f_x/f_c corresponding to various values of f_e/f_c . The general expression for these distributions is

$$\frac{f_x}{f_c} = \frac{f_e}{f_c} + \frac{4y}{b} \left(1 - \frac{y}{b}\right) \left(1 - \frac{f_e}{f_c}\right).$$

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