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Average and edge stresses for flat plates under shear and compression

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AVERAGE AND EDGE STRESSES FOR FLAT PLATES UNDER SHEAR AND COMPRESSION

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AVERAGE AND EDGE STRESSES FOR FLAT PLATES UNDER SHEAR AND COMPRESSION

1. NOTATION

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

$f_{average}$	average direct stress in plate in direction of compression	N/m ²	lbf/in ²
f_b	direct stress at which plate first buckles under compression alone	N/m ²	lbf/in ²
f_{edge}	direct stress at sides of plate parallel to direction of compression (positive if compressive)	N/m ²	lbf/in ²
q	applied shear stress	N/m ²	lbf/in ²

2. NOTES

In Figure 1 the ratio $f_{average}/f_b$ is plotted against the ratio f_{edge}/f_b for various values of q/f_b .

The plate is compressed in the direction of its length, which is assumed to be three or more times its width. The edges are simply supported and remain straight. It is assumed that after buckling the longitudinal edges are held a fixed distance apart.

The stresses $f_{average}$ and q correspond to the loads carried by the plate; in addition, load may be carried by the edge members, the direct load carried by the longitudinal edge members, for example, being proportional to f_{edge} .

All strains are assumed to be within the elastic range.

3. DERIVATION

1. KROMM, VON A. Verhalten eines von Schub und Druckkräften beanspruchten
MARGUERRE, K. Plattenstreifens oberhalb der Beulgrenze. *Luftfahrtforschung*, Vol. XIV,
pp. 627-639, 1937.

4. EXAMPLE

4.1 Example 1

It is required to find the direct load that a long flat simply-supported plate 6 in wide and 0.048 in thick will carry when $f_{edge} = 30\,000$ lbf/in² and $q = 12\,000$ lbf/in². The plate is manufactured from aluminium alloy and has $E = 10 \times 10^6$ lbf/in² and a Poisson's ratio, ν , of 0.3.

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