

STRENGTH OF CASTELLATIONS IN SHEAR

1. NOTATION

b	width of castellation at root	m	in
E	modulus of elasticity	N/m ²	lbf/in ²
f_n	stress at which $E_t = \frac{1}{2}E$ (see Item No. 76016)	N/m ²	lbf/in ²
h	height of castellation	m	in
m	material characteristic (see Item No. 76016)		
q	shear stress in castellation at root	N/m ²	lbf/in ²
Q	total load on each castellation, $Q = qbt$	N	lbf
t	thickness of castellation	m	in

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

2. NOTES

In Figure 1 the shear stresses q at buckling and at failure of castellations are plotted against h/t for various values of b/h .

The problem of castellations under shear occurs when wing or fuselage frames have to be cut out to allow the passage of stringers, the resulting structure having the appearance of battlements. The curves are based on the mean results of experiments made with rectangular castellations in a clad material having properties represented approximately by $f_n = 52\,000$ lbf/in², $E = 10 \times 10^6$ lbf/in² and $m = 25$. For small values of h/t castellations fail through the yielding of the material due mainly to the high tensile bending stress at the root. For higher values of h/t failure is preceded by buckling. This buckling generally occurs in the plastic range, though for the highest values of h/t the buckling may be in the elastic range, especially for the higher values of b/h . It is assumed that the castellations are rigidly supported along their roots; if this is not so an allowance may be made by increasing h . The data on which the Item is based are strictly limited to the range of the curves presented and extrapolation to values of b/h higher than those of the curves is not advised.

For non-rectangular castellations the Data Sheet may be applied with little loss of accuracy in the plotted range provided the sides of the castellations do not deviate from the normal to their roots by more than 20 degrees and b is measured at the roots of the castellations.

3. DERIVATION

1. LEACH, J.F. Strength tests on fuselage frame castellations. Bristol Aeroplane Company, Report No. C.R. 530, September 1948.

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4. EXAMPLE

It is required to find the buckling and failing stresses in a castellation when $h = 2.1$ in, $b = 3$ in and $t = 0.064$ in.

Therefore $h/t = 2.1/0.064 = 33$ and $b/h = 3/2.1 = 1.43$.

Hence, from Figure 1, with interpolation, the buckling stress is $12\,000 \text{ lbf/in}^2$ and the failing stress is $16\,000 \text{ lbf/in}^2$.