

THE EFFECT OF MEAN STRESS ON FATIGUE STRENGTH (PLAIN TEST PIECE)

1. NOTATION

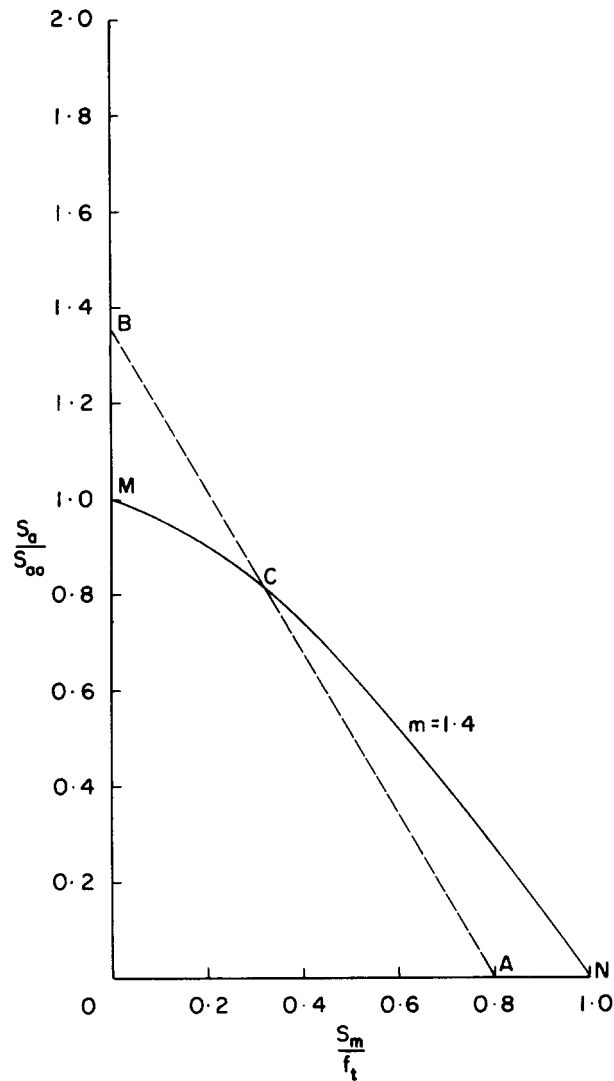
f_p	proof stress in tension	N/m ²	lbf/in ²
f_t	tensile strength of material	N/m ²	lbf/in ²
m	a parameter characterising the shape of the R - M diagram		
N	endurance		
S_a	alternating stress on net area associated with S_m	N/m ²	lbf/in ²
S_{a0}	alternating stress on net area associated with $S_m = 0$	N/m ²	lbf/in ²
S_m	mean stress on net area	N/m ²	lbf/in ²

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

2. NOTES

Values of S_a/S_{a0} are plotted against S_m/f_t for various values of m . Any such curve relating alternating stress and mean stress for a constant endurance N is described as an R - M diagram. The set of curves on this Item enables the selection of an appropriate R - M diagram for a plain specimen, provided that results appropriate to some value of mean stress are available in addition to the value of S_{a0} . Each such diagram is characterised by a value of m . If S_{a0} only is known, then for provisional estimation $m = 1$ may be assumed.

Straight lines can be drawn on the diagram intersecting both axes so as to represent constant values of the maximum stress in a cycle, $S_m + S_a$. Points on the R - M diagram to the right of the intersection with such a line occur at values of maximum stress that exceed the constant value represented by the straight line and points to the left occur at values less than this. If such a line AB in Sketch 2.1 overleaf represents the stress at which yielding occurs, then the point C divides the R - M diagram into MC, in which fatigue failure under substantially elastic conditions occurs, and CN, in which fatigue failure will be preceded by marked plastic deformation. If the criterion for point C is assumed to be that the maximum stress in the cycle is equal to the proof stress, then it may be found conveniently as the intersection between the R - M diagram and a straight line joining B to A on the two axes, where B has the value f_p/S_{a0} and A the value f_p/f_t .



Sketch 2.1

3. DERIVATION

The expression
$$S_a = S_{a0} \left[1 - \left(\frac{S_m}{f_t} \right)^m \right]$$

GUNN, K.

Effect of yielding on the fatigue properties of test pieces containing stress concentrations. *Aeronaut. Q.*, Vol. VI, Part 4, pp. 277-294, November 1955.