



ESDU Struct 02.00.00

Issued October 1962

With Amendment A

April 1969

Criteria of yielding and failure

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CRITERIA OF YIELDING AND FAILURE

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CRITERIA OF YIELDING AND FAILURE

1. NOTATION

f_{ey}	equivalent direct yield stress	N/m ²	lbf/in ²
f_{et}	equivalent direct failing stress	N/m ²	lbf/in ²
f_x	direct stress acting in direction of y -axis	N/m ²	lbf/in ²
f_y	direct stress acting in direction of x -axis	N/m ²	lbf/in ²
f_1, f_2, f_3	principal stresses	N/m ²	lbf/in ²
q	shear stress	N/m ²	lbf/in ²
ν	Poisson's ratio		

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

2. NOTES

2.1 General

Most mechanical tests on materials are performed under a uniaxial tensile load. In order to predict the behaviour of materials under states of stress that are more complex than uniaxial tension it is necessary to be able to identify the magnitude of combined stresses which correspond to certain limiting states in the tension test.

For design purposes *yielding* and *failure* are defined in terms of *proof* and *ultimate* stress.

It is necessary to distinguish between the characteristic behaviour of two separate classes of materials, namely "brittle" and "ductile".

2.2 Brittle Materials

2.2.1 Principal Stress Criterion

Brittle materials behave sensibly elastically until failure and therefore only a true failure criterion need be considered. For such materials, experiment indicates that the stress that corresponds to the uniaxial tensile failing stress is the tensile principal stress of greater magnitude. This principal stress criterion is associated with the name of Rankine.

$$f_{et} = (f_1, f_2)_{max} = \left[\frac{f_x + f_y}{2} \pm \left\{ \left(\frac{f_x - f_y}{2} \right)^2 + q^2 \right\}^{1/2} \right]_{max}$$

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