THE FAILURE OF DUCTILE STRUCUTRES IN REVERSED BENDING

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Abstract

The work presented here constitutes an investigation of the behaviour of mild steel, and components thereof, under conditions of reversed bending in the inelastic range at relatively slow rates of cycling.

The range of deformations and frequencies considered are in the category of those associated with low endurance fatigue problem in metals, where failures with 10^5 cycles.

A cyclic loading machine is described which is designed to impose either constant load or deformation cycling conditions on small scale components in reversed flexure at frequencies in the range from 1 – 150 c.p.m., but only the constant deformation cycling system is employed in this work.

The first part of the investigation is concerned with an examination of material behaviour in reversed bending (i.e. pure bending) at three frequencies – 1, 10 and 100 c.p.m. – and strain ranges in the region from 0.5 – 12%. Axial extension assumed some significance during the tests at the larger strain ranges, as did cyclic heating at the higher frequency. The development of axial strain is studied in some detail and an explanation of its cause is put forward.

A moment-curvature relationship for the material in a cyclic state is established along with a fatigue resistance law for the range of deformations considered; the former being restricted to cyclic operations in the range from 1 – 10 c.p.m.

The second part of the investigation deals with the behaviour of two simple types of structural component – a simple single span beam under central point loading and a three span continuous beam with a central point load on the middle span – under conditions of reversed bending similar to those employed in pure bending tests.

The information obtained in pure bending is used to interpret the behaviour of these components, and analyses are developed, with the aid of the cyclic moment-curvature elation,

which when employed in conjunction with the fatigue resistance law enable predictions of the cyclic lives of these components to be made.