THE FAILURE OF DUCTILE STRUCTURES

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Abstract

The plastic theory of mild steel that has been developed under the direction of Professor J.F. Baker during the past ten years has now reached a stage which it may be applied to the design of steel-framed structures. The present dissertation embodies some experimental and theoretical results obtained during the last three years and indicates the means by which redundant structures may be analysed and designed.

After a brief historical review, the dissertation falls into two main sections. The first is concerned with the exact analysis of the behaviour of steel members when subjected to loads such that the yield stress is exceeded, and deals with an experimental and theoretical investigation of the effect of overstrain, with plastic slope-deflexion equations, and with the solution of transversely loaded beams by means of relaxation methods; the second section shows that an approximate plastic-hinge theory may be developed from the more exact work preceding and applied to the design of portals and other structures, some examples of which are worked in greater or less detail. Experimental confirmation is given for a single-bay rectangular portal under the action of side and vertical loads; the major part of the laboratory work is contained in this section.

In conclusion, the Appendix attempts to explain results obtained in a tension test when slight eccentricities of loading are present: these mask the effect of a drop of stress at yield and have led some writers to doubt the validity of the upper yield stress in mild steel.