CRITICAL LOADING CONDIDTIONS IN ENGINEERING STRUCTURES

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Abstract

An account is given of investigations directed towards the derivation of a plastic design method for structural steelwork. The first section of the dissertation deals with steel members and frames in which conditions of instability do not rise, and begins with a critical study of the simple plastic theory of bending of beams, with particular reference to the effect of shear forces. Methods of analysing the stresses and deflexions in frameworks by means of tabulated bending coefficients are described, and results are presented of theoretical investigations into the effects of strain hardening and residual welding and rolling stresses. Experimental investigations into the validity of the simple plastic theory as applied to continuous and encastered beams of rolled mild steel are described.

The second section deals with the behaviour of members under conditions of instability, and consists mainly of a theoretical investigation into the lateral instability of steel I-beams in the partially plastic range. An analysis is also given of the effect of small axial loads in beams stressed beyond the elastic limit.

The third section deals with the derivation of design loads appropriate to plastic design methods, and describes an investigation into the effect of wind loads in structures in the partially plastic state. In this investigation an attempt is made to derive static wind pressures which are equivalent in their destructive action to the actual fluctuating pressures to which a structure would be subjected during a high wind.

In the forth section of the dissertation, the advantages and disadvantages of the plastic theory as a basis for design are discussed. An assessment is made of the extent to which existing knowledge of the behaviour of structures at collapse and of the loads to which they may be subjected is adequate for this purpose.