

THE ELASTIC-PLASTIC BEHAVIOUR OF MILD STEEL PLATES IN COMPRESSION

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Abstract

The investigation into the elastic-plastic behaviour of mild steel plates has aimed at determining the ultimate load carrying capacity of square and circular plates loaded in the plane of the plate. It has been restricted to the simplest of boundary conditions by assuming simple supports along the perimeter of the plate and strain hardening effects have been excluded, the analysis being confined to an elastic perfectly plastic material obeying a Johansen Yield Criterion of constant maximum stress.

The ultimate load has been obtained from the intersection of an elastic-plastic loading path, which occurs subsequent to the elastic-plastic buckling of the plate, and a rigid plastic unloading line. For stocky plates, whose elastic critical stress is equal to or greater than the yield stress, it has been shown that the ultimate load is equal to the yield load. It has also been shown that the ultimate load is related to the magnitude of the initial imperfections in the plate, this load being a maximum for an ideal initially plane plate.

The problem of the behaviour of circular plates has been limited to a theoretical investigation. Experiments were not carried out owing to the difficulty of applying radial loads of large magnitude to a plate of this shape. The theoretical investigation, however, has been supplemented by suggesting an elastic-plastic loading path for a circular plate with clamped edges.

Extensive experiments have been carried out on square plates and the theory has been verified to large transverse deflexions of such plates. These experiments have been conducted on thin walled tubes of square cross-section where the walls of the tube have been found to approximate the conditions of a simply supported plate. Tests have also been carried out on the webs of I sections though these experiments have not proved too successful owing to the effects of elastic restraints along the unloaded edges.

The general analysis developed in this dissertation has been compared with previous solutions for the ultimate strength of plates in compression.