

# THE PLASTIC BEHAVIOUR OF COLUMNS AND BEAMS

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## Abstract

The dissertation deals with various aspects of the behaviour of steel structural members when subjected to combinations of axial force and bending moment which cause the strains in parts of those members to exceed the elastic limit. The first section of the dissertation describes experiments on three portal frames constructed of rolled steel joists and loaded to collapse. Two of these portals had fixed feet, and the third was built on small piers rigidly attached to stanchions. The experimental measurements are analysed according to the simple plastic theory, and some general conclusions are drawn.

The reduction of the full plastic moment of a cross-section which is also carrying a thrust is discussed in the second section of the dissertation, and the characteristics of cross-sections having an axis of symmetry and subjected to combined moment and thrust are determined theoretically. These results are applied to the design of arches.

The third section is concerned with the collapse of compression members due to instability, and differential equations are derived which describe the behaviour of a stanchion bent in single curvature by symmetrical end moments. These equations are solved both for 'I' sections bent about the minor axis and for rectangular sections by numerical methods using the EDSAC, and curves are derived for use in designing such stanchions.

In the final section of the dissertation the interaction of stanchions and beams in a steel building framework is considered, particular attention being paid to the behaviour of an internal stanchion in such a framework when both the stanchion itself and some of the beams which frame into it are strained beyond the elastic limit.