

7
For the Ph.D. Degree

CARRYING CAPACITY OF MILD STEEL ARCHES

BY LEONARD KELMAN STEVENS

Corpus Christi College, Cambridge, and the University of Melbourne

THE application of plastic theory methods to the design of certain types of steel-framed structures has now been generally accepted. Portal frame buildings designed by the plastic theory have been constructed, and these have been found to be safe and more economical in steel than comparable elastic designs.

In applying these methods to the design of mild steel arches some modifications are necessary because of the characteristics peculiar to this type of structure. First, considerable axial forces are usually associated with arch action, and these reduce the maximum developable moment of resistance of the section. Secondly, a small deformation may produce significant changes in the force and bending moment systems. Although it is usually assumed that changes of geometry have a negligible effect upon the behaviour of most structures, a well-designed arch will have the thrust line close to the rib throughout, and is therefore sensitive to small relative moments.

For these reasons, the load-deflexion behaviour and collapse conditions predicted by the simple plastic theory may be considerably in error. The theoretical investigations described were made in order to determine the importance of these effects and to devise a method of predicting the inelastic behaviour with an accuracy acceptable for design purposes. An experimental programme included tests to destruction of both small- and large-scale arches with various loadings, shapes, and end conditions.