THE PLASTIC BEHAVIOUR OF TUBULAR COMPRESSION MEMBERS

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Abstract

The problem was to investigate theoretically and experimentally the plastic behaviour of mild steel compression members of an annular cross-section when subjected to end loads of equal and unequal end eccentricities.

In order to provide a theoretical answer to this problem, it was first necessary to specify a collapse criterion. This was used to find the critical length of a compression member under a known thrust and subjected to end loads of equal or unequal eccentricities. It was then necessary to compute the physical characteristics of compression members on the point of collapse. These computations were made for a comprehensive range of axial loads and ratios of end eccentricities. An electronic digital computer was used in this work, and the results are expressed as graphs in which all the quantities are non-dimensional. It should be noted that the theory does not take into account the effect of shear, strain history, residual stresses, shakedown, fatigue and local buckling.

A total of fifteen stanchion tests were conducted, using specimens of an annular cross-section with an outside diameter of 4.5 in. and thickness of 0.138 or 0.25. The lengths of the specimens were either 5 ft. or 9 ft., and three types of loading were used: (1) single curvature bending with equal end eccentricities, (2) single curvature bending with no moment at one end, and (3) single curvature bending with equal but opposite end eccentricities.

The agreement between the plastic theory and the experimental collapse loads is considered to be good. It would appear that considerable economy will result from using the plastic theory to analyse stanchions rather than the elastic one.

A method of analysing stanchions in a framework is advanced.