THE STRENGTH OF ELASTICALLY RESTRAINED MILD STEEL TUBULAR STRUTS

Paul Grundy

Abstract

Current design methods of struts in trusses are examined and it is found that there is no exact general solution of the ultimate strength based upon elastoplastic material. One solution is found for tubular struts bent in single curvature with end restraints for equal rotational stiffness, which is the worst condition for moments of a given magnitude. In the analysis only struts at collapse are considered. For each strut configuration the end rotational stiffnesses necessary for the strut to be at collapse are found using an adjacent equilibrium criterion. The solutions are found using an electronic computer to integrate the moment-curvature functions, and charts of results applicable to all practical lengths of tubular struts are found.

A supplementary analysis shows the effect of the stiffness of end restraint and a safe method of including the effect of initial curvature in the inelastic analysis. A further analysis develops the idea of an “elastic hinge” to compare the collapse load conditions of struts in single curvature with struts of other shapes. A significant reduction in the necessary end stiffness of restraint is found for unsymmetrical struts.

The design and operation of a testing rig for small tubular struts is described and the results of fifty eight tests are given. The single curvature tests are compared with the theory, which is found to be conservative, and the reasons for this are discussed. The tests show the significance of various factors, in particular that the nett initial central deflection before the load is applied is the most significant factor affecting the proximity if the collapse load to the squash load, and the load generally falls steeply with contraction after the collapse load is obtained.