LOCAL AND FLEXURAL FAILURE IN STEEL COMPRESSION MEMBERS

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Abstract

The dissertation reports research into the compressive failure of welded steel members. The members are of thin-plate construction where failure can result from interaction between local yielding and buckling (or both) and flexural buckling. Consideration is given to two types of member in particular: stiffened compression panels and thin-walled box columns. The investigation comprises both theoretical and experimental programmes. Efforts are made to ensure that the results relate as directly as possible to practical situations.

The opening half of the dissertation discusses the local buckling aspect of the problem. A description is given of a series of tests in basic (simply supported) plate strength and the effect thereon of transverse welds. A novel method for generating design curves of basic plate strength is proposed. Strength predictions obtained using the proposed formulae agree well with experimental and theoretical results. Design curves are proposed for both lightly welded and heavily welded plate elements. Idealised forms of plate load-shortening behaviour are postulated.

The remainder of the dissertation is concerned with the local flexural interaction problem. A theoretical method for predicting the strength of stiffened compression panels and thin-walled box columns is described and is used to analyse a large number of different cases. The stiffened panel is treated as a column, i.e. transverse membrane effects are assumed negligible. Local buckling is allowed for in plate elements only, and by applying to the plate element an average compressive “stress-strain” curve interpolated from Moxham’s theoretical analysis. Local buckling of the webs of square thin-walled box columns is allowed for in an approximate way. The stiffened panel is analysed both as a pin-ended column and as a continuous multi-span column. It is seen that a continuous stiffened panel is likely to be stronger that the corresponding pin-ended case if failure occurs in the plate, and weaker if failure occurs in the stiffener.

A series of combined compression and bending test on short lengths of thin-walled box section is described.

Design curves are proposed for the strength of thin-walled box columns and stiffened compression panels. A general method for generating such curves is developed and the unknown parameters are then fixed with fixed reference to the theoretical results referred to above. The proposed plate strength design curves are an essential ingredient. The effects of local buckling and residual stress are allowed for in a simple way. The design curves are shown to give a satisfactory agreement with the small number of suitable test results available.