PROBLEMS IN STRENGTH OF STIFFENED STEEL COMPRESSION PANELS

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Abstract

The dissertation describes work on the failure, in compression, of elements of stiffened steel panels. Attention is directed to geometries where local buckling and yielding interact, and where analysis should account for the presence of residual stresses and initial out-of-flatness and out-of-straightness of the structure.

Tests are described on plates loaded in compression, constrained by transverse stiffeners to buckle with a short buckle length, giving aspect ratios of 0.4 to 1.0. Strength was found to rise as aspect ratio was reduced. Residual stresses due to welding were measured, and were not as expected from previous work.

Measurements made on steel box-girder bridges are examined to determine the magnitudes, form and variability of initial out-of-flatness and out-of-straightness of plates and stiffeners. For plates, the variations in compressive strength due to varying out-of-flatness are considered, and compared with strength due out-of-flatness are considered, and compared with strength variations due to the variability of material properties. Values are proposed for incorporation in design rules.

A method for the analysis of a single stiffener, loaded in compression is described. The governing equations are written in finite difference form and solved numerically. In the plastic range, an approximate full-section yield criterion is used in an extension of the Ilyushin “method of successive elastic solutions”. Initial out-of-flatness may be included in the analysis. The method has been too used to examine the performance of plain flat stiffeners, including the effect of rotational restraint to the supported unloaded edge.

A rig for testing single stiffeners in compression is described. Boundary conditions are those appropriate to a stiffener in eccentrically stiffened plating. In tests on a single bulb flat stiffener, the effects of initial out-of-flatness, eccentric loading and restraint to the supported unloaded edge were examined.

Tests are described on single welded splices to plain flat and bulb flat stiffeners. Despite an apparent eccentricity of loading the performance of the splice is satisfactory. Tests covered plain flat and single sided bulb flat stiffeners and their splices.