THE STRUCTURAL BEHAVIOUR OF COMPOSITE COLUMNS

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Abstract

The work described in this dissertation forms part of a research programme on composite steel and concrete construction at Cambridge, and is concerned with the study of concrete encased steel columns.

The composite column is analysed both by a double numerical integration of the governing non-linear differential equations and by assuming the deflected shape to be part of a cosine wave, for columns loaded about one axis. A biaxial analysis has been developed using a double numerical integration for the differential equations for columns loaded about both axes. An extensive experimental programme has been carried out on twenty-three encased columns and three bare steel columns of small cross-section. The variables investigated were level of end load and ratio of end-rotations for two slenderness ratios. Previously it had been assumed that failure of pin-ended composite columns occurred due to excessive bending in the plane of loading. The results show, as might be expected, that pin-ended composite columns under certain loading conditions fail by a premature lateral collapse. There is generally good agreement between theory and experiment.

The computer programmes were used to examine the effect of the assumption of reversibility of the stress-strain relations and to do a pilot study of the effects of sustained load.

A reasonably simple set of approximate expressions have been obtained to estimate the stiffness for a given load and moment and hence the curvature. Theses expressions have been used in conjunction with the assumed part-cosine wave deflected shape and give reasonable approximations to the end-moment end-rotation curves of composite columns by hand calculation.