ANALYSIS AND BEHAVIOUR OF LONG RESTRAINED COLUMNS UNDER UNIAXIAL AND BIAXIAL BENDING

BY

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C E R T I F I C A T E

This is to certify that the thesis entitled ' ANALYSIS AND BEHAVIOUR OF LONG RESTRAINED COLUMNS UNDER UNIAXIAL AND BIAXIAL BENDING' being submitted by Mr. P. Suryanarayana to the Indian Institute of Technology, Delhi for the award of the degree of Doctor of Philosophy in Civil Engineering is the bonafide research work carried out by him. Mr. Suryanarayana has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis which to the best of my knowledge has reached the requisite standard. The material contained in this thesis has not been submitted, in part or full to any other University or Institute for the award of any degree or diploma.

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A C K N O W L E D G E M E N T S

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A B S T R A C T

An analytical method for obtaining the load-deflection and moment-end rotation characteristics of long rectangular reinforced concrete columns under uniaxial and biaxial bending is presented. The analysis can be applied to obtain the deformation of the column beyond the maximum load, the calculations being carried out to the point of material failure due to crushing of concrete. The columns are assumed to be elastically restrained against rotation at the ends and braced against sideway. The effect of initial imperfection is not considered.

The method for uniaxial bending is first presented and checked against existing theoretical results. Test results presented by various authors are also compared with the values obtained by the theoretical analysis of the test columns in order to study the general validity of the method and of the material properties assumed.

The method is then used in the analysis of restrained composite columns (the encased steel section being replaced by equivalent reinforcement areas) under uniaxial bending for a range of values of slenderness, end restraints, end eccentricities and concrete cover.

Both symmetric and nonsymmetric conditions of loading are covered. Based on these studies the conclusions regarding the behaviour of these columns are summarised.

A simpler but approximate analysis (which replaces the restrained column by an equivalent pinended column) is examined and is shown to yield conservative results. The effect of each of the governing parameters on the error in the failure load given by the equivalent pinended column approach is discussed.

The method of analysis for columns under biaxial bending is then presented. The method is checked against the few theoretical and experimental results available in the literature. Reinforced concrete columns with varying parameters are analysed and conclusions regarding the behaviour summarised.

An interaction formula for biaxially loaded columns proposed earlier for design purposes is examined for both pinended and restrained columns. The effect of various column parameters on the error in the failure loads calculated by the interaction formula is discussed. It is shown that the formula generally gives conservative results. However the computed failure loads may be too conservative if the uniaxial failure loads required in the formula are calculated using the equivalent pinended column approach.

In the concluding chapter possible extensions of the present computer programs to cover the cases of circular columns, initial imperfection, sway etc. are outlined.

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