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BEHAVIOR OF HOLLOW STEEL SECTIONS FILLED WITH SAND AND EPOXY RESIN MIXES

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This thesis is submitted to Ain shams University, Cairo, Egypt, for the Doctor of Philosophy in Civil Engineering (Structural Engineering).

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No part of this thesis has been submitted for a degree or a qualification to any other University or Institution.

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ABSTRACT

The behavior of the composite sections has been examined, particularly for the composite columns. Some previous research used concrete to fill in steel tube columns to improve the different buckling modes of steel tubes and increase the strength of the columns. Other researchers used the sand to fill in steel tube columns to improve the different buckling modes of steel tube columns.

This research aim is to improve the behavior of hollow steel sections to resist different buckling modes. In this context, the study is presently being conducted on hollow steel sections filled with materials having lighter weight, more ductility, high tensile strength, and easy to operate. The aim of mixing sand with epoxy resin is to improve the shear strength of the filling material. Properties of epoxy materials are better than properties of cement as better adhesion, low shrinkage, lower weight, higher tensile strength, high ductility, better workability, and better resistance to physical and chemical attacks.

This research focuses on the behavior of hollow steel sections filled with sand and epoxy resin mixes under concentric loads. A total of 16 specimens of square hollow and composite columns have been examined to test the behavior of slender hollow steel sections filled with sand and epoxy resin mix. In this process the experimental program considers two groups of test specimens, the first group has 7 models of Hollow Steel columns (Group-H). The second group has 9 models of composite steel columns (Group-C). Different parameters were considered in this study which are epoxy to sand ratios mixes, steel tube width-to-thickness ratio (b/t), and the height-to-width ratios of steel tubes (h/b).

A nonlinear finite element model (FEM) using the multi-purpose FE program ANSYS has been developed. The validity of the developed model was examined by comparing with the experimental data of the current experiments. The comparison indicated that the results of the FEM well agree with the experimental results. Upon completing the FE model verification, it was used to extend the range of investigated parameters. Results from a wide range parametric study were utilized to propose design formulae and design charts to be used for calculating the capacity of hollow steel tubes filled with sand and epoxy resin mixes.

Based on test results obtained, it became clear the enhancement in the behavior of steel hollow section filled with sand and epoxy resin mix also, it is confirmed that tube length has a considerable effect on the carrying capacity and the failure mode. In all test tubes, fracture occurred by the convex local buckling of the steel section due to the outward thrust of the filling material.

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