ABSTRACT

Reactive Powder Concrete (RPC) is a high strength, new generation concrete, formed from a special combination of constituent materials. The composition of reactive powder concrete includes cement (ordinary Portland cement), fine sand, silica fume, quartz powder, and high tensile steel fibres. Reactive powder concrete is grouped under ultra high performance concrete. This concrete has a very high compressive strength of 200 MPa which can be improved further by introducing steel pellets upto 800MPa. This new family of concrete has improved ductile behavior with a flexural strength of 25MPa to 40MPa.

The aim of this research program is to find the suitability of Reactive Powder Concrete for prefabricated structures especially angle sections. The first step of this project is to characterize the material property of RPC mix. The mix proportion suggested by CSIR-SERC, Chennai, was taken into consideration for preparing the RPC mix. In addition, the mechanical property of the RPC structural components prepared from the recommended mix proportion was studied.

This research program includes three experimental phases and one analytical phase. The first phase of this research includes the experimental investigation of the mechanical properties of Reactive Powder Concrete using compression, tension flexure and shear test. Also constitutive modeling equations for RPC under compressions were developed by slightly modifying VOO’s models. The tensile properties of RPC were simulated and Equations controlling the stress-strain characteristics were formulated using Li’s equations. The tensile Post crack behavior of RPC were found by using the code sp 159-15. A simple micro-mechanical shear lag model adopted by Li and Leung(1992) is used to predict the behavior of a fibre being pulled out of a matrix material.

The second phase of this research involved in the study on the feasibility of RPC for structural components as angle sections and
infilled tubes. Detailed study was carried out by conducting compressive and four point bending tests. Also, RPC infilled tubes were tested for axial compression to study the stress-strain characteristics of RPC infilled tubes. The infilled tube results were checked against the various codal values and Eurocode finds to give a better correlation under compression. The third phase includes the optimization of connection details for bolted RPC plates.

The fourth phase of thesis research involved a methodical and comprehensive investigation aimed at widening the scope of finite element analysis to investigate the buckling and flexural behavior of RPC angle sections. Comparison of experimental and finite element analysis showed that the buckling and ultimate failure behavior of RPC angle sections could be simulated well using appropriate finite element models.