ABSTRACT

Increase in demand and decrease in supply of aggregates for the production of concrete, result in the need to identify new sources of aggregates. Construction materials are increasingly judged by their ecological characteristics. Recycling of concrete gains importance because it protects natural resources and eliminates the need for disposal by using the readily available concrete as an aggregate source for new concrete. Several investigations made to study the effects of recycled aggregate on the engineering properties of concrete.

The advancement of concrete technology, as well as the development of new materials and components has resulted in increased performance and strength needs, which are not adequately satisfied any longer. Maintenance, repair, and rehabilitation of existing cement concrete structures also involve a lot of problems causing significant expenditures. Hence, there is an urgent need to pay more attention for improving the properties of concrete with respect to strength and durability, especially in aggressive environment. Here recycled concrete aggregate is used as a substitute for fine aggregate. Recycled concrete aggregate is used for 40% of fine aggregate and natural sand is retained for the remaining part. High Performance concrete (HPC) of M60 Grade is attempted here with two types of admixtures i.e. silica fume and fumed silica.
High Performance Concrete appears to be a better choice for a strong and durable structure. Very few studies have been reported in India on the use of RCA (recycled concrete aggregate) for development of HPC and also durability characteristics of these mixes have not been reported properly. Investigations are being carried out in order to make a quantitative assessment of different natural fine aggregates replacement levels with recycled concrete aggregate on the strength and durability properties of M60 grade of HPC mixes and also to arrive at the optimum level of replacement of cement with silica fume and fumed silica at different water binder ratios.

There are several attempts to develop a method for the proportioning of mixes with cement replacement material, which could be classified as addition, replacement or rational methods. Existing methods of mix proportioning are not adequate for the optimization of many factors that must be considered for HPC. Therefore, a simplified and modified mix design procedure based on the BIS and ACI methods of concrete mix design has been formulated in this thesis. The HPC mix M60 grade was designed using the above formulated mix design procedure and experimental investigations were carried out to verify the proposed mix proportioning method at different w/b ratios.

In this thesis, investigations were carried out on mechanical properties such as compressive strength, splitting tensile strength, flexural strength, modulus of elasticity and flexural toughness, and on durability properties such as saturated water absorption, porosity, sorptivity, permeability, acid resistance, impact strength, rapid chloride penetration,
corrosion resistance and alkalinity measurement of M60 grade of HPC mixes with different replacement levels of cement by silica fume or fumed silica. The results of these investigations demonstrates the superior mechanical and durability characteristics of silica fume and fumed silica based concrete mixes. Based on the results obtained, the replacement of cement with 15% of silica fume and 1% of fumed silica which yields superior mechanical and durability characteristics was arrived at. The details of the investigations along with the results are presented in this thesis.