ABSTRACT

Quality aggregates have become scarce and costly in many places in India, due to sudden increase in construction activities required for the development of new infrastructure facilities. The use of waste materials in construction appears to be an attractive proposition because of their low cost, environmental considerations and depleting source of quality aggregates, if good performance can be ensured through appropriate technology. One of the problems arising from continuous technological and industrial development is the disposal of waste materials. Various solutions have been sought out for this major environmental problem and the best solution found is recycling. As is in the rest of the world, as a result of fast population growth and urbanization, the construction industry is growing at a great pace in our country as well. Everyday old buildings are being knocked down and replaced with the new ones. The debris from these demolished buildings is thrown away, causing environmental pollution, or is used as filling material.

Factories producing ceramic materials such as electrical insulators, glazed ceramic tiles and sanitary items, also produce a large amount of waste due to handling and manufacturing defects. The reuse and recycling of these materials is still not a common practice, especially in India, where more than 95% of the total ceramic wastes produced is deposited in dumping grounds.
Thermal power stations using pulverized coal as fuel produce enormous quantities of ash as waste products of combustion. In India, it is estimated that thermal power plants produces about 100 million tonnes of fly ash per annum. Hence the problem of ash disposal is expected to become acute due to the limited space available for ash disposal near most of the thermal power plants. At present, percentage utilization of fly ash is only around 15 to 20%. Generally, fly ash is used as replacement of cement, as an admixture in concrete and in manufacturing of cement. As percentage utilization of fly ash is very low, an effort is made to increase its utilization by using it as partial replacement for fine aggregate in concrete.

Since control of pollution of waste materials increasingly important, it would be a good solution to reuse the wastes. One such attempt is made in this study. An experimental investigation is carried out:

- To study the properties of recycled aggregates
  - a) Recycled concrete aggregate
  - b) Ceramic waste aggregate
- To study the properties of lean concrete made with recycled concrete aggregate/ceramic waste aggregate
- To study the effect of fly ash on mechanical and durability properties of lean concrete made with recycled aggregates
- To study the performance of pavement base course constructed using lean concrete made with recycled aggregates and fly ash

This thesis presents the results of an experimental investigation carried out to evaluate the mechanical and durability properties of lean concrete in which the fine aggregate (river sand) was partially replaced with
Class C fly ash and coarse aggregate used was recycled aggregates. Fine aggregate was replaced with five percentages (10, 20, 30, 40 and 50%) of fly ash. Mechanical and durability properties of recycled aggregate concrete without fly ash reduced compared to natural aggregate concrete. Test results indicate significant improvement in the strength properties of recycled aggregate concrete by 50% replacement of fine aggregate with fly ash. Properties of lean concrete made with ceramic waste aggregate as coarse aggregate and upto 50% replacement of fine aggregate with fly ash seem to be very similar to natural aggregate concrete.

In continuation of the experimental research conducted in laboratory, to understand the performance of the lean concrete in the field, studies have been carried out by constructing a model pavement using lean concrete made with recycled aggregates as coarse aggregate and 50% replacement of fine aggregate with fly ash as base course. Based on the results obtained, it was observed that the performance of the lean concrete base course pavement with 50% replacement of fine aggregate with fly ash has performed well during a service period of one year.

In conclusion, use of recycled concrete aggregate and ceramic waste aggregate in lean concrete production helps in solving a vital environmental issue apart from being a solution to the problem of inadequate concrete aggregates in concrete. In addition, results of the experimental investigation suggest that Class C fly ash could be very conveniently used in lean concrete mixes as partial replacement for fine aggregate.