ABSTRACT

India is now in a stage where construction of roads, bridges, ports, factories, residential and commercial buildings, etc. is taking place at very rapid pace and will continue in coming decades as most of the cities will start building their metro construction. Concrete industry is one industry that is very important for any developing country where large amount of material is consumed. The materials are being utilized in a fast pace. Any other new material that can be used in concrete would decrease the pace of consumption of the materials making the construction little more sustainable.

On the other hand, marble and granite are in great demand as finishing material. A large amount of extraction waste is being created. A large amount of powder slurry is also being generated due to sawing and polishing processes. This powder slurry is very consistent particle size distribution and has particle size of the order on cement and fly ash.

To study the environmental effect due to the wastage created by marble and granite industries, the author visited Kishangarh, Makrana and Rajsmand in Rajasthan for marble and Khamam in Andhra Pradesh for granite. It was observed that the environmental problems in Khamam were more severe as it was more unorganised compared to the situation in Rajasthan. In both the cases, the amount of waste generation is too large and the situation is waiting for an environmental chaos. Rizzo et. al. [94] had reported that these fine materials could percolate into the soil and create soil and water-related pollution with grave consequences.

The author presented and estimation of the marble and granite reserve as reported by Indian Bureau of Mines [1-2], and estimated the production of the marble slurry based on production of marble slabs. Based on the cement consumption reported by Cement Manufacturers’ Association [9], author showed that it is possible to consume the slurry produced. Carrying out cost benefit, there would be direct financial benefit. Other indirect benefits that the country should recognize are the environmental benefits
of such utilization and decrease of consumption of fine and coarse aggregates and thereby provide tax benefits.

Various researchers have attempted utilization of marble and granite powders. Some talked of cement replacement whereas most talked sand replacement. A few work has been done on utilization of granite powder. Initial research work consistently reported lower strength on utilization of these materials. These problems were solved by proper estimation of water in the mix in this thesis.

This thesis presents a scientific study about the utilization of this marble and granite in normal and self-compacting concrete. Determination of SSD condition, its specific gravity, and moisture content are important. The methodology presented in this thesis can consistently achieve the design strength.

The most important contribution of this thesis is

a) It established a procedure of utilization of these fine materials such that it can consistently achieve strength of concrete similar to the composition without them.

b) It establishes the importance of water correction and its methodology for fine material with high water absorption capacity.

c) Marble and granite powders, being fine of the order of cement and fly ash, can significantly contribute to the fines and create a cohesive mix.

d) Marble and granite powders can be consumed to the order of 200 kg/ m$^3$ for high strength and to the order of 360 kg/ m$^3$ for normal concrete, contributing to 8% to 15% of the volume of concrete respectively.

e) Plasticizer demand depends on the particle size where marble and granite powders need to be considered in addition to the cementitious material while calculating the plasticizer dosage.

f) It emphasises the direct cost benefit and indirect benefits of marble and granite utilization. The indirect benefits are the environmental benefits and decrease in consumption of fine and coarse aggregates.