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Performance of recycled aggregate in concrete from demolishing waste

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Abstract
Demolition of old structures to make way for new and modern ones is common features in metropolitan areas due to rapid urbanization. However, very little demolished concrete is recycled or reused. The strict environmental laws and lack of dumping sites in urban areas on one hand are making the disposal of demolition wastes problematic while on the other hand the quarrying of raw materials is becoming difficult. The present research work is an experimental investigations carried out to evaluate the effect of partial replacement of cement, fine aggregate and coarse aggregate by different parts of demolished wastes on strength and workability of concrete made. For the study, design mix concrete of grade M25 (Referral concrete) was prepared using IS: 10262-2009. Thereafter, the replacement of different constituents of concrete, one at a time was carried out by replacing these with the different sieved fractions of crushed demolition waste. The compressive strength at 7, 14 and 28 days, and workability in terms of slump value were measured. The compressive strength of these mixes was measured on 150mm cubes. The compressive strength of recycled concrete (FAR concrete) with Demolition Waste in Concrete 20% fine aggregate replacement by demolition waste fine aggregate at 28 days is comparable to that of referral concrete. The compressive strength of recycled concrete (CAR concrete) made using 30% of demolition waste coarse aggregate is almost like referral concrete. Further, the results indicate that still higher replacement of the constituent materials is possible without much compromising the 28 days strength and workability.

Keywords: Demolished waste, recycled aggregate, compressive test, flexural test, split tensile strength

1. Introduction

Construction and demolition waste is defined as waste which are produced from construction, repairing and demolition activities including damaged products and materials arising from construction works. Construction sector is one of the biggest waste producers worldwide. Landfill is the best cheapest and traditional disposal method for C&D wastes, but in accordance with the existing tremendous pressures on landfill area, recycling should be the main focus for the waste management. Waste utilization and management involves ecofriendly and socially favorable way. Management generated from construction and demolition activities may prove to be useful for developing environmental conditions, pollution control, land conservation and energy resources. Precise data on C&D waste generated in India is unavailable. This is because of the absence of rules laid down by regulatory bodies. C&D waste management in India is not well designed as no separate designed action plan is available with government departments and municipal corporations. Use of construction and demolition materials satisfying requirements of quality for the use should be made mandatory for new constructions with

affordable rates. Utilization of C&D waste in construction industry is a new innovative practice. Use of C&D waste concrete will promote and encou sustainable developments. Use of C&D waste material will lower the energy within the buildings which will make them more energy efficient.

Construction materials are increasingly judged by their ecological characteristics. Concrete recycling 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 or other applications. Recycling of concrete is a relatively simple process. It involves breaking, removing, and crushing existing concrete into a material with a specified size and quality. The crushing characteristics of hardened concrete are similar to those of natural rock and are not significantly affected by the grade or quality of the original concrete. Recycled concrete aggregates produced from all but the poorest quality original concrete can be expected to pass the same tests required of conventional aggregates.

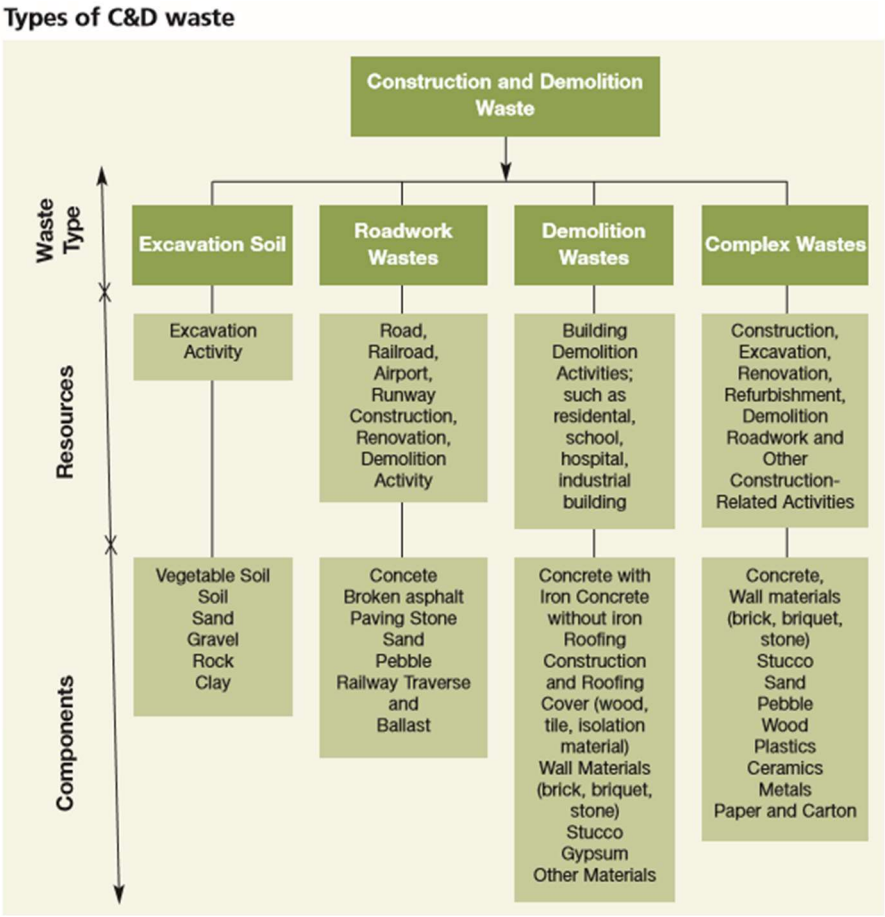

Figure1 : Types of C&D waste

2. India: Present scenario of Construction and Demolition waste:

Asian institute of technology, Thailand had conducted a survey in various Asian countries and published a report on reduce, reuse and recycle (3r) practices in construction and demolition waste management in Asia in May 2008. Presently, C & D waste generation in India accounts up to 23.75 million tons annually and these figures are likely to double fold up to 2016. C&D waste and specifically concrete has been seen as a resource

in developed countries.

Sadhan Ghosh, president of the International Society of Waste Management, India reports that estimated waste. generation during construction is 40 to 60 Kg. per sq. m. Similarly, waste generation during renovation/ repair work is estimated to be 40 to 50 kg/sq. m. The highest contribution to waste generation is due to demolition of buildings.

Demolition of Pucca and Semi-Pucca buildings, on an average generates 500 & 300 kg/ sq.m of waste respectively. In India nearly 50% of Construction & Demolition waste is being re-used and recycled, while the remainder is mostly landfilled. The cost of construction materials is increasing enormously. In India, the cost of cement during 1995 was Rs.125/kg and in 2020 the price increased to Rs. 310/bag. In case of bricks the price was Rs. 0.66 per brick in 1995 and the present rate is Rs. 5 per brick in 2020. With the environmental hazards caused by excessive and illegal extraction of river sand, the mining of river sand is banned since April 1, 2012. The raw materials used in construction are largely non-renewable natural resources hence meticulous use of these materials is essential.

The demand for aggregates in 2007 has seen an increase by five percent, to over 21 billion tones, the largest being in developing countries like China,India, etc

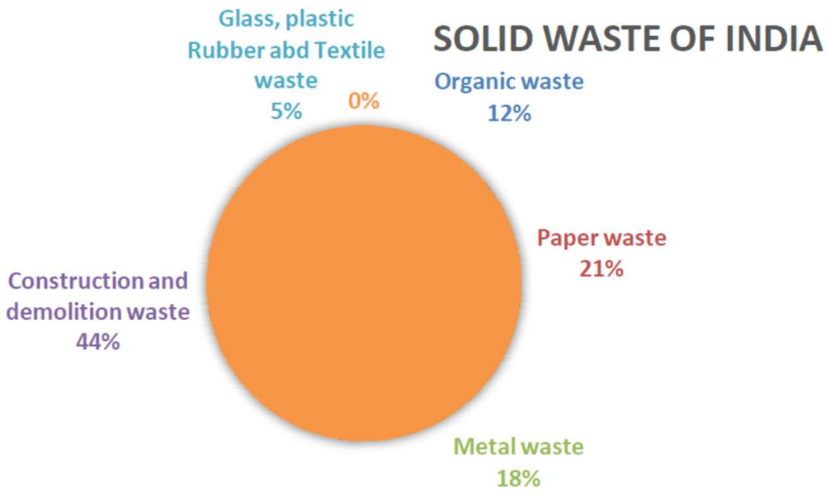

Figure2: Construction and Demolition Overview, 2012

3. Experimental Investigation of Recycled aggregate

A. Compressive Strength Test

Concrete cubes of sizes 150mm×150mm×150mm were tested for crushing strength. Compressive strength depends on loads of factor such as w/c ratio, cement strength, excellence of concrete material and excellence control during manufacture of concrete. These cubes are tested by compression testing machine after 7 days, 14 days or 28 days curing. The sample is placed centrally on the base plate of machine and the load have to be apply gradually at the rate of 140 kg/cm2 per minute till the specimen fails. Load at the failure separated by area of sample gives the Compressive strength of concrete. The sample to increased load breaks down and no greater load greater load can be constant. The maximum load applied to specimen shall then be recorded and any unusual value noted at the time of failure brought out in the report. The cube Compressive strength, then fc=P/A N/mm2 Where P is an ultimate load in N, A is a cross sectional area of cube in mm2

Figure 3: Cube casted and tested for compressive test

B. Split Tensile Strength of Concrete

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to
determine the tensile strength of concrete to determine the load at which the concrete members may crack. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. Split tensile strength test was conducted by using the method prescribed by IS5816-1999. Cylinders of 150mm×300mm were used for this test. The specimens were tested for 7, 14, 28 days the cylinder specimen was placed in horizontal direction on the testing machine. The splitting of cylinder is shown in figure. The following relation is used to find out the spilt tensile strength of cylinder

Figure 4: Split tensile strength on cylinder

C. Flexure Strength Test

Flexural strength test on concrete beam to determine the strength of concrete. Flexural strength test was conducted by using the method prescribed by IS 516 – 1959.

Figure 5: Flexure Strength Test

4. Replacement of Demolished Coarse Aggregate in Concrete

The results completed in the present investigation are reported in the form of Graphs for various percentage of recycled aggregate as a replacement to coarse aggregate. The following are the percentages replacement of cement i.e. 20%, 40%, 60%, 80%, 100%.

A. Slump Test

Slump test is used to determine the workability of fresh concrete. Slump test as per IS: 1199 – 1959 is followed. The apparatus used for doing slump test are Slump cone and tamping rod. The internal surface of the mould is thoroughly cleaned and applied with a light coat of oil. The mould is placed on a smooth, horizontal, rigid and non-absorbent surface. The mould is then filled in four layers with freshly mixed concrete, each approximately to one-fourth of the height of the mould. Each layer is tamped 25 times by the rounded end of the tamping rod (strokes are distributed evenly over the cross section). After the top layer is rodded, the concrete is struck off the level with a trowel

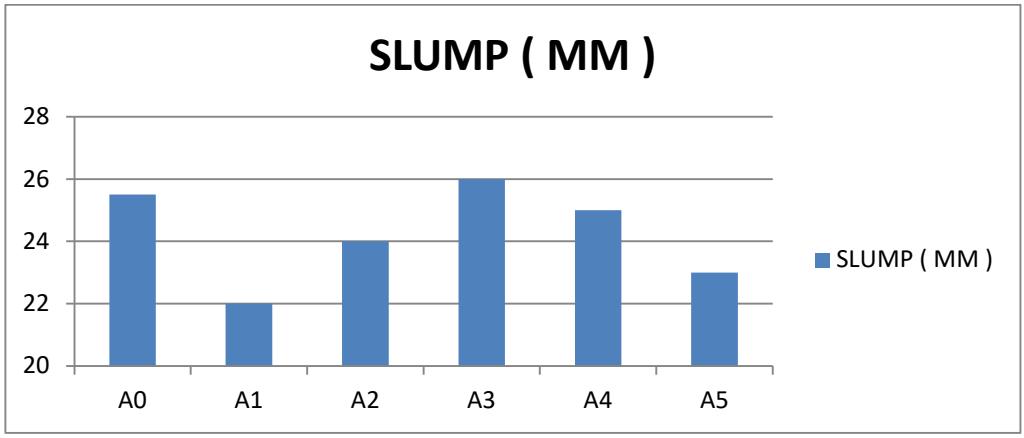

Figure 6: Slump Cone Test

B. Compressive Strength Results

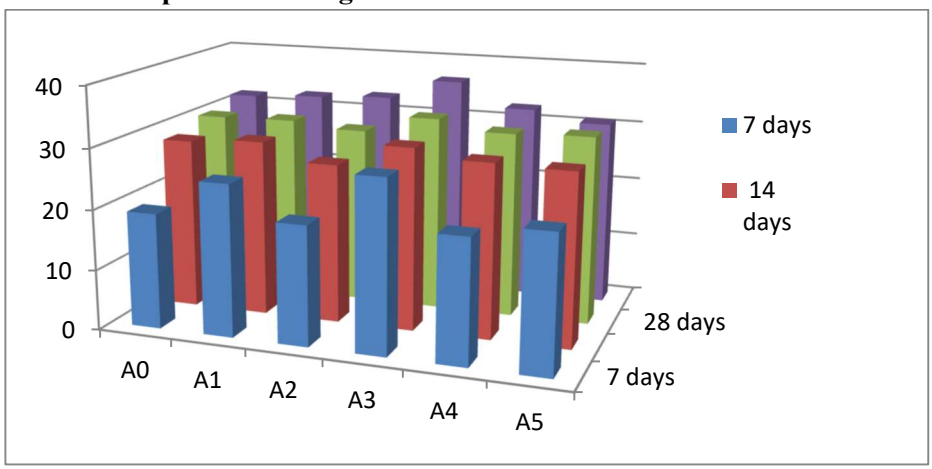

Figure 7: Compressive Strength Test Result Graph

C. Split Tensile Strength Test Results

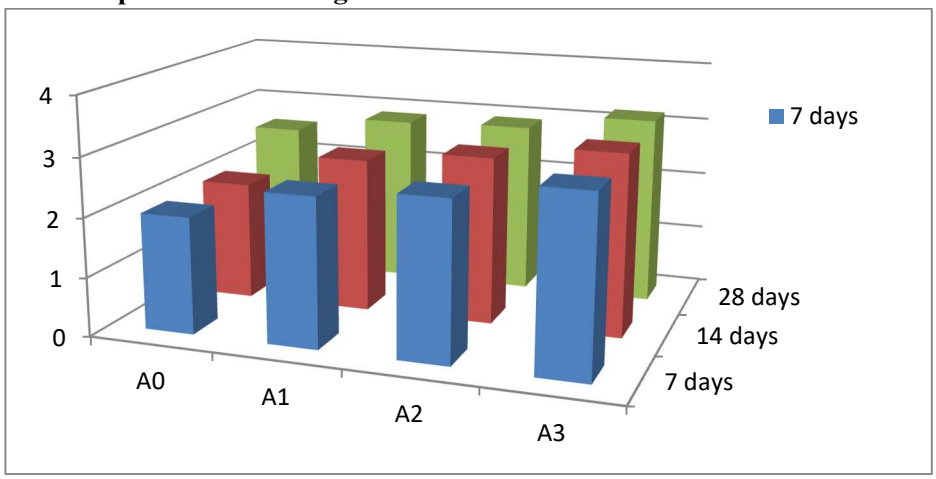

Figure 8: Split Tensile Strength Test Result

D. Flexural Strength Test Results

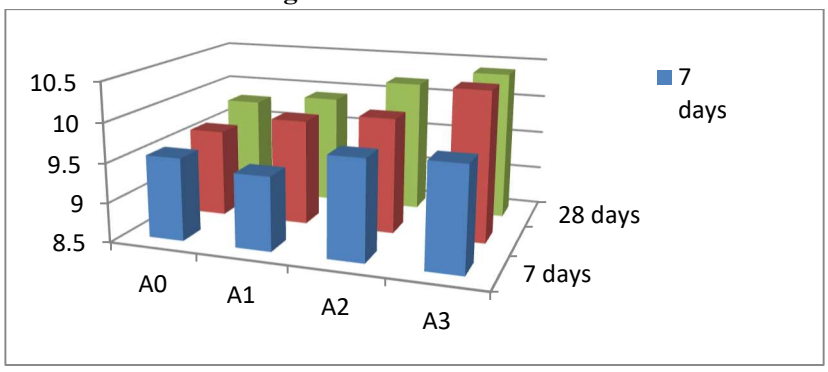

Figure 9: Flexural Strength test results

5. Replacement of Demolished Fine Aggregate in Concrete

The results completed in the present investigation are reported in the form of Graphs for various percentage of recycled aggregate as a replacement to coarse aggregate. The following are the percentages replacement of cement i.e. 20%, 40%, 60%, 80%, 100%.

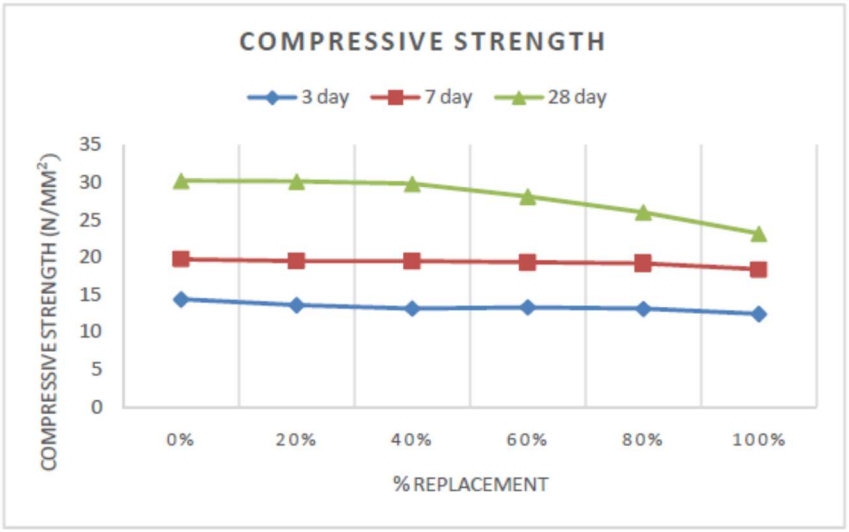

Figure 10: Compressive strength of cubes

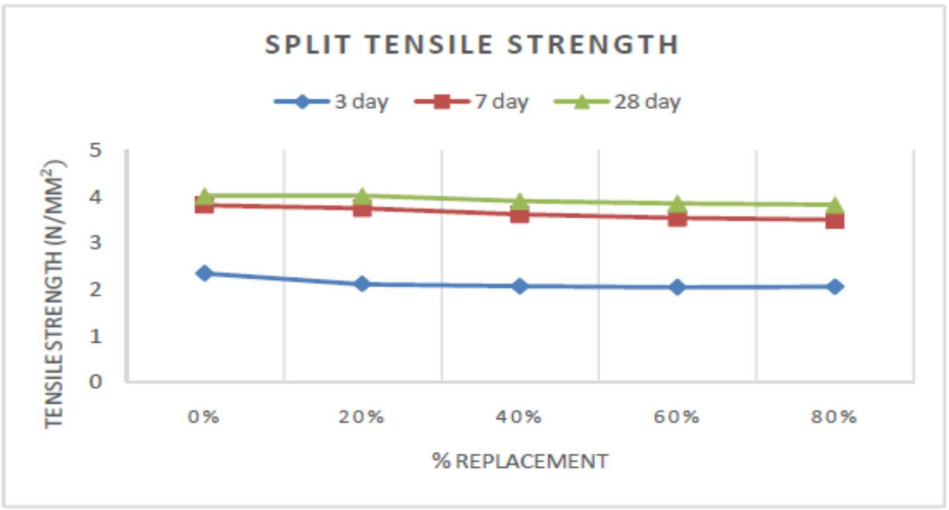

Figure 11: Split Tensile strength of cylinders

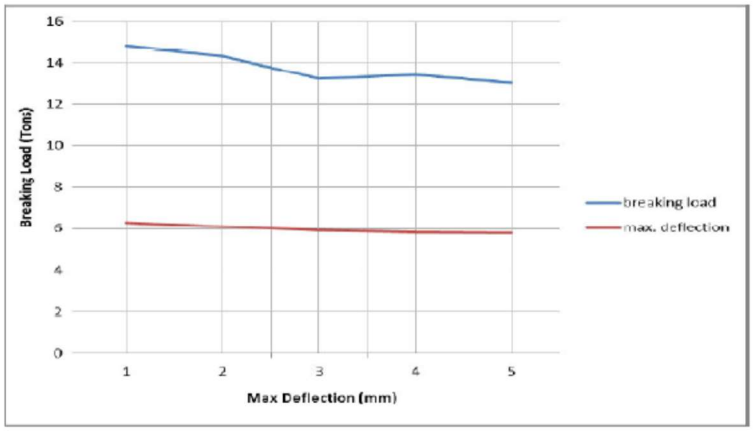

Figure 12: Flexural strength of beam

6. Conclusion

Concrete recycling will become one of the most important elements for construction sustainability. Concrete in which binders, additives and aggregates are all made of cement or materials of cement, and all of these materials can be used as raw materials of cement after hardening. Concrete which contains waste products as aggregate is called 'Green' concrete. This paper focuses on the feasibility of construction waste aggregate to making new green concrete. Based on limited experimental investigation concerning the strength tests i.e. compression, split tensile and flexural strength the following observations are regarding the resistance of replacement done with Recycled Coarsed Aggregate to Natural Coarse Aggregate And Recycled Fine Aggregate to Natural Fine Aggregate in M25 concrete

1. The reuse of dismantled concrete will help in improvement of overall environment of the region. Firstly, by reduction in mining and secondly reduction in air pollution resulting from production of aggregates (dust pollution) and transportation of aggregate from mining to consumption point

2. The replacement of recycled demolished concrete can be optimized as a fine aggregate in the concrete
3. Strength properties linearly decreased in comparison to conventional concrete at the replacement of 0%, 20%, 40%, 60%, 80%, and 100%.
4. Replacement is done up to 100% but up to 20% replacement is more suitable for replacement.
5. The use of dismantled aggregate in making fresh concrete will also help in reduction of solid waste dumping on existing landfill sites
6. The compressive strength of the concrete is increases with increasing the percentage of demolished material upto 30%
7. Using demolished aggregate concrete as a base material for roadways reduce the pollution involved in trucking material.

Reference

- S. Prakash Chandar : Experimental investigation on partial replacement of fine aggregate by demolished concrete in the production of normal concrete. International Journal of Civil Engineering and Technology Volume 8, Issue 4, April 2017
- M. Anjaneyulu Naik1, A. Ramakrishnaiah : an experimental study on utilization of demolished concrete waste for new construction 2018 JETIR April 2018, Volume 5, Issue
- Hanifi Binici. Have studied the Durability if concrete made with granite and marble as recycle aggregates.
- IS 383 (1970): Specification for Coarse and Fine Aggregates from Natural Sources for Concrete [CED 2: Cement and Concrete].
- IS 10262:2009, 'Concrete mix proportioning', Bureau of Indian Standards, New Delhi, India. [6].IS 456:2000, 'Indian standard plain and Reinforced Concrete Code of Practice',Bureau of Indian Standards, New Delhi, India.
- IS: 456-1978, "Code of practice for plain and reinforced concrete."Indian Standard Institute,New Delhi.
- IS:6461-1973,"Properties of concrete", (part VIII), Indian Standard Institute, New Delhi.
- IS: 6461 – 1973, "Glossary of terms relating to Cement concrete", Indian Standard Institute, New Delhi.
- Hansen, T.C, and Marga, M (1992), Strength of recycled concrete made from coarse and fine recycled concrete aggregate. Ibid 135, pp.605-612.
- Mrunalini Deshmukh : Replacement of Fine Aggregate by Demolished Waste Concrete. International Conference On Emanations in Modern Technology and Engineering (ICEMTE-2017) Volume: 5 Issue: 3