MANUFACTURE OF CONCRETE USING SOLID WASTE FROM CONSTRUCTION INDUSTRY

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Abstract: Solid waste management is associated with the control of waste generation, its storage, collection transfer and transport, processing and disposal in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental consideration.The disposal of waste generated due to the demolition of building and other concrete structures is a major challenge in the present era. Hence an attempt has been made to investigate the fresh and hardened properties of concrete made with recycled aggregates. For the present investigation two mixes, one with natural aggregates and another with recycled aggregates designed for M20 grade of concrete are considered, the results obtained are compared and Specific conclusion on the properties of concrete are drawn based on the experimental investigation.

Keywords: Waste Concrete, Recycled aggregates, Compressive Strength, Flexural Strength, Split Tensile Strength.

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1. INTRODUCTION

Bangalore has a population of 6 million and has more than 2000 industries working at various industrial estates and other locations around the city. It was reported that about 1500 tons of municipal waste per day is being generated from Bangalore city. Studies reveal that there is no scientific treatment and disposal facility for scientific management of the waste generated. The waste from industries and community areas is disposed in an unscientific manner at several open dump sites across the city. There are more than 60 dump sites consisting of both municipal and industrial waste in existing in and around Bangalore city; the locations are totally unhygienic.

The hazardous waste generation in the state is about 80,000 tons per year.

Municipal waste generated in Bangalore city alone is about 0.5 million tons per year.

2. LITERATURE REVIEW

SherifYehia et al.[1] discussed the suitability of producing concrete with 100 % recycled aggregate to meet durability and strength requirements for different applications and found from the experimental results that concrete with acceptable strength and durability could be produced if high packing density is achieved.**Valeria Corinaldesi**[2]investigatedthe mechanical behaviour and elastic properties of recycled aggregate concrete (RAC), he prepared RAC by using a coarse aggregate fraction made of recycled concrete coming from a recycling plant in which rubble from concrete structure demolition is collected and suitably treated. Different water-to-cement ratios were adopted ranging from 0.40 to 0.60. Concrete workability was always in the range 190–200 mm. Results obtained from his experiments revealed that structural concrete up to C32/40 strength class can be manufactured with RAC. Moreover, results obtained from experimentation were discussed in order to obtain useful information for RAC structure design, particularly in terms ofelastic modulus and drying shrinkage prediction.**S. Muneeraet. al**analysed the properties of recycled coarse aggregates, and judged its effectiveness in use of concrete. Concrete mixes were designed with 28 day compressive strength as 20 MPa. The concrete mixes were designed using IS10262:1982 i) conventionally used coarse aggregates and ii) 10%, 20%, 30%, 40%, 60%, 75%,100% replacement of recycled coarse aggregate, thy found from the experimental investigation that there is only 5 – 10%. Reduction in the strength of concrete and the reduction in strength is attributed to the decrease in adhesive strength between the RCA aggregates and the cement binder.

3. EVOLUTION OF WASTE CONCRETE

Construction and demolition waste is defined as the solid waste generated by the construction, remodeling, renovation, repair, alteration or demolition of residential,commercial, government or institutional buildings, industrial, commercial facilities and infrastructures such as roads, bridges, dams, tunnels, railways and airports. Construction and demolition waste is considered as high volume, low risk. It is commonly understood that this waste can be considered a resource, either for reuse in its original form or for recycling or energy recovery.

Because of increasing waste production and public concerns about the environment, it is desirable to recycle materials from building demolition. If suitably selected, ground, cleaned and sieved in appropriate industrial crushing plants, these materials can be profitably used in concrete. Despite this, most Construction and Demolition waste ends up in landfills. This paper highlights the need for its recycling and options that can be implemented for its efficient use in the field of concrete technology in general.

During the rock processing, lot of dust is evolved. As the sizes of particles are smaller, they get easily transported in the air and settle on crops, plants as a result of sedimentation. High concentrations of dust on plants results in poor plant performance and yield.

Apparently the poor health status of the people could be attributed due to high concentration of particulate matter generated from the quarries, the water gets contaminated.

By recycling concrete, valuable landfill space and natural resources are preserved. This concept is part of thelarger “sustainable construction” philosophy that seeks to minimize waste generation and encourage recycling in order to prevent adverse long-term environmental effects. Waste concrete management includes following steps

1. Storage and segregation.
2. Collection and transportation.
3. Recycling and reuse.
4. Disposal.

Recycling of this waste by converting it to aggregate offer dual benefit of saving landfill space and reduction in extraction of natural raw material for new construction industry. Basic method of recycling of concrete and masonry waste is to crush the debris to produce a granular product of given particle size. Plants for processing of demolition waste are differentiated based on mobility, type of crusher and process of separation.

To ensure the usage of this construction and demolition wastes, we are substituting them in the place of natural coarseaggregate (ie, 100% replacement). Even fine aggregate is replaced by quarry dust for 40% composition. Water cement ratio of 0.4 is been maintained.

4. METHODOLOGY AND EXPERIMENTAL PROGRAMME

Two mixes one using natural aggregates and one with recycled aggregates are considered for the study, for each Mix A series of 9 cubes, 9 cylinders and 9 prisms of standard size are casted and cured for 3, 7 and 28 days. The cubes and cylinders are tested for compressive and split tensile strength in the compression testing machine, and flexural strength test is carried out in flexural testing machine. The mix design adopted for the investigation is M20 Grade(1:1.5:3)

The two mixes are represented in table below

Mix 1	Concrete with Natural Aggregates
Mix 2	Concrete with Recycled Aggregates

5. EXPERIMENTAL RESULTS

After the concrete has hardened, its resistance to their loads is called its strength, the strength of concrete plays a vital role in its structural behavior and design of cement concrete structural member.

The strength of concrete is commonly considered as most valuable property of concrete. The strength of concrete usually gives the overall picture of quality of concrete.As the strength is directly related to structures of hardened cement paste.

Among all strengths, the compressive strength is generally considered as most important property of concrete and gives overall picture of quality of concrete in the present study compressive strength, split tensile strength and flexural strength are taken into account.

5.1. PROPERTIES OF FRESH CONCRETE

Workability is the ability of a fresh concrete mix to fill the form/mold properly with the desired work (vibration) and without reducing the concrete's quality. Fresh properties of concrete gives the plasticity of concrete mix. In the present investigation Workability concrete is measured by using slump Cone test, and the results obtained for the mixes are tabulated in table 1.

Table1: Fresh Properties of Concrete

CONCRETE TYPE	SLUMP (mm)
Mix 1	78
Mix 2	68

5.2. COMPRESSIVE STRENGTH

Mostconcrete structures are designed under all assumptions that the concrete develops compressive stresses, but not tensile stresses. The compressive strength is the main criteria for the purpose of structural design, the compression tests are relatively easy to carry out.

The test for determining compressive strength for concrete employs cube specimen of 150mm size and cured for 3, 7 and 28 days which is subjected to compression in a compression testing machine. The compressive strength test results are for 3, 7 and 28 days are shown in table 2 and fig1.

Table2: Average Compressive Strength of Concrete

Mix	Grade	Age of Sample	Weight (Kg)	Load (kN)	Strength (N/mm²)
Mix 1	M20	3	8.220	222	9.9
		7	8.130	319	14.2
		28	8.270	429	19.9
Mix 2	M20	3	8.100	165	7.3
		7	8100	274	12.3
		28	8.260	378	18.8

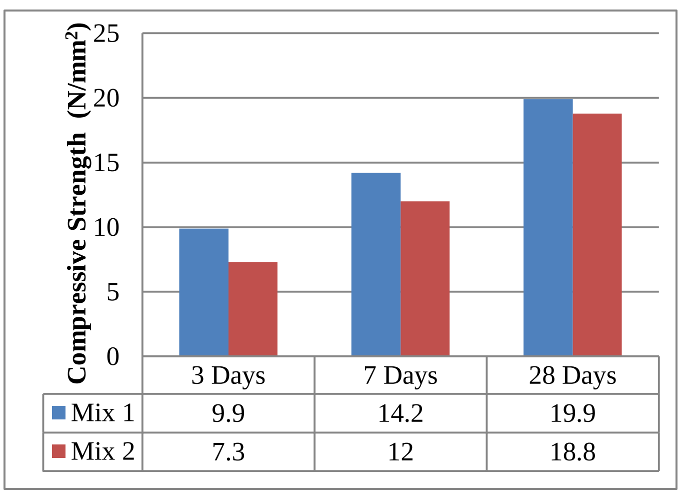

Fig 1: Compressive Strength of Concrete

6. SPLIT TENSILE STRENGTH

This is an indirect test for concrete. This method has developed in Brazil and has come into general use and been standardized throughout the world. The specimen is a 150 x 300 mm cylinder made and cured in the same manner as compared to compressive test. Two wooden strips are placed. One at the top and the other at the bottom. The specimen and the same is loaded in compression. The tensile strength is computed in this manner is apparently about 15% higher than that determined by direct tension tests.

In order to obtain the split tensile strength for 3, 7 and 28 days, tests are conducted on cylinders. The procedure for the test is explained in the earlier chapter. The results of split tensile strength test were tabulated in table 3 and fig 2.

Table3: Average Split Tensile Strength of Concrete

Mix	Grade	Age of Sample	Weight (Kg)	Load (kN)	Strength (N/mm²)
Mix 1	M20	3	13	86	1.27
		7	13.1	100	1.42
		28	12.9	95	1.34
Mix 2	M20	3	13.12	50	0.7
		7	13.14	70	1.0
		28	12.9	77	1.1

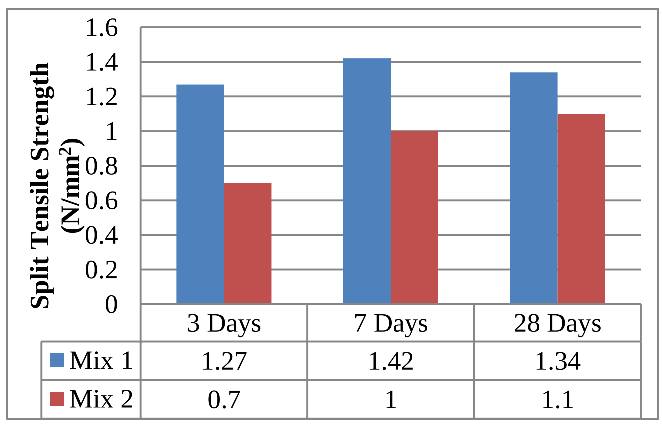

Fig 2: Split TensileStrength of Concrete

6.1. Flexural strength

When concrete is subjected to bending, tensile, compressive stress and in any cases direct shearing stresses occur. The most common example of concrete structure subjected to flexure are highway pavements and the strength of concrete for pavement is commonly evaluated by means of bending tests on 100 x 100 x 500 mm beam specimens. Flexural strength is expressed in terms of "modulus of rupture", which is the maximum tensile (or compressive) stress at rupture. The flexural strength results for both mixes are presented in table 4 and fig3.

Table4: AverageFlexural strength of Concrete

Mix	Grade	Age of Sample	Weight (Kg)	Load (kN)	Strength (N/mm2)
Mix 1	M20	3	12.100	4.6	2.3
		7	12.130	6.1	3.05
		28	12.300	8.9	4.45
Mix 2	M20	3	12.240	3.9	1.58
		7	12.210	5.8	2.95
		28	12.290	8.3	4.25

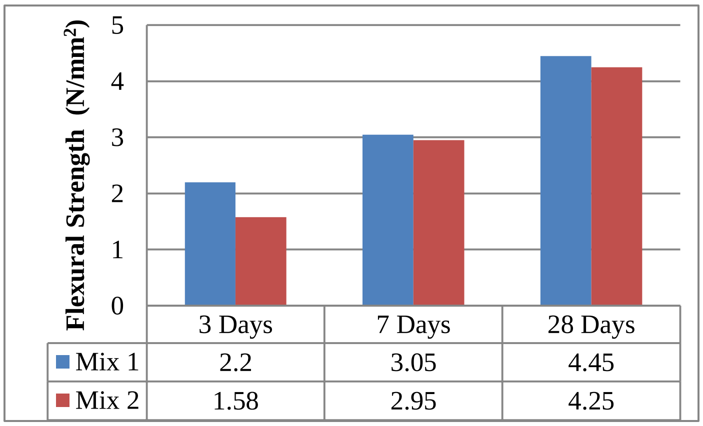

Fig 3: Split Tensile Strength of Concrete

7. CONCLUSION

By initiating the recycling technology of concrete, landfill space can be saved and extraction of natural raw material for new constructions can be minimized. The main thing is, chances for creating a greener city can be enhanced.

Moreover the recycled concrete is working well with desirable strength properties, it can be observed from the results of experimental investigation that the concrete prepared using recycled aggregateshave marginal variation of strength compared to NATURAL AGGREGATE CONCRETE.

8. RECOMMENDATIONS FOR FUTURE WORK

1. To study Behavior of recycled concrete with the implication of admixtures.

Investigate the properties of recycled concrete with partial replacement of crushed concrete powder which will be accumulated during the breaking of waste concrete.

2. To study the rheologicalbehavior of this concrete for different water cement ratios and different grade of concrete.

9. REFERENCES

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