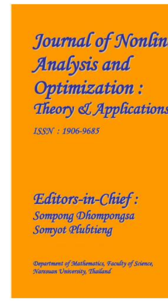

Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 15, Issue. 1, No.15 : 2024
ISSN : **1906-9685**

STRENGTH CHARECTERISTICS OF CONCRETE BY REPLACING NATURAL SAND BY M-SAND AND COARSE AGGREGATES BY RECYCLED CORASE AGGREGATES IN M40 AND M60 GRADE CONCRETE

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Abstract *The most widely used material in this world is concrete. After water, concrete is placed in second position. The use of natural sand in conventional concrete has become of vital importance which is scarce to obtain. Sand is basic concrete making construction material required in large quantities. Manufactured sand is one among such materials to replace river sand which can be used as an alternative fine aggregate in mortars and concrete. In general concrete is a combination of cement, fine and course aggregate. These days, natural river sand is difficult to acquire and extraction of sand from river has represented an awesome threat to environment. In addition, government has connected limitation on extraction of sand from riverbed. Subsequently, insufficiency of natural river sand and increase in demand contemplate research seek towards alternate fine aggregate. This seek turns the research intention towards effective utilization of Manufactured sand (M-sand) for commercial purpose. The concrete waste obtained from these processes is called "Demolished Concrete". The environmental protection and for promotion of the principles of sustainable development has led to recycled aggregate. Demolished sites and restoration schemes are sources of large amounts of solid waste, which today is being used as landfill. The reusing and recycling the demolished concrete a better economy can be achieved without an effecting of environment.*

An attempt had been made in the present investigation to discuss the properties of concrete such as workability and strength of concrete which is prepared by replacing natural sand with M-sand and coarse aggregates by recycled coarse aggregates at different replacement levels (0%+0%, 5%+10%, 10%+20%, 15%+30%, 20%+40% and 25%+50%) for M40 and M60 Grade of concrete.

KEY WORDS: *M-sand, Strength, Recycled coarse aggregates, compressive strength, split tensile strength, flexural strength*

1. INTRODUCTION

Concrete is one of the most popular materials for construction owing to the fact that it can be cast into just about any shape, it has good compressive strengths, is readily available just about anywhere and is relatively cheap in comparison to other materials available for construction, such as M Sand and Recycled aggregates composites. Concrete is made from a mixture of cement powder coarse and fine aggregates, normally sand and crushed rock and water. It can be either mixed in a hand mixer or by a large batch plant.

Since manufactured sands possess different properties to natural sands it would be beneficial to be able to predict the properties of the resultant concrete without extensive laboratory testing. There have been numerous attempts to model the influence of the physical and chemical characteristics of aggregates on the fresh and hardened properties of concrete and provide concrete mix design procedures. These, to some extent, take into account a number of the aggregate characteristics: the particle size distribution, maximum aggregate size and aggregate type (natural or crushed). However, as these procedures are based on statistical data from many concrete mixes, the results are generalized and in the case of a specific type of aggregate, like crusher dust or manufactured aggregates, might not yield the expected final concrete properties. Furthermore, the concrete compressive strength estimates are based on the w/c ratio, which for typical aggregates might be correct, but for very angular or very fine aggregates might prove to be an inaccurate representation of the strength. Similar effects might be encountered in consistency measurements.

Concrete aggregates gathered from obliteration destinations is put through a devastating machine. Smashing offices acknowledge just uncontaminated solid, which must be free of junk, wood, paper and other such materials. Metals, for example, rebar are acknowledged, since they can be expelled with magnets and other arranging gadgets and softened down for reusing somewhere else. The staying total lumps are arranged by estimate. Bigger lumps may experience the crusher once more. Subsequent to squashing has occurred, different particulates are sifted through an assortment of techniques including hand-picking and water buoyancy.

The objective of the present project work is to study the behavior of concrete in partial replacement for sand with manufactured sand and coarse aggregates with recycled aggregates in proportions. It includes a brief description of the materials used in the concrete mix, mix proportions, the preparation of the test specimens and the parameters studied. In order to achieve the stated objectives, this study is carried out in different stages. In the initial stage, all the materials and equipment needed must be gathered or checked for availability. Once the characteristics of the materials selected have been studied through appropriate tests, the applicable standards of specification are referred. The properties of hardened concrete are important as it is retained for the remainder of the concrete life. In general, the important properties of hardened concrete are strength and durability. An experimental program is held to measure strength of hardened concrete.

the properties of concrete by using M Sand as fine aggregates like 0%, 5%, 10%, 15%, 20% and 25%. And Recycled coarse aggregates as coarse aggregates like 0%, 10%, 20%, 30%, 40% and 50% for both M40 and M60 grade concrete.

2 LITERATURE STUDIES

Anagha Kalpavalli[1], Dr. S. M. Naik[2], etc.,

This experimental investigation involves evaluating the properties of the constituents of concrete including the demolished concrete wastes which shall be used as coarse aggregates in new concrete with the aim of producing high strength concrete. From this it was concluded that the specific gravity and bulk density of recycled aggregates is lower than that of conventional aggregates. This is because of the attached mortar present on the aggregate surface. The water absorption of recycled aggregates is higher than the natural aggregates. The range may vary based on the type of aggregates and in this case it is 6% higher.

Garboczi et al (2001) depicted how a combination of X-Ray tomography, image analysis-type techniques, and spherical harmonic analysis can give a complete 3-D mathematical characterization of an aggregate particle. Databases of 3-dimensional aggregate shape can be constructed and characterizing various aggregate sources is possible.

3. MATERIALS AND MIX RATIOS USED IN THE STUDY

3.1 Materials used for the study

3.1.1 Cement

Throughout the experiment, ordinary Portland cement (OPC) of 53 Grade from a single lot was employed. It had no lumps and was fresh. The following table lists the tests that were used to establish the cement's physical characteristics in accordance with Indian Standard IS: 8112:l1989. To avoid its qualities being compromised by moisture, cement is kept with great care.

Fig 1:OPC 53 Grade concrete

3.1.2 Coarse aggregates

Two crushed stone samples that were readily accessible locally and held on 10 mm while passing through 12.5 were combined to create the coarse aggregate. After being cleaned to get rid of dust and dirt, the aggregates were dried until they were surface dry.

Fig 2: Coarse aggregate

3.1.3 Fine aggregates

Filling the gaps with coarse aggregate and serving as active material are the two most important tasks of successful installation. Fine aggregate can be classified as fine sand, coarse sand or fine sand according to its size. IS: 383-1970 divided fine aggregates into four classification categories (classes I to IV) based on size distribution.

3.1.4 M Sand

Manufactured sand (M-Sand) is a substitute of river sand for concrete construction. Manufactured sand is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm. Manufactured sand is an alternative for river sand. Due to fast growing construction industry, the demand for sand has increased tremendously, causing deficiency of suitable river sand in most part of the word.

Fig 3:M Sand

3.1.5 Recycled coarse aggregates

Construction and demolition waste contributes up to 40 percent of all waste generated worldwide. The majority of recycled aggregate that is used in Australia is recycled concrete aggregate (RCA) produced form construction and demolition waste, as it is the most suitable replacement of natural coarse aggregate. Fine recycled aggregates are also used to replace natural sand however this isn’t as prominent. Utilising recycled aggregate can result in around 60 percent less waste and 50 percentage less mineral depletion per cubic metre of concrete produced. The strength of ordinary Portland cement concrete utilising recycled aggregate depends largely on the percentage of recycled aggregate used. The larger the percentage of RCA, the weaker the concrete becomes in both compressive and tensile strength. Recycled concrete aggregate Portland cement based concrete also suffers from high water absorption and thus up to 160% higher shrinkage and creep concrete made with natural aggregates.

Fig 4: Recycled coarse aggregates

Water

It is generally advised to mix and cure concrete using potable water. Therefore, concrete is made using this drinkable water. The water may be used in the concrete mixture since it is mostly devoid of harmful pollutants.

3.2 Mix proportioning

For M40 grade concrete

- Cement 438 kg/m3
- Water 197 kg/m3
- Fine aggregate = 717.12kg / m * 3
- Coarse aggregate = 1115kg / m*3
- w/c ratio =0.45

Ratio= 1:1.63:2.54

For M60 grade concrete

- Cement 504.21 kg/m3
- Water 141.61 kg/m3
- Fine aggregate = 708.48kg / m * 3
- Coarse aggregate = 1108.13 kg / m*3
- w/c ratio =0.29

RATIO= 1:1.40:2.19

3.3 Mix trials used in the study

1. Mix 1 -0%MS+0%RCA
2. Mix 2 – 5%MS+10%RCA
3. Mix 3 - 10%MS+20%RCA
4. Mix 4 – 15%MS+30%RCA
5. Mix 5 - 20%MS+40%RCA
6. Mix 6 - 25%MS+50%RCA

4. EXPERIMENTAL STUDY

To evaluate the strength and strength of concrete structures using M40 age M60 grade concrete, we need to use the grid, rollers and prisms to compare the compressive strength, uniform strength distribution, specific strength and bond strength at different cure times.

4.1 Batching

The process of gathering the amount of supplies needed for the job is called batching. Two techniques are often used to measure the amount of material: weight batching and volume batching. I used weight batching to measure the amount of materials in the current investigation.

4.2 Mixing of the Concrete

I blended the items according to the trails after calculating the amount of each ingredient. To produce a uniform mix, we must first mix the coarse and fine aggregates for a while. Then, we must add the cement and M Sand and coarse aggregates, and mix the combination once more for a little while longer to get the same mix throughout the material. Finally, add the water in accordance with the mix design calculations to create newly mixed M40 and M60 grade concrete.

Fig 5: Mixing of concrete

4.3 Casting of Specimens

To test the strength and endurance of the concrete, we must cast specimens such as cubes, cylinders, and prisms once the components have been mixed.

Fig 6: Cube specimens

Fig 7: Cylinder specimens

4.4 Curing Of the Specimens

To examine compressive strength, tensile strength and tensile strength, samples should be cured with five test mixtures for seven, fourteen and twenty-eight days. But to test the service life, we need to at least subject the samples to acid and alkali tests.

4.5 Tests to be conducted on concrete

4.5.1 Slump cone test and compaction factor test

One of the most important features of a well-designed innovation is functionality. In this study, slump factor and compaction factor tests were used to determine the performance of concrete mixtures. The figure below shows the collapse equations for various factors.

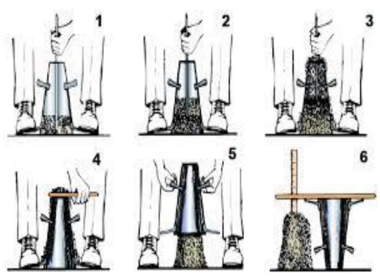


Fig 8: Slump cone test of concrete

4.5.2 Compressive strength of concrete

Using a universal testing machine (UTM), the compressive strength of concrete after curing is determined for tests 1 to 6. The compressive strength of concrete after 7, 14 and 28 days of curing is shown in the figure below.

Fig 9: Failure of specimen after testing

4.5.3 Split tensile strength of concrete

Cylinder samples are used to compare the tensile strength of M40 and M60 class concrete mix tests from test 1 to test series. The dimensions of the cylinder were determined to be 300 mm long and 150 mm in diameter. The difference in strength after 7, 14 and 28 days is shown in the graph below.

Fig 10 : Split tensile strength of concrete

4.5.4 Flexural strength of concrete

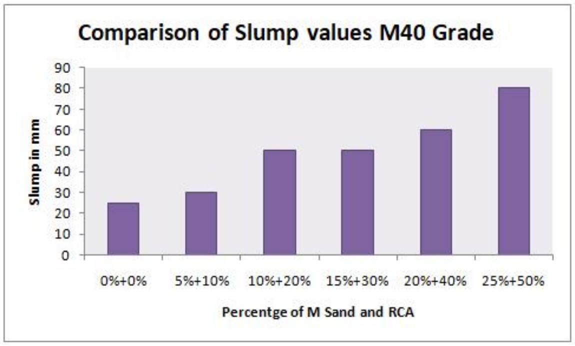
Flexural strength of M40 and M60 class concrete mix tests from test 1 to test series. The dimensions of the cylinder were determined to be 300 mm long and 150 mm in diameter. The difference in strength after 7, 14 and 28 days is shown in the graph below.

Fig 11 : Split tensile strength of concrete

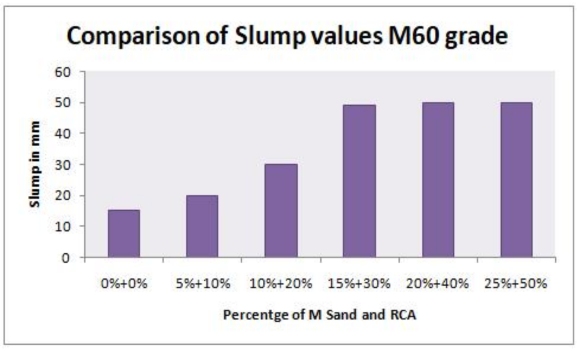
5 RESULTS AND ANALYSIS

5.1 Workability of concrete

5.1.1 Slump cone test

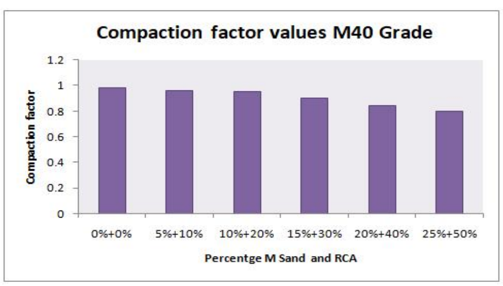


Graph 1: Comparison of M40 grade slump cone test results

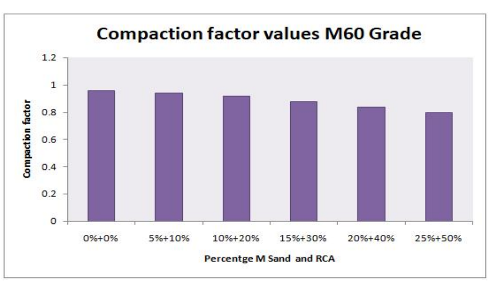


Graph 2: Comparison of M60 grade slump cone test results

5.2 Compaction factor test results

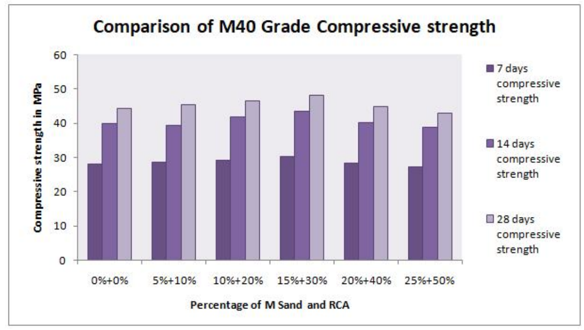


Graph 3: Comparison of M40 grade compaction factor results

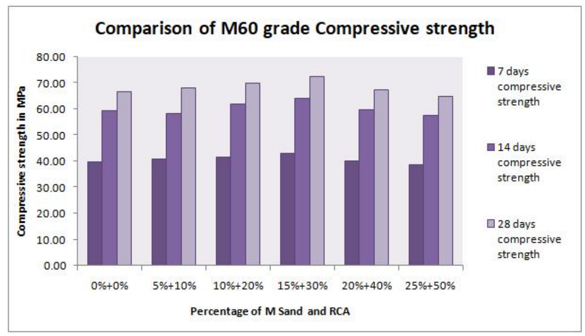


Graph 4: Comparison of M60 grade compaction factor results

5.2 Compressive strength of concrete

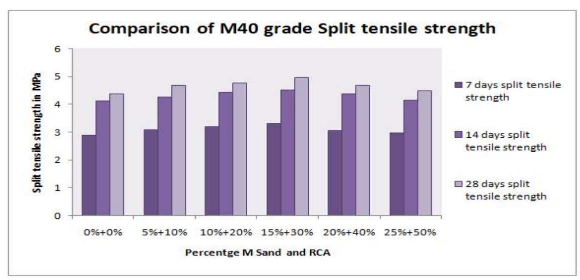


Graph 5: Comparison of M40 grade compressive strength

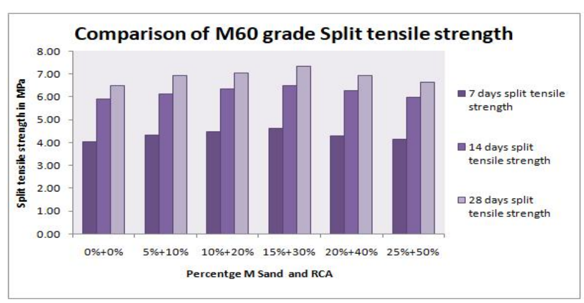


Graph 6: Comparison of M60 grade compressive strength

5.3 Split tensile strength of concrete

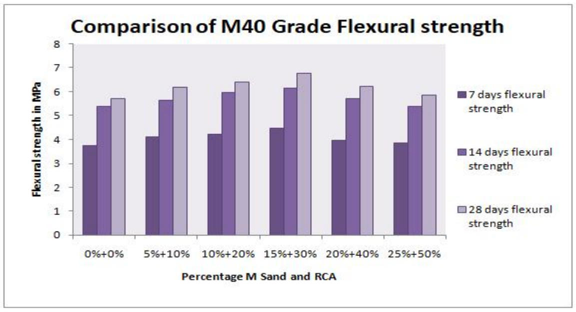


Graph 7: Comparison of M40 grade split tensile strength

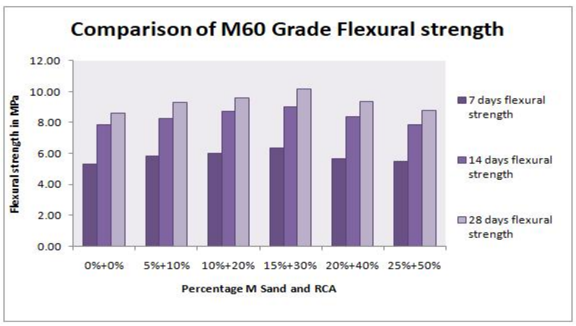


Graph 8: Comparison of M60 grade split tensile strength

5.4 Flexural strength of concrete



Graph 9: Comparison of M40 grade split tensile strength



Graph 10: Comparison of M60 grade split tensile strength

6 Conclusions

From the above study the following conclusions were made

1. The value of slump for the concrete increases with increasing the percentage of Recycled Coarse aggregates and M Sand for both M40 and M60 Grade concrete. The value of compaction factor for the concrete decreases with increasing the percentage of Recycled Coarse aggregates and M Sand for both M40 and M60 Grade concrete.
2. Compressive strength for 7days, 14days, and 28days for the concrete increases initially up to 15% M Sand 30% Recycled Coarse aggregates than decreases with increasing the percentage of M Sand and Recycled Coarse aggregates. The optimum value for the compressive strength was obtained at 15% M Sand and 30% Recycled Coarse aggregates.
3. Split tensile strength for 7days, 14days, and 28days for the concrete increases initially up to 15% M Sand 30% Recycled Coarse aggregates than decreases with increasing the percentage of M Sand and Recycled Coarse aggregates. The optimum value for the split tensile strength was obtained at 15% M Sand and 30% Recycled Coarse aggregates.
4. Flexural strength for 7days, 14days, and 28days for the concrete increases initially up to 15% M Sand 30% Recycled Coarse aggregates than decreases with increasing the percentage of M Sand and Recycled Coarse aggregates. The optimum value for the flexural strength was obtained at 15% M Sand and 30% Recycled Coarse aggregates.
5. The addition of Recycled Coarse aggregates significantly increased the compressive, tensile and flexural strengths of concrete with maximum strengths in each case being achieved at 15% M Sand 30% Recycled Coarse aggregates..

So the replacement of M Sand and 30% of Recycled Coarse aggregates is generally useful for better strength values in M40 grade and M60 grade of concrete.

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