"EXPERIMENTAL STUDY ON CONCRETE BLOCKS FROM RECYCLED AGGREGATES"

S B Ankesh[1], Venugopal M L[2], Sumanth S[3], Vinodkumar[4], Abhishek B S[5]

[1]Assistant Professor, Department of Civil Engineering, Dr. Ambedkar Institute of Technology, Bengaluru, India
[2,3,4,5]B E Students, Department of Civil Engineering, Dr. Ambedkar Institute of Technology, Bengaluru, India

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Abstract - *When the useful life of the structure is over it will be demolished and all the demolished wastes just find their way to landfills. Finding large areas for landfills is becoming very difficult. This serves waste management and disposal issues, paving way to waste utilization in construction industry from the sustainability point of view. As there is an ever-increasing paucity of natural aggregate and an exponential rise in its price structure, there is a need to recycle aggregates from demolished concrete waste obtained from non-functional and superseded structures. The aim of this project is to determine strength characteristics of concrete using recycled aggregates from demolition waste so as to use it as an alternative for the natural aggregates. In this project work, the concrete grade M25 was selected and IS: 10262-2009 method was used for mix design. In the present experimental investigation an attempt is made to study the strength performance of concrete using Recycled Coarse Aggregates in replacement levels of 10%, 20%, 30%, 40% & 50% to Natural Coarse Aggregates (NCA) and Recycled Fine aggregates (RFA) in replacement levels of 3%, 6%, 9%, 12% & 15% to Natural Fine Aggregates (river sand). The compressive strength of concrete with different percentages of RCA and RFA have been determined for 7 days, 14 days and 28 days whereas the split tensile strength of concrete with different percentages of RCA and RFA have been determined for 7 days and 28 days. The compressive strength and split tensile strength values thus obtained are compared with the conventional concrete (0%) and the conclusions are made accordingly.*

Key words: Demolition Waste, Recycled Aggregates, Natural Aggregates, Compressive Strength Test, Split Tensile Strength Test, etc.,

1. INTRODUCTION

Concrete is the manmade material widely used for construction purposes. The usual ingredients in concrete are cement, fine aggregate, coarse aggregate, and water. In a building construction, concrete is used for the construction of foundations, columns, beams, slabs and other load bearing elements. Concrete can be casted in any shape. Since, it's a plastic material in fresh state, various shapes and sizes of forms or formwork are used to provide different shapes such as rectangular, circular, etc. Concrete is the most utilized material after water in the world. Concrete has comparatively high compressive strength but significantly lower tensile strength. The method of selecting appropriate ingredients of concrete and determining their relative amount with the intention of producing a concrete of the necessary strength, durability and workability as efficiently as possible is termed as concrete mix design.

The use of recycled concrete aggregate (RCA) in concrete as partial and full replacements of natural coarse aggregate (NCA) is growing interest in the construction industry, as it reduces the demand for virgin aggregate. In addition, the use of RCA leads to a possible solution to the environmental problem caused by concrete waste, and reduces the negative environmental impact of the aggregate extraction from natural resources.

The function of the fine aggregate is to assist in producing workability and uniformity in the mixture. The river deposits are the most common source of fine aggregate. Now-a-days the natural river sand has become scarce and very costly. Hence, we are forced to think of alternative materials. The demolition fine aggregate may be used in the place of river sand partly. A comparatively good strength is expected when sand is replaced partially with or without concrete admixtures. Recycling building concrete wastes as aggregates to make new concrete mixes is a modern trend for limiting ecological pollution by minimizing concrete waste and reducing the need for natural aggregates. Many studies have investigated the feasibility of the use of demolished concrete as coarse aggregates. The reuse of buildings waste is gaining more and more interest around the world, considering the production of significant quantities of buildings remains and the considerable changes in the applied environmental regulation.

1.1 RECYCLED AGGREGATES FROM DEMOLITION WASTES

Construction industry has all along depended on river sand, pebbles, and gravel sourced from riverbeds as source of coarse & fine aggregates. These were cheap and easily available even though these were never of consistent quality causing problems for major constructions such as dams etc. Thus, the industry has been able to circumvent a crisis situation by use of legally mined sand from rivers as also using Manufactured sand to meet its requirements and aggregates obtained by recycling of Construction & Demolition Waste. The demolition waste is a component of what is called the 'inert' that cannot be destroyed by the normal process of disposing/utilizing of municipal wastes such as burning or composting. So, these are dumped as landfills at various places, which not only lock up the location for any use but are also an environmental hazard. Additionally, huge costs are incurred in their segregation, storage, and transportation.

In India, there is not much development in this field. In the international experiences cited above, there is considerable emphasis on recycling of C&D waste in India. Concrete are routinely trucked to landfills for disposal, but recycling has a number of benefits that have made it a more attractive option in this age of greater environmental awareness, more environmental laws, and the desire to keep construction costs down. Concrete aggregate collected from demolition sites is put through a crushing machine. Crushing facilities accept only uncontaminated concrete, which must be free of trash, wood, paper and other such materials. Metals such as rebar are accepted, since they can be removed with magnets and other sorting devices and melted down for recycling elsewhere. The remaining aggregate chunks are sorted by size. Larger chunks may go through the crusher again. After crushing has taken place, other particulates are filtered out through a variety of methods including hand-picking and water flotation. Crushing at the actual construction site using portable crushers reduces construction costs and the pollution generated when compared with transporting material to and from a quarry.

1.2 SOURCES OF DEMOLITION AND CONSTRUCTION WASTES

Whenever any construction/demolition activity associated with buildings, roads, flyovers, remodeling etc., takes place construction and demolition waste is generated. Concrete and masonry waste which is more than 50% of the waste from C&D activities are not being currently recycled in India.

The main reasons for increase of volume of demolition concrete / masonry waste are as follows;

- Many old buildings, concrete pavements, bridges and other structures have overcome their age and limit of use due to structural deterioration beyond repairs and need to be demolished.
- The structures, even adequate to use are under demolition because they are not serving the needs in present scenario.
- New construction for better economic growth and job opportunities.
- Structures are turned into debris resulting from natural disasters like earthquake, cyclone and floods etc.
- Creation of building waste resulting from manmade disaster/war.

1.3 OBJECTIVE AND SCOPE OF WORK

The main objective of this study is to experimentally investigate the suitability of recycled aggregate from demolition wastes on the strength aspects of concrete.

The specific objectives are as follows;

- To replace natural coarse aggregate (NCA) by recycled coarse aggregate (RCA) at increments of 10%, 20%, 30%, 40%, 50%. And natural fine aggregate (river sand) with recycled fine aggregate (RFA) at increments of 3%, 6%, 9%, 12% and 15%.
- To study and compare the strength parameters of hardened concrete specimens with and without recycled aggregates.
- To reduce the impact of waste concrete aggregates dumping on land sites and to utilize these concrete aggregates in study for sustainable construction, so as to reduce the carbon foot print.

2. LITERATURE REVIEW

2.1 USAGE POTENTIAL OF RECYCLED AGGREGATES IN MORTAR AND CONCRETE; SUBHASH C. YARAGAL AND MUHAMMAD ROSHAN A.K (2017).

In this work, an attempt is made to study the performance of concrete using water soaked Recycled Coarse Aggregates (RCA) in replacement levels of 0%, 25%, 50%, 75% and 100% to Natural Coarse Aggregates (NCA). Further suitable performance enhancement techniques to RCA based concrete were attempted, to achieve compressive strength at least equal to or more than that for no RCA based concrete (control concrete). Performance enhancement study is reported here for 50% and 100% RCA based concretes. Further attempts have also been made to use Recycled Fine Aggregates (RFA) with appropriate modifications to serve as fine aggregates in mortar and concrete. Using RFA blended with river sand fractions as well as RFA with Iron Ore Tailings (IOT) fractions, have given good results to serve as fine aggregates to the extent of 100% replacement levels in mortars and concretes.

2.2 A STUDY ON STRENGTH CHARACTERISTICS OF CONCRETE BY REPLACING COARSE AGGREGATE BY DEMOLISHED COLUMN WASTE; Shashank H, Shivaraja Hanumantha Madar, Askarali Hajaresab Jakathi, Pujari Varunkumar Vijaykumar (2018). The project aims at reuse of demolished column concrete. In our research work, we have collected the demolition waste from our college work site where the column in the top floor of our college building was demolished for the purpose of renovation. The demolished column is of M20 grade concrete and the age of concrete is 10 years. Our project deals with replacing of coarse aggregate by demolished column waste in various proportions of 10%, 20%, 30%, 40%, 50% and 100%. Cubes, cylinder, beams were casted for different mix proportions and kept curing for 7, 14 and 28 days. After the curing the cubes, cylinder and beams were tested to find the compressive strength, split tensile strength and flexural strength of concrete. The results were discussed and conclusions were made accordingly.

2.3 PERFORMANCE OF RECYCLED AGGREGATE CONCRETE FOR M25 GRADE CONCRETE; S. Manasa, M. Uday Bhaskar, G. Naveen Kumar (2019).

The main focus of this paper is to use find the strength qualities of recycled aggregates so as to use it as an alternative for the natural aggregates in high strength concrete for various construction activities. Comparison of workability, compressive strength, tensile strength, elastic modulus and flexural strength of recycled aggregate concrete is made with natural aggregate concrete. Here M25 grade concrete is taken and the natural aggregates were replaced with recycled aggregates in various percentages of 0%, 25%, 50%, 75% and 100%. The compressive strength and tensile strength of RCA concrete have been determined for 7 days and 28 days where as the modulus of elasticity and the flexural strength of RCA concrete are determined after curing for the period of 28 days. The tests done on RCA concrete are compared with concrete which is obtained by natural aggregates.

2.4 EXPERIMENTAL INVESTIGATION OF CONCRETE BLOCKS MANUFACTURED USING RECYCLED COARSE AND FINE AGGREGATES OBTAINED FROM BUILDING DEMOLITION WASTE; Mr. Srinidhi Lakshmi Kumar, Dr. Dushyanth V Babu R, Mr. Shaik Numan Mahdi (2018).

100% natural coarse aggregate has been replaced by recycled coarse aggregate and up to 40% of M-sand is replaced by recycled fine aggregate and solid concrete blocks are manufactured. The blocks have been subjected to various tests such as block density, water absorption, drying shrinkage, compressive strength and also durability tests like weight loss and strength loss after acid attack. It has been observed from the test results that natural coarse aggregates can be 100% replaced by recycled coarse aggregates and up to 20% of natural fine aggregates and m-sand can be replaced by recycled fine aggregate obtained from building demolished waste without compromising much on the strength and durability criteria.

2.5 EXPERIMENTAL STUDY ON STRENGTH BEHAVIOUR OF RECYCLED AGGREGATE CONCRETE; Md Shakir Ahmed, H S Vidyadhara (2013).

The main objective of this investigation is to find out up to what percentage the Natural Coarse Aggregate (N.C.A) can be replaced by recycled coarse aggregate (R.C.A) in the concrete mix and to find out the extra quantity of cement to be added for each percentage replacement by R.C.A. to achieve its target mean strength. Natural coarse aggregates in concrete were replaced with 0%, 20%, 40%, 60%, 80% and 100% of crushed concrete coarse aggregates. For the strength characteristics, the result showed a gradual decrease in compressive strength, split tensile strength, flexural strength and modulus of elasticity as the percentage of recycled aggregate is increased.

2.6 CONCRETE USING RECYCLED AGGREGATES; Dr. K. Ramadevi, Dr. R. Chitra (2017).

This research work aims at making one such experiment where recycled aggregates are produced from C&D waste and thus paves a way for the effective management of concrete debris. The concrete waste was collected from the waste yard in the college campus, segregated, crushed in jaw crusher, sieved, washed and used for concreting for a mix proportion of M25, as a replacement for natural coarse aggregates in proportions of 0%, 30%, 60% and 100%. On testing, the compressive strength was found to be increasing and split tensile strength and flexural strength were observed to be nearly equal to that of normal concrete mix. Therefore, use of recycled concrete aggregate showed acceptable performance with respect to mechanical properties. The recycled aggregates obtained from waste concrete are more angular and have higher absorption and specific gravity than natural coarse aggregates and it resulted in increased strength and improved load carrying capacity.

2.7 UTILIZATION OF DEMOLISHED WASTE AS COARSE AGGREGATE IN CONCRETE; Abdulsamee M. Halahla, Mohammad Akhtar, Amin H. Almasri (2019).

In this research, old concrete was crushed and used as recycled aggregates to obtain new concrete. The core test results can be thought of as aggregate properties for the new concrete. Then, the compressive strength and splitting tensile strength of the new recycled aggregate concrete (RAC) were determined experimentally by casting cubes and cylinders, respectively. It was found that the evolution of compressive strength of recycled aggregate concrete is similar in behaviour to the concrete with natural aggregate, except that it is about 10% lower in values. All mechanical tests showed that recycled aggregate concrete has slightly lower values of ultimate compressive strength, initial elastic modulus, and splitting tensile strength, compared to natural aggregate concrete. However, the differences can be considered negligible, where it did not exceed 5%.

2.8 EVALUATION OF HIGH-STRENGTH CONCRETE MADE WITH RECYCLED AGGREGATE UNDER EFFECT OF WELL WATER; Ahmed A. Mohammed Ali, Roua Suhail Zidan, Tuqa Waleed Ahmed (2020).

This study sought to determine the effect of the more readily available well water in Mosul City when combined with recycled aggregate on compressive, splitting, and flexural strengths of high-strength concrete. The mixtures were prepared using four different percentages of RCA, replacing 0 %, 25 %, 50 %, and 100 % natural coarse aggregate (NCA). In total, eight mixtures were designed, four mixtures cured by potable water (PW), and the other four mixtures cured by well water. The results showed the compressive strength decreases by about 16.0 % when using well water for concrete made with NCA. Also using WW caused drop about 13.2 %,10.0 % and 8.5 % for concrete containing 25 %, 50 % and 100 % RCA, respectively. The flexural and splitting tensile strength also reduced when using well water.

2.9 RECYCLED CONCRETE AGGREGATES; Akansha Tiwari (2015).

This paper reports the basic properties of recycled fine aggregate, recycled coarse aggregate and also comparing it with the natural aggregate. In this research concrete waste from demolished structure has been collected and coarse aggregate of different % is used for preparing fresh concrete. Many researchers state that recycled aggregates are only suitable for non-structural concrete application. This study shows that the recycled aggregates that are obtained from concrete specimen make good quality concrete. The slump of recycled aggregate concrete is more than the normal concrete. At the end it can be said that the RCA up to 50-51 % can be used for obtaining good quality concrete.

2.10 EXPERIMENTAL INVESTIGATION OF CONCRETE WITH RECYCLED AGGREGATES FOR SUITABILITY IN CONCRETE STRUCTURES; Arkadiusz Denisiewicz, Małgorzata Sliwa, Krzysztof Kula and Tomasz Socha (2019).

This paper presents the experimental tests of concrete made on the recycled aggregates basis. Tests were carried out to determine the concrete suitability for construction purposes. The physical and strength properties were determined for three types of recycling aggregates. The aggregates were obtained from sanitary ceramics 'SC' (washbasins and toilet bowls), building ceramics 'BC' (solid bricks), and concrete rubble 'CR'. The results obtained in tests of compressive strength, bending tensile strength, water absorption, total shrinkage, watertightness, and frost resistance of concrete made of SC and CR aggregates gave grounds for stating its suitability for structural purposes. Concrete based on the BC aggregates is not recommended for structural applications.

3. MATERIALS AND METHODOLOGY

3.1. MATERIALS USED

3.1.1 CEMENT: Ordinary Portland Cement (OPC) of 53 grade (Birla Super) confirming to (IS 8112 -1989) was used. To find the quality of cement, few tests have been conducted in the Laboratory. The results have been tabulated in table-1.

Table-1: Test result on Cement

SL NO	EXPERIMENT	RESULTS
1	Specific gravity	3.10
2	Fineness	7%
3	Standard consistency	32%
4	Initial setting time	50min

3.1.2 FINE AGGREGATE: The locally available natural river sand belonging to zone-2 and passing through 4.75mm sieve and holding on 75-micron sieve as per IS 383-1970 was used for the project work. The results have been tabulated in table-2.

Table-2: Test result on Fine Aggregate

SL NO.	EXPERIMENT	RESULTS
1	Sieve analysis	Fineness modulus = 3.62
2	Specific Gravity	2.70

3.1.3 COARSE AGGREGATE: The coarse aggregates comprising of size 20mm & 12.5mm in saturated surface dry condition were used. The coarse aggregate used are 20 mm graded aggregates as per IS:383-1970 specification. The results have been tabulated in table-3.

Table-3: Test result on Coarse Aggregate

SL NO	EXPERIMENT	RESULTS
1	Sieve analysis	Fineness modulus = 6.42
2	Specific gravity	2.68
3	Water absorption	0.75 %

3.1.4 RECYCLED AGGREGATE: It is a term that describes crushed cement concrete or asphalt pavement from construction debris that is reused in other building projects. The use of recycled materials for construction is a sustainable move in the construction industry.

It has numerous energy consumption, reducing waste heading to the landfill and reducing emissions. Not only is it a great option for the environment, but using aggregate materials leads to cost savings.

For the present work, the demolished concrete wastes were obtained from the landfill area near to the campus of Dr. Ambedkar Institue of Technology. The obtained demolished concrete was crushed manually using hammers to the required aggregate size. These concrete pieces were then thoroughly sieved to remove the loose mortar particles. Then those recycled aggregates were washed thoroughly to remove the adhered mortar present in the aggregate, and kept for sun drying. The demolished concrete was hammered precisely such that not much of adhered mortar were present. The recycled aggregates were further not soaked in water. The test results have been tabulated in table-4 and table-5 respectively for recycled coarse aggregate (RCA) and recycled fine aggregate (RFA).

Table-4: Test result on recycled coarse aggregate (RCA)

SL NO	Experiment	RESULTS
1	Specific gravity	2.59
2	Sieve analysis	Fineness modulus = 5.52
3	Water absorption	2.5%

Table-5: Test result on recycled fine Aggregate (RFA)

SL NO	EXPERIMENT	RESULTS
1	Sieve analysis	Fineness modulus = 3.21
2	Specific Gravity	2.65

3.1.5 WATER: Water is a vital element of concrete as it effectively took an interest in chemical response with cement, clean versatile water which is accessible in our college is utilized. The water used for casting and curing should satisfy as per IS 456-2000.

3.2. METHODOLOGY

Preliminary Tests: These were performed on the fine aggregates, coarse aggregates and cement to confirm their suitability for concrete making. The preliminary test results are tabulated in Tables-1,2,3,4 and 5.

Mix Design: Concrete mix design for M25 grade is done as per IS: 10262 – 2009. The results of concrete mix design are tabulated in Table-6.

Table-6: Mix Proportion

WEIGHT	W/C	CEMENT	FA	CA
Kg/m^3	0.45	437.77	661.338	1109.379
Ratio	-	1	1.51	2.53

The material required for this experiment is 150 kg of cement (3 bags), 220 kg of river sand, 300 kg of natural coarse aggregate, 99kg of recycled coarse aggregate (RCA) and 19 kg of recycld fine aggregate (RFA). A total of 54 cubes and 24 cylinders were casted.

Preparation of moulds for casting: Before casting the specimens, all cube and cylinder moulds were cleaned, screwed tightly and oil was applied to all surfaces to prevent adhesion of concrete during casting. Cubes of size 150 x 150 x 150 mm were used to prepare concrete specimen for the determination of compressive strength, and cylinders of 150mm diameter and 300mm height were used to prepare concrete specimen for the determination of split tensile strength.

Batching: The materials were weigh batched using electronic weighing machine.

Mixing: Mixing was done in a lab concrete mixer. The mixing was done as per the standard for min 3 min.

Compaction: Placing of concrete in oiled mould was done in three layers for cubical mould and five layers for cylindrical mould, each layer tamped at least 25 times with the tamping rod.

Curing: After 24 hours, all the casted specimens were demoulded from the moulds and marked (To identify the casting batch) and immediately put into the curing tank for a period of 7, 14 and 28 days for different specimens. The specimens were not allowed to become dry during the curing period.

Testing: A total of 54 cubes and 24 cylinders were casted and curing was done to the specified number of days. The Specimens were taken out from the curing tank which were immersed after 7, 14 and 28 days to perform compressive test and split tensile strength test. The specimens were tested on the universal compression testing machine. Three numbers of cubical specimens for various percentage of replacements were tested for the compressive test at 7, 14 and 28days and the average value was calculated for the cubes. Two number of cylindrical specimens were tested for split tensile test at 7 and 28 days of curing period, and the average was calculated for the cylinders.

4. RESULTS AND DISCUSSION

4.1 SLUMP TEST

In order to measure workability, the most commonly used test is Slump test. If the concrete is very wet or very dry then this method is not suitable.

From the Slump Test, the slump value is observed to decrease with increase in the percentage replacement of natural aggregates by recycled aggregates. This is due to the high water absorption of recycled aggregates. The variation of the slump is shown in chart-1.

Table-7: Slump values

% Replacement	Slump (mm)
0%	88
10%(RCA), 3%(RFA)	76
20%(RCA), 6%(RFA)	66
30%(RCA), 9%(RFA)	50
40%(RCA), 125(RFA)	35
50%(RCA), 15%(RFA)	28

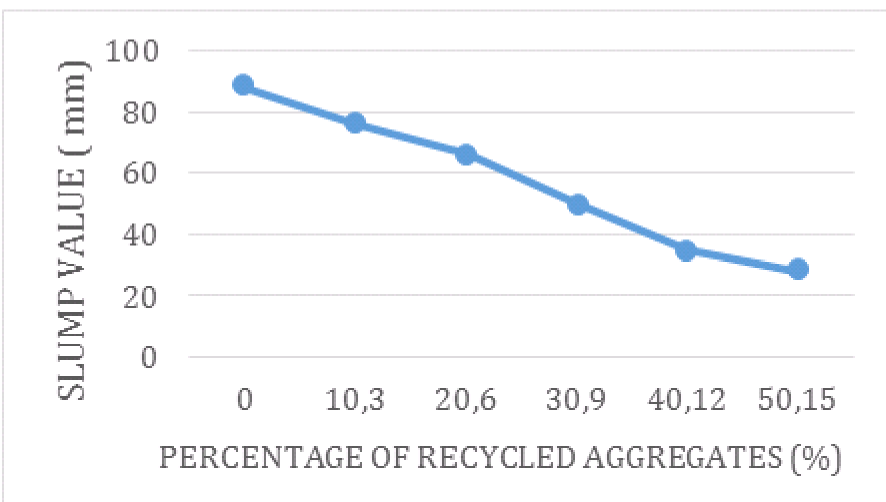

Chart-1: Variation of slump

4.2 COMPRESSIVE STRENGTH TEST

The compression test is carried out to determine the characteristic strength of the concrete. The Compressive strength results of 7 days, 14 days and 28 days are tabulated for different replacement ratios for M_{25} Grade concrete mix in table-8, and the variation is shown in the chart-2,3,4 respectively.

It can be seen that the replacement of coarse aggregate with 10%, 20% and 30% of recycled coarse aggregate (RCA) and fine aggregate with 3%, 6% and 9% of recycled fine aggregate (RFA) shows a gradual increase in the compressive strengths, which are 31.85 N/mm^2, 32.85 N/mm^2 and 34.26 N/mm^2 respectively.

The compressive strength for replacement of 30% RCA and 15% RFA is almost similar to the compressive strength of conventional concrete (0% replacement) which is 36.15 N/mm2 at 28 days.

From the results obtained the compressive strength was maximum for the replacement of natural aggregates with 30% RCA and 15% RFA, which is 34.26 N/mm2 at 28 days. The compressive strength for 40%, 50% of RCA and 12%,15% of RFA was found to decrease, which was 32.28 N/mm2 and 31.53 N/mm2 respectively, but it crosses the targeted mean strength of 31 N/mm^2 at 28 days for M_{25} grade concrete.

Table-8: Compressive strength results for 7, 14 and 28 days of curing period

% Replacement of natural aggregates by recycled aggregate		Average Compressive strength (N/mm^2)		
RCA (%)	RFA (%)	7 Days	14 Days	28 Days
0	0	25.46	33.88	36.15
10	3	19.29	25.83	31.85
20	6	22.40	27.05	32.87
30	9	25.22	29.55	34.26
40	12	24.15	29.18	32.28
50	15	25.08	28.71	31.53

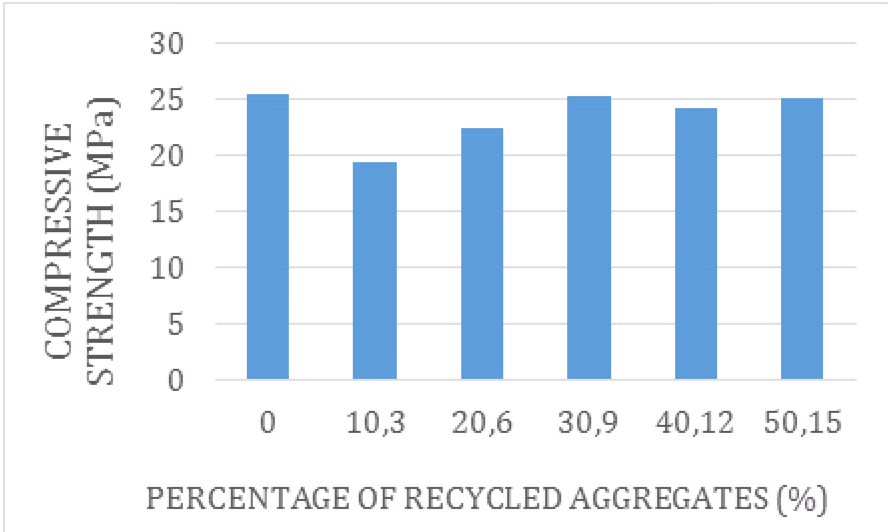

Chart-2: Variation of 7 days compressive strength

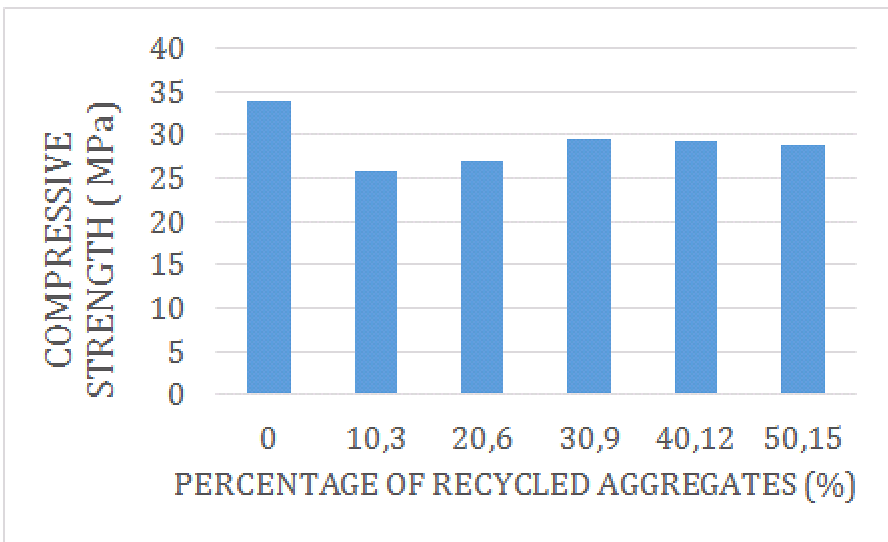

Chart-3: Variation of 14 days compressive strength

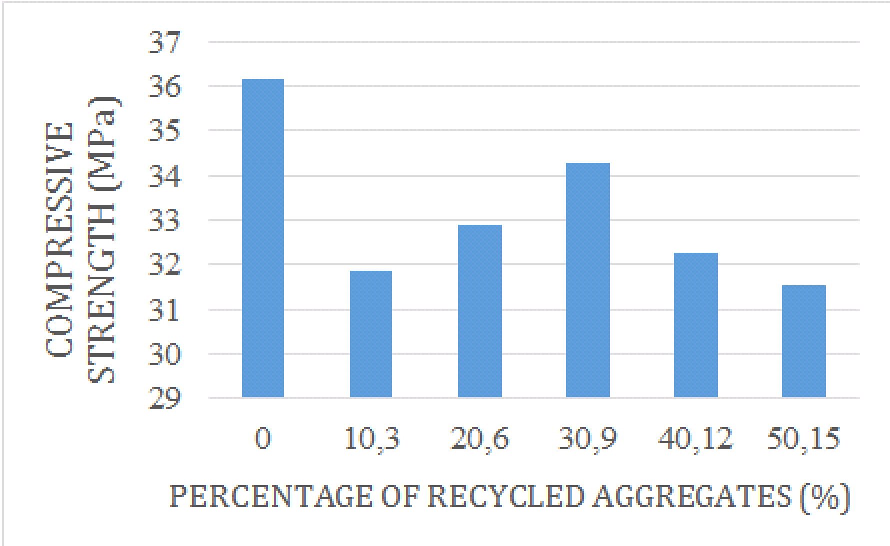

Chart-4: Variation of 28 days compressive strength

4.3 SPLIT TENSILE STRENGTH TEST

Table-9: Split tensile strength results for 7 and 28 days of curing period

% Replacement of natural aggregates by recycled aggregate		Average Split Tensile strength (N/mm^2)	
RCA (%)	RFA (%)	7 Days	28 Days
0	0	1.88	2.64
10	3	2.20	2.93
20	6	2.13	2.62
30	9	2.24	2.60
40	12	2.41	2.56
50	15	2.64	2.48

The splitting tensile strength test for cylinder of 150 mm in diameter and 300 mm high at age of 7 days and 28 days was carried out, and the results are tabulated in table-9, and the variation of the split tensile strength for 7 days and 28 days tests are shown in the chart-5.

The average split tensile strength of the conventional concrete (0% replacement) at 28 days is 2.64 N/mm2. The split tensile strength at 7 days of curing is found to increasing with the increase in amount of the recycled aggregate. Whereas the split tensile strength at 28 days curing period reduces with the increase in amount of recycled aggregate.

The maximum split tensile strength was observed with 10% RCA and 3% RFA replacements of natural aggregates.

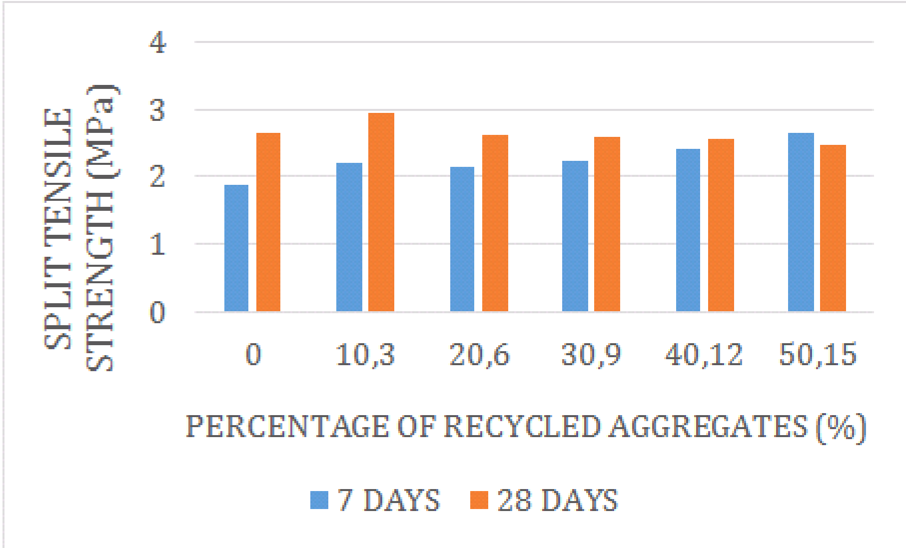

Chart-5: Variation of 7 and 28 days split tensile strength

5. CONCLUSIONS

Compressive strength and Split tensile strength test of concrete made with and without recycled aggregates has been determined at 7, 14 and 28 days of curing. The suitability of recycled aggregates in concrete has been determined by replacing the natural aggregates with 10%, 20%, 30%, 40% and 50% of Recycled coarse aggregate (RCA) and 3%, 6%, 9%, 12%, 15% of Recycled fine aggregate (RFA) for M25 grade.

The following conclusions are derived from the present study;

- The specific gravity 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 RCA is higher than the natural aggregate. This is also because of the attached mortar present on the aggregate surface which has a tendency to absorb more water.
- The Slump was found to decrease in concrete mixes with RCA and RFA replacements. This is due to the high water absorption of recycled aggregates.
- In this study it is found that there is not much variation in strength between conventional concrete and 30% replaced aggregate concrete, which proves the previous works.
- In this investigation it is found that up to 30% replacement of natural coarse aggregates by RCA and 9% replacement of natural fine aggregates by RFA can be done and used in the construction with M25 grade concrete,
- Since the compressive strength of concrete containing 50% of RCA and 15% RFA is more than the targeted mean strength, up to 50% replacement of natural coarse aggregates by RCA and 15% replacement of natural fine aggregates by RFA can be done without any compromise of strength.
- Concrete has maximum tensile strength with 10% of RCA and 3% of RFA. Further It can be concluded that the split tensile strength follows the trend of reduction in strength with increased replacement.
- As there is considerable reduction in split tensile strength of concrete with recycled aggregates, the loss in strength should be considered while designing members using recycled aggregate concrete.
- RFA was limited to 15% since it was not processed. But, with processing and modifications some researches show that RFA can be effectively used without loss in performance.
- As the degree of processing gets better and better the recycled aggregate tends to be closer to natural aggregate.
- When demolished waste is used in concrete, the cost of production will be economical. Hence, overall cost of the project will come down.
- Use of demolished waste in concrete will save in energy and reduce noise pollution which will create during the blasting of rocks for obtaining fresh coarse aggregate, thus helps in protecting the environment which is the need of the hour for present and in. future too.

From the above investigations it can be concluded that replacement of up to 30% of natural coarse aggregates by RCA and 9% of natural fine aggregates by RFA is suitable to obtain good compressive strength. And up to 50% RCA and 15% RFA crosses the targeted mean strength.

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