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UTILIZING RECYCLED CONSTRUCTION AND DEMOLITION CONCRETE WASTE AS AGGREGATE FOR STRUCTURAL CONCRETE

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Abstract: This study investigates the use of recycled materials in concrete manufacturing as a substitute for natural coarse aggregate to achieve the desired strength. It examines the mechanical and physical properties governing the strength of recycled coarse aggregate concrete compared to fresh concrete. The research employs various concrete specimens made with recycled aggregate and evaluates them against conventional concrete. The study also assesses the use of recycled aggregate in a consistent concrete mix of M20 with a fixed water-cement ratio. Two different ages of recycled aggregate are considered, with a 30-year age gap, and samples are compared to conventional cement. While few studies have explored the use of fine aggregates in this context, none have discouraged their use in construction. This project utilizes recycled aggregate in concrete and conducts laboratory-based experiments by crushing concrete specimens (cubes and prisms). A total of 21 cubes and 21 prisms are cast and tested for 28 days, with an additional 9 cubes and 9 prisms cast using different proportions of recycled coarse aggregate (30%, 60%, and 100%) for one age of recycled aggregate. Furthermore, 9 additional cubes and 9 prisms are cast using recycled aggregate from another age, along with virgin coarse aggregate. The remaining 3 cubes and 3 prisms are made using conventional M20 mix concrete. The study aims to reduce concrete waste, address ecological challenges, and mitigate the negative impact of natural coarse aggregate extraction. It focuses on recycling construction waste from demolished concrete structures to extract aggregate for use as a replacement. Given the challenges faced by emerging nations and cities in managing construction waste, this research investigates whether recycled aggregate from demolition debris can effectively substitute natural coarse aggregate in concrete structures while maintaining the same strength. The recycled material, obtained from various locations and ages, undergoes processing and experimentation using a control mix of M20, replacing locally available concrete mixtures at proportions of 30%, 60%, and 100%.

Keywords - Natural Aggregate (N.A.), Recycled Aggregate (R.A.), Water Absorption, Impact Value, Abrasion Value, Attrition Value

INTRODUCTION

Everyone knows know concrete is the principal building material worldwide. Only aggregates constitute the concrete's skeleton since 2/3 of it is aggregate. The majority of aggregate is coarse aggregate, therefore the world is aware of its need. The globe is looking at aggregates made from old building and road trash since extracting natural coarse aggregate causes environmental imbalance. Recycling coarse aggregate helps control concrete waste and save the environment.

The fundamental issue with recycled aggregate is that it cannot replace naturally coarse material. This attribute of recycled concrete mixture are mostly reliant on the recover material quality. Collecting and transporting recycled material might affect its quality. The major goal of this project is to improve the rigidity of cube and flexural by replacing the native fine aggregates with recycled aggregates aggregate maybe it may be of half or totally replacement. For this, we need to know the catering aggregate's absorption of water, specific gravity, form, texture, and physical qualities. Many nations employ building and demolition debris (recycled coarse aggregate) as secondary usage in structural works. The demolition trash from ancient structures is worthless. Recycling coarse aggregate requires gathering demolition trash and crushing the concrete. Recycled coarse aggregate will consume less motor content and have some motorized content on its surface, allowing live water absorption. Void ratio and porosity exceed natural coarse aggregate. Crushing creates many microcracks in recycled coarse material.

LITERATURE REVIEW

Pavan:Recycled concrete aggregate study

This journal discusses hardened concrete test findings. Explained testing. Concrete cubes and cylinders undergo compressive and split tensile strength tests after 28 days of curing. OPC and PSC are tested on recycled coursed aggregate concrete.

Tushar:

A research on recycled aggregate concrete found that using up to 30% did not affect the structure's practical needs. IS 2386 says tasteful reused totals are tested and compared. Reusing materials in construction saves energy and money on transportation and uncovering. This truly reduces waste material's impact on condition.

Surya, M.A., KantaRao: Recycled aggregate cementitious for Roads And bridges they did the project on recycled aggregate for mobility and noted that The reused total presented in the current investigation satisfied the codal requirements for RCA with respect to physical and mechanical properties, but the equivalent were relatively low than those for widely accepted totals. In pressure, split strain, and flexure, the standard cement mixes NAC, NAF, and the RAC blends R50, R75, and R100 behaved similarly. With increasing RCA, RAC modulus decreased. RAC structures may deform more than NA concrete structures. RAC water assimilation increased with reused totals. RAC was somewhat more resistive than NAC. RAC resists chloride better, reducing fortification erosion. Before using RAC in transportation foundation, a detailed study on its long-term performance is needed.

Sandeep Singla2, Jitender Sharma1: Study of Supplementary Cementitious materials Aggregates reduces water concrete percentage in reused overall blend improves stiffness and modulus of flexibility. RCA-replaced blends have higher water persistence and porosity than standard blends. Reducing w/c may change these qualities. Since RCAs include mortar, their unique gravity, water intake, and California abrasion indicate worse quality than NCAs. RCAs make a rich mix by adding 10% water and 5% bond. Recycled materials make harsh mixtures with lesser functionality than NAs.

RECYCLE AGGREGATE SOURCE

The major source of recycling coarse aggregate is concrete structures that have reached their service life, such as old homes, roadways, industrial buildings, hospitals, theatres, government buildings, and others that have been damaged by fire, earthquakes, land slides, etc. Recycled aggregate is hard to discover in demolition trash, and obtaining the right size is challenging. The retrieved aggregates will not have the same qualities as natural aggregate.

This project collects two distinct ages of crumb rubber, AGE 2 and AGE 2. Finding aggregates of diverse ages is a common problem.

EXPERIMENTAL PROGRAM

MATERIALS USED

- Cement
- Fine aggregate(less than 4.75 mm)
- Coarse aggregate(of 12 mm)
- Water

RESULT

Sample cement specific gravity = 3.14 5.1.1.2 DRY SIEVE: IS: 4031 (Part 1) – 1996 determines cement fineness.
Sieving measures cement fineness.

APPARATUS: The fraction of concrete grain sizes bigger than the specified particle sizes is then calculated.

- Balance (10 gm. closest to 10 mg)
- Sieve (90µm IS)
- Bristol Brush
- Material:
- Cement
- Water

PROCEDURE:

Take the cement's correct weight of roughly 100 g to 0.01 gramme. use a 90-micron Indian standard sieve.
Break any sample air-set slumps using fingertips.
Shake the pan for 10 minutes to get the most cement through the sieve.
Brush and weigh the sieve residue.
Express the leftover residue as a percentage closest 0.1.
Repeat the method twice with 100gm samples.
Table 1: Fineness of sieve analysis

IS Sieve number	sample Weight taken(W)(gm.)	Residue Weight (R)(gm.)	Percentage of residue	residue average percentage
1	100	9.5	9.5	9.43
2	100	9	9	
3	100	9.8	9.8	

Residue percentage of cement sample by dry method of sieving 9.43 %

Table Results of Compressive Cube Strength

S.NO	REPLACEMENT PERCENTAGE	DAYS OF CURING	AGE 1 (10 YEARS)	AGE 2 (40 YEARS)
			CUBE (N/mm^2)	CUBE (N/mm^2)
1	30	28	18.976	28.250
2	60	28	26.944	30.368
3	100	28	23.26	27.56

Flexural strength:-

To calculate the bending strength of concrete cubicspecimens.

Apparatus:

1. Flexural testing beam moulds,
2. tamping rod,
3. metallic sheet,
4. Universal testing machine.

RESULTS AND CONVERSATION

The results of tests on cubes and prisms made with varying percentages of recycled coarse aggregate in instead of natural cement content have shown that:

1. The change out of recycled aggregate is showing results that are nearly identical to those of specimens cast with formal a period of 28 days curing.
2. Natural coarse aggregate is being replaced with 30% recycled aggregate to increase the mix's strength.
3. The strength is reportedly strong in the case of cubes and there are some differences in the case of prisms when substituting 60% of recycled material with natural coarse aggregate.

4. Recycled aggregate will provide enough results and fulfil the required standards for the specimens made with conventional aggregates, according to test findings.

5.The ideal combination for obtaining extra strength is combining natural coarse gravel with recycled coarse aggregate that has a 60% replacement rate.

6.Prisms manufactured with 100% replacement have more strength than those made with 30% and 60% replacement.

7. AGE 2 has provided additional strength compared to regular concrete, age 1, and age 2, which all had 100% strength.

8. The year 2 has shown greater strength than with the 10 years of age for 28 days of curing in the case of cube for 30% and 60% replacement.

Chart 1:- showing the compressive strength of cube with AGE 1 recycled aggregate by replacing it with 30%, 60% and 100

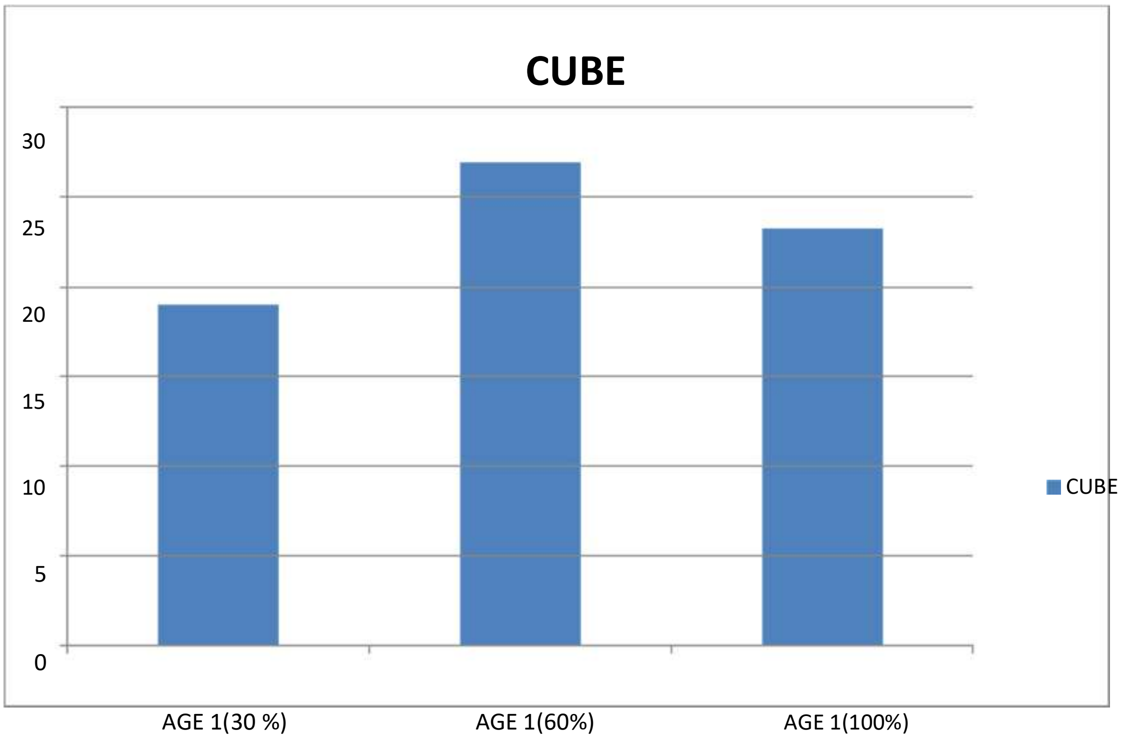


Chart 2:- showing the flexural strength of prism with AGE 1 recycled aggregate by replacing it with 30%, 60% and 100 %

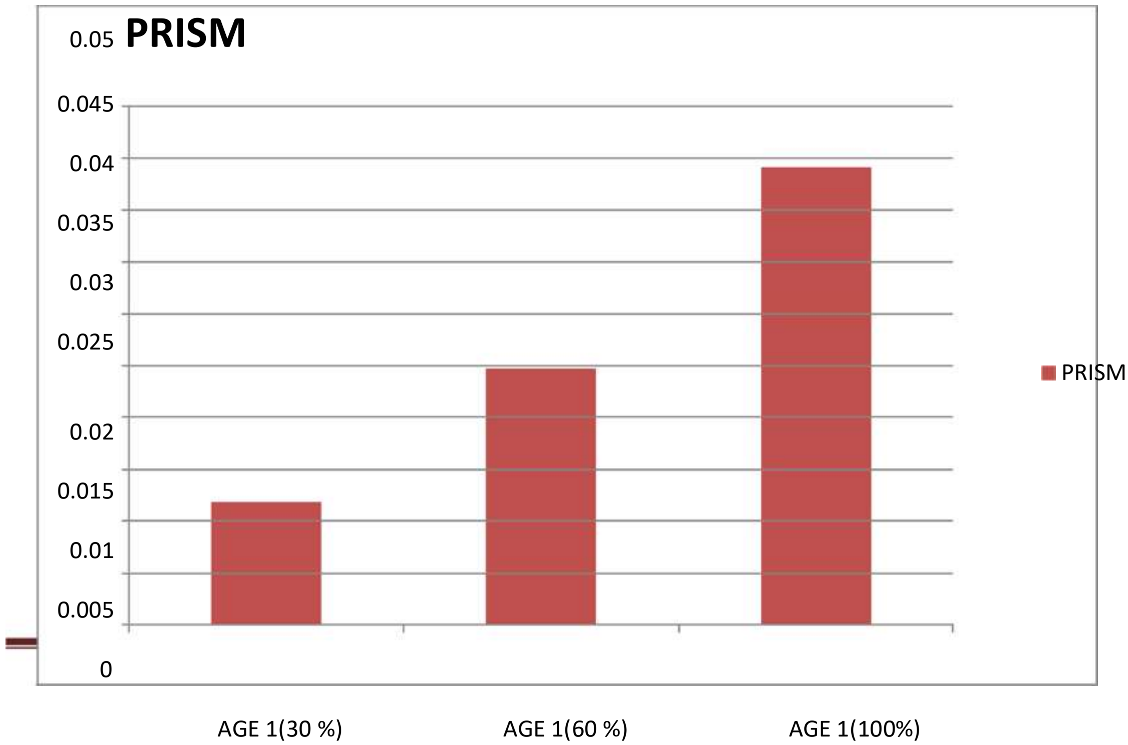


Chart 3:- showing the compressive strength of cube with AGE 2 recycled aggregate by replacing it with 30%, 60% and 100 %

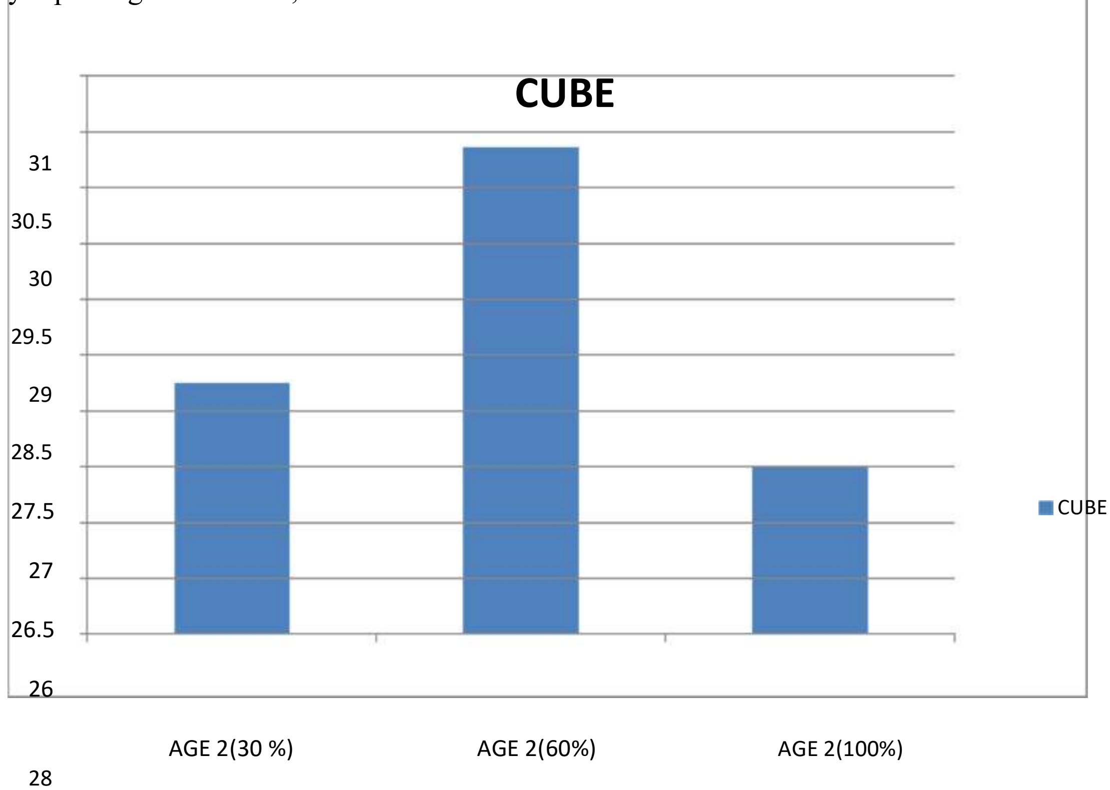


Chart 4:- showing the flexural strength of prism with AGE 2 recycled aggregate by replacing it with 30%, 60% and 100 %

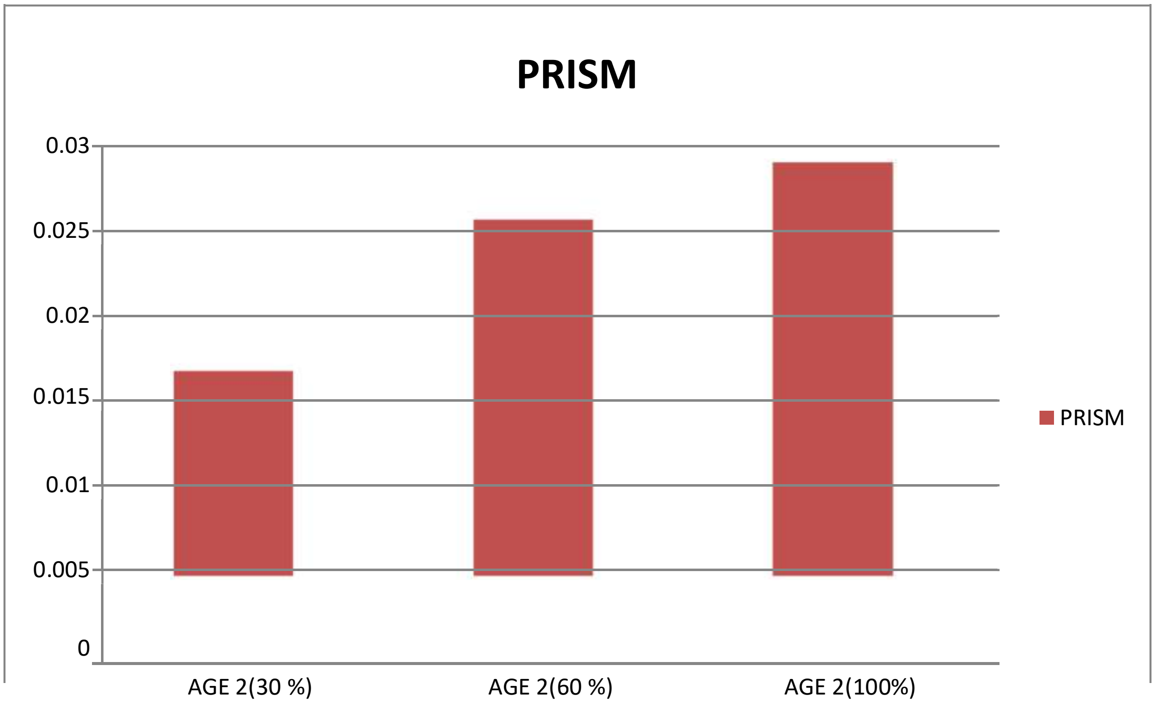
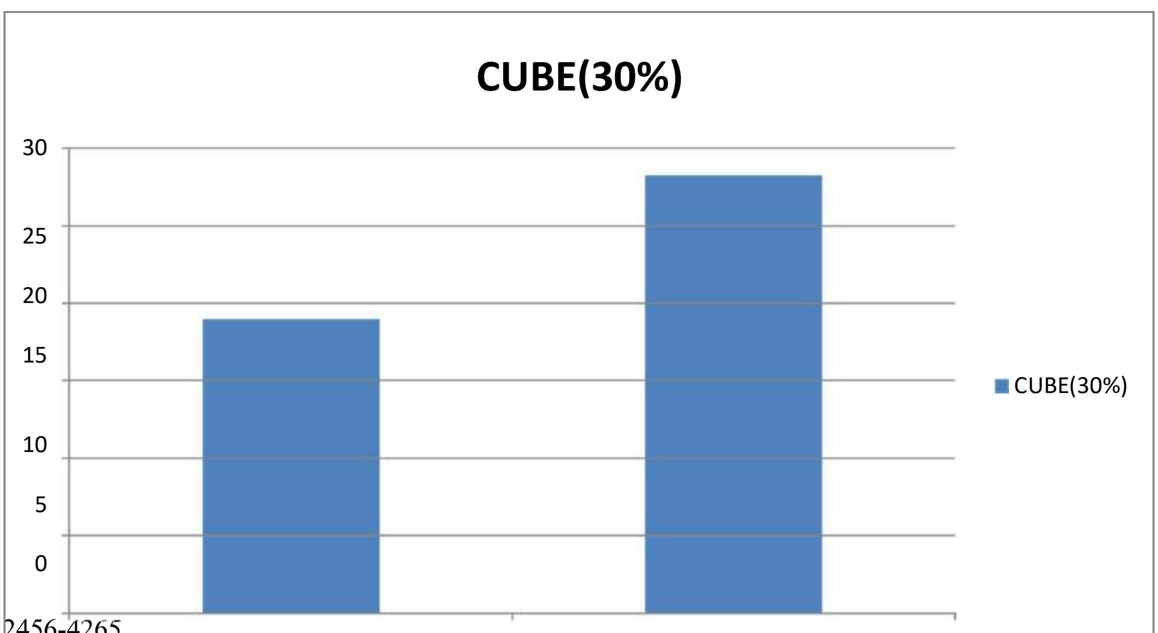


Chart 5:- comparison strength between AGE 1 and AGE 2 with 30 % recycled coarse aggregate



AGE 1 AGE 2

Chart 6:- comparison strength between AGE 1 and AGE 2 with 60 % recycled coarse aggregate

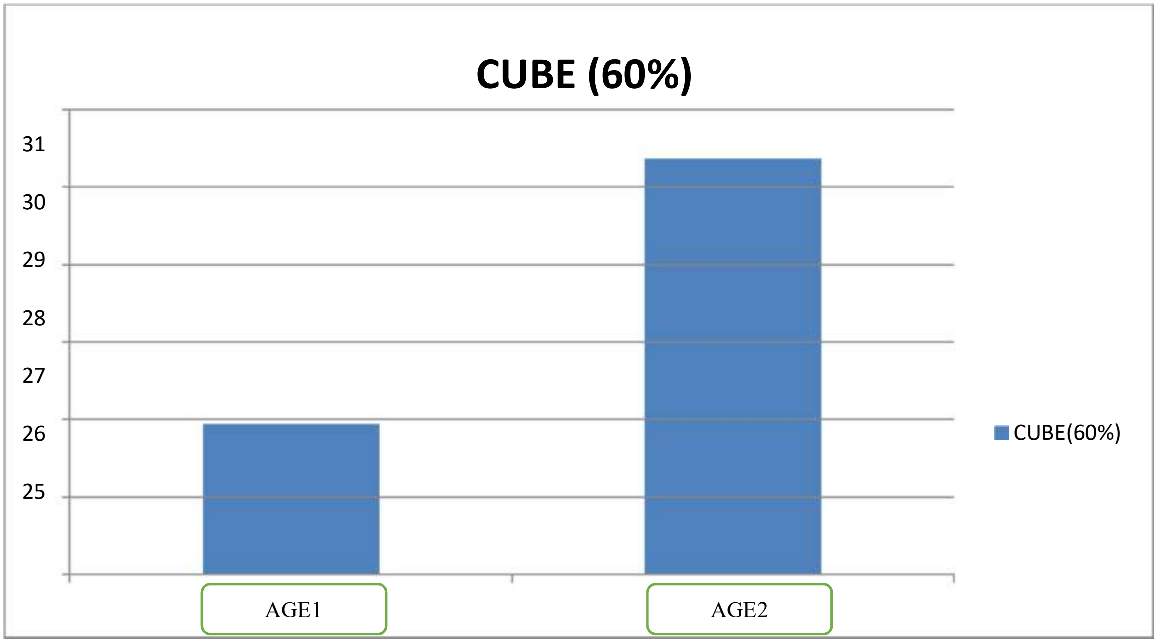


Chart 7:- comparison strength between AGE 1, AGE 2 and traditional concrete with 100% recycled coarse aggregate

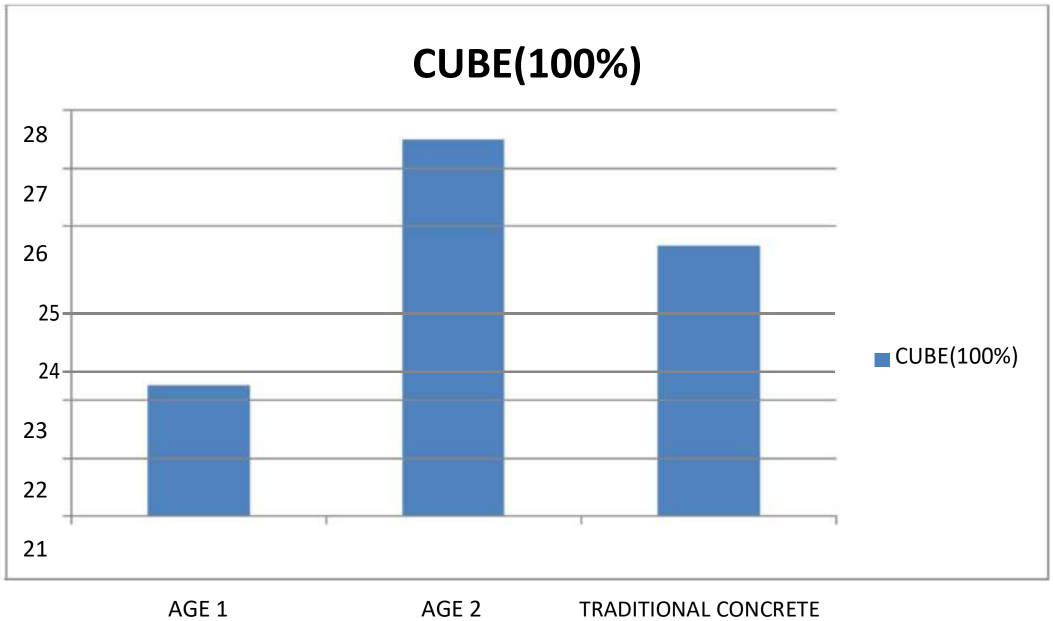


Chart 8:- comparison strength between AGE 1 and AGE 2 with 30 % recycled coarse aggregate

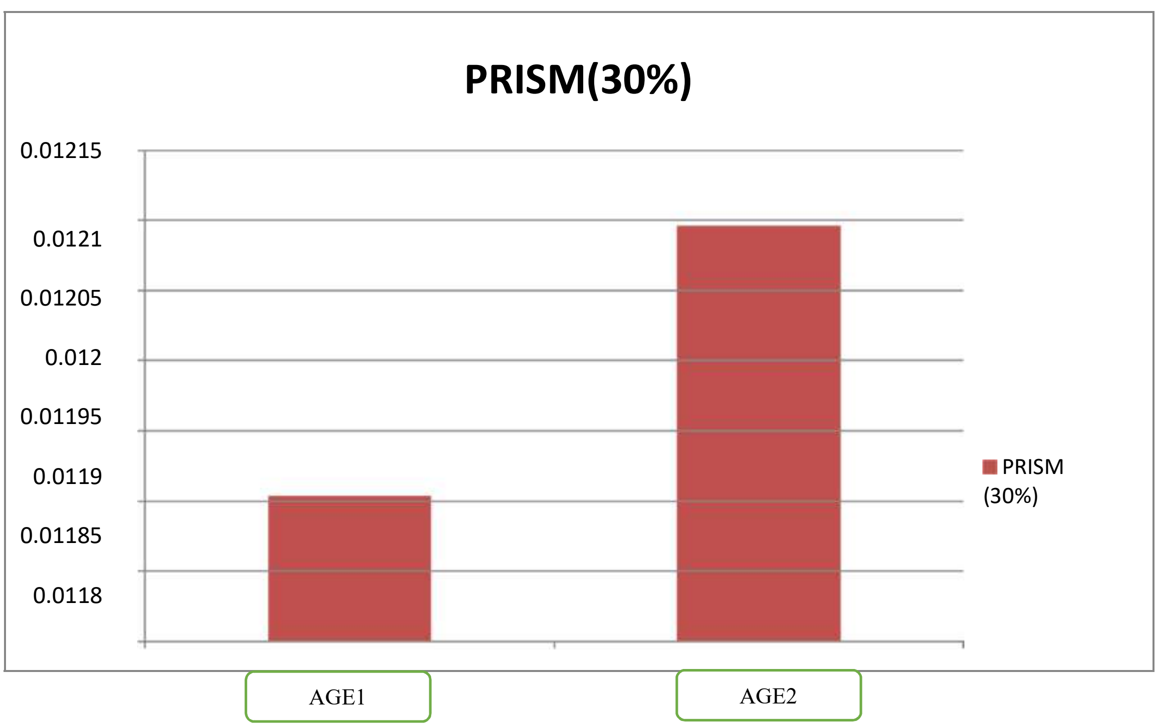


Chart 9:- comparison strength between AGE 1 and AGE 2 with 60 % recycled coarse aggregate

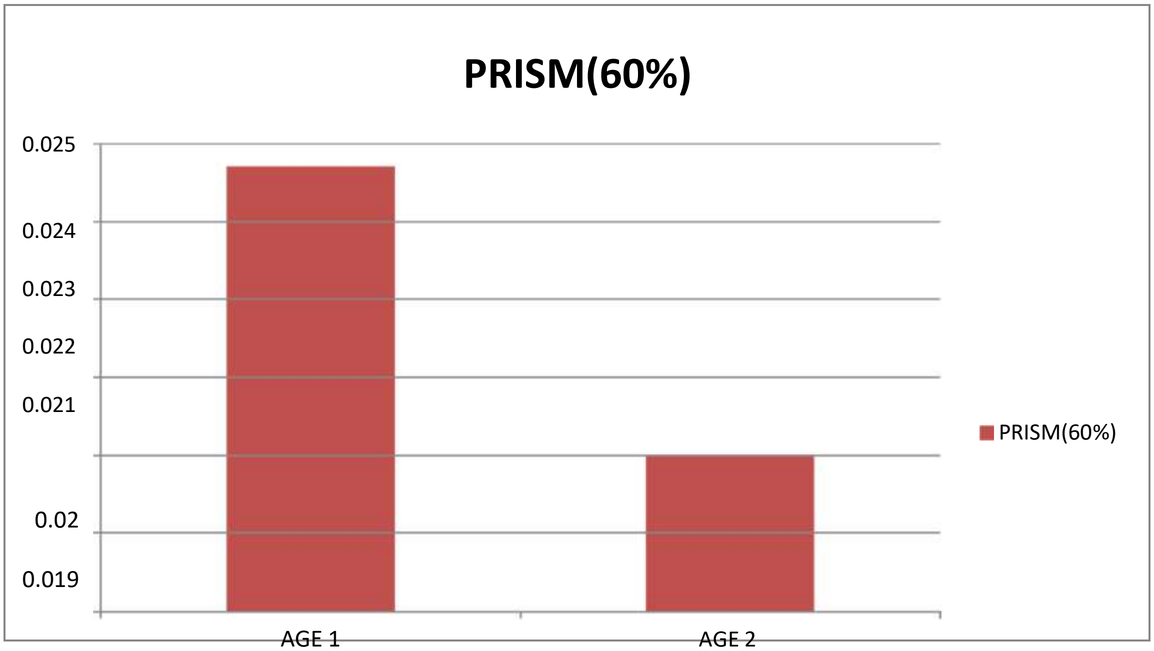
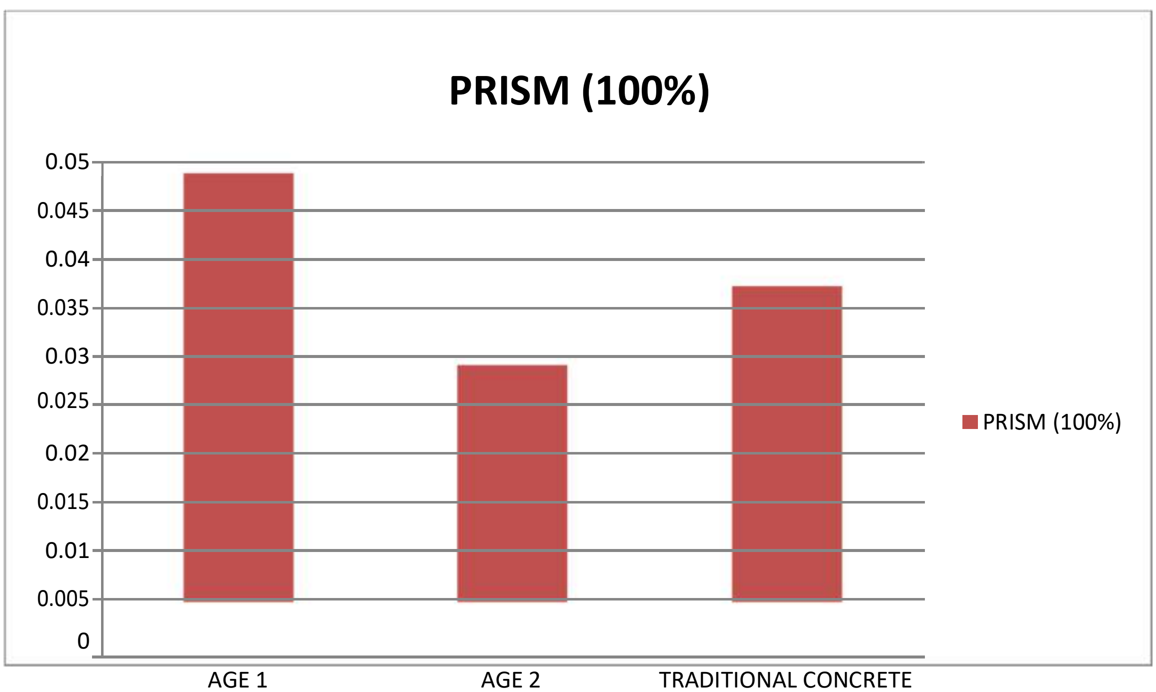


Chart 10:- comparison strength between AGE 1 and AGE 2 and traditional concrete with 100 % recycled coarse aggregate



CONCLUSION

1. Concrete which has the combination replacing the natural coarse aggregate by recycle coarse aggregate of 30 % has ha small little variant in the strength
2. Concrete mixing with the combination of replacement of natural coarse aggregate with recycle coarse aggregate of higher percentage than 30% are giving the result more than the standard one
3. As the surface of the recycle aggregate is of high angular, it also have an water absorption much higher than the natural coarse aggregate
4. The recycle aggregate has the surface which is attached with the cement particles, thus make the bond much higher than the traditional one

Compressive strength of traditional concrete = 25.67 N/mm^2

Table 15:- Test results for the cube

S.NO	REPLACEMENT PERCENTAGE	DAYS OF CURING	AGE 1 (10 YEARS)	AGE 2 (40 YEARS)
			CUBE (N/mm^2)	CUBE (N/mm^2)
1	30	28	18.976	28.250
2	60	28	26.944	30.368
3	100	28	23.26	27.56

Flexural strength of traditional concrete = 0.0325 n/mm^2

Table 16:- Test results for the prism

S.NO	REPLACEMENT PERCENTAGE	DAYS OF CURING	AGE 1(10 YEARS)	AGE 2(40 YEARS)
			PRISM (N/mm^2)	PRISM (N/mm^2)
1	30	28	0.0119	0.0120
2	60	28	0.0247	0.0210
3	100	28	0.0441	0.0244

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