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Experimental Study of Partial Replacement of Construction and Demolition Waste in Concrete

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ABSTRACT—The cost of construction materials are increasing to high rates for a conventional building is a major factor that affects the housing delivery worldwide. This has necessitated research for alternative cost effective materials in construction. There is a large amount of demolished waste generated every year in India and other developing countries. Demolished waste
includes concrete blocks which can be recycled into stone aggregates through pre-screening, crushing, screening and separating of aggregate. The experimental investigations will carried to evaluate the effect of partial replacement of coarse aggregate by demolished waste on compressive strength and workability of demolished concrete. In this project, I will replace fine aggregates and coarse aggregates with the demolished concrete in the range 0%, 05%, 10%, 15% using M20, M25, and M30 grade of concrete. Sieve analysis will perform for recycled demolished concrete and coarse aggregates. The prepared concrete mix will compare and test in terms of compressive strength and Split tensile strength to conventional concrete. The test will be performed at 7 and 28 days in order to evaluate the strength properties. Finally, comparing the strengths of all concretes and prefer the best strength concrete.

Keywords: Demolished Concrete, Compressive Strength, Split Tensile Strength

I. INTRODUCTION

Concrete is the premier civil engineering construction material. Concrete is considered as brittle material, primarily because of its low tensile capacity and poor fracture toughness. Concrete manufacturing involve consumption of ingredients like cement, aggregates, water and admixtures(s). Among all the ingredients, aggregates form the major part. Inert granular materials such as sand, crushed stone or gravel form the major part of the aggregates. Traditionally aggregates have been readily available at economic prices and of qualities to suit all purposes. But, the continued extraction of aggregates from nature has caused its depletion at an alarming rate. Many of the non-decaying waste materials will remaining the environment for hundreds, perhaps thousands of years. The non-decaying waste materials cause a waste disposal crisis, thereby contributing to the environmental problems. Use of this materials in such a rate leads to preservation of natural aggregates sources. In light of this in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete a sustainable and environmentally friendly construction material.

Volume of demolished concrete is increasing because of the following factors:

i. Demolishing of structure for construction of new ones.
ii. Destruction of structures due to natural calamities.

These are some factors due to which billion tons of waste got produced every year. So the investigation we have conducted is about to evaluate the compatibility of productive waste (Demolished Concrete) in concrete production. These lead to the use of recycled aggregate in new concrete production, which is deemed to be a more effective utilization of concrete waste. However, information on concrete using recycled aggregate is still insufficient, and it will be advisable to get more detailed information about the characteristics of concrete using recycled aggregates.

ADVANTAGES:

□ □ The use of demolished concrete as replacement to coarse aggregate in concrete has benefits in terms of cost and reduction of pollution from construction industry.

□ □ The cost of concrete production will reduce considerably compared to conventional concrete produced by using freshly obtained coarse aggregate.

□ □ Since it is readily available at very low cost, its application will reduce the construction pollution and

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enhances the effective use of construction waste which helps in controlling Solid Waste Management.

II. LITERATURE REVIEW

Shivakumar.et.al (2018) have concluded that " this experimental study, the utilization of building demolished waste in the manufacturing of Porous concrete as a replacement of coarse aggregate. By the investigation it is found that the porous concrete results are encouraging to use as a porous material for the drain-ability and has been found to be comparable to the conventional concrete. Porous concrete may be an alternative to the conventional concrete because of low density and high porosity".

Jitender Sharma.et.al , (2014) have concluded that experiment describes the introduction and production of recycled concrete aggregates and its various applications in the construction industry. When the water cement ratio used in recycled aggregate mix is reduced, tensile strength and modulus of elasticity are improved.

Preeti Saini.et.al, (2015) "This experiment focuses on the coarse RCA which is the coarse aggregate from the original concrete that is created after the mortar is separated from the rock which is reused. The use of RCA in new construction applications is still a relatively new technique. Literature survey reveals that compressive strength primarily depends upon adhered mortar, type of aggregates, age of curing and ratio of replacement from new material to aggregate and cement, water absorption, strength of parent concrete, interfacial transition zone and moisture content.

T. Subramani .et.al, (2015),This experiment was carried out to study on concrete which incorporate Over Burnt Brick Ballast and concrete waste partially due to their abundance. 25%, 50% (M15, M25) incorporation was used as partial replacement of natural coarse aggregate in concrete. As the percentage of crushed concrete coarse aggregates and crushed brick fine aggregates is increased, Coarse aggregate is replacement level of 25% & 50 % brick waste in concrete mixes was found to be the level to obtain higher value of the strength and durability at the age of 28 days. 25% & 50 % concrete waste in concrete mixes was found higher value of the strength compared with brick waste used in concrete. Finally conclude the compressive strength, flexural & split tensile strength was high when containing concrete waste 50 % in concrete compared with M15 and brick waste used in concrete.

S. Prakash Chandar.et.al, (2018) ,The replacement of recycled demolished concrete can be optimized as a fine aggregate in the concrete. Strength properties linearly decreased in comparison to conventional concrete at the replacement of 0%, 20%, 40%, 60%, 80%, and 100%. Replacement is done up to 100% but up to 80% replacement is more suitable for replacement. We can use this productive waste in a very beneficial way by doing recycling.

III. MATERIALS

A.CEMENT:

Cement is one of the binding materials in this project. Cement is the important building material in today's construction world 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989. Ordinary Portland cement, 53Grade conforming to IS: 269 – 1976.

SL.NO	PROPERTIES	CEMENT
1	Standard consistency in %	37
2	Initial setting time in minutes	40
3	Fineness modulus in %	7.67
4	Specific gravity	3.15

B.FINE AGGREGATE:

Fine aggregate is the essential ingredient in concrete that consists of natural sand or crushed stone. The quality and fine aggregate density strongly influence the hardened properties of the concrete.

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SL.NO	PROPERTIES	FINE AGGREGATE
1	Bulk density in kg/m3	1541.80
2	Fineness modulus in %	3.464
3	Specific gravity	2.705
4	Water absorbtion	0.85

C.COARSE AGGREGATE

Coarse-grained aggregates will not pass through a sieve with 4.75 mm openings. Those particles that are predominantly retained on the 4.75 mm (No. 4) sieve and will pass through 3-inch screen, are called coarse aggregate

S.No	Properties	Values
1	Size	20mm
2	Zone	II
3	Specific gravity	2.69
4	Bulk Density (g/cc)	1.28

D.RECYCLED COARSE AGGREGATE

Recycled aggregate are comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions and demolition debris. These materials are generally from to achieve this, major emphasis must be laid on the use of wastes and byproducts in cement and concrete used for new constructions.

SL.NO	PROPERTIES	RECYCLED COARSE AGGREGATE
1	Water Absorption	0.98
2	Flakiness Index	15.79
3	Elongation Index	14.53
4	Specific. Gravity	2.79
5	Crushing Value	19.21
6	Impact Value	11.78

IV.TESTING OF CONCRETE

A. TESTING OF FRESH CONCRETE

i. The concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows.

Fig 7: Slump Test

ii. It is an empirical test that measures the workability of fresh concrete. it measures the consistency of concrete.

SLUMP RESULTS

Concrete	Slump value	Type of slump
M20(5% DW)	100	Medium
M20(10% DW)	90	Medium
M20(15% DW)	100	Medium

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M25 (5% DW)	85	Medium
M25(10% DW)	90	Medium
M25(15% DW)	90	Medium
M30(5% DW)	100	Medium
M30(10% DW)	100	Medium
M30(15% DW)	95	Medium
M20	90	Medium
M30	95	Medium
M35	95	Medium

B.TESTING OF HARDEN CONCRETE

I. COMPRESSIVE STRENGTH OF CONCRETE

The casted concrete is cured in tank which consists full of water for 28days, the concrete is tested in CTM. The tests are done for 7days and 28 days. The mixture is casted in cubes has dimension of 150x 150 x 150mm and cylinder of diameter 150mm and height 300 mm.

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Fig 8: Compressive strength Test

II. SPLIT TENSILE STRENGTH

The casted concrete is cured in tank which consists full of water for 28 days,The concrete is tested in UTM. The tests are done for 28 days.

Fig 8: Split tensile strength Test

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VIII. RESULTS AND DISCUSSIONS

Chart 1 represents the comparision of compressive strength of the M20 DW concrete , M30 DW concrete , M25 DW concrete in 7 days.

S.No	Percentage	M20 DW	M25 DW	M30 DW
1	5	17.33	21.44	24.77
2	10	16.44	17.33	21.33
3	15	14.22	17.77	22.22
4	0	14.14	17.33	21.07

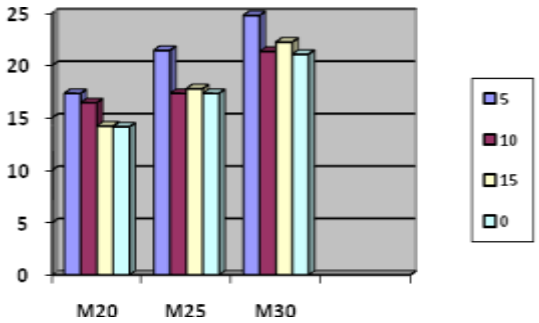

Chart 1: Compressive Strength In 7days

DISCUSSIONS:

By comparing the three different grade of concrete with three different composition, the concrete with 5% of partial replacement of demolished concrete hashigh strength in 7 days.

Chart 2 represents the comparision of compressive strength of the M20 DW concrete , M30 DW concrete , M25 DW concrete in 28days.

S.No	Percentage	M20 DW	M25 DW	M30 DW
1	5	25.11	38	47.5
2	10	24.43	35.88	46.8
3	15	25.54	33.4	49
4	0	25.11	36.1	45.7

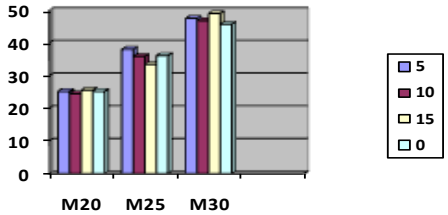

Chart 2: Compressive Strength In 28 days

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DISCUSSIONS:

By comparing the three different grade of concrete with three different composition, the concrete with 15% of partial replacement of demolished concrete has high strength.

Chart 3 represents the comparision of Split tensile strength of the M20 DW concrete , M30 DW concrete , M25 DW concrete in 7 days.

S.No	Percentage	M20 DW	M25 DW	M30 DW
1	5	1.33	1.56	2.49
2	10	1.39	1.97	2.35
3	15	1.34	2.32	2.53
4	0	1.36	1.97	2.47

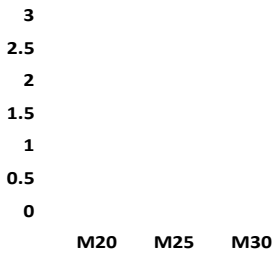

Chart 3: Split tensile Strength In 28 days

DISCUSSIONS:

By comparing the three different grade of concrete with three different composition, the concrete with 15% of partial replacement of demolished concrete has high strength.

IX.CONCLUSION

- Based on the results of these works it can be concluded that demolished wastemixed cubes has equal strength with that of conventional concrete cubes in certain categories.
- M20, M25, M30 cubes takes equal load compared to conventional concrete, and It is equal grade concrete's load carrying capacity is slightly decreased.
- The Cost of the construction has been reduced by adding the demolished waste to the materials of construction.
- The pollution in landfill by the demolished waste has been reduced.
- The compressive strength & split tensile strength of 15% M30 Demolished Waste Concrete is higher than the all results in this experimental analysis.

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