Experimental Investigation on Partial Replacement of Coarse Aggregates by Demolished Concrete

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Abstract:- Concrete is the main component of construction. Concrete is a composition of cement, fine aggregates, coarse aggregates, and water. But the rapid depletion of those resources and therefore the increasing cost is emerging as an attention-seeking issue, thanks to which construction industries face crises for the straightforward availability of those resources. This is why various alternatives are being adopted to counter this problem like reuse and recycling of construction waste. Our project aims in this field of utilizing demolished concrete. During this project, we replaced coarse aggregates with the demolished concrete within the range 0%, 5%, 10%, 15%, 20% using M25 grade concrete. The prepared concrete mix is compared and would be tested in terms of compressive strength, workability test, etc. to standard concrete. The test is going to be performed at 7, 14, and 28 days to gauge the strength properties. We also carry out the rate analysis for M25 Reinforced concrete work with 1.5% steel slab using normal conventional concrete and for same RCC work using demolished concrete.

Keywords: Compressive strength, slump cone test, recycled demolished concrete.

I. INTRODUCTION

As we know the present world is heavily feeding on concrete to huge content, the demand for the construction aggregates has increased. So, to catch up with demand natural resources are substituted with some recycled resources that are used such as demolished concrete.

Demolished concrete is produced when structure made up of concrete is demolished and the amount of waste concrete left after demolition is named as demolished concrete. We can use this product waste in a very beneficial way of doing recycling. As we know, recycling and reusing waste products always proved to be eco-friendly and economic. Waste products can add advantage in the construction work if used according to their potential. Demolished concrete is available at various construction sites in huge quantities which are now posing a serious problem of disposal. Nowadays these materials are being used in construction work to meet the resource requirement.

The volume of demolished concrete is increasing because of the following factors:

- Demolishing the structure for the construction of new ones.
- Destruction of structures due to natural calamities.

These are some factors due to which billions of tons of waste got produced every year.

The paper is based on evaluating the compatibility of productive waste (DEMOLISHED CONCRETE) in concrete production.

II. LITERATUERE REVIEW

1) "Use of demolished concrete waste in partial replacement of coarse aggregates in concrete" SSRG International Journal of civil engineering (SSRG-IJCE)- volume 3

In this paper, it is discussed that there is a large amount of demolished waste generated every year I India and other developing countries. This study is a part of a comprehensive carried out to gauge the effect of partial replacement of coarse aggregate by demolished waste on compressive strength and workability of (DAC) demolished aggregate concrete.

For the study 3,7, and 28 days compressive strengths were recorded. In this study, we have taken the demolished concrete aggregate 10%,20%,30% by weight of the conventional coarse aggregate and the concrete cubes were cast by that demolished concrete aggregate then further tests conducted such as workability, compressive strength for that DAC and the result

obtained are found to be comparable with the conventional concrete.

2) "Demolished waste as coarse aggregate in concrete." J. Acad. Indus. Res. Vol. 1(9) February 2013.

In this experimental study, calculate the effect of partial replacement of coarse aggregate by demolished waste on workability and compressive strength of recycled concrete. Compressive strength observed for 7 and 28 days. The compressive strength thus, observed was compared with the strength of conventional concrete. Test results showed that the compressive strength of recycled concrete up to 30%

replacement of coarse aggregate by demolished concrete at the end of 28 days is similar to the conventional concrete.

3) "Use of Building Demolished waste as coarse aggregate in Porous Concrete" IJRET: International Journal of Research in Engineering and Technology.
In this experimental study, the use of building demolished waste within the manufacturing of porous concrete as a replacement of coarse aggregate. Various proportions of cement, water, and percentage of coarse aggregate and building demolition waste are used. In this paper 40:60, 50:50, and 60:40 ratio of coarse aggregate and demolition wastes are used with the water-cement ratio 0.4 to 0.48. 28 days cube compressive strength from 5.22 MPa to 8.32 MPa are observed as per IS 12727:1989 for the ratio 1:10 and 1:12 respectively. By the investigation, it is found that the porous concrete results are encouraging to use as a porous material for the drain ability is like the traditional concrete.

4) "Use of construction renovation and demolition waste in Partial replacement od coarse aggregate in M20 Concrete." IJRET: International Journal of Research in Engineering and Technology.
Concrete is a pourable mix of cement, water, sand, and gravel that strengthens into a super-strong building material. So, experiments were performed inside the laboratory. Concrete made up of partial replacement of coarse aggregate with construction and demolition waste materials like ceramic tiles waste, plastic debris, crushed bricks. The resulting concrete thus produced was tested on the following parameters like compressive strength, workability, flexural strength. The results thus obtained are compared with plain cement concrete. By using low weight materials like plastic debris, we got lightweight concrete. We have increased the quantity of plastic debris and deducted some quantity of other waste, by this the workability standards are maintained. Wastes can cause pollution that affects human health. Using these wastes effectively in construction activities the speed of pollution can also be can be controlled.

5) "Use of recycled aggregate concrete." IOSR Journal of mechanical and civil engineering (IOSR-JMCE)
This paper reports the basic properties of recycled fine aggregates and recycled coarse aggregate & also compares these properties with natural aggregates. Basic concrete properties like compressive strength, flexural strength, workability, etc. are explained here for various combinations of recycled aggregate with natural aggregate. Code guidelines of recycled aggregates concrete in various countries are stated here with their effects on concrete work. In general, the present status of recycled aggregates in India along with its future need and its successful utilization are discussed here.

6) "Partial replacement of coarse aggregate with demolished waste along with adding of admixture." IJARIIT: International Journal of Advance Research, Ideas and Innovations in Technology.
In this experimental study, the replacement of different constituents of concrete, one at a time was carried out by replacing these with the different sieve fractions of crushed demolition waste. The compressive strength at 7,14 and 28 days and workability in terms of slump value were measured. Test results show that demolished aggregate possess relatively lower bulk crushing, density and impact standards and higher water absorption as compared to natural aggregate. Tests conducted on demolished aggregates and results compared with natural coarse aggregates satisfactory as per IS 2386. The compressive strength of demolished aggregate concrete is comparatively lower up to 15% than natural aggregate concrete. All the demolished waste added cubes are added with the admixture i.e.; sodium naphthalene formaldehyde.
The compression strength of the different proportions are taken and the results are clear that the constant of adding superplasticizer and 10% of adding demolished waste shows the difference in a graph and at the 15% of adding demolished waste to the concrete attains the maximum strength but at the 20% of adding demolished waste the strength has been reduced and it didn't attend the required strength.
(K.Lochan Sai Teja, 2018).

III. MATERIALS & METHODOLOGY

A. MATERIALS USED:

- Ordinary Portland cement 53 grade
- Fine aggregates
- Coarse aggregates
- Recycled aggregates

B. TEST ON AGGREGATE:

i. Impact strength test:

Aggregates Impact strength is determined by impact testing machine. Impact value of fresh aggregates and recycled aggregates are shown in table 1.

Table 1: Impact value of Fresh aggregates and Recycled aggregate

S.NO.	Particulars	Impact value
1	Fresh aggregates	7.89
2	Recycled aggregates	38.46

ii. Specific gravity test:

Aggregates specific gravity is determined by pycnometer. Specific gravity of fresh aggregates and recycled aggregates are shown in table 2.

Table 2: Specific gravity of fresh aggregates and recycled aggregate

S.NO.	Particulars	Specific gravity
1	Fresh aggregates	2.74
2	Recycled aggregates	2.32

C. CUBE CASTING & CURING:

Initially, the constituent materials were weighed and dry mixing was administered for cement, sand and coarse aggregate. Mixing is done by a drum mixer. The mixing duration was 2-5 minutes and then the water added as per the mix proportion. The mixing was carried out for 3-5 minutes. Then the mix poured into the cube molds of size 150×150×150mm and then compacted manually using a tamping rod as in fig 2.

The cubes are demolded after 1 day of casting and then kept in respective water for curing at room temperature the cubes are taken out from curing after 7, 14, & 28 days for testing. The demolished concrete has been collected from an authorized and recognized local lab in Maharashtra. (M.S.shetty, 1982)

FIG-1: CASTING OF CUBES

D. TESTING:

- SLUMP CONE TEST

The slump test is a measure of the workability of the concrete. The apparatus for conducting the slump test basically consists of a metallic mould within the sort of a frustum of a cone.

The cone was filled in 3 layers, each layer approximately one-third the volume of the mould. Each layer is tamped 25 times by a tamping rod. After the top layer has been compacted, the concrete is struck off level with a trowel and tamping rod.

Remove any excess emission of concrete from around the base of the cone and lift the cone clear of the concrete allowing the concrete to settle or slump under its own weight. Slowly lift the cone vertically, with the lifting operation taking approximately 3 to 7 seconds.

The amount of slump is measured immediately after the mould is lifted by placing the rodding bar across the inverted mould and measuring from the top of the mould to the displaced original centre of the top of concrete. The difference in level between the height of the mould and that of the maximum point of the subsided concrete is measured. The change in height in mm is taken as a slump of concrete. (M.S.shetty, 1982).

- COMPRESSIVE STRENGTH TEST OF CONCRETE

By this single test, one judge whether concreting gas been done properly or not. For cube test size 150 mm x 150 mm x 150 mm are commonly used. This concrete is poured within the mould and tempered properly so as to not have any voids. After 24 hours these moulds are removed. Test specimens are put in water for curing. The highest surface of this specimen should be made even and smooth. This is done by putting cement paste and spreading smoothly on the entire area of the specimen.

These specimens are tested by a compression testing machine after 7 days curing, 14 days curing and 28 days curing. Load at the failure divided by area of cross section of specimen gives the compressive strength of concrete.

IV. COST ANALYSIS

When demolished concrete is used, for 10m^3 RCC work, the total saving is Rs.513. From the cost analysis, when 10% replacement of coarse aggregate is done with demolished concrete, the overall cost of project will come down at least by 1%. This drags down the cost for buying raw materials & transportation. On the large-scale projects, the savings for the project would be significant. Hence, replacement of demolished concrete waste in new concrete will decrease the cost of making concrete and reduce the waste generated from the old demolished concrete. Hence, recycled aggregate concrete may be an alternative to the conventional concrete.

V. RESULTS

TABLE 3: Slump cone test results

SR.NO	% Usage of recycled aggregates	Workability(mm)
1	0%	130mm
2	5%	175mm
3	10%	150mm
4	15%	100mm
5	20%	20mm

TABLE 4: Compressive strength test results

S. No	% Usage of recycled aggregate	Compressive strength (N/mm^2)		
		7 days	14 days	28 days
1	0%	22.22	28	32.44
2	5%	20	20.89	21.78
3	10%	22.66	32.44	36.44
4	15%	21.33	26.22	28.44
5	20%	17.33	25.78	27.11

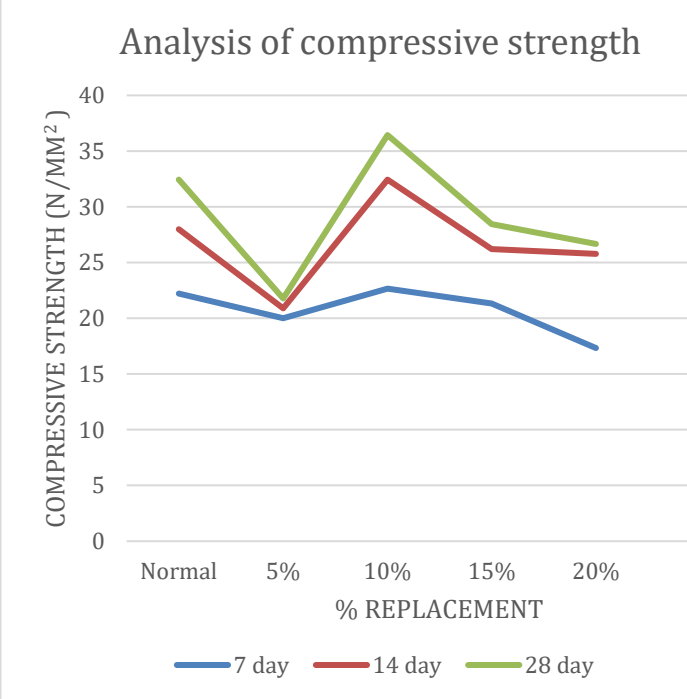

FIG 2: Compressive strength of cubes

VI. CONCLUSION

- From the experimental investigations, it can be hence concluded that the optimum replacement for this particular mic for high strength concrete is 10%. Up to this replacement, good compressive strength can be achieved using recycled aggregates.
- The test values of compressive strength for 10% and 15% of demolished concrete aggregates are near to the value of standard concrete or conventional concrete
- Beyond this replacement, the strength acquired reduces gradually and does not cross the target strength and to overcome this problem, a suitable adjustment in mix design is required.
- From cost analysis, when 10% replacement of coarse aggregate is done with demolished come down at least by 1%. This drags down the cost for buying raw materials & transportation.
- When demolished waste is used in concrete, the cost of production will be economical. Hence, overall cost of project will come down.
- Hence, recycled aggregate concrete may be an alternative to the conventional concrete.

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