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Replacement of Natural Aggregate by Recycled Aggregate with No Fine in Concrete-with Constant Percentage of Flyash

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Abstract: ***The research is done in order to experiment the reuse of demolished aggregate. As we all know that the demolished concrete creates lot many problems to the soil as well as the environment. The disposal of the demolished concrete is very necessary as well as difficult. Hence to make the construction eco-friendly and economic, the demolished concrete is used in the concrete mix. The demolished concrete that is to be used in the concrete mix is processed by concrete testing. The recycled aggregate is used as a replacement of the coarse aggregate in the proportion of 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100%. A constant percentage of fly ash is used as a replacement of cement. As there is no fine sand the fly ash will help to bind up the concrete mix. The compressive testing of these cubes is done on 7th and 28th day of curing. The test results of the slump cone test as well as the compressive strength are mentioned. Hence the research concludes that the recycled aggregate with constant amount of fly ash as a replacement of cement can be used as a conventional and eco-friendly and recycled construction material.***

Keywords: Demolished concrete, eco-friendly, fly-ash, compressive strength, slump-cone test, recycled coarse aggregate, no-fine sand.

I. INTRODUCTION

As we all know the present environmental conditions and the soil is getting worse day by day due to the production and disposal of tons of garbage on daily basis. This garbage not only uses useful land but also degrades the quality of soil. Construction and demolition waste are the waste material which is generated from the process of construction, demolition and renovation of any structure. The waste items that is likely to be found is concrete, wood, drywalls, metal, plastic, pipes, aggregate, paper, insulators, fasteners, etc. All these waste material affects environment in some or the other way. Mostly the developers and the contractors dispose this waste in the preservation of environment and for the economic purposes, research and experiments are done to find a new approach of managing and disposing this waste which can reduce the quantity of waste that is disposed in the landfills which affects the environment. Recycling of this waste can be done in order to reduce the quantity of waste as well as it produces recycles coarse aggregate which when used reduces the cost. In the past decades, a small amount of interest was paid to the tremendous amount of construction and demolition waste that was dumped into the landfills or the dumping grounds. As a result, there are many environmental problems uprising due to this type of disposal. As the recycled coarse aggregate is lighter in weight, the concrete in which it is used is considered as low-density concrete, also the waster absorption property of the recycled coarse aggregate is better then that of the normal aggregate. Hence the use of recycled coarse aggregate can be of greater success as far as the environment and economy is considered. If development is to lead to sustainable benefits for mankind, effluent people showed change their habits of using natural resources. In the below experiment there is no use of fine sand as it is a natural resource and also not economical.

II. MATERIAL

1) *Cement:* Ordinary Portland cement (53 grade) confirming to IS 8112-1989 is to be used. Tests were conducted on cement like specific gravity, consistency tests, setting tests, compressive strength test at 28 days.

Sr. No.	Properties	Result	Properties as per IS 8112-1989
1	Specific gravity	3.15	3.10-3.15
2	Standard consistency	31.5	30-35
3	Initial setting time	91 min	30 min minimum
4	Final setting time	211 min	600 min minimum
5	Compressive strength	58 N/mm^2	53 N/mm^2 minimum

Table no 1- Property of Ordinary Portland Cement (OPC) 53 grade

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2) Coarse Aggregate: The properties of coarse aggregate are tested and shown in the table no 2

Sr. No.	Properties	Value
1	Specific gravity	2.94
2	Fineness modulus	7.07
3	Water absorption	0.40%
4	Particle shape	Angular
5	Impact value	11.42%
6	Los Angles abrasion value	8.32%

Table no 2- Tests on Coarse aggregate

3) Recycled Coarse Aggregate: The crushed recycled coarse aggregate of 20 mm size obtained from locally available nearby construction. The properties of Recycled coarse aggregate are tested and shown in the table no 3

Sr No.	Properties	Value
1	Specific gravity	2.36
2	Fineness modulus	7.70
3	Water absorption	2.40%
4	Particle shape	Angular
5	Impact value	19.18%
6	Los Angles abrasion value	25.55%

Table no 3 – Test on recycled coarse aggregate

4) Supplementary Cementation material- Fly Ash

Chemical Properties of Fly Ash tested as the method as per as IS 1727-1967

Sr. No	Chemical Properties	Fly Ash (clam F)
1	Sio_2	62.22
2	MgO	6.09
3	SO_3	3.00
4	CaO	5.30
5	LOI	9.98
6	Al_2O_3	7.63
7	Fe_2O_3	0.13

Table no 4- Test results of Fly Ash

5) Water- Water is an important ingredient of water as it actually participated in the chemical reaction with cement. Since it helps to form the gel into the concrete as it also gives strength to the concrete. The quantity and quality of water is required to be looked into very carefully.

III. METHODOLOGY

In the following experiment, the cement is mixed with recycled coarse aggregate, water. Concrete is replaced with alternative recycled coarse aggregate by variations of percentage of replacement. The recycled coarse aggregate is used as a partial substance for coarse aggregate within the series of 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% ny coarse aggregate with a constant percentage of fly ash that is 30% of cement is replaced by fly ash in the concrete mixture. For analyzing the recycled coarse aggregate and different variations in the mix total 66 cubes of the standard size which is 150x150x150mm has been casted for compression test. After 24 hours are completed the cubes are opened and allowed for curing in the curing tank with tap water, fully submerged in the water tank. The cubes are tested at the required $7^{th}$and 28^{th} day.

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IV. MIX DESIGN

The procedure of choosing appropriate parts of concrete and finding with their relative quantity with the objective of manufacturing a concrete of the necessary strength, durability and workability as inexpensively as achievable is termed as concrete mix design.

Percentage recycled coarse aggregate	Weight of cement(kg/m^3)	Weight of (30%) Fly Ash (kg/m^3)	Weight of coarse aggregate(kg/m^3)	Weight of recycled coarse aggregate (kg/m^3)	Weight of water (kg/m^3)
0%	384	115.20	1715.990	0	192
10%	384	115.20	1596.901	664.189	192
20%	384	115.20	1477.812	763.278	192
30%	384	115.20	1358.723	882.367	192
40%	384	115.20	1239.634	1001.456	192
50%	384	115.20	1120.545	1120.545	192
60%	384	115.20	1001.456	1239.634	192
70%	384	115.20	882.367	1358.723	192
80%	384	115.20	763.278	1477.812	192
90%	384	115.20	664.189	1596.901	192
100%	384	115.20	0	1715.990	192

Table no 5- Mix proportion of concrete materials.

V. WASTE DISPOSAL AND WASTE MANAGEMENT.

Demolished waste from the structure is used as recycled coarse aggregate as an alternative source of natural coarse aggregate. The disposal of waste is neither cost effective nor environmentally friendly. When the recycled coarse aggregate is used as a substitute material, it helps the structure to be eco-friendly as well as economic. As waste disposal has many methods like landfills, incineration, waste reduction, etc. But the most useful method can be recycling and reusing the waste as far as possible, by which it does not create any harm to the environment and the soil where it would be landfilled.

VI. RESULTS

In the above study, the casted concrete cubes are investigated under various tests, to estimate the strength and other properties of the casted concrete cubes.

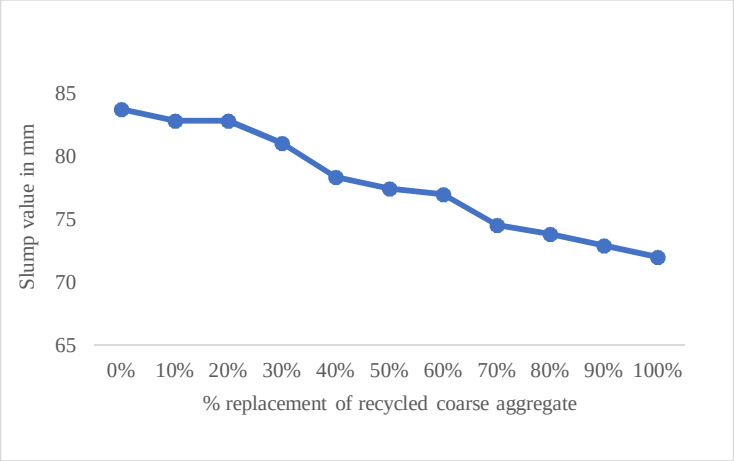
A. Slump Cone Test.

The slump test determines the workability of the concrete mix. From this test it is identical that as the percentage of replacement of the recycled coarse aggregate increases, the slump value decreases as shown in table 6.

Percentage of replacement	Slump value
0	83.7
10	82.8
20	82.8
30	81.0
40	78.3
50	77.4
60	76.95
70	74.52
80	73.80
90	72.90
100	72.00

Table no 6- Slump value of concrete mix

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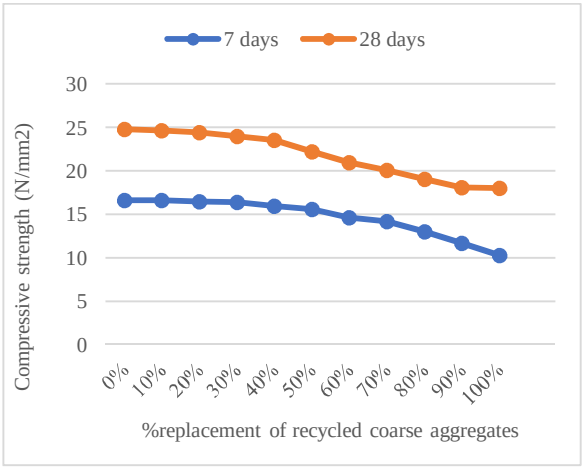
Graph no 1- Slump value variations

B. Compressive Strength Test

The cubes were casted and cured for 28 days. The tests were conducted on 7th and 28th day.

Percentage of recycled coarse aggregates	7-days	28-days
0%	16.61	24.803
10%	16.58	24.653
20%	16.5	24.463
30%	16.4	24.023
40%	15.98	23.543
50%	15.56	22.203
60%	14.6	20.953
70%	14.15	20.093
80%	13	19.063
90%	11.65	18.123
100%	10.31	18.023

Table no 7- Compressive test of cubes at 7th and 28th day of curing



Graph no 2- Representing the compressive strength of cubes

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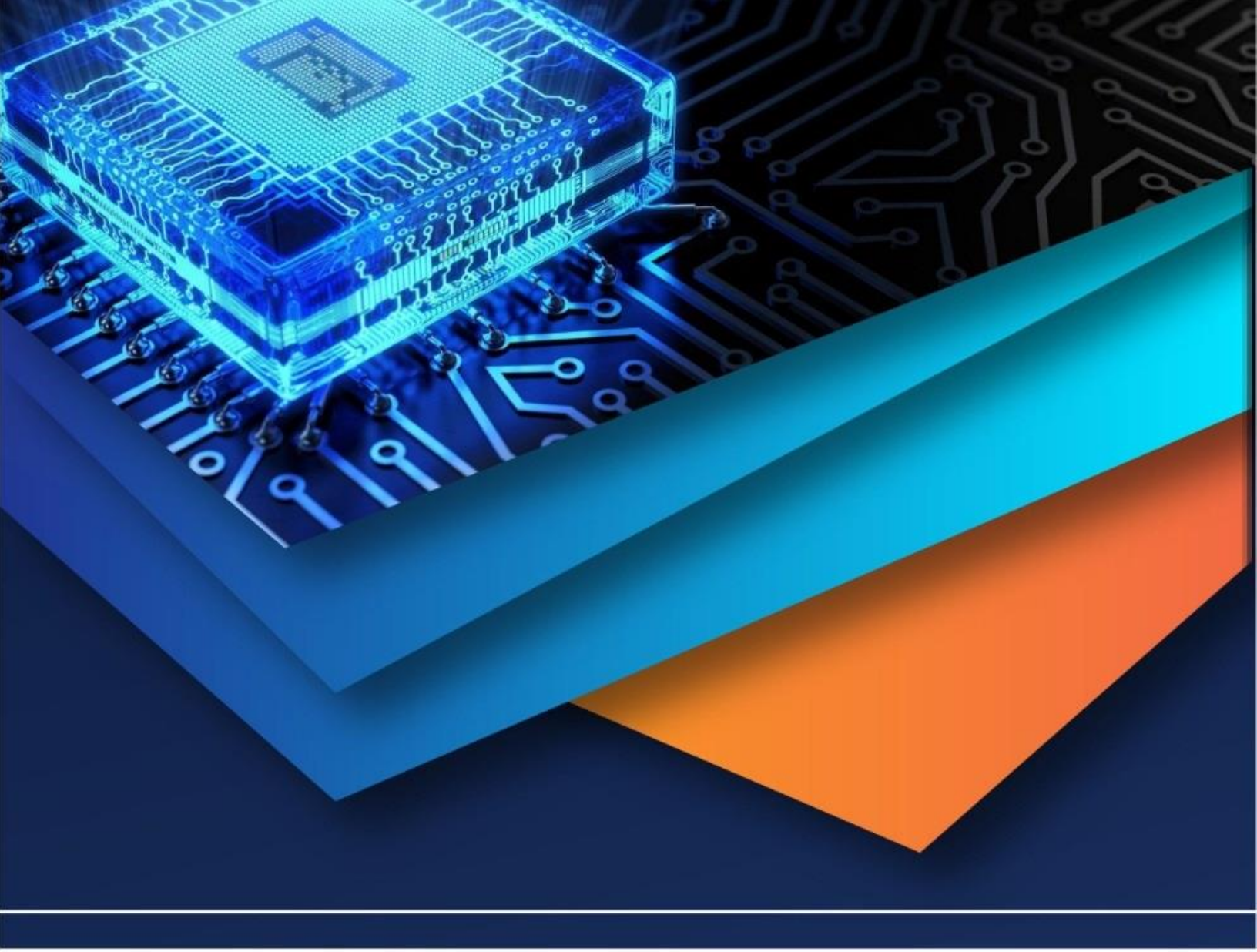
VII. CONCLUSION

A. The above study indicated the collective use of demolition waste.
B. Recycled coarse aggregate can be effectively used as partial replacement of natural aggregate in the construction.
C. With the use of recycled coarse aggregate, the construction becomes economic as well as eco-friendly. This reduces the waste in environment
D. Due to the use of fly ash, the use of sand is decreased and construction becomes economic.
E. The recycled coarse aggregates can be used in various structures like roads, footpaths, buildings, etc

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