

Experimental Studies on Concrete by Using Recycled Aggregates

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Abstract- There is a critical shortage of virgin aggregates and hence the availability of demolished concrete for use as recycled concrete aggregate (RCA) is increasing. Using the waste concrete as RCA conserves virgin aggregates, reduces the impact on landfills, decreases energy consumption and can provide cost savings. Recycled aggregates are comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions and demolition debris. Recycled aggregates for application in strength structural concrete, which will give a better understanding on the properties of concrete with recycled aggregate, as an alternative material to coarse aggregate in structural concrete. In the present study recycled coarse aggregate have been used to replace virgin coarse aggregate & Partial Replacement with fly ash. The properties of fresh as well as hardened concrete made of partial replacement of recycled coarse aggregate are found out and the results are compared with that of concrete Fly ash confirming to IS 3812:2003 was used as a part replacement of cement. Fly ash was replaced by cement in with 10%, 20%, & 30% again natural aggregates were replace with recycled coarse aggregates (RCA) in % of 10%, 20%, & 30 %. Concrete mix 1:1:2 were used in this study for experimental purpose.

Keywords— Recycled Coarse Aggregate, Natural Coarse Aggregate, slump test, Compressive Strength

I. INTRODUCTION

Concrete is the second largest consumed product than water all over the world due to rapid industrialization across the major cities. Recycled Coarse Aggregates (RCA) are obtained by crushing of concretes from demolition of concrete structural components in many structures such as: old buildings, concrete pavements, bridges & structures, at the end of their service life & utility, structures deteriorated beyond the possibility of repairs, structures that are turned into debris resulting from natural disasters (such as floods, earthquake, tsunami, manmade disaster/war, etc.), The basic requirement for recycled coarse aggregate (RCA) concrete is that should be sound and hard with normal weight. The RCA shall not contain excessive amount of dirt, dust, plaster and any other injurious foreign matter which may adversely affect

RCA concrete. Because of porosity the RCA may loss its workability and strength more rapidly than traditional concrete. So the RCA concrete may require more water to achieve required workability and strength... fly ash is also a by product from various industries. Fly ash is a group of materials that can vary significantly in composition. It is residue left from burning coal, which is collected on an electrostatic precipitator or in a bag house. It mixes with flue gases that result when powdered coal is used to produce electric power. The advantages of using fly ash far outweigh the disadvantages. The most important

benefit is reduced permeability to water and aggressive chemicals. Properly cured concrete made with fly ash creates a denser product because the sizes of the pores are reduced. This increases strength and reduces permeability. Globally, the concrete industry consumes large quantities of natural resources, which are becoming insufficient to meet the increasing demands

II. OBJECTIVE

- ✓ To observe performance of the recycled aggregate concrete of various mix cases in its fresh and hardened state
- ✓ To examine the properties of the fresh recycled aggregate concrete and hardened recycled aggregate concretes.
- ✓ To examine the mechanical properties of recycled aggregate.

III. EXPERIMENTAL PROGRAMM

Result of Cement

*Table Error! No text of specified style in document..1
Cement Testing*

SR.NO	Types Of Test	Results	IS limits
1	Types Of Cement	OPC 53 Grade	
2	Consistency	30%	
3	Initial Setting time	110min	>30 min
4	Final Setting time	200min	<600 min
5	Specific Surface Area	288.82	
6	Soundness Test	1 mm	<10 mm
7	Specific Gravity Of Cement	3.15	
8	Compressive Strength	28 N/mm ²	> 27 N/mm ²
9		42 N/mm ²	>37 N/mm ²
10		56 N/mm ²	>53 N/mm ²

Result of Fine Aggregates

Table Error! No text of specified style in document..2 Fine Aggregates Result

SR.NO	Types Of Test	Results
1	Fineness Modulus	2.60
2	Silt & clay content	2.30
3	Specific Gravity	2.65
4	Water Absorption	3.19
5	Bulk Density of sand	1.60

Result of Natural Coarse Aggregates (NA)

*Table Error! No text of specified style in document..3
Result of NA*

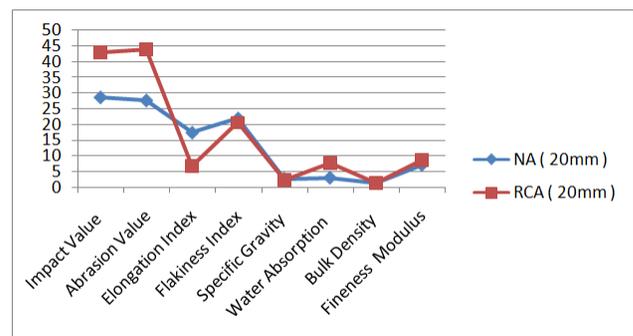
SR.NO	Types Of Test	NA (20 mm)
1	Impact Value	28.52%
2	Abrasion Value	27.54%
3	Elongation Index	17.33%
4	Flakiness Index	21.83%
5	Specific Gravity	2.73
6	Water	3.07

	Absorption	
7	Bulk Density	1.40kg/lit

Result of Recycled Coarse Aggregates (RCA)

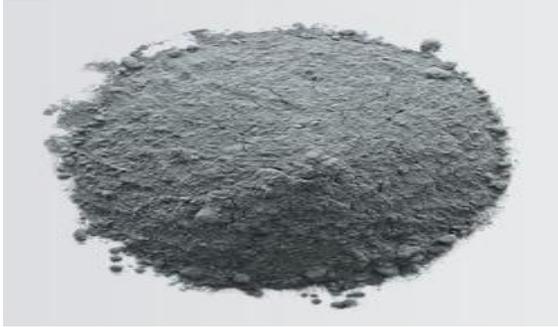
Table Error! No text of specified style in document..4 Result of RCA

SR.NO	Types Of Test	RCA(20mm)
1	Impact Value	43.06%
2	Abrasion Value	43.96%
3	Elongation Index	6.55%
4	Flakiness Index	20.55%
5	Specific Gravity	2.30
6	Water Absorption	7.71
7	Bulk Density	1.28kg/lit



*Error! No text of specified style in document..1 Comparative Results between NA & RCA
Fly Ash*

The burning of anthracite and bituminous coal typically produces Class F fly ash which contains less than 10% lime (Coo). This ash has pozzolanic properties. In the presence of water and free lime, the ash will react into cementitious Compounds.



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Class F Fly Ash*

Fresh test of Concrete

Workability by slump cone was determined by using IS: 1199-1959 for RCA concrete mixes. Concrete mixes were prepared with 10%, 20%, 30% Replacement of FA with cement & 10%, 20%, 30% Replacement of RCA with NA.

*Table Error! No text of specified style in document..5
Partial Replacement of 10% Fly Ash with Cement & 10%,
20%, 30% Replacement of RCA with NA*

Replacement Of RCA	Slump Value (mm)
10%	26
20%	30
30%	30

*Table Error! No text of specified style in document..6
Partial Replacement of 20% Fly Ash with Cement & 10%,
20%, 30% Replacement of RCA with NA*

Replacement Of RCA	Slump Value (mm)
10%	26
20%	27
30%	27

*Table Error! No text of specified style in document..7
Partial Replacement of 30% Fly Ash with Cement & 10%,
20%, 30% Replacement of RCA with NA*

Replacement Of RCA	Slump Value (mm)
10%	28
20%	27
30%	28

IV. HARDENED TEST ON CONCRETE

Compressive Strength

Sampling and analysis of concrete have been carried out as per IS: 1199 – 1959. The quantities of cement, fly ash, each size of aggregate, and water for each batch was

determined by weight, to an accuracy of 0.1 percent of the total weight of the batch. Fresh properties of concrete (i.e. workability) were measured with help of slump cone test and test was carried out in accordance with IS: 1199 – 1959. The cubical moulds were used 150x150x150 mm while cylindrical mould was of 150 mm diameter and 300 mm height and both conforming to IS: 10086-1982 All strength tests were carried out in accordance with IS: 516 – 1963.

*Table Error! No text of specified style in document..8 Result
of Partial Replacement of 10% Fly Ash with Cement &
10%, 20%, 30% Replacement of RCA with NA*

% Replacement of RCA	10% Replacement FA	
	7 DAYS (N/mm ²)	28 DAYS(N/mm ²)
10%	21.7	31
20%	18.52	26.46
30%	17.02	24.28

*Table Error! No text of specified style in document..9 Result
of Partial Replacement of 20% Fly Ash with Cement &
10%, 20%, 30% Replacement of RCA with NA*

% Replacement of RCA	20% Replacement FA	
	7 DAYS (N/mm ²)	28 DAYS(N/mm ²)
10%	20.95	29.86
20%	17.41	24.85
30%	16.19	23.11

*Table Error! No text of specified style in document..10
Result of Partial Replacement of 30% Fly Ash with
Cement & 10%, 20%, 30% Replacement of RCA with NA*

% Replacement of RCA	30% Replacement FA	
	7 DAYS (N/mm ²)	28 DAYS(N/mm ²)
10%	20.60	29.16
20%	16.40	24.76
30%	15.44	22.04

V. CONCLUSIONS

Aggregate grading:

- Grading of recycled coarse aggregate normally satisfies the standards for natural aggregate

Shape and surface texture of aggregate particles:

- In terms of morphological characteristics, recycled aggregate is less favourable than natural aggregate. The grains are irregular, mostly with angular shape, rough and with cracked surface and porous. These grain characteristics grains significantly affect the workability of fresh concrete, as well as the

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permeability of liquids and gases in The hardened state; they also significantly depend on the properties of concrete used in recycling for production Of aggregate, especially its strength, porosity, exploitation conditions to which it was subjected, but also on the ways and levels of recycling – the type of applied crusher and possible additional processing procedures

Water absorption:

- Water absorption of recycled aggregate is a characteristic by which this aggregate differs most from the aggregate obtained from natural resources it has been shown that recycled concrete aggregate has a significantly higher absorption level compared to natural aggregates. The reason for that is that the original cement mortar, which is an integral part of the recycled aggregate, has a significantly more porous structure in comparison to natural aggregate, Where by its porosity primarily depends on the water cement ratio of the original (old) concrete. Thus, the Absorption of water of recycled aggregate is even bigger, as the quantity of mortar, which is attached grains of the original recycled aggregate, increases. It has been shown in practice that the stated amount of cement mortar in recycled aggregate ranges from larger than what is required by standards for natural aggregate

Bulk density of aggregate:

- The bulk density of the recycled aggregate, due to a higher porosity of mortar layer, has a lower value than the bulk density of natural aggregates

Crushing and abrasion resistance:

- The resistance to crushing and abrasion of recycled aggregate is less than the respective resistance of natural aggregate, which is a consequence of easier separation and crushing of the mortar layer around the recycled aggregate grains .In addition, recycled aggregate, in most cases, meets standard requirements in terms of the resistance to crushing and abrasion, which are prescribed for aggregates from natural resources

10 % Replacement of fly ash with cement & 10% replacement of RCA with NA achieve maximum compressive strength of concrete.

Significant steps are being taken to improve the quality of RCA and new standards are easing its use in higher value applications

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