Experimental Analysis of Demolished Concrete by Using its Coarse Aggregate as Recycling Material

Sagar M. Pawar[1*], Anil T. Babar[2*]

Department of Civil Engineering, Karmayogi Engineering College Shelve, Pandharpur Punyashlok Ahilyadevi Holkar Solapur University, Solapur, M.S, India.

*Corresponding author
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ABSTRACT

Concrete is most widely used in construction material all over the world in view of its compressive strength, Moulding ability, structural ability and economic consideration. Recycling of Demolished concrete aggregate means the process of collection and reusing it in their original form. Use recycled aggregate (RCA) in concrete is helpful for protection of environment and economic point of view. Recycled aggregate are the material for future, as it is used up to 20 % of replacement by natural aggregate available from quarries. This paper gives application of coarse aggregate from recycled demolished concrete when used in M20 mix proportion with different percentage of recycled aggregate replaced with natural one and its result analysed at 7,14, and 28 days of compressive strength.

Keywords: Concrete, RCA, Compressive strength

1 Introduction

India, a huge quantity of construction and demolition wastes is produced every year. These waste materials require a large place to dump it and hence the disposal of debris or concrete waste becomes a severe social and environment problem. Hence it is necessary to protect and preserve the natural resource. Therefore, recycling of demolished waste, course aggregate are important in construction industry. In addition to environment protection, it reduces the demand of land require for its disposal of the concrete waste. Solid concrete waste is generated during construction and demolished activities include fine aggregate, course aggregate. Recycling of this waste by converting into usable aggregate not only saves landfill space but also reduce the demand for extraction of natural raw material for new construction activity. Recycling is defined as the process of collecting, preparing recyclable material and by reusing them in their original form or in manufacturing process that do not cause the destruction of recyclable material and it's further use [1].

The fine aggregate and course aggregate are the most important ingredients in any concrete grade. All these should satisfy the required characterized [2] as per IS 383:1970. In this work two types of aggregate are used including natural sand (below 4.75 mm size) as fine aggregate and Recycled course aggregate below 20 mm size. These two ingredients directly affect the strength of concrete. In order to reduce usage of natural aggregate, recycled aggregate can be used as the replacement material. The RCA is in grey colour.RCA is also used in embankment filing, land filling, used as sub surface base in road construction work. It also help to protect excavation of natural material , waiting in availability of new material, less emission of carbon due to less use of stone crusher. This paper gives comparison of compressive strength of concrete cube prepared by conventional material and by RCA material. The waste from concrete structure has become serious problem all over the world, so we have to make a concrete which reduce the demolished concrete and maintain the environmental balance. Also maintain strength of concrete by using that recycled aggregate as compare to normal aggregate.

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2 Materials and Methods

Cement: Fineness modulus of cement is important in view of rate of hydration,to gain strength. Fineness modulus is nearly about 4%. Initial setting time and final setting time is checked with the help of vicat's apparatus. Initial setting time is the time elapsed between the moments that the water is added to cement to the time that the cement paste starts losing its plasticity. The final setting time is the time elapsed between the moments of the water is added to the cement and the time when the paste has completely lost its plasticity and attained sufficient firmness to resist certain definite pressure. Normal consistency of cement observed is 26%. The initial setting time of cement observed is 37 min. And the final setting time observed is 420 min.

Aggregate: In this work we use three types of aggregate as fine, course and recycled course aggregate.

Fine aggregate: The sand used throughout the experimental work is obtained from the river. Specific gravity of sand is obtained by using pycnometer equipment. The specific gravity of sand is obtained by using following formula,

G = (M2 – M 1) / (M2 –M1) – (M3 – M4)

Here, G= specific gravity of sand

M1 = Weight of empty clean pycnometer bottle

M2 = Weight of pycnometer bottle containing 10 gm of dry sand sample

M3= Weight of Pycnometer bottle with dry sand sample filled by distilled water

M4 = Weight of pycnometer bottle full with distilled water

The specific gravity of fine aggregate obtained is 2.36

The fineness modulus of fine aggregate obtained by using sieve analysis is 2.42

Coarse and recycled aggregate: Impact value of course aggregate obtained is 11.21% whereas it is obtained for recycled coarse aggregate is 13.59%. This impact valve obtained is as per IS 283 -1970.

Sieve analysis of coarse aggregate is conducted to determine the particle size distribution in a sample aggregate known as gradation such as 10 mm, 20 mm, 40 mm etc. The sieve analysis test carried out as per IS 2386 (1963). The fineness modulus of coarse aggregate obtained is 8.92

Water: The requirements of mixing water for concrete almost any natural water that is drinkable and has no odor. Excessive impurities in water effect setting time and strength of concrete and also cause efflorance (Deposition of white salt on the surface of concrete, starting corrosion of reinforcement, and reduced durability.

3 Theory and Calculation

M20 grade concrete obtained Average compressive strength after 28 days of curing is 26.6 Mpa. Quantity of ingredients in M20 grade concrete is obtained as below after Mix design.

Cement = 439.11 Kg/cu.m

Water = 197.16 liter

Fine aggregate = 722.26 Kg

Coarse aggregate = 1083.39 Kg

W/C ratio = 0.45

Therefore, W/ 439.71 = 0.45

W = 197.59 liter -- it is correct.

We obtained Proportion of Mix design as

M20 = 1:1.5:3

M20 = 1: 1.64: 2.46

All test on cement, fine aggregate, coarse aggregate, demolished coarse aggregate are taken as per IS codes.

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3.1 Mathematical Expressions and Symbols

Procedure adopted for testing is as below:

1. Collection of all required material for concrete
2. Preparation of material
3. Check out the properties of all the material
4. Batching of material as per proportion
5. Mixing
6. Placing of concrete
7. Compaction of concrete
8. De-moulding
9. Curing
10. Testing of Hardened concrete

    We use Fine aggregate which passes through IS sieve of 4.75mm size, coarse aggregate passes through IS Sieve 20 mm , OPC of 53 grade and recycled coarse aggregate Passing through IS sieve 20 mm , water used is fresh and cold.

Following properties of materials are tested as per respective IS codes

Material	Test	IS code
Cement (53 Grade)	1. Compressive strength 2. Setting time	1. IS 8112:1989 2. IS 8112:1989
Fine aggregate	1. Specific gravity 2. Fineness modulus	1. IS 383: 1770 2 IS 383:1970
Coarse aggregate	1. Specific gravity 2. Impact value 3. Crushing value 4. Fineness Modulus	1. IS 383 :1970 2. IS 383 :1970 3. IS 383 :1970 4. IS 383 :1970

Batching: The measurement of material for making concrete is known as Batching. There are two types of batching.

1. Volume batching
2. Weight batching.

Mixing of concrete: The mixing of material is essential to get uniform concrete. The mixing should ensure that the mass becomes homogeneous, uniform in color and consistency.

There are two methods adopted for mixing concrete are:

1. Hand Mixing
2. Machine Mixing

Placing of concrete: The main objective is to deposit the concrete as close as possible to its final position so that segregation is avoided and the concrete can be fully compacted.IN the placing of concrete the workability is one of the most important factor.

Compaction: it is the process adopted for expelling the entrapped air from the concrete. In the process of mixing, transporting, placing of concrete air is likely to get entrapped in the concrete.

De-moulding: It is the process of remove the cube from the mould. It is done after 24 Hrs.of placing of concrete.

Curing: It is necessary to cure the concrete cube for 28 days to get enough strength. Concrete derives its strength by the hydration of cement particles.

We test the compressive strength of concrete cube after curing for 7, 14 and 28 days.

Testing: The cubes are taken for compressive strength test. The compressive strength test has done on concrete as per IS 516:1959. It is tested on Compressive testing machine.

4 Results and Discussion

Compressive strength results:

A) Normal concrete:

Days	Load (KN)	Compressive strength(MPa)	Average strength (MPa)
7	220	9.77	9.32
	195	8.66	
	215	9.55	
14	325	14.44	13.92
	310	13.77	
	305	13.55	
28	590	26.22	26.14
	580	25.77	
	595	26.44	

B) Recycled aggregate:

1. 5 % Replacement

Days	Load (KN)	Compressive strength (MPa)	Average strength (MPa)
14	320	14.22	13.70
	305	13.55	
	300	13.33	
28	560	24.88	25.25
	575	25.55	
	570	25.33	

2. 10 % Replacement

Days	Load (KN)	Compressive strength (MPa)	Average strength (MPa)
14	300	13.33	12.81
	295	13.11	
	270	12.00	
28	560	24.88	24.44
	550	24.44	
	540	24.00	

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3. 15 % Replacement

Days	Load (KN)	Compressive strength (MPa)	Average strength (MPa)
14	290	12.88	12.14
	270	12.00	
	260	11.55	
28	500	22.22	22.58
	510	22.66	
	515	22.88	

3. 20 % Replacement

Days	Load (KN)	Compressive strength (MPa)	Average strength (MPa)
14	245	10.88	10.21
	230	10.22	
	215	9.55	
28	480	21.33	21.25
	495	22.00	
	460	20.44	

5 Conclusions

Following conclusion drawn from Experimental study analysis:

- Recycled aggregate concrete may be an alternative to the conventional aggregate.
- Water required producing the same workability, increases with the increase in the percentage of demolished waste.
- Up to 20 % of coarse aggregate replaced by demolished waste give strength closer to the strength of plain concrete cubes.

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