
OPTIMUM SIZE OF RECYCLED AGGREGATES

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ABSTRACT:

A increasing gap between supply and demand of natural fresh aggregate for the production of cement concrete has resulted to identify the new sources of aggregates. At the same time, in Urban areas, the disposal of increasing amount of demolished wastes from deteriorated and obsolete structures create a big problem. Many researches has been done to reuse these waste material of demolished structures.

In the present paper, the optimum size of these recycled aggregates is tried to find out in view of compressive strength, water absorption and other properties of concrete. Experimental work was planned to determine the compressive strength of concrete made from different sizes of recycled aggregates and also from naturally fresh aggregates for after 7 days, 14days and 28 days.

It was observed that loss of compressive strength of cement concrete is minimum in case of 16mm size of recycled aggregates as compared to fresh naturally aggregates.

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INTRODUCTION:

Recycled Concrete is simply the old concrete that has been achieved from pavements, demolished buildings and crushed to the specified size. Huge amount of buildings waste becomes available each year during the demolition of old structures to make new and modern ones. Disposal of this waste may be a big problem in view of the scarcity of a suitable dumping grounds and meeting the environmental requirements. Recycling concrete may a good solution as reuse of demolished waste avoids the problem of disposal as well as reduce the gap between the demand and supply crushed granite fresh aggregates. The various applications of recycled concrete are as It may be a reasonable substitute in the regions where other natural aggregates are scare and there is a severe waste disposal problem. It may be used in lean concretes or base and sub-base in pavements.

In the present paper the optimum size of recycled aggregates corresponding to maximum compressive strength of Portland cement concrete was tried to find out by conducting various experiments on Portland cement concrete made from different sizes of recycled aggregates .

It was concluded that the optimum size of recycled aggregates is 16mm where loss of compressive strength as compared to concrete with fresh aggregates is minimum.

PREVIOUS WORK DONE:

Ahmad Tazyeen et have determined compressive strength of concrete using demolished waste for partially replacing cement and similarly aggregates @ 10 percent, 20 percent and 30 percent by weight of cement as partial replacement of cement and recycled concrete aggregates with demolished waste mixed @ 10percent , 20 percent and 30 percent by weight of fine aggregates as a partial replacement of fine aggregates. The test were conducted after 28 days as per IS: 516-1959 and it was observed that Slump or compaction factor goes on decreasing marginally with the increase in percent of demolished waste. The 28 days compressive strength of 30% cement replaced concrete is almost half of that of conventional concrete cubes. The compressive strength of 30% fine aggregates replaced concrete is higher than that of 30% cement replaced concrete and 28 days split tensile strength of 10% and 20% cement replaced concrete is between 83-90% of that of conventional concrete.

Mandal S. Ghose have used OPC 53 grade confirming to IS: 12269-1987(1). The fine aggregate

were natural sand of zone-III as per IS 383-1970(2). The recycle aggregates produces from crushing the 150 mm standard cubes. The crushed product passing 40mm IS sieve was considered as recycled aggregates. It was observed that workability of recycled aggregates concrete was not effected adversely with the increase in replacement ratio of recycled aggregates. While Hansen, Narud, Bairragi have found a reduction of slump value in concrete by raising the amount of recycle aggregate in the concrete. It was seen that when compared with the control concrete specimen, a drop of 10 to 13% in compression and 12 to 16% in direct tension and 14 to 24% in flexure was noticed in case of by the recycled aggregate concrete with recycle aggregates varies from 50 to 100% .

Ramaamurthy K. Gumaste used three types of recycled coarse aggregates prepared from old concrete cubes of unknown strength, masonry with wire cut bricks and masonry with tables molded bricks by crushing, first using a 1000KN compression testing machine, followed by use of hammer. Then the crushed products were screened through 25mm sieve and the aggregates retained on IS sieve no 480 were used for making recycled aggregates concrete. It was observed that the specific gravity of demolished concrete aggregates is lower than that of natural fresh aggregates, The rodded bulk density of recycled concrete aggregates is higher than that of fresh aggregates and it's loose bulk density is lower than that of fresh aggregates, The elongation and flakiness indices of recycled concrete aggregate were closer to that of fresh granite aggregates, Relatively higher water is required to recycled aggregate concrete. The compressive strength of concrete of recycled brick masonry aggregates concrete, even in case of a very lean mix of 1:4:7 is of the order of 9 to 10 N/mm² which may be considered equivalent to the compressive strength of commonly available good quality bricks suitable for low rise load bearing masonry construction and it may be recommended that recycle concrete may be used for linear mixes and PCC works.

EXPERIMENTAL WORK

Various experiments to determine the properties of materials were conducted and after these concrete mix was designed for different sizes of coarse aggregates which was followed by casting, curing and testing of concrete specimens. Properties of material are as follows:

Physical properties of cement:-

S.NO.	Characteristics	Value	Value specified as per IS:8112-1989
1	Standard Consistency	29.5	----
2	Finess of Cement	7	<10
3	Setting Time INITIAL	30 minutes	>30
	FINAL	400 minutes	<600
4	Specific Gravity	3.1	---
5	Compressive strength after		
	7 days	19.83	>16
	14 days	32.61	>22
	21 days	43.00	>43

physical property of fine aggregates :-

FINNESS MODULUS 1.52

SPECIFIC GRAVITY 2.64

ZONE IV

sieve analysis of coarse aggregates :-

IS SIEVE DESIGNATION	% PASSING FOR 12.5mm SIZE AGGREGATES	% PASSING FOR 16.0 mm SIZE AGGREGATES	% PASSING FOR 20.0mm SIZE AGGREGATES
40 mm	-	-	100
20 mm	-	10	80
16mm	100	85	78
12.5 mm	85	81	73
10 mm	15	30	20

water:

The water used for mixing and curing was free from deleterious materials as per clause 4.3 of IS:456-1974. Laboratory tap water was used for mixing and curing purposes.

concrete mix design:-

Concrete Mix Design was proportioned based on IS method for various sizes of coarse aggregates.

DETAILS OF CONCRETE MIX:-

Size of C.A.	Mix	Cement	Fine	Coarse Aggregates		w/c Ratio
				RECYCLED	NATURAL	
12.5 mm	M _{12.5}	1	1.5	2.8	2.8	0.525
16 mm	M ₁₆	1	1.548	3.191	3.191	0.525
20 mm	M ₂₀	1	1.54	3.49	3.49	0.525

TESTING:-

Compression Testing Machine was used for testing the concrete cubes of 150X150mm Size after 7, 14, 28 days of curing. The compressive strength of cubes have been determined as per IS 516-1959 at the loading rate of 140 kg/cm²/min. On 200 tonnes compression testing machine.

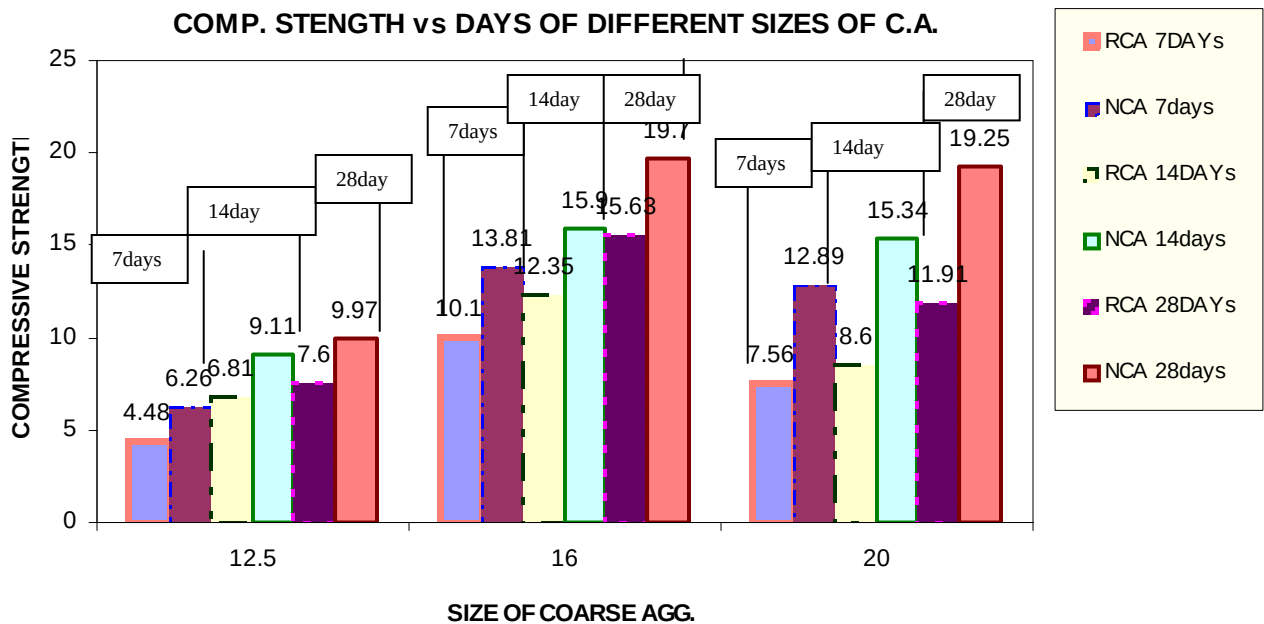
RESULTS:-

The average compressive strength of concrete cubes cast using different sizes of recycled and fresh natural aggregates were determined at the age of 7, 14, 28 days as presented in the table

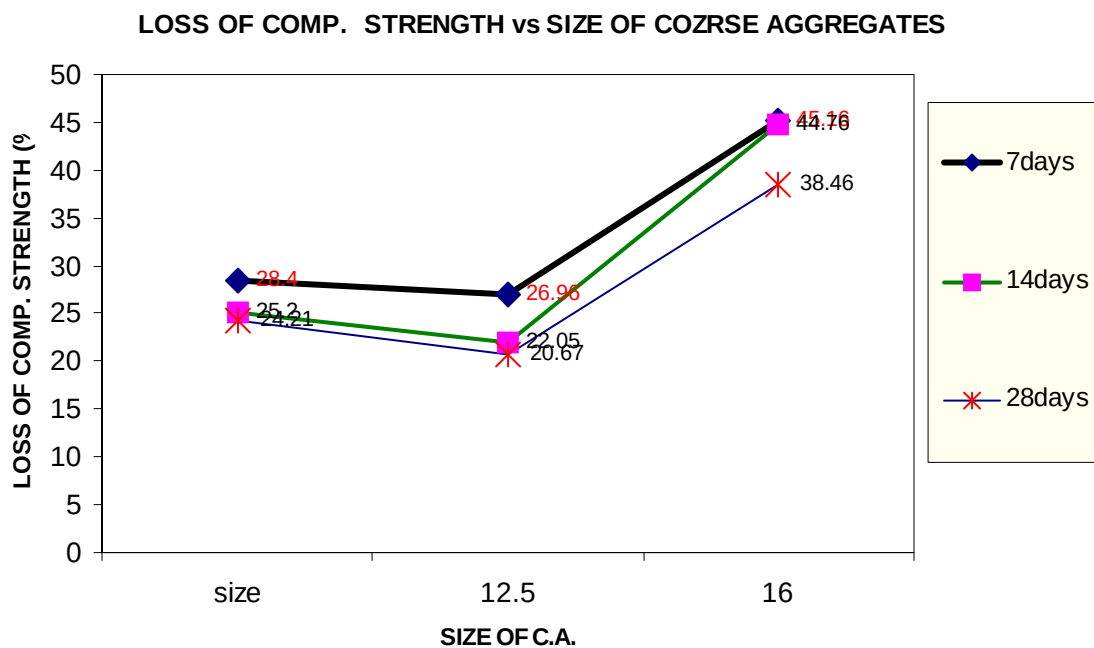
COMPRESSIVE STRENGTH OF RECYCLED AND NATURAL FRESH AGGREGATES:-

Size of Aggregates	Compressive Strength after 7 days in N/mm ²		Compressive Strength after 14 days in N/mm ²		Compressive Strength after 28 days in N/mm ²	
	RCA	NCA	RCA	NCA	RCA	NCA
12.5 mm	4.48	6.26	6.81	9.11	7.6	9.97
16 mm	10.10	13.81	12.35	15.9	15.63	19.70
20 mm	7.56	12.89	8.6	15.340	11.91	19.25

The Graphical representation of the test results are as below:-



loss of compressive strength of concrete cubes casted from Recycled aggregates and fresh natural aggregates in percentage is represented as below:-



DISCUSSION AND CONCLUSION:-

The reduction of compressive strength of concrete made from recycled aggregates to that of

concrete made from natural fresh aggregates may be attributed to following factors:-

- The total porosity of recycled concrete is more because considerable quantities of old mortar surrounds the recycled aggregates after crushing
- The amount of weak bond areas between old/ new mortar are significantly more in recycled aggregate concrete
- The resistance to recycled aggregates to mechanical action is significantly lower than that of natural aggregates..

The early age strength is more effected which may be attributed to the change in w/c ratio in cement matrix surrounding the CA. The loss of strength in case of 16mm size recycled aggregate is minimum and hence the optimum size of recycled aggregates is 16mm. The mechanical properties of recycled aggregates are slightly lower than that of natural aggregates. The physical properties of recycled aggregates are slightly higher than that of natural aggregates. Hence Recycled concrete should be used as non-structural concrete. (lean concrete)

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