Use of Recycle Aggregate and Marble Sludge Powder as A Partial Replacement of Concrete Ingredients

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Abstract— The concrete found to be very durable when mixed with proper ingredients, adjusting water-cement ratio and proper control during mixing stage. The ingredient which constitute in the concrete is normally cement, sand and coarse aggregate in presence of water, but due to continuous demand of these material the scarcity developed in market hence the alternative material for producing the concrete is need of time. The marble sludge powder is waste and readily available which can be used as cement partial replacement. The use of recycle coarse aggregate from demolished structure as a partial replacement of coarse aggregate is an innovative approach to produce concrete without affecting its durable nature but try to enhance the strength of mix by replacing it. In this paper different percentage of recycle coarse aggregate (RCA), marble sludge powder is replaced with coarse aggregate and cement to produce concrete, the replacement percentage ranges from 20%, 30% and 40%. The results of these innovative samples is then compared with conventional concrete of grade M25.

Key words: Concrete, Coarse Aggregate, Recycle Coarse Aggregate (RCA), Marble Sludge Powder

I. INTRODUCTION

The concrete which is always in demand since from the discovery of cement. concrete is very durable and very strong material produce from the mixture of Cement, Sand and Coarse aggregate with limiting amount of water cement ratio. therefore material required for producing concrete always in demand, although these material are generally relate to naturally available sources. As the demand of concrete increases the demand ingredient is also increases. To encounter the never ending demand the cheaper alternative are being tested as a partial replacement of concrete ingredient. The old demolished structure when demolished it produce the enough recycle aggregate which can be used as partial replacement of fresh available aggregate. The cleaning of coarse aggregate is very easy from the scrape of demolished structure. Recycling offers mainly three benefits as follows:

1) Reduction in the demand of fresh natural aggregate for producing concrete.
2) Reduction of transportation and Production cost of natural aggregate.
3) Use of waste by recycling otherwise that will be used for filling trenches.

The cement is a key ingredient which binds the different material constituting in concrete. the cement can be replaced by marble sludge powder. the marble has been commonly used since from the ancient time in the building industry. the marble industry's disposal of marble powder into the environment is become major problem. the marble mainly reach in calcium oxide and can be used partial replacement of cement.

In this proposed research Recycle coarse aggregate (RCA) is used as partial replacement of coarse aggregate and marble sludge powder as a cement partial replacement. In this research work effort made to study the percentage suitability as well as mechanical behavior of concrete when its ingredient is partial replaced.

II. PROPERTIES OF CONCRETE INGREDIENT

The material used for carrying out the experimental work of project is as, Cement (Grade 53), Coarse Aggregate, Fine Aggregate, and Recycle Coarse aggregate as a partial replacement of coarse aggregate. The very fine marble sludge powder is also used as partial replacement of cement. The marble powder is tested for its fineness and found average fineness of 2.38%. The physical properties of other concrete ingredients as follows,

A. Physical Properties:

Material	Test	Result
Natural Sand	Specific gravity	2.6
	Fines modules	2.51
	Zone	II
	Bulk Density	1570 kg/m^3
Coarse Aggregate	Specific gravity	2.65
	Fineness modulus	7.238
	Max. Size Aggregate (MAS)	20
	Bulk Density	1840 kg/m^3
Recycle Coarse aggregate (RAC)	Specific gravity	2.58
	Fineness modulus	7.32
	Max. Size Aggregate (MAS)	20
	Bulk Density	1740 kg/m^3

Table 1: Physical properties of concrete ingredient

III. MIX PROPORTION

Mix design is obtained for M25 grade of concrete by using Indian standard code 10262 : 2009 guideline.

Sr. No.	Material	Quantity	Proportion
1	Cement	437.5 kg/m3	1
2	Sand	687 kg/m3	1.57
3	Coarse aggregate	1084.9 kg/m3	2.46
4	Water	175	0.4
6	Slump	75 - 100	----

Table 2: Mix proportion for M25 grade conventional concrete

IV. COMBINATION OF MATERIAL

In this experimentation, coarse aggregate is partially replaced by Recycle Coarse aggregate(RCA) and cement by marble Sludge powder. Test was started with control conventional concrete of M25 grade. Following table shows the percentage variations of cement, sand and coarse aggregate with its partial replacement.

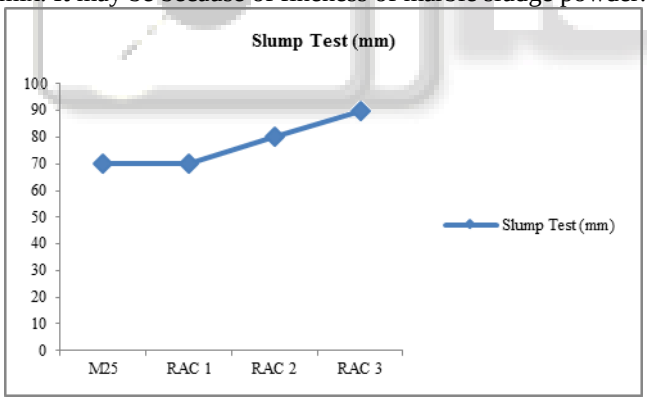
Sr. No	Nomenclature	Coarse Aggregate (%)	RCA (%)	Cement (%)	Marble Sludge powder (%)
1	Conventional (M25)	100	0	100	0
6	RCA 1	80	20	80	20
7	RCA 2	70	30	70	30
8	RCA 3	60	40	60	40

Table 3: Nomenclature of samples with different amount of replacement

V. TESTING ON CONCRETE

A. Fresh Concrete:

The workability was tested by slump cone test on conventional (M25) mix and different combination coarse aggregate with Recycle Coarse Aggregate (RCA), marble sludge powder. It found that with the addition of RAC along with Marble Sludge powder increases workability in concrete mix. It may be because of fineness of marble sludge powder.



Graph 1: Slump value of different samples.

B. Hardened Cocncrete:

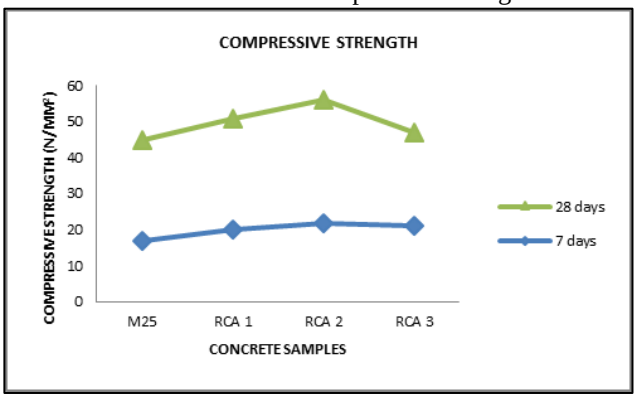
1) Compressive Strength:

The compressive strength was measured on three cubes of 150mm size at the age of 7 and 28 days. the mean value of three cubes were reported on strength. At testing age the concrete samples were removed from the curing tank i.e. on 7 and 28 days. The samples were centrally placed in a compression testing machine and tested by applying load gradually. The strength development results are shown in Figure for reference, M25 and RCA1 to RCA3 mixtures.

The early strength of sample RCA1 to RCA3 has shown the early strength improvement the 7 days strength of compressive strength is found more as compared to conventional concrete M25. The 28 days strength of sample RCA1, RAC2 is 20% more with respect to conventional concrete of M25 and RAC3 strength among all concrete samples falls drastically, but the strength decreases as the increase in the addition mainly due of marble sludge powder.

Type	7 Days	28 Days
Conventional (M25)	17	28
RAC 1	20	31
RAC 2	22	34
RAC 3	21	26

Table 4: Result of Compressive strength



Graph 2: Result comparison of Compressive strength

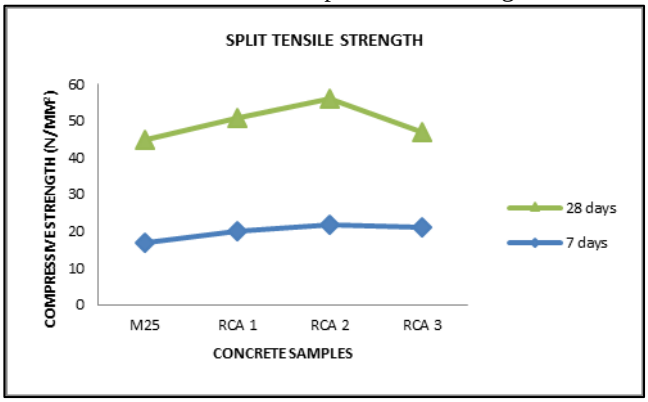
2) Split Tensile Strength:

The split tensile strength of concrete done on three cylinder having size 150×300 mm at the age 7 and 28 days and by taking mean of three cylinder it show the split tensile strength which is reported on compression testing machine. The strength development results are shown in Graph no. 3 for reference, M25 and RAC1 to RAC3 mixtures.

The early strength of sample RAC1 and RAC2 is found more than the conventional concrete of grade M25. The early strength of RAC3 is less as compared to conventional M25 concrete. The 28 days strength of sample RAC1, RAC2 and RAC3 is found more. The RAC2 gains the highest strength as compared to conventional M25 concrete which has the replacement of 30%.

Type	7 Days	28 Days
Conventional (M25)	1.55	2.44
RCA 1	1.7	2.7
RCA 2	1.85	2.8
RCA 3	1.5	2.5

Table 5: Result of Split tensile strength



Graph 3: Result comparison of Tensile strength

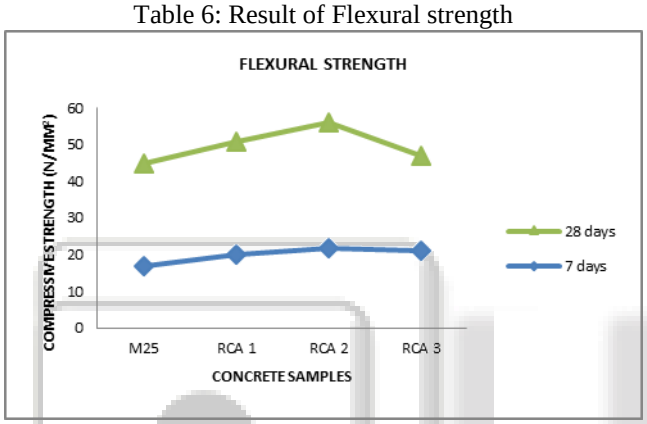
3) Flexural Strength:

The flexural strength of concrete was measured on three beam having size of 150×150×700 mm at the age 7 and 28 days and mean value was reported on strength on universal testing machine. The strength development results are shown in Graph no. 4 for reference, M25 and RC1 to RC6 mixtures

The 7 day strength of sample RAC1 and RAC2 is more as compared to conventional concrete M25, the RAC3 sample strength is less then than M25 concrete The 28 days strength of RAC1 and RAC2 sample is high but 28 days strength of RAC3 sample is less than conventional concrete M25.

Type	7 Days	28 Days
Conventional (M25)	1.42	1.92
RCA 1	1.5	2.1
RCA 2	1.58	2.4
RCA 3	1.4	1.8

Table 6: Result of Flexural strength



Graph 4: Result comparison of Flexural strength

VI. CONCLUSION

1) The workability of concrete found to be gradually increasing with the addition of RAC and Marble sludge powder as a partial replacement of concrete ingredient.
2) The 7 days early strength of every sample is improved with respect to the conventional concrete. Although the sample RAC2 shows appreciable strength gain after early days of curing.
3) The 28 days compressive strength of RAC1 and RAC2 mix is found to be 20-25% more than conventional concrete M25. The use of 30% marble sludge powder and Coarse aggregate befits the compressive strength of concrete.
4) Split tensile strength of 7 days of every concrete sample is found to be more than conventional concrete but the Sample RAC3 shows the nearly equal strength. The 28 days strength of every sample is also found to be more as compared with M25 concrete.
5) The flexural strength of 7days strength of every sample is more and Sample RAC3 shows the strength 1.4N/MM^2 where as the early days strength of M25 concrete is 1.42N/MM^2. The 28 days concrete sample RAC1 and RAC2 is found to be more than conventional concrete M25 but the strength of sample RAC3 falls as the replacement increases.

The use of marble sludge powder and Recycle coarse aggregate found really benefiting when both are used in a quantum as a partial replacement up to 30%. The strength properties of concrete found to be increase to the replacement level of 20% to 30%.

REFERENCES

[1] Indian standard code IS 2386 - 1963 for method of test for aggregate for concrete.
[2] Indian standard code IS 10262 - 2009 and IS 10262 - 1982 for concrete mix proportion.
[3] Indian standard code IS 456:2000 Revised for Plain and Reinforced Concrete -Code of practice.
[4] Indian standard code 516:1959 for Methods of tests for Strength of Concrete.
[5] Indian standard code IS 5816:1999 for Splitting Tensile strength of Concrete method of test.

