Recycling of Concrete (Recycling Coarse Aggregate)

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***Abstract*—This Research paper is a live study on the above mentioned title "Recycling of Concrete" This paper consist the introduction of recycled concrete aggregate with its uses and properties. Various test results on Recycled concrete aggregate also described. It also consist the difference between RCA and natural aggregate. The future recommendations are also discussed in addition.**

Keywords—Recycled Coarse Aggregate (RCA), Concrete Mix Design(CMD), Natural Aggregate(NA)

I. INTRODUCTION

As we know the term 'concrete" is a mixture of cement + sand + coarse aggregate with water. Concrete is widely used in both substructure and super structure as main constructional material. It is most important substance of a structure. There is 3-R system in each industry which is further explained as Reduce – Recycle – Reuse. The term Reduce is not capable in case of waste concrete because it is not possible due to its massive property. Hence we use Recycle term so we can reuse the waste. Recycled aggregates are a way of reusing materials by keeping them from being disposed into landfills [1]. Recycling of concrete is a simple process. It involves breaking, removing, and crushing existing concrete into a material with a specified size and quality.

As per study about 75 to 80% of total construction material consist coarse aggregate portion. When the structure is demolished, the waste concrete in a large quantity is produced. It is a major and major problem for environmental and economic aspect also.

II. EASE OF USE

The amount of waste concrete was about 23.75 million ton in year 2007 according to Hindu Online of March 2007. Every year millions of tones waste concrete produced which can be doubled till next seven years, which is so far as compared to other developed countries. Hence to prevent from the very harmful alarms Recycling of concrete is done and most economic construction material known as Aggregate is collected for Reuse [2].

III. OBJECT

Many engineers and senior faculties have also studied and researched also before us. In same manner we also studied and researched about the recycling of concrete [3]. We collect the material and screen the coarse aggregate and conduct various experiments on it and find final results. We find that the properties or test results differ 15% from its standard results [4]. The present study investigates the effects of using RCA as a Coarse aggregate on the mechanical properties of concrete [5]. To investigate the Laboratory tests is also main object of the study.

IV. MATERIALS AND METHODS

A. Materials

- *Cement*: Ordinary Portland cement was used because it is easily available in market. The cement was used in measuring Slump value and Compaction factor. The Specific gravity of cement was 3.2 and the fineness of cement was 4%.
- *Coarse Aggregate*: The Coarse aggregate was used as Recycled coarse aggregate (RCA). The specific gravity of the RCA was 2.30. The Fineness modulus was 3.67
- *Fine Aggregate*: Natural river sand was used as fine aggregate. The Specific gravity of Fine aggregate was 2.68.

B. Methods

- *Fineness Modulus*: This test was done with the help of various sieves. The aggregate was properly sieved by this test. The relative percentage of aggregate was determined by this test so we can say it like grain size distribution also. This test was done by sieve analysis in laboratory using Sieve shaker. The nominal size of the aggregate was determined by Fineness modulus test.
- *Specific gravity*: The specific gravity of an aggregate is a measure of quality of material. According to IS Code 2386(Part III)-1963 the strength is lower with lower specific gravity value .This test was done by using wire basket.
- *Crushing value test*: The crushing value test was carried out by compression testing machine (CTM). The total load of 40 tones was applied at the rate of 4 ton per minute. The percentage crushing value was determined by divided the passing weight from total weight of aggregate.
- *Slump Test*: The Unsupported fresh concrete, flows to the sides and a sinking in height takes place. This vertical settlement is known as slump. Slump test is carried out by using RCA with Concrete mix Design CMD method and the slump was measured by using temping rod and Steel rule.
- *Compaction Factor Test*: Workability gives an idea of the capability of being worked, i.e. idea to control the quantity of water in cements concrete mix to get uniform strength. Compaction test was done by using Compaction factor test apparatus.

V. RESULTS AND DISCUSSION

C. *Fineness Modulus Test :* The test was conducted as per describe as per procedure. The test was then further spread and determine results 5.67 as Fineness Modulus. The test results were accurate as normal aggregate. Hence we can easily use the RCA.

D. *Specific gravity Test :* The Specific Gravity test was conducted as per IS: 2386 (Part III) – 1963. The Specific gravity of coarse aggregate was determined as 2.309. It was 13% reduce from standard value 2.67 which is in the range from 2.5 to 3.0. The Specific gravity of fine aggregate was also accurate.

E. *Aggregate Crushing value test:* This test was performed as per IS: 2386 (Part IV) – 1963. The crushing value of RCA was 20%. It was also less than the upper limit according to IS Code which is 30%. Hence the RCA is used as road construction material also.

F. *Slump Test:* The Slump test was also conducted in laboratory according to IS: 1199 – 1959. This Test gives test results as 100 mm which is designed for 100 mm assumption by CMD.

G. *Compaction Factor Test:* This Test was performed as per IS: 1199 – 1959. The Test results were 0.93. It is observed that the workability of concrete increases with using RCA.

VI. FIGURES AND TABLES

TABLE 1. FINENESS MODULUS OF COARSE AGGREGATE

S.No.	Sieve Size	Mass retained	Cumulative mass retained	Percentage cumulative mass retained (C)
1	80 mm	0	0	0
2	40 mm	0	0	0
3	20 mm	3600	3600	72
4	12.5 mm	1200	4800	96
5	10 mm	150	4950	99
6	4.75 mm	50	5000	100
7	2.36 mm	0	5000	100
8	PAN	0	5000	100
				$\sum C = 567$
Fineness Modulus ($\sum C/100$)				5.67

TABLE 2. SPECIFIC GRAVITY OF COARSE AGGREGATE

Weight of sample in water with basket (W_1)	12.130 Kg
Weight of basket with water(W_2)	10.136 Kg
Weight of saturated surface dried aggregate(W_3)	2.860 Kg
Weight of oven dried aggregate (W_4)	2.000 Kg
Specific Gravity [W_4/ {(W_3–(W_1-W_2)}]	2.309

TABLE 3. SPECIFIC GRAVITY OF FINE AGGREGATE

Weight of Empty Pycnometer	466 g
Weight of Sand sample 1/3 filled with Pycnometer	966 g
Weight of sample with water full of Pycnometer	1446 g
Weight of water full of Pycnometer	1132 g
Specific Gravity[(W_2-W_1)/{(W_2-W_1)- (W_3-W_4)}]	2.68

TABLE 4. AGGREGATE CRUSHING VALUE

	Sample 1	Sample 2
Weight of aggregate sample(W_1)	2.500	2.450
Weight of aggregate passing through IS Sieve 2.36 mm.	0.500	0.450
Aggregate Crushing value (W_2/ W_1) X 100	20%	18.36 %
Mean Aggregate Crushing value	19.18 %	

TABLE 5. SLUMP VALUE

Quantity of Cement	4.43 Kg
Quantity of 20 mm Aggregate	6.17 Kg
Quantity of 10 mm Aggregate	4.12 Kg
Quantity of Fine Aggregate	8.08 Kg
Quantity of water	1.99 Kg
Slump Value	**100 mm**

TABLE 6. COMPACTION FACTOR TEST

Water cement Ratio	0.45
Initial Weight of empty Cylinder (W_1)	11.350 Kg
Mass of Partially compacted concrete with cylinder (W_2)	21.650 Kg
Mass of fully compacted concrete with cylinder (W_3)	22.450 Kg
Compaction Factor [(W_2-W_1)/(W_3-W_1)]	0.93

Fig : 1 Natural Aggregate

Fig : 2 Recycled Aggregate

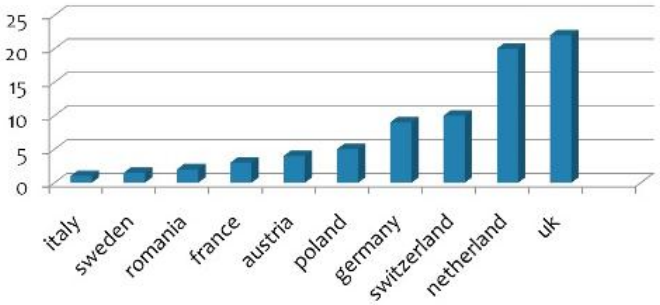

fig : 3 uses of recycled concrete aggregate

VII. COMPARASION BETWEEN RCA AND NA

As per past studies it is found that the differences in various properties are seen as following:-

Property	RCA	NA
Shape and Texture	Angular with rough surface	Angular but smooth as compared to RCA
Specific Gravity	2.1-2.4	2.4-2.9
Absorption Capacity	3.7-8.7%	0.8-3.7%
Dry density	Lower	High

VIII. CONCLUSION

It has been observed that the recycled coarse aggregate is used as normal aggregate. The workability of the concrete is increased by using RCA. Maximum properties of Recycled coarse aggregate have shown good with a little variation. Recycled aggregate materials produce harsh mixes with lower workability than Natural aggregates. New standards should be introduced for recycled aggregates so that these materials can be used successfully in future.

IX. FUTURE RECOMMENDATIONS

- As per past studies and researches it is so necessary to use the Recycled concrete aggregate for the construction work.
- Necessary infrastructure should also be available for testing the quality of recycled aggregates.
- Project developers need to be educated on on-site waste management plans.
- Concerned authorities need to plan an awareness campaign, using the electronic and online media to promote the virtues of recycled aggregates.
- The Scope of Recycled concrete Aggregate should be increased as possible as.

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