

Recycled Course Aggregate used in Concrete

Amarsingh Rathod¹ Shubham Baldawa² Udayraj Bhalerao³ Prof. Bilal Haji⁴ Dr. Ajay Dahake⁵

^{1,2,3}U.G. Student ⁴Assistant Professor ⁵H.O. D

^{1,2,3,4,5}Department of Civil Engineering

^{1,2,3,4,5}Marathwada Institute of Technology Aurangabad, 140406

Abstract— The aim for this project is to determine the strength characteristics of recycled aggregates for application in high strength structural concrete and to determine and compare the high strength concrete by using different percentage of recycled aggregates. The investigation was carried out using workability test, compressive test and tensile splitting test. There were total of four batches of concrete mixes, consists of every 30% increment of recycled aggregate replacement from 0% , 30% 100%, 10% silica fume in 100% RCA Water/cement ratio of 0.40 and 0.50. The workability of concrete considerably reduced as the amount of recycled aggregate increased. This was evaluated through standard slump test and compacting factor test. For strength characteristics, the results showed that a gradually decreasing in compressive strength, tensile Splitting strength as the percentage of recycled aggregate used in the specimens increased.

Key words: Recycle, Construction material, Coarse Aggregate, Silica fume, Demolition Structure, Slump Cone, Compressive Strength, Tensile Splitting Test

I. INTRODUCTION

The demand for construction is exceed in per year. The many structure civil work infrastructure, low & high-rise building, local & domestic development concrete a manufacture structure increase in the use of natural course aggregate to for development of the country. The as per report of Hindu in march 2007 India generates 23.75 million tons demolition waste annually. As per report of central pollution control board (CPCB) in India 48 million tons solid waste in produce out of which 14.5 million wastes is produce by from construction waste sectors. Out of total construction demolition waste 40% in concrete and production of concrete 70 -75 % aggregate required out of 60-67% CA & 33-40% FA. This situation lead stoat question about the preservation no natural aggregate sources many European countries have place d taxes on the use of natural aggregates. A possible solution to the problem to recycle demolished concrete and produces an alternative aggregate for structural concrete in this way.

They use RCA construction can be use environmental port sectional economical RCA Means’s generally produce by the crushing of concrete rubble, screening then removal of contaminant such a reinforcements ,papers ,woodland type of material use in concrete. This material available in the generally earthquake material, age of building, breakdown building, bridge, road and lot of civil work.

The RCA material are use in road construction back fill retaining wall ,low grade concrete production ,drainage and brick work ,block work and low cost housing.

II. METHODOLOGY

Materials & Process - Plain cement concrete (PCC) & reinforce cement concrete (RCC) is collected from sites (G.S.Mandal’s Marathwada institute of technology, Aurangabad) respectively. This collected material is crushed by hammer to separate the aggregates & reduce their sizes in smaller fraction. On these separated aggregates various testes are conducted in laboratory as per Indian Standard code & their results are compared with natural aggregates. Recycled aggregate reduces the impact of waste on environment. By using some percentage in construction sector, cost is saved, due to reduction of transportation & manufacturing process.

After cleaning the aggregates, batching process was started for 7 and 28 days cube and 28 days cylinder. different percentage of mixture used as 0% ,30% 100%,10% silica fume in 100% Recycle aggregate replacement of RCA For each two specimen has been tested compressive strength tensile splitting strength the proportion used for cube and cylinder is given table below the test on specimen as per grade M15, M20 & M25 by using O.P.C. Grade 53

	Mix 1 (%)	Mix 2 (%)	Mix 3 (%)	Mix 4 (%)
NCA	100	70	-----	-----
RCA	-----	30	100	100+10 silica fume

Table 1: Percentage of aggregate used in all four batches of mixes.

Placing, Compaction and Casting of Concrete Specimens---Before the placing of concrete, the concrete mould must be oiled for the ease of concrete specimens stripping. The oil used is a mixture of diesel and kerosene. Special care was taken during the oiling of the moulds, so that there no concrete stains and left on the moulds. Once the workability test of recycled aggregate concrete was done, the fresh concrete must placed into the concrete moulds for hardened properties tests. Every batch of recycled aggregate concrete required 2 moulds. The dimensions of moulds were 150mm ×150mm×150mm. and cylinder dimension 150mm×300mm. During the placing of fresh concrete & recycle aggregate concrete into the moulds, compaction was done using a Steel rod. The poking of the rod of concrete allows destruction of air voids of the fresh concrete & recycle aggregate concrete to release any entrained air voids contained in the fresh concrete.

The leveling of concrete was done on the surface of the concrete. Leveling is the initial operation carried out after the concrete has been placed and compacted. After the leveling of the fresh concrete & recycle aggregate concrete specimen was done, the concrete in the mould was left overnight to allow them to set



Fig. 1: Mixing Concrete



Fig. 2: Mould Dimensions:

150mmx150mmx150mm

All concrete specimens were placed into a pool of water further for 7&28 days for the hardened properties test of recycled aggregate concrete. Curing is an important process to prevent the concrete specimens from losing of moisture while it is gaining its required strength.

III. TESTS & RESULT ON RECYCLED AGGREGATE

A. Properties Of Recycled Concrete Aggregate:

1) Specific Gravity

The specific gravity in saturated surface dry condition of recycled concrete aggregate was found from 2.43 which are less but satisfying the results.

2) Water Absorption:

The RCA from demolished concrete consist of crushed stone aggregate with old mortar adhering to it, the water absorption ranges from 5%, which is relatively higher than that of the natural aggregates. The water absorption results.

3) Crushing and Impact Values:

As per IS 2386 part (IV), the crushing and impact values for concrete wearing surfaces should not exceed 30% & for other than wearing surfaces 45% respectively. The crushing & impact values of recycled aggregate satisfy the BIS specifications limit. From crushing & impact test it is found that use of recycled aggregate is possible for application other than wearing surfaces.

SR. No.	PARTICULARS	VALUES	
		NCA	RCA
1	Specific gravity	2.4-3.0	2.43
2	Water absorption	0.29%-0.3%	5%
3	Bulk density	1678.2 KN/m ³	1469.8KN/m ³
4	Crushing values	18.4%	31.65%
5	Impact values	17.65%	34.21%

Table 2: Crushing and Impact Values

B. Slump Test:

Slump test is used to determine the workability of fresh concrete. The test is simple and cheap. It is suitable to use in the laboratory and also at site. Although the test is simple, but the testing has to be done carefully due to a huge slump may obtain if there is any disturbance in the process. . slump test will not indicate well for the concrete, concrete with very high workability and also very low workability. This is because a very high workability concrete will lose the shape by flowing and collapse, where a very low workability will not collapse. Table below shows the average slump recorded during the test

Percentage of recycled aggregate (%)	Water cement ratio %	Slump (mm)
0% recycled aggregate	0.43	90
30% recycled aggregate	0.43	95
100% recycled aggregate	0.43	110
100% recycled aggregate	0.50	85
100% recycled aggregate with 10% silica fume cement	0.50	90

Table 3: The slump result for each batch of mix concrete

C. Compressive Test On Cubes:

The average compressive strengths of cubes cast are determined as per IS 516 using RCA and natural aggregate at the age 7& 28days and reported in Table As expected, the compressive strength of RCA is slightly lower than the conventional concrete made from similar mix proportions. The reduction in strength of RCA as compare to NAC is in order of 6-12% and 8-14%for M-15, M-20 & M-25 concretes respectively.

Mix Grade	Day	100% NCA	NCA 70% +RCA 30%	RCA 100%	RCA 100% + Silica fume 10%
M15	7	25.80	20	18.66	19.55
	28	30.40	22.74	20.74	22.54
M20	7	31.70	24	22.66	23.11
	28	38.40	28.74	25.84	28.74
M25	7	30.10	27.44	24.44	25.66
	28	40.60	30.54	28.11	30.74

Table 4: Variation of compressive strength (N/mm)

D. Tensile Splitting Test:

The tensile splitting test was just carried out after 28days of casting. It is because once the concrete specimens reach day 28, the increased rate of concrete stress was uniform and there is not much stress increased after 28days. The testing

specimen was 150mm diameter and 300mm length. Two specimens were used in the testing for every batch. The indirect tensile test was carried out in the

[10] ‘Aggregate Recycling In Concrete “Google, Encyclopedia

Grade	Day	100 % NCA	70% NCA + 30% RCA	100% RCA	Silica fume 10% + RCA 100%
M 20	28	3.20	2.95	2.55	2.00
M 25	28	3.80	3.2	2.60	2.33

Table 5: Tensile Splitting Test

IV. CONCLUSION

- 1) The experimental results show the recycled aggregate will influence much in fresh and hardened properties of a concrete. As the percentage of the recycled aggregate increased, the workability and strength of the concrete will decrease.
- 2) The comparing the different type of 100% recycled aggregate specimens, it was found that silica fume cement recycled aggregate concrete mix batch were not sufficient to achieve the high strength target.
- 3) Use of recycled aggregate up to 30% does not affect the functional requirements of the structure as per the findings of the test results.
- 4) Various tests conducted on recycled aggregates and results compared with natural aggregates are satisfactory as per IS 2386.
- 5) Additional of 10% silica fume was observed to be optimum resulting in an increase of 7% in compressive strength when compare to sample 100%RCA with no silica fume .
- 6) The water cement ratio from 0.43 NAC and from 0.43 to 0.5 for RCA the result show that is it required to increase water by 7 to 9 % to achieve the same level of workability when using RCA
- 7) Due to use of recycled aggregate in construction, energy & cost of transportation of natural resources & excavation is significantly saved. This in turn directly reduces the impact of waste material on environment.

REFERENCES

- [1] Sudhir P.Patil, Ganesh S. Ingle , Prashant D.Sathe “ Recycled coarse aggregates” MIT Pune india 2013. PP 27-33
- [2] Mr. Tushar R. Sonawane , Prof. Dr. Sunil S. Pimplikar “ Use Of Recycle Aggregate Concrete” H.O.D. Civil Engg. Depatment M.I.T. Pune. PP 52-59
- [3] Ashraf M. Wagih, Hossam Z. El-Karmoty , Magda Ebid , Sameer H. Okba “Recycle Construction And Demolition Concrete waste As Aggregate for Structural Concrete” (2012) PP 194-200
- [4] P Huoth, T.G.suntharavadivel, K Duan “ Effect Of Silica Fume On Recycle Aggregate concrete “ Central Queensland University (2014) PP 249-254
- [5] IS 2386 (Part-I, II, and III)-1963 ‘Method of Tests for Aggregates for Concrete’
- [6] IS 9103(1999): Specifications for concrete admixtures.
- [7] Concrete mix proportioning guidelines IS 10262:2009.
- [8] Concrete mix design by M.S. Shetty.
- [9] Concrete technology by M.S. Shetty.