

COMPARATIVE ANALYSIS OF RECYCLED AND NATURAL AGGREGATES UNDER DIFFERENT TEST

Sourabh Chaturvedi¹, Sooraj jain²

¹PG Student, Department of Civil Engineering, Samrat Ashok Technological Institute, Vidisha (M.P.) 464001, India

² Assistant Professor, Department of Civil Engineering, Samrat Ashok Technological Institute, Vidisha (M.P.) 464001, India.

Abstract - The recycled aggregate is crushed, the inorganic particle processed from the destroyed building is classified. Its waste material is crushed in a crushing machine and separated from the IS sieve altogether. The main objective of this study is to discover the engineering properties and application of recycled aggregate and natural aggregates.

Recycled coarse aggregates are also known as artificial aggregates which is obtained from destroyed buildings. The destroyed construction material is commonly used as landfill material in India.

We find the mechanical properties of recycled aggregates such as specific gravity tests, water absorption, gradation, practicality, compressive strength, tensile and flexural strength tests. We also tested compressive strength, flexural strength, and split tensile strength at different mixing ratios of natural aggregates and recycled coarse aggregates such as 90:10, 80:20, 70:30, 60:40 and 50:50. We came to the conclusion that 90:10 gave the best result on an average of 3 samples of each ratio.

Keyword: Recycled aggregate, Natural aggregate, sand, cement, compressive strength.

1. INTRODUCTION

Demolition is the process that works by hand. Normally in India construction material is destroyed which is completely useless material used to fill landfill. The demolished building material is continuously growing and it reaches half of the national total waste, so these demolished building materials are necessary to prevent its reuse increasing landfill.

The landfill site is far from the site of the demolished site and they are also very difficult to find and it is expensive due to their transportation costs for regular construction at any site, there is a constant supply of recycled concrete aggregates. Recycling of demolition waste materials in new buildings can answer these problems. Grinding reinforced concrete buildings will reduce the amount of landfill by about 80%. Recycled waste can be used in many ways, such as for soil stabilization, land filling, the bottom layer of the pavement surface, etc. and can also be sold to

people. Therefore, reducing the environmental burden for fresh natural aggregate production for construction.

Reuse is the human activity of the material process used in creating new objects. The use of natural aggregates in the sub-base is too much to cut the supply of natural aggregates; the natural aggregates have to be replaced with recycled aggregates. This will reduce the cost of construction and also reduce waste.

1.1 Research Aim

The objective of this study is to explore the strength characteristic of recycled aggregate concrete, which will lead to a complete apprehension of the characteristics of concrete with recycled aggregates, which may be an alternative material for normal coarse aggregates in structural concrete.

2. Material and Method

2.1 Cement

According to IS 1489: (Part - 1) 1991 Portland Pozzolana Cement (PPC) has been used, PPC concrete is thicker and more impermeable than OPC. The long-term strength of PPC is higher than that of OPC.

2.2 Water

Water used in concrete conforms to IS 456: 2000. When we use water in concrete, it should be free from harmful amounts of oil, acids, alkalis, salts and other organic materials. Which can be harmful to concrete.

2.3 Recycle Aggregate

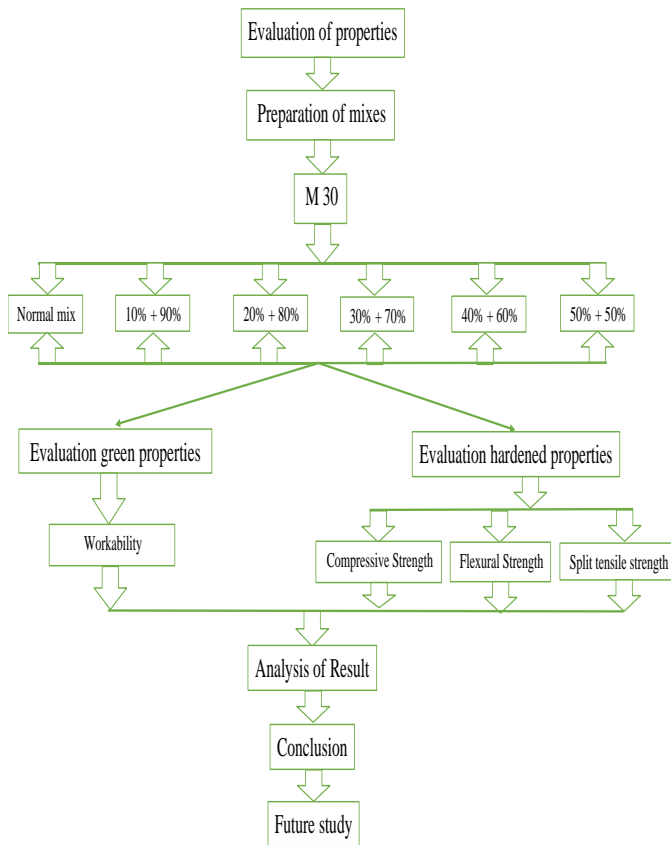
The recycle aggregate is a waste material, which is collected from the demolished concrete structure. The recycled aggregate for this project is assembled from a demolished concrete building which is located in Bhopal. These total aggregates are used after passing through IS 20 mm sieve.

2.4 Natural Aggregate

Natural aggregate used in concrete conforms to IS 383. Natural aggregates are collected from the crusher plant

where hard rock is crushed into various shapes which we collect from IS 20 mm sieve.

2.5 Methodology chart



3. Experimental program

We will discuss laboratory work. Which needs to be executed to obtain data and information related to the study. Experiments are conducted that need to be performed on physical properties. Here some tests have been done on them to see the property and behavior of the material which will help in the mix design of concrete. All tests conducted on sand, cement and aggregates are presented below:

3.1 Test on Aggregates

1. Specific Gravity and Water Absorption test
2. Sieve analysis test
3. Aggregate Crushing value test
4. Aggregate Impact Value test
5. Los Angeles abrasion test

3.2 Test on Fine Aggregate (Sand)

1. Gradation Of sand

2. Specific gravity and Water absorption test

Table 3.1: - Mix Proportion M 30 Grade concrete

Water (Kg/M ₃)	Cement (Kg/M ₃)	Fine aggregate (Kg/M ₃)	Coarse Aggregate (Kg/M ₃)
152	380	684.01	1243.56
0.40	1	1.80	3.27

4. Result and Discussion

This chapter discuss on a material test result and strength of concrete result. Number of tests conducted on material, green and harden properties to find the workability & harden properties of recycled concrete in concrete.

4.1 Test on Aggregate

4.1.1 Sieve Analysis test (IS 2386(Part I) - 1963)

Sieve Analysis of Natural Aggregate 20mm

Total Weight: 5000 g

Table 4.1: - Sieve Analysis for Natural Aggregate

IS Sieve	Weight (g)	Cumulative Retained Weight (g)	Cumulative Retained %	Cumulative % passing
40	0	0	0	100
20	94	94	1.88	98.12
10	4889.5	4987.5	99.75	0.25
4.75	2.50	4990.0	99.80	0.20

Sieve Analysis of Natural Aggregate 10mm

Total Weight: 5000 g

Table 4.2: - Sieve Analysis for Natural Aggregate

IS Sieve	Weight (g)	Cumulative Retained Weight (g)	Cumulative Retained %	Cumulative % passing
12.5	0	0	0	100
10	673	63	13.46	86.54
4.75	4291	4964	99.28	0.72
2.36	9.50	493.50	99.47	0.53

Sieve Analysis of Recycled Aggregate 20mm

Total Weight: 5000 g

Table 4.3: - Sieve analysis for Recycled Aggregate

IS Sieve	Weight (g)	Cumulative Retained Weight (g)	Cumulative Retained %	Cumulative % passing
40	0	0	0	100
20	90	90	1.8	98.2
10	4892.5	4982.5	99.65	0.35
4.75	3.50	4986	99.72	0.28

Sieve Analysis of Recycled Aggregate 10mm

Total Weight: 5000 g

Table 4.4: - Sieve analysis for Recycled Aggregate

IS Sieve	Weight (g)	Cumulative Retained Weight (g)	Cumulative Retained %	Cumulative % passing
12.5	0	0	0	100
10	665	665	13.3	86.7
4.75	4298	4963	99.26	0.74
2.36	10.5	4973.5	99.47	0.53

4.1.2 Important properties of Aggregates are below:

Table 4.4: - Test result of Aggregates

Test Name	Natural Aggregate	Recycled Aggregate	Reference
Specific Gravity	2.70	3.35	IS 2386(Part III) - 1963
Water Absorption	0.962	2.16	IS 2386(Part III) - 1963
Aggregate Crushing value	14.67	18.15	IS 2386 (Part IV) - 1963
Aggregate Impact Value	11.37	14.8	IS 2386 (Part IV) - 1963
Los Angeles abrasion	15.45	19.44	IS 2386 (Part IV) - 1963

4.2 Test on Sand

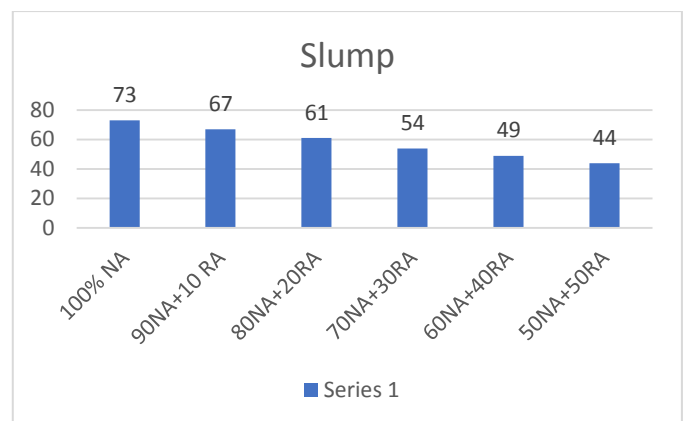
Specific gravity and water absorption test (IS 2386(Part I) - 1963)

Table 4.5: - Specific gravity and water absorption test

S. No.	Determination No.	Test I	Test II
1.	Wt. of SSD sample, W1	528.5	592
2.	Pycnometer + water + sample, W2	1900.71	1939.52
3.	Pycnometer + water, W3	1573	1573
4.	Wt. of oven dry sample in air, W4	520.64	583.31
5.	Bulk specific gravity $SDD = \frac{W4}{(W2-W3)}$	2.593	2.587
6.	Apparent specific gravity $= \frac{W4}{W4-(W2-W3)}$	2.699	2.691
7.	Water absorption $= \frac{100x(W1-W4)}{W4}$	1.51	1.49
Average	Water absorption	1.50	
Average	Specific gravity	2.590	

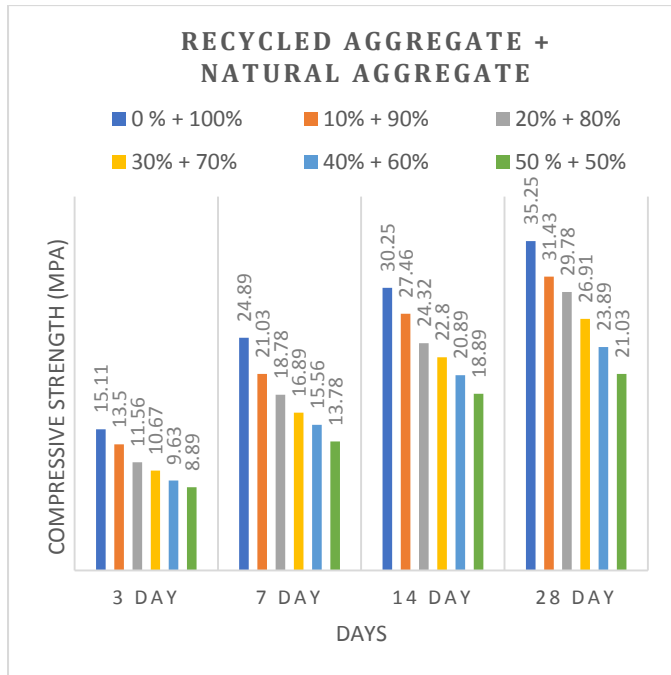
4.3 Slump cone test

We have seen the slump value, the highest slump in 73 mm and the lowest slump value in 44 mm. The results indicated that if the concrete has a high percentage of recycled aggregate mixture, the work capacity and hardness decrease. While a low percentage of recycled aggregates are used in the symposium, the workability and hardness increase.



Graph 4.1: - Slump cone test value

4.4 Compressive strength test result according to percentage of recycled aggregate

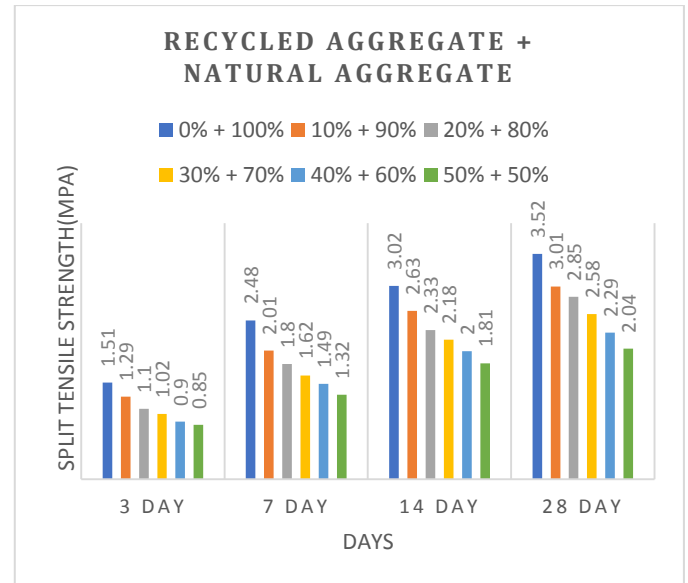


Graph 4.2: - Compressive strength of concrete



Figure 4.1: - Compressive Strength test and Breaking Cube

4.5 Split tensile strength test result according to percentage of recycled aggregate

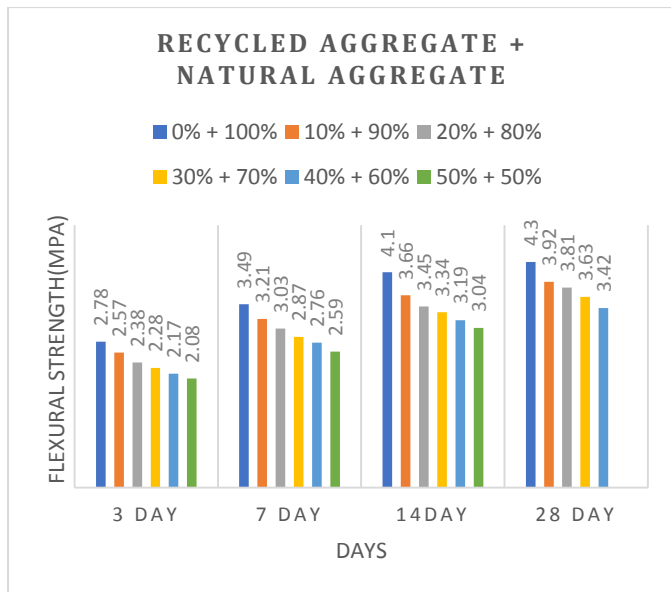


Graph 4.3: - Split tensile strength of concrete



Figure4.2: - Split Tensile strength

4.6 Flexural Strength test result according to percentage of recycled aggregate



Graph 4.4: - Flexural strength of concrete



Figure 4.3: - Flexural Strength test

5. CONCLUSIONS

This study was intended to compare a strength with respect of different percentage of recycle aggregate in M30 grade of concrete. The test result suggests that the percentage of natural aggregate by replacing of recycled aggregate when percentage of recycle aggregate is increase so compressive strength to low. It's up to 10 % of recycle aggregate use in concrete mix it's achieves in near to target strength.

Hence recycled aggregate may be alternative of the natural aggregate up to 50%. The workability of concrete is want to high so quantity of recycle aggregate is decrease.

When recycled aggregate use in concrete mix, water content in concrete has to be a carefully supervised. Water absorption capacity of recycled aggregate is high compare to natural aggregate. Analysis of the result of the effect of using recycle aggregate in different percentage to show the following conclusion-

In this study is has been found that the compressive strength of concrete in mix of 90:10(natural aggregate: recycle aggregate) in become a near of target strength. The split tensile and flexural strength of concrete is also touch to near target strength. The mix of 10 % of recycle aggregate in concrete mix of compressive strength is 31.43 Mpa, split tensile is 3.01 Mpa and flexural strength is 3.92Mpa is achieved.

5.1 Future Recommendation

1. In the present study concrete mix were made by replacement of natural coarse aggregate by recycled coarse aggregate with 10 %. We suggest to the researcher do the same work with increase in 5 % to gives the better result & accuracy.
2. When decreasing a water cement ratio, recycled coarse aggregate may be achieved a higher strength. Hence to achieve the more compressive strength of a concrete by reducing the water cement ratio so reducing the water content from the concrete by use of super plasticizer or admixture.
3. After finding the properties of waste coarse aggregate in the laboratory, we suggest that use the waste coarse aggregate as a concrete wall & paving block.

REFERENCES

1. Aasif Baig, Rakhi M. Shelke and Veena Ganvir (2017), "Engineering Performance of Recycled Aggregate Concrete Made from Crushed Concrete, International Journal of Recent Advances in Engineering & Technology (IJRAET), Volume-5, Issue -7-8, 2017, p.p.20-25.
2. Anil Kumar and Sumesh Jain (2015), "Use of Recycle Aggregate as Coarse Aggregate In Fresh Concrete," International Journal of Technical Research (IJTR), Vol. 4, Issue 2, Jul-Aug 2015, p.p.75-76.
3. Bilal S. Hamad, Ali H. Dawi, Anas Daou, Ghassan R. Chehab(2018), "Studies of the effect of recycled aggregates on flexural, shear, and bond splitting beam structural behaviour" Case Studies in Construction Materials, Elsevier Ltd, p.p.1-17.
4. Chaitradip Sarkar, Parikshit Chauhan, Naved Khan, Abu Sufiyan Khan, Mohammad Aquib (2018), " Comparative

- Study of Natural and Recycled Aggregate Concrete” International organization of Scientific Research Journal of Engineering (IOSRJEN), Vol. 08, Issue 6 (June. 2018), V (III), PP 66-70.
5. IS: 2386 (Part-1,3&4), 1963: “Methods of test for aggregate for Concrete” determination of specific gravity, density, voids, water absorption and Mechanical properties.
 6. IS: 383, 1970, (Reaffirmed 2005): “Specification for coarse and fine aggregate from natural sources for concrete”
 7. IS: 456, 2000: “Plain and Reinforced Concrete – Code of practice”
 8. IS: 516, 2000: “Methods of tests for strength of concrete”
 9. IS:10262, 2009: “Guidelines for Concrete Mix Design Proportioning [CED 2: Cement and Concrete]”
 10. Manjunath M and Prakash K B (2015), “Correlation between flexural strength of natural aggregate concrete and recycled aggregate concrete,” International Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 06, Sep-2015, p.p.947-951.
 11. Marta Kosior-Kazberuk and Mateusz Grzywa (2014), “Recycled Aggregate Concrete as Material for Reinforced Concrete Structures,” Journal of Sustainable Architecture and Civil Engineering, ISSN 2029-9990, 2014. No. 2(7).
 12. Mirjana Malešev, Vlastimir Radonjanin and Snežana Marinković, “Recycled Concrete as Aggregate for Structural Concrete Production,” open access (2010)
 13. Naga Sai, P.P.V. Kishore (2018), “An Experimental Study on Strength Properties of Concrete using Recycled Aggregate as Replacement in Coarse Aggregate” International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 6 Issue II, February 2018, p.p.665-676.
 14. Peng WANG, Xiang-Gang ZHANG, Fang WANG, Ming-Rong DENG1, Wen-Bo QIN and Qi TIAN (2016), “Test Study on Cube Compressive Strength of Recycled Lightweight Aggregate Concrete” 2nd Annual International Conference on Advanced Material Engineering (AME 2016)
 15. Sherif Yehia and Akmal Abdelfatah (2016), “Examining the Variability of Recycled Concrete Aggregate Properties” International Conference on Civil, Architecture and Sustainable Development (CASD-2016) Dec. 1-2, 2016 London (UK).
 16. Shetty, M. S., 2008, Concrete Technology, S. Chand & Company LTD.