# Study and Experimentation on Recycling of Dismantled Concrete

**Linganna**
Department of Civil Engineering, Sree Dattha Institute of Engineering and Science, Hyderabad, Telangana, India

***ABSTRACT***

Concrete is a combination of Cement, Natural sand, and Aggregates. Cement is a binding property and a mixture of several chemical compounds. Aggregates are granites which are indigenous rocks which are excessively available. Natural sand is river sand which is declining day by day and its utilization is increasing day by day. Because of this reason it is especially important to find an alternative for this problem. Dismantled RCC structure produce heavy concrete waste is a waste. This is abundantly available and usually dumped in the earth's crust, due to which fertility of the soil decrease and land becomes useless, to avoid this kind of problems concrete waste can be reused in the concrete and can be used in construction. Concrete waste can be partially replaced as coarse aggregate in construction. Based upon the requirement we can change the % of CA replaced by RCA so that the construction becomes economical, we can also use 100% RCA as CA for concrete walls used as partisan walls as there will be no loads on the structure.

**Keywords:** Concrete, natural sand, recycling.

## 1. INTRODUCTION

Urbanization growth rate in India is extremely high due to industrialization. Growth rate of India is reaching 9% of GDP. Rapid infrastructure development requires a large quantity of construction materials, land requirements and the site. For large construction, concrete is preferred as it has longer life, low maintenance cost and better performance. For achieving GDP rate, smaller structures are demolished,and new towers are constructed. Protection of environment is a basic factor which is directly connected with the survival of humans. Parameters like environmental consciousness, protection of natural resources, sustainable development, play an important role in modern requirements of construction works. Due to modernization, demolished materials are dumped on land and not used for any purpose. Such situations affect the fertility of land. As per report of Hindu online of March 2007, India generates 23.75 million tons demolition waste annually. As per report of central pollution control board (CPCB) Delhi, in India, 48million tons solid waste is produced out of which 14.5-million-ton waste is produced from the construction waste sector, out of which only 3% waste is used for embankment. Out of the total construction demolition waste, 40% is of concrete, 30% ceramics, 5% plastics, 10% wood, 5%metal, and 10% other mixtures. As reported by global insight, growth in global construction sector predicts an increase in construction spending of 4800 billion US dollars in 2013. These figures indicate a tremendous growth in the construction sector, almost 1.5 times in 5 Years. For production of concrete, 70-75% aggregates are required. Out of this 60-67% is of coarse aggregate and 33-40% is of fine aggregate. As per recent research by the Fredonia group, it is forecast that the global demand for construction aggregates may exceed 26 billion tons by 2012.

### 1.1. Objectives

The experiment was carried out to overcome the problems created due to huge requirement of the raw material for manufacturing of conventional building material and also to minimize hazards caused by industrial waste on the environment, some other objectives are:

- To use the demolished and construction waste aggregate in the new concrete as the recycled concrete aggregate reduces the environmental pollution as well as providing an economic value for the waste material.
- To study the utilization of demolished and construction waste as a replacement of natural coarse aggregate.
- To study the physical properties of demolished and construction waste aggregate by conducting experimental work.
- To development of alternate low cost and environment suitable building materials from industrial wastes in an economical way.
- Importance must be given to cheap and locally available building materials and hence it is necessary to check and utilize the suitable waste products to replace some of the coarse aggregate.

## 2. DISMANTLING OF THE MATERIAL

The concrete from the dismantled buildings are taken and by using hammer we break the concrete blocks into 20mm size aggregates as we do this manually we get irregular shapes and hence after preparing of the recycled aggregate we need to sieve the material through IS 20mm sieve and hence we get the required size of the aggregate.The following figures show the preparation of the recycled aggregate from the dismantled building material

Figure 1: Concrete waste

Figure 2: Recycled Coarse Aggregate

### 2.1. Project Outline

The methodology we follow for recycling of concrete are as follows:

- Select a grade of concrete for which a conventional mix is to be done.
- Now, materials required for preparation for conventional concrete must be brought and material testing must be done in the laboratory before mix is prepared.

- All the physical tests on the aggregates must be done acc to

  IS:2386 (PART I) - Particle size and shape.

  IS:2386 (PART III) – Specific gravity, Density, Voids, Absorption and Bulking.

- Also find the properties of the cement which is used in the mix.
- Now, using IS 10262:2009 design the suitable mix for required grade of a conventional concrete by considering the physical properties of the material.
- Using the above mix design prepare the mix and workability test has been done and 6 cubes are casted to find the 3Days, 7 days and 28 days strength of the concrete.
- Now, phase I of the project is completed next phase is preparing the concrete by utilizing demolished concrete as a part of coarse aggregate.
- Demolished concrete is collected from the site seeing that it does not contain any chemicals.
- Now, using hammer make break the concrete waste into suitable size.
- Physical properties of this demolished concrete is been found and accordingly we adjust the water content for the new mix design and we find strength of the concrete by preparing the cubes of different proportions of coarse aggregate and demolished concrete.
- Now, the cubes are tested for compressive strength and compare for best combination of RCA and CA.

## 3. TEST RESULTS

Table 1: Physical Properties

| | Natural Aggregates | Recycled aggregates | Fine aggregates | cement |
|---|---|---|---|---|
| Specific gravity | **2.68** | **2.22** | **2.52** | **3.2** |
| water absorption | **0.28%** | **0.35%** | - | - |
| Bulk density | **1680kg/m$^3$** | **1430kg/m$^3$** | **1487.4kg/m$^3$** | - |
| Fineness | - | - | - | **92.7%** |
| Initial setting time | - | - | - | **29min** |

Table 2: Compressive Strength

| Type of concrete | 7 days | 14 days | 21 days |
|---|---|---|---|
| CA | **18.82** | **22.4** | **27.9** |
| RCA | **17.84** | **19.04** | **25.77** |
| 50%RCA+50%CA | **16.29** | **20.01** | **24.06** |
| 25%RCA+75%CA | **18.14** | **19.54** | - |
| 75%RCA+25%CA | **14.05** | **15.6** | - |

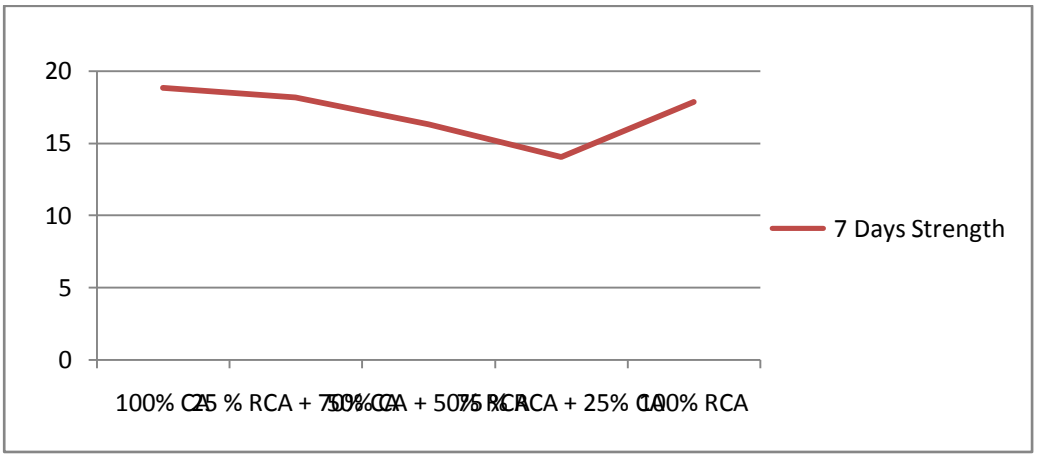


Figure 3: 7 Days strength of different proportions of concrete.

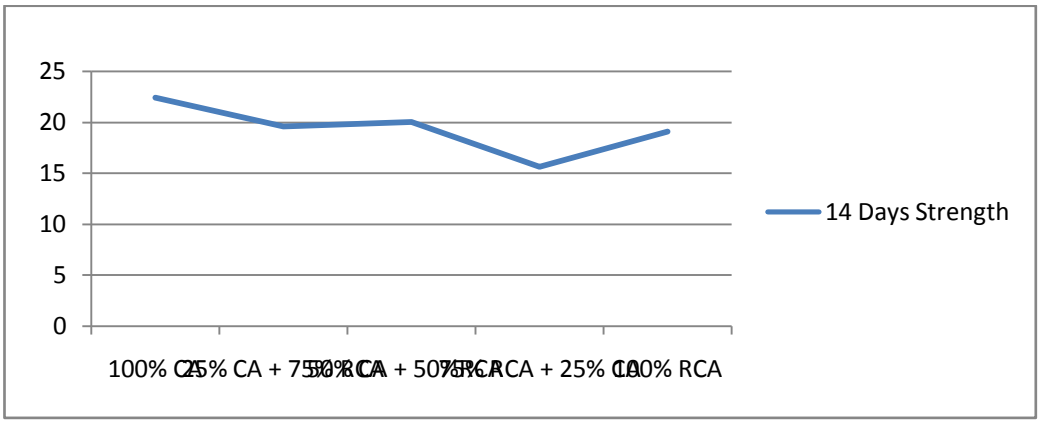


Figure 4: 14 Days strength of different proportions of concrete

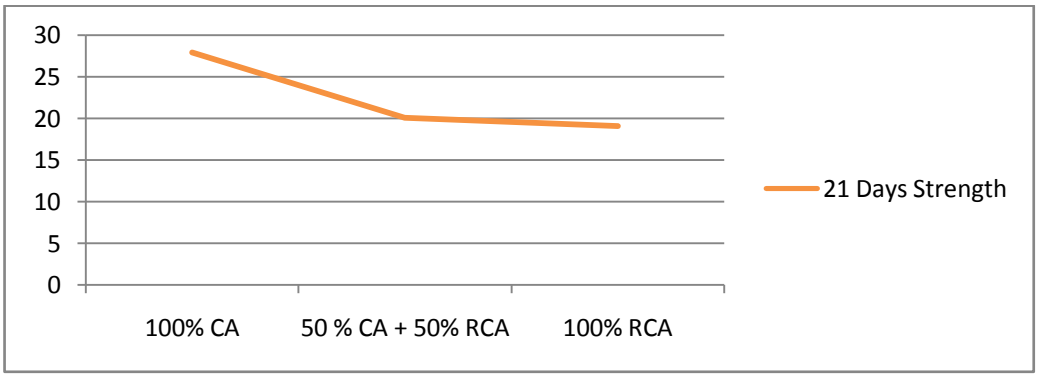


Figure 5: 21 Days strength of different proportions of concrete

Table 3: Tensile Strengths

| | CA | 50% CA + 50% RCA | RCA |
|---|---|---|---|
| 28 days strength | **3.4** | **3.52** | **3.02** |

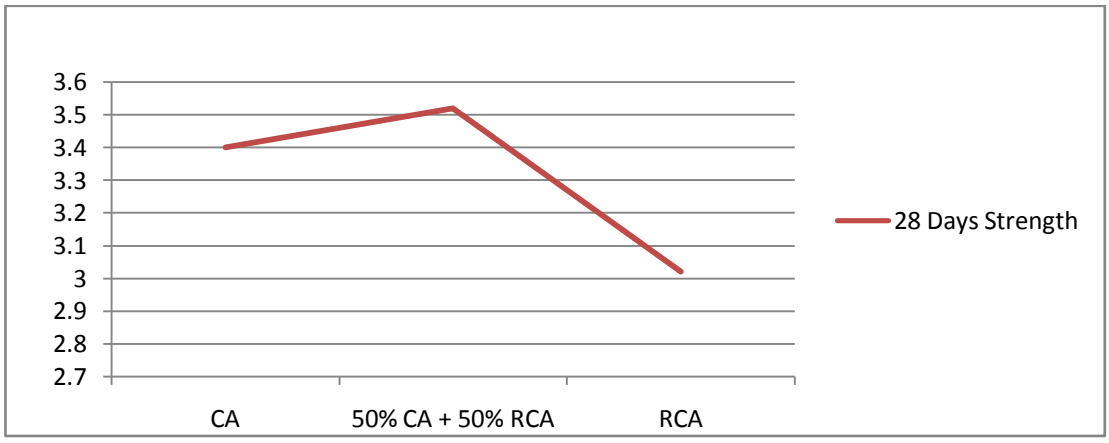


Figure 6: 21 Days tensile strength of different proportions of concrete

## 4. CONCLUSION

Demolished aggregate is collected from site and then this aggregate is broken into 20mm size coarse aggregate and then different parameters must be evaluated such as specific gravity, sieve analysis for natural sand as. Other parameters like water absorption test, fineness of cement is evaluated for aggregates and cement. These all parameters are required to obtain mix design of concrete moulds. When mix design is evaluated as per IS code, concrete moulds are prepared and compressive strength of them is known for every 3, 7, and 21days, tensile strength is found for 21 days.With every 100%, 75%, 50%, and 25% replacement of RCA with CA, compressive strength must be evolved, and comparative studies must be made between conventional concrete and partially replaced concrete.

- Various tests conducted on RCA are compared with Indian code and the results are satisfactory and hence these can be used as aggregates.
- Due to use of RCA in construction energy, cost of transportation are saved.
- Up to 50% replacing of RCA we get satisfactory strength
- Production cost decreases remarkably.
- Due to lack of treatment of RCA adequate strength is not archived but by applying some treatment processes we can further improve the strength of the RCA.
- Tensile test shows concrete has good tensile strength when replaced 50%.
- Water absorption of RCA is high when compared with conventional aggregate.

Further we can still investigate whether the increase in the strength of concrete is decreasing or increasing because as we are using RCA due to presents of some chemical impurities there may be a chance of decrease in the strength suddenly so by further investigation we can find the faults and hence we can find out some treatment for that in the initial stage and hence this type of mix can be feasible in the future.

## REFERENCES

[1] Akmal S. Abdelfatah and Sami W. Tabsh "Review of Research on and Implementation of Recycled Concrete Aggregate in the GCC" Advances in Civil Engineering Volume 2011 (2011), Article ID 567924.

[2] Brett Tempest; Tara Cavalline; Janos Gergely; David Weggel "Construction and Demolition Waste used as Recycled Aggregates in Concrete: Solutions for Increasing the Marketability of Recycled Aggregate Concrete" 2010 Concrete Sustainability Conference, © National Ready Mixed Concrete Association.

[3] F. A. Mirza and M. A. Saif, "Mechanical properties of recycled aggregate concrete incorporating silica fume," in Proceedings of the 2nd International Conference on Sustainable Construction Materials and Technologies, Coventry University and The University of Wisconsin Milwaukee Centre for By-products Utilization, Ancona, Italy, June 2010.

[4] MirjanaMalešev, VlastimirRadonjanin and SnežanaMarinković "Recycled Concrete as Aggregate for Structural Concrete Production"www.mdpi.com/journal/sustainability30 April 2010.
[5] Parekh D. N. and Dr. Modhera C. D. "Assessment of Recycled Aggregate Concrete" publish by JERS/Vol.II/ Issue I/January-March 2011.
[6] S R Yadav, S R Pathak, "Use Of Recycled Concrete Aggregate In Making Concrete- An Overview" 34th Conference on OUR WORLD IN CONCRETE & STRUCTURES: 16 – 18 August 2009, Singapore.
[7] Y P Gupta "USE Of Recycled Aggregate In Concrete Construction:A Need For Sustainable Environment" 34th Conference on OUR WORLD IN CONCRETE & STRUCTURES: 16 – 18 August 2009, Singapore.
[8] Best Practice Guide for the use of "Recycled Aggregates in New Concrete" published by the Cement & Concrete Association of New Zealand (CCANZ) in October 2011.
[9] The Institution Recycling Network Mark Lennon "Recycling Construction And Demolition Wastes" A Guide for Architects and Contractors April 2005.
[10] Working Sub-Group on construction and demolition waste 16th April, 2009