

# EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF RECYCLED AGGREGATE IN MULTISTOREY BUILDING

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## ABSTRACT

*Recycled aggregate concrete is one of the developing technology in the constructions. Though the growth and need of the building is increased the need for resources are also in demand. Hence in order to avoid the demand and to reduce the wastage of materials, recycled aggregate concrete is introduced. In the comparison of recycled aggregate concrete to conventional concrete the RAC (recycled aggregate concrete) gives effective result in workability. The 28 days result of compressive test of recycled concrete aggregate is comparatively satisfactory with conventional concrete. In the case of the partial replacement of the RAC (recycled aggregate concrete) the compressive strength of the concrete is tested for 7, 14, 28 days and the result obtained is the lower than conventional concrete but depending upon the partial replacement the strength of recycled aggregate will give the expected result. The partial replacement is done from 5% to 30%, above 35% the strength of recycled aggregate decreases.*

**Keywords:** *Recycled aggregate concrete, Recycled aggregate, demolished waste, Compressive strength,*

## I. INTRODUCTION

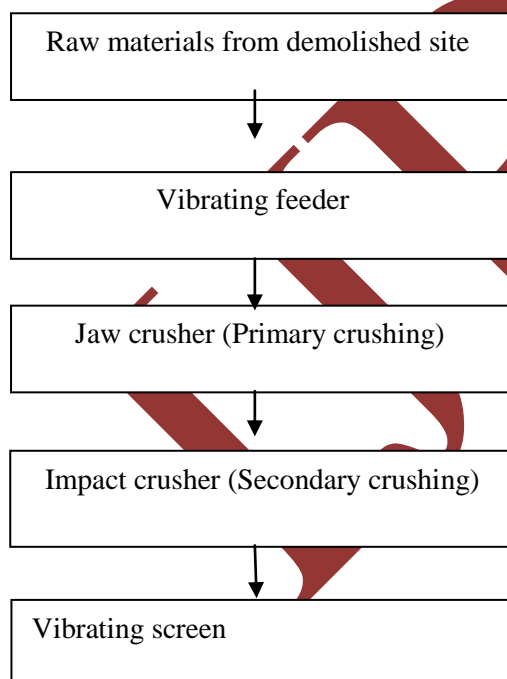
In the modern evaluation of buildings and technologies, people tend to move to the development through modernized building. Hence, the refreshment of the building is done either demolishing or renovating the structures for ten years once, In this case the cost of materials, labor cost, etc., increase due to amelioration. Hence by keeping the economy cost in the mind, and also in order to avoid the wastage of materials recycled aggregate concrete is introduced. In the developing world, the number of high rise buildings also gets increase and the regular method of renovation of multi storey building is done by demolishing it.

Demolishing or renovating the buildings results in lots of material wastage. Also, reconstructing the same building requires more cost. Crushing and recycling the demolished materials will reduce the cost as well as the material wastage. Replacing the RAC in place of normal aggregate materials will be satisfactory because the demolished aggregate materials are used to be in the field for more than 10 years hence already it will obtain the maximum strength therefore by replacing the recycled aggregate will only increase the strength, but in the rare case they also decrease the compressive strength in those case fibers and chemical admixtures are added. Due the pores and the water absorption will leads to decrease the strength

Also the recycled aggregate can only replace by certain percentage, because full replacement of recycled aggregate to normal coarse aggregate which tends to decrease the strength which leads to failure in the concrete, therefore replacement is done only upto 30%. The replacement of recycled aggregate concrete with other fibers like steel, glass fiber, polypropylene etc. can be used but only motive is by only using the recycled aggregate concrete we can obtain the maximum and expected strength.

The process of recycled aggregate is quite simple process, the raw materials from the demolished site should be separated from size where small sized raw material can be avoided, and then they are proceeding to the recycling procedure.

Once they are separated the raw material are send to the vibrating feeder which also help to separate the raw materials according to the size they those materials are send to the jaw crusher which the primary crushing process of aggregate once the primary is finished they are send to secondary crushing machine which impact crusher where they are crushed neatly and they send to vibrating screen which is used to help the recycled aggregate to separate according to size then the recycled aggregate is ready for the construction.



## II. OBJECTIVE

The main objective of the project is avoid the wastage of demolished waste of construction site and used those materials as a recycled aggregate as a partial replacement of coarse aggregate in

the high rise building.

### III. LITERATURE REVIEW

**Abhiram.K and Saravanakumar.P** this experimental study deals with the suitability of recycled aggregate (RA) in place of Natural Aggregate (NA) which mainly depends on the properties of the recycled aggregate. The recycled aggregate which contains loose mortar particles and the surface cracks will result in inferior aggregate properties. The properties of coarse recycled aggregate will be enhanced by surface treatment method which is handled in this experimental study. Here the recycled aggregate is soaked in hydrochloric (HCL) acid at 0.1M concentration. The effect of RA on the concrete are determined before and after the treatment. Instead of 10-30% decrease in strength of the value, the strength of RA has been increased after the treatment. By using the treated recycled aggregate in concrete instead of untreated recycled aggregate is a better way.

**BINCY PAUL, MINU ANNA JOHNY, and SURYA M C** In this experimental study, the contradiction between the continual development of the construction industry and the shortage in the resources will really become more severe due to the rapid development of construction industry. The sustainable development of the constructions will lead to excessive consumption of the natural resources and the environmental deterioration. Every year, the solid waste which is large in amount is produced due to construction of new buildings. Deep researches should be carried out over the reuse of the construction waste, since it is becoming a common concern issue. There will be huge economic and environmental benefits over the usage by reusing and recycling the construction waste (recycled aggregate). In this experimental study as an additive at varying percentage, recycled coarse aggregate and metakaolin used instead of coarse aggregate. Thus the mechanical property of M40 grade HPC has been studied. The metakaolin included in the concrete will enhance the engineering properties of the basic materials and the concrete.

**D.V. Prasada Rao and P.L. Sindhu Desai** they have carried out their experimental study of the recycled aggregate with their students. Every year in India a large amount of construction and demolition waste is produced. The disposal of the waste materials needs a large area for dumping which is really becoming a problem. There is also increase in the cost of fine and coarse aggregate because the depletion of the natural resources for making the conventional concrete naturally reduces their availability. So using the recycled demolition wastes as coarse aggregate is gaining more importance in the construction industry. Thereby the need for the land for disposing the waste will be reduced along with the natural resources will be conserved by using the recycled demolition wastes. The physical, mechanical and durable characteristics assessment of the recycled coarse aggregate should be considered important when using the recycled coarse aggregate in the structural concrete. To assess recycled coarse aggregate application as structural concrete the physical and mechanical properties of the concrete should be evaluated, with the recycled coarse aggregate, the current work points towards evaluation of the concrete, in which recycled coarse aggregate is used completely instead of natural coarse aggregate. Here the

mechanical and durability properties are also examined and finally compared with the NAC concrete as part of the experimental result examination. The durability and the compressive of the concrete are tested using rapid chloride permeability test (RCPT) for obtaining the mechanical properties of RCA. RCA has been obtained from tested concrete specimens from laboratory. High percentage of water absorption is the main problem in the RCA concrete. The Recycled coarse aggregate has a large amount of mortar attached to it on its surface, hence RCA has more compressive strength than the natural coarse aggregate. In RCPT the chloride penetrating rate is moderate for all grades of concrete in NCA, but in RCA it is high. It can be concluded from the experimental study, some limited application can use RCA as structural concrete, since the percentage of the water absorption is high.

**Fathei Ramadan salehlamein, MochamadSolikin** they researched about the properties of recycled aggregate concrete. They used the modified recycled aggregate for this process. In this case the recycled aggregate, the percentage of RAC should be taken into concern because it will not be obtained by high performance concrete. The main objective of the research is about the difference between the conventional concrete to recycled aggregate concrete in the case of specific gravity and the apparent gravity, water absorption. Also, this research executed the variation in percentage of the recycled aggregate concrete from 0% to 65% as the replacement.

**Marco Breccolotti, Antonella D'Alessandro, Francesca Roscini, Massimo Federico Bonfigli** They carried experimental study on the stress strain behavior of RAC. In recent, the recycling awareness also uses the resources used in the civil engineering. By using the recycled aggregate concrete there are various cons such as pollution reduction and natural resource conservation. Though there is increase in the interest on usage of structural concrete with recycled aggregate still the studies of the mechanical behavior of such materials wherein it can be used as an alternative to standard concrete are lacking. There is no information as such on the mechanical characteristics of RAC form the structural code and some other codes just provide the basic information. The mechanical behaviors of the RAC under uniaxial and compressive loads are studied in the experimental investigation. The cyclic behavior and the monotonic complete stress strain curves are analyzed under high compressive load. The mechanical behavior of the material after undergoing subsequent analytical investigation from stress-strain behavior of RAC is found significant. The peak resistance, total elongation, the modulus of elasticity, the elastic deformation and the proportional limit from the envelope diagram helps us to understand the mechanical capabilities and to work on further experiments over the materials. Loads with varying values between 25% and 70% and loads with varying values between 25% and 80% has undergone cyclic tests with repeated loads carried over the peak loads. The test investigation resulted in 0%, 50% and 100% recycled coarse aggregate percentages. This experimental study states the usage of concrete with recycled aggregate by providing more information on the mechanical behavior and to model them better such that it can be more enhanced for the usage in civil engineering.

**N.Sivakumar, S.Muthukumar, V.Sivakumar, D.Gowtham, V.Muthuraj** In this paper High strength concrete is studied. The main ingredient in producing concrete is the aggregate which covers 75% of total concrete mix. The properties of the aggregate are major factor of the strength of the concrete produced. Most construction industries are progressively using this material due to its high demand. Thus, as an alternative coarse aggregate is required. In this paper the strength and durability of high strength structural concrete is studied by using recycled coarse aggregates. Thereby the properties of the concrete with recycled aggregate can be understood better. Here low cost recycled coarse aggregate is used in place of other coarse aggregate in high strength structural concrete. Strength and durability related tests like modulus of elasticity tests, acid resistance test, split tensile strength test of cylinders, compressive strength test of cubes, modulus of elasticity tests and test for saturated water absorption and porosity were examined. 50% of recycled coarse aggregates and high strength concrete mixes by 0, 10, 20, 30, and 40 are used instead of coarse aggregates. A 50% replaced mix with reduced w/c ratio was also tested. As a conclusion from the experimental investigation it was originated for making high strength concrete by adjusting the admixture contents and w/c ratio recycled coarse aggregate can be used.

**Parekh D. N and Dr. Modhera C. D** congregated an assessment of recycled aggregate concrete. Environmental protection and economical terms can be attained by using the recycled aggregate in concrete. Many construction projects in America, Asia and Europe have started using the recycled aggregate applications in their projects. Also, there are many infrastructural laws relaxation for using the recycled aggregate. In this assessment recycled fine and coarse aggregates basic properties are studied and the properties of the natural aggregates are also compared. The changes in aggregate properties were also determined; their effects on concreting work are also examined. And also the properties of recycled aggregate concrete are determined. Some of the basic properties of the concrete workability, flexural strength and compressive strength etc. are elucidated for different combinations of recycled aggregate to that of natural aggregate.

**Sellakkannu N. & Subramani V** they have studied about the mechanical behavior and the properties of recycled aggregate concrete. The modern development focuses on the natural resource conservation and environmental preservation. Recycled Aggregates are produced from demolished material obtained from the building demolitions. The required grading is then obtained by crushing, screening and washing them. The concrete is produced from the recycled coarse aggregate which is obtained by crushing the concrete. Recycled aggregate are more equal to quarried aggregates and they are cheaper too. In future the most used materials would be the recycled. The cost of making concrete is reduced and they are eco-friendly too.

**Sherif Yehia, Kareem Helal, Anaam Abusharkh, Amani Zaher, and Hiba Istaitieh** they carried out experimental study about the durability and strength of recycled aggregate concrete. In this experimental study fabricating the concrete with 100% RAC's suitability is examined. The strength requirements and durability can be observed for different applications. The strength and

the durability of the concrete depend on both mechanical and physical characteristics such as shape, texture, specific gravity, absorption, aggregate strength and gradation. The exposure conditions and loading conditions of the demolished structures are the main factors in determining the quality of the recycled aggregate. Hence this experimental study was focused on evaluating the mechanical and physical properties of the recycled aggregate for six months. Along with which the fine and coarse recycled aggregate concrete are also evaluated. The results of several concrete mixes were prepared with 100 % recycled aggregates and the results were compared to control mix. The microstructures of the selected mixes are evaluated using SEM. As a conclusion the durability and strength of the concrete with acceptable strength can be produced only if high packing density is accomplished.

**Tomas U. Ganiron Jr** In the building sector, the debris gives the major contribution to the total environment, in order to increase the scope of recycling to the future needs and also they are used in the case of design phase. There are so many economic and environmental benefits from the reclaiming aggregate of the concrete debris. This experimental study uses crushed concrete debris in place of fine aggregate in a mortar mixture. Both conventional mortar mixture and concrete debris mixture will be in same proportions.

#### IV. ADVANTAGES OF RECYCLED AGGREGATE CONCRETE

- Cost saving
- Eco friendly
- Versatility
- Durability

#### V. APPLICATION AND LIMITATION OF RECYCLED AGGREGATE CONCRETE

Some of the application of RAC, CSIRO reported that the Class 1A RCA, which is a well graded, good quality RAC, had the potential for use in a vast range of applications, they are subject to appropriate test or performance requirements. Applications include partial replacement of recycled aggregate to conventional concrete (up to 30%) production for non-structural work and mostly for road pavement. The main application of recycled aggregate is to remove the scarcity of the construction materials. Also it is found that the RAC can be used upto to 30 to 40 Mpa which highly reflect that the high strength concrete is not suitable RAC.

Some of the limitation of RAC, it is found that the recycled aggregate have many limitation while comparing with conventional concrete

- Low specific gravity
- High water absorption
- High water demand



- Shrinkage

## VI. CONCLUSION

Recycled aggregate concrete is used in order to avoid the wastage of material from the demolished construction site hence by replacing the RAC with the conventional concrete tends to decrease both the compressive and tensile strength in that case the partial replacement is done. Recycled aggregate concrete can be partially replaced therefore we can get the result as better while comparative with full replacement. Also the main reason for decrease in strength is due to high water absorption.

By the replacement of RAC from 0% to 30% which tends to slightly increase in both the compressive and tensile strength. Hence using RAC which help increase the recycling process and also it one the best method to avoid wastage from demolished construction sites.

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