International Journal of Innovative Research in Computer Science & Technology (IJIRCST)
ISSN: 2347-5552, Volume-11, Issue-1, January 2023
https://doi.org/10.55524/ijircst.2023.11.1.15
Article ID IRPV1087, Pages 78- 81
www.ijircst.org

# Experimental Study on Potential Use of Recycled Aggregates in Concrete

**M. Venkata Naga Siva Sankar Reddy[1], K. Manoj Kumar[2], B. Prathyusha[3], Y. Aeronika Angel[4], B. Akhil[5], N. Bhanu[6], and S. Ajay Reddy[7]**

[1,2]Assistant Professor, Department of Civil Engineering, PACE Institute of Technology & Sciences, Ongole, Andhra Pradesh, India
[3,4,5,6,7]B. Tech Scholar, Department of Civil Engineering, PACE Institute of Technology & Sciences, Ongole, Andhra Pradesh, India



**ABSTRACT-** Use of recycled aggregate in bonds may be advantageous for specialized security. The building blocks for the future are recycled aggregates. Numerous development projects being conducted in various European, American, Russian, and Asian nations have begun using recycled aggregate. Various nations are easing infrastructure regulations to encourage more use of recycled aggregate. The main characteristics of recycled fine aggregate and recycled coarse aggregate are reported in this study, along with a distinction between these characteristics and trademark sums. All aggregate attributes' fundamental modifications are resolved, and their implications for setting up work are finally explored. The qualities of concrete using recycled aggregate are further chosen in accordance with this. Fundamental strong properties like compressive quality, flexural quality, workability etc are elucidated here for different mixes of reused aggregate with standard aggregate. Codal standards of reused sums concrete in various countries are communicated here with their effects, on establishing work. All things considered, show status of reused aggregate in India close by its future need and its viable utilize are discussed here.

**KEYWORDS-** mechanical properties; load test; sustainable concrete; durability; benefits and uses; recycled aggregate; crushing process; recycled aggregate; sustainable concrete; and structural concrete.

## I. INTRODUCTION

A rough estimate puts the yearly use of aggregates in concrete at 165 million tons, or around 30% of the global market for aggregates. Therefore, there is strong motivation to create alternate aggregate sources based on garbage. Given that recycled concrete aggregate (RCA) or RAC is combined with other materials and is therefore inappropriate for ready-mixed concrete, the aggregate products now emerging from the majority of aggregate recycling operations are unbound infill, capping, sub-base, and pipe bedding. RCA provided in ready-mixed concrete has been used in a few site experiments, however these weren't A rough estimate puts the yearly use of aggregates in concrete at 165 million tons, or around 30% of the global market for aggregates. Therefore, there is strong motivation to create alternate aggregate sources based on garbage. Given that recycled concrete aggregate (RCA) or RAC is combined with other materials and is therefore inappropriate for ready-mixed concrete, the aggregate products now emerging from the majority of aggregate recycling operations are unbound infill, capping, sub-base, and pipe bedding. Although these weren't common choices, there have been some site trials using RCA provided in ready-mixed concrete.

Utilities businesses create trench arising that contains stone, concrete, brick, asphalt, and clay, which may subsequently be added to a low strength concrete production process.  trench filling substance that is economical. There is potential to employ incinerator bottom ash aggregate in foamed concrete, and foamed concrete is now used in trench rehabilitation utilizing RCA's 4mm fines. The potential for using recycled aggregates in concrete has increased thanks to the concrete standard BS 8500, also known as Aggregates for concrete (BS EN 12620). Although it is currently not readily available, it is anticipated that the usage of recycled aggregates for concrete will increase over the coming years.

India's industrialization has resulted in an extremely high pace of urbanization growth. India's GDP growth rate has reached 9%. Rapid infrastructure growth necessitates a lot of building supplies, space, and a location. Concrete is preferred for major building projects due to its longer life, lower maintenance requirements, and superior performance. Smaller buildings are destroyed and new towers are built to increase the GDP rate. A fundamental aspect that is closely related to the survival of the human race is environmental protection. The prerequisites for modern construction work include factors like environmental awareness, resource protection, and sustainable development. Modernization has led to the disposal of demolished items on the land without any further use. Such circumstances have an impact on soil fertility. According to a March 2007 Hindu web study, India produces 23.75 million tons of demolition garbage each year. According to a research by the Central Pollution Control Board (CPCB) in Delhi, India produces 48 million tons of solid waste, of which 14.5 million tons come from the building waste industry, and only 3% of that debris is used to build embankments. According to experimental studies on the usage of Building Demolished Waste (BDW), structural concrete with recycled aggregate exhibits behavior that is similar to that of concrete with traditional natural aggregate. Utilizing waste products like BDW, fly ash, ground granulated blast furnace slag (GGBS), etc. is essential for today's sustainable growth. Utilizing such materials.

## II. LITERATURE REVIEW

The author fervently contends that both public and private entities must make a significant commitment and investment if sustainability is to be achieved. Some materials, like plastic and glass, are recycled again. Similar to how concrete can be continuously utilized if the standard is correct. Recycling of solid waste for use in building is becoming a more significant transportation and pollution reduction are benefits.

Parekh and Modhera (2011) highlight the problems with sustainability and the scarcity of natural resources. They advise using industrial wastes like fly ash and blast furnace slag as well as recycled and secondary aggregates (RSA), such crushed concrete and asphalt. Products are currently being recycled to create new materials. Numerous studies demonstrate that concrete produced in this manner has a High-strength concrete may currently be created utilizing this environmentally friendly technique and a form. of course particles that can have mechanical qualities similar to those of traditional concretes.

The amount of recycled aggregate differs from river aggregate by % of 0, 50, and 100, respectively, according to Mirjana4etMale. The qualities of workability (slump test) immediately following mixing and 30 minutes later, bulk density of fresh concrete, air content, bulk density of hardened concrete, water absorption (at age of 28 days), wear resistance (at age of 28 days), and compressive strength (at ages of 2, 7, and 28 days), among others, are all examined.

According to Brett et al.2 (2010), using recycled aggregates in concrete is both technically and economically feasible. In addition to demolition trash, RA might also include surplus concrete materials that were sent back to the production facility.

Mirza and Saif [3] have investigated how silica fume affects the properties of recycled aggregate concrete. By weight, the replacement rates for natural aggregate with recycled aggregate were 0, 50, and 100%, whilst the replacement rates for cement with silica fume were 5, 10, and 15%. The findings demonstrate that when recycled aggregate and silica fume levels rise, so do the compressive and tensile strengths values of the recycled concrete aggregate. The study also shows that 5% silica fume must be added to the mix in structural concrete in order to accommodate 50% recycled aggregate. According to Gupta7, coarse aggregate is typically derived from cracked rocks found in hills or river beds. However, due to the regional depletion of good conventional aggregate, recycled aggregate technology needs to be developed and commercialized. It is comparable to fly ash, an industrial waste product that can be found in the electrostatic precipitators of several super thermal power plants. When used in concrete, it is chemically reactive when combined with cement. This is helpful as a partial cement substitute since it makes concrete more impermeable. Thus, it has a larger application in the building sector. He further warns that extensive recycling of demolition debris would not only provide a solution to the expanding energy and trash disposal issues, but will also assist the construction industry in obtaining locally sourced aggregates. Depending on where it will be used, such demolition waste can be crushed to the necessary size. The crushed material is then screened to create recycled aggregate in the proper sizes. Recycled Aggregates are an aggregate made from demolished structures.

Sankarnarayanan10 et al. research the situation in India where there is a presence of C&D waste and other inert material (such as drain silt, dust, and grit from road sweeping) and make the following observations:

- These wastes have the ability to conserve energy and natural resources (such as stone, river sand, soil, etc.).
- It's taking up a lot of room in landfills.
- Construction and demolition trash has potential uses after processing and grading; however, in India, no systematic attempt has been undertaken yet. Its presence ruins the processing of biodegradable as well as recyclable garbage. Construction and demolition waste utilization is relatively prevalent in industrialized countries.

## III. LOGISTICS OF RECYCLED AGGREGATE PRODUCTION

The best scenario for using leftover concrete as aggregate is when the concrete factory and the aggregate plant are on the same property. This reduces the amount of leftover concrete that must be transported to the crushing plant. On larger projects, the utilization of strategically placed mobile crusher facilities can shorten transportation routes for recovered material and demolition concrete. Production of Concrete Aggregate from Demolition

### *A. Material*

Older concrete that has been removed from foundations, pavements, bridges, or buildings during demolition is crushed and processed into different size fractions to create recycled aggregates. In order to avoid contamination by soil or other leftover building materials like plaster or gypsum, reinforcing steel and other embedded components, if any, are removed. To assist prevent contamination, it is recommended to keep used concrete separately from other demolition debris. Rarely would records of the history of the demolition concrete be available, but if they were, they would be helpful in assessing the potential of the recycled aggregate concrete.

### *B. PROCESSING*

Steps involved in recycled aggregate concrete:

- Crushing
- Pre-sizing
- Sorting
- Screening
- Contaminant
- elimination

Production Sequence of RAC:

- Primary jaws, cones, or huge impactors are used in crushing and screening systems to take debris between 30 inches and 4 feet in height.
- Depending on the project, the equipment utilized, and the intended end product, a secondary cone or impactor may or may not need to be run, followed by primary and secondary screens.
- Dirt and foreign objects will be eliminated by a scalping screen. Fine particles will be eliminated from coarse aggregate by a fine harp deck screen.
- To make sure the recycled concrete product is free of dirt, clay, wood, plastic, and organic contaminants, additional cleaning is required.
- This is done by water floatation, hand picking, air separators, and electromagnetic separators.

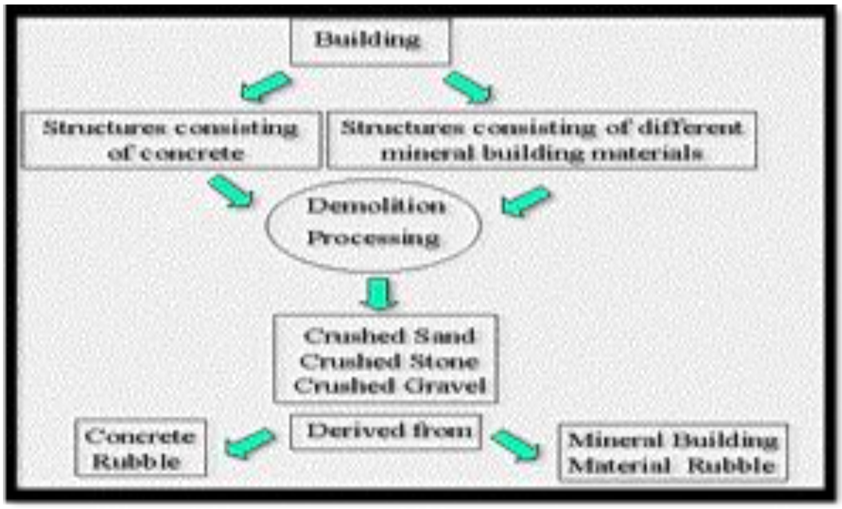


Figure 1: Processing of RAC

## IV. RECYCLED WASH WATER AND AGGREGATES RECOVERY

If the mortar is thoroughly washed, trucks returning from a site where it washed out discharge and coarse sand are collected from the "liquid fine can be recycled and considered equivalent to virgin aggregate." out.

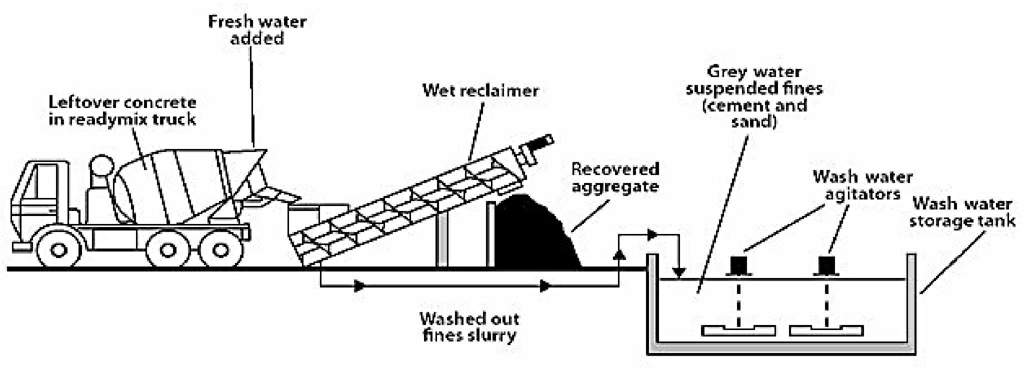


Figure 2: Use of RCA in concrete

Typical recycling system for wash water and aggregate recovery. Typical rural low volume ready mix plants run a recycling system that permits the clear wash water to be reused when the solids from the fines are settled out of suspension. Periodically, the settling materials are removed and given time to dry before being disposed of in landfills. Larger factories often use a recycled wash water system (see Figure 1 and 2) because the volume of solid waste they must dispose of is prohibitive.

### *A. Quality Control*

Investigating the original concrete and applying the recycled coarse aggregate concrete are the two steps in the quality control process. The manufacture & construction specifications for recycled coarse aggregate concrete are followed for quality control. Each of the three individual processes for the material are covered by quality control.

### *B. Mix Design*

According to conventional wisdom, when natural sand is utilized, up to 30% of naturally crushed coarse aggregate can be swapped out for similarly sized recycled aggregate without noticeably changing the concrete's mechanical qualities. Drying shrinkage and creep will increase with rising replacement amounts, but tensile strength and elastic modulus will decrease.

However, there are minimal changes in compressive strength and freeze-thaw resistance. It is advised that RCA be batched in a rewetted and almost saturated surface dry condition, similar to lightweight aggregates, for further details. The paste content or quantity of water reducer must typically be increased in order to attain the same workability, slump, and water-cement ratio as conventional concrete. The same techniques used for conventional concrete can be used to transport, lay, and compact concrete containing RCA. Utilizing fine RCA necessitates extra caution. Only ten to twenty percent of fine RCA is useful. It is important to test the aggregate at various substitution rates. When making fresh concrete, recycled and virgin aggregate are blended far too frequently.

## V. WORKABILITY

The size and shape of the section, the amount and spacing of reinforcement, and the method utilized for transportation, placement, and compaction all affect how workable concrete is for successful placement and compaction. Establish the level of quality control and the mean goal strength ft. from the required characteristic compressive strength at 28-day fck.

## VI. TESTS ON RECYCLED AGGREGATE

### *A. Specific Gravity*

The specific gravity of recycled concrete aggregate was found to range from 2.58 to 2.63, which is less but still satisfactory. Specific gravity of less than 2.4 may result in segregation, honeycombing, and decreased concrete production.

### *B. Water Absorption*

The RCA from demolished concrete consist of crushed stone aggregate with old mortar adhering to it, the water absorption ranges from 1.2% to 6.85%, which is relatively higher than that of the natural aggregates. Thus the water absorption results are satisfactory.

### *C. Bulk Density*

The bulk density of recycled aggregate is lower than that of natural aggregate, thus results are not satisfactory; due to less Bulk Density the mix proportion gets affected.

### *D. Crushing and Impact Values*

The recycled aggregate is relatively weaker than the natural aggregate against different mechanical actions. 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.

### *E. Compressive test on cubes*

According to IS 516, the average compressive strengths of cubes cast at ages 3, 7, and 28 days were calculated using RCA and natural aggregate. The results are shown in Table 2. As might be expected, RAC's compressive strength is a little bit lower than that of ordinary concrete manufactured with a same mix ratio. For M-40 and M-50 concrete, respectively, the strength reduction of RAC as compared to NAC is in the range of 8-13% and 7-12%. The grade of the destroyed concrete, the replacement ratio, the w/c ratio, the processing of recycled aggregate, and other factors all affect how much strength is reduced. According to test results, recycled aggregate cube strength exceeds goal strength, allowing for usage in construction. The split tensile has significantly increased.

## CONCLUSIONS

- According to the findings of the test results, using recycled aggregate up to 30% does not affect the functional requirements of the Structure.
- As per IS 2386, numerous tests on recycled aggregates were undertaken, and the results when compared to natural aggregates were adequate.
- Energy and costs associated with the transportation of natural resources and excavation are considerably reduced by the use of recycled aggregate in construction. This directly lessens the environmental impact of waste material.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## REFERENCES


[1] Abdelfatah, Akmal & Tabsh, Sami. (2011). Review of Research on and Implementation of Recycled Concrete Aggregate in the GCC. Advances in Civil Engineering. 2011. 10.1155/2011/567924.

[2] Tempest, B.Q., Cavalline, T.L., Gergely, J., & Weggel, D.C. (2010). Construction and Demolition Waste used as Recycled Aggregates in Concrete: Solutions for Increasing the Marketability of Recycled Aggregate Concrete.

[3] Mechanical properties of the second recycled steel, F. A. Mirza and M. A. Saif, Coventry University and the University of Wisconsin Milwaukee Center for By-Product Utilization hosted the International Conference on Sustainable Construction Materials and Technologies in Ancona, Italy, in June 2010.

[4] YP Gupta “Use of Recycled Aggregate In Concrete 34th Construction: Conference World in Concrete & Structures, Singapore, 16–18 August 2009

[5] Recycled Concrete Aggregates Association of New Zealand (CCANZ) released a Best Practice Guide for its use in October 2011.

[6] Mark Lennon's "Recycling Construction and Demolition Waste Contractors" from The Institution Recycling Network, published in April 2005

[7] Working Sub-Group on Construction and Demolition Waste, Sneana Marinkovi, Vlastimir Radonjanin, and Mirjana Maleev, 2009.