A Review Paper on use of Recycled Aggregates in Concrete

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Abstract - **A number of investigations have been carried on the mechanical properties, durability and structural performances of recycled aggregate concrete (RAC). The application of recycled aggregate to use in construction activities have been practice by developed European countries and also of some Asian countries. We know that concrete is the main construction material across the world and the mostly used in all types of civil engineering works. As aggregate represents about 70-80% of concrete components, so it will be beneficial to recycle the aggregate for construction works and also to solve the environmental problems. In this paper a study has been made on the past researches carried out by the different scholars and their results have been studied.**

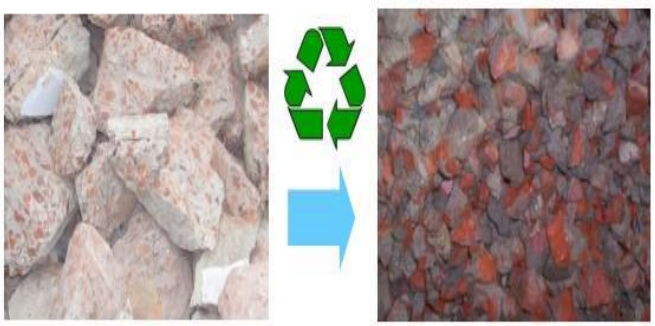
***Keywords: Recycled aggregate concrete (RAC), Performance of recycled aggregate concrete, compressive strength*.**

I. INTRODUCTION

The need and importance of concrete in construction industry is ever increasing. Recycled Aggregate Concrete (RAC) is concrete that using Recycled Aggregate (RA) as partially or fully replacement in coarse and fine aggregate. It is believed RA have been used from 1945 in concrete producing and started when World War II damaged a large quantity of concrete structures and the high demand of aggregate to rebuild the structures. Concrete is the favorite choice as a construction material among civil engineers around the globe for decades. It is preferred for its better performance, longer life and low maintenance cost. To achieve rapid urbanization every year smaller structures are demolished and newer and bigger ones are constructed. These demolished materials (majority of which is usually concrete) are often dumped on land and is not reused for any purpose. This practice affects the fertility of land. With the wave of sustainability also impacting the construction industry, scientist and engineers throughout the world are looking for sustainable and reusable construction materials. One such material is recycled aggregate concrete. Utilizing recycled aggregate is certainly an important step towards sustainable development in the concrete industry and management of construction waste. Recycled aggregate is variable properties. Quality of the recycled aggregate depends upon the collected material quality and its delivery to the plants.

A. Recycled Aggregate Concrete

Recycling is the act of processing the used material for use in creating a new product. The usage of natural aggregate is getting more and more intense with the advanced development in infrastructure area. Recycled aggregate is comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions and demolition debris. Recycled aggregates are produced from the re-processing of mineral waste materials, with the largest source being construction and demolition waste. These wastes are normally composed of concrete rubble usually, constitutes the largest proportion of C&D waste. It has been shown that crushed concrete rubble, after separation from other C&D waste and sieved, can be used as a substitute for natural coarse aggregates in concrete or a sub-base or a base layer in pavements.



Demolished Concrete Blocks Recycled Coarse Aggregate (RCA)

II. LITERATURE SURVEY

Okorie Austine Uche (2008)[1], studies the influence of recycled aggregate concrete (RCA) as a substitute for virgin coarse aggregate in the compressive strength of `plain concrete and concluded the use of recycled concrete aggregates (RCA) as alternative to natural or virgin aggregate in structural concrete reduces the strength development of the concrete.

Ismail Abdul Rahman et al (2009)[2] presented the effects of size of Recycled Aggregate on compressive strength and found that the compressive strength has been improved.

Mirjana Malešev et al (2010)[3] performed comparative analysis of the experimental results of the properties of fresh and hardened concrete with different replacement ratios of natural with recycled coarse aggregate and the author found the results on the basic properties of concrete with three different percentages of coarse recycled aggregate content (0%, 50% and 100%). He found that workability of concrete with natural and recycled aggregate is almost the same if ―water saturated—surface dry recycled aggregate is used. Bulk density of fresh concrete is slightly decreased with increasing quantity of recycled aggregate.

Concrete compressive strength mainly depends on the quality of recycled aggregate

Parekh D. N. et al (2011)[4] studied the basic properties of recycled fine aggregate and recycled coarse aggregate. He also compares these properties with natural aggregates and resulted that recycled aggregate concrete has better resistance to carbonation than natural aggregate concrete.

Katrina Mc Nei et al (2013)[5] studied about the properties of the RCA, the effects of RCA use on concrete material properties, and the large scale impact of RCA on structural members and found that aggregate properties are most affected by the residual adhered mortar on RCA due to less density and more porosity of the RCA. They also investigated that the RCA particles are more round in shape and have more fines broken off in L.A. abrasion and crushing testes.

Jitender Sharma et al (2014)[6] studied about the introduction and production of recycled concrete aggregates and its various applications in the construction industry and they found that when the water cement ratio used in recycled aggregate mix is reduced, tensile strength and modulus of elasticity are improved.

Jitendra Kumar Tanaji Mohite et al (2015)[7] studied about the different test on the natural aggregate, recycle aggregate and blended aggregate and compare results and found that the strength of the recycled aggregate concrete is slightly less for the same condition as that of the natural aggregate. The amount of the reduction depends on the parameters such as amount of blending of the recycled aggregate, w/c ratio, quality of the processed recycled aggregates.

Prabhat kumar et al (2016)[8] presented a review of existing literature work for understanding thoroughly about RCA and the concluded from various studies that Natural aggregate can be used with recycle aggregate with a ratio of 80:20 and 70:30. Higher ratio of Recycle aggregate can worsen the properties and strength of mix and due to use of recycled aggregate in construction industry it can slow the impact of waste on environment. Also it will promote sustainable growth.

Anurag Gautam et al (2017)[9] presented the effect of replacing river sand partially by quarry dust. The proportions of quarry dust replacing by 0%, 25%, 35%, 45% and 55%. The materials testing, workability, compressive and tensile strength of concrete were examined at 7th, 14th and 28th day of curing of M20 grade of concrete. They examined that the results are comparatively good by replacing partially with natural sand. The replacement of quarry dust up to 45% gives better result. The compressive strength and tensile strength of 45% replacement gives 31.92 N/mm^2 and 3.85 N/mm^2 respectively at 28th day of curing.

Animesh Awasthi et al (2018)[10] studies the effect of adding Recycled Aggregate Concrete Containing Silica Fume as Partial Replacement for Cement and found that the higher water absorption capacity of recycled aggregates has great influence on the water added to the mix, which can affect concrete's workability. They also found that it is possible to gain the same compression and split tensile strength as conventional concrete up to 30% replacement of natural aggregate with recycled ones. But both the compression and split tensile strength values are decreasing with the increase in replacement levels of recycled aggregates. The increase of recycled aggregates content beyond 30% has a negative effect on compressive strength of recycled aggregates concrete. The reduction in compressive strength after 28 days is about 10% when 50% recycled aggregates are used.

Application of Recycled Aggregates:

- It helps to promote sustainable development in the protection of natural and reduces the disposal of demolition waste from old concrete.
- Recycled concrete can be also used in the production of concrete for pavements, shoulders, median barriers, sidewalks, curbs and gutters, building and bridge foundation.
- Growth in the use of recycled concrete for retaining wall backfill, port land cement concrete mix, landscaping rock, drainage aggregates, and erosion control is also happening.

Comparison of Past studies-

Year	Test Carried	Results
2009	6 mixes were made and the various test has been conducted	The size of RA will affected the strength in compressive strength, the results shows the 10mm and 14mm size of RA is better than 20mm size.
2011	Study of Assessment of Recycled Aggregate Concrete	RA can be used in concrete and that there is few (if any) applications issue related to its use.
2014	Properties of recycled aggregate and their comparison with natural aggregate has been studied	The specific gravity, water absorption and Los Angeles abrasion clearly indicate that RCAs are of lower quality than NCAs as they contain mortar.
2017	Quarry dust is used in place of natural river sand and then compressive strength test and tensile strength has been carried out	The compressive strength and tensile strength of 45% replacement gives 31.92 N/mm^2 and 3.85 N/mm^2 respectively at 28th day of curing.
2018	Recycled aggregate containing silica fume was used as the partial replacement of cement and various tests has been carried out	The increase of recycled aggregates content beyond 30% has a negative effect on compressive strength of recycled aggregates concrete. The reduction in compressive strength after 28 days is about 10% when 50% recycled aggregates are used.

III. CONCLUSION

From the above study the following conclusions can be drawn.

- It is clear that recycled aggregate can be used with natural aggregates.
- Higher ratio of Recycle aggregate can worsen the properties and strength of mix.
- Due to use of recycled aggregate in construction industry it can slow the impact of waste on environment.
- Furthermore improvement is needed in the recycled aggregated cement.

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