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A STUDY ON USE OF RECYCLED CONCRETE AGGREGATE (RCA) IN M-25 GRADE CONCRETE

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Abstract - *The aim of this study is to evaluate the performance of recycled concrete aggregate in concrete mix in cement concrete for workability and strength of concrete using OPC (43 grade). Waste arising from construction and demolition (C & D) constitutes one of the largest waste streams within country. Of this a large proportion of potentially useful material disposed of as landfill.*

The study shows that plain as well as reinforced concrete can be crushed using primary and secondary crushers to provide crushed aggregate with an acceptable quality to current BS 882 requirements. Because of the attached cement paste in the RCAs, the density of these materials is about 3-10% lower and water absorption is about 3-5 times higher than the corresponding natural aggregates.

In this study RCA has been added in concrete which varies from 0% to 100% at an interval of 25% by total weight of coarse aggregate. A total four mixes were prepared for M 25 of concrete. This study investigates the performance of concrete mixture in terms of Compressive, spilt and flexure strength for 7days and 28 days and durability against acid and alkali attack

Key Words: **Recycled Aggregates, Durability, Sustainability**

1. INTRODUCTION

Recycling concrete is a viable option to decrease the demand on high quality natural resources and to limit the amount of waste that is disposed in landfills. Recycled concrete has been primarily used as a unbound material in embankments, bases, and sub-bases. Engineers have also used recycled concrete as an aggregate in the construction of new structures such as concrete pavements but with limited frequency. The use of recycled concrete in load bearing structures has not gained wide acceptance probably because of the lack of accessible information on the subject, such as expected fresh and hardened material properties. Concrete is not the only recycled material that has been used in previous construction applications. Recycled asphalt, fly ash, and slag have been used in past projects. Recycled materials contribute to material sustainability, reduce environmental impact of demolished materials, and can have positive financial implications for certain projects. The cost of a project could decrease if concrete does not have to be hauled and dumped, and instead be used to replace a portion of virgin aggregate in the new concrete structure.

2. LITERATURE REVIEW

Dr. K. Ramadevi & Dr. R. Chitra (2017), studied concrete using recycled aggregates. & used for concreting for a mix proportion of M-25, as a replacement of natural coarse aggregate in proportion of 0%, 30%, 60% and 100%. In this study it is found that there is not much variation in strength between ordinary concrete and 30% replaced aggregate concrete, but when the percentage of aggregate replaced increases, there is a constant increase in strength. Because it has been found that RA obtained from recycling concrete are more angular and have higher absorption and sp. gravity than NCA, it may result on increase of strength and improved load carrying capacity**.[1]**

V.Divya Sri, G.senthil kumar, S.Praksh Chandra(2016) took experimental study on shear strength of recycled aggregate concrete. They find that water absorption ratio is higher than natural aggregate concrete due to porosity of recycled aggregate the shear capacity of natural aggregate concrete is high with respect to recycled aggregate concrete .The rate of reduction shear strength of recycled aggregate concrete is up to 20% when compared with natural aggregate concrete .The specimen shearing failure pattern is observed at supports of a beam. **[2]**

Akansha tiwari (2015), conducted a investigation on concrete with recycled concrete aggregate. She make concrete cube with 0%, 25%, 50%, 75%, and 100% replacement of natural coarse aggregate and the same has been tested for 7 and 28 days for determination of compressive strength and tensile splitting test. She conclude that

Slump of normal concrete is less than the recycle one observed from slump test while making concrete. Water absorption of RCA is higher than the natural aggregate. The compressive strength of concrete containing 50% RCA has strength in close proximity to that of normal concrete. Concrete has good tensile strength when replaced up to 25-30 %. Strength of concrete is higher during the starting stages and then it reduces gradually. **[3]**

Neeraj jain, Mridul garg and A.K. Minocha (2015) conducted study on green concrete from sustainable recycled coarse aggregates. For the investigation carried out for mechanical and durability aspects of RCA concrete, the following conclusion are concluded that physical & mechanical properties of recycled coarse aggregate to control (natural agg) and the properties get improved after washing due to remove of weak and porous adhered mortar. The compressive, tensile and flexural strength of hardened concrete using natural aggregate was more than the concrete using recycled aggregates. A decrease of 7-19 % of comp strength of recycled concrete has been observed with increase in RCA content from 50 to 100%. **[4]**

Fathei Ramadan salehlamein, Mochamad Solikin, Ir. SriSunarjono (2015) study effect of recycled coarse aggregate on concrete properties. They conclude that the value of sp. Gravity and apparent sp. Gravity of natural coarse aggregate were meet the requirement however the recycled aggregate does not meet the requirement and was lower than the natural coarse aggregate, then the value of absorption and loss angle of natural coarse aggregate was lower than recycled aggregate and meet the requirement. It can be concluded that the value of compressive strength will be decreased when recycled aggregate was used and also modulus of elasticity decreases when recycled aggregate used and flexural strength will also decrease when recycled aggregate added, however there is no significant changes in flexural strength test .Based on the research result for batch 1, (20mm maximum) the decrease in compressive strength with 35%, 50%, 65% replacement of RCA is 7.87%, 16% and 23.3% respectively. However in batch 2 (10mm max) the decrease with 35%, 50% and 65% of RCA is 8.1%, 17.4% and 23.2% respectively and hence % of RCA that can be used in concrete is maximum 35% replacement of recycled coarse aggregate.**[5]**

3. METHODOLOGY

1. Arranging the testing laboratory for conduction of experiments,
2. Listed out various tests involve in mix design of concrete, as per IS codes of reference,
3. Procurements of materials for testing and concrete preparation,
4. Performance of experiments for calculation of material properties which are used in mix design calculation.
5. Mix design calculation according to code of practice IS 10262 : 2009,
6. Mix trials were performed to find target compressive strength at optimum water-cement ratio for controlled concrete i.e. standard concrete,
7. For controlled concrete - Making and curing compression test specimens in the laboratory as per code of practice IS : 516 - 2009,
8. Testing of specimens for compressive split and flexure strength at 7 days and 28 days, as per code of practice IS : 516 - 2009, and
9. Graphical representation of test result.
10. For specified concrete (concrete made with RCA) -

    Making and curing compression test specimens in the laboratory as per code of

    Practice IS: 516 - 2009, with different combinations of using alternative material with

    Partial replacement of coarse aggregates,
11. Testing of specimens for compressive spilt flexure strength at 7 days and 28 days, as per code of practice IS : 516 - 2009, and
12. Graphical representation of compressive strength test result comparing with controlled concrete strength.

4. RESULTS AND DISCUSSIONS

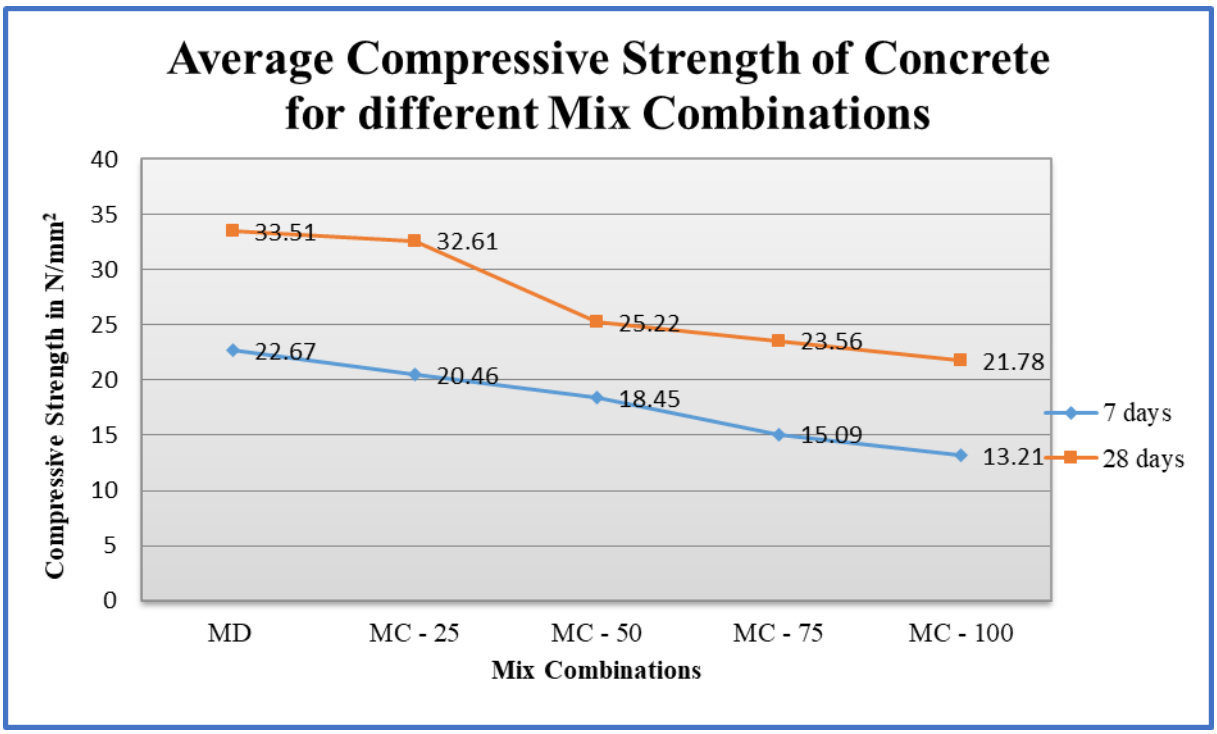

Fig. 4.1. Average Compressive strength of concrete for different mix combinations at 7 days and 28 days

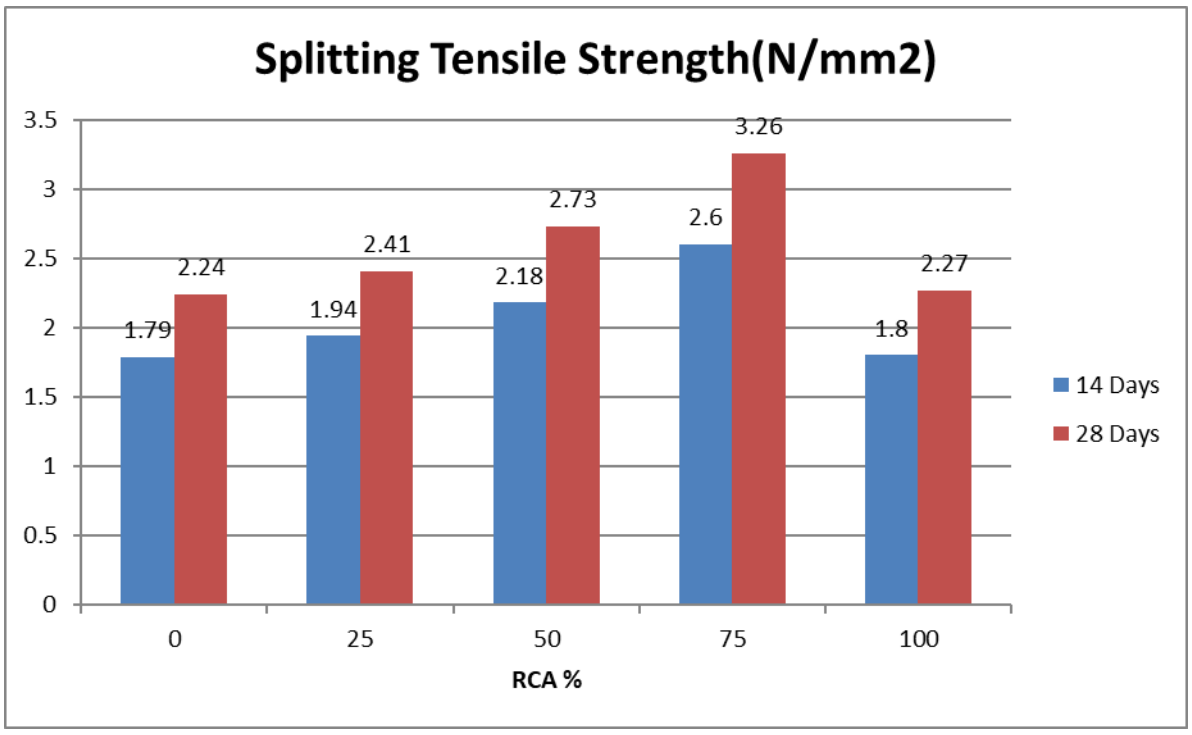

Fig 4.2 Comparative Splitting Tensile Strength of M25 Grade

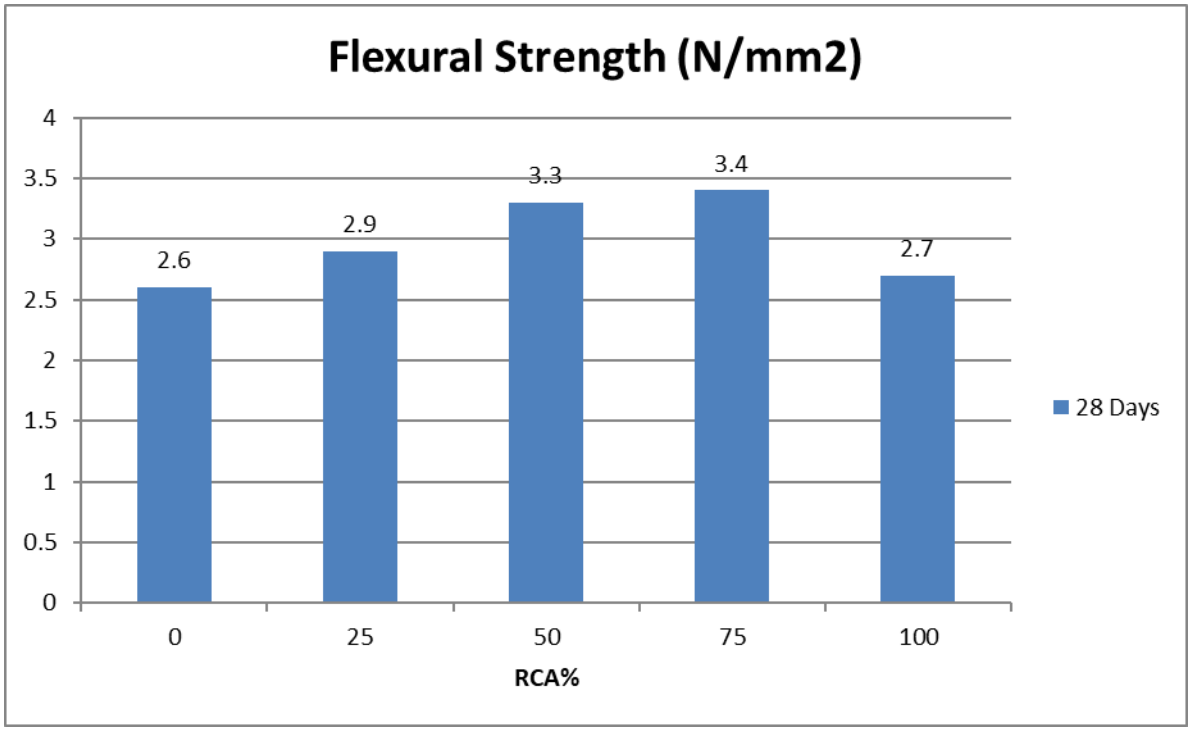

Fig 4.3 Comparative Flexural Strength of M25 Grade

5. CONCLUSIONS

After collecting and analyzing all the results, we can conclude that, 25 % replacement of natural coarse aggregate with recycled coarse aggregate provide desirable compressive strength of 25 N/mm2. After increasing the percentage of recycled coarse aggregate in fresh concrete, compressive strength decreases. At higher percentage of recycled coarse aggregate i.e. 50% & 100% slump and compaction factor is also low, which shows poor workability.
Partial replacement of Recycled concrete aggregate with natural aggregate up to 25% in fresh concrete mix also provides satisfactory results on account of durability.

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