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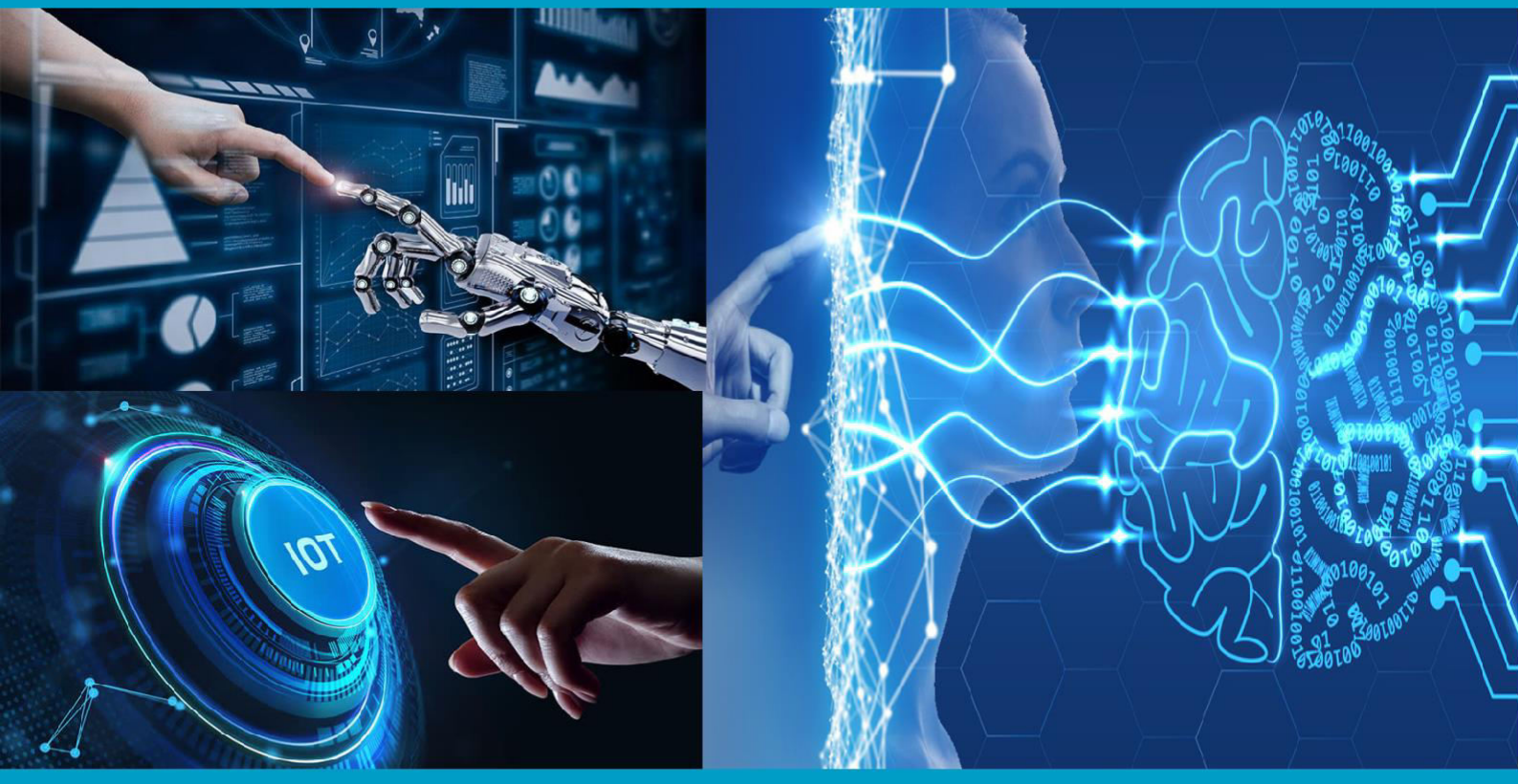

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Experimental analysis on Replacing Coarse Aggregates with Sustainable Recycled Coarse Aggregates in the Concrete

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ABSTRACT: Sustainability is important to the well-being of our planet, continued growth of a society, and human development. Concrete is one of the most widely used construction materials in the world. However, the production of Portland cement, an essential constituent of concrete, leads to the release of significant amounts of CO2, a greenhouse gas production of one ton of Portland cement produces about one ton of CO2 and other GHG's. The environmental issues associated with GHG's, in addition to natural resources issues, will play a leading role in the sustainable development of the cement and concrete industry during this century.

KEYWORDS: Sustainability, concrete, resources.

I. INTRODUCTION

1.1 General:

Due to the rapid urbanization and industrialization the construction industry has been has been progressing and expanding like never before and this has resulted in increasing carbon emissions and greenhouse gases. Since, there have been lots of ongoing construction projects across the world there has been massive need for construction materials which are mostly non-renewable. We civil engineers have limited land available to use for construction and to cater it to the increasing population there has been an increase in the demolition and reconstruction projects as well and these projects give rise to the increase in demolition waste. At first this demolition waste was disposed in the landfills, but due to the increase in construction activities it is impossible to dispose it all in the landfills which are already running out of space. Hence, we as engineers need to work out as one to find alternative solutions or materials to reuse the demolished waste backin to the construction projects without any disadvantages or demerits.

1.2 Objectives:

1. To study and analyze the various results on the different concrete mixes.
2. To compare strength and workability of concrete for different % of replacements.

II. RELETED WORK

The quality of recycled coarse aggregate (RCA) is dependent on its two main constituents including main aggregate and adhered mortar. The amount and quality of adhered mortar affect the properties of RCA. Zitouni et al. investigated the microstructure of new paste with different levels of recycled aggregate in comparison to the normal SCC. 30% RA replacement did not affect the new paste of SCC. A variation of porosity was observed for new paste 50 and 100% replacement; however, recycled aggregate improved the pore structure of the new paste. The macropores increased due to the release of water adsorbed by recycled aggregate during the presaturation process. The compressive strength is affected not only by the porous old paste of recycled aggregate but also by the porosity of the new paste.

The properties of RCA are inferior as compared to those of natural coarse aggregate. The interfacial transition zone (ITZ) characteristics are affected by RCA. Moreover, RCA has lesser density, higher porosity, and higher water absorption in comparison to natural coarse aggregate. This is due to adhered mortar present on the surface of RCA. Therefore, a proper mix design is needed to obtain the required quality of concrete made with RCA. This research builds on the existing understanding of SCC through an investigation of the properties of fresh and hardened concrete. This study evaluates the utilization of inferior recycled aggregate in self-compacting concrete with a total replacement of natural aggregate. The self-compacting mortar (SCM) was used to study the effect of RCA on the hardened properties of concrete mortar.

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III. METHODOLOGY

Looking at recent developments in climate change, environmental and natural disasters it's high time that we as human beings start looking for alternate ways in our everyday life in both social and work/field life. Since we as Civil engineers are a major contributors to the environmental decline and biodiversity it is also our job to make sure that we don't keep on overdoing these things and look for ways that help with the sustainability of this planet.
Since standard concrete and its materials manufacturing gives out greater amount of carbon emissions it does affect the environment on a very large scale. So we as Civil Engineering students set this aim up for our project to try and develop concrete from reused and recycled waste which gives better strength as well as helps with the sustainability of the environment.

IV. RESULT AND DISCUSSION

The characterization of self-compacting concrete is carried out by flow tests including filling ability, passing ability, and segregation resistance. After the completion of mixing, all the fresh properties are investigated within 20 minutes. The objective was to reduce the resulting variability due to loss of workability.
(1) Filling Ability Tests. The workability of SCC in an unconfined test condition is called filling ability. It is assessed by slump flow with T_{50} and V-funnel flow times. First, the standard slump cone flow test was carried out to measure the flow spread under the self-weight of SCC without the presence of obstructions. In this method, the cone was filled with SCC without compaction. Then, the cone was lifted, and slump flow was obtained by taking the average diameter of two perpendicular measurements (Figure 1). The T_{50} slump flow time is the duration of the flow spread of 500 m, and it indicates the viscosity of SCC.

Figure 1. Standard slump cone test and V-funnel test.

Figure 2. L-box test and J-ring test.

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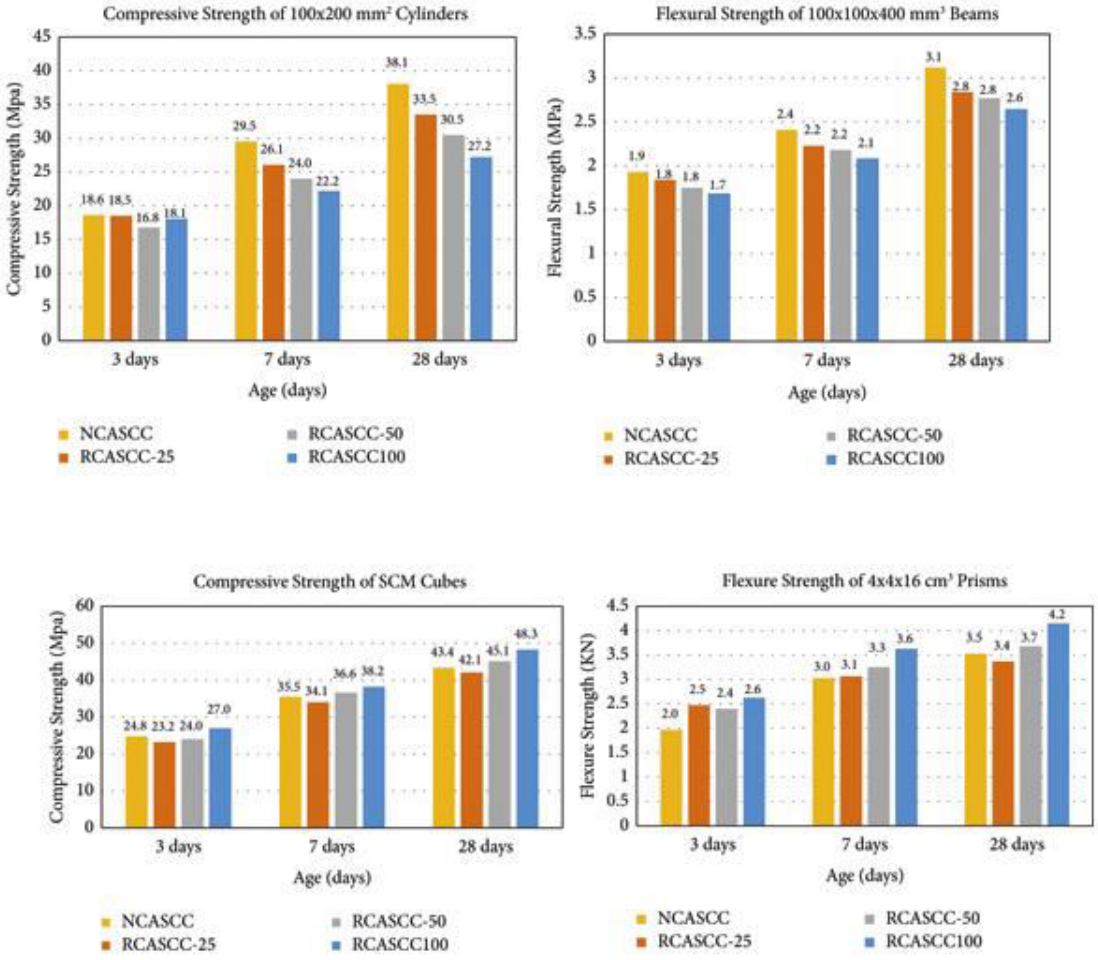
Compressive Strength Test –

Compressive strength of concrete is a measure of its ability to resist static load, which tends to crush it. It is one of the most common tests conducted on hardened concrete. Further many other characteristics if concrete are derived from the strength of the concrete. The compressive strength of the concrete gives a good and clear initial idea about the strength of the concrete batch that is supposed to be used.

The concrete cube of size 150mm*150mm using normal aggregate are 3 no's and recycled aggregates for different proportions are 9 no's are tested as per IS 516:1959(Reaffirmed 1999) the results of compressive strength at the end of 28 days are taken and compressive strength of natural and recycled aggregates are mentioned in following tables. Also graphical figures are shown below.



Slump Cone Test –

Slump cone test is used to measure the consistency/flow of the concrete before it sets. It gives us the workability of the concrete which is freshly made. If the concrete is not made properly, the slump cone test helps us determine it with the reading and hence that batch of concrete can be disposed and a fresh batch can be prepared.

The apparatus used for this test is very easy to use and it is called as Abrams Cone or rather just a slump cone in simple terms.

V. CONCLUSION

The physical properties of recycled coarse aggregate (RCA) including bulk density, specific gravity, crushing value, and impact value are inferior to those of natural coarse aggregate (NCA). RCA shows more water absorption as compared to NCA. These properties of RCA are affected by residual mortar adhering to coarse aggregate. The fresh property test results reveal that the viscosity of SCC made with RCA increases with the addition of RCA. Moreover, the fresh properties of SCC including filling ability, passing ability, and segregation resistance remain satisfactory and within the acceptable limits as per guidelines provided by EFNARC.

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The hardened properties results show that the compressive strength of RCASCC-100 decreased to about 70% of NCASCC, while flexural strength decreased to about 85% of NCASCC on the 28th day of casting. Since the loss of strength is comparatively less, so it is possible to use recycled coarse aggregate as a replacement for natural coarse aggregate to produce structural concrete.

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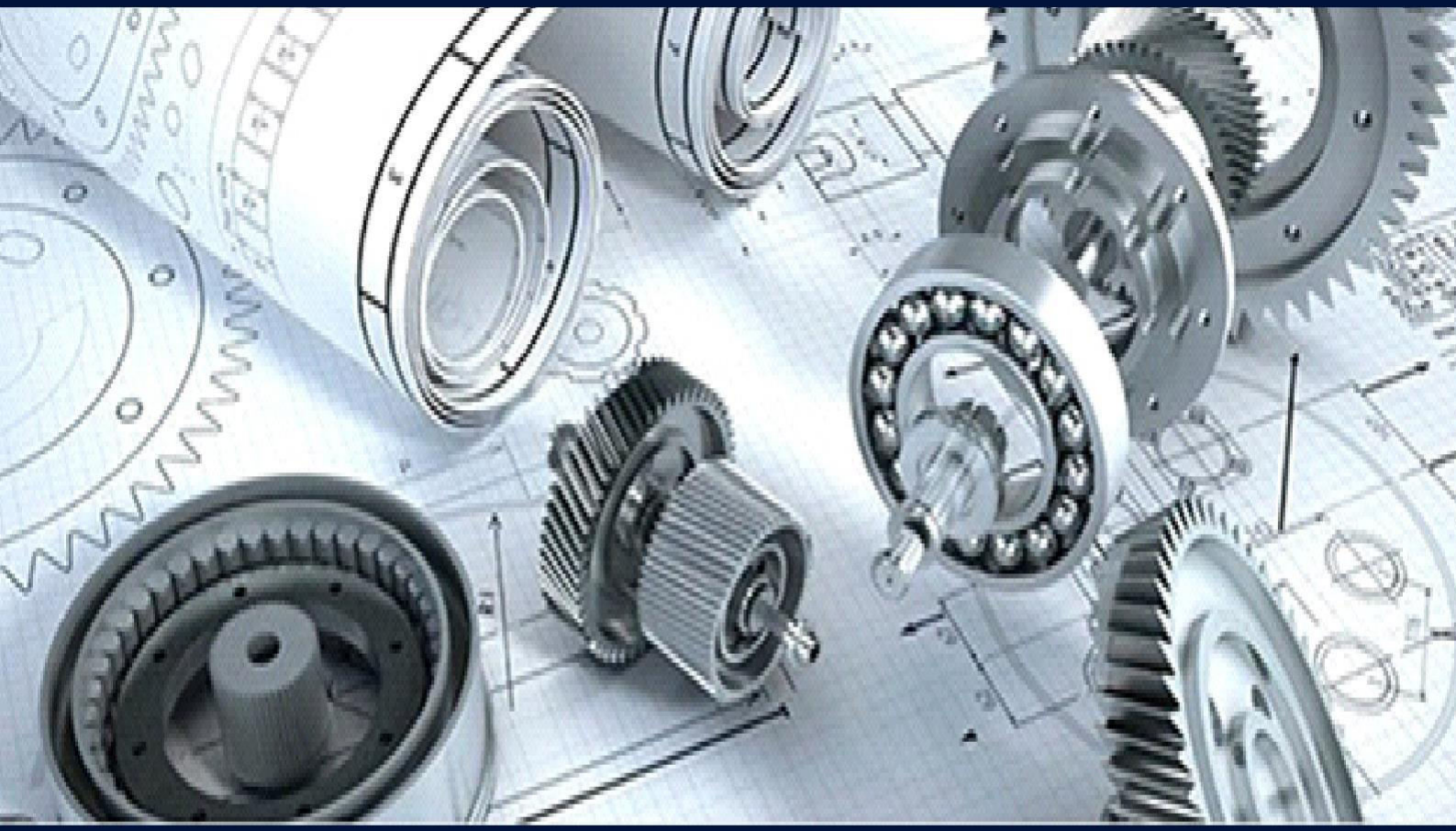

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