Replacing Coarse Aggregates with Sustainable Recycled Aggregates in Concrete

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ABSTRACT

Sustainability is important to the well-being of our planet, continued growth of a civilization, and human progress. Concrete is one of the most commonly used construction materials in the world. However, the manufacturing of portland cement, an important constituent of concrete, leads to the release of momentous amounts of CO2, a greenhouse gas emission of one ton of portland cement produces about one ton of CO2 and other GHGs. The environmental problems associated with GHGs, in addition to natural resources problems, will play a leading role in the sustainable development of the cement and concrete industry. The focus of our research will primarily be aiming on the coarse aggregate replacement with recycled coarse aggregate materials. In order to attain the goal of ecological development it is necessary to make use of recycled materials and reuse them to provide a helping hand in controlling climate change and other environmental disasters. We have replaced the natural coarse aggregate or NCA with 100% of recycled coarse aggregate or RCA. The goal is to design a concrete that gives high strength, is cost-effective to produce on a larger scale and also gives increased workability

Keyword: *Recycled coarse aggregate,* Natural coarse aggregates (NCA), *sustainable concrete, compressive strength and workability.*

1. INTRODUCTION

Due to the rapid sprawl and industrial development the construction industry has been has been progressing like never before and this has resulted in increasing carbon releases and greenhouse gases. Since, there have been lots of ongoing construction projects across the globe there has been huge 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 back in to the construction projects without any disadvantages or demerits.

Aggregate constitutes the largest proportion of concrete by volume, and its use is important because it improves both the volume stability and durability of the resulting concrete. We have been using the sand from the river beds as natural fine aggregates (NFA) and the crushed rocks as natural coarse aggregates (NCA) which have been formed over centuries of natural processes.

2. MIX DESIGN

Concrete mix design is the method of proportioning of materials of concrete to enhance its properties during plastic phase as well as during hardened phase, as well as to find economical mix proportions. Designed mix concrete recommends proportions of cement, sand, aggregates and water (and sometimes admixtures) based on

actual material quality, degree of quality control, quality of materials and their moisture content for given concrete compressive strength required for the project.
Designed mix concrete are carried out in laboratory and based on various tests and reconsiderations in mix designs, the final mix proportions are suggested.

Table 1.1: Mix Design for Conventional Concrete

Conventional Cube	Cement	Sand	Aggregates
For 1 cube	1.36 kg	2.27 kg	4.25 kg
For 6 cubes	8.16 kg	13.62 kg	25.5 kg

Table 1.2: Mix Design for Recycled Coarse Aggregate Concrete Cube

RAC Cubes (for 6 cubes)	Cement	Sand	Aggregates	Recycled coarse aggregates
50% replacement	8.16 kg	13.62 kg	12.75 kg	12.75 kg
75% replacement	8.16 kg	13.62 kg	6.375	19.125 kg
100% replacement	8.16 kg	13.62 kg	-	25.5 kg

3. RESULTS

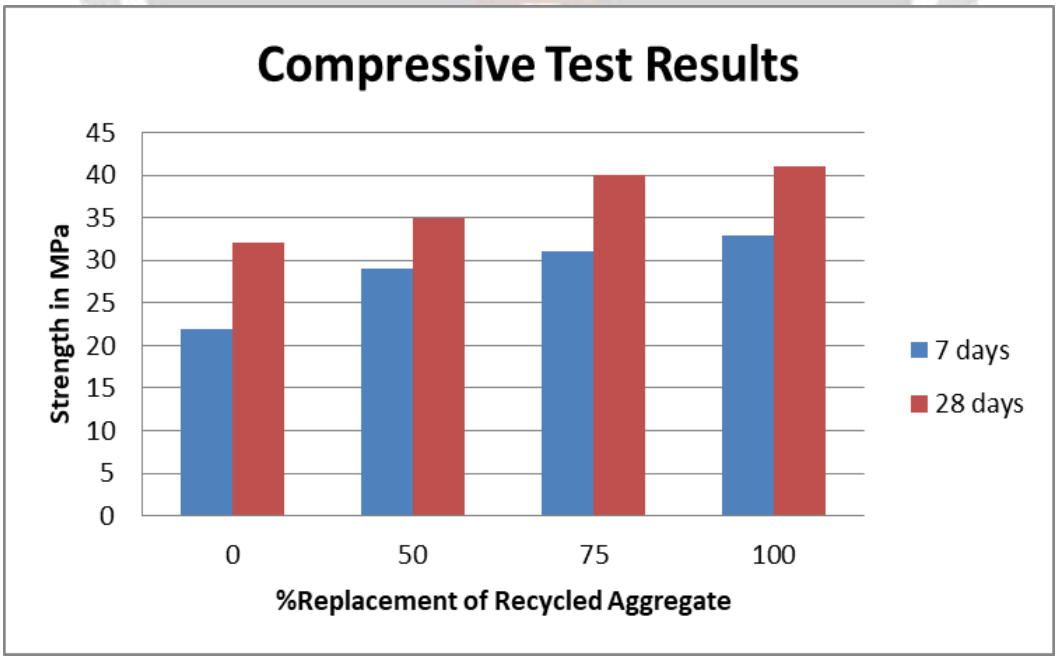

Chart-1: Compressive test results of concrete

3. CONCLUSIONS

The study is intended is to find the effective ways to reuse the construction and demolition waste as a replacement for natural coarse aggregate. After the analysis of compressive strength and slump cone test we have concluded the following things:

1. Recycled construction waste can indeed be used as a replacement for natural coarse aggregates.
2. With the increase in replacement content of NCA with RCA we did not find any significant decrease in strength. The reason for this might be that the aggregates that were obtained from a well-treated plant through the recycling process and were well graded which helped in good bonding of concrete with no voids within it.
3. With the increase in replacement quantity we observed that the slump goes on decreasing. The slumps for 0%, 50%, 75% and 100% were 118mm, 115mm 110mm and 98mm respectively. The decrease in slump value is due to the reason that recycled coarse aggregates have higher water absorption when we compare it with the natural coarse aggregates.
4. As the experimentation was done for the concrete prepared for insignificant quantities of cubes which were to be casted, the workability might decrease when the recycled coarse aggregates are to be used in the concrete for heavy RCC works.
5. The recycled coarse aggregates have higher absorption rates as compared to natural aggregates, hence it is fair enough to assume that the recycled concrete is suitable for concreting works when the concrete is to be prepared on site and used instantly. Manufacturing recycled concrete in RMC plants and transporting them over to the site locations might result in less workability when the concrete arrives and quick

4. REFERENCES

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