Experimental Behavior of Recycled Aggregate Concrete by using Different type of Cement

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Abstract- Concrete is most widely used construction material in the world and also one of the most important materials employed in public works and building construction projects. Concrete is used since so many decades. It means that we have utilized a tremendous amount of concrete and also will have to continue to use it. As Concrete is the world's most widely used construction material, but at the same time, it is not an environmentally friendly material because it destroys and uses up large quantities of natural resources and it is also a source of environmental impact because after its use, it is generally deposited in landfills.cement with replacing the natural aggregate with recycle concrete aggregates by (0%, 30%, 60% and 90%). The compressive strength of concrete after 7 days and 28 days and workability are compared for recycled concrete aggregate concrete and natural aggregate concrete

Keywords- cement,recycled ,concret

I. INTRODUCTION

The basic ingredients of the concrete are cement, fine and coarse aggregates and water. Aggregate is a broad category of coarse material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geo-synthetic aggregates. Aggregates are the most mined materials in the world. Fine and coarse aggregates are naturally occurring resources, which results that these resources are depleting at a very high rate. Growing awareness on protection of environment and conservation of natural resources, together with this the problem of waste disposal, especially, the demolition rubble has become a major concern for planners and engineers, environmentalists results in making efforts to use the waste produced from the demolition of various structures as a substitute of natural aggregates. Researchers has suggested the possibility of appropriately treating and reusing concrete as aggregate in new concrete, especially in lower level applications.

Production process of RCA

I. Recycling plant
II. Sources of Recycled Aggregate
III. Equipment used during recycling process
IV. Transportation
V. Crushing Plant
VI. Screening plant and washing plant
VII. Stockpile

II. LITERATURE REVIEW

This section of the paper represents the literature review of the work and defined the existing approaches and models. This study helps to enhance the knowledge related to the topic.

Aggregate type: Yang et al.(2008) graded the aggregate as per KS14 and found that the initial slump of fresh concrete slightly decreased with the increase of the replacement level of recycled aggregates but was hardly affected by their type. Poon et al. (2007) observed that the initial slump slightly increased with the increase of the replacement level of recycled coarse aggregates used in a saturated surface dry state. Water volume: Poon et al.(2004)studied the moisture condition of the aggregate on initial slump showed that the initial slump of recycled aggregate concrete was significantly affected by the moisture condition of aggregates. Water in aggregate: Lin et al. (2004) concluded that the initial slump of recycled aggregate concrete was mainly affected by w/c and volume ratio of recycled coarse aggregate rather than the type of recycled aggregates. In addition, particle distribution and shape of aggregates would also have an influence on the initial slump of fresh concrete.

The workability of RAC for the same water content in the concrete is lower as reported by many researchers, especially when the replacement levels exceed 50% (Topcu and Sengel,2004). In order to improve the workability, certain measures in the direction of changing the moisture condition of the RA, have been suggested (Oliveira et al., 1996; Poon et al., 2002, 2004). In another study several concrete mixes were prepared with varying methods of recycled coarse aggregate preparation, in terms of saturation. It was found that, extra water corresponding to absorption of the aggregate mixed during concrete preparation produced the most consistent results as far as workability is concerned (Rao, 2005).

Xiao et al. (2012) concludes that compressive strengths of recycled coarse aggregate are generally lower than those of conventional concrete. Furthermore, compressive strength values decrease with the increase of RCA amounts. Several reasons could be responsible for the reduction of the compressive strength for RAC, including an increased concrete porosity and a weak aggregate-matrix interface bond.

Kim et al. (2012) observed that compressive strength decreased when the coarse aggregate was replaced with the recycled. Additional replacement of the fine aggregate reduced the strength as the recycled fines amount increased.

When the fine aggregate replacement was greater than 60% the strength reduction became more significantly.

Poon et al. (2004) studied Influence of moisture states of natural and recycled aggregates on the compressive strength of concrete, and concluded that the concrete mixtures prepared with the incorporation of recycled aggregates, the air dried (AD) aggregate concretes exhibited the highest compressive strength. The surface dried density (SSD) recycled aggregates seemed to impose the largest negative effect on the concrete strength, which might be attributed to ''bleeding'' of excess water in the pre-wetted aggregates in the fresh concrete. Based on the results of his study, aggregates in the AD state and contain not more than 50% recycled aggregate should be optimum for normal strength recycled aggregate concrete production. Khatib et al (2005) found that the absorbed water in the recycled aggregate may have helpedwith internal curing by providing a source of water to react with the cement. The relative compressive strength of recycled aggregate concrete decreases with the increase of relative water absorption of aggregate and the relative compressive strength can also be significantly affected by the w/c and curing condition. Rahal et al (2007) when relative water absorption of aggregate is below 1.8%, the compressive strength of recycled aggregate concrete maintains more than 80% of that of the control concrete with natural aggregates, whereas the compressive strength of recycled aggregate concrete having relative water absorption of aggregate above 5.5% drops significantly, by as much as approximately 40% of that of the control concrete with natural aggregates. Insufficient hydration and a weak interface-zone formed between different components of the concrete matrix owing to a large amount of old cement paste on the surface of recycled aggregates, which can be the cause of a poor development of the compressive strength of concrete.

III. PROPOSED WORK

The details of experiment programmed in terms of material properties, test set-up for measuring different parameters are the testing procedure discussed in this section.

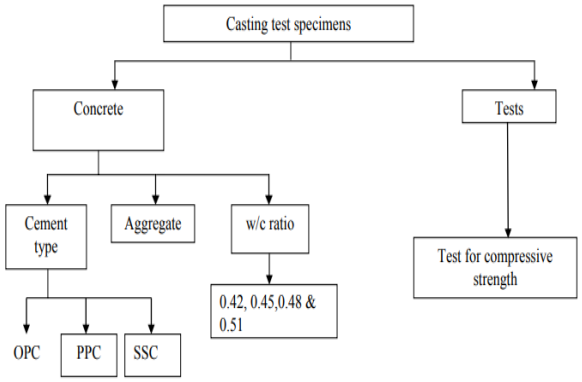

Fig.1: Experiment details for compressive strength

Cement: It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. Three different types of cement used were 1) Ordinary Portland cement (OPC) satisfying Indian standards IS: 8112-1989. 2) Portland pozzolana cement (PPC) having 20% pozzolana (fly ash) content, satisfying Indian standards IS: 1489 (Part I) – 1991. 3) Steel slag cement

Aggregates: The material which passes through 4.75 mm sieve is termed as fine aggregate. Usually natural sand is used as a fine aggregate at places where natural sand is not available crushed stone is used as a fine aggregate. The sand used for the experimental works procured and conformed to grading zone II.

CASTING OF SPECIMENS

In this section casting procedure for compressive strength test and pull out strength test are Discussed 3.6.1 Casting for Compressive Strength test 150mm cube is used to study the compressive strength of various mixes. The cubes are filled with fresh concrete using vibrating table. Immediately after casting cubes, the specimens are covered with gunny bags to prevent water evaporation. Three cubes are casted for each parameter. The compressive strength test is carried out for 7 days and 28 days. Therefore, six identical specimens are casted for each concrete mix. The cubes after casting are shown in Figure

IV. TESTING OF SPECIMENS

In this section test setup for both the tests (compressive strength test and pull out strength test) are discussed. Test setup for Compressive Strength test Three identical specimens are crushed at 7days and three identical specimens are crushed at 28 days. The compressive strength is calculated by dividing the failure load by average cross sectional area. The compressive strength testing machine of capacity 3000 KN is used for determining the maximum compressive loads carried by concrete cubes. The compressive strength test machine which used in all tests at the test age the specimens are taken out of the curing tank and kept outside for 10 minutes.

V. RESULTS

In the first part of this section, the effect of replacement ratio of recycled coarse aggregate on workability of concrete by using OPC, PPC and SSC is discussed. In the second part the effect of replacement ratio of recycled coarse aggregate on compressive strength of concrete by using OPC is discussed. The effect is studied at a range of w/c ratios. The third consists of discussion the effect of replacement ratio of recycled coarse aggregate on compressive strength of concrete by using PPC is discussed w.r.t different water cement ratios. The fourth part consists of discussion the effect of replacement ratio of recycled coarse aggregate on compressive

strength of concrete by using steel slag based cement is discussed w.r.t different water cement ratios.

a) Effect of water cement ratio and RCA replacement ratio
During mixing it is observed that as we increase the replacement ratio of recycled aggregate, the workability decreases. This decrease in workability was then controlled by addition of extra dose of superplasticizer.The decrease in workability with the addition of RCA can be due to the adhered cement mortar attached with recycled aggregates.
b) Effect of cement type Moreover the workability also decreases with change in type of cement. It is observed that for all w/c ratios, workability is very low in case of SSC as compared to PPC and OPC. This may be due to the ball bearing effect of fly ash with recycled aggregates as compared with slag. Additional quantity of super plasticizer is added for the different recycled coarse aggregate replacement percentage in the concrete mixture and for different w/c ratios and different type of cements to maintain the selected slump value i.e 50-60 mm as presented in figure

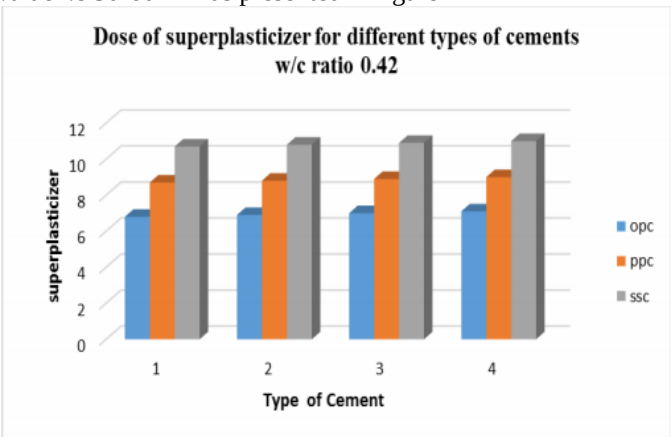

Fig.1: Dose of super plasticizer for different types of cements w/c ratio 0.42

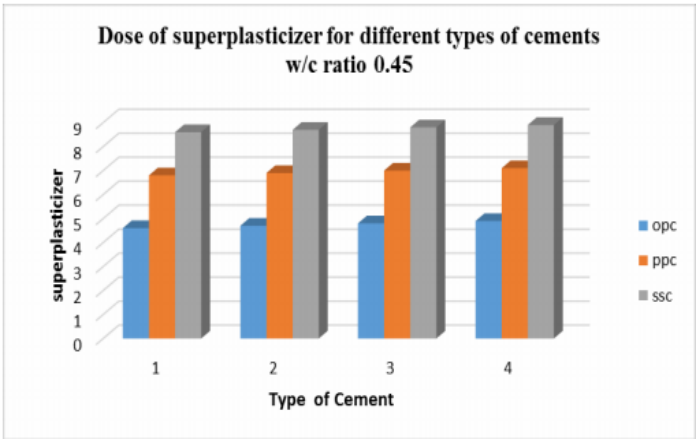

Fig.2: Dose of superplasticizer for different types of cements w/c ratio 0.45

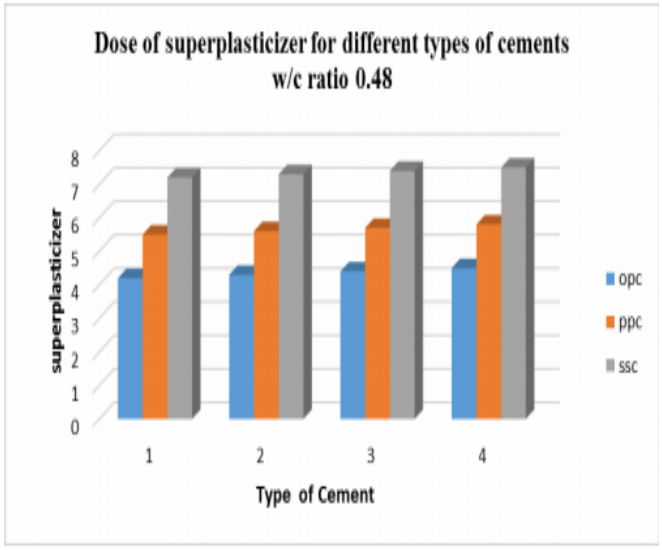

Fig.3: Dose of super plasticizer for different types of cements w/c ratio 0.48

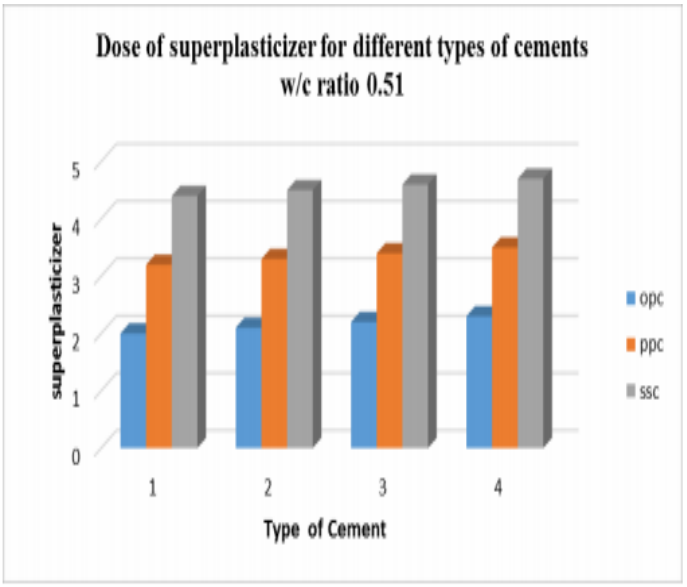

Fig.4: Dose of super plasticizer for different types of cements w/c ratio 0.51

VI. COMPRESSIVE STRENGTH

Three cubes (150mm) from each batch of concrete mix are casted and cured for 7 and 28 days in order to determine compressive strength of RCA concrete. All specimens are cast in a single mix and direct weight to weight replacement of natural coarse aggregate is carried out with recycled coarse aggregate at a replacement ratio of 0, 30, 60, and 90 %. The mixes are casted at water-cement ratio of 0.42, 0.45, 0.48 and 0.51. This corresponds to range of strength varying from low strength concrete to moderate strength concrete.

Effect of recycled coarse aggregate on compressive strength using OPC

As can be seen from Figure 1.2 – 1.5, for all water-cement ratios, the 28 days compressive strength decreases as the percentage of replacement increases. Maximum decrease in compressive strength is 20% and average decrease is 10%. However the same trend is at 7 days strength but with lesser decrease in strength.

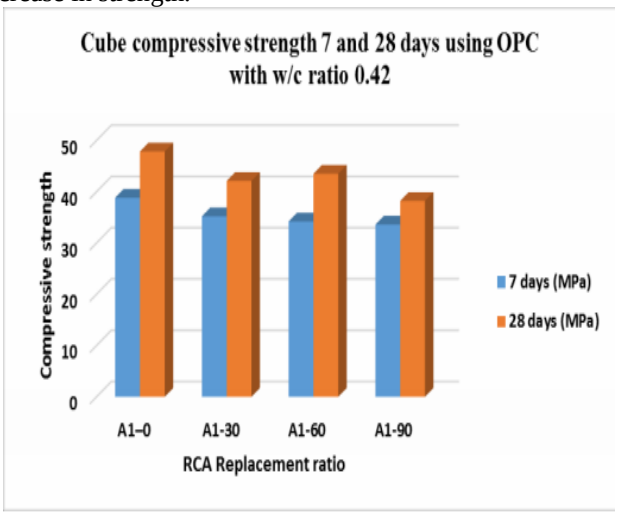

Fig.5: Cube compressive strength 7 and 28 days using OPC with w/c ratio 0.42

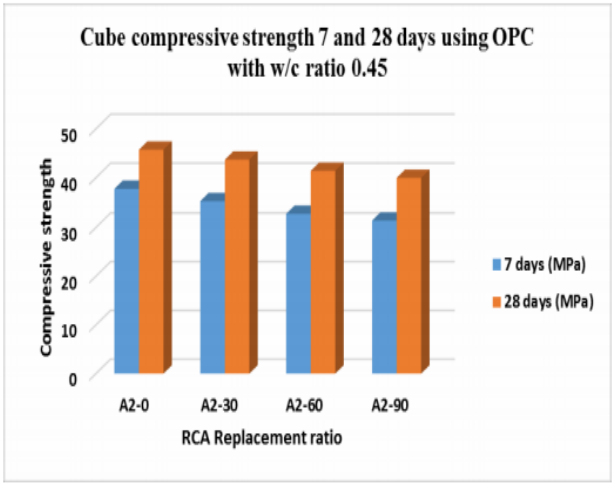

Fig.6: Cube compressive strength 7 and 28 days using OPC with w/c ratio 0.45

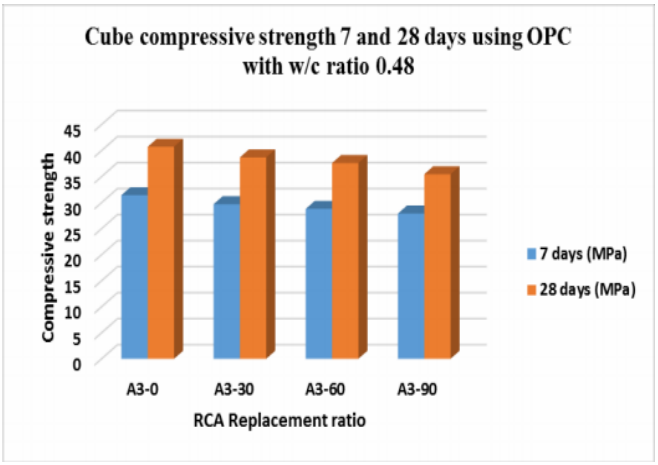

Fig.7: Cube compressive strength 7 and 28 days using OPC with w/c ratio 0.48

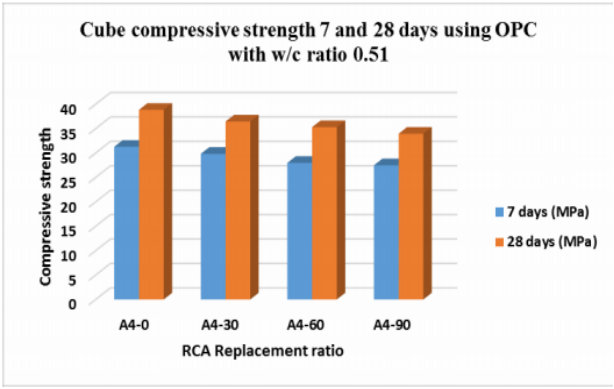

Fig.8: Cube compressive strength 7 and 28 days using OPC with w/c ratio 0.51

VII. CONCLUSION

The reuse of recycled materials derived from construction and demolition waste is growing all over the world. The main scope of the work is to prepare the concrete by using different type of cement with replacing the natural aggregate with recycle concrete aggregates by (0%, 30%, 60% and 90%). The compressive strength of concrete after 7 days and 28 days and workability are compared for recycled concrete aggregate concrete and natural aggregate concrete. .The major observations from this experimental work are as follows:

1. RAC requires more water for the same workability than normal concrete; the same can be controlled by addition of super plasticizers.

2. The use of RCA as coarse aggregate in concrete mixes resulted in a marginal decrease in the strength depending on the replacement ratio and the grade of concrete.

3. As compared to OPC & PPC the 28 days strength of PPC is better than the corresponding strength of OPC for all w/c ratios & all percentage replacements of RCA.

4. The performance of SSC & PPC concrete is almost same at all percentage replacement levels that shows the type of cement does not have much effect when compared with percentage of RCA.

5. SSC cement performs in decrease in workability and there is marginal increase in strength. 6. Considering all the mixes it can be said that PPC at 90% replacement level of RCA is giving the most economical and sustainable mix

VIII. REFERENCES

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