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Use of Recycled Coarse Aggregates in SCC

Purva P. Awari
VIVA Institute of Technology

Abstract: *Nowadays major challenges faced by civil engineering field is to execute project which comes harmonised with the character. This is achieved to some extent by judicious use of natural resources in construction practices. In the recent years the demand for construction materials has grown hugely, so has the quantity of construction and demolition waste, putting tremendous pressure on the surroundings. This has encouraged the use of recycled mixture in concrete that not solely permits for a additional economical life cycle of natural resources however conjointly contributes to environmental protection resulting in property development. In this study coarse recycled mixture (RCA) square measure utilized in the assembly of self compacting concrete (SCC) in variable share replacements of natural coarse aggregate (NCA) from 1/3 to 100 percent with increment of twenty fifth. This investigation is an try to look at the influence of recycled mixture on strength of self compacting concrete. It is observed that recycled mixture are often effectively utilized in the assembly of SCC with none vital reduction in strength and sturdiness.*
Keywords: *Recycled coarse aggregate, Self-compacting concrete*

I. Introduction

Self-compacting concrete (SCC) is an innovative concrete that will not need vibration for putting and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. The hardened concrete is dense, homogeneous and has the same engineering properties and sturdiness as ancient vibrated concrete. Self-compacting concrete offers a rapid rate of concrete placement, with faster construction times and ease of flow around full reinforcement. The fluidity and segregation resistance of SCC ensures a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and sturdiness to the structure. SCC is often made with low water-cement quantitative relation providing the potential for prime early strength, earlier demoulding and faster use of components and structures. The elimination of vibrating instrumentality improves the atmosphere on and close to construction and formed sites wherever concrete is being placed, reducing the exposure of workers to noise and vibration. The improved construction practice and performance, combined with the health and safety benefits, make SCC a terribly engaging answer for each formed concrete and engineering construction.SCC also achieves same engineering properties and sturdiness as ancient vibrated concrete. The use of SCC has gained a wider acceptance in recent years.

As there is urbanization growth in India is incredibly high attributable to manufacture growth. Rapid infrastructure development needs a giant amount of construction materials, land requirements & the web site. For achieving GDP smaller or previous structures square measure destroyed and new towers square measure made. Protection of environment is a basic issue that is directly connected with the survival of the human resource. Parameters like environmental consciousness, protection of natural resources, sustainable development play Associate in Nursing vital role in trendy necessities of construction works. Due to modernization destroyed materials square measure drop toward land & not used for any purpose. Such situation have an effect on the fertility of land. From environmental point of read ,for production of natural aggregates of 1 MT emissions of zero.0046 million tonne of carbon exist. The use of recycled aggregate typically will increase the drying shrinkage, creep & porosity to water.

II. Literature Review

Prashant O. Modani, e al said that the recycling of construction and demolition waste is a promising way towards sustainable construction to create a sustainable solution to warrant the problem of environment protection also he stated the effect of coarse recycled concrete aggregates on the fresh and mechanical properties of self compacting concrete. Puja Rajhans e al carried out an experimental work on SSC i.e The Two stage mixing approach(silica fume, fly ash and cement) (TSMAsfc) is employed, in which 6% silica fume and proportional amount of cement is added to the recycled aggregate in the premix stage. Experimental results show that 100% replacement of RCA marginally affects the mechanical properties in two stage mixing approach (TSMA). However, TSMAsfc significantly improves all the mechanical properties as compared to normal mixing approach (NMA) and TSMA. Akash Rao et al did an investigation study on the use of recycled aggregates in concrete provides a promising solution to the problem of C&D waste management based on production and utilization of RA in RAC, can be used in lower end applications of concrete and the properties of RA and RAC it is clear that RAC can be used in lower end applications of concrete with, RA can be used for making normal structural concrete with the addition of flyash, condensed silica fume, etc.

Mirjana Malešev Vlastimir Radonjanin Snežana Marinković ,.in this the author's explain that the performance of recycled aggregate concrete, even with the total replacement of coarse natural with coarse recycled aggregate, is mainly satisfactory, not only in terms of the mechanical properties, but also the other requirements related to mixture proportion design and production of this concrete type. All the conclusions made in this work about the tested properties of fresh and hardened concrete and consequently, about the behavior of beams subjected to bending, are valid for recycled aggregate concrete produced with quality recycled aggregate, obtained from demolished concrete with good mechanical properties, as it was the case in this experimental research.

III. Objective

To find out the % use of RCA feasible for construction. And to reduce the impact of waste materials on environment.To find out the ways of cost saving such as transportation, excavation etc. To help in achieving a sustainable development in the field of construction. To achieve desirable strength of concrete using RCA. To reduce the increasing quantity of demolished constructional waste. To obtain the desirable workability by using RCA.

IV. Scope of Work

In order to reduce the consumption of energy and available natural resources. Minimizing the environmental impact, energy and CO2 intensity of concrete used for construction is increasingly important as resources are declining. The impact of greenhouse emissions becoming more evident. Thus, it is logical to use life cycle and sustainable engineering approaches. rapid rate of industrialization has made recycling of construction material play an important role in the preservation of natural resources. To reduce the pressure on naturally available materials by replacing it with recycled aggregates.

V. Materials

5.1.Cement

An ordinary Portland cement (Grade 53) conforming to IS 12269 (1987) was used as the main binder for the experimental investigation. Other cementations materials such as alccofine 1203 also used in SCC Mixtures & fly ash is used as a mineral admixture.

5.2 Fine Aggregate

Locally available crushed sand conforming to of IS 383:1970 was used in the present investigation. The physical properties such as specific gravity, bulk density, water absorption and fineness modulus were investigated.

5.3 Coarse Aggregates

In this study, natural coarse aggregates obtained from a local supplier were used. The recycled aggregates were obtained from demolished constructional sites were used for present study. The maximum size of aggregate was limited to 20mm.

5.4 Superplasticizer

The superplasticizer used was a polycarboxylic ether polymer based admixture. The main reason of utilizing superplasticizer in SCC it gives good flowability with very high slump that is to be used in heavily reinforced structural member.

5.5.Water

Ordinary tap water is used.

VI. Mix Design

For the purpose of the experiment five types of concrete mixes were made. In each mix natural coarse aggregate was replaced by recycled coarse aggregate in the ratio of 0%, 25 %, 50%, 75% and 100% by volume. The preliminary mix design was carried out for target strength of 30 MPa. After the initial mix design, the trial mixes were prepared and tested for the fresh properties of SCC as per EFNARC guidelines. The mixes were designated as a combination of two numbers separated by an alphabet R for recycled aggregate. The first number represent the strength of concrete followed by R and a number which represent the percentage of recycled aggregate in concrete. There is no standard method for SSC mix design and many academic institutions, admixture, ready mixed, precast and concreting companies have developed their own mix proportioning methods. Mix design often use volume as a key parameter because of the importance of the need to over fill the voids between the aggregates particles. Further information on mix design and on methods of evaluating properties of SSC can be found in the EFNARC Guidelines of SSC. Hence the following mix design is recommended for M30 grade SSC.

Table:1 Concrete mix proportions

MATERIAL	CM	R25	R50	R75	R100	TOTAL IN KG
CEMENT	225.0	225.0	225.0	225.0	225.0	1125.2
Flyash	45.0	45.0	45.0	45.0	45.0	225.0
Alccofine	30.0	30.0	30.0	30.0	30.0	150.0
FINE AGGREGATE	350.4	350.4	350.4	350.4	350.4	1751.9
CA1	194.7	194.7	194.7	194.7	194.7	973.3
CA2	233.6	175.2	116.8	58.4	0.0	584.0
RCA	0.0	58.4	116.8	175.2	233.6	584.0
WATER	81.0	81.0	81.0	81.0	81.0	405.1
ADMIXTURE	3.5	3.5	3.5	3.5	3.5	17.3

Table 2: mix types

Mix Types	30R0	30R25	30R50	30R75	30R100

VII. Fresh State Properties

Self- Compacting Concrete is characterized by filling ability, passing ability, flowing ability and resistance to segregation. Different methods have been developed to characterize the properties of SCC. No single method has been found till date, which characterizes all the relevant workability aspects and hence, each mix was tested by more than one test method for the different workability parameters. In this investigation the fresh state properties of SCC were tested by following methods as suggested by EFNARC. Slump flow test and V-funnel test for knowing the filling ability of concrete mixes.

7.1Slump flow test:
The slump-flow is a test to assess the flowability and the flow rate of self-compacting concrete in the absence of obstructions. It is been described in EN 12350-2. The result is an indication of the filling ability of self-compacting concrete.

7.2V-Funnel:
The V-funnel test is used to assess the viscosity and filling ability of self-compacting concrete. A V shaped funnel is filled with fresh concrete and the time taken for the concrete to flow out of the funnel is measured and recorded as the V-funnel flow time. For V-funnel test the flow time should be 8-12 sec.

VIII. Result

8.1.Fresh State Properties:

Results obtained by fresh concrete testing are displayed in Table : Slump flow test used to examine flowability property of SCC. All mixes exhibited slump flow in the range of 640-800 mm which ranks all the designed mixtures as per EFNARC guidelines which is the most common class in general civil engineering usage and practice. As per EFNARC specification V-funnel time ranging from 8 to 12 seconds is considered adequate. The test results of V-funnel test for all mixes meet the requirement of flow time which is an indication of good filling ability even with congested reinforcement. The table below is the representation of data obtained during the test of fresh state properties of concrete.

Table 3: Result of Fresh State Properties of SSC

Workability Test	Units	VALUE
Slump flow	mm	760
V funnel	Sec	10

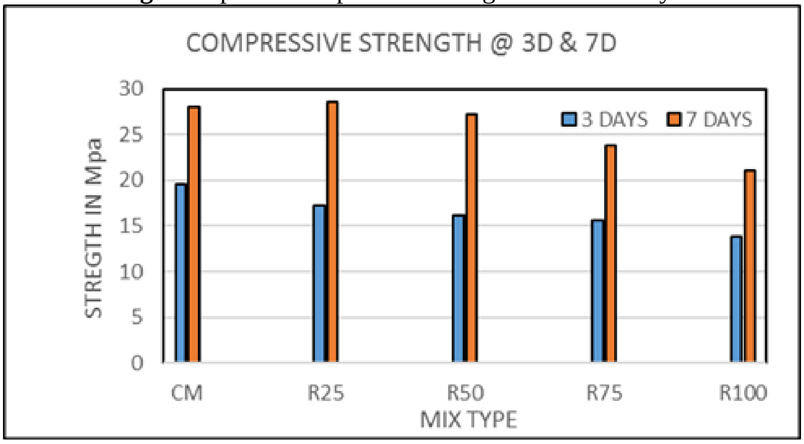
8.2. Strength Investigations:
8.2.1Compressive Strength:

The hardened concrete properties such as compressive strength were tested in the laboratory. The results are presented along with their graphical plots and discussions. The compressive strength is measured using both cube and cylindrical specimens. The size of the cube specimen is 150 mm × 150 mm × 150 mm . Table below shows the results of the 3 days and 7 days compressive strength of concrete. From the results, the compressive strength seems to increase slightly with the addition of RCA. This could be due to the higher absorption capacity of the recycled aggregate. When the water is absorbed by aggregate, more space left by the water being absorbed can be occupied by aggregates in a unit volume. Hence the density of recycled concrete is lower. The results of compressive strength of concrete with 0%,25%, 50%, 75% and 100% replacement of RCA which is achieved after testing are given below also the graph shows the details about the strength obtained **:**

Table 4 compressive test result

MIX TYPE	COMPRESSIVE STRENGTH @ 3D (Mpa)	COMPRESSIVE STRENGTH @ 7D @ (Mpa)
CM	19.63171	28.00159
R25	17.26141	28.55872
R50	16.20439	27.19032
R75	15.56862	23.84939
R100	13.76303	21.09731

Fig 1 Graph for compressive strength at various days



Thus it can be concluded that RCA upto 25% is satisfactory to use. It will also be economical with the reduce in transportation cost of dumping the aggregates. Primary reason of strength reduction may be the adhered mortar to the RCA and other non-aggregate material. This can be corrected by using proper cleaning techniques and casting methods under highly skilled supervision.

IX. Conclusion

From the experimental work carried out on "Recycle of Concrete Aggregates" the following conclusion can be drawn:

1) There is a significant scope for utilization of recycled aggregate as an appropriate and green solution for sustainable development in construction industry.
2) There is a negligible effect of incorporation of recycled aggregate on fresh properties of self compacting concrete.
3) The effect of recycled coarse aggregate on the compressive strength of concrete is evident from the results. However the loss in strength was not considerable which is an encouraging sign to promote the use of recycled aggregates in structural concrete.
4) The compressive strength of concrete containing 25% RCA has strength in close proximity to that of normal concrete.
5) The strength of concrete is high during initial stages but gradually reduces during later stages.
6) Due to lack of treatment process for RCA adequate strength is not achieved but by applying more advanced and sophisticated treatment process the strength can be improved.

As SCC technology is now being adopted in several countries throughout the world, in absence of suitable standardized check strategies it is necessary to look at the present check strategies and determine or, when necessary to develop check strategies appropriate for acceptance as International Standards. Such test strategies have to be capable of a speedy and reliable assessment of key properties of recent SCC on a construction web site. At the same time, testing equipment ought to be reliable, easily moveable and cheap. A single operator should perform the check procedure and therefore the check results got to be understood with a minimum of coaching. In addition, the results have to be defined and specify completely different SCC mixes. One primary application of these test strategies would be in verification of compliance on sites and in concrete production plants, if self-compacting concrete is to be manufactured in giant quantities. Thus the usage of RCA in concrete mixture is found to have strength in shut proximity thereto of natural combination and might be used effectively as a full worth part of latest concrete. production plants, if self-compacting concrete is to be manufactured in giant quantities. Thus the usage of RCA in concrete mixture is found to have strength in close proximity thereto of natural aggregate and will be used effectively as a full worth component of new concrete.

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