International Journal of Scientific Research & Engineering Trends
Volume 8, Issue 3, May-Jun-2022, ISSN (Online): 2395-566X

An Experimental Study on Self Compacting Concrete with Recycled Concrete Aggregate

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Abstract- The usage of natural aggregate is becoming more intense with the advanced development in construction. Recycled aggregate can be used as a suitable replacement for natural aggregate. Recycling of aggregate material from construction and demolition waste may reduce the demand - supply gap and reduce consumption of natural resources. The advance in the pre stressed concrete and multistoried structures has given impetus for making high performance concrete. When the general performance of concrete is substantially higher than that of normal type concrete, such concrete is regarded as high performance concrete (HPC). High- performance concrete (HPC) exceeds the properties and constructability of normal concrete.HPC is usually more brittle when compared with normal strength concrete, especially when high strength is the main focus of the performance. These deficiencies can be overcome by adding fibres. Fibre reinforced concrete has become popular due to its crack arresting mechanism, strengthening property, high energy absorption properties, ductile behavior and post-cracking tensile strength. The aim of this thesis is to study the flexural as well as shear behaviour of fibrere in forced high performance recycled aggregate concrete in beams under monotonic for optimum percentages of fibres.

Keywords- Self compacting concrete (SCC), Recycled concrete aggregate (RCA), Natural Aggregate self compacting concrete (NASCC), Recycled Aggregate self compacting concrete (RASCC).

INTRODUCTION

The growing need for infrastructural development produced a huge demand on construction materials. Concrete is the widely used construction material and it require salarge percentage of natural resources forits production. Thus concrete construction industry became the largest consumer of natural resources. The increase in demand leads to over exploitation and scarcity of natural resources. So it is high time to concentrate in developing eco- friendly and sustainable methods in concrete production. For this reason producing a durable concrete with the available waste materials without affecting the functionality of concrete, will direct a sustainable path for the construction industry.

Accumulation of waste and its management became a threatto environment and society. In India, about 960 million tones of solid wastes are being generated per year. Of this 14.5 million tonnes are from construction industry[1].Construction wastes include brick, bitumen, sand, gravel, masonry and concrete. These wastes are recycled and utilized in buildings and the share of recycled materials is 25% for old buildings and 75% for new buildings. Concrete waste can be effectively recycled to produce RCA which we can use in concrete in place of natural aggregates. RCA should be graded according to the requirement and it can replace both coarse and fine aggregates provided. It should not affect the strength and durability of the produced concrete. The usage of RCA for the production of concrete is much advisable, not only it reduces the use of virgin raw materials but also gives a better solution for the disposal problems of demolished concrete structures.

II. METHODOLOGY

Procurement of materials Materials for the thesis work such as cement, coarse aggregate, fine aggregate, RCA, steel bars, silica fume and super plasticiser were procured. Portland Pozzolana Cement (PPC) was used for the experimental investigation. Crushed aggregate with a maximum size of 12 mm available from local sources were used as coarse aggregate for the study. Manufactures sand (M sand) was used as fine aggregate. Demolition wastes of concrete structures were collected from a 15 year old multi-storied building at Pappanam code and were used as RCA after crushing it to the required size.

Silica fume obtained from Bisons Shelter Systems Pvt. Ltd. was used as mineral admixture for the study. Silica fume improves the mechanical and rheological properties. It improves the durability of the concrete microstructure through filler effect and thus reduces segregation and bleeding. Cera hyper plast XR-W40 was used for the work as super. Clean, potable water available in the laboratory was used for the experiments the workability of SCC decreased very slightly with the addition of RCA.

The decrease in slump flow value of RASCC-100 with that of NASCC were 2%. The L-box value decreased by 6% but V-funnel and U-box of RASCC-100 increased to 22% and 9% respectively

III. DISCUSSIONS

The decrease in slump flow and L-box value indicates increased viscosity of RASCC. The increase in V-funnel and U-box results of RASCC may be due to decrease in flowability. Since all the values were within the permissible limit as per EFNARC specifications, it can be concluded that complete replacement of RCA is possible according to the workability criteria.

A difference of 5 N/mm2 from the target strength was permitted, as per IS 456, Hence RA-SCC-100 having 53.33 N/mm2 compressive strength can be taken as the optimum mix of RASCC, which has maximum replacement level as well as satisfactory strength and workability criteria. The better performance of RCA in the present study may be due to high powder content and reduced coarse to fine ratio. This will help to cover the irregularity and surface cracks of RCA.

Also since we adopted TSMA for mixing RCA, the fine particles fills into the pores and provides better strength as well as reduced water absorption.

IV. CONCLUSION

The workability of SCC decreased very slightly with the addition of RCA. The decrease in slump flow value of RASCC with that of NASCC were 2%. Similarly the L-box value decreased by 6%. The results for V-funnel and U-box of RASCC increased compared to NASCC up to 22% and 9%. But the values were confirming EFNARC specifications. The decrease in compressive strength of RASCC compared to NASCC was only 11%.Density of RASCC decreased 6% with that of NASCC, which will help to reduce the self-weight of the structure.

The cylinder compressive strength, split tensile strength, modulus of rupture and modulus of elasticity decreased in RASCC by 8%, 2%, 9% and 6% to that of NASCC. But the mechanical properties of both mixes were within the permissible limits of IS specifications. 7 day compressive strength developed was 52% and 50% of 28 day at for NASCC and RASCC respectively. The increment in compressive strength after 90 day curing of NASCC and RASCC were 13% and 12% of 28 day compressive strength. Strength development rate was observed to be

The diffusion coefficient of RASCC increased by 12% to that of NASCC using RCPT. All the specimens indicated low chloride penetration as per the ASTM C-1202, which indicates dense packing structure of SCC. Specimens immersed in sulphuric acid for acid resistance test, underwent surface erosion but exposing of coarse aggregate did not occurred. The mass loss suffered by NASCC and RASCC specimens immersed in 2% sulphuric acid at the end of 60 days are 5% and 8% respectively and the reduction in compressive strength of NASCC and RASCC are 21% and 25%. Durability characteristics of RASCC found to decrease compared with NASCC for water absorption and Sorptivity.

The increase in water absorption and Sorptivity values in RASCC 12% and 5%respectively.Bond specimens of NASCC and RASCC with 12mm, 16mm and 20mm bars failed by pull out. But the bond specimens with 10mm bars undergone yield failure in both NASCC and RASCC.

This may be due to large concrete cover to bar diameter ratio. The reduction in ultimate bond stresses were 6%, 8%, 4% and 4% for 10mm, 12mm, 16mm and 20mm bars. The reduction in bond stress at 0.025 slip of RASCC are 10%, 14%, 11% and 26% for 10mm, 12mm, 16mm and 20mm bars. Similarly at 0.25 mm slip the decrease in bond stress of RASCC are 5% and 3% for 16 mm and 20mm bars. In the small diameter bond specimens (10mm and 12 mm) the slips are less than 0.2 mm.

In larger diameter bar specimens, the slips are less than 0.5 mm and 2.5 mm for 16 mm and 20 mm bars. The peak bond stress is 2 to 4 times more than designed bond strength values of IS 456:2000 which indicates good bond strength of SCC. The energy absorption capacity and toughness increased 5% and 35% in RASCC compared to NASCC. But stiffness decreased to 6% by the addition of RCA. Increased energy absorption capacity represents better ductility of RASCC.

The crack patterns are almost similar and the number of cracks of RASCC was more but they were minor cracks. In the crack pattern, both mixes are having flexural cracks, and no shear cracks were observed. The strength and durability was reduced in RASCC compared to NASCC, it is marginal. So it can be concluded that complete replacement of coarse aggregate is possible with RCA.

The small reduction in strength can be neglected by considering ecological value of the concrete. The performance of RCA was better than expected results. This may be due to the increased powder content of SCC which helped to cover the cracks of RCA and in turn increased its strength.

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