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Research Paper

A review paper on Self Compacting Concrete with Recycled Aggregates

S.b. suman[1], Aryan singh[2], Manish sharma[3] , Gaurav Singh punder[4]
[1] *Associate Professor, Civil Eng., Meerut Institute of Engineering & Technology,Meerut, U.P. 2, 3, 4 B. Tech Student, Civil Eng., Meerut Institute of Engineering & Technology, Meerut, U.P*

Abstract— *Self Compacting Concrete (SCC) is an innovative concrete that doesnot require any vibration for compaction. The study was carried out by replacing various percentages (10%, 20%, 30%) of natural aggregates in SCC with recycled coarse aggregates and the properties of SCC were evaluated. A comparison of SCC with concrete compacted using conventional method was also included in the study. The additive used in SCC for the study was Fly ash.*
The mix designs arrived for an M-30 mix. To reduce the water- binder ratio andto get sufficient flowability for SCC a polycarboxylic based superplasticizer was used. Mix design for SCC was carried out as per 'European Guidelines for SCC' based on 'Nan Su et-al method' of mix design. Fresh properties including Slumpflow test, T-500 test, V-funnel and L-box test were carried out for SCC. Hardened properties of concrete like Compressive Strength, Flexural Strength, split tensile Strength and Water absorption test were carried out for traditional concrete and SCC. By comparing the strength parameters of different mixes, it was observed that SCC is a good alternative of traditional concrete with and without using recycled aggregates.

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I. INTRODUCTION

Recently, there has been an increasing trend toward the use of sustainable materials. Sustainability helps the environment by reducing the consumption of non-renewable natural resources. Concrete the second most consumed material in the world after water uses a significant amount of non- renewable resources. As a result, numerous researchers have investigated the use of recycled materials in the production of concrete such as fly ash [1,2] and recycled aggregate [3-7]. In the recent time due to significant increase in population and urbanization large amount of waste from construction and demolition are generated. Therefore, majority of the developed/ developing countries are facing the problem of handling and disposal of such construction and demolition wastes. Considering this aspect, there has been a growing emphasis on the utilization of waste materials and by-products in construction activities. Use of waste materials not only helps in getting them utilized but also has numerous indirect benefits such as savings in energy and protection of environment. Over the last decades, large amount of experimental works have been carried out to investigate the material properties [8–14] and durability [15–16] of recycled aggregate concrete (RAC). Accordingly, significant progress has been gained by applying recycled aggregates into construction materials in the form of RAC members [17]. Compared with natural aggregates, recycled aggregates usually have greater porosity and water absorption, lower density, and lower strength than normal aggregate [18–21]. As a result, RAC structural components invariably experience inferior physical and mechanical properties compared to normal aggregate concrete (NAC), such as low mechanical performance and poor durability behaviour [22–23]. For concrete made with 100% recycled aggregates, the compressive strength of RAC was reportedly decreased by 9–40% [24-25]. It is generally accepted that the lower elastic modulus of RAC is attributed to a lower modulus of elasticity of recycled aggregate, and the lower strength of RAC is mainly due to the weaker mortar as well as the weaker interfacial transition zone (ITZ) between the old mortar and new mortar [26]. Irrespective of all the inferior properties of recycled aggregate, many researchers are of the opinion that recycled aggregate are a good alternative to natural coarse aggregate in concrete considering its environmental and economic benefit apart from reducing load on natural resources in construction industry.

II. MATERIALS

An ordinary Portland cement (Grade 53) conforming to IS12269:1987 [27] was used in all compositions. Its specific gravity, specific surface area and 28 days compressive strength were 3.18, 380 m²/kg, and 56.5 MPa respectively. In order to increase the powder content in SCC silica fume obtained from Elkem Company of grade 920D having specific gravity 2.3 was used. Locally available river sand was used as fine aggregate. The grading of sand satisfied the IS383:1970. The natural aggregate used was crushed basalt of maximum size 20 mm, obtained from nearby stone quarry. The recycled aggregate of 20 mm maximum size used in the investigation was obtained from the demolished cubes tested in concrete technology lab of civil engineering department of B.N. College of Engineering. All the aggregates were immersed in water up to 24 hours and surface dried before use to compensate the effect of initial higher water absorption of recycled aggregates. The aggregate were tested as per IS 383-1970. Table 1 reports the results of various physical properties of aggregates. The superplasticizer used was a polycarboxylic-ether polymer-based admixture, commercially branded as Aramex 400 obtained from Fosroc chemicals. Table 1 Physical properties of aggregates Characteristics Natural Coarse Aggregate Recycled Coarse Aggregate Fine Aggregate Specific Gravity 2.65 2.19 2.60 Bulk Density, kg/m3 1614 1356 1690 Water Absorption, % 1.31 5.64 0.84 Fineness Modulus 6.2
5.962.36 Impact Value, % 9.88 17.36 –

III. MATERIALS AND PROPORTIONS

A. Material Properties The materials used for concrete were Binder materials, Fine aggregate (FA), Coarse aggregate (CA), superplasticizers and water. Different binders used in this study were Cement and fly ash(FYA). Cement used for the study was Ordinary Portland Cement (OPC) of grade 53. The manufacturer of the cement is Ramco. Fly ash used in the study was of Class-F grade. Fine aggregate used was M-sand from Poabs, Angamaly. Coarse aggregate were 12.5mm and 20mm crushed granite stones from a local quarry (CA12.5 and CA20) and recycled aggregate from 15 year old concrete building. Master Glenium SKY 8233was used as superplasticizer for the study. It is an admixture based on modified polycarboxylic ether. Properties of different aggregates.

IV. RESULT AND DISCUSSION

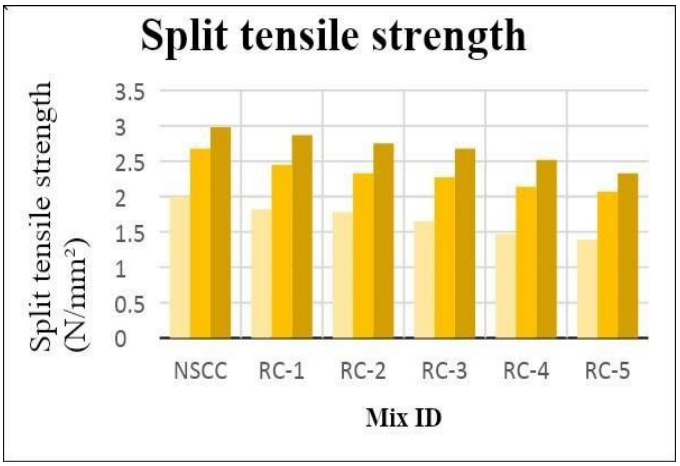
Fresh and hardened properties of concrete were studied for NVC and SCC with different percentages of RCA. Slumpflow, T-500, V-funnel and L-box tests [2] were carried out in the laboratory as per EFNRC guidelines to determine the fresh properties of SCC. Fresh properties of concrete obtained in the lab tabulated in . The values obtained are within the rangespecified in EFNRC guidelines. The slump-flow is the mean diameter of slump flow test by using a slump cone, expressed to the nearest 10 mm.

The T500 time is the time in seconds the concrete has flowed to a diameter of 500 mm in the slump flow test. The time taken for the concrete to flow out of the V-funnel is measured and recorded in second is the V-funnel flowtime.

Mix Type	Slump Flow,mm	T_{500} Slump Flow, sec	V-Funnel, sec	L Box,H1/H2
R0	720	2.15	6.08	0.97
R20	670	2.82	6.18	0.92
R40	655	2.63	6.29	0.92
R60	650	2.78	6.72	0.90
R80	685	2.43	6.18	0.87
R100	620	3.11	7.22	0.90

Graph for compressive strength at various days

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



V. CONCLUSION

It is desirable to use SCC because of its advantages like faster rate of construction and superior level of finish and also it can be used in congested reinforcement very well. Since the strength is not much reduced with recycled aggregates and flow properties were good recycled aggregatecan be effectively used in SCC. Early age strength was less in SCC compared to traditional concrete. While comparing the Split tensile strength SCC gave highest result. But with coarse aggregate replacement gives a less value.

When Flexural strength was studied all concrete mixes gave similar to that of traditional concrete. The water absorption increased in SCC with recycledaggregate was due to the higher water absorption in RCA. But it is within satisfactory limits. So RCA is a good alternative of CA in SCC. SCC with morepercentage of RCA is to be studied.

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