An Experimental Study to Produce Sustainable Concert by using Manufactured Sand and Waste Glass

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Abstract— Concrete is today more than 9000 years old and has undergone several changes not only in its composition but also in its performance and applications. From a simple beginning around 7000BC to most complicated design and application in 2013AD, concrete has been used in several structures from housing to various infrastructure projects. Concrete has played a key role in development of our planet earth in developed, developing and under developed countries. Today, development of every type needs concrete, be it in infrastructure, in industry or even in space technology and telecommunication. In the last millennium concrete had demanding requirements both in terms of technical performance and economy and yet greatly varied from architectural masterpieces to the simplest of utilities. Natural sand is excavated from river bed which impacts on environment in many ways. Due to digging of the sand from river bed reduces the water head, so less percolation of rain water in ground, which result in lower ground water level. There is erosion of nearby land due to excess sand lifting as well as it destroys the flora & fauna in surrounding areas. Due to limited supply of natural sand, cost is very high and its consistent supply cannot be guaranteed. Under these circumstances use of alternative of River Sand becomes unavoidable. Also, for sustainable development, it is indeed necessary to utilize various solid waste which leads to environment degradation. From reviewing various literatures, it seems to be possible to develop Concrete by using manufactured sand and Solid Waste of Glass. The effort was concentrated to make such Concrete by Experimental program in which workability & Strength parameters were Checked. First Concrete mix design is done by using manufactured sand and conventional Coarse aggregate, and then Waste Glass is added as replacement of Conventional Coarse aggregate up to 50 % at 10% interval. The results shows that RCA can be utilized to make concrete and hence it can help to solve it's disposal problem and avoid environment degradation.

Key words: Concrete, Compressive Strength, Manufactured sand, Waste glass

I. INTRODUCTION

Concrete is one of the most widely used construction materials in the world. Conventionally concrete is mixture of cement, sand and aggregate. Properties of aggregate affect the durability and performance of concrete, so fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river sand. Scarcity of good quality Natural River sand due to depletion of resources and restriction due to environmental consideration has made concrete manufactures to look for suitable alternative fine aggregate. One alternative is "Manufactured sand". Though manufactured sand has been in use in concrete manufacturing in India, the percentage of its contribution is still very negligible. A well processed manufactured sand as partial or full replacement to river sand is the need of time as a long term solution in Indian concrete industry until other suitable alternative fine aggregate are developed. Also if Solid waste like Glass can be utilized in concrete then it will certainly help for goal of sustainable development. Concrete must keep evolving to satisfy the increasing demands of all its users.

II. DESIGN MIX MATERIALS

A. Cement

The cement used is SANGHI OPC 53 grade cement. The Ordinary Portland Cement of 53 grade conforming to IS: 12269-2013 was used. Tests were conducted on cement like Consistency tests, Setting tests, Soundness, Compressive strength N/mm^2 at 28 days.

Item	Tests	Results Obtained	Requirement as per IS: 12269-
1	Consistency (%)	33 %	
2	Fineness	6 %	< 10 %
3	Initial Setting Time (minutes)	121	> 30
4	Final Setting Time (minutes)	216	< 600
5	Compressive		
	3 days	28.8	> 27
	7 days	39.9	> 37
	28 days	56.03	> 53
6	Soundness (Le-Chetelier Method)	2 mm	< 10 mm

Table 1: Properties of Cement

B. Coarse Aggregate

The fractions above 4.75 mm are termed as coarse aggregate. Two types of Coarse Aggregates from crushed Basalt rock, conforming to IS: 383-1970were used as shown in table II & III below:

Sr. No.	Tests	Results	Requirement as per IS : 383-1970
1	Gradation precent passing on IS sieve		
	40mm	100 %	100 %
	20mm	97 %	95 to 100 %
	10mm	30 %	25 to 55 %
	4.75mm	2 %	0 to 10 %
2	Impact value (%)	13.62	Sub base < 50 %
			Base course < 40 %
			Surface course < 30 %
3	Specific Gravity	2.81	----
4	Water absorption	0.91	< 2 %

Table 2: Properties Of Coarse Aggregate (Mm Nominal)

Sr. No	Tests	Results	Requirement as per IS : 383-1970
1	Gradation precent passing on IS sieve		
	12.5mm	100 %	100 %
	10mm	92 %	95 to 100 %
	4.75mm	17 %	25 to 55 %
	2.76mm	3 %	0 to 10 %
2	Specific Gravity	2.79	----
3	Water absorption (%)	0.96	< 2 %

Table 3: Properties Of Coarse Aggregate (10 Mm Nominal)

C. Sand

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river fine aggregate was used as fine aggregate conforming to the requirements of IS: 383-1970. The river fine Aggregate is washed and screened, to eliminate deleterious materials and over size particles.

Sr. No.	Tests	Results
1	Gradation percent Passing on IS Sieve	
	4.75 mm	100 %
	2.36 mm	86 %
	1.18 mm	67 %
	600 micron	40 %
	300 micron	16 %
	150 micron	3 %
2	Grading Zone	II
3	Fineness modulus	2.88
4	Specific gravity	2.69
5	Water absorption (%)	1.41

Table 4: Properties Of Manufactured Sand

D. Design Mix Methodology

A Concrete M25 grade was designed as per IS: 10262-2009 method and the same were used as reference mix. The design mix proportion is as below:

For 1 m^3	Water	Cement	Fine Aggregate	Coarse Aggregate
By Weight [kg]	200 L	400	665	1085

Table 5: Mix Design Proportion

III. COMPRESSIVE STRENGTH TEST

Compressive strength tests were performed on compression testing machine using cube samples at 7 days and 28 days. Six samples for each percentage of Manufacture sand were casted and then tested. The average strength values are reported in this paper at 7 & 28 days

Fig. 1: Set up of Compressive Testing Machine Source: B.V.P.I.T(D.S), Umrakh

IV. WORKABILITY AS SLUMP (MM)

Experimental Concrete mix was tested for workability by slump test as per Indian standard. The results of workability are shown in Table X.

Fig. 2: Slump cone test for Workability Source: B.V.P.I.T(D.S), Umrakh

V. RESULTS OF EXPERIMENTAL STUDY

Sr. no.	Id-mark	Slump in 'mm'
1	REF	95
2	WG10	81
3	WG20	73
4	WG30	62
5	WG40	59
6	WG50	54

Table 6: Result of Slump Cone Test

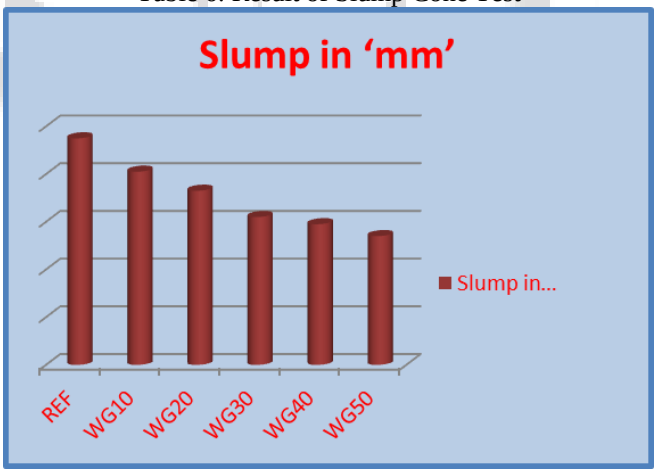

Fig. 3: Graphical Representation of Results of Slump Cone Test

Sr. no.	Id-mark	Compressive Strength (N/mm^2)	
		7 days	28 days
1	REF	25.11	33.93
2	WG10	23.39	31.98
3	WG20	21.95	31.67
4	WG30	20.30	27.87
5	WG40	19.22	26.51
6	WG50	16.88	24.64

Table 7: Result of Compressive Strength Test

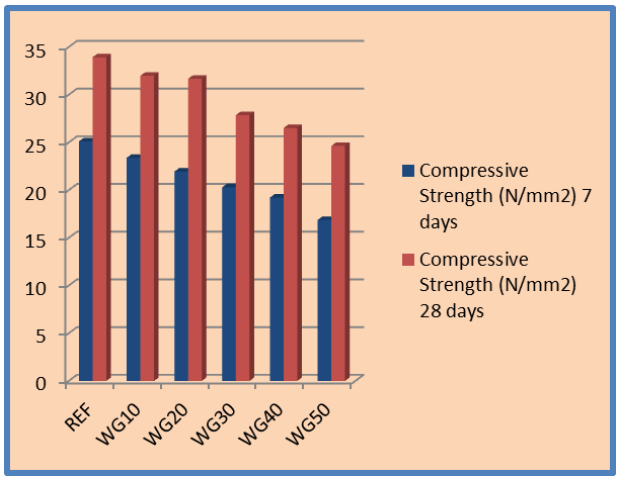

Fig. 4: Graphical Representation of Results of Compressive Strength Test

VI. CONCLUSION

The major outcomes of these project work are below:

1) The Workability of concrete reduces as percentage of Waste glass replacement for conventional coarse aggregates increases.
2) The Compressive strength of concrete reduces as percentage of Waste glass replacement for conventional coarse aggregates increases.
3) in this study, The Compressive strength of concrete for 20 % replacement of conventional Coarse aggregates by Waste glass suggest optimum replacement level for required strength.
4) It does not seems much but if we utilize even this much percentage, it will help us to solve environment problems associated with disposal of this waste material and it will be initial step towards sustainable development.

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