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A STUDY ON STRENGTH & DURABILITY PROPERTIES OF HIGH STRENGTH CONCRETE WITH HYBRID FIBRES

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Abstract—Increase in construction activities have led to an increase in demand for the various raw materials in concrete, specifically river sand which is the widely used fine aggregate. Due to increase in mining activities, the availability of this natural sand is becoming scarce. So it is necessary to think about alternatives for natural sand. Robo sand was one of the alternate materials proposed. Robo sand has many advantages, one of the major areas of concern is the fine material of size 150 micron and down removed during the manufacturing process and accumulated as a waste material.

The purpose of this research is to experimentally investigate the effect of Robo sand in structural concrete by replacing river sand and develop a high strength concrete. It is proposed to determine and compare the differences in properties of concrete containing river sand and Robo-sand. It is also proposed to use different fibres and chemical admixtures to increase the strength and workability of concrete respectively. The investigations are to be carried out using several tests which include compressive test and durability test.

Keywords— Robo sand, Natural Sand, chemical admixture, fibres, compressive strength, durability test.

I. INTRODUCTION

With the basic limit in the accessibility of improvement sands alongside the natural weights to curb extraction of sand from waterways, the utilization of made sand as a substitution is expanding. With the limit on sand mining executed with the aid of quite a number states, and with the expanding activity for flow sand for development works, several structural designers have communicated the want to increase utilization of made sand in the improvement business. According to reports, made sand is commonly utilized all round the globe and authorities of giant ventures the world over demand the obligatory utilization of fabricated sand on account of its consistent degree and zero pollution. Solid combination layout of M40 evaluate was finished by Indian Standard code Concrete 3D form and spherical and hole examples were tried for assessment of compressive, break up tension a solidness test individually. As of late, the wording "High Strength Concrete" has been brought into the development business. The American Concrete Institute (ACI) characterizes high generally be accomplished routinely when utilizing customary constituents and typical blending, setting and curing rehearses. A critique to the definition expresses that a high quality cement is one in which certain attributes are created for a specific application and condition.

The main objectives of this project are as below:

- To develop high strength concrete by replacing natural sand with Robo sand and additional fibres like Glass, Nylon.
- To examine the workability of manufactured sand and using chemical admixture in concrete.
- To investigate the performance of these concrete terms of its compressive strength and durability test.

II. MATERIALS USED

The materials usually used in the concrete mix are cement, fine aggregate (Robo sand& River Sand), coarse aggregate, fibers & water. The materials used in this project for concrete mix are,

Cement:

Portland Pozzolana cement of 43 Grade conforming to IS 8112 -1989**,** and the specific gravity of cement was found to be 3.15.Many tests were conducted to cement some of them are consistency tests, setting tests, etc. It The properties of cement are given in table 1.

Table: 1 Properties of Cement:

SI.NO.	PROPERTY	VALUE
1	Specific gravity	3.15
2	Initial setting time	45 min
3	Final setting time	385 min
4	Fineness modulus	6%

Fine aggregate

For whole produces strong whole are finished outcomes whilst for solid makers, totals are crude substances to be utilized for stable generation. The nature of totals can be affected whilst crude materials, rock or shake might also have attributes which can't be changed with the aid of the era procedure. One critical issue is steady grant obviously, great total. In such manner a path complete created by way of pulverizing basaltic stone and circulate sand is the real regular wellspring of first-rate whole in our nation. However the excellent development action is bringing about creating lack and cost increment of the frequent sand in the state furthermore the total and stable industry are by using and through confronting a developing open mindfulness recognized with herbal dangers.

In this way, searching for a realistic choice for common sand is an absolute necessity. One alternative utilized as substitution is the utilization of Robo sand. Because of the figure deficiency in provide of everyday sand and multiplied development hones time come when Robo sand will expect a fundamental phase as a fixing in stable era of sand would change.

Fine aggregate used in this research is M- sand. At the factor when shake is pounded and estimated in quarry the principle factor has with the aid of and massive been to deliver direction complete and road development materials. Robo sand is characterised as a reason made pounded high-quality complete delivered from terrific source materials. Fabricated sand has been created by means of assortment of pounding types of equipment together with cone crushers, have an effect on crushers, cross crushers, road rollers and so on. The crude fabric for Robo sand generation is the parent mass of shake. It relies upon on the mother or father shake that the synthetic, mineral properties, surface, synthesis

The aggregates whose dimension is less than 4.75mm. It was once gathered from,, India. The bulk density of manufactured sand used to be 1860 kg/m3.

Table: 2 Properties of Robo-Sand:

S.NO.	Property	Value
1	Specific Gravity	2.68
2	Fineness modulus	5.2
3	Water Absorption	3.9%
4	Surface texture	Smooth

***Super plasticizer**:*

In order to improve the workability of high-performance concrete, super plasticizer in the form of Sulphonated Napthalene Polymers complies with IS 9103:1999 and ASTM C 494 type F as a high range water reducing admixture (CONPLAST SP 430) was used. This had 40% active solids in solution. The specific gravity is 1.22.It is a brown liquid instantly dispensable in water. It was collected from **High tech- chemicals**, Salem, India.

Fig 1-Conplast SP- 430.

Table: 3 Properties of super plasticizer:

SI. NO	PROPERTIES	VALUE
1	Appearance	Brown liquid
2	Specific gravity	1.220-1.225@30°C
3	Water soluble chloride	Nil
4	Alkali content	Less than 55g.Na2O
5	Chloride content	0.2% Max
6	Air entrainment To produce	Nil
7	Nitrate content	Nil

Fibers:

1) Glass fibers:

Glass fibers are made of silicon oxide with addition of small amounts of other oxides. Glass fibers are characteristic for their high strength, good temperature and corrosion resistance, and low price. Alkali resistant E-glass fibers of 12mm length, 0.014mm nominal diameter, specific gravity of 1.9 and density of 2650 kg/m3 were used.

The glass fibers used in concrete suppressed the localization of micro cracks in to macro cracks hence tensile strength increase. It improves durability of concrete by increasing the strength of concrete. The aspect ratio of Glass Fibers is 857.1. The number of fibers per 1 kg is 212 million. It was collected from **.**

Fig2-Nylon fibers

III . MIX DESIGN

In this study, control mix A was designed as per IS 10262:1986 to achieve a target compressive strength of 40 Mpa. River sand was used to 100% replace Robo-sand using Portland pozzolana cement (PPC). The various fibers of 0.5%, 1%,1.5% and 2% by volume fraction of concrete were used. The casted cubes are test for 7, 28, days Compressive strength and Durability test.

A total no. of 10 mixes was cast using different percentages of various fibers by volume of concrete. The proportion of Cement, Robo sand, Coarse Aggregate, and Fibers & Water was kept same for all mixes. Various parameters used in the research are given below:

- Concrete mix ratio: 1:1.3:2.01
- Water cement Ratio: 0.375
- Fibre percentages by volume of concrete:

  Glass fibers - 0.5%, 1% , 1.5%.&2%

  Polypropylene – 0.5%, 1% , 1.5%.&2%

  Super Plasticizer (CONPLAST SP 430) – 1%

  Mix with 0% Fibers content was declared as control mix.

CURING OF SPECIMENS

All naturally cast examples were left in the molds for 24 hours before being shaped. The shaped examples were cured in water and hydrochloric acid (HCL) and sodium hydroxide (NAOH) for 7, 28 days, were air dried and after that tried for its compressive quality, split elasticity and strength test according to Indian benchmarks.

III. TESTING OF SPECIMENS

Workability Test

The properties of fresh concrete such as the unit weight, the initial slump and the slump after 30 minutes of the mixtures are presented in Table 3.15. It was observed that the workability of concrete decreased as the percentage of different fibres will be added. The optimum m- sand with percentage of fibres by Gf, Pp, is 0.5%,1.0%,1.5%,2.0% for strength related tests for M40 grade of concrete ***Compressive strength of concrete:***

Compressive quality of cement is the most helpful and critical property of cement. Numerous different properties of cement, for example, sturdiness, protection from shrinkage Young's modulus, impenetrability and so forth are subject to the compressive quality of cement. The reason for the pressure test is to decide the devastating quality of solidified cement and is directed on shape examples of 150x150x150mm size. Standard shape examples are threw and tried for compressive quality following 7 days and 28 days. For setting up the examples, the lasting steel molds size of 150mmx150mmx150mm were utilized.

Before blending the solid, the molds were kept prepared. The sides and the base of the shape were appropriately oiled for simple demoulding. In the wake of emptying concrete into the form, Table vibrator was utilized to smaller the solid and after that the best surface was given a smooth wrap up. In the wake of throwing, test examples were demoulded following 24 hours and were kept in the curing tanks until the season of test.

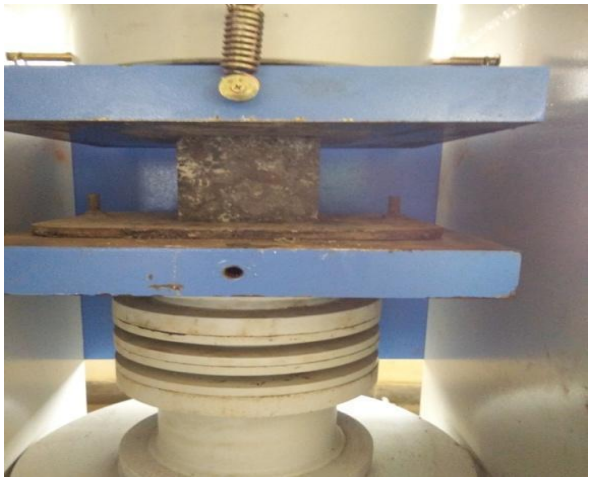


Fig: 3 Compressive Strength Test

Percentage Strength of Concrete at Various Ages. The strength of concrete increases with age. Table shows the strength of concrete at different ages in comparison with the strength at 28 days after casting.

Age	Strength percentage
1 day	16%
3 days	40%
7 days	65%
14 days	90%
28 days	99%

Durability Test of Concrete:

The ability of cement concrete to withstand weathering action, chemical assault and any system that can deteriorate its circumstance is recognised as sturdiness of concrete. The concrete that retains its original form, great and service potential inspite of any variety of environmental prerequisites is durable concrete.

Durability of concrete is very extensive component while considering concrete properties, so here we shall talk about about the major critical elements that worsen the sturdiness of concrete and the take a look at performed to qualify the amount of detoriation resulted due to such factors. For durability test we are using strong acid HCL and strong base NAOH.

Fig:4 Durability Test

V. RESULTS AND DISCUSSION

Workability Test

TABLE: 3 Workability Test Results

M_{40} Mix id	% of fibres added	Slump (mm)
T	0%	41
T1	Glass fibres& Nylon 0.5%	39
T2	Glass fibres& Nylon 1%	36
T3	Glass fibres& Nylon 1.5%	35
T4	Glass fibres& Nylon 2%	35

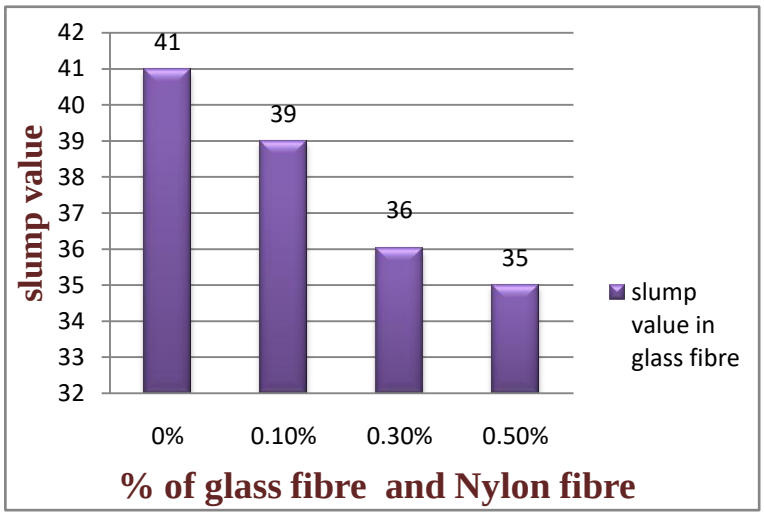


Chart no.1 Slump value in glass and nylon fibre

COMPRESSIVE STRENGTH TEST

Table: 4 Compressive Strength Test Results

S.No.	Cube ID	compressive STRENGTH(N/mm^2) (9SSSSSSSSTRENGTHstrength N/mm^2	
		7 days	28 days
1	Conventional Concrete	30	42.5
2	River&Robo sand(25+75)	32.8	44.35
3	Gf&Pp-0.5%	45	50.23
	Gf&Pp-1%	48	53.23
	Gf&Pp-.5%	50.10	55.34
	Gf&Pp-2%	50.25	55.78

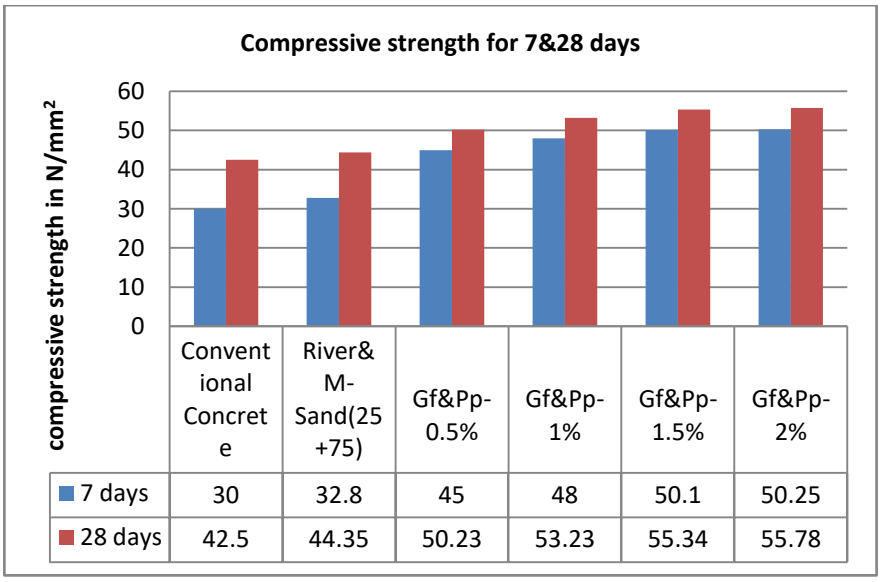


Chart No:2 Compressive Strength for 7 &28 Days.

DURABILITY TEST.

Table: 5 Durability Test Results

S.No	Cube ID	INTIAL WEIGHT (kg)	FINAL WEIGHT(kg)AFTER CURING		COMPRESSIVE STRENGTH IN WATER CURING (N/mm^2)	COMPRESSIVE STRENGTH AFTER CURING (N/mm^2)		% LOSS IN COMPRESSIVE STRENGTH	
			IN ACID	IN BASE		IN ACID	IN BASE	IN ACID	IN BASE
1	Conventional Concrete	2.2	1.8	2.1	34.6	30	31.3	13.2	9.5
2	River& Robo sand (25+75)	2.6	2	2.29	39.35	34.8	36.9	11.55	6.2
3	Gf&Pp 0.5%	2.68	2.49	2.60	50.23	47.36	48.25	5.87	3.9
4	Gf&Pp-1%	2.72	2.59	2.61	53.23	50.05	51.93	5.97	2.4
5	Gf&Pp-1.5%	2.73	2.64	2.70	55.34	51.6	54.00	6.70	2.4
6	Gf&Pp-2%	2.79	2.65	2.3 8	55.78	52.03	53.87	6.78	1.9

This test was directed according to IS 516-1959. The 3D shapes of standard size 150mm x150mm, barrels measure 100mm dia x 200mm high were utilized to locate the compressive and elasticity of cement. Examples were put on the bearing surface of Compression Testing Machine (CTM) without unconventionality and a uniform fee of stacking used to be connected till the disappointment of the examples. The best load was mentioned and the compressive and stress used to be figured.

It is watched frame the outline 4.1 that the 3D square compressive quality expanded up to 1.5times contrast and River sand. It is watched frame the outline 4.2 that the split elasticity expanded up to 1.5times contrast and River sand.

DISCUSSION

The results of the experimental investigations are discussed in the following sections

Compressive Strength

1.In Conventional as nicely as High Strength concrete the compressive strength at 7 days &28 days are located and results are tabulated.

2.It is observed that with the addition of 0.5%,1.0%,1.5%,2.0%, fibres into concrete, compressive strength of concrete extended by way of 7.73%,10.73%,12.84%,and 13.25%, respectively at 7 Days.

3..The above stated addition in energy may additionally be due to the interplay of fibres with concrete which furthers helps in providing a bond between cement molecules.

4.It is watched the compressive satisfactory improved up to 1.5times contrast and River sand..

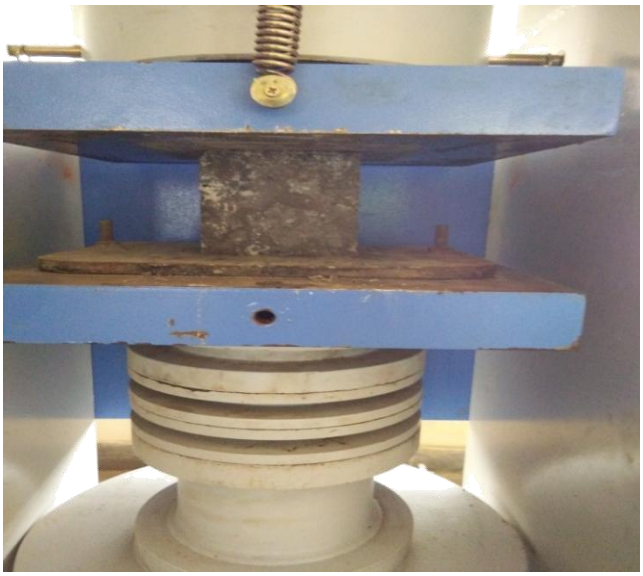
Durability Test

1.From table 6.1, it can take a look at that the share loss of weight discount in acid curing decreases with the amplify of fiber content material .

2.The% loss in weight reduction in acid curing is excessive with 0.5% of fiber content material ,but this reduction was low with 2.0 percent of fiber content.

3. From desk 6.1, it can have a look at that the proportion loss of compressive energy reduction in alkali curing decreases with the increase of fiber content.

4.The average %loss in compressive Strength reduction in alkali curing of concrete is 4% when in contrast to base curing



Testing of cubes

VI. CONCLUSIONS

- A Comprehensive report had been done on different diaries and books identified with the high quality cement with fabricated sand and different strands.
- Every one of the written works are considered in the field produce sand, diverse strands and concoction admixture.
- From the outcomes it is reasoned that the Robo sand can be utilized as a trade for fine total. It is discovered that 75% substitution of fine total by Robo sand give most extreme outcome in quality perspectives than the customary cement.
- The proper materials important for the readiness of examples for experimentations have been accomplished. The amount of examples and the tests to be led have been foreordained. The including level of 0.5%, 1%, 1.5%, 2% in glass, Polypropylene.
- The greatest quality achieves the level of 1.5%. The outcomes demonstrated that the substitution of 75% of fine total by Robo sand and strands initiated higher compressive quality and higher split elasticity.
- The workability of cement was increment and also diminish the droop esteems on the grounds that the made sand was more water retention contrast with the stream sand. The expansion the workability in concrete including some level of admixture like Super Plasticizer.
- These additionally the workability increment least esteems. So substitute compound admixture utilized as a part of the fabricated sand and increment the droop esteems.
- The compressive quality of the review M40 cements made with PPC. The outcomes demonstrate that the 7, 28 days compressive qualities ran from 39.88, 50.33, MPa, separately. The 75% supplanted stream sand in to made sand to meet the prerequisite of review M40 concrete.
- High quality solid utilizing fabricated sand with strands. The most extreme quality achieves the solid shape and chamber is 2% of strands by volume of cement. The cost likewise least for contrast with different strands.

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