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STUDY ON WORKABILITY AND COMPRESSIVE STRENGTH OF CONCRETE

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ABSTRACT

The various materials such as Cement, sand, and aggregate are primary needs for the construction industry. Sand is an important material to use for concrete in which plays an important role in the design of mix. The project discussed about the different test procedures of cement and both aggregates, and also to achieve the high-quality strength of concrete adding with Nano silica of 1% for M75 grade concrete. The aim of the project is to calculate the characteristics strength of compressive and tensile strength by adding 1% rippled steel fibers. The result of the project revealed that enhance the tensile and compressive strength of concrete.

Keywords: Nano Silica, Steel Fibres, Compressive Strength, Tensile Strength, Super plasticizer.

I. INTRODUCTION

Cement is a crystalline of calcium silicates and calcium compounds having the hydraulic properties. The four major compounds that constitute cement (bogue's compounds) such as tri calcium silicate, dicalcium silicate, tetra calcium alumino ferrate and tri calcium aluminate,. Tri calcium silicate and dicalcium silicate are the main contributors to the cement strength combined with 70 percentage of cement. Anhydrous cement content does not combined with fine and coarse aggregates. It requires adhesive property which can be achieved by mixing water which is known as hydration of cement. Heat of hydration is the reaction of cement added with water having an exothermic heat quantity. The study and control of heat of hydration becomes important in the construction of concrete dams and other mass concrete constructions Concrete is a construction material composed of cement, fine aggregates (sand) and coarse aggregates mixed with water which get hardens with setting time. Generally, the Portland cement is used for the production of concrete and the study of Concrete technology deals with the properties of cement concrete as well as reinforced cement concrete and its more practical applications.

Silicon dioxide - nano particles, also called as Nano silica, are the source for a excessive deal of bio-medical research due to their firmness, low toxicity and capacity to be functionalized with a series of polymers and molecules.

According to their structure, Nano-silica particles are classified into P-type and S-type. The P-type particles are categorized by several Nano pores having a pore rate of 0.61 ml/g. The S- type particles have a moderately lesser surface area. The P-type Nano-silica particles show a higher ultraviolet reflectance when linked to the S-type. Chemical composition silica is 46.83% and oxygen is 53.33%.

Materials researchers at North Carolina State University have fine-tuned a technique that enables them to apply precisely controlled silica coatings to quantum dot Nano rods in a day-up to 21 times faster than previous methods.

II. MATERIALS

Cement

The cement is known as building materials, also binding agent that sets and hardens to adhere to building materials such as stones, bricks, tiles etc. Cement commonly states that has a very fine powdered constituent mainly made up of Calcium Like limestone, Silicaon like sand or clay, Aluminium like Bauxite and iron ore, and also may consist of chalk, shells, shale, marl, blast furnace slag, clay and slate. The raw components are treated in the manufacturing cement plant and heated to form a rock-hard matter, which is then crushed into a fine powder to be traded. Cement is mixed with water that origins a chemical reaction and forms a cement paste that sets and strengthens to bind separate constructions of building constituents. It is used to make concrete as well as mortar, and to protected the infrastructure by binding the building blocks. Cement mixed with water, chemicals of aluminates, and silicates and then making a water repellent hardened mass that is used for water-

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proofing.

COARSE AGGREGATE

Generally, the particles are mainly retained on the 4.75 mm sieve and will pass through 3-inch screen. used in the mix proportion. Larger pieces of aggregates offer lesser surface area of the particles than an equal volume of small pieces. Use of the largest acceptable size of coarse aggregate permits a decrease or reduced in cement and water necessities. It also permitted can affect in interlocking and form arches or blocks within a concrete form. Then it allows the area becomes a void or pores and to filled with finer particles of cement and sand only and outcomes in a weekend area.

FINE AGGREGATES

Those particles passing the 9.5 mm(3/8in.) sieve, almost entirely passing the 4.75mm (No. 4) sieve, and predominantly retained on the 75 µm (No. 200) sieve are called fine aggregate.

NANOSILICA

It can control the degradation of the fundamental C-S-H(calcium-silicate-hydrate) reaction of concrete cause by calcium leaching in water. Blocks water penetration and therefore lead to improvements in durability. The compressive strength of the nano silica material is three to six times higher when related to Ordinary Portland Cement.

CRIMPED STEEL FIBRES

Steel fibers strengthen concrete by resisting tensile cracking. It means that provide a greater resistance to reduce cracks inside the hardened concrete material, as well as greatest resistance to resist heavy loads, both dynamic or fixed.

Table 1: Specifications of Crimped Steel fibers

Properties	Specifications as per ASTM A820 M04 Type 1
Length of fibre(l)	5cm
Aspect ratio	30 to 60
Diameter	0.45 to 0.8mm
Appearance	Clear, Bright
Form	undulated along the length
Material type	Low carbon drawn wire

WATER

The water is major role used in the mixing, laying compaction, setting the material and hardening of concrete. Concrete strength only depends upon the quantity and quality of water and used for mixing.

III. MATERIALS RESULT

Table 2: Experimental results of cement

S. No	EXPERIMENT	RESULTS
1	Specific gravity of cement	3.150
2	Normal consistency	30%
3	Initial setting time of cement	Initial- 30min
4	Final setting time of cement	Final- 600min

Table 3: Experimental results of aggregate

S.No	EXPERIMENT	RESULTS
1	Specific gravity of coarse aggregates	2.74
2	Specific gravity of fine aggregates	2.65
3	Sieve analysis of fine aggregate	**Zone 2** (Grading zone)

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4	Sieve analysis of coarse aggregate	Graded aggregate is **20mm single size aggregate**
5	Loose density of fine aggregate in Kgs	4.94
6	Bulk density of fine aggregate in Kgs	5.53
7	Loose density of coarse aggregate in Kgs	13.8
8	Bulk density of coarse aggregate in Kgs	19.39
9	Water absorption in coarse aggregate	0.05%

Table 4: Experimental results of the Nano silica

S.No	NANO SILICA PARTICLES	PERCENTAGE
1	Liquid content	70%
2	Solid content	30%

Since grading of fine aggregate has great impact on quality of concrete produced. Therefore, it is necessary to do as per Code IS: 2386 (Part 1) – 1963 should be followed. By this analysis of N- sand corresponds to grading Zone – 2 which is taken by us. And also the Grading of coarse aggregate significantly influences of the cohesiveness of the concrete mix. Therefore, it is also necessary to do as per standards. By this analysis of the coarse aggregate which corresponds to the 20mm single size aggregate.

IV. RESULTS AND DISCUSSION

Figure 1: Experimental Setup of the Compressive Strength

EXPERIMENTAL RESULTS

The tests have done the concrete specimen i.e., According to the cubes designed quantities and the specimens are cured and tested respectively. Slump value is obtained for M75 grade concrete equal to 120mm. These all cubes are cured for 7 days, 28 days respectively and obtained results are tabular below:

COMPRESSIVE STRENGTH

The result of the Compressive Strength for 7 Days (Without Steel fibres):

Cube size = 150mm×150mm×150mm Area of Specimen = 22500 mm^2

Table 5: The result of the Compressive Strength for 7 Days curing of concrete (without steel fibers)

Cube No's	Peak Compressive Load (KN)	Area of Specimen (mm^2)	Compressive Strength of Specimen (N/mm^2)	Average. Compressive Strength of Specimen (N/mm^2)
1	1212	22500	53.86	64.06
2	1438	22500	63.91	
3	1711	22500	76.04	

Number of Concrete Cubes can be determined by the Characteristic Compressive Strength using Compression Testing Machine (CTM). The cube strength of 7 days must be achieved 65% of Target Mean Strength for M75 grade of concrete i.e., (48.75N/mm^2) as shown in the Table 5. From the above table, we have noticed that the value is greater than 65%.

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Table 6: The result of the Compressive Strength for 7 Days curing of concrete (with steel fibre)

Cube No's	Peak Compressive Load (KN)	Area of Specimen (mm^2)	Compressive Strength of Specimen (N/mm^2)	Avg. Compressive Strength of Specimen (N/mm^2)
1	1272	22500	56.53	50.56
2	1074	22500	47.73	
3	1067	22500	47.42	

The cube strength of 7 days must be achieved 65% of Target Mean Strength for M75 grade of concrete, the average strength for 7 days curing is 50.56 N/mm^2 as shown in the Table 6. As Calculations the average strengths for 7 days curing of concrete without steel fibres is better than concrete with steel fibres.

28 days Accelerated Strength results (Without Steel fibres):

The corresponding strength at 28 days found out from the following correlation. R28 (Strength @28 days) = 8.09 + 1.64 Ra (As per code IS: 9013 – 1978).

Table 7: Accelerated concrete strength values for without steel fibres

Cube No's	Peak Compressive Load (KN)	Area of Specimen (mm^2)	Load/Area Compressive Strength of Specimen (N/mm^2)	Avgerage Compressive Strength of Specimen (N/mm^2)
1	1458	22500	64.80	58.93
2	1320	22500	58.67	
3	1200	22500	53.33	

Graph indicates the variations in the Compressive Strength without Steel Fibres @ 28 days period of time. The Characteristic Compressive Strength of the cube can be tested using Compression Testing Machine (CTM) in the laboratory.

28 days Accelerated Compressive Strength results (With Steel fibres):

Table 8: Accelerated concrete strength values for with steel fibres:

Cube No's	Peak Compressive Load (KN)	Area of Specimen (mm^2)	Load/Area Compressive Strength of Specimen (N/mm^2)	Avg. Compressive Strength of Specimen (N/mm^2)
1	1074	22500	47.73	51.71
2	1272	22500	56.53	
3	1145	22500	50.89	

Graph indicates the variations in the Compressive Strength with Steel Fibres by considering different percentages replacement of River sand at 28 days time period.

In general, the cube strength of 28 days can must be achieved 100% of Target Mean Strength in which we have achieved maximum values due to the high performance of Admixture.

As per above graph the Accelerated average strengths for 28days curing with 0% replacement of River sand is 92.908 N/mm^2, with 25% replacement is 94.463 N/mm^2, with 50% replacement is 92.471 N/mm^2 and with 75% replacement is 98.520N/mm^2.

Comparison of 28-days Accelerated Compressive strength between concrete with steel fibres and without steel fibres (M75):

Tables indicate the variations in the Compressive Strength of **with and without** Steel Fibres by considering different percentages replacement of River sand @28 days period of time.

As per above graph the Accelerated average strengths for 28 days used for curing of concrete without steel

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fibres is better than concrete with steel fibres.

The cube strength of 28 days can must be achieved 100% of Target Mean Strength in which we have achieved better than target mean strength for using high performance Super plasticizer i.e., AURAMIX-500.

SPLIT TENSILESTRENGTH

The results of Split Tensile Strength for different percentages of River sand Replacement with and without steel fibres in concrete28-days

Diameter of the cylinder = 15cm

Height of the cylinder = 30cm

Formula of Split Tensile Strength (N/mm^2) T = $\frac{2*P}{\pi*L*d}$

Area of cylinder = 177cm^2

The indicates the variations in Split Tensile Strength with steel fibres and without Steel Fibres by considering different percentages replacement of River sand at 28 days period of time.

Table 9: Shows the split tensile strength results of concrete (W&WO steel fibres)

With/Without Steel fibres (W or WO)	Peak Splitting Tensile load (KN)			Average Split Tensile Strength (N/mm^2)
	Cylinder 1	Cylinder 2	Cylinder 3	
W	200	193	204	2.81
WO	223	213	214	3.07

As per above graph the Average split strengths @ 28 days for curing of concrete without steel fibres is better than concrete with steel fibres.

The cube strength of 28 days can must be achieved 100% of Target Mean Strength in which we have achieved better than target mean strength by using high performance Superplasticizer i.e., AURAMIX-500.

V. CONCLUSION

An investigation of experimental work is carried out are the following points such as,

- Addition of steel fibres will increase the self-weight of the concrete due to increase the weight of the structure.
- The value of compressive strength of concrete is increased at natural sand and also Nano silica aggregates.
- Addition of Nano silica particles, this Nano silica rich go forward in the before time age strength of concrete compared to the 28-day increase in strength.
- Also, the addition of steel fibers enhances these tensile strengths of concrete.
- The river sand, Nano silica particles and steel fibers combinations achieved better than target mean strength by using Superplasticizer i.e.,AURAMIX-500.

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