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An Empirical Research on Consequences of Nano Silica on Performance of OPC and Blended Cement

Shaik Abdul Azeez Baba
PG Student, Dept. of Civil Engineering
Annamacharya Institute of Technology and Sciences
Kadapa, India

P. Pradeep Kumar
Assistant Professor, Dept. of Civil Engineering
Annamacharya Institute of Technology and Sciences
Kadapa, India

Dr. P. Sri Chandana
Professor & HOD, Dept. of Civil Engineering
Annamacharya Institute of Technology and Sciences
Kadapa, India

***Abstract*— Concrete is the most common material for construction. The total production depends upon the cement content only. Due to the usage, large amount of cement produces increasing the CO_2emissions, to reduce the cement percentage in concrete mixes the Nano silica ($nSiO_2$) is used as the replacement of the cement.**

Nowadays is mainly focusing on the basic science of cementations material at atomic or nano level. Further, researches are continuing to improve the sustainability and durability of concrete and it has the mechanical properties and significant increment in cementations material. This paper summarizes the effect of nano silica addition on mechanical properties of concrete. It provides the current development of application of nano-silica in motor and concrete by using Ordinary Portland Cement and Blended Cement.

The Nano silica is available in 10-50 nm as particle size. The 17nm particle size is used for the whole project. This paper aim is to study the mechanical properties of the specimen using the nano silica by replacement of the cement. The ratio in weight of the nano cement with respect to normal cement. The mortar specimen size is 70.6x70.6x70.6 mm. The concrete cube size is 150 x 150 x 150 mm was maintained and water cement ratio 0.40 was maintained throughout the project. The 0%, 1.5%, 3.5%, 5.5% and 7.5% of nano silica should be replaced with weight of the cement.

***Index Terms*— Nano silica, Compressive strength, Split tensile strength-Ray Diffraction, SEM analysis, Cement type: OPC and Blended Cement.**

I. INTRODUCTION

Concrete's versatility strength and market have made it the world's mainly used construction material. The India exploits concerning 7.3 million cubic meter of concrete every year. So that the atmosphere pollution and the construction cost increases. Construction material enhance with the requirement of concrete, so also the stipulate for bright colective raise.

The main problems that is having global warming and environmental devastation now a days. Heightening distress about worldwide ecological issues, move the large scale manufacturing, mass-utilization, mass-waste, society to a zero-production society is currently seen as necessary. The cement falling with nano-silica percentage substitute.

By using nano-sized material is nano-silica. The permeability of hardened concrete is reduced and compressive strength that will increases. The interesting properties of and the integration of nano–silica depreciate reliability of cement composites.

The compressive strength and split tensile strength will make bigger the supplied with nano silica. The Nano sized particles will arrange the cement material supported with powerful. The particles of calcium-silicate-hydrates (C-S-H) at the interfacial change zone together with the cement and combined. The setting of time decreases Nano silica with silica fumes.

Production method of Nano-Silica:

Now a days, there are different methods to produce $nSiO_2$ products. One method is based on a sol-gel process at a room temperature. The starting materials are delivered in a solvent, after which the PH of the solution is changed to silica gel. The produced gel is elderly to end up a xerogel. The xerogel is dispersed again with stabilized agent Na, K, NH3 to produce a rigorous spreading and it is appropriate for use in concrete industry. A substitute production method is Vaporization of silica by reducing quartz at 1500 to 2000^{o}C.

Further, $nSiO_2$ is shaped as a by-product of the manufacture of silicon metals and Ferro-silicon. Nano silica produced by this method is very fine powder consisting of spherical particles.

Finally $nSiO_2$ can produce by precipitation method. In this method, nSiO2is precipitated from a solution at temperature is 50 to 100^{0}C. It was developed by Eller in1954. Such as sodium silicate (Na_2SiO_3), burned rice husk ash (RHA), magnesium silicate.

Effects of Nano silica in mortars and concrete:

The first one is chemical effect and the second one is physical effects. At the chemical outcome: the pozzollanic response of silica with calcium hydroxide and it is forms CSH-gel at final stage.

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At the physical effect: micro silica is about 100 times smaller than the cement. Some researchers found that the 1 kg of silica permits to reduction of about 4 kgs of cement, and this can be higher if Nano silica is used. Micro silica can fill the voids in the hydrated cement paste.

Nano - silica addition in mortar and concrete can result in different effect. The fundamental mechanism is associated with high floor are of Nano silica precipitation of CSH-gel with nucleation.

It has no longer determined whether or not the more rapid hydration of cement in the presence of nano-silica is because of chemical response. The impact of Nano silica addition on concrete water permeability and microstructure. Different concrete mixes have been evaluated incorporating nano silica debris of 10 nm to twenty nm. Fly ash and gravel to acquire the equal droop time for nano silica concrete and simple concrete. The consequences can show that nano silica can improve the micro shape and it reduces the water permeability for hardened concrete. Decreasing the permeability in concrete with nano silica concentration and fly ash content material. Nano silica concrete is more uniform and compact than for ordinary concrete.

Application of nano–silica:

Addition of nano-silica in plain concrete is called as High Performance Concrete (HPC), eco-concretes and self-compacting concretes (SCC).For the last types of special concretes, the application of these materials is a necessity. Nano -silica is implemented in High performance concrete and self-compacting concrete exactly as an anti-bleeding agent. Eco- concretes are combinations wherein cement is replaced by way of waste substances which include sludge ash, incinerated sludge ash, fly ash or supplementary waste substances. The main trouble of this mixture is long setting length and low compressive strength. For fixing this drawback is solved by adding the Nano silica to eco-concrete mixes. It is increased placing time and better compressive strength. The check outcomes for the slurries that the addition of nano silica reduces the putting time strength of the cement.

The nano silica will be mixed with mortar, cement paste and urban. The nano silica combination gives the mechanical residences, durability houses. In this mission the nano silica can be mixed with mortar and urban and it gives the excessive mechanical property while evaluating mortar.

II. METHODOLOGY

Materials:

Ordinary Portland cement:

Ordinary Portland cement of manufactured by Zuari Company, conforming to IS 12269: 1989, 53 grade cement was used. The specific gravity of the cement is 3.15. The initial and final setting times were found as 30 minutes and 600 minutes respectively.

TABLE 1: Physical properties of cement

PARTICULARS	RESULTS
Exact gravity	3.15
Initial setting time	30 mins
Final setting time	600 mins

TABLE 2: Chemical composition of cement

Oxide	Percent content
CaO	60-67
SiO_2	17-25
Al_2O_3	3.0-8.0
Fe_2O_3	0.5-6.0
Mgo	0.1-4.0
Alkalies (K_2O,Na_2O)	0.4-1.3
SO_3	1.3-3.0

Blended Cement:

The Evidence of the primary Blended Cements dates got here to Roman times, when volcanic ash become used in blend with slaked lime to provide the person a product advanced higher early electricity than the standard slaked lime. Evidence of this will be seen in the Aqueducts and the Coliseum in Rome.

In Italy wherein the volcanic ash was observed that vicinity is called Pozzuola, hence the time period being known as a pozzolan. In fact, it's miles much more likely that the lime the Romans calcined (fumes) for the reason of slaking approached an argillaceous lime in chemical composition and in place of it has milled to be clearly slaked function.

An aggregate of Portland cement and different material like as pozzolona, hydrated lime, and many others. Blended either all through or after the end grinding of the cement on the mill. Concrete can be produced with mixed cement containing cementitious materials most normally silica or fly ash need to deliver on the batch plant.

Fly ash based Blended Cement:

Initial experiments like compressive strength test on mortar cubes and concrete cubes were conducted on Ordinary Portland Cement and Portland Pozzolana Cement (being referred as Blended Cement in the present study).

The physical and chemical composition of Blended Cement was supplied by the manufacturing company.

TABLE 3: Chemical composition

Sl.N o	Parameter	Result
1.	Insoluble Material (% by mass)	18.90
2.	Magnesia (% by mass)	0.99
3.	Sulphuric Anhydride (% by mass)	2.67
4.	Loss on Ignition (% by mass)	2.04
5.	Total Chlorides (% by mass)	0.001

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Advantages of concrete made from Blended Cement

Blended cements can produced the benefits in overall performance while slag cement is used as a separate thing inside the concrete mix. By varying the proportions of the blend, and attributes including alkali silica reaction and sulphate reaction can be attained with blended cement.

Fine Aggregate:

Normal sand:

The normal sand collected from the Bahudha river and it is the locally obtainable compressed sand, and it is transient during 4.75 mm IS. Sieve is used. The specific gravity of the sand is established to be 2.82.

Ennore sand: The Ennore sand is passing 50 microns IS Sieve.

Natural Coarse-Aggregate:

It is collected from the R.K.Padu, it is nearby obtainable material. To attain a sensibly good grading, 60% of the collective passing during 20 mm I.S. sieve and reserved on 12.5mm I.S. The specific gravity of the mutual combined is 2.70.

Nanosilica:

The nano silica is purchased from Astraa chemicals at Chennai. The used nano silica having the pH value is 4.12. The particle size of the Nano silica is 17 Nanometers. Chemical composition of silica fume is presented in TABLE. In the present experimental investigation, 1.5%, 3.5%, 5.5%, and 7.5% of nano silica has been replaced with the cement.

TABLE 4: Specifications of nano silica

Test item	Standard requirements	Test results
Exact surface area (M^2/G)	200±20	202
pH Value	3.7-4.5	4.12
Loss in drying @105^{0}C (5)	≤1.5	0.47
Loss in ignition @ 1000^{0}C (%)	≤2.0	0.66
Sieve residue(5)	≤0.04	0.02
Tampered density g/l	40-60	44
SiO_2 content (%)	≥99.8	99.88
Carbon content (%)	≤0.15	0.06
Chloride content (%)	≤0.0202	0.009
Al_2O_3	≤0.03	0.005
TiO_2	≤0.02	0.004
Fe_2O_3	≤0.003	0.001
Specific gravity	2.2-2.4(generalised)	
Particle size	17 nano meters	

Concept of mix design for concrete

Mix design can be defined as the process of selecting the suitable materials knows its relative proportions of minimum strength and its durability. The first aim is to achieve the specifying minimum strength. And the second in most economical. The main procedure at mixing time is batching, mixing, curing and testing.

In this investigation M_{25}grade of concrete is considered. The mix of concrete is designed as per the guidelines given in IS 10262-2009; the mix proportions are 1:2.3:3.7 with water cement ratio of 0.40.

MIX DESIGN PROCEDURE (IS 10262 -2009)

Grade of Concrete M_{25}

Characteristic Compressive Strength = 25N/mm^2
Maximum Size of aggregate = 20 mm (Angular)
Degree of workability = Good
Type Exposure = Mild

1. The target mean strength is determined using following relation

   $f_t = f_{ck} + (t * S)$

   Where f_t= Target Mean Strength @ 28 days
   f_{ck}= Characteristic Compressive Strength @ 28 days
   t = A Statistical value depending upon the results and No. of tests.
   S = Standard deviation shown from IS: 10262-2009
   Assuming not more than 5% results are expected to fall below the Characteristic Compressive Strength. In which case the of 't' is 1.65. Standard deviation for M25 grade of concrete is 4.

   $F_t = 25 + (1.65 \times 4) = 31.6$ N/mm^2
2. The water cement ratio required for the target mean strength of 31.6 N/mm^{2}is 0.40
3. From IS: 10262-2009 for the 20mm maximum size of aggregate the air content (entrapped air) is 2%.
4. From IS: 10262-2009 for concrete grade up toM25 and 20mm maximum size of aggregate and natural sand conforming to Zone – II, the water content and percentage of sand in total aggregate by absolute volume are 186 ltrs.
5. For change in value of Water Cement ratio and Compression Factor, the following adjustments are required according to IS: 10262-2009 in water content and percentage of sand in total aggregate.
6. Estimated water content for 50-75 mm slump = 138 ltrs.

   Required Water content = 138 ltrs.
7. Water Cement Ratio = 0.40

   Required Cement Content = 345 kg /m^3
   This cement content is adequate for mild exposure.
8. The quantities of fine and coarse aggregates are calculated from the following relation

$$V = \left[W + \frac{C}{Gc} + \left(\frac{1}{1-P} \times \frac{F.A_a}{Gf}\right)\right] \times \frac{1}{1000} \&$$

$$V = \left[W + \frac{C}{Gc} + \left(\frac{1}{P} \times \frac{G.A_a}{Gf}\right)\right] \times \frac{1}{1000}$$ respectively

Where,

V = absolute volume of fresh concrete, which is equal to gross volume (m^3) minus the volume of entrapped air.
W = Mass of water (kg) per m^3 of concrete
C = Mass of cement (kg) per m^3 of concrete
S_C = Specific gravity of Cement
P = Ratio of FA to total aggregate by absolute volume
f_a, C_a = Total masses of FA and CA (kg) per m^3 of concrete respectively and
S_{fa}, S_{ca} = Exact gravities of saturated, surface dry fine aggregate and coarse aggregate respectively.

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f_a = 795.31kg/m^3
C_a = 1285.53kg/m^3
The total quantities of ingredients for M25 grade Concrete are as follows Water

Water/Cement ratio	= 0.40
Cement content	= 345 kg/m^3
Fine Aggregate	= 795.3 kg/m^3
Coarse Aggregate	= 1285.5 kg/m^3
Water content	= 138 kg/m^3

Mix Proportion is cement: fine aggregate: coarse aggregate

1 : 2.3 : 3.7

Details of Specimen:

The mechanical tests were conducted for the prepared specimen. They are

1. Compressive strength test for the 150 x 150 x 150 mm cubes.
2. Tensile strength test.

The compressive strength and tensile strength specimen prepared with 0, 1.5, 3.5, 5.5 and 7.5% replacement of cement.

The details of each category are described below.

(1) *Details of cement mortar by using OPC and Blended cement:*

Size of specimen	: 70.6 x 70.6 x 70.6 mm
Cement mortar proportion	: 1:3
% of nano silica	: 0, 1.5, 3.5, 5.5, 7.5%
No. of specimen	: 60

(2) *Details of concrete cubes by using OPC and Blended cement:*

Size of specimen	: 150 x 150 x 150 mm
Water cement ratio	: 0.40
Mix proportion is	: 1:2.3:3.7
% of nano silica	: 0, 1.5, 3.5, 5.5, 7.5%
No. of specimen	: 60

(3) *Details of cylinders by using OPC and Blended Cement:*

Water cement ratio	: 0.40
Mix proportion is	: 1:2.3:3.7
% of nano silica	: 0, 1.5, 3.5, 5.5, 7.5%
No. of specimen	: 60

Testing of specimens:

(1) Testing of mortar cubes:

The cement mortar cube is 70.6 x 70.6 x 70.6 mm was tested by using the compression testing machine. The specimen results are calculated at 3days, 7days, 14days and 28days and are tabulated.

Fig 1: Testing of Mortar cubes

(2)Testing of concrete cubes:

The concrete cube is 150 x 150 x 150 mm was tested by using the compressive testing machine. Compressive strength depends on water- cement ratio. Test for compressive electricity is achieved both for dice or cylinder. Compression check is finished in a compression trying out machine confirming to IS: 516-1959. All the concrete specimens had been examined in a potential of 2000KN compression trying out gadget. Place the specimen within the middle of the machine on the bottom plate and apply the burden regularly till the specimen fails. Record the maximum load applied to the specimen. The specimen results are calculated at 3days, 7days, 14days and 28days and are tabulated.

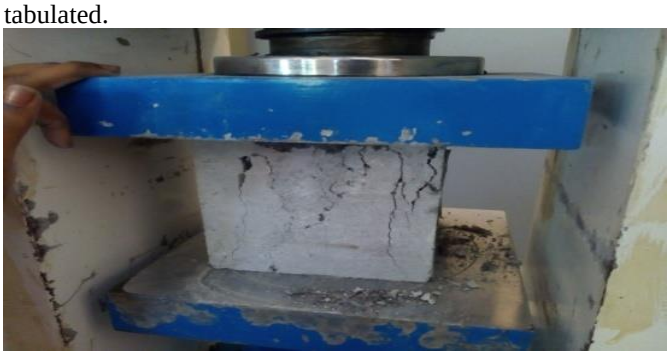

Fig 2: Testing of Concrete cubes

(3)Testing of cylinders:

The cylinder is used to calculate the split tensile test. Spilt tensile strength test was conducted in accordance to ASTMC96. Cylinders of 150mm diameter × 300mm height were casted and tested, the test specimen is placed in machine in the given space and place the two strips of 3mm thick and 12mm wide approximately at the top and bottom of the plate.

The spilt tensile strength was conducted on compressive testing machine. The specimens were tested for 3 days, 7days, 14days and 28 days. This test is conducted in a capacity of 2000KN compression testing machine. The cylinder specimen is placed in horizontal in the testing machine. The split tensile stress is obtained using the formula based on IS: 5816-1970.

The following relation is used to find out the spilt tensile strength of cylinder is

$$F_t = \frac{2P}{\pi LD}$$

Where F_t = Modulus of rupture
D = Diameter of the cylinder in mm

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L = Length of the cylinder in mm.
P = Compressive load on the cylinder (N).

Fig 3: Testing of Cylinders

Objectives of test specimen

1. To study the mechanical behaviour of the all specimen.
2. To obtain the strength at increasing the percentage of Nano silica.
3. To study the mechanical behaviour of the cement mortar by using OPC and Blended cement.

1. For Cement mortar:

(i) By using cement without replacement of nano silica

The Cement – sand proportion is 1:3 for the Cement mortar, the water cement ratio is 0.40. The specimen size is 70.6 x 70.6 x 70.6 mm. The 3 days, 7days, 14 days and 28 days test should be conducted for obtaining the strength.

(ii) By using cement with replacement of Nano silica

The Cement – sand proportion is 1:3 for the Cement mortar, the water cement ratio is 0.40. The specimen size is 70.6 x 70.6 x 70.6 mm. The quantity of Nano silica 1.5, 3.5, 5.5 and 7.5 % by weight of cement should be used. The 3days, 7days, 14 days and 28 days test should be conducted for obtaining the strength.

2. For casting Cubes

(i) By using cement without replacement of Nano silica

The M25 mix design is used for casting the specimen. The water cement ratio is 0.40. The specimen size is 150 x 150 x150 mm. The 3 days, 7 days, 14 days and 28 days test should be conducted for obtaining the strength.

(ii) By using cement with replacement of Nano silica

The M25 mix design is used for casting the specimen. The water cements ratio is0.40. The specimen size is 150 x 150 x 150 mm. The quantity of Nano silica 1.5, 3.5, 5.5 and 7.5 % by weight of cement should be used. The 3 days, 7days, 14 days and 28 days test should be conducted for obtaining the strength.

3. For casting cylinders

(i) By using cement without replacement of Nano silica

The M25 mix design is used for casting the specimen. The water cement ratio is 0.40. The 3 days, 7days, 14 days and 28 days test should be conducted for obtaining the strength.

(ii) By using cement with replacement of Nano silica

The M25 mix design is used for casting the specimen. The water cement ratio is 0.40. The quantity of Nano silica 1.5, 3.5, 5.5 and 7.5 % by weight of cement should be used. The 3 days, 7 days, 14 days and 28 days test should be conducted for obtaining the strength.

III. RESULTS AND DISCUSSIONS

This chapter deals the strength properties and results of the compressive strength for mortar cubes and concrete cubes, split tensile strength by without replacement of cement and with replacement of cement by Nano Silica.

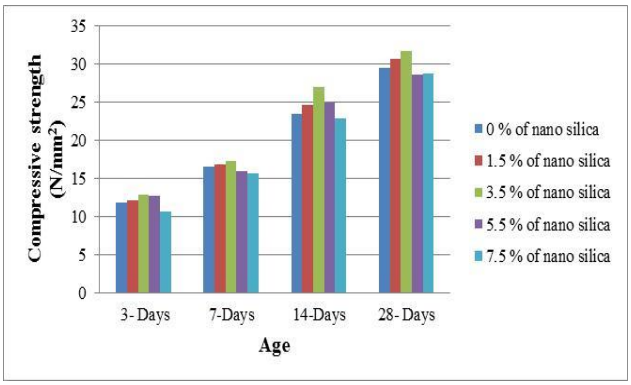
The result of the present experimental investigation is shown in tabular and graphical method.

Test results

(1) Cement mortar Ordinary Portland cement and Blended Cement

TABLE 5.Results for cement mortar by using OPC

Sl.No	% replacement of Nano silica	Description	3 days	7 days	14 days	28 days
1	0	P.C	11.9	16.5	23.5	29.4
2	1.5	$nSiO_2$	12.1	16.8	24.6	30.7
3	3.5	$nSiO_2$	12.9	17.3	26.9	31.6
4	5.5	$nSiO_2$	12.7	15.9	24.9	28.6
5	7.5	$nSiO_2$	10.6	15.6	22.8	28.7



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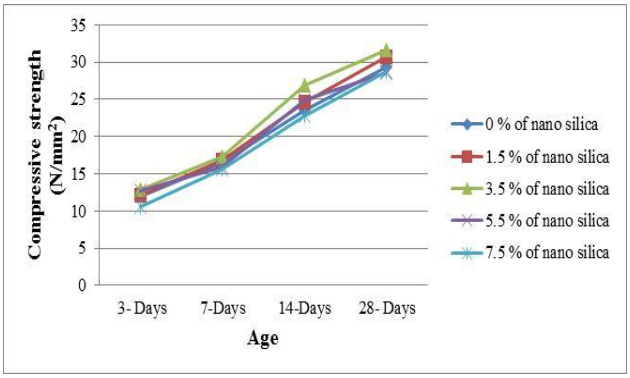
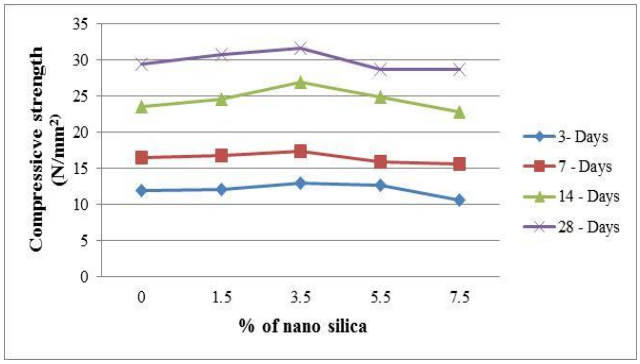
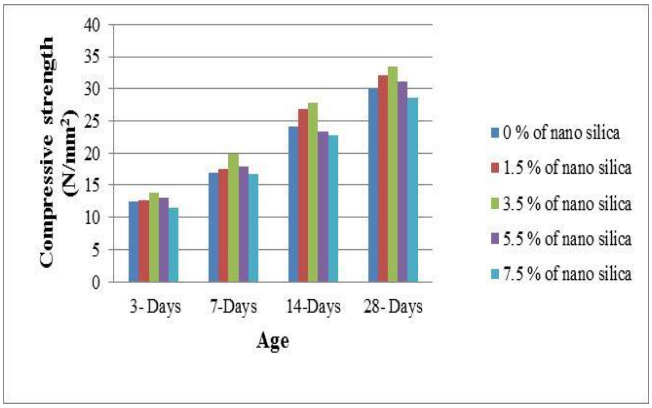


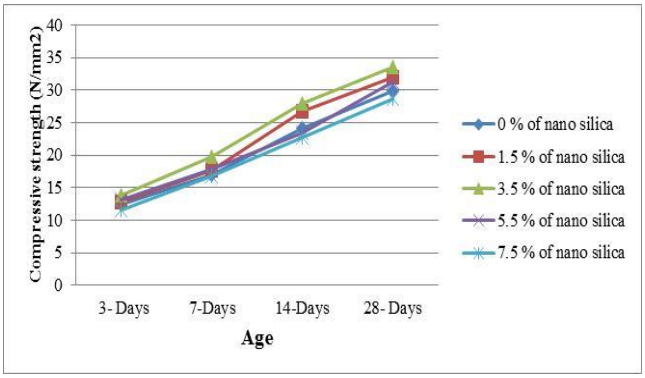


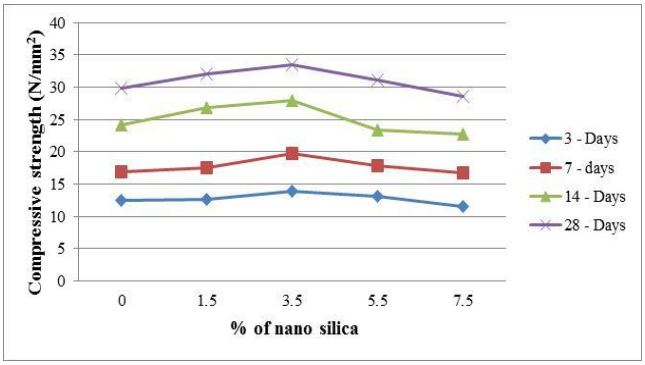
Graph 1: Cement mortar by using OPC

TABLE 6. Results for cement mortar by using Blend

Sl.No	% replacement of Nano silica	Description	3 days	7 days	14 days	28 days
1	0	P.C	12.5	16.9	24.1	29.9
2	1.5	$nSiO_2$	12.7	18.6	26.8	32
3	3.5	$nSiO_2$	13.9	19.8	27.9	33.5
4	5.5	$nSiO_2$	13.1	17.9	23.4	31.2
5	7.5	$nSiO_2$	11.5	16.8	22.8	28.6





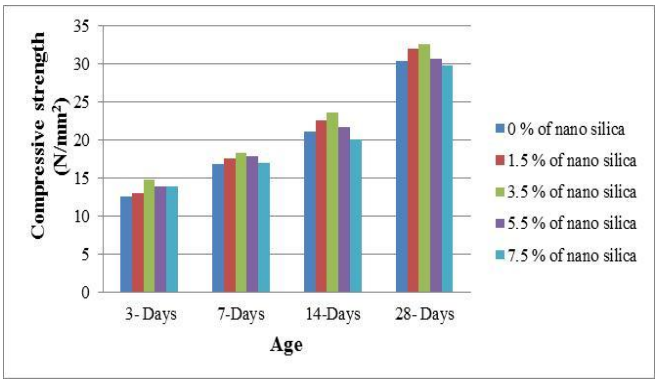


Graph 2. Cement mortar by using Blended Cement

(2) Compressive Strength for concrete cubes

TABLE 7. Compressive strength results for concrete cubes by using OPC

Sl.No	% replacement of nano silica	Description	3 days	7 days	14 days	28 days
1	0	P.C	12.5	16.8	21	30.4
2	1.5	$nSiO_2$	13.0	17.6	22.5	31.9
3	3.5	$nSiO_2$	14.8	18.3	23.6	32.6
4	5.5	$nSiO_2$	13.9	17.9	21.6	30.6
5	7.5	$nSiO_2$	13.8	17.0	20.0	29.8



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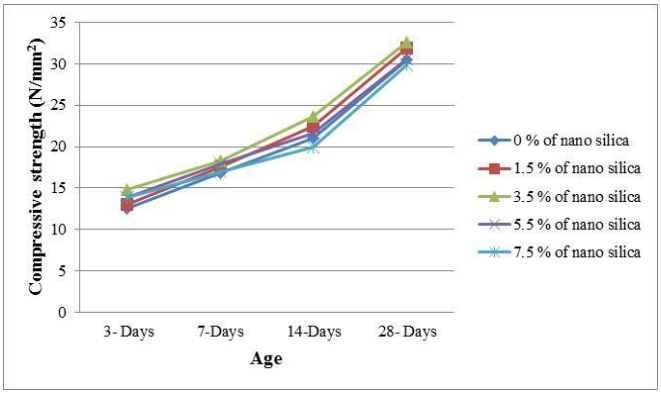
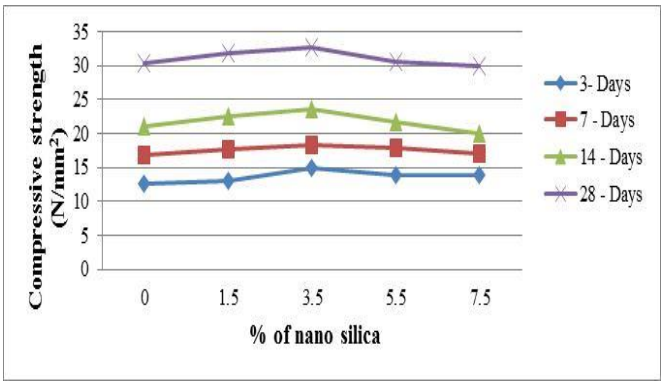
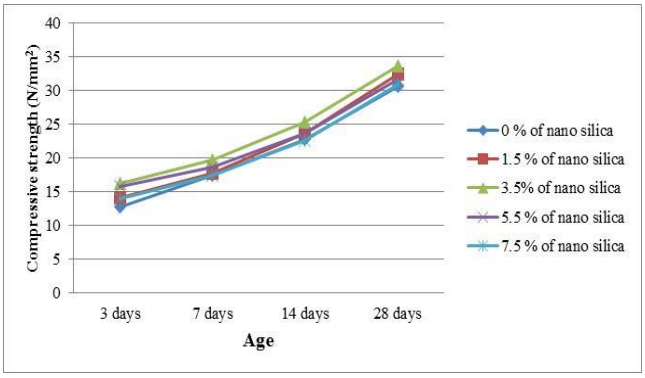
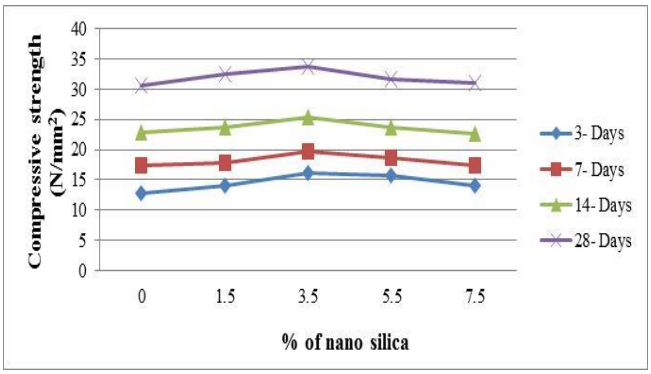




Graph 3: Compressive strength for concrete cubes by using OPC



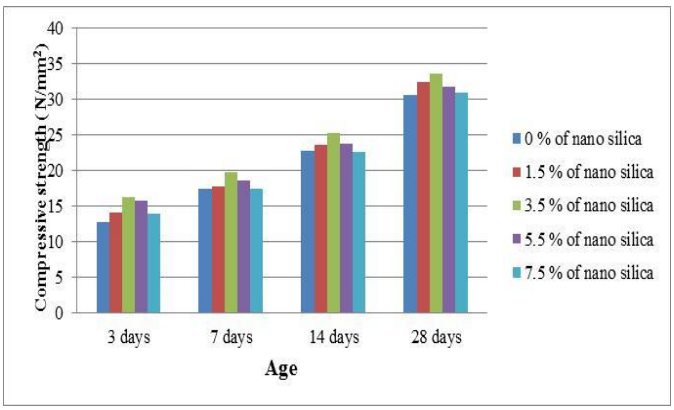


Graph 4: Compressive strength for concrete cubes by using Blended Cement

Using Blended Cement

TABLE 8. Compressive strength results for concrete cubes by using Blended Cement

Sl. No	% replacement of nano silica	Description	3 days	7 days	14 days	28 days
1	0	P.C	12.7	17.4	22.8	30.6
2	1.5	$nSiO_2$	14.1	17.8	23.6	32.4
3	3.5	$nSiO_2$	16.2	19.7	25.3	33.6
4	5.5	$nSiO_2$	15.8	18.6	23.7	31.7
5	7.5	$nSiO_2$	14	17.4	22.6	30.9

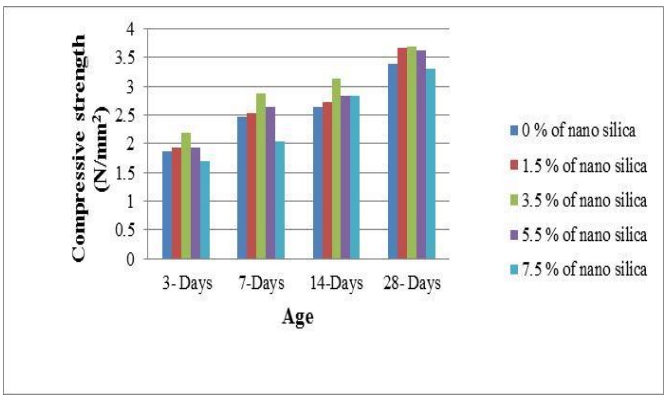


Split tensile test:

Using OPC

TABLE 9. Split tensile test results for cylinders by using OPC

Sl. No	% replacement of nano silica	Description	3 days	7 days	14 days	28 days
1	0	P.C	1.87	2.47	2.63	3.4
2	1.5	$nSiO_2$	1.93	2.53	2.73	3.67
3	3.5	$nSiO_2$	2.2	2.87	3.13	3.7
4	5.5	$nSiO_2$	1.93	2.63	2.83	3.63
5	7.5	$nSiO_2$	1.7	2.03	2.83	3.16



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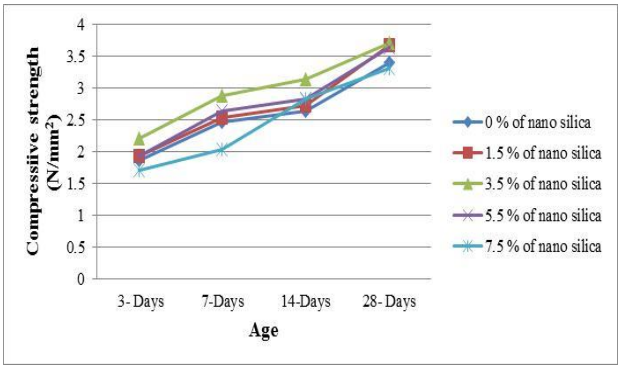
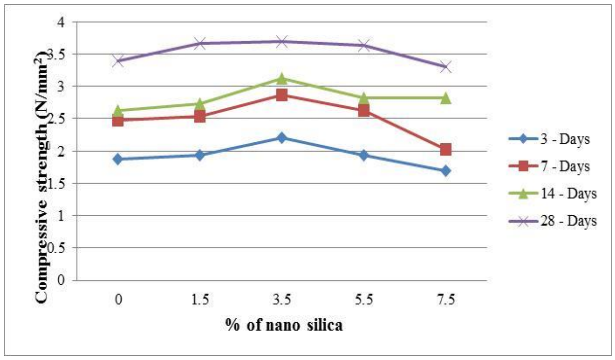
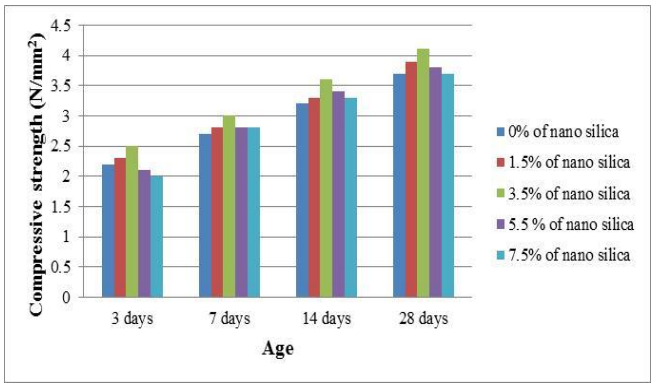


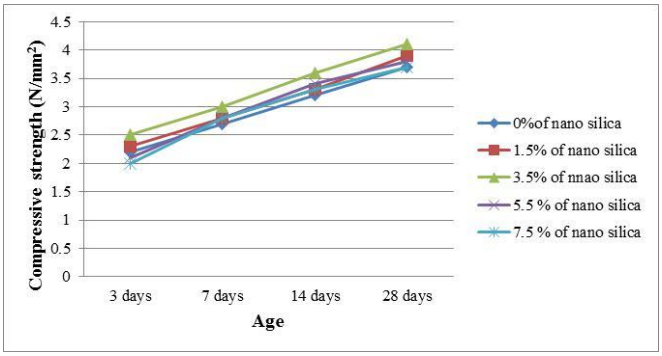


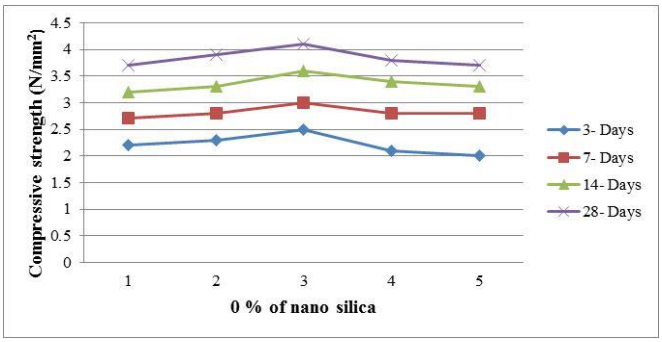
Graph 5: Split tensile test for cylinders by using OPC Using Blended Cement

TABLE 10. Split tensile test result for cylinders by using Blended cement

Sl. No	% replacement of nano silica	Description	3 days	7 days	14 days	28 days
1	0	P.C	2.2	2.7	3.2	3.7
2	1.5	$nSiO_2$	2.3	2.8	3.3	3.9
3	3.5	$nSiO_2$	2.5	3.0	3.6	4.1
4	5.5	$nSiO_2$	2.1	2.8	3.4	3.8
5	7.5	$nSiO_2$	2.0	2.8	3.3	3.7





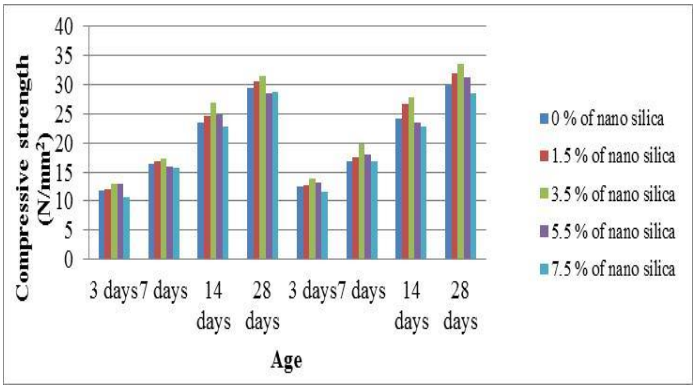


Graph 6: Split tensile test for cylinders by using Blended cement

Comparison of cement mortar for OPC and Blended cement

TABLE 11. Comparison of cement mortar by using OPC and Blended cement

% Replacement of nano silica	OPC				Blended Cement			
	3 days	7 days	14 days	28 days	3 days	7 days	14 days	28 days
0	11.9	16.5	23.5	29.4	12.5	16.9	24.1	29.9
1.5	12.1	16.8	24.6	30.7	12.7	18.6	26.8	32
3.5	12.9	17.3	26.9	31.6	13.9	19.8	27.9	33.5
5.5	12.7	15.9	24.9	28.6	13.1	17.9	23.4	31.2
7.5	10.6	15.6	22.8	28.7	11.5	16.8	22.8	28.6



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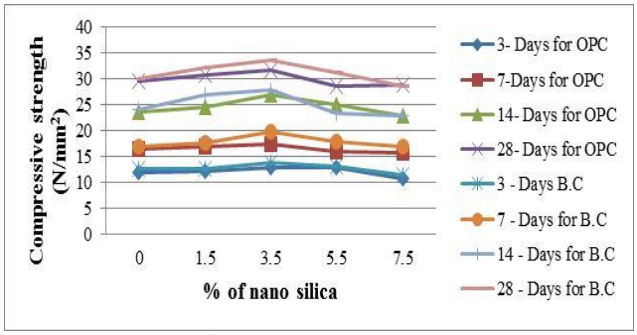
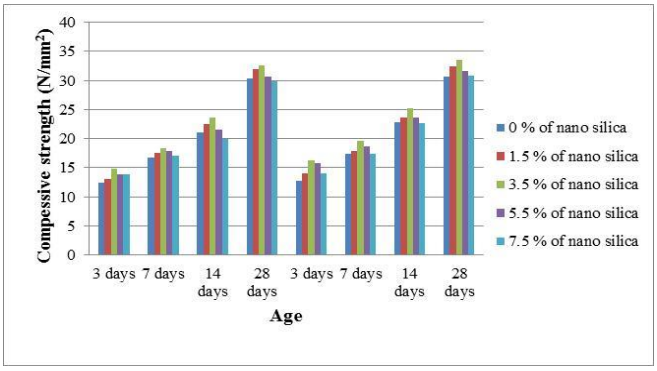


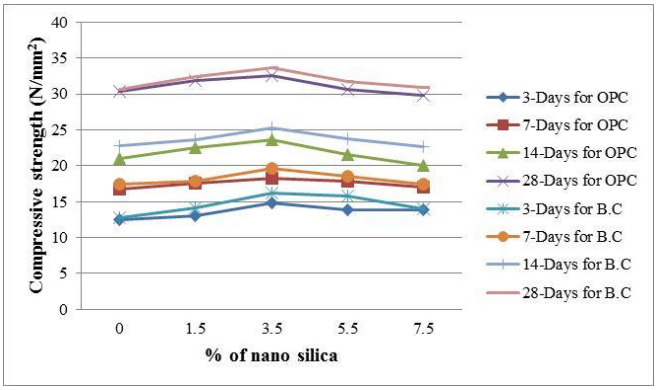
Graph 7: Comparison of cement mortar cubes by using OPC and Blended Cement

Comparison of concrete cubes by using OPC and Blended cement:

TABLE 12. Comparison of concrete cubes by using OPC and Blended cement

% Replacement of nano silica	OPC				Blended cement			
	3 days	7 days	14 days	28 days	3 days	7 days	14 days	28 days
0	12.5	16.8	21	30.4	12.7	17.4	22.8	30.6
1.5	13	17.6	22.5	31.9	14.1	17.8	23.6	32.4
3.5	14.8	15.3	23.6	32.6	16.2	19.7	25.3	33.6
5.5	13.9	17.9	21.6	30.6	15.8	18.6	23.7	31.7
7.5	13.8	17	20	29.8	14	17.4	22.6	30.9



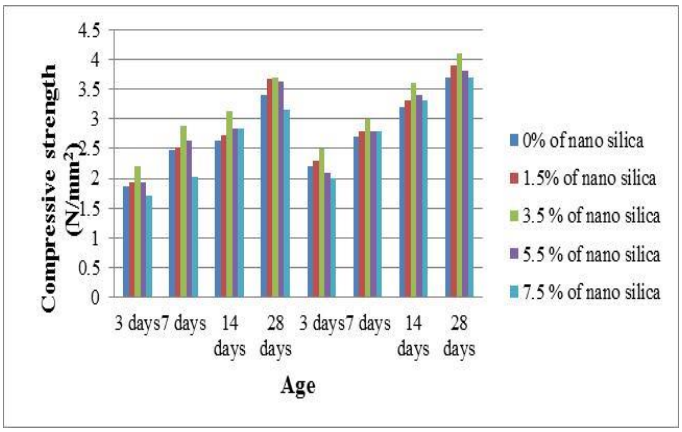


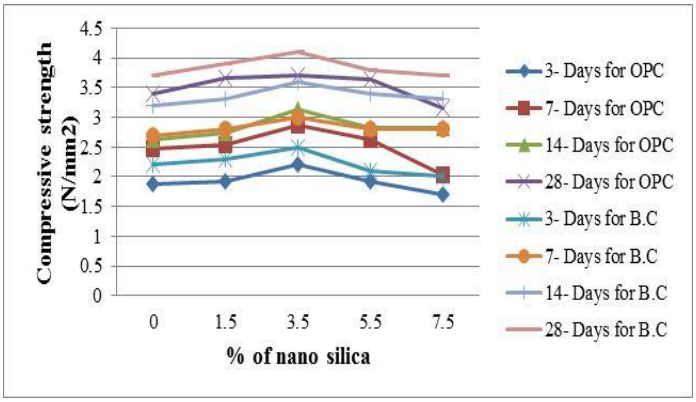
Graph 8: Comparison of concrete cubes by using OPC and Blended Cement

Comparison of Cylinders by using OPC and Blended Cement:

TABLE 13. Comparison of cylinders by using OPC and Blended Cement

% Replacement of nano silica	OPC				Blended cement			
	3 days	7 days	14 days	28 days	3 days	7 days	14 days	28 days
0	1.87	2.47	2.63	3.4	2.2	2.7	3.2	3.7
1.5	1.93	2.53	2.73	3.67	2.3	2.8	3.3	3.9
3.5	2.2	2.87	3.13	3.7	2.5	3.0	3.6	4.1
5.5	1.93	2.63	2.83	3.63	2.1	2.8	3.4	3.8
7.5	1.7	2.03	2.83	3.16	2.0	2.8	3.3	3.7





Graph 9: Comparison of Cylinders by using OPC and Blended Cement

X-Ray Diffraction:

It is a rapid analytical technique. It is used for identification of crystalline material such as minerals, inorganic compounds etc. and it can analyze material is homogenized, and finely ground.

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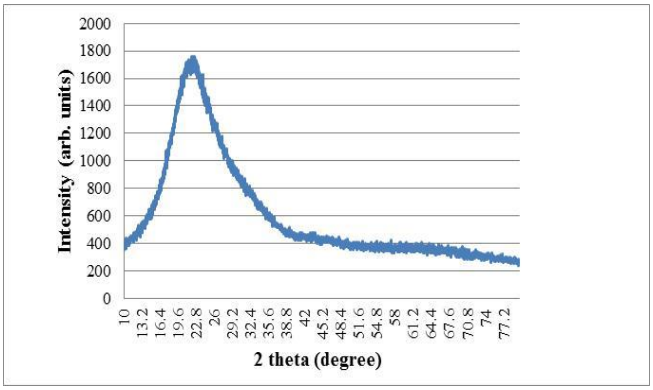
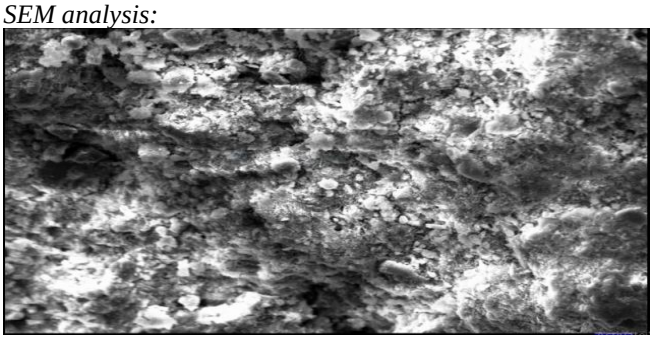
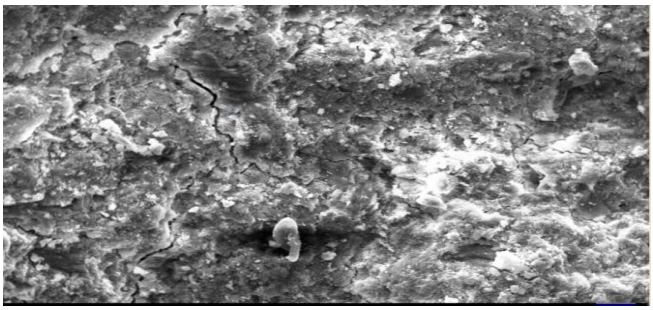


Graph 10: X – Ray Diffraction for nano silica

SEM analysis:



(a) For 3.5% of nano silica replacement



(b) For 5.5% of nano silica replacement

The morphology of the nano silica samples with (3.5% and 5.5%) nano silica addition is explained by using Scanning Electron Microscope and is shown in fig (a) and (b).

IV. CONCLUSIONS AND SCOPE FOR FUTURE INVESTIGATION

Conclusions

The purpose of this study is to conclude the strength of the materials by with the nano silica and also comparison with the Ordinary Portland Cement and blended cement for the cement mortar. Analyzing the results attained from this investigation, the following conclusions are drawn.

1. The compressive strength of the OPC cement mortar is lower than the Blended cement mortar.
2. The strength will enlarge by using the enlarge percentage of the Nano silica.
3. Up to 3.5% replacement of Nano silica should increase the strength and at 5.5% and 7.5% of silica substitute reduces the strength.
4. Compressive strength augments with growing the Nano silica content up to the 3.5% of substitute by weight of the cement.
5. The stability and setting time is dissimilar for the percentage augment of $Nsio_2$.
6. To optimize the presentation of Nano silica in OPC and Blended Cement.
7. Supported on the mechanical properties results it can terminate that Nano silica can get better the mechanical properties strength.

Scope for future investigation

1. The mechanical properties of concretes with the Nano silica as replacements for cement in concrete can be studied by using super plasticizers.
2. Stability studies can be approved on these existings.
3. The workability properties of these existing can be studied and self-compaction concretes with Nano silica can be studied
4. High strength, high presentation concretes with other mixture can be tried.

REFERENCES

[1] **D.V.PrasadaRao (2016)** – Study the effect of nano silica containing metakaolin.

[2] **DarishHajizadeh (2016)** – Study the application of nano silica in concrete.

[3] **Arshdeep Singh (2015)** et al this experimental study they Targeted on investigating the effect of nano silica and fly ash on fresh homes and compressive energy of recycled mixture concrete. To take a look at the clean residences of concrete, stoop test turned into done for workability necessities. The primary is to provide an explanation for the compressive electricity of concrete with fly ash, nano silica and recycled aggregates.

[4] **Satyajit Parade (2015**) et al this study concerns with the usage of nano silica of length 236 nm to improve the compressive energy of concrete. An experimental research has been performed by changing the cement with nano silica of zero.3%, 0.6% and 1% b.W.C. The check performed on it shows a massive boom in early-age compressive strength. The principal purpose is to study the impact of nano silica on the compressive power of concrete.

[5] **Paratibha Aggarwal (2015)** et al the main aim of this paper is to study the use of nano-silica in cement based materials. The evaluate paper summarizes the effect of nano-silica addition on mechanical. It affords the modern development of software of nano-silica in paste, mortar and urban. Finally, the destiny fashion/capacity and implication of nano silica in cement-primarily based substances

[6] **K.V.Priya, D.Vinutha (2014)** [9] explained the effects of nano silica in rice husk ash. This project studies on the preparation of rice husk ash by burning at 700 ^{0} C silica content obtained after heat treatment is 90.3%. in this

[7] project the SEM analysis shows the 2.5 N NaOH for 3h provided agglomerate particles with dimension 5-10nm.When compared to with the normal silica the addition of nano silica in rice husk ash shows the higher strength.

[8] **M.Iyappan,Dr.A.Jaganathan (2014)**[10]gives the investigation results for the high strength self-compacting concert with nano silica. In these study three percentages of replacement Nano silica is used. 4 % of replacement with nano silica is increased at the 28 days test for the compressive strength and split tensile strength results.

[9] **Satyajit Parade (2014)** [11] investigated the effect of nano silica on compressive strength of concrete. In this study they used the 263 nm is the particle size of the nano silica. An experimental investigation is carried out by replacing the 0.3%, 0.6% and 1% of nano silica replacing with the weight of the cement. For the 1% of replacement nano silica with cement is increased at the 28days strength.

[10] **DariushHajizadehAs (2014)** [12] study gives the review about the application of nano silica in concrete to improve the mechanical properties. .