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USE OF NANO SILICA TO STUDY THE PERFORMANCE OF THE CONCRETE

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Abstract: *This study deals with use of Nano materials into the in the form of silicon dioxide having Nano scale into the concrete. Concrete with the utilization of Nano silica its enhances its strength & durability hence the application of Nano size material into the construction industry. Experimental studies were conducted by varying dosage of Nano silica to understand the effect of mechanical response of the concrete The content of snps is 1% to 3 %. this percentage of Snps is adding the mechanical property enhance at 3 % was those optimum dose. The review paper summarizes the effect of Nano silica addition into the standard grade concrete to improve the durability and mechanical property of the concrete. The experimental results are studied, discussed, and presented.*

Keywords **–**Silica Nano particles, mechanical properties, chloride attack, durability.

I.INTRODUCTION

the construction industry are need the sustainability into the construction work and they need to reduces the carbon emission into the concrete industry. Hence they are need to the using supplementary cementious material into the concrete. The Nano silica are naturally stable material. The Nano particles having range of 1 nm to 50 nm. The 17 nanometer scale particle are used of silica into the concrete mix. They investigated the strength and durability of concrete with the addition of a small quantity of Nano silica to cement. The present study exhibits the effect of Nano silica on strength properties of concrete and durability behavior with adding of Nano silica into the concrete investigate the rapid chloride attack, sulfuric acid attack and hydrochloric attack with the 5% concentration solution. Mechanical strength investigates compressive stress, split tensile, flexural strength. The Nano silica material are used to resist the environmental impact in coastal region and also check to using the performance of concrete using the nanomaterial of silicon dioxide using in concrete mix design. The property of strength, durability and other characteristics are depending upon the method of mixing quality of materials, mix design of concrete, methods of placing of concrete, method of compaction and quality of curing water. The reason of use of concrete is possesses excellent resistance of water, concrete elements formed in variety of shape and sizes, concrete material are easily available and cheapest.

II.NEED OF THE STUDY.

The concrete is backbone of construction industry in whole world. Construction industry is research the reduction of carbon emission to using the pozolanic material. This work presents an experimental investigate the properties of concrete using Nano silica. Hence this project is helps to those interesting of the developing the concrete mix design into the involved in the effective use nanoscience and technology those produce are the nanomaterial using in concrete.it is important to use the Supplementary cementing materials in form of Nano silica using in concrete to proposed study and familiar the effects of nanoparticle of silicon dioxide being used proposed for application in concrete and to work on the to study the early age concrete characteristics and harden state concrete are results are checking for the evaluation and formulation of concrete mixtures to determine the effects of those factors study the performance of concrete in project work.

III. MATERIAL AND METHODOLOGY

A. Test Specimens

The strength property of concrete is determined by casting specimens of cube size 150 mm×150 mm×150 mm for compression, beam of size 500 mm× 100 mm× 100 mm for flexure and cylinders of size 300 mm×150 mm for split tensile strength and cured 28 days. For durability test rcpt concrete molds use the 100 mm dia 50 mm thickness and acid attack test the cube are immersed into the acid solution at 30 and 60 days.

B. Materials

Cement

Ordinary Portland cement (43 grade) is used for the concrete specimen casting work.

Nano silica

the nano silica used for the present study is in powder form. it is acquired from astraachemicals Chennai.

Fine aggregate

Regionally sourced basalt stone by crushed sand confirming to IS 383-1970, was used.

Coarse aggregate

Angular aggregate of maximum size 10 mm to 20 mm, conforming to IS 383-1970 was utilized.

Water

Regionally sourced potable water is used for mixing and curing confirming IS 456-2000.

Properties of nano silica

The physical and chemical composition of Nano silica are listed table 1,

Table 1 physical and chemical composition of nano silica

Properties	**Nano silica**
Specific gravity	2.2
Fineness sqm/g	202
colour	white
Density g/l	44
Loss of ignition %	0.66
SiO_2 %	99.8
Particle size	17 nm

C. METHODOLOGY

Concrete was planned for compressive, split tensile & flexural strength of M25 and M30 standard strength concrete used because The regional surrounding area and Indian structure are generally used those standard grade concrete.

CONCRETE MIX DESIGN

Concrete mix design is prepared as per IS 10262-2019 and IS 456-2000 for the target strength and exposure and slump for 31.2 n/sqmm and 38.25 n/sqmm moderate and 100 mm slump respectively. The content of snps (1%,2%,3%) was added by the weight of binder.

Table 2 Mix Proportions of M25 Concrete grade for different nano silica content

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NS %	Cement	FA	CA	w/c
1 to 3	1	2.16	2.92	0.45

Table 3 Mix Proportions of M25 Concrete grade for different nano silica content

NS %	Cement	FA	CA	w/c
1 to 3 %	1	2.33	2.8	0.45

TESTING

The compressive strength test of cube and cylinder are conducted respectively, the compressive strength and split tensile strength carried in Compressive testing machine accordance with IS 516:1959 with rate of loading is 1.37 kN/min.the flexural strength testing according IS 516:1959 with centrally point loaded carried on Universal testing machine. The durability test of rapid chloride ion is performed as per ASTM C1202.after the chloride attack the detoriated concrete They are useful or not is checked by Ultrasonic pulse velocity test as per IS 13311:1992.

IV. RESULTS AND DISCUSSION

A. Workability of Nano Silica

When nano silica was mixed with concrete paste, observed the slump value and nature of the cement concrete paste with the compared controlled concrete workability results for nano silica into the concrete mix they are listed as below the table 4.

Table 4. Workability results for addition of nano silica in concrete

NS %	Slump Value (mm)	
	M25	M30
0	90	102
1	82	96
2	75	87
3	68	65

B. Flow Test

The fresh concrete is used to the flow measuring test.the flow of concrete also denotes the fluidity in pumpable concrete in addition of Nano silica they are water is required slightly more than the conventional concrete. Because the silica Nano particles are cohesive nature. The flow is necessary because they are easy to handle and pumpable in ready mix concrete. Below this table the flow is more into the addition of NS. The flow is explained into the below the table. The flow is more than control concrete.

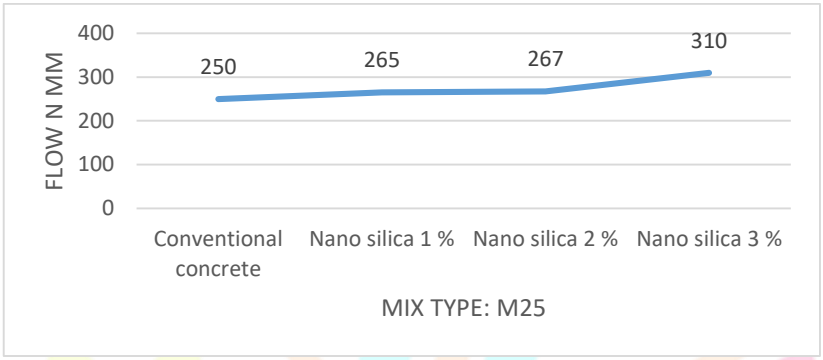

Fig 1. concrete flow measurement in mm

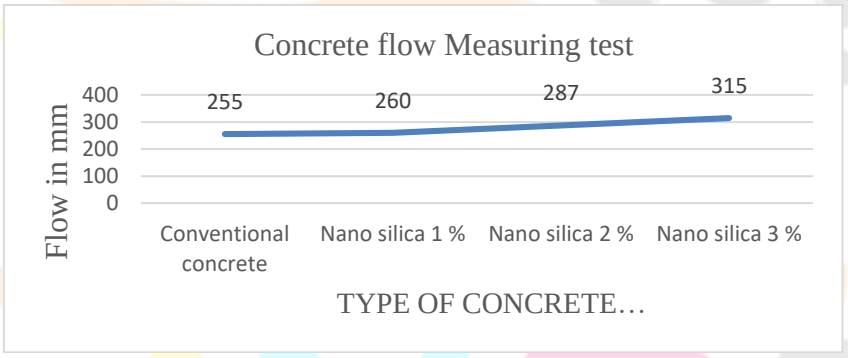

Fig 2. concrete flow measurement in mm

C. Compressive strength of mixes

Cube specimens were casted for *M25* and M#0 and tested 7 and 28 days on a compression testing machine.to evaluate the optimum quantity of nano silica for addition. Observed significance betterment in the compressive strength of high pozolanic property of nano silica and also acts as filler into the pore of concrete then concrete much denser. For the mechanical property of the addition of nano silica optimum at level 2% and 3% was every grade. Beyond the 3% increasing trend is not observed and also effect the economical aspet.it was found the compressive strength increase upto the level depends on the content of nano silica, w/c ratio and curing time, pH of the water, compaction method particle size of the concrete ingredient material those are the parameter are effected into the design mix of those concrete. The ordinary and nano silica concrete compressive strength as explained as below the table…

Table 5 ordinary and nano silica concrete compressive strength at 7 days and 28 days of M25 concrete mix

NS %	Compressive strength (Mpa)	
	7 Days	28 Days
0	15	28.60
1	16.46	31.80
2	17	35.55
3	20.6	38.85

RESULTS DISCUSSION

The increase in content of nano silica at the level of 2 % and 3% the silica content develops the strength at those level with difference of conventional concrete comparison at M25 mix 28 days as 11.18%, 24.30%, 35.85% respectively those optimum content. Beyond the 3 % the more water content required for the nano silica mix concrete.

Table 6 ordinary and nano silica concrete compressive strength at 7 days and 28 days of M30 concrete mix

NS %	Compressive strength (Mpa)	
	7 Days	28 Days
0	16.50	33.25
1	17.8	34.85
2	20.10	38.50
3	21.15	43.2

RESULTS DISCUSSION

The increase in content of nano silica at the level of 2 % and 3% the silica content develops the strength at those level with difference of conventional concrete comparison at M25 mix 28 days as 4.81%, 15.80%, 30% respectively those optimum content. Beyond the 3 % the more water content required for the nano silica mix concrete.

D. ORDINARY AND NANO SILICA CONCRETE: FLEXURAL STRENGTH STUDIES

The flexural strength of M25, M30 grades of concrete with nano-silica for 0%,1%,2%,3% adding and this test is done on the 28 days those percentages beyond the 3% not carried with reference the compressive strength same trend those percentage level.

Table 7 Flexural strength of plain concrete beam M25

Mix % NS	28 days Mpa
0	1.82
1	1.90
2	2.48
3	2.78

DISCUSSION OF FLEXURAL STRENGTH

The flexural strength is increased at the percentage level of nano silica at 1% to 3% due to nano size of particles they are fill the voids and improve the flexural strength of the beam. The increment of M25 mix 4.39%,36.2%,52.74 % respectively.

Table 8 Flexural strength of plain concrete beam M30

Mix % NS	28 days Mpa
0	1.91
1	2.17
2	2.66
3	3.1

The flexural strength is increased at the percentage level of nano silica at 1% to 3% due to nano size of particles they are fill the voids and improve the flexural strength of the beam. The increment of M30 mix 13.61%, 39.26%,50.78 % respectively.

D. Ordinary and Nano silica concrete: split tensile strength studies

The split tensile of the cylinder the test is done on the ctm machine the test results are described as the below of the table of both are the mixes grades the tensile strength is slightly increases of those mix level of nano silica the difference between the conventional and ns concrete at the 1.68%,6.30%,7.98 % respectively of the M25 mix.

Table 9 Split tensile strength of concrete M25

Mix % NS	28 days Mpa
0	2.38
1	2.42
2	2.53
3	2.9

Split tensile strength studies

The test results are described as the below of the table of both are the mixes grades the tensile strength is slightly increases of those mix level of nano silica the difference between the conventional and ns concrete at the 1.26%, 5.88 %,14.28% respectively of the M30 mix.

Table 10 Split tensile strength of concrete M30

Mix % NS	28 days Mpa
0	2.41
1	2.52
2	2.60
3	3.3

DURABILITY TEST ON CONCRETE

The durability terms are important because they are effect the service life of the structure the term of durability is the ability of resisting the weathering action, chemical attack and abrasion. We undergo the procedures of carried out the different mixes of the concrete. Then find out the optimal percentage of nano silica into the concrete that achieves the durability of the concrete.

Test results of rapid chloride permeability in concrete the graph are present the total charges passed in concrete as per ASTM 1202,

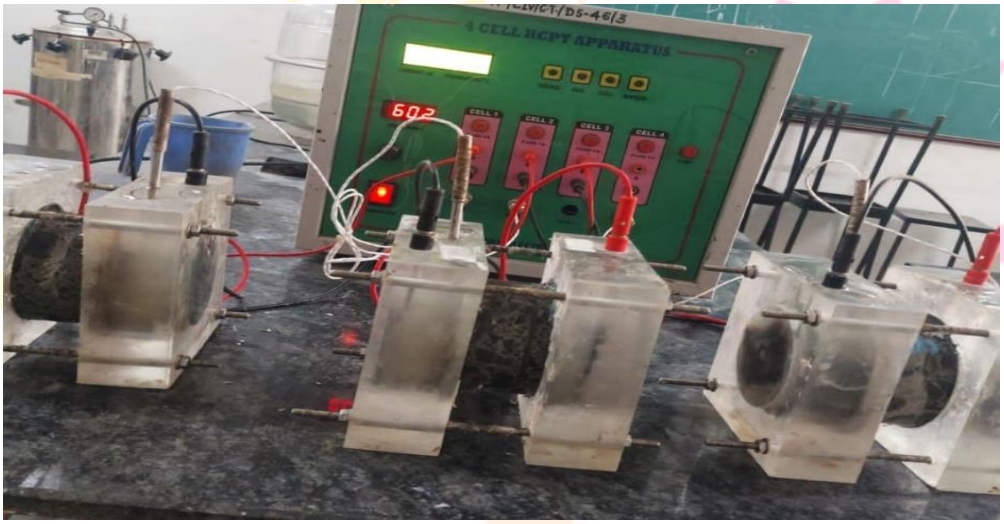

Fig 1: Rapid chloride Cell setup of chloride ion permeability

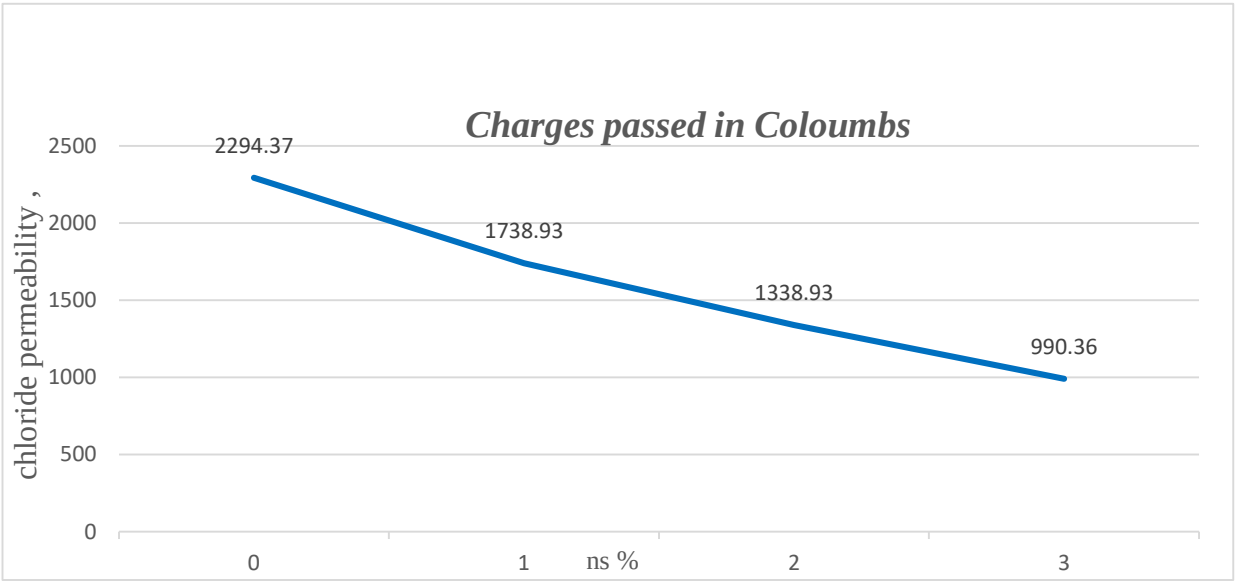

Fig 2. Chloride permeability passing at different Ns percentage level

The chloride permeability of the concrete cell as compare to conventional concrete and ns concrete the test results are explained above the graph the chloride permeability is very low at 2 % ns level and very low at 3 % level hence the ideal percentage for nano silica for durability point of view is 2% and 3% of the design mix of the concrete.

Non Destructive test of detoriated chloride attack concrete,

The ultrasonic pulse velocity test is carried out those chloride attack concrete cell specimens and the check the pulse velocity in as per IS 13311-part-1 decide the concrete quality grading.

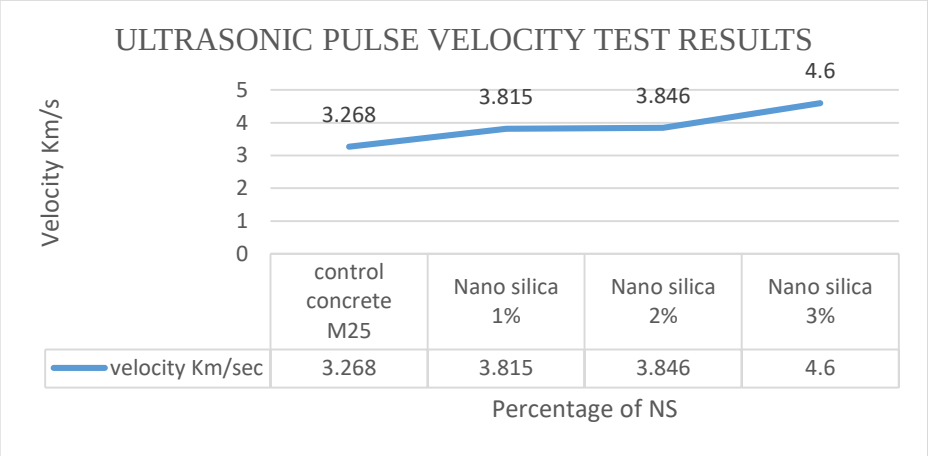

Fig 3. pulse velocity passing Mix of ns

The pulse velocity is passes through the chloride attack of the concrete specimens the ordinary concrete is such detoriated but the Nano silica concrete is having good pulse velocity are passes hence after the chloride attack the nano silica concrete is stable by checking of the Ultrasonic pulse velocity test of those the concrete mix grade.

Fig 4 : UPV test setup

V.CONCLUSIONS

The impact of adding nano silica material to standard grade concrete on the mechanical and durability behaviour of concrete mixes is the main focus of this investigation.

1. The mixes of Nano silica 3% at the rise the compressive strength Mix M25 level to 35.85% and Mix M30 at Nano silica mixed 3% at 30% rise compressive strength.
2.The flexural strength of concrete grade M25 with 3% nano silica 52.7% at those mix level of NS is increased and also Mix M30 the flexural strength of concrete the NS 3% at the level of percentage increased to 50.78 %.
3.The split tensile strength is also increased at the NS 3% level of mix M25 and M30 the mix they increased 21.84% ,36.92% respectively.
4. Use of nano silica in concrete is advantageous because it improves resistance to chloride attack at percentages of 2% and 3%, extending the durability of Mix M25 and M30.
5. When acid attack concrete is tested using an ultrasonic pulse velocity test, conventional concrete degrades, but nano silica concrete mix levels with 1% to 3% of those concrete quality grading as good to excellent showed stronger resistance to acid attack than those ordinary concrete mixes.

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