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Repercussion of Nano silica on M40 Grade Concrete

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Abstract*: Nano innovation is most encouraging region of science. Distinctive nano materials like nano silica, nano titanium oxide, carbon nano tube and so on are presently a days utilized by the engineers in development work. This paper introduces the impact of Nano-Silica as mineral admixtures in cement, with particular 1%, 2%, 3% and 4% nano silica doses with or without partial replacement of cement by weight. So here in this paper we will determine the effect of nano silica on the mechanical properties of the concrete. In the main stage the M40 grade concreate mix design is done utilizing IS: 10262:2009 without Nano silica or with replacement of nano silica at 1%, 2%, 3% and 4% dosage by weight of cement. The compressive strength and flexure strength is determine by universal testing machine.
Keywords: Concrete, Nano silica, compressive strength, flexure strength.

I. INTRODUCTION

Presently days the concrete business is searching for new materials to upgrade the mechanical properties of cement. In the improvement of material quality, the nanotechnology is advancing in numerous parts and this innovation is likewise contributing in cement industry to upgrade the properties of concrete mix.

For cement in the current past numerous admixtures came as substitution to the concrete and some of the time as added substances moreover. In this view in this the exploratory work has been engaged to concentrate the impact of nanosilica on cement. A concise survey on miniaturized scale silica and nano silica is displayed beneath.

Albert Lazaro and H. J. H. Brouwers passed on that utilization of nano-silica decreases the CO2 impression of the fabricated concreate items and enhances the properties in solidified state. Therefore a concrete with better execution, bring down expenses and ecologically maintainable is planned.

It has been explored Nano silica (Sio2) enhance compressive quality, flexural quality and scraped spot of cement. As indicated by Marcelo Gonzalez study, Frictional and sound ingestion reaction of cement can be made strides.

II. EXPERIMENT PROGRAM

In this research work total 45 standard cubes was casted for compressive strength and 5 concrete beam was casted for flexural strength. Concrete mix for M40 calculations was delineated by IS: 10262-2009. The basic properties of material are evaluated out for mix design and are contemplated in this paper. The trial adjusted was under taken to the standard concrete cube of size (150 × 150 × 150) mm for compressive quality of concrete and standard concrete beam (150 × 150 × 700) mm for flexural quality of concrete. Analyse about the flexural quality and compressive quality of concrete with and without nano silica.

III. MATERIAL USED

A. Cement

The cement utilized as a part of the examination is standard Portland cement (OPC) of M53 grade. The physical properties of cement are exhibited in Table 1.

Table 1: Properties Of Cement

Sr no.	Characteristics	Result	Limitation as per IS Code	IS Code
1	Fineness	3.15	<10 gm	IS:4031(Part -1) - 1996
2	Normal Consistency	30	-	IS:4031(Part -4) - 1988
3	Initial Setting Time	110 min	30 min minimum	IS:4031(Part -5) - 1988
4	Final Setting Time	223 min	600 min maximum	IS:4031(Part -5) - 1988
5	Specific Gravity	3.15	-	
6	Compressive Strength at 28 days	55.2 N/mm2	53 N/mm2	IS:4031(Part -6) - 1988

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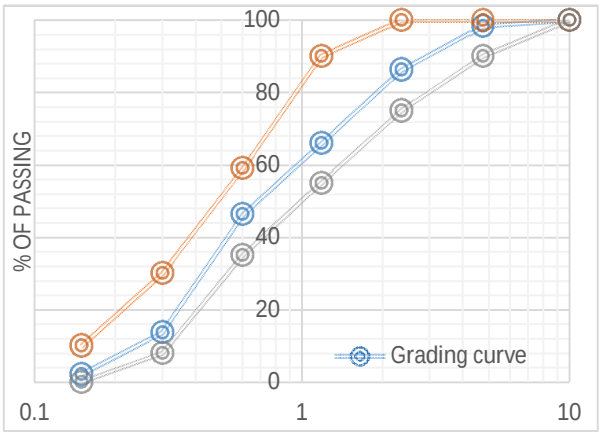
B. Fine Aggregate

River sand is utilized as fine total, which is of Zone II, in view of particle size dissemination. In view of the essential tests, the properties of fine total are organized in table 2.

Table 2: Properties of Fine Aggregate

Sr.no	Characteristics	Result
1	Type	Natural
2	Specific Gravity	2.64
3	Water Absorption	1.20 %
4	Fineness Modulus	2.87
5	Grading Zone	Zone-II

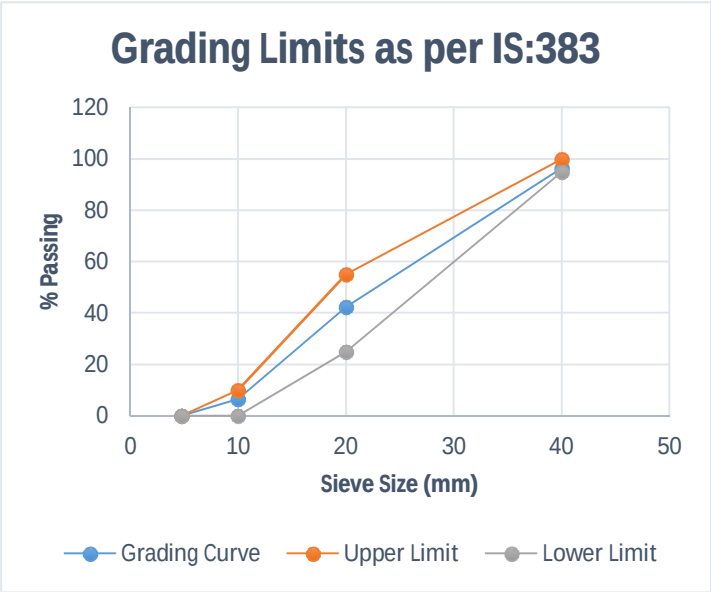


C. Coarse Aggregate

Crashed stone of size 20mm down size got from the crusher is utilized as a part of the examination. The Properties of the coarse total tried as per IS 2386:1963 are given in table 3

Table 3: Properties of Coarse Aggregate

Sr. no	Characteristics	Result
	Type	Crushed Angular aggregate
1	Maximum size	20 mm
2	Specific Gravity(20 mm)	2.84
	10 mm	2.64
3	Water Absorption (20 mm)	0.64 %
4	Water Absorption (10 mm)	1.20 %
5	Crushing Value	10.90 %
6	Impact value	11 %
7	Los Angles Abrasion Test	14 %
8	Shape test(Combined Index)	26.90 %



D. Water

Locally available portable water is used for mixing and curing of the specimens.

E. Admixture (MasterRheobuild 1126)

MasterRheobuild 1126 is High-range, impeding superplasticiser for high performance concrete. It is made out of engineered polymers uncommonly intended to permit significant decline of mixing water while keeping up control on reach out of set blockade. It is preferred admixture for triple mix binder framework based high performance concrete (HPC) mixtures or blends containing micro silica or metakaolin. In this research, Form the several trial mix and based on experience it is incorporated 0.9 % by weight of cement in concrete

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F. Nano Silica

Physical properties of nano silica is given in table 4

TABLE 4: Properties of nano-SiO2

Properties	Characteristics
Surface area (m2/g)	200±30
SiO2 content (percent)	>99.8
Moisture (percent)	<1.5
Specific gravity (gr/cm3)	2.1

G. Concrete Mix Design M-40 Grade (IS: 10262-2009)

Concrete mix design was done by IS: 10262-2009. In first stage concrete normal mix design was completed then appropriate concrete mix ratio found for the 1%, 2%, 3% and 4% partial replacement of nano silica by weight of cement.

Table no 5: Mix design for normal concrete

Volume Of Cement	1 M^3
Cement	416 Kg
Water	158
Fine Aggregate	664.36 Kg
Kapachi (20mm)	775.72 Kg
Grit (10mm)	517.15 Kg
Admixture	3.74 Kg
Nano Silica	0
Mix Ratio Material:	1:1.60: 3.11

Table no 6: Mix design for 1%, 2%, 3% and 4% replacement of Nano silica

	1% Nano Silica	2% Nano Silica	3% Nano Silica	4% Nano Silica
Volume Of Cement	1 M^3	1 M^3	1 M^3	1 M^3
Cement	411.84 Kg	407.68 Kg	403.52 Kg	399.36 Kg
Water	156.50	154.90	153.33	151.75
Fine Aggregate	665.25 Kg	666.14 Kg	667.04 Kg	667.93 Kg
KAPACHI (20mm)	776.76 Kg	777.80 Kg	778.85 Kg	779.90 Kg
GRIT (10mm)	517.84 Kg	518.54 Kg	519.23 Kg	519.93 Kg
Admixture	3.71 Kg	3.67 Kg	3.63 Kg	3.59 Kg
Nano Silica	4.16 Kg	8.32 Kg	12.48 Kg	16.64 Kg
Mix Ratio Material:	1:1.62: 3.14	1:1.63: 3.18	1:1.65:3.22	1:1.67:3.25

H. Measurement of Workability

Slump test fulfills the criteria's laid down in MoRTH cl. 602.3.4.2. In this my study, Slump test requirement is 30 plus or minus 15 for the rigid road concrete. It is dependent on aggregate moisture content, concrete temperature and mixing. One can determine the mixture's vulnerability to segregation when placed. It is seen that nano silica causes obstruction to the free flow of concrete.

Table 7- Result of concrete slump test (MORT&H cl.602.3.4.2)

	Normal Concrete	1% of Nano silica	2% of Nano silica	3% of Nano silica	4% of Nano silica
Required	30 ± 15	30 ± 15	30 ± 15	30 ± 15	30 ± 15
Initial	46	43	42	39	39
After 30 min	39	38	34	29	28
After 60 min	36	33	30	25	24
After 90 min	30	29	26	22	20

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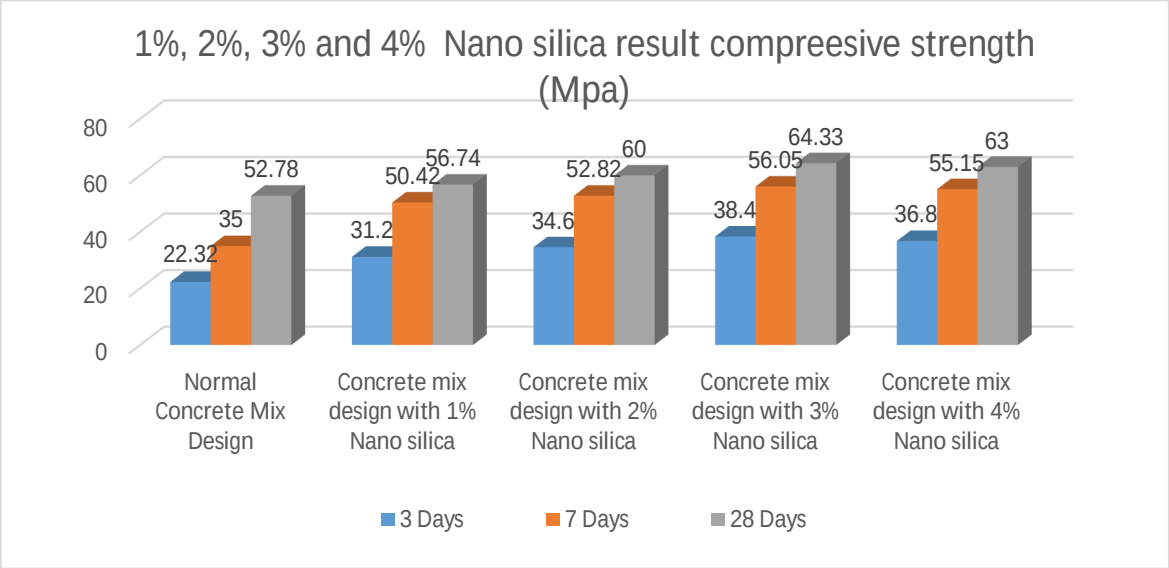
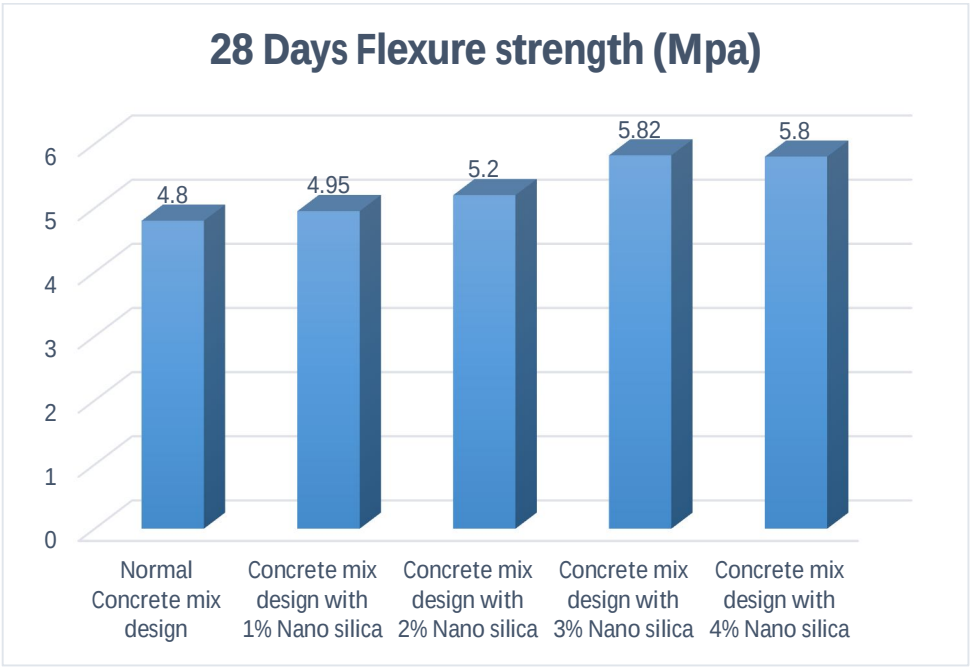
I. Compressive Strength



J. Flexure Strength



IV. CONCLUSIONS

This study has been made to focus the impact of nano silica in suitable measurements on strength of concrete. The research facility examinations gave the accompanying conclusions:

Workability reduces at higher dosage of nano silica from beginning dosage used. The concrete is to be transported from the mixing stage to the spot of setting the mix for road work;

The compressive and flexure strength of concrete linearly increase with the increase of replacement of nano silica at 1%, 2%, 3% dosage but at 4% replacement it slightly decrease. The maximum compressive strength was observed at 3% replacement of cement by weight 64.33 Mpa and flexure strength was observed 5.82 Mpa.

Nano silica can be used as construction material for rigid pavement. Nano silica can reduces the thickness of the pavement because of higher of flexure strength, it would be make economical pavement structure and to improve understanding of their performance is

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an important output of nanotechnology characterization of pavement materials as one will see the next creation of rigid pavement designers and highway contractors.

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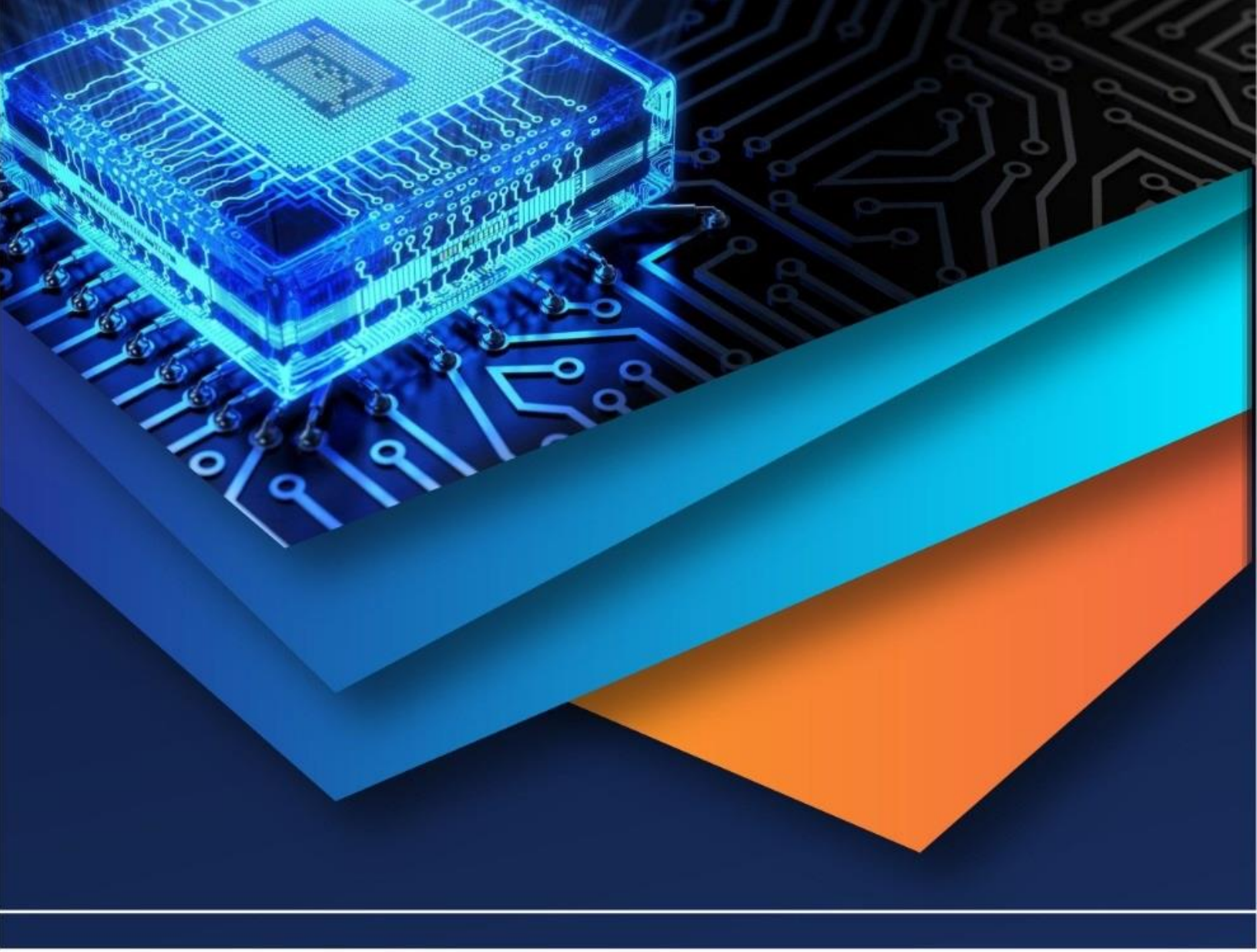

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