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Mechanical properties of High Strength concrete with Micro Silica and Nano Silica

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Abstract
Concrete is the maximum flexible fabric. because of the persevering and ceaseless requests made on cement to meet the unique difficult requirements, broad and huge unfold examination work is being achieved inside the space of substantial innovation. Engineers are regularly aggressive the limits to improve its overall performance with the assist of progressive chemical admixtures and supplementary cementitious materials like fly ash, silica fume, and granulated blast furnace slag, metallic slag and so on., scholars have advanced variations of concrete mixtures like Admixture Concrete, Fiber reinforced Concrete (FRC), Polymer Impregnated Concrete (%), high performance Concrete (HPC), Self-Compacting Concrete (SCC), Geopolymer Concrete etc. presently, Nano era being implemented to concrete includes the use of nano materials like nano silica, nano fibers etc. by means of accumulation the nano materials clever concrete composites with superior properties may be formed.
The usage of huge quantity of cement produces increasing co2 releases, and significance the greenhouse effect. A way to reduce the cement content in concrete mixes is the use of silica fume it really is an amorphous (+non-crystalline) polymorph of silicon dioxide, silica. it is an ultra-high-quality powder composed as a of the silicon and ferrosilicon alloy manufacture and consists of globular particles with a mean particle diameter of zero.1 to 0.5 µ. Nano material concrete is new era concrete; the composition of nano material concrete includes cement, nano silica grain of the scale of 10 nm - 140 nm, water, mixture and coarse combination. Nano materials like nano silica, nano titanium oxide, carbon nano tubes, nano alumina and so on, which can be currently applied in concrete to modify its strength properties. Nano silica will react with C3S and C2S inside the cement and produce CSH-2 as a way to form a strong and stable bond of gel.
In the current study strength properties which includes Compressive strength, split tensile strength and flexural strength of M40 and M50 grades of concrete with using micro silica (5%, 7.5%, 10%, 15%) and nano silica (1%, 1.5%, 2%, 2.5%) as partial replacement of cement were studied. It was observed from the experimental take a look at that concrete composite with superior properties may be produced the use of micro silica, nano silica and mixture of micro silica and nano silica.
Keywords: *Micro silica, Nano Silica, Compressive strength, Split Tensile strength, Flexural strength test*

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I. INTRODUCTION

Concrete is a mixture of coarse aggregates, fine aggregates, cement, with combination of required quantity of water. it's far a extensive used production material for varied styles of structures ascribable to its structural stability and strength. increasing the event demanding situations in combos with the new innovations in substances and production techniques have given new basis for manufacturing excessive performance concrete systems. presently concrete is obtaining used for huge kinds of features to make it applicable in varied conditions. In these conditions common location concrete ought to fail to exhibit the favoured excellent overall performance or strength. In such cases, pozzolanic or mineral admixtures accustomed regulate the homes of traditional concrete.

Pozzolanic materials are chemical compound and aluminous material, that in themselves own very little or no complete price, but will, in finely divided type and in the presence of wet, with chemical compounds react with hydroxide liberated on affiliation, at degree Centigrade, to make compounds, possessing properties. at the association of tri-calcium salt and di-calcium salt, hydroxide is created joined of the products of association. This compound has no entire price and it's soluble in water and may be leached out by way of percolating water. The substance or aluminous compound all through a finely divided type react with the hydroxide to make terribly stable complete substances of subtle composition regarding water, variety twenty and compound. generally amorphous salt reacts plenty more quickly than the crystalline type. It’s regarded that hydrated oxide is regenerate in to insoluble material by using the reaction of pozzolanic materials.

Silica fume can be a fine pozzolanic material to be able to be a of building matter metal. the most serviceable uses of compound fume in concrete are ascribable to its physical and chemical properties; it is a considerably quality and extraordinarily reactive pozzolanic material. Incorporation of compound fume in to the concrete will have excessive strength and strength. The assembly of waste substances is very large so the stress for selling house to dispose this material are excessive. by using this reference of compound Fume, its unit of size generally tested that the range of compound fume is increasing once a year due to actively for several features like in creation, off shore, machine motives, piping and etc... To journey searching the promoting residence for these materials can increase the price in the metallic industries, due to they want to achieve for the planet for this purpose. The really worth of land currently could be quite precious significantly at urban and commercial residence. So, by pattern oxide Fume (waste substances) from the trade as a mineral admixture alternative or greater in practise of concrete will store our earth for a property placing.

One of the most used nano material is Nano Silica (NS). this is often the primary Nano product that has replaced the small silicon dioxide. The advancement created by the study of concrete at nano scale has proved nano silicon dioxide far higher than silicon dioxide that is employed in common concrete. Nano-silica possess a lot of pozzolanic nature, has the aptitude to react with the loose lime throughout the cement association and forms more C-S-H gel provides strength, non-porous and durability to concrete

One of the most important and extremely important helpful makes use of of technology in generation is to use in concrete. It's applied in regarding of all construction fields like roads, bridges, homes and sundry construction works. Concrete unit of measurement typically changed in various methods; one in every of that is to function nano particles to that. Researchers are aiming for how better expertise of the delicate structure of cement- based substances at nano tiers. this could come to be in new technology of more potent and additional strong concrete with favored behaviors and properties. affiliation of cement produces a inflexible, heterogeneous microstructure

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II. MATERIALS AND METHODOLOGY

CEMENT

In this present investigation radical school cement of trendy hydraulic cement (OPC) of 53 Grades changed into used that satisfies the wants of IS: 12269-1987. the following assessments place unit conducted on cement.

AGGREGATE

Aggregates are the important ingredient materials in concrete. they communicate bulk volume to the concrete and reduce the shrinkage end result. They occupy seventy to 80 % of the general volume of concrete.

Fine Aggregate: regionally out their sand collected from watercourse Tungabhadra became used. the subsequent tests location unit conducted on fine mixture according to IS: 383-1987

Coarse Aggregate: The overwhelmed aggregate became used from the local quarry. on this test the aggregate changed into used of 20mm down and tested as per IS: 2386-1963(I, II, III) specification. the following tests area unit conducted on coarse aggregate.

Silica Fume

The oxide fume changed into utilized in those experiments conforms to ASTM C 1240 and IS 15388:2003. The oxide fume is particularly fine particle that exists in white colour powder type. Oxide fume has been procured from Astrra chemical substances Ltd-Chennai.

Nano silica

on this experimental study aggregate nano oxide of CemSyn®-XFX is hired, it is a series of oxide based often binders /fillers obtained from Bee-chem.: chemical substances Ltd., Kanpur.

MIX DESIGN OF CONCRETE

Mix style can be outlined due to the fact the approach of choosing suitable components of concrete like cement, aggregates, water and determinative their relative proportions with the element of producing concrete of needed minimum strength, workability and durability as economically as possible. The combine proportions of M40 and M50 grades concrete place unit performed exploitation IS: 10262-2009

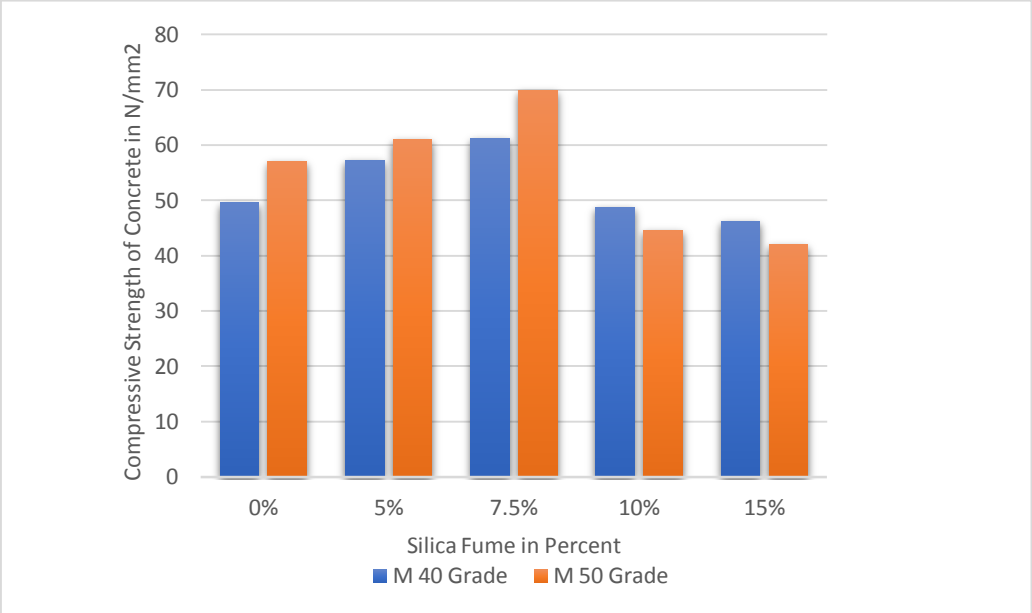
TEST PROGRAMME

In this ability research its miles aimed to look at the strength characteristics of concrete consisting of compressive strength, split durability and flexural strengths of M40 and M50 grade concretes, by enhancing preferred concrete with totally different percentages of oxide fume (zero%, 5%, 7.5%, one hundred percent & 15%) and nano oxide (1%, 1.5%, 2%, & 2.5) by using partial alternative of cement by using weight. numerous mix proportions of M40 and M50 grade concretes with nano silica, small oxide, combos of nano silica and micro silica

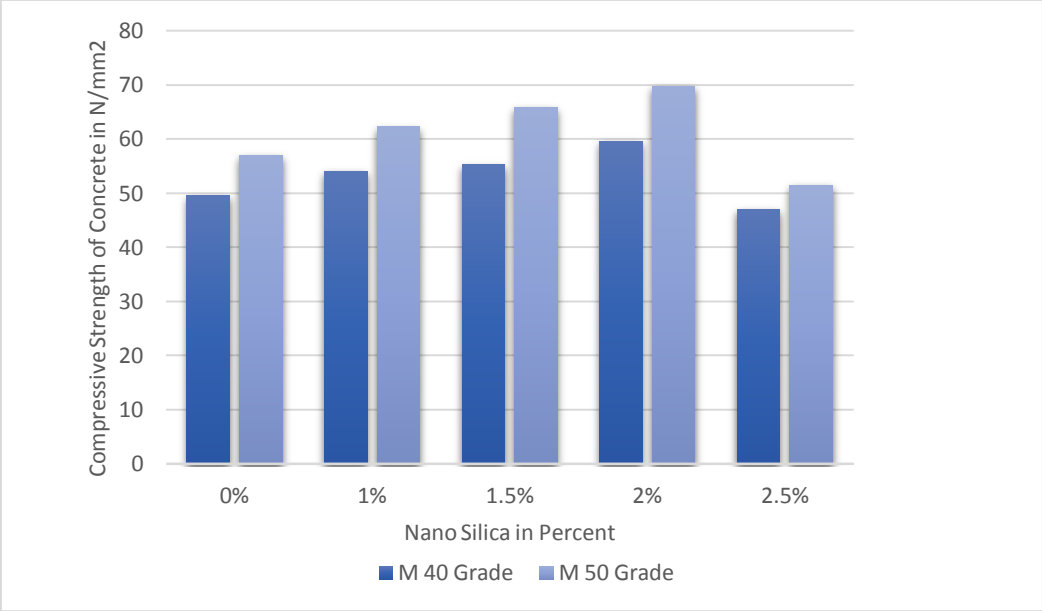
Compressive strength:

The compressive strength of M40 and M50 grade concrete, SF concrete and NS concrete at the age of 28 days

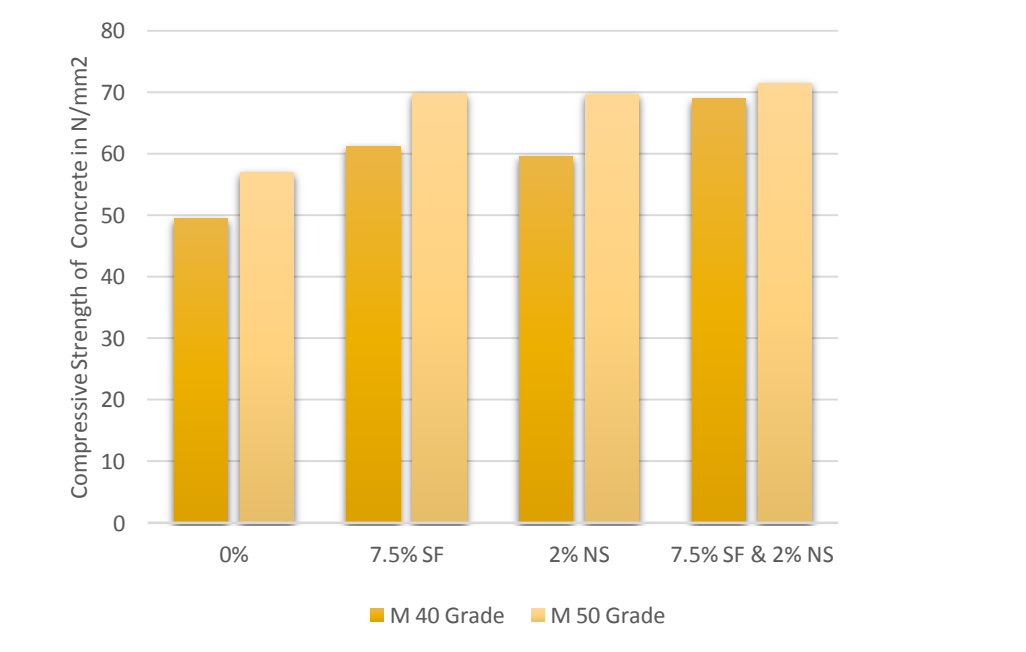
S.No	% Silica Fume	% Nano Silica	Compressive Strength of Concrete in N/mm^2			
			$M_{40\ Grade}$	% Increase or decreased	M_{50} Grade	% Increase or decreased
1	0%	0	49.65	0	57.04	0
2	5%	0	57.81	15.37	61.02	6.93
3	7.5%	0	61.42	23.65	69.84	22.54
4	10%	0	48.47	-1.64	44.85	-21.86
5	15%	0	46.02	-6.74	42.70	-26.24
6	0	1%	54.13	9.19	62.62	9.17
7	0	1.5%	55.26	11.46	65.78	15.35
8	0	2%	59.62	20.26	69.79	22.24
9	0	2.5%	47.01	-5.17	51.42	-9.86
10	7.5	2%	62.53	25.79	71.51	25.34



Discrepancy of compressive strength of Silica Fume concrete at 28 days



Dissimilarity of compressive strength of Nano Silica concrete at 28 days



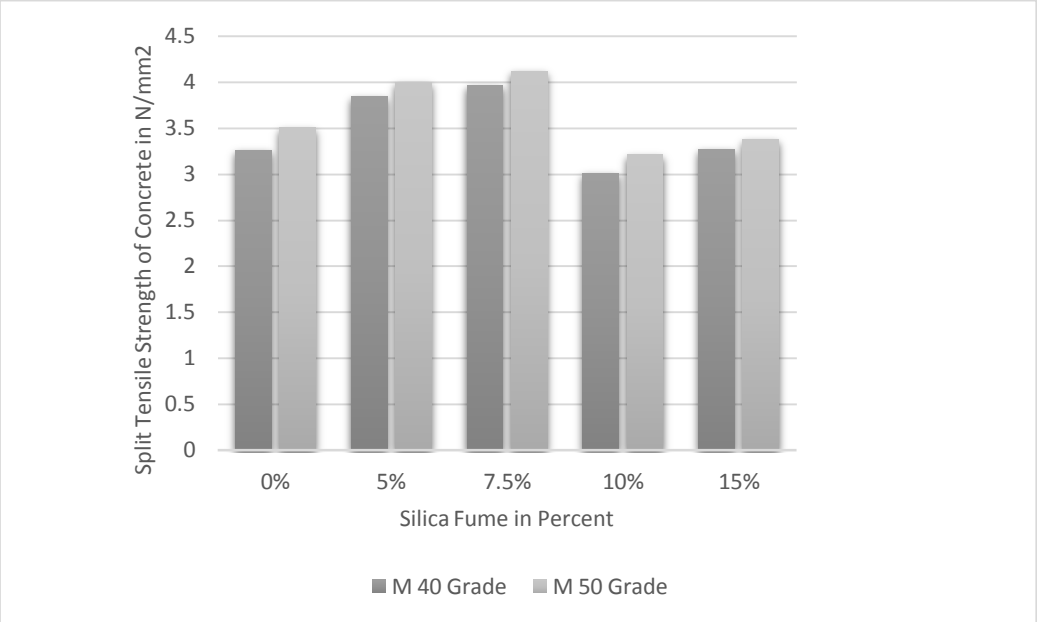
Variation of compressive strength of both Silica Fume and Nano Silica concrete at 28 days

Split Tensile Strength:

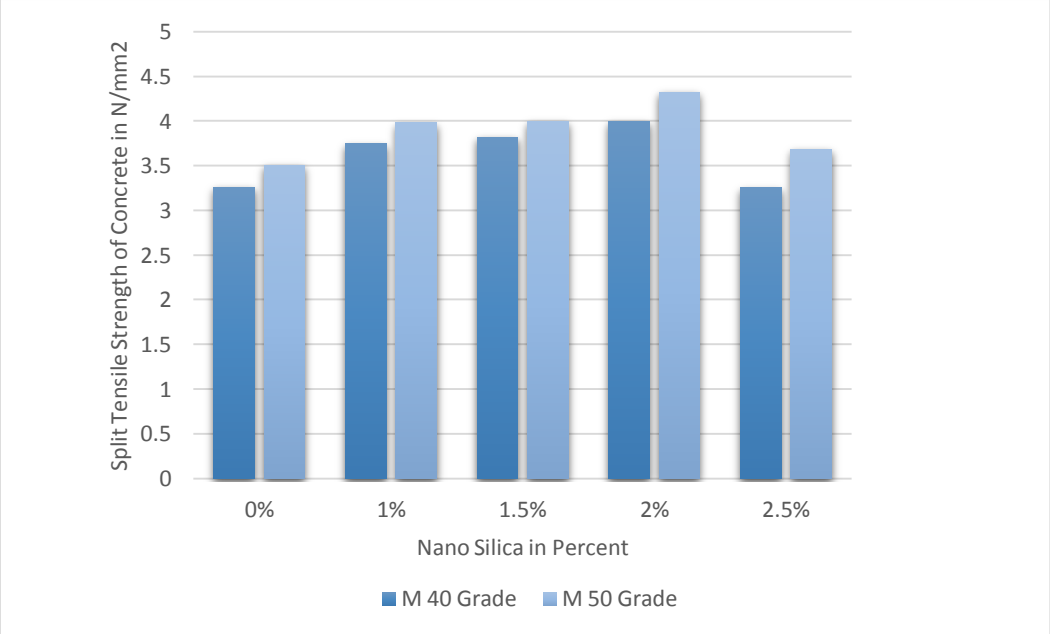
Split Tensile Strength of Concrete at 28 days

SNO	% Silica Fume	% Nano Silica	Split Tensile Strength of concrete in N/mm^2			
			M_{40} Grade	% increase or decreased	M_{50} Grade	% increase or decreased
1	0%	0	3.27	0	3.52	0
2	5%	0	3.86	17.81	4	14.20
3	7.5%	0	3.96	21.48	4.13	17.62
4	10%	0	3.01	-7.67	3.22	-8.37
5	15%	0	3.27	0.31	3.39	-3.52
6	0	1%	3.73	14.97	3.99	13.62

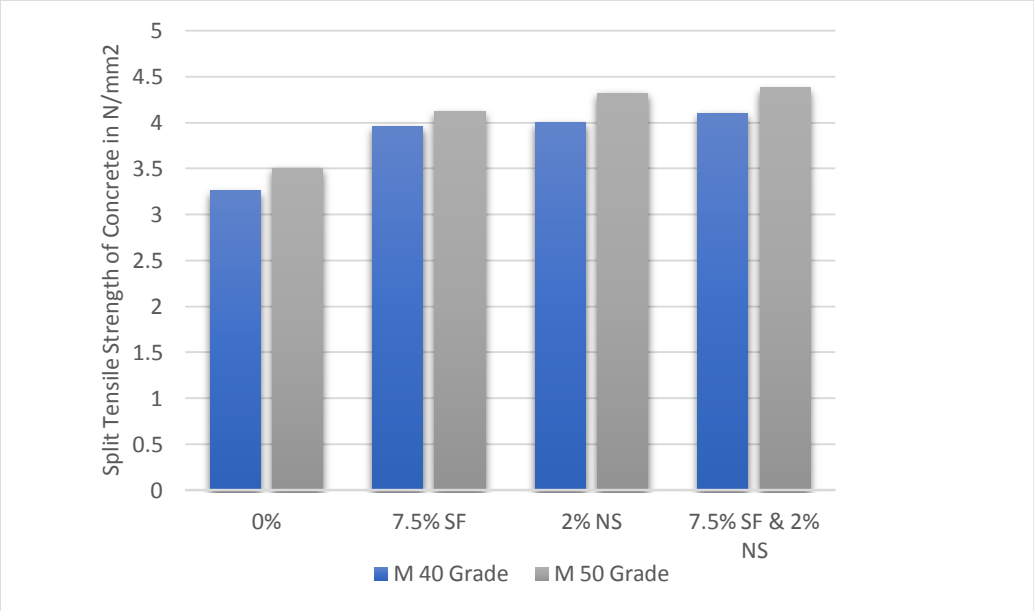
7	0	1.5%	3.82	17.15	4	14.19
8	0	2%	4	22.71	4.31	23.33
9	0	2.5%	3.26	-0.22	3.67	5.06
10	7.5	2%	4.2	25.77	4.39	25.04



Discrepancy of Split Tensile Strength of Silica Fume concrete at 28 days



Discrepancy of Split Tensile strength of Nano Silica concrete at 28 days



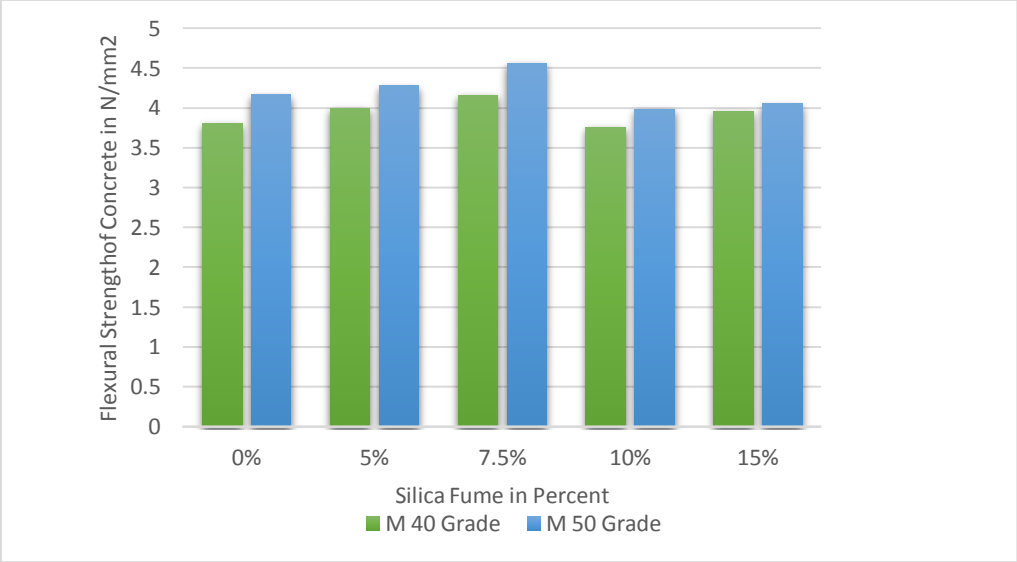
Dissimilarity of Split Tensile Strength of both Silica Fume and Nano Silica concrete at 28 days

Flexural Strength:

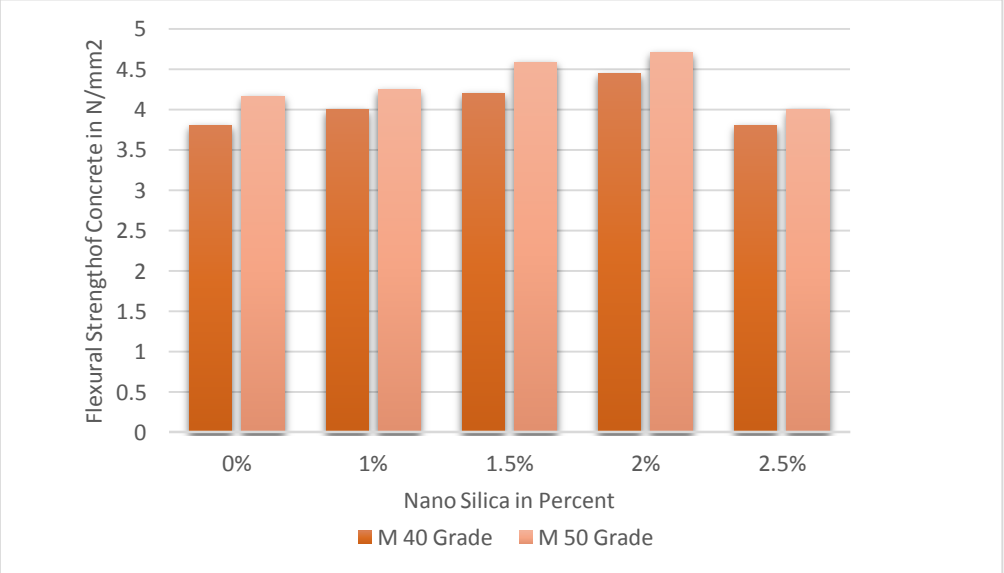
The flexural strength of M40 and M50 grade concrete, SF concrete and NS concrete at the age of 28 days

Flexural strength of concrete at 28 days

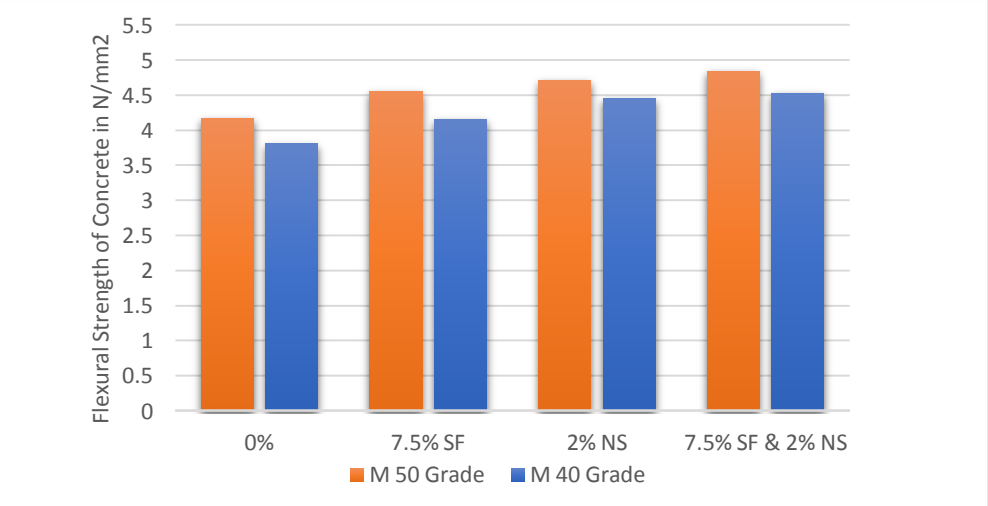
SNO	% Silica Fume	% Nano Silica	Flexural Strength of concrete in N/mm^2			
			M_{40} Grade	% increase or decreased	M_{50} Grade	% increase or decreased
1	0%	0	3.82	0	4.19	0
2	5%	0	4	4.92	4.29	2.65
3	7.5%	0	4.17	9.19	4.57	9.353
4	10%	0	3.77	-1.30	3.99	-4.42
5	15%	0	3.95	3.92	4.04	-2.80
6	0	1%	4	4.97	4.24	1.917
7	0	1.5%	4.3	10.24	4.58	10.06
8	0	2%	4.44	16.81	4.72	12.93
9	0	2.5%	3.81	-0.27	4	-4.03
10	7.5	2%	4.54	18.88	4.83	16.05



Discrepancy of Flexural strength of Silica Fume concrete at 28 days



Variation of Flexural strength of Nano Silica concrete at 28 days



Variation of Flexural strength of both Silica Fume and Nano Silica concrete at 28 days

IV. CONCLUSIONS

Based on experimental results the following conlusions are drawn

1. Compressive strength, split tensile strength and flexural strength of both mixes M40 and M50 grades were increased gradually up to replacement level 7.5% SF and up to replacement level 2% NS and then decreased.
2. The workability of both M40 and M50 grade concretes were decreased with increase in replacement of SF and NS in concrete.
3. Maximum compressive strength, split tensile strength and flexural strength with replacement of cement by 7.5% SF for M40 grade concrete is 23.56%, 21.47% and 9.18% over conventional mix of M40 grades.
4. Maximum compressive strength, split tensile strength and flexural strength with replacement of cement by 2% NS for M40 grade concrete is 20.27%, 22.70% and 16.80% over conventional mix of M40 grades.
5. Maximum compressive strength, split tensile strength and flexural strength with replacement of cement by 7.5% SF for M50 grade concrete is 22.53%, 17.61% and 9.35% over conventional mix of M50 grades.
6. Maximum compressive strength, split tensile strength and flexural strength with replacement of cement by 2% NS for M50 grade concrete is 22.23%, 22.32% and 12.94% over conventional mix of M50 grades.
7. The percentage increase in compressive strength of concrete with combination of SF at 7.5% and NS at 2% is 25.80% for M40 grade and 25.35% for M50 grade concrete more when compared to normal concrete of M40 and M50 grades respectively.
8. The percentage increase in split tensile strength of concrete with combination of SF at 7.5% and NS at 2% is 25.76% for M40 grade and 25.03% for M50 grade concrete more when compared to normal concrete of M40 and M50 grades respectively.
9. The percentage increase in flexural strength of concrete with combination of SF at 7.5% and NS at 2% is 18.89% for M40 grade 16.06% for M50 grade concrete more when compared to normal concrete of M40 and M50 grades respectively.

RECOMMENDATIONS FOR FEATURE WORK

1. Further studies can be carried out with the high-grade concretes.
2. In this present study colloidal nano silica was used, the further study can be carried out by using nano silica powder.
3. Further studies can be carried out with suitable combinations of different nano materials like nano metakolin, nano iron, and nano titanium and carbon nano tubes.

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