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# Impact of Nano Silica On Mechanical Properties of Concrete Using Optimised Dosage of Nanosilica As A Partial Replacement of Cement

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***Abstract*** *- Concrete with the utilization of Nanomaterials enhances its strength & durability, due to which it finds its applicability in the construction industry. The addition of nanomaterials reduces the cement content as cement increases the emission of carbon dioxide, which causes the greenhouse effect. In the present work, cement is replaced with various dosages of nano-silica to understand its influence on the mechanical response of the concrete. Experimental studies were conducted by varying the dosage of nano-silica as a partial substitution for cement for high-strength concrete mixes. From the experimental studies, it can be observed that 3% was the optimum dosage of replacement of nano-silica. Beyond 3%, the results corresponding to the mechanical properties are not promising. The experimental results are studied, discussed, and presented.*

**Keywords -** *High strength concrete, Mechanical Properties, Nano silica Concrete, Nano Materials, Optimum dosage.*

## I. INTRODUCTION

The construction industry was presenting advanced materials for the betterment of construction. The important material used in higher quantities is the cement for the construction; growing manufacturing of cement content leads to environmental pollution. A crucial and emergency approach is to bring down the usage of cement quantity in concrete by replacing it with substitute materials like Micro-silica, Nano Silica, Silica- fume, thereby reducing environmental pollution up to a great extent. The utilization of nano-silica, its influence on concrete is not yet fully analyzed. The present study means to exhibit the effect of nano-silica on the Strength properties of concrete using optimized dosage. P. Karthika et al. l investigated the strength durability of concrete with the addition of a small quantity of nano-silica to cement as a replacement. The compression strength of concrete is raised by around forty percent by the addition of 2% nano-silica in concrete. Ali Nazaria et al. l investigated compressively, split tensile, flexural strength together, and strength has been improved by adding nano-silica. Some authors [P. Jaishankar, K. Saravana raja Mohan] et al. l conducted an experiment on adding nano-silica toM70 High-performance concrete and studied strength and durability by replacing 0%,5%,10%,15%&20%.

## II. Materials and Methodology

### *A. Test specimens*

The strength properties of concrete are determined by casting specimens of cubes size 150 mm×150 mm×150mm for compression, beams of size500 mm ×100 mm ×100 mm for flexure, and cylinders of size 300 mm×150 mm for split tensile strength and cured for 28 days,90 days,180 days&obtained results for the various percentage of nano-silica.

### *B. Materials*

#### *Cement*

We have used OPC53gradecementfor this study, confirming IS12269:1987.

#### *Nano Silica*

The nano-silica used for the present analysis is in colloidal form. It is acquired from Astraachemicals, Chennai.

#### *Fine Aggregates*

Regionallysourcedcleanriver sand, conforming to IS383-1970, was used.

#### *Coarse Aggregates*

Rounded aggregates of maximum size 20 mm, conforming to IS383-1970 was utilized.

***Water***

Regionally sourced potable water is used for mixing & curing.

***Superplasticizer***

Superplasticizer contrasts 430fromForsook from chemical India Ltd. were utilized as a water-reducing agent in order to improve workability.

### *C. Methodology*

Concrete was plannedfor compressive, Split tensile&Flexural strength of M40, M50&M60 gradeswith W/Cproportions of 0.48, 0.45& 0.40 according toIS:10262-2009 with conplastsp 430 assuper plasticizer.

**Table1 Mix Proportions of M40 grade of concrete for different Nano silica(NS) content**

| NS | Cement | FA | CA | w/c |
|---|---|---|---|---|
| 0 | 1.00 | 2.27 | 2.90 | 0.48 |
| 1 | 0.99 | 2.27 | 2.90 | 0.48 |
| 2 | 0.98 | 2.27 | 2.90 | 0.48 |
| 3 | 0.97 | 2.27 | 2.90 | 0.48 |
| 4 | 0.96 | 2.27 | 2.90 | 0.48 |
| 5 | 0.95 | 2.27 | 2.90 | 0.48 |

**Table2 Mix Proportions of M50 grade of concrete for different Nano silica(NS) content**

| NS | Cement | FA | CA | w/c |
|---|---|---|---|---|
| 0 | 1.00 | 2.10 | 2.67 | 0.45 |
| 1 | 0.99 | 2.10 | 2.67 | 0.45 |
| 2 | 0.98 | 2.10 | 2.67 | 0.45 |
| 3 | 0.97 | 2.10 | 2.67 | 0.45 |
| 4 | 0.96 | 2.10 | 2.67 | 0.45 |
| 5 | 0.95 | 2.10 | 2.67 | 0.45 |

**Table3 Mix Proportions of M60 grade of concrete for different Nano silica(NS) content**

| NS | Cement | FA | CA | w/c |
|---|---|---|---|---|
| 0 | 1.00 | 1.75 | 2.24 | 0.40 |
| 1 | 0.99 | 1.75 | 2.24 | 0.40 |
| 2 | 0.98 | 1.75 | 2.24 | 0.40 |
| 3 | 0.97 | 1.75 | 2.24 | 0.40 |
| 4 | 0.96 | 1.75 | 2.24 | 0.40 |
| 5 | 0.95 | 1.75 | 2.24 | 0.40 |

## III. RESULTS & DISCUSSIONS

### *A. Workability of Nano silica Concrete*

When nano-silica was mixed with the mortars, observed the influence on water requirement for mixing was. Concrete Specimens of dimensions 150mmX150mmX150mm are cast and are cured for a period of 7 & 28 days for M40, M50 &M60 grade concrete specimens.

**Table4 Workability results for NS replaced High strength concretes**

| NS(%) | Slump value (mm) | | |
|---|---|---|---|
| | M40 | M50 | M60 |
| 0 | 90 | 110 | 70 |
| 1 | 79 | 99 | 60 |
| 2 | 68 | 81 | 49 |
| 3 | 59 | 69 | 38 |
| 4 | 48 | 60 | 30 |
| 5 | 39 | 49 | 22 |

### *B. Compressive Strength Studies on Ordinary and Nano Silica Concrete*

Cube specimens were cast for M40, M50, and M60 grades and tested for 7& 28 days on a compression testing machine as per IS:516-1959. To evaluate the optimum quantity of nano-silica for addition, a string of compression tests are performed for varied percent of nano-silica for replacing cement (1%, 2%, 3%, 4%, 5%).

The compressive strength variation of M40, M50, and M60grades of concrete with nano-silica replacement of 0%,1%,2%,3%,4%,5%with cement at the age of 28days,90 days,180 days is shown in the Table5-10. Observed significance betterment in the compressive strength because of high pozzolanic property of nano-silica and also acting as avoids filler results in much denser concrete. The optimum addition of Nano silica in concrete is observed as 3% of cement weight replaced for every grade was considered. Though improvement in compressive strength for all the percentage replacements observed, beyond 3% replacement, the increasing trend is not observed. It was found that compressive strength increases up to a level depends on the content of nano-silica, w/cratio& curing time.

**Table5 Ordinary & Nano Silica(NS) Concrete compressive strength at 28, 90,180 Days ofM40 Grade concrete for w/c=0.48**

| NS(%) | Compressive strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 49.50 | 58.20 | 61.00 |
| 1 | 52.10 | 60.80 | 63.80 |
| 2 | 56.34 | 65.50 | 68.30 |
| 3 | 60.45 | 71.30 | 75.60 |
| 4 | 55.75 | 65.30 | 68.90 |
| 5 | 54.25 | 62.70 | 65.70 |

**Table6 Percentage increase in Ordinary & Nano Silica(NS) Concrete compressive strength for M40 Grade concrete for w/c=0.48**

| NS(%) | Compressive strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 17.58 | 23.23 |
| 1 | 16.70 | 22.46 |
| 2 | 16.25 | 21.23 |
| 3 | 17.95 | 25.06 |
| 4 | 17.13 | 23.58 |
| 5 | 15.57 | 21.10 |

**Table7 Ordinary & Nano Silica(NS) Concrete compressive strength at 28, 90,180 Days ofM50 Grade concrete for w/c=0.45**

| NS(%) | Compressive strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 59.25 | 69.40 | 74.00 |
| 1 | 62.75 | 72.10 | 77.00 |
| 2 | 64.50 | 76.00 | 80.60 |
| 3 | 67.26 | 79.80 | 86.80 |
| 4 | 63.45 | 72.80 | 77.60 |
| 5 | 62.15 | 71.50 | 75.90 |

**Table8 Percentage increase in Ordinary & Nano Silica(NS) Concrete compressive strength for M50 Grade concrete for w/c=0.45**

| NS(%) | Compressive strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 17.13 | 24.89 |
| 1 | 14.90 | 22.71 |
| 2 | 17.82 | 24.97 |
| 3 | 18.64 | 29.05 |
| 4 | 14.74 | 22.30 |
| 5 | 15.06 | 22.12 |

**Table9 Ordinary & Nano Silica(NS) Concrete compressive strength at 28, 90,180 Days ofM60 Grade concrete for w/c=0.40**

| NS(%) | Compressive strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 69.15 | 81.60 | 86.50 |
| 1 | 72.95 | 85.40 | 88.80 |
| 2 | 76.95 | 89.30 | 94.00 |
| 3 | 78.35 | 92.50 | 97.20 |
| 4 | 74.65 | 87.50 | 90.60 |
| 5 | 71.45 | 82.00 | 87.20 |

**Table10 Percentage increase in Ordinary & Nano Silica(NS) Concrete compressive strength for M60 Grade concrete for w/c=0.40**

| NS(%) | Compressive strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 17.13 | 25.10 |
| 1 | 17.07 | 21.73 |
| 2 | 16.05 | 22.15 |
| 3 | 18.06 | 24.06 |
| 4 | 17.22 | 21.37 |
| 5 | 14.77 | 21.04 |

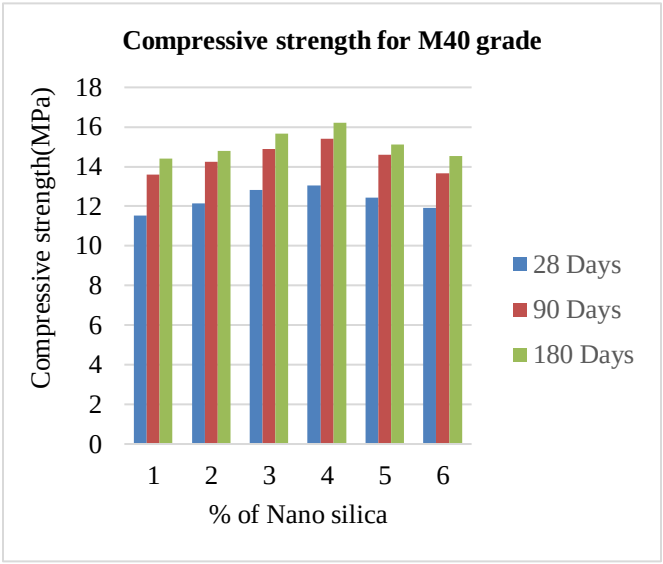


**Fig. 1 Compressive Strength of M40 Grade concrete**

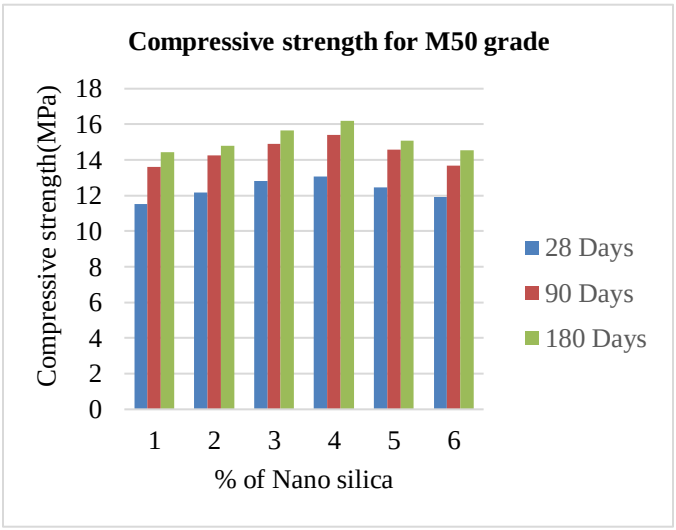


**Fig. 2 Compressive Strength of M50 Grade concrete**

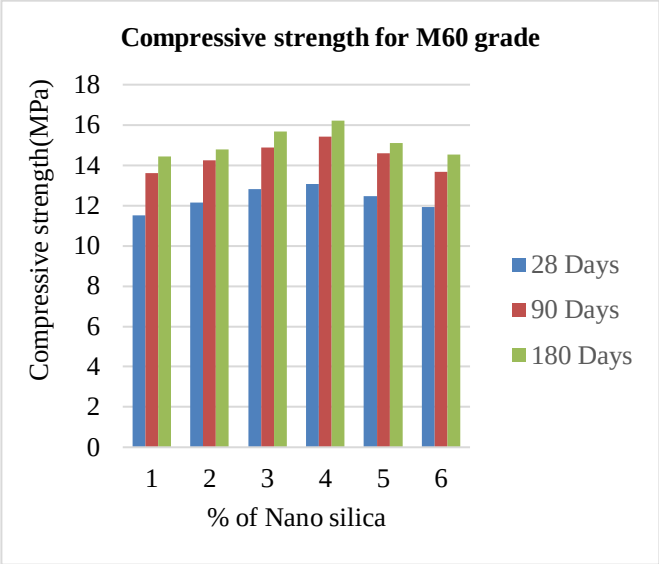


**Fig. 3 Compressive Strength of M60 Grade concrete**

### *C. Ordinary & Nano Silica Concrete: Flexural strength studies*

Specimens of size 100x100x500mm beams are cast & cured for a period of 28days,90 days,180 daysof different grades of concretes M40, M50, and M60. The Flexural strength of M40, M50, and M60 grades of concrete with nano-silica replacement for 0%,1%,2%,3%,4%,5%with cement at the age of 28 days, 90 days, 180 days is shown in Table11-16. Same as the compressive strength, the optimum dosage is noticed as 3%, beyond which decreasing trend is observed.

**Table11 Ordinary & Nano Silica(NS) Concrete flexural strength at 28, 90,180 Days ofM40 Grade concrete for w/c=0.48**

| NS(%) | Flexural strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 4.96 | 5.34 | 5.46 |
| 1 | 5.05 | 5.45 | 5.60 |
| 2 | 5.26 | 5.68 | 5.82 |
| 3 | 5.46 | 5.92 | 6.10 |
| 4 | 5.24 | 5.67 | 5.82 |
| 5 | 5.16 | 5.56 | 5.67 |

**Table12 Percentage increase in Ordinary & Nano Silica(NS) Concrete flexural strength for M40 Grade concrete for w/c=0.48**

| NS(%) | Flexural strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 7.67 | 10.08 |
| 1 | 7.92 | 10.90 |
| 2 | 7.99 | 10.65 |
| 3 | 8.43 | 11.73 |
| 4 | 8.21 | 11.07 |
| 5 | 7.75 | 9.89 |

**Table13 Ordinary & Nano Silica(NS) Concrete flexural strength at 28, 90,180 Days ofM50 Grade concrete for w/c=0.45**

| NS(%) | Flexural strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 5.38 | 5.84 | 6.03 |
| 1 | 5.54 | 5.94 | 6.14 |
| 2 | 5.62 | 6.10 | 6.28 |
| 3 | 5.74 | 6.25 | 6.52 |
| 4 | 5.58 | 5.97 | 6.17 |
| 5 | 5.52 | 5.93 | 6.10 |

**Table14 Percentage increase in Ordinary & Nano Silica(NS) Concrete flexural strength for M50 Grade concrete for w/c=0.45**

| NS(%) | Flexural strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 8.56 | 12.09 |
| 1 | 7.22 | 10.83 |
| 2 | 8.54 | 11.74 |
| 3 | 8.89 | 13.58 |
| 4 | 6.99 | 10.58 |
| 5 | 7.42 | 10.51 |

**Table15 Ordinary & Nano Silica(NS) Concrete flexural strength at 28, 90,180 Days ofM60 Grade concrete for w/c=0.40**

| NS(%) | Flexural strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 5.82 | 6.33 | 6.52 |
| 1 | 5.98 | 6.47 | 6.60 |
| 2 | 6.15 | 6.63 | 6.79 |
| 3 | 6.20 | 6.74 | 6.90 |
| 4 | 6.05 | 6.55 | 6.67 |
| 5 | 5.92 | 6.34 | 6.54 |

**Table16 Percentage increase in Ordinary & Nano Silica(NS) Concrete flexural strength for M60 Grade concrete for w/c=0.40**

| NS(%) | Flexural strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 8.76 | 12.03 |
| 1 | 8.20 | 10.37 |
| 2 | 7.80 | 10.41 |
| 3 | 8.71 | 11.30 |
| 4 | 8.26 | 10.24 |
| 5 | 7.10 | 10.48 |

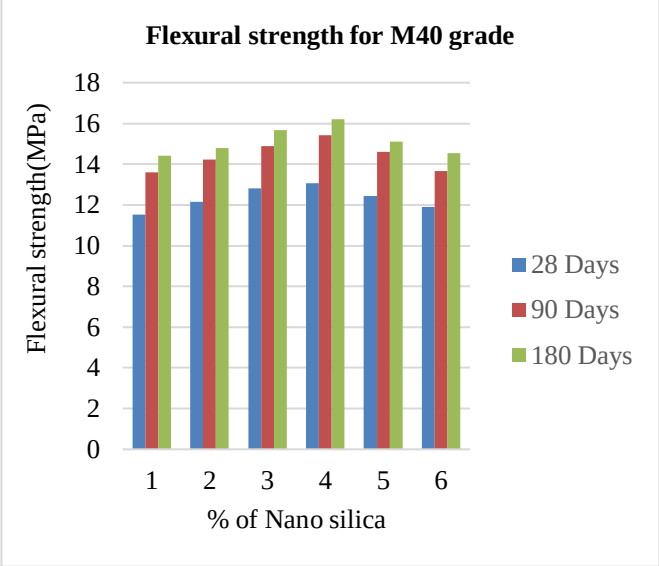


**Fig. 4 Flexural Strength of M40 Grade concrete**

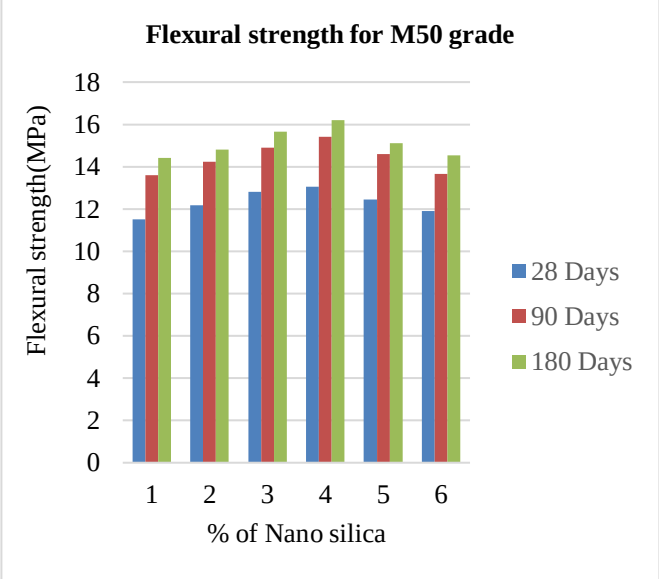


**Fig. 5 Flexural Strength of M50 Grade concrete**

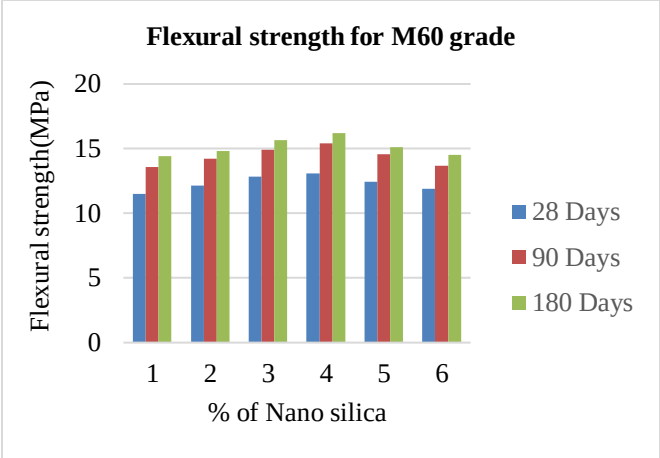


**Fig. 6 Flexural Strength of M60 Grade concrete**

***D. Ordinary and Nano Silica ConcreteSplit tensile strength studies***

Split tensile tests are performed on 300mm×150mm size cylinders at 7 & 28 days, with replacement ofcement for various percentages as mentioned in the above sections, and the same increasing trend was observed up to 3% replacement, and then the split tensile strengths were decreased by a further increase in the dosage. A maximum percentage increase of 22.22%, 13.41 %, 14.02 % is observed at 28 days for M40, M50, and M60 grades, respectively. Table17-22 present split tensile strengths at 28,90,180 days for M40, M50 and M60 grades for 0.48,0.45 and 0.4 w/c ratios.

**Table17 Ordinary & Nano Silica(NS) Concrete split tensile strength at 28, 90,180 Days ofM40 Grade concrete for w/c=0.48**

| NS(%) | Flexural strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 8.25 | 9.72 | 10.19 |
| 1 | 8.70 | 10.20 | 10.68 |
| 2 | 9.40 | 10.92 | 11.40 |
| 3 | 10.10 | 11.90 | 12.70 |
| 4 | 9.30 | 10.90 | 11.50 |
| 5 | 9.06 | 10.46 | 10.96 |

**Table18 Percentage increase in Ordinary & Nano Silica(NS) Concrete split tensile strength for M40 Grade concrete for w/c=0.48**

| NS(%) | Split tensile strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 17.82 | 23.51 |
| 1 | 17.24 | 22.76 |
| 2 | 16.18 | 21.28 |
| 3 | 17.83 | 25.75 |
| 4 | 17.20 | 23.65 |
| 5 | 15.45 | 20.97 |

**Table19 Ordinary & Nano Silica(NS) Concrete split tensile strength at 28, 90,180 Days ofM50 Grade concrete for w/c=0.45**

| NS(%) | Split tensile strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 9.88 | 11.60 | 12.40 |
| 1 | 10.46 | 12.05 | 12.86 |
| 2 | 10.76 | 12.70 | 13.40 |
| 3 | 11.26 | 13.30 | 14.50 |
| 4 | 10.57 | 12.14 | 12.94 |
| 5 | 10.36 | 11.92 | 12.70 |

**Table20 Percentage increase in Ordinary & Nano Silica(NS) Concrete split tensile strength for M50 Grade concrete for w/c=0.45**

| NS(%) | Split tensile strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 17.40 | 25.50 |
| 1 | 15.20 | 22.95 |
| 2 | 18.03 | 24.54 |
| 3 | 18.12 | 28.78 |
| 4 | 14.86 | 22.43 |
| 5 | 15.06 | 22.60 |

**Table21 Ordinary & Nano Silica(NS) Concrete split tensile strength at 28, 90,180 Days ofM60 Grade concrete for w/c=0.40**

| NS(%) | Split tensile strength (MPa) | | |
|---|---|---|---|
| | 28 days | 90 days | 180 days |
| 0 | 11.52 | 13.60 | 14.42 |
| 1 | 12.16 | 14.24 | 14.80 |
| 2 | 12.82 | 14.89 | 15.67 |
| 3 | 13.06 | 15.42 | 16.20 |
| 4 | 12.45 | 14.59 | 15.10 |
| 5 | 11.91 | 13.67 | 14.54 |

**Table22 Percentage increase in Ordinary & Nano Silica(NS) Concrete split tensile strength for M60 Grade concrete for w/c=0.40**

| NS(%) | Split tensile strength (MPa) | |
|---|---|---|
| | % increase (28 days vs. 90 days) | % increase (28 days vs. 180 days) |
| 0 | 18.06 | 25.18 |
| 1 | 17.10 | 21.72 |
| 2 | 16.14 | 22.24 |
| 3 | 18.08 | 24.05 |
| 4 | 17.19 | 21.29 |
| 5 | 14.78 | 21.09 |

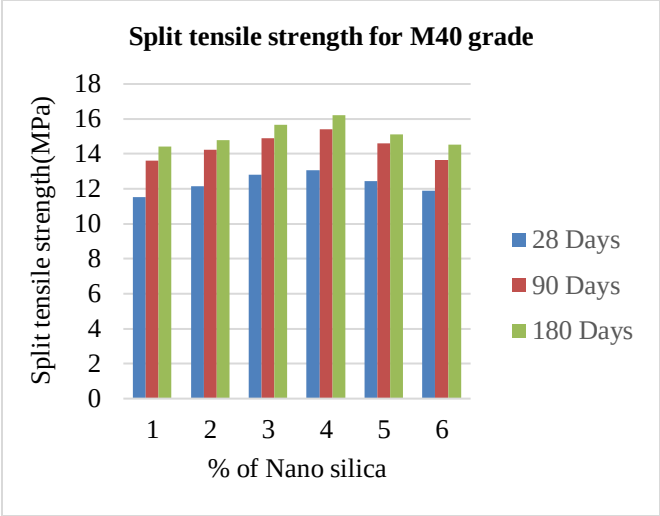


**Fig. 7 Split Tensile Strength of M40 Grade concrete**

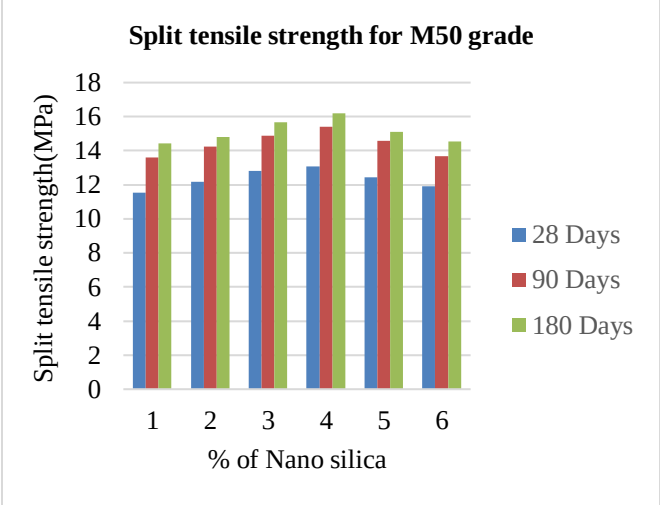


**Fig. 8 Split Tensile Strength of M50 Grade concrete**

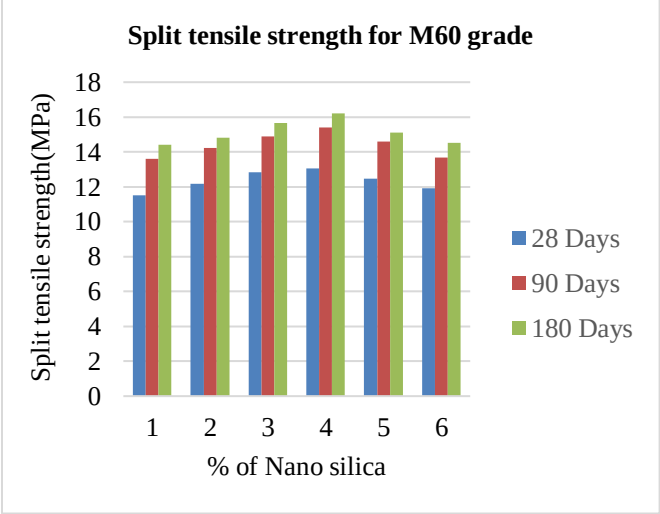


**Fig. 9 Split Tensile Strength of M60 Grade concrete**

## IV. CONCLUSIONS

The given conclusions are made from the experimental investigation in the present paper.

- Cement replacement up to 3% with nano-silica showed an increase in compression, split tensile and flexural strength for M40, M50& M60 grades of concrete & further addition of strength showed a decreasing trend.
- The compression strength of concrete gradeM40 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days are 49.50MPa, 58.20MPa, 61.00MPa, whereas nano-silica concrete is 60.45MPa,71.30MPa,75.60MPa.
- The compression strength of concrete grade M50 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days are 59.25Mpa,69.40MPa,74.00MPa, whereas nano-silica concrete is 67.26MPa, 79.80MPa 86.80MPa.
- The compression strength of concrete grade M60 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days are 69.15MPa, 81.60MPa, 86.50MPa, whereas nano-silica concrete is 78.35MPa, 92.50MPa, 97.20MPa.
- The flexural strength of concrete grade M40 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days are 4.96MPa, 5.34MPa, 5.46MPa, whereas nano-silica concrete is 5.46MPa, 5.92MPa, 6.10MPa.
- The flexural strength of concrete grade M50 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days 5.38MPa, 5.84MPa, 6.03MPa, whereas nano-silica concrete 5.74MPa, 6.25 MPa, 6.52MPa.
- The flexural strength of concrete grade M60 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days 5.82MPa, 6.33MPa, 6.52MPa whereas nano-silica concrete 6.20MPa, 6.74MPa, 6.90MPa.
- The split tensile strength of concrete grade M40 with 3% nano-silica replacement shows a higher value as an optimized dosage. Compressive strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days are 8.25MPa, 9.72MPa, 10.19MPa, whereas nano-silica concrete 10.10MPa, 11.90MPa, 12.70MPa.
- The split tensile strength of concrete grade M50 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days are9.11.60MPa, 12.40MPa, whereas nano-silica concrete 11.26MPa, 13.30MPa, 14.50MPa.
- The split tensile strength of concrete grade M60 with 3% nano-silica replacement shows a higher value as an optimized dosage. The compression strength of ordinary concrete for curing periods of 28 days, 90 days, 180 days are 11.52MPa, 13.60MPa, 14.42MPa, whereas nano-silica concrete 13.06MPa, 15.42MPa, 16.20 MPa.
- The percentage rise in compression strength of M40 grade compared to 28 days vs. 90 days,28 days vs. 180 days are 17.58%, 23.23% for ordinary concrete whereas 3% optimum dosage of nano-silica is 17.95%, 25.06%.
- The percentage rise in compression strength of M50 grade compared to 28 days vs. 90 days, 28 days vs. 180 days are 17.13%, 24.89% for ordinary concrete whereas 3% optimum dosage of nano-silica is 18.64%, 29.05 %.
- The percentage rise in compression strength of M60 grade compared to 28 days vs. 90 days, 28 days vs. 180 days are17.28%, 25.10 % for ordinary concrete whereas 3% optimum dosage of nano-silica is 18.06%, 27.06%.
- The percentage rise in flexural strength of M40 grade compared to 28 days vs. 90 days,28 days vs.180 days are 17.58%, 23.23% for ordinary concrete whereas 3% optimum dosage of nano-silica is 17.95%, 25.06%.
- The percentage rise in flexural strength of M50 grade compared to 28 days vs. 90 days, 28 days vs. 180 days are 17.13%, 24.89% for ordinary concrete whereas 3% optimum dosage of nano-silica is 18.64%, 29.05 %.
- The percentage rise in flexural strength of M60 grade compared to 28 days vs. 90 days, 28 days vs. 180 days are17. 28%, 25.10 % for ordinary concrete whereas 3% optimum dosage of nano-silica is 18.06%, 27.06%.

- There is a significant improvement in the compression, split tensile flexural strength of concrete because of the high pozzolanic nature of nano-silica and also acting as voids Filler of in concrete which results in much denser concrete. The perfect dosage of nano-silica is 3% of cement weight replacement. Values show that after 3%, the corresponding strengths decrease with further additional usage of nano-silica content, imparting negative effects on the hydration process.

## REFERENCES


[1] Kumar A, Singh G., Effect of Nano Silica on the Fresh and Hardened Properties of Cement Mortar, International Journal of Applied Engineering Research. 3(13) (2018) 11183-11188.

[2] Bajpai V, Chandra K, Singh M K., Experimental study on partial replacement of cement with nano-silica in concrete, International Research Journal of Engineering and Technology.5(1) (2018).

[3] Sakthivel R, Balasundaram D N., Experimental Investigation On Behaviour Of Nano Concrete, International Journal of Civil Engineering and Technology. 7(2) (2016) 315–320.

[4] Vasanthi P, Senthil selvan S, Benita Hexton D, Mohamed Salman Farooq I and Suresh P., Durability Study on Nano Concrete, International Journal of ChemTech Research. 10(3) (2017) 693-698.

[5] Guleria A N, Salhotra S., Effects of silica fume (micro-silica or nano-silica) on mechanical properties of concrete: a review, International Journal of Civil Engineering and Technology. 7(4) (2016) 345–357.

[6] El-Feky M S, Serag M I, Yasien A M and Elkay H., Bond strength of nano-silica concrete subjected to corrosive environments, ARPN Journal of Engineering and Applied Sciences. 11(23) (2016).

[7] Kiran V S, Chowdary V S, and Rao P V., Comparison of mechanical properties of nano concrete with conventional high strength concrete, Indian Concrete Journal. (2016) 95-100.

[8] Pranay Lanjewar, Anjali Jaiswal, Ayushman Jain, et al., Experimental Study on the Strength and Durability of Nano-Concrete, International Journal of Innovative and Emerging Research in Engineering. 4(3)(2017) 2394 – 3343.

[9] Patel DA, Mishra C B, Repercussion of nano-silica on m40 grade concrete, International Journal for Research in Applied Science & Engineering Technology. 5(4) (2017) 1571-1575.

[10] Mr Shaik mohammed siraj, Mr Mohammed Zia Uddin, Mr Mohammed AbdulSuhaibFaraz Khan, Mr Shaik Qhizar, Mr MohammdMiranHussaini, Dr Mohammed Rafeeq, Mr Mohammed Safi Uddin, Cembinder Concrete using Robo Sand, SSRG International Journal of Civil Engineering 4(4) (2017) 25-27.

[11] Shah M M A, Balaji E, Pandian GAM, Experimental study on mechanical properties of high strength concrete using Nano-Silica, International Research Journal of Engineering and Technology. 3(4) (2016) 2395.

[12] Sakthivel R, Vijay S, Ramachandran T, Saravanakumar M, Experimental behavior of natural hybrid fibre reinforced slab with nano concrete under static loading, International Journal of Applied Engineering Research. 12(23) (2017) 13194-13200.

[13] Sakthivel R, Rajkumar K, Roja R, Reji R, Investigation of natural hybrid fiber reinforcedbeam with nano concrete under cyclic loading, International Journal for Research Trends and Innovation. 2(5) (2017) 2456-3315.