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# EXPERIMENTAL STUDY OF MICRO AND NANO FILLERS ON THE STRENGTH CHARACTERISTICS OF CONCRETE

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## ABSTARCT

*Concrete is the most adaptable material due to the persevering and nonstop requests made on solid, Engineers are consistently pushing the cutoff points to enhance its execution with the assistance of imaginative concoction admixtures and supplementary cementitious materials like fly fiery remains, silica smolder, The utilization of extensive amount of bond produces expanding co2 discharges and result the green house impact. A technique to lessen the bond content in concrete blends is the utilization of silica rage which is a formless polymorph of silicon dioxide, silica. It is aultra fine powder gathered as a result of the silicon and ferrosilicon combination generation Nano innovation is a standout amongst the most encouraging ranges of science. The utilization of Nano materials in concrete is new insurgency. Nano materials like Nano silica, Nano titanium oxide which are by and by utilized as a part of cement to adjust its quality properties. In the present investigation, Compressive Strength, flexural strength, Sorptivity with addition of the Microsilica (0%, 0.5%, 0.75%, 1.0%, 1.5% )and Nanosilica (0%,0.5%,0.75%,1.0%,1.5%)of concrete were examined.*

***Keywords- Concrete, Filler, Micro Silica, Nano Silica, Sorptivity***

## I. INRODUCTION

In the most standard sense, bond is a fastener that sets and solidifies autonomously and additionally ties different materials together. Bond mortar is a building compound made by blending fine total and a choice of solidifying material with a predetermined measure of water. Mortar has been utilized for quite a long time as a methodsfor following blocks or solid pieces to each other. Bond mortar keeps on being utilized as a part of a wide range of sorts of development, for example, the folio between blocks in dividers, wall, and walkways, to make snappy repairs in yard sections and reset extricated stones or blocks in a walkway or holding divider. Tragically, development industry is not just one of the biggest purchasers of common assets and vitality, but on the other hand is in charge of huge discharges of green house gasses (GHGs) for example, carbon dioxide in charge of an unnatural weather change. Concrete is most likely interesting in development, it is the main material selective to the business and along these lines is the recipient of a reasonable extent of the innovative work cash from industry. Concrete is a composite development material made fundamentally out of total, bond, and water, which is a nanostructured, complex, multi-stage material that ages after some time. The mortar properties in crisp state, for example, workability are represented by the molecule estimate conveyance and the properties in solidified state, for

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example, quality and solidness, are influenced by the blend evaluating and coming about molecule pressing. Rheological properties of a crisp bond glue assume a vital part in deciding the workability of cement. The water necessity for stream, hydration conduct, and properties of the solidified state to a great extent relies on the level of scattering of concrete in water. Components for example, water content, early hydration, water decreasing admixtures and mineral admixtures like silica seethe decide the level of flocculation in a bond glue.

Silica rage has been perceived as a pozzolanic and cementitious admixture which is compelling in upgrading the mechanical properties all things considered. The pozzolanic response brings about a diminishment of the measure of calcium hydroxide in cement, and silica rage decreases porosity and enhances solidness. It quickens the disintegration of C-S and arrangement of C-S-H with its movement being contrarily relative to the size, and furthermore gives nucleation destinations to C-S-H. It is in charge of an extra increment in quality and synthetic resistance and diminishing in water retention . Indeed, even little increases (0.5 wt. % fastener) of these particles are extremely effective regarding change in mechanical properties of bond based materials. This is particularly articulated at early ages and for cements with standard quality review. In this way, use of SF and NS could be a fruitful technique for development of low qualities of concrete based materials. Also, when low water content is utilized, sparing points of interest and higher solidness are normal.

## II. EXPERIMENTAL PROGRAM

The experimental program carried out to investigate, Compressive Strength, Flexural strength (Strength tests) and sorptivity testof concrete with addition different percentages of Micro silica ,Nano silica.

## III. MATERIALS USED

There are several materials used in the experimental analysis and those materials are discussed below.

### 3.1Cement

The cement used complies with the Ordinary Portland cement (OPC) 53 grade Ultra tech cement. The specific gravity of cement is 3.14. The test conducted on cement for different properties as per IS 4031 (part II):1988.

### 3.2 Fine Aggregate

Locally available natural sand was used specific gravity, fineness modulus and were found to be 2.6, 2.96 respectively Sand was confirming to zone II as per IS 383:1970.

### 3.3 Coarse Aggregate

In the present study, locally available coarse aggregates of maximum size 20mm were used specific gravity, fineness modulus and were found to be 2.62, 7.40 respectively.

### 3.4Water

Water used for mixing and curing is fresh potable water, which is free from any injurious amounts of oils, acids, alkalis, sugar, salts and organic materials or other substances that may be deleterious to concrete or steel confirming to IS : 3025 : 1964 (part 22 & 23) and IS 456 : 2000.

### 3.5. Micro silica

The silica fume was used in these experiments conforms to IS 15388:2003. The silica fume is extremely fine particle, which exists in white color powder form. Silica fume has been procured from Astrra chemicals Ltd-Chennai

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### 3.6 Nano-Silica

In this research, Nano silica used id from water soluble type with 30% suspension by the name CemSynXTX produced by BEECHEMS Kanpur

### 3.7Super Plasticizer

In this research, super plasticizer SP 425 was used to improve the workability of concrete.

## IV. CASTING AND CURING OF THE TEST SPECIMENS

### 4.1 Mixing

Measured quantities of coarse aggregate, fine aggregates were spread out over an impervious concrete floor. The dry Ordinary Portland cement (Ultra tech 53 grade) was spread out on the aggregate and mixed thoroughly in dry state turning the mixture over and over until uniformity of colour was achieved. Water was measured exactly by weight and it was thoroughly mixed to obtain homogeneous concrete .Nano silica gel is added to the mix. The time of mixing shall be in 10-15 minutes.

### 4.2 Placing and compacting

The cube mould shall be of 150 mm size confirming IS 10086:1982, the prism mould shall confirm to IS 10086:1982 and cylinder moulds are cleaned, and all care was taken to avoid any irregular dimensions. The joints between the sections of mould were coated with oil and a similar coating of mould oil was applied between the contact surfaces during the filing.The interior surfaces of the assembled moulds were thinly coated with mould oil to prevent adhesion of the concrete and platform for casting. The mix was placed in the 3 layers each layer was compacted using table vibrator to obtain dense concrete.

### 4.3 Curing

The test specimens cubes, prisms, and cylinders were stored in place, free from vibration, in moist air at 90% relative humidity and at a temperature of 27±2ºC for 24±1/2 hour from the time of addition of water to the dry ingredients. After 24 hours the specimens weredemoulded and immediately immersed in clean, fresh water tank for a period of 28 days.

## V. TESTING OF SPECIMENS

After the specimen cured for the required period were taken out from water tank and prepared for testing on universal testing machine to find the Mechanical properties such as compressive strength on cubes, flexural strength on prisms, sorptivity on cubes

### 5.1Testing Procedure for Compressive Strength

The specimens were tested in accordance with IS 516:1969, the testing was done on universal compression testing machine of 2000kN velocity. The machine has the facility to control the rate of loading with a control valve. The machine has been calibrated to the required standards. The platens are cleaned; oil level is checked and kept ready in all respects for testing.After the required period of curing, the cube specimen are removed from the curing tank and cleaned to wipe off the surface water. It is placed on the machine such that the load is applied centrally the smooth surfaces of the specimen are placed as the bearing surfaces. The top plate is brought in contact with the specimen by rotating the handle. The oil pressure valve is closed and the machine is switched ON.A uniform rate of

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loading 140kg/sq.cm/min is maintained. The maximum load at failure at which the specimen breaks and the average value is taken as the mean strength.

The compressive strength is taken as the load applied on the specimen divided by the area of the load bearing surface of the specimen (P/A).

### 5.2 Testing Procedure For Flexural Strength

Flexural strength is expressed in terms of modulus of rupture, which is the maximum stress at the extreme fibers in bending. It is calculated by flexure formula. After removal of the beam specimen from the curing tank, they are tested on the load frame of 20kN capacity in accordance with IS 9399:1679. The load frame is provided with two rollers at a distance of 400mm apart at the base. The load is applied through two similar rollers mounted at the third point of the supporting span spaced 133mm apart and centrally with the respect to the base rollers.The axis of the specimen is carefully aligned with the axis of the loading frame. The load is applied gradually without shock increasing continuously such that the extreme fiber stresses increase at a rate of 7kg/ sq.cm/min. i.e., application of load it at the rate of 4000N/min. the load is divided equally between the two roller points and it increased until the specimen fails. The load is measured by a load gauge (proven ring) mounted on top of the loading rollers the modulus of rupture is calculated for the maximum load taken by the member.

### 5.3 Sorptivity Test

The sorptivity can be determined by the measurement of the capillary rise absorption rate on reasonably homogeneous material. Water was used of the test fluid. The cylinders after casting were immersed in water for 28 days curing. The specimen after drying in oven at temperature of 100 + 10 °C were drowned with water level not more than 5 mm above the base of specimen and the flow from the peripheral surface is prevented by sealing it properly with non-absorbent coating. The quantity of water absorbed in time period of 30 minutes was measured by weighting the specimen on a top pan balance weighting upto 0.1 mg. surface water on the specimen was wiped off with a dampened tissue and each weighting operation was completed within 30 seconds. Sorptivity (S) is a material property which characterizes the tendency of a porous material to absorb and transmit water by capillarity.

The cumulative water absorption (per unit area of the inflow surface) increases as the square root of elapsed time (t) $I=S.t^{½}$

Therefore

$S=I/ t^{½}$

Where; S= sorptivity in mm, t= elapsed time in mint.

$I=\Delta w/Ad$ $\Delta w$= change in weight = W2-W1

W1 = Oven dry weight of cylinder in grams

W2 = Weight of cylinder after30 minutes capillary suction of water in grams.

A= surface area of the specimen through which water penetrated.

d= density of water

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## VI.TEST RESULTS

Table 1 Compressive strength test(Mpa)

| SNO | % of silica fume | Compressive strength |
|---|---|---|
| **1** | 0 | 37 |
| **2** | 0.5 | 39 |
| **3** | 0.75 | 43 |
| **4** | 1.0 | 45 |
| **5** | 1.5 | 41 |

**Table 2 Flexural strength test(Mpa)**

| SNO | % of silica fume | Flexural strength |
|---|---|---|
| 1 | 0 | 5.84 |
| 2 | 0.5 | 7.07 |
| 3 | 0.75 | 8.10 |
| 4 | 1.0 | 8.95 |
| 5 | 1.5 | 6.99 |

**Table 3 Sorptivity(in mm/min(0.5))**

| SNO | % of silica fume | Sorptivity |
|---|---|---|
| **1** | 0 | 5.23 |
| **2** | 0.5 | 4.97 |
| **3** | 0.75 | 4.50 |
| **4** | 1.0 | 4.32 |
| **5** | 1.5 | 4.10 |

**Table 4 Compressive strength test(Mpa)**

| SNO | % of Nano silica | Compressive strength |
|---|---|---|
| **1** | 0 | 37 |
| **2** | 0.5 | 40 |
| **3** | 0.75 | 42 |
| **4** | 1.0 | 46 |
| **5** | 1.5 | 43 |

**Table 5 Flexural strength test(Mpa)**

| SNO | % of Nano silica | Flexural strength |
|---|---|---|
| **1** | 0 | 5.84 |
| **2** | 0.5 | 6.2 |
| **3** | 0.75 | 7.9 |
| **4** | 1.0 | 8.1 |
| **5** | 1.5 | 5.8 |

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**Table 6 Sorptivity(in mm/min(0.5))**

| SNO | % of silica fume | Sorptivity |
|---|---|---|
| **1** | 0 | 5.23 |
| **2** | 0.5 | 4.65 |
| **3** | 0.75 | 4.07 |
| **4** | 1.0 | 3.80 |
| **5** | 1.5 | 3.48 |

## VII. GRAPHS

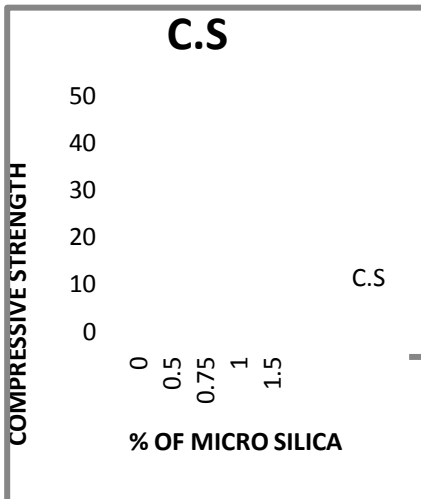


**Fig no 1 compressive strength of MSC**

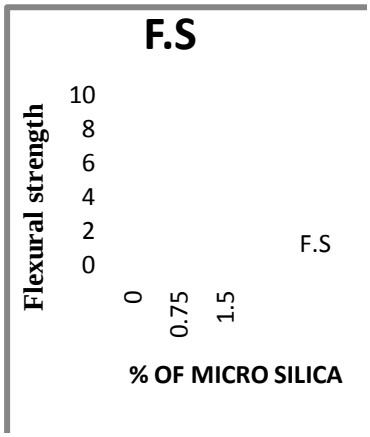


**Fig no 2 Flexural strength of MSC**

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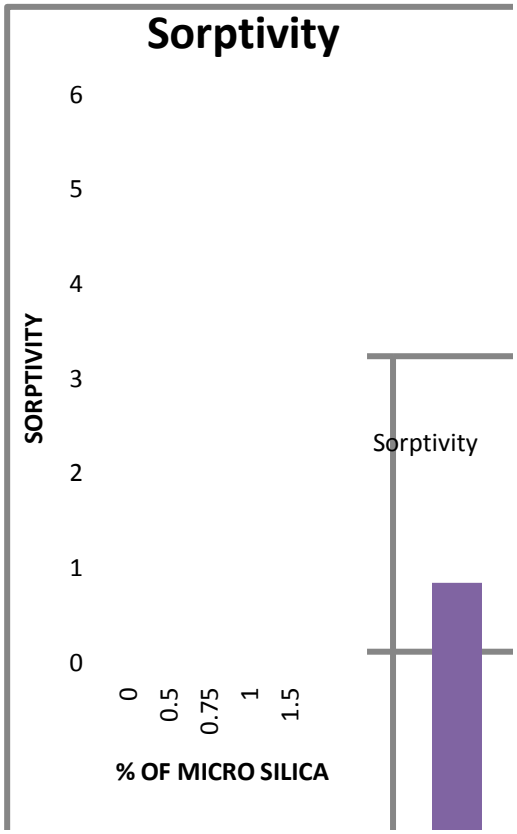


**Fig no 3 Sorptivity of MSC**

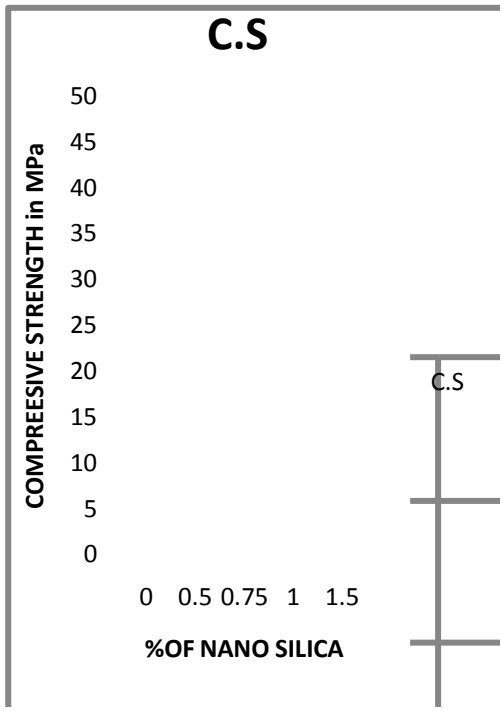


**Fig no 4 compressive strength of NSC**

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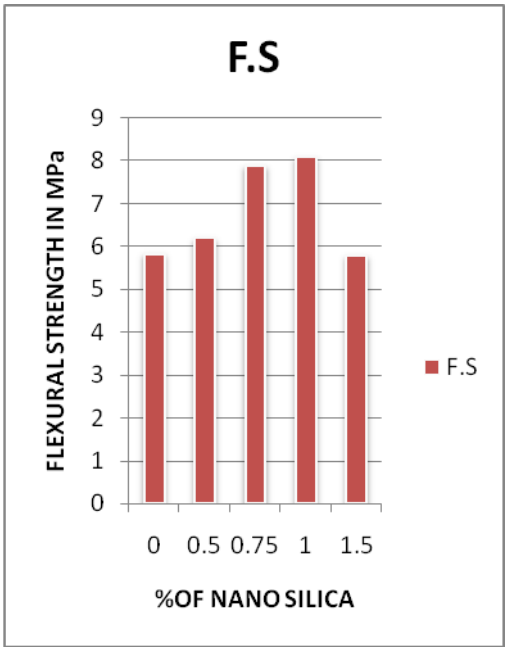


**Fig no 5 Flexural strength of NSC**

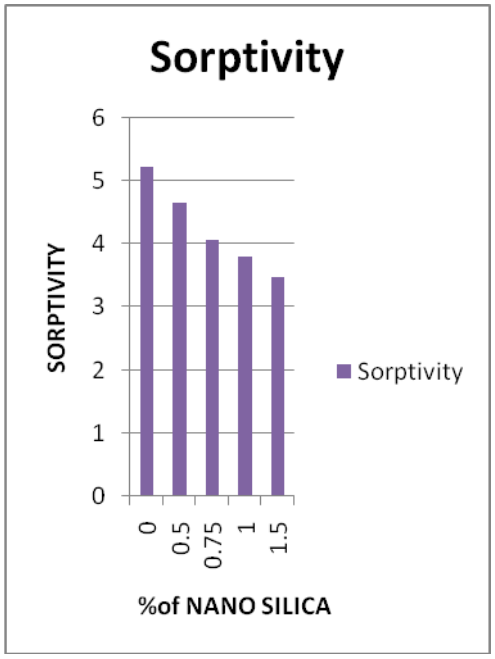


**Fig no 6 Sorptivity of NSC**

## VIII. CONCLUSIONS

- The addition of Micro silica increases the compressive strength for 28 days upto 1% and decreases at 1.5% for the M35 standard grade.
- The addition of Micro silica increases the flexural strength for 28 days upto 1% and decreases at 1.5% for the M35 standard grade.
- The sorptivity values of Micro silica concrete decreases as the Micro silica content increases from 0% to 1.5%.
- The addition of Nano silica increases the compressive strength for 28 days upto 1% and decreases at 1.5% for the M35 standard grade.

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- The addition of Nano silica increases the flexural strength for 28 days upto 1% and decreases at 1.5% for the M35 standard grade.
- The sorptivity values of Nano silica concrete decreases as the Nano silica content increases from 0% to 1.5%.

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