International Journal of New Technology and Research (IJNTR)
ISSN: 2454-4116, Volume-7, Issue-12, December 2021 Pages 01-04

# A Study on Strength and Durability of M35 Concrete Using Micro Silica and Flax Fiber

**Mohammad Sheesh, Dr. Vishnu Sharma**

*Abstract*— **In all over the world India is the second largest producer of cement. Cement demand in India is expected to increase due to government pushes for large infrastructure project leading to 45 million tonnes (MT) cement needed in three years. The use of the cement result in emission of CO2 gasses which is major environmental concern. In this study partial replacement of cement of M-35 grade of concrete using Nano-Silica (NS)at varying percentage i.e. 0%, 0.5%, 1.0%, 1.5% and 2% and addition of Flax Fiber with same percentage has been done. The study deals with nano-materials, by virtue of their very small particle size can affect the concrete properties by altering the microstructure**

**In first phase M-35 concrete has been made using 0% Nano-Silica i.e. controlled mix and observation has been made for compressive and tensile strength at 7 and 28 days.**

**The second phase is totally concerned with the partial replacement of cement in M-35 concrete using Nano-Silica (NS)at varying percentage i.e. 0%, 0.50%, 1.0%, 1.5% and 2% and addition of Flax Fiber with same percentage. The result obtained from second phase of experiment has been compared with the result obtained from the first phase and analysis has been made.**

*Index Terms*— **Nano silica, Flax Fiber, Compressive strength, Split Tensile Strength, microstructure.**

## I. INTRODUCTION

Due to suddenly growth in the population in all over the world then to technology is also grow up and balance the need of the people, and there is need to improve the strength and durability of the concrete. Lots of material is used for production of concrete, as cement plays a major role due its size, adhesive property, making of process of cement and which type of process are used to making it. So production of good quality of concrete, the mechanism of cement hydration has to be studied properly and better substitute to it have to be suggested. Different materials such as supplementary cementitious material or $SCM_s$ are added to concrete to improve its properties. Some of these are fly ash, blast furnace slag, rice husk, silica fumes and even bacteria of various Technologies in use, nano technology looks to be promising approach in improving the properties of concrete.

The use of fibres in concrete is from ancient times, to increase the tensile strength and flexure strength of concrete various researchers investigate the effect of fibres on various properties of concrete. Since then Fibres such as steel, glass, carbon and polypropylene are use in concrete. Addition of fibre in concrete also influences its brittle behaviour and ductility.

**Mohammad Sheesh**, M. Tech Research Scholar, Department of Civil Engineering ,YIT, Jaipur
**Dr. Vishnu Sharma** ,Professor, Department of civil engineering, YIT, Jaipur

## II. REVIEW OF LITERATURE

**Min. Hong Zhang et.al. (2012)** studied the effect of NS & high volume slag mortar on settingtime and early strength and observed that rate of hydration increases with addition of NS, compressive strength of slag mortar increases with increase in NS dosages from 0.5 to 2% by weight of cement. 2% NS reduces initial and final setting time and compressive strength increases by 22% and 18% at 3 days and 7 days with addition of 50% slag. NS with particle size 7 & 12 nm are more effective in increasing cement hydration and reaction compared with silica fume.

**G. Dhinakaranet. al. (2014)** analysed the microstructure and strength properties of concrete withNano SiO2. The silica was ground in the planetary ball mill till nano size reached and it was blended in concrete with 5%, 10% and 15% b.w.c. The experimental results showed gain in compressive strength with maximum strength for 10% replacement.

**Mukharjee and Barai (2014)** the compressive strength and characteristics of Interfacial Transition Zone (ITZ) of concrete containing recycled aggregates and nano-silica. An improvement in the compressive strength and microstructure of concrete was observed with the incorporation of nano-silica.

**Yeswanth et al., (2016)** investigated the effect of polypropylene fiber on concrete with addition of fibres and fly ash. Different volume of fiber 0%, 0.05% ,0.1%, 0.15%, 0.2%, 0.25%, 0.30%, 0.35%, 0.40% were used to the volume of concrete and fly ash of 0%, 10%, 20%, 30%, 40% of volume of cement were used. It has been found that the addition of PPF has a little adverse effect on the workability of concrete containing fly ash while the addition of polypropylene fiber and fly ash has greatly improved the strength of hardened concrete. There was also increase in cracking resistance when compared to other concrete composites without fiber and fly ash.

**Rani and Priyanka (2017)** conducted an experimental study on the behaviour of mechanical properties of self-compacting concrete using polypropylene fiber which includes compressive and flexural strength. Comparison of polypropylene fibres mix and conventional mix was also done. From the study the maximum quantity of fiber in SCC was 0.75% to 1% of the total cement content per mix found.

## III. MIX PROPORTION:

For a batch of 6 cubes of 150mm side, the volume of concrete required

$= (0.15)^3 \times 6 \times 1.2 = 0.024\ m^3$ (taking account of 20 % extra for losses)

**Table 4 Relative Proportion of Material**

| | | |
|---|---|---|
| Cement Required | 0.024×413.33 | =9.92kg |
| Fine Aggregate Required | 0.024×624 | =14.90kg |
| Coarse Aggregate Required | 0.024×1221 | =29.30kg |
| Water Required | 0.024×186 | =4.50kg |

| Cement | Water | Sand | 20mm | 10mm | Admix |
|---|---|---|---|---|---|
| 413.33kg | 4.464kg | 624 kg | 647.13 Kg | 573.87 Kg | 0.02976Kg |
| 1Kg | | 1.51 kg | 1.56 Kg | 1.39 Kg | 0.003Kg |

**Cement: Sand: Coarse Aggregates = 1 : 1.51 : 2.94**

## IV. RESULTS AND DISCUSSION

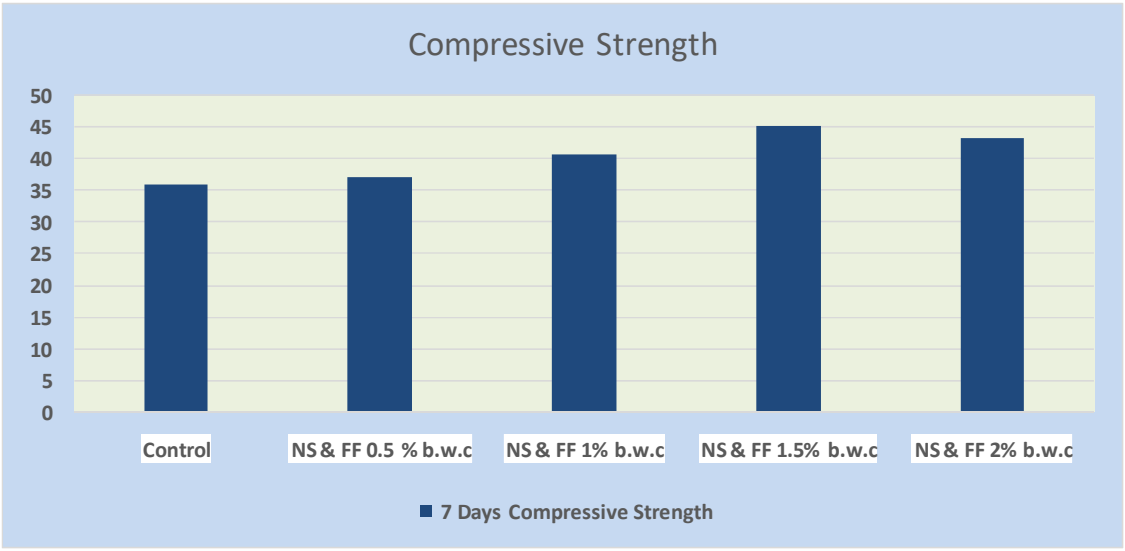


**Fig 1 Comparison of 7-day mean strength of different specimen**

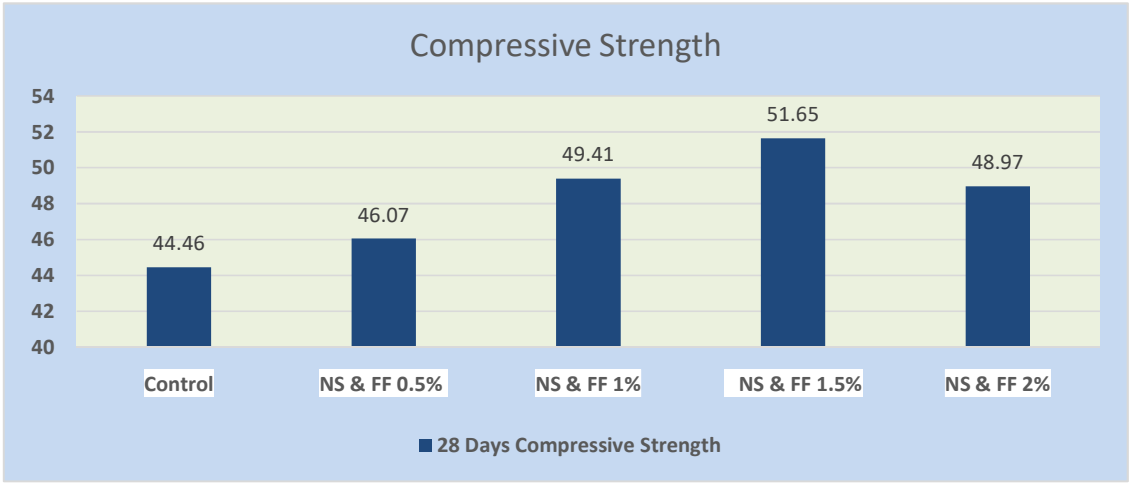


**Fig 2 Comparison of 28-day mean strength of different specimen**

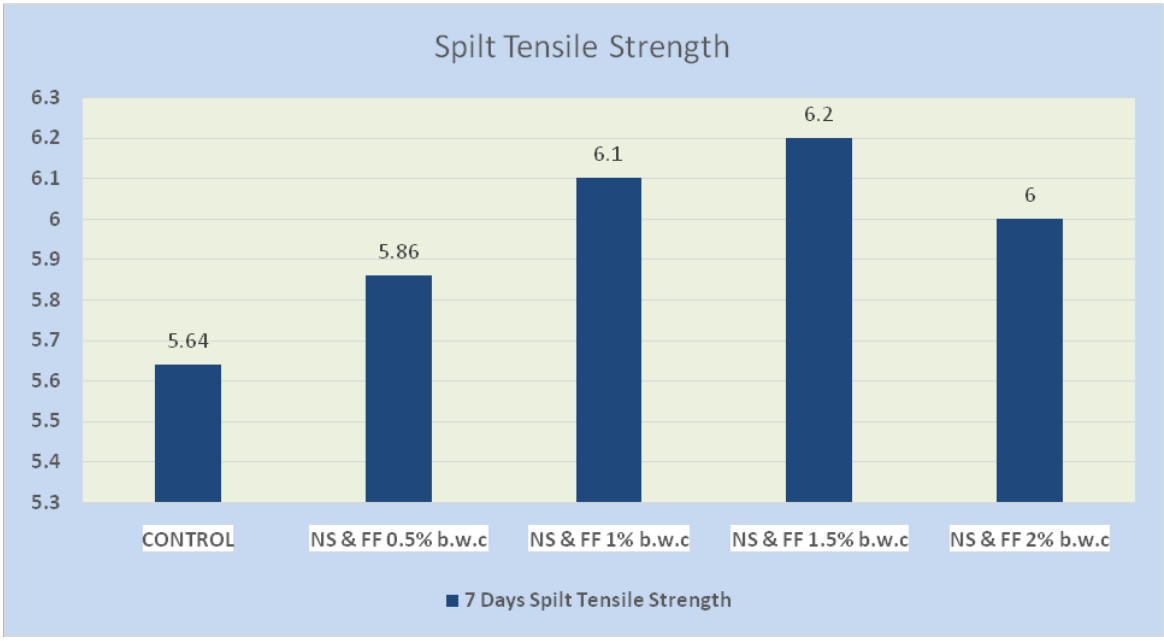


**Fig 3Comparison of 7-days means strength of different specimen**

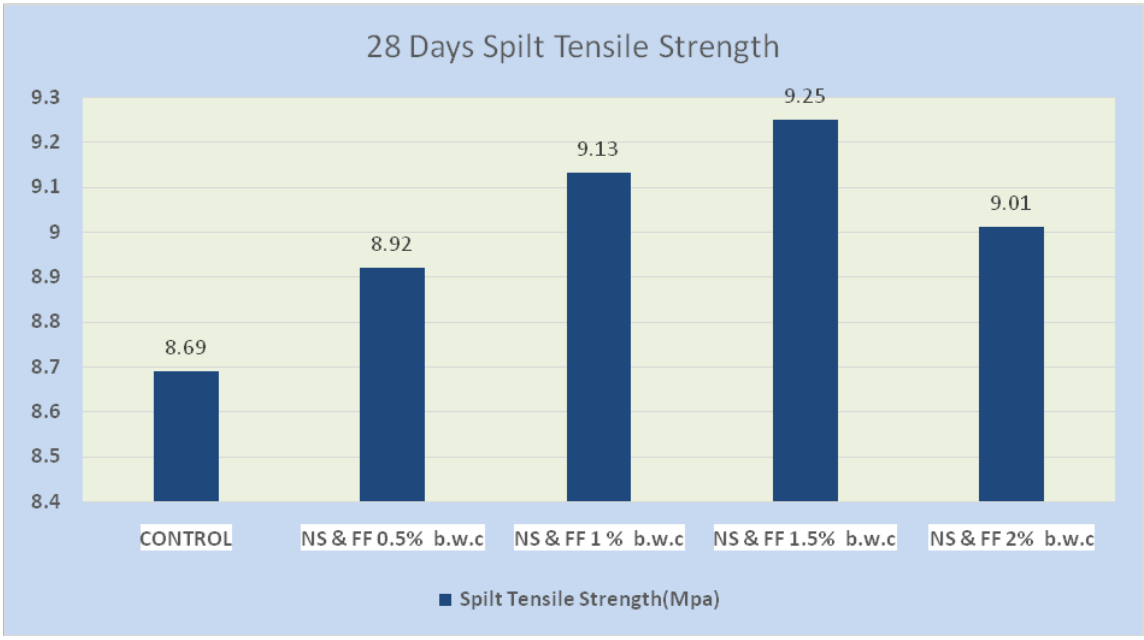


**Fig 4Comparison of 28-days means strength of different specimen**

## V. CONCLUSION AND DISCUSSION

### *A. CONCLUSION*

i. From the compressive strength results, it can be observed that increase in compressive strength of concrete is observed on addition of a certain minimum quantity of Nano $SiO_2$and flax fiber. The increase in strength is maximum for NS+FF 1.5% b.w.c and least for NS+ FF 0.5% b.w.c.

ii. On addition of Nano $SiO_2$and Flax Fiberthere is a substantial increase in the early-age strength of concrete compared to the 28 day increase in strength.

iii. The UPV test results show that the quality of concrete gets slightly affected on addition of Nano SiO2 and Flax fiberbut the overall quality of concrete is preserved.

### *B. DISCUSSION*

i. The increase in compressive strength can be attributed to the filling of voids in the microstructure by the Nano $SiO_2$ particles which prevents the growth of $Ca(OH)_2$ crystals. In addition to it the nano silica reacts with calcium hydroxide crystals converting them into C-S-H gel. The reduction in the $Ca(OH)_2$ content is the reason for increase in compressive strength of concrete.

ii. $Ca(OH)_2$ crystals are present in the Interfacial Transition Zone (ITZ) which is between the aggregates and the hardened cement paste. Nano SiO2 reacts with these crystals and

decreases their concentration, hence, strengthen the ITZ. Due to lesser concentration Nano SiO2 are consumed in the reaction and hence the increase in strength is inhibited with time.

iii. A study of relevant papers show that concrete blended with Nano $SiO_2$ sets quicker compared to normal concrete. Since, the mix design is carried out without the aid of supper-plasticizers, the mix dried up fast which affected the compaction of the mix using mechanical vibration. Lumps of the mix could be seen during the mixing of concrete. With increase in percentage of Nano $SiO_2$ the compaction gets tougher. This is the reason for degradation in its quality. It is advisable to use superplasticizers with nano silica.

iv. The Nano SiO2 added to the mix filled up the pores in between the C-S-H gel, hence, making the microstructure more compact and uniform.

## REFERENCES

[1] IS:2386-1963 (Part-III). *Methods of Test for aggregates for concrete Part III specificgravity, density, voids, absorption and bulking.* Bureau of Indian Standards.

[2] IS:383-1970. *Specification for coarse aggregate and fine aggregate from natural sourcesfor concrete.* Burea of Indian Standards.

[3] IS:455-1989. *Portland Slag Cement- Specification.*Burea of Indian Standards.

[4] IS:456-2000. *Plain and Reinforced concrete- code of practice (Fourth Revision).* Bureau of Indian Standards.