ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017

TO STUDY THE INFLUENCE OF NANO SILICA ON THE STRENGTH & DURABILITY OF SEIF COMPACTING CONCRETE.

Gugulothu Ramesh Assistant Professor, ECE.

Siddhartha Institute Of Technology & Sciences. Hyderabad.

Abstract– *Concrete is the most used universal element or ingredients among all other building materials. Certain admixtures are added to cement to overcome the problems such as durability, toughness, strength, low permeability and resistance to chemical attack. The application of nanotechnology in concrete has added a new dimension to the efforts to improve its properties. Addition of Nanomaterial modifies the properties of concrete by changing its microstructure by their small particle size. The objective of this is to study the mechanical properties of concrete with Nano materials such as ultrafine fly ash, Nano-silica. The addition of Nano-silica will be in the range of 1.5%, 3% and 4.5% for partial replacement of cement by weight. The percentage of ultrafine fly ash will be in the range of 0%, 10%, 20% for partial replacement of cement by weight. Different water binder ratio of 0.3, 0.325, 0.35 and 0.375 and aggregate binder ratio of 2.0 are used. Optimum strength will be observed at 10% of ultrafine fly ash and 4.5% Nano-silica admixtures in (ultrafine flyash, Nano-silica) combination will generate moderately better results compared to nominal conventional concrete. The fresh concrete properties are slump cone tests, and hardened concrete tests are compressive strength, split tensile strength, flexural strength are studied and evaluated at 7 days and 28 days respectively.*

***Key Words*: Durability, toughness, strength, low permeability and resistance to chemical attack, nanotechnology, water binder ratio, Nano silica, cement paste, cement hydration, mechanical properties.**

1. INTRODUCTION:

The concrete which possess high durability, high strength, high density, low permeability and resistance to chemical attack when compared to conventional concrete is termed as High Performance Concrete.

In high performance concrete usually the concrete contains one or more mineral admixtures such as Nano-silica, Meta kaolin, pulverized fly ash, micro silica, Ground Granulated Blast Furnace Slag etc. and super plasticizers as chemical admixture along with conventional concrete elements.

High Performance Concrete is a particular series of concrete deliberate to provide several benefits in the creation of concrete structures.

Nanotechnology is rapidly becoming the Industrial Revolution of 21st century. It will affect almost every aspect of one's life. In comparison to other technologies, nanotechnology is much less well defined and well-structured. It is known that 'Nano' is a Greek word and means 'dwarf'. It does not mean dealing with dwarfs but it became a common word for everything which is smaller than 1 Micron or 1 million of a millimeter. 1 Micron is 1000 Nanometer.

The nanoscience and nano-engineering of concrete are terms that have come into common usage and describe two main approaches of applications of nanotechnology in concrete. Until today, concrete has primarily been seen as a structural material. Nanotechnology is helping to make it a multipurpose "smart" functional material. Concrete can be nano-engineered by the incorporation of nano-sized building blocks or objects e.g., nanoparticles, nano admixtures and nanotubes to control material behavior and add trailblazing properties, or by the grafting of molecules onto the cement particles, cement phases, aggregates, and additives (including nano-sized additives) to provide the surface functionality adjusted to promote the specific interfacial interactions of the molecules. Recently, nanotechnology is being used in many applications and it has received increasing attention also in building materials, with potential advantages and drawbacks being underlined. Silica fume has been recognized as a pozzolanic and cementitious admixture which is effective in enhancing the mechanical properties to a great extent.

The pozzolanic reaction results in a reduction of the amount of calcium hydroxide in concrete, and silica fume reduce porosity and improve durability. It accelerates the dissolution of C-S and formation of C-S-H with its activity being inversely proportional to the size, and also provides nucleation sites for C-S-H. It is responsible for an additional increase in strength and chemical resistance and decrease in water absorption. The addition of micro and nano silica particles to cement paste could effectively reduce the degradation rate as well as its negative consequences. Even small additions (0.5 wt. % binder) of these particles are very efficient in terms of improvement in mechanical properties of cement based materials. This is especially pronounced at early ages and for concretes with regular strength grade.

ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017

Therefore, application of ultrafine fly ash and nano silica could be a successful method for improvement of low strengths of cement based materials. In addition, when low water content is used, economic advantages and higher durability are expected. However, when mortars with nanosilica and ultrafine fly ash are produced using low water content, the resulting material has inadequate workability for most applications. In this case, adding extra amount of water has to be done, but the benefits of mineral additions on the hardened state properties would be minimized. The use of plasticizers and super plasticizers is always desirable to improve the rheological properties without the need for addition of extra water.

The cement consumption is directly related to the country's infrastructure sector and thus growth is paramount in determining the development of the country. With a current production capacity of around 366 million tonnes (MT), India is the second largest producer of cement in the world. Environmental standpoint cement has a negative impact, because manufacturing it emits about a ton of greenhouse gas (CO2) into the atmosphere for every ton of cement manufactured. Production of Portland cement not only releases 7% of the World's carbon dioxide, the cement industry also uses a lot of natural resources such as limestone, clay, petroleum, coal and other substances to preserve the natural resources and to reduce the pollution due to the production of cement is by limiting the cement content in the concrete without compromising the strength. There were efforts before to partially replace cement in concrete with new compounds and industry by-products. The aim of the present experimental investigation is to find the influence of combined application of Nano-Silica and Fly Ash on the strength properties of concrete. Fly Ash and Nano-Silica are used as partial replacement of cement. In the present experimental investigation the cement is partially replaced by 10%, 20% and 30% of Fly Ash and 1.5%, 3% and 4.5% of Nano-Silica by weight. The effect of combined application of ultrafine Fly Ash and Nano-Silica on compressive strength, split tensile strength, flexural strength and modulus of elasticity of M43 grade of concrete are investigated.

The test results of concrete prepared using the combination of different proportions of ultra-Fine Fly Ash and Nano-Silica are compared with that of controlled concrete. The variation of different test results of concrete prepared with various proportions of Fly Ash and Nano-Silica indicates the same trend. Based on the test results, it can be observed that concrete prepared with 20% Fly Ash and 3% Nano-Silica combination possesses improved strength properties compared to the controlled concrete. The increase in the various strength characteristics of concrete prepared using Fly Ash and Nano-Silica can be attributed to the effective particle packing and also the availability of additional binder in the presence of Fly-Ash and Nano-Silica.

Silica is the common name for materials composed of silicon dioxide (SiO2) and occurs in crystalline and amorphous forms. Silica fume or micro-silica (SF) is a byproduct of the smelting process in the silicon and ferrosilicon industry. The American concrete institute defines silica fume as 'Very fine noncrystalline silica produced in electric arc furnaces as a by-product of production of elemental silicon or alloys containing silicon'. It is a grey colored powder, similar to Portland cement or fly ashes. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle size (diameter) of 150 nm. The main field of application is as pozzolanic material for high performance concrete.

Nanosilica is typically a highly effective pozzolanic material. It normally consists of very fine vitreous particles approximately 1000 times smaller than the average cement particles. It has proven to be an excellent admixture for cement to improve strength and durability and decrease permeability. Nano Silica reduces the setting time and increases the strength (compressive, tensile) of resulting cement in relation with other silica components that were tested. Nano-silica is obtained by direct synthesis of silica sol or by crystallization of nano-sized crystals of quartz.

1.1 Need for the Study:

- To understand the characteristics of fresh concrete workability with addition of admixture and verified by slump cone test.
- To study the characteristics properties of Fly ash and Nano-silica in the high performance concrete.
- To study the properties of fresh and hardened concrete of high performance concrete with fractional substitute of cement by Nano-silica in term of percentage such as 0%, 1.5%, 3% and 4.5%.
- Using industrial waste materials like ultra-fine fly ash cost effective concrete will be produced.
- To study the effect of Nano-silica and fly ash on the fresh and hardened strengths of concrete.
- To analyze strength of concrete by comparing the different hardened concrete specimens.

2. LITERATURES REVIEW:

As a precursor to begin with a project, it is more essential to have general and detailed information pertaining to the subject content, strategic approaches, available research in the subject area, interpreted results and drawn conclusions. Keeping above in mind, a detailed review is conducted to know the available information in the subject, need for research, development and improvements. It gives us an idea about the objective to be achieved from the present work. Literature review is carried out by referring the journals,

ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017

dissertation reports, relevant IS codes and browsing the websites. The list of journals, books, website referred is given in reference section.

Soil stabilization is in research from historical times using lime. Various researchers have contributed research work in the area of stabilizing the soil using slag, lime, fly ash and other industrial waste material. In this direction, intensive research was done with GGBS and the findings showed that GGBS can bring down the expansive capability of clay soils that are stabilized with lime and containing sulfate. Making use of industrial by-products like GGBS for stabilization, the soil stabilization is gaining momentum.

Researchers have tried using GGBS. Evaluation of the potential of utilization of GGBS to stabilize soil was undertaken by various researchers.

[1] **H. Li et. al. (2004)** investigated the behavior of mortars with NS and observed that increase in 7 days and 28 days strength compared to plain concrete. He has done analysis of microstructure and found that all the pores in the concrete are filled with Nano particles and amount calcium hydroxide was reduced due to the reaction of pozzollana.

[2] **Tao Ji (2005)** has done experimental studies on the properties of concrete by partial replacement of cement with Nano material and found that addition of Nano silica resists the permeability of water and uniformity and compact of microstructure.

[3] **M.Nill et.al. (2009)** investigated the joint effect of colloidal Nano silica and micro silicaon concrete properties and observed that maximum strength reached by the concrete when it is incorporated with 1.5 % NS and 6% micro silica. Lowest capillary absorption rate for 1.5% NS and 3 % micro silica.

[4] **Alirza Naji Givi et.al. (2010)** investigated the effect of Nano silica particle size. Initially the cement was replaced cement with 0.5 % , 1%, 1.5% and 2% NS of size 80nm and 15nm. It was found that split tensile strength and compressive strength increased.

[5] **Mounir Ltifia , Achraf Guefrechb,, Pierre Mounangab, Abdelhafid Khelidj. (2011)** These research persons have done experimental investigation on effect of incorporation of nano silica in to the concrete. The aim of this study was to study the behaviour of mortars and paste on addition of nano silica. They had replaced the cement by Nano silica at the rate of 3% and 10% by cement weight. The results were showing increase in compressive strength. Formulation of mortar: sum of Nano particles and cement was considered as binder content. They have made fresh mortars with Water binder ratio of 0.5 and Binder/sand weight ratio of 1:3. Replacement of cement was 0%, 3% and 10%. The conclusion was increase in percentage of addition of NS increase in the strength.

3. MATERIALS USED:

The Main ingredients which are used in this investigation are described below

CEMENT: OPC 43 grade (IS 8112-1989)

Cement can be pronounced as an amorphous compound of Ca-silicates and other Ca compound. The 4 most important compound that make cement (Bogue's Compounds) are Tri-calcium silicates, shortened as C3S, Di-calcium silicates (C2S), Tri-calcium aluminates (C3A), Tetra calcium aluminum ferrites (C4AF) where C stand for Calcium-oxide, S stand for Silicon-oxide, A stand for Aluminum oxide and F for Ferric oxide. Tri-calcium silicate and di-calcium silicate is the main supplier to the strength of cement, mutually comprise about 70 % of cement mixture. As per IS 4031-1988 different properties of cement have been tested. In our study we used UltraTech OPC.

Fine aggregates

M-Sand as a Fine aggregate which is used in the project were collected from Bengaluru conforming IS 383-1970 passing 4.75 mm and retained on 75 micron were used.

Coarse Aggregates

Used locally available aggregates from stone crushed quarry which are angular, flaky, round shaped particles. Particles were used with size below 20mm are used.

Nano Silica

Specific gravity of Nano-silica is 2.3, in this article we used Nanosilica which is white amorphous in nature of size 20nm, 1000 times finer than the cement particles. The NS is expensive compared to any other admixture or cement materials, thus the main reason to use with care and caution, this type of admixture is highly active particle which improves the overall strength, microstructure of cement, durability and increases the life span of structures. Purchased from Astra Chemicals, Ahmadabad and the properties of physical and chemical composition are given below. The most reactive material is Nano silica which is also called as pozzolanic material. the properties of physical and chemical composition are given below.

Ultra-fine fly ash

Ultrafine fly ash material is an admixture which is used in the concrete as an ingredient to increase the strength and durability properties. Cement can be replaced by UFFA in the concrete. UFFA is obtained by air separation method that includes air classification. UFFA has mean particle size of 3 micrometers. 90 percent of the UFFA having particle size < 7 micro meters by volume. After processing Fly ash to UFFA, its rheological behavior and reactivity both are improved.

ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017

Most important advantage of UFFA is its tendency of reducing water demand.

SUPER PLASTICIZERS

1. In our experiment we used the chemical admixture CONPLAST SP430 and manufactured by FOSROC, Bangalore.

2. It complies to IS: 9103 – 1999 and also BS, ASTM principles.

3. When this chemical admixture is added to the cement concrete. The obtained workability doesn't affect any strength property, microstructure but workability is improved .

Water

The water, which was used for making concrete and for the curing, and it should be clean and free from harmful impurities. The P^H value should be less than 7.

Table - 1.0: Material requirement and mix design

Sample calculation of the quantities required for the mix with aggregate – binder ratio 2.0 and water binder ratio 0.325 for 0% flyash and 0 % of NS				
	A/B =	2.00		
	W/B =	0.325	Sp.gr of Water =	1.00
	Cement =	1.00	Sp.gr of Cement =	3.08
	Flyash =	0.00	Sp.gr of flyash =	2.33
	Nanosilica	0	SP.grNS	2.3
			Sp.Gr of C.A =	2.75
			Sp.Gr of F.A =	2.67
Sl.no	Material	Absolute volume of 50 kgs cement bag (m3)	Material per cubic meter of concrete (kgs)	
1	Cement	0.0162	721.675	
2	Fly ash	0.0000	0.000	
4	Water	0.0163	234.545	
5	Coarse aggregate	0.0218	866.011	
6	Fine aggregate	0.0150	577.340	
7	Nano silica	0.0000	0.000	
	Total volume =	0.0693		
	Volume required			
	For 4cubes	6 * 0.10*0.10 * 0.10	0.0060	m^3
	For 4 cylinders	6 * 3.14* 0.10^2 * 0.2 / 4 =	0.0094	m^3
	For 4 beams	6* 0.1 * 0.1* 0.50 =	0.0300	m^3
	Total		0.0454	m^3
	Add 10 % extra		0.0045	m^3
	Gross Total		0.0500	m^3
	Quantity of cement		36.06	Kg
	Quantity of fly ash		0.00	Kg
	Quantity of water		11.72	Lit
	Quantity of coarse aggregate		43.27	Kg
	Quantity of fine aggregate		28.85	Kg
	Quantity of NS		0.00	Kg
	Quantity of SPr		0.361	lit

4 MIX PROPORTIONS

In this project, we mainly deals with the mechanical property on fresh and hardened cement concretes such as slump cone test and compression, tensile, flexural strength. Workability, strength property can be observed from above tests, also compare the strength of Nanosilica combinations and ultra fly ash respectively. The test consists of freshened and hardened state of concrete in which slump cone test and strength test are made. Three types of strength specimen with dimensions are Cubes of 100mm*100mm*100mm, Cylinders of 300mm height*150mm dia, and Prism or Beams of 500mm*100mm*100mm.

1. Initially before starting test the physical properties like specific gravity, bulk density, water absorption, elongation index, flakiness index, impact, and Crushing test are conducted on materials which are required for the experimentation.

2. In our project mineral admixture like Nano-Silica, ultra-fine Fly Ash and chemical admixture like Complots SP430 are used. Firstly instructions are read carefully before using this type of materials among which Nano-silica is highly active minerals, so gloves are worn always while dealing with such types of minerals.

3. Ultrafine Fly ash is directly mixed while it is in dry condition. But for Nano-silica it can be mixed with concrete in two types, firstly it can be mixed with super plasticizers water solutions and secondly it can be mixed with fine aggregates (sand) by portioning.

4. In first stages the high performance concrete are prepared from mixing cement with aggregates, water and plasticizers for different specimen like cubes, cylinder and beams with different 0.3, 0.35, and 0.4 w/c ratio and cured for 7 and 28 days respectively.

5. Plasticizers are used to make concrete ease flow. Workability is measured by freshen concrete, which defines the flow ability of concrete and also indirect measurement for consistency.

6. After curing these specimens subjected to compressive strength, tensile strength and flexural strength tests.

7. The mixing of Nano-silica content with high performance concrete are tested for 7 and 28 days respectively and follow the procedure of point (5) and (6).

8. Further the mixing of ultrafine fly ash with high performance concrete in the range of 10%, 20% and 30% by cement weight is prepared for compressive, tensile and flexural test specimens.

9. Tested after 7 and 28 days curing respectively.

ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017

10. Same procedure of (8) an (9) is followed for different water /cement ratio in high performance concrete.

11. Later the strength is compared from reference high performance concrete with high performance concrete contains Nano-silica and Ultrafine fly ash.

5. TEST RESULTS

The various strength tests that are to be done listed as below.

5.1 Compressive Strength Test:

The compressive strength of concrete is one of the utmost important and valuable properties of concrete. In most structural application concrete is understood primary to resist compressive stress. Series of conventional concrete cubes of 100mm*100mm*100mm are tested in compressive testing machine after 7 and 28 days curing, compressive strength is calculated by dividing load by area of specimen and results are given below.

$$F_c = P/A \ N/mm^2$$

Where,
P=cube compressive load affecting failure
A=cross section area of cube in mm2

Figure – 5.1 Compressive tests on concrete cube.

The following tables shows 7days and 28 days compressive strength of partially replaced concrete cubes at the rate of 0%, 10%, 20% UFFA and 0%, 1.5%, 3%, 4.5% NS.

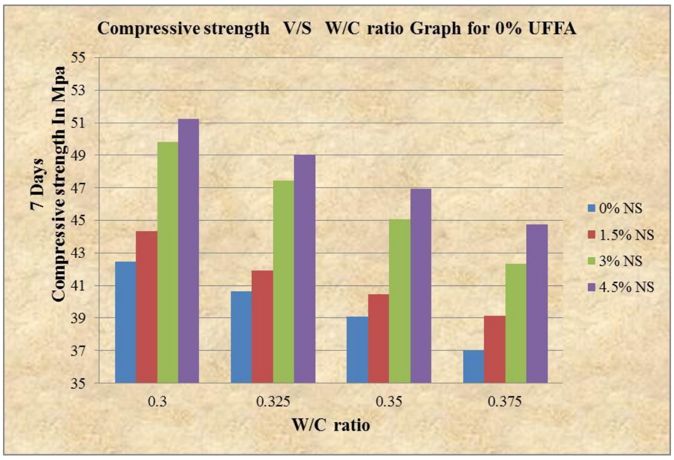
Table no 2: compressive test results

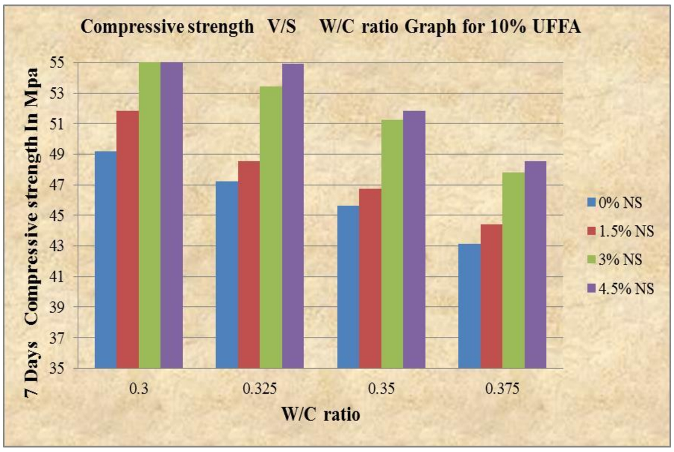
COMPRESSIVE STRENGTH WITH 0% UFFA									
	7 days Compressive strength in MPA					28days Compressive strength in MPA			
W/C	0.3	0.325	0.35	0.375		0.3	0.325	0.35	0.375
0% NS	42.47	40.62	39.07	37.04		59.32	55.77	52.15	50.88
1.5% NS	44.36	41.93	40.44	39.15		61.47	57.42	54.66	52.06
3% NS	49.82	47.44	45.06	42.33		65.88	62.33	58.11	54.92

COMPRESSIVE STRENGTH WITH 10% UFFA									
	7 days Compressive strength in MPA					28days Compressive strength in MPA			
W/C	0.3	0.325	0.35	0.375		0.3	0.325	0.35	0.375
0% NS	49.18	47.21	45.61	43.15		68.56	64.13	61.84	58.94
1.5% NS	51.86	48.54	46.74	44.42		72.82	66.25	63.32	60.74
3% NS	56.21	53.45	51.23	47.81		75.65	69.71	66.86	63.91
4.5% NS	57.61	54.92	51.82	48.56		82.36	80.47	76.96	70.61

COMPRESSIVE STRENGTH WITH 20% UFFA									
	7 days Compressive strength in MPA					28days Compressive strength in MPA			
W/C	0.3	0.325	0.35	0.375		0.3	0.325	0.35	0.375
0% NS	42.26	40.11	38.77	36.88		60.47	58.11	53.88	50.77
1.5% NS	44.58	41.33	39.24	38.62		61.88	59.55	57.33	52.16
3% NS	50.16	45.68	42.82	40.82		66.02	62.44	59.04	54.44
4.5% NS	51.72	48.06	45.15	42.44		67.55	64.07	61.22	55.41

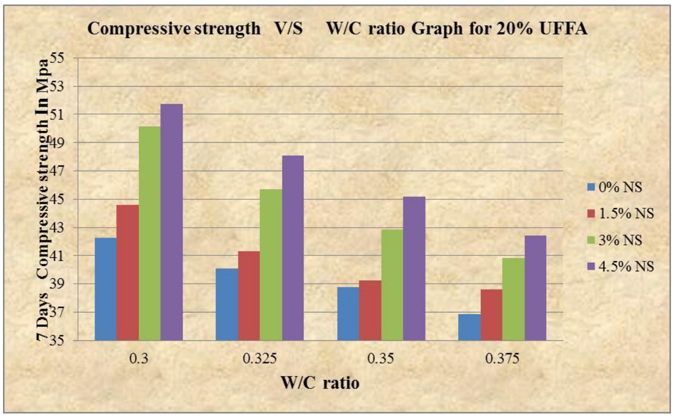
Graphs : compressive strength in at various results

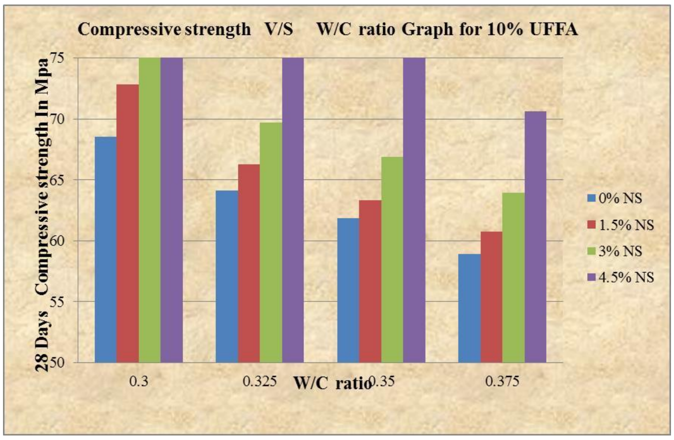


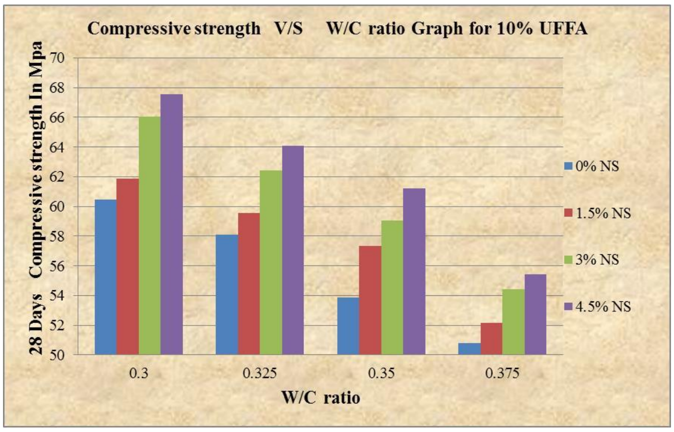


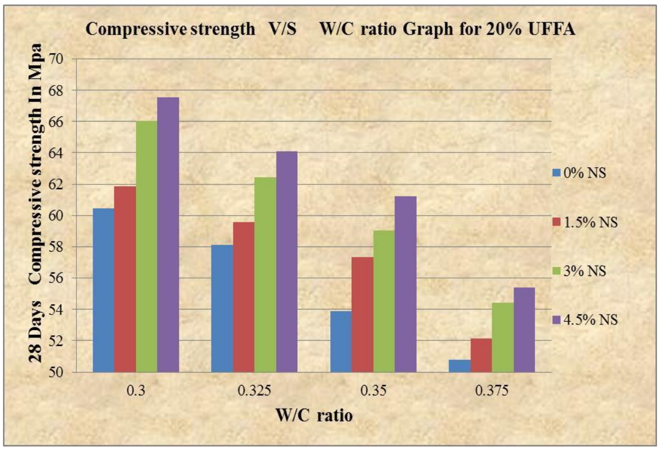
4.5% NS	51.21	49.04	46.92	44.77		67.27	63.82	61.66	56.53

ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017









5.2 SPLIT TENSILE STRENGTH OF CONCRETE CYLINDERS

Tensile strength is one of the simple and significant properties of concrete. Size of test specimen of 300mm height and 150mm diameter thick cylindrical mould is used. The base plate shall be 6.5mm thick so that they do not leave from a plant surface by more than 0.02mm. The load is applied on cylinder which is placed horizontally between the two plates of the compressive testing machine. Noted and calculated the tensile strength. After 7 and 28 curing.

$$F_{st} = 2P/\pi LD \text{ N/mm2}$$

Where,
Fst= split tensile strength N/mm2,
P= maximum load in N
L= length of specimen,
D= cross section diameter

Figure 5.2: splite tesile strength

The following tables shows 7days and 28 days Split tensile strength of partially replaced concrete cylinders at the rate of 0%, 10%, 20% UFFA and 0%, 1.5%, 3%, 4.5% NS

Table 2 : split tensile strength results

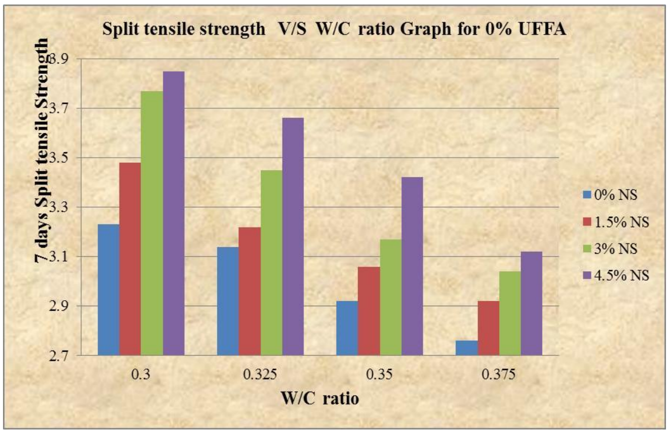
SPLIT TENSILE STRENGTH WITH 0% UFFA									
	7 days Split tensile strength in MPA					28days Split tensile strength in MPA			
W/C	0.3	0.325	0.35	0.375		0.3	0.325	0.35	0.375
0% NS	3.23	3.14	2.92	2.76		4.72	4.44	4.17	3.85
1.5% NS	3.48	3.22	3.06	2.92		4.81	4.67	4.38	3.91
3% NS	3.77	3.45	3.17	3.04		4.92	4.82	4.59	4.26
4.5% NS	3.85	3.66	3.42	3.12		4.97	4.88	4.72	4.14

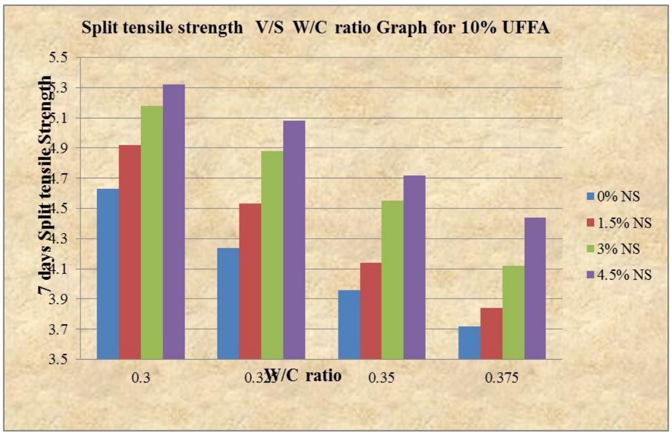
SPLIT TENSILE STRENGTH WITH 10% UFFA									
	7 days Split tensile strength in MPA					28days Split tensile strength in MPA			
W/C	0.3	0.325	0.35	0.375		0.3	0.325	0.35	0.375
0% NS	4.63	4.24	3.96	3.72		4.82	4.52	4.25	3.94
1.5% NS	4.92	4.53	4.14	3.84		5.17	4.78	4.47	4.12
3% NS	5.18	4.88	4.55	4.12		5.42	4.94	4.66	4.41
4.5% NS	5.32	5.08	4.72	4.44		5.51	5.11	4.87	4.36

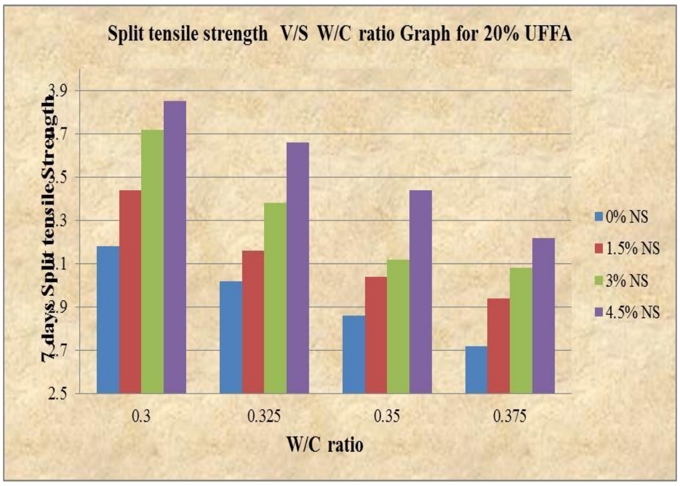
ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017

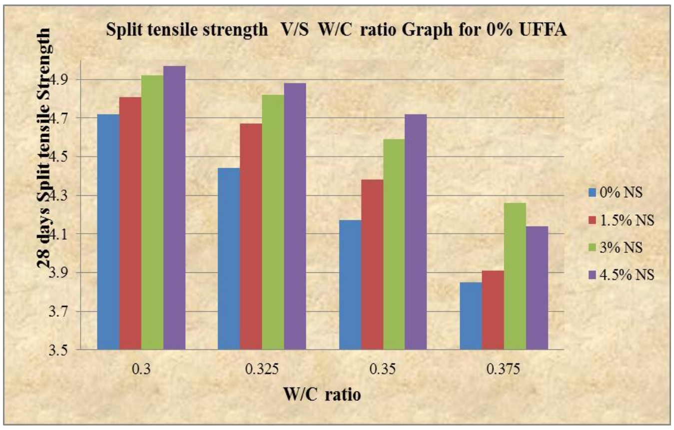
SPLIT TENSILE STRENGTH WITH 20% UFFA									
	7 days Split tensile strength in MPA					28days Split tensile strength in MPA			
W/C	0.3	0.325	0.35	0.375		0.3	0.325	0.35	0.375
0% NS	3.18	3.02	2.86	2.72		4.53	4.32	4.11	3.78
1.5% NS	3.44	3.16	3.04	2.94		4.78	4.48	4.29	3.87
3% NS	3.72	3.38	3.12	3.08		4.94	4.72	4.43	4.22
4.5% NS	3.85	3.66	3.44	3.22		5.03	4.82	4.58	4.06

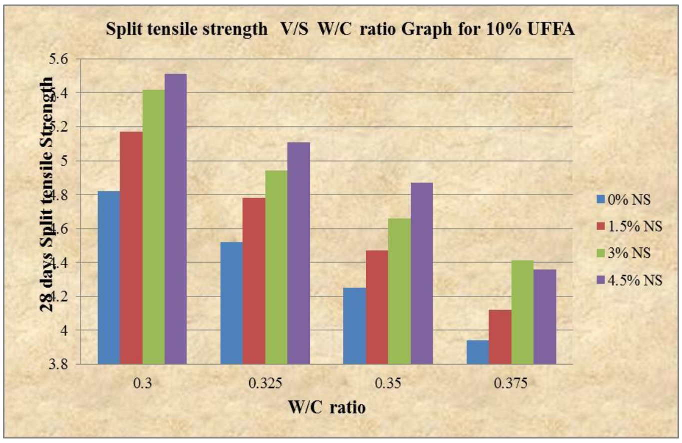
Graphs of split tensile strength V/S W/C Ratio

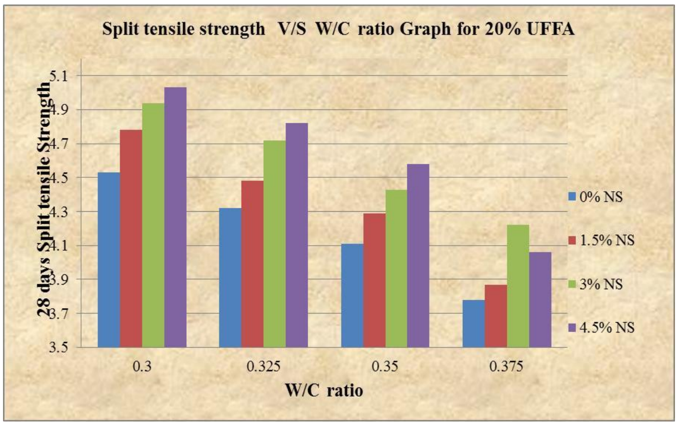












5.3 FLEXURAL STRENGTH OF CONCRETE PRISMS (BEAMS)

The prism is normally tested to recognize the bending performance of the hardened concrete. The test is conducted in universal testing machine of 60T load capacity. Normal prisms of dimensions 500mm×100mm×100mm were cased and to study the bending movement of concrete under the two point load. The max tensile stress read at the failure of prism is called modulus of rupture and is computed. The flexural strength of the specimen shall be expressed as the modulus of rupture. If equal distance between the line of action and nearer support then

fb= PL/bd2 N/mm2.

Where,

Fb= modulus of rupture, b= measured width of specimen
D= measured depth of specimen at the point of failure
L= length of the span on which the specimen was supported
P= maximum load applied to the specimen

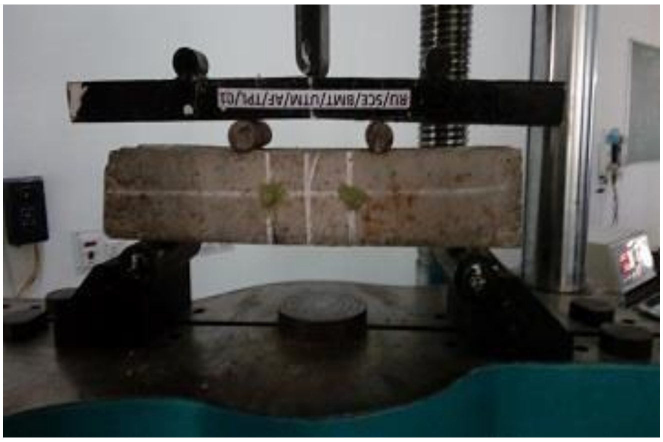


Figure – 5.3 flexural strength test.

The following tables shows 7days and 28 days Flexural strength of partially replaced concrete prisms/beams at the rate of 0%, 10%, 20% UFFA and 0%, 1.5%, 3%, 4.5% NS.

FLEXURAL STRENGTH WITH 0% UFFA

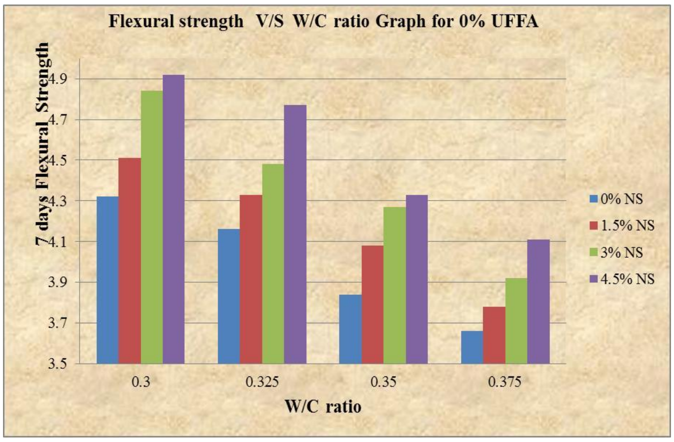
	7 days Flexural strength in MPA				28days Flexural strength in MPA			
W/C	0.3	0.325	0.35	0.375	0.3	0.325	0.35	0.375
0% NS	4.32	4.16	3.84	3.66	5.62	5.24	4.92	4.62
1.5% NS	4.51	4.33	4.08	3.78	5.75	5.55	5.18	4.77
3% NS	4.84	4.48	4.27	3.92	5.32	5.72	5.48	4.82
4.5% NS	4.92	4.77	4.33	4.11	5.98	5.86	5.62	4.94

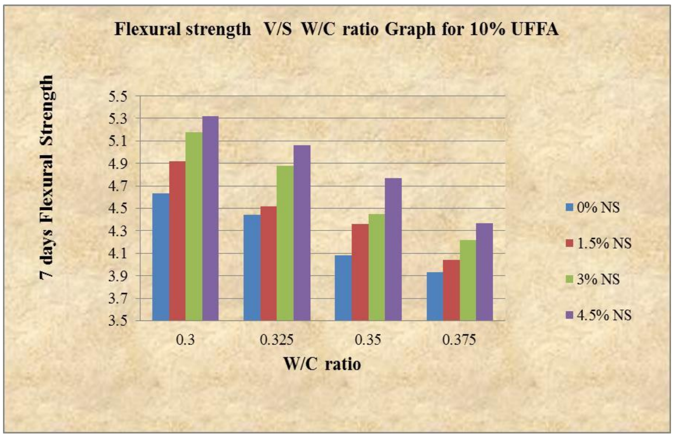
FLEXURAL STRENGTH WITH 10% UFFA

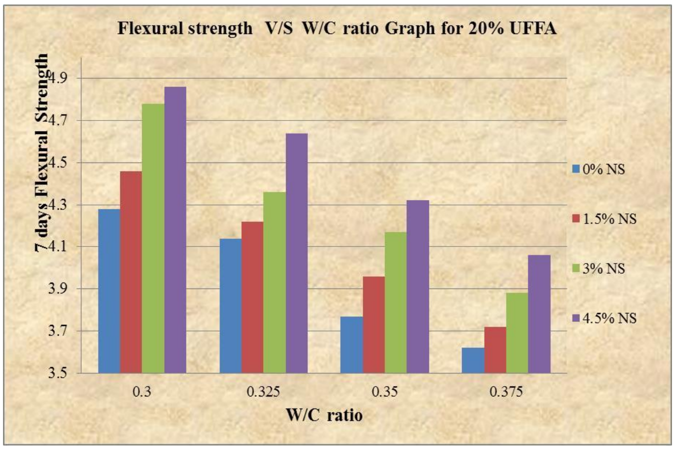
	7 days Flexural strength in MPA				28days Flexural strength in MPA			
W/C	0.3	0.325	0.35	0.375	0.3	0.325	0.35	0.375
0% NS	4.63	4.44	4.08	3.93	6.05	5.82	5.46	4.92
1.5% NS	4.92	5.52	4.36	4.04	6.14	6.02	5.64	5.12
3% NS	5.18	4.88	4.45	4.22	6.32	5.94	5.77	5.24
4.5% NS	5.32	5.06	4.77	4.37	6.41	6.17	5.88	5.34

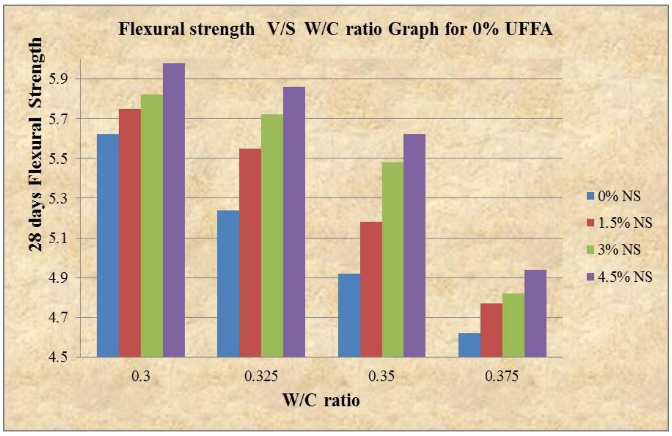
FLEXURAL STRENGTH WITH 20% UFFA

	7 days Flexural strength in MPA				28days Flexural strength in MPA			
W/C	0.3	0.325	0.35	0.375	0.3	0.325	0.35	0.375
0% NS	4.28	4.14	3.77	3.62	5.54	5.17	4.88	4.55
1.5% NS	4.46	4.22	3.96	3.72	5.68	5.44	5.06	4.72
3% NS	4.78	4.36	4.17	3.88	5.82	5.62	5.38	4.84
4.5% NS	4.86	4.64	4.32	4.06	5.94	5.77	5.55	4.93

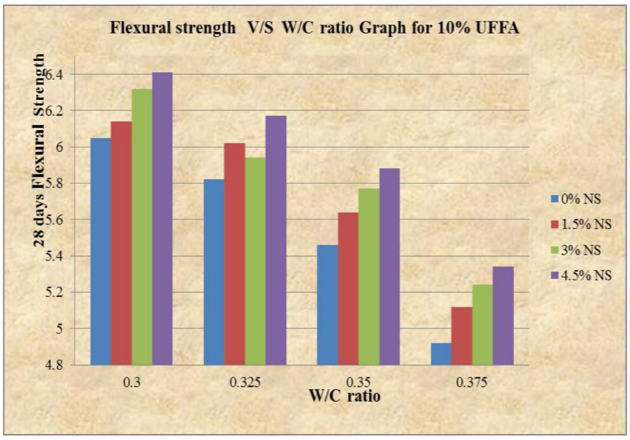


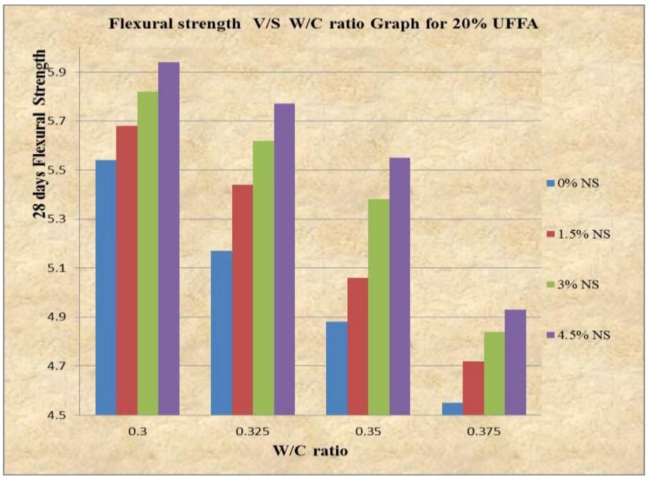






ISSN 2454-8065 International Journal of Applied Theoretical Science and Technology
Volume 05, Issue 10, pp1208-1218, 30th November 2017





6 CONCLUSIONS:

From the Nano-silica and ultra-fine fly ash combination test results the following conclusion can be drawn

1. The strength of HPC increases with addition of ultrafine fly ash and Nano-silica.

2. The strength of HPC decreases with increases in w/c ratio.

3. The compressive strength of HPC increases with increase in percentage of Nano-silica. It is observed that at 7 days the increase in strength is 8.74, 8.42, 7.84 and 7.73% at 1.5%, 3% and 4.5% of Nano-silica. For 28 days the increase in strength is 7.95, 8.05, 9.51and5.65 at 1.5%, 3% and 4.5% of Nano-silica respectively.

4. The compressive strength of HPC and increases with increase in percentage of ultrafine admixture up to 10% and further increase in ultrafine decreases the strength.

5. At 10% ultrafine fly ash the 28 days compressive strength observed is 73.44N/mm^{2}at 4.5% of Nano-silica. At 20% addition the strength decreases and it is 67.55 N/mm^2.

6. The increase in percentage of compressive strength at 0%, 1.5%, 3% and 4.5% of Nano-silica with 10% ultrafine fly ash is 54.07 N/mm^2 respectively.

7. The split tensile strength of HPC increases with increase in percentage of Nano-silica. It is observed that 7 days the increase in strength is 0.53, 0.42, 0.5, and 0.36at 1.5%, 3% and 4.5% of Nano-silica. For 28 days the increase in strength is 0.25, 0.44, 0.55, and 0.29 at 1.5%, 3% and 4.5% of Nano-silica respectively.

8. The compressive strength of HPC increases with increase in percentage of admixture ultrafine fly ash up to 10%. Further increase in ultrafine fly ash decreases the strength.

9. At 10% ultrafine fly ash the 28 days strength observed is .69N/MM^2 at 4.5% of Nano-silica. At 20% addition the strength decreases and it is 0.5 N/mm2.

10. The increase in split tensile strength of HIGH PERFORMANCE CONCRETE at 0%, 1.5%, 3% and 4.5% of Nano-silica with 10% ultrafine fly ash is 0.69, 0.59, 0.62, 0.42% respectively.

11. The flexural strength of HIGH PERFORMANCE CONCRETE increases with increase in percentage of Nano-silica. It is witnessed that 7 days the increase in strength is 0.6, 0.61, 0.49 and 0.45% at 1.5%, 3% and 4.5% of Nano-silica. For 28 days the increase in strength is 0.36, 0.63, 0.7% and 0,32% at 1.5%, 3% and 4.5% of Nano-silica respectively.

12. The flexural strength of HIGH PERFORMANCE CONCRETE increases with increase in percentage of admixture ultrafine fly ash up to 10%. Further increase in ultrafine fly ash decreases the strength.

13. At 10% ultrafine fly ash the 28 days strength observed is 6.41N/mm2 at 4.5% of Nano-silica. At 20% addition the strength decreases and it is 5.94N/mm2.

14. In overall the ultrafine fly ash admixture at 10% is observed high strength.

7 REFERENCES:

1. Mehta, P K,, "influence of fly ash characteristics on the strength Portland –fly ash mixture "cement and concrete resource, V.15, No, 4, july 1985, pp, 669-674

2. Hassan, K E and cabrera , J G' the use of classified fly ash to produce high performance concrete " fly ash silica fume, slag and natural pozzolonas in concrete proceeding from the sixth CANMET/ACI international conference, Bangkok, Thailand , SP-178 V.1, V m malhotra ed, American concrete institute, farming hills. Mich, 1998pp,67-80

3. ACI116R-90 (2011)" cement and concrete terminology" American concrete institute farming hills, MI

4. Amine M. and el-hassan, K A (2015), "effect of using different types of nano materials on mechanical

properties high strength concrete " construction and building materials ,80, 116-124sz

5. T. shanmugapriya 1, R N Uma2, optimization of partial replacement of M sand by natural sand in high performance concrete with silica fume (2008)

6. T subbalaxmi, b vidivelli; mechanical properties of high performancein corporating with qurry wastes

7. Priyadarshini, A. Krishnaurthy , adiparashakti engineering college, melmaruvathuru; high performance concrete using quarry dust as fine aggregate.