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INFLUENCE OF NANO PARTICLES IN CONCRETE – A REVIEW

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ABSTRACT

Nano innovation is one of the most dynamic exploration areas which have wide application in all development fields and industry. In this paper an examination is carried out about the influence of Nano materials like Nano silica, Nano carbon tubes and Nano titanium dioxide. Nano silica has heat transfer and UV ingestion attributes. By the partial substitution of Nano materials and the mix of other advantageous cementitious materials improves the properties of concrete in fresh and solidified state compared with traditional concrete properties like strength, workability and durability.

Key words: Nano Particles, Strength, Durability, Workability, Nano Technology

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1. INTRODUCTION

The concrete is a significant material produced using a blend of conventional Portland cement, water, fine, and coarse aggregates and with some minimum voids. It is the most generally utilized development material on the planet. In the current development fields and industry Nano innovation is one of the most dynamic examination regions which have wide applications in practically all the development fields [1, 44-47]. It's been required to improve its quality and properties of concrete by the partially substitution of Nano materials and the mix of other valuable cementitious materials have indicated huge improvement than ordinary concrete [2]. Nano concrete is characterized as a concrete made by filling the pores in conventional concrete utilizing Nano particles. The new age of concrete formed of various materials of nano particles is named as a nano material concrete. In the current exploration research work the impact of various nano particles and further more with a blend of various

mineral admixtures are mostly replaced by concrete with various dosages [3]. As the nano particles and mineral admixtures are acquired from various sources like artificial, characteristic materials, mechanical wastes or by products are used in work which will devour less measure of time and vitality to obtain the materials . The nano particles and further more with a blend of various mineral admixtures are used as a pozzolanic material, and has been inspected that the huge impact in improving the concrete properties like strength , workability and durability. The current paper has an out look of the survey work examined on various concrete properties hardened and fresh state by fusing nano particles and mineral admixtures. In the recent years the nano technology developing at a noticeable rate [4]. The use of nano particles have developed a new potential and there is a global interest in the examination of nano particles in concrete construction industry. The properties of cement mortar and concrete are examined by the impact of nano materials.

1.1. Nano Silica

Nano silica Silicon dioxide nano particles, otherwise called silica nano particles or nano silica, in nature, silica makes up quartz and the sand. It is the first Nano product that replaced the smaller scale silica [4]. The investigation of concrete at Nano scale has demonstrated Nano silica obviously superior to silica utilized in traditional concrete.

The silica has been one of the world's most generally utilized added substances in concrete for more than 80 years. It properties permits high compressive quality, toughness and impermeability, and they have been a piece of numerous significant concrete structure. It's being its moderately significant expense and tainting which unfavorably influences the earth and the soundness of the development laborers. Subsequently, administrators must play it safe to abstain from breathing in small scale silica to forestall silicosis, a destructive ailment of the lungs [4]. In 2003, an product which could supplant micro silica was created having better qualities causing a lower cost and furthermore satisfying condition guideline of ISO-14001. Utilizing devices of material science, science and late Nano innovation progressive product Nano silica was created which had unrivaled focal points in correlation with small scale silica. A liter container of Nano silica was proportional to a barrel loaded with small scale silica, additional concrete and super plasticizing admixtures. Compressive strength of 70 to 100 N/mm^2 has been accounted for at 28 days. . Nano-silica expansion to concrete based materials can likewise control the degradation of the central C-S-H (calcium-silicate hydrate) response of concrete brought about by calcium draining in water just as block water entrance and consequently lead to upgrades in concretes.

1.2. Titanium Dioxide

Nano titanium dioxide is separated into two precious stone types of rutile and anatase. It has high immaculateness, a normal molecule size of under 100nm, extraordinary straight forwardness and great UV ingestion [4]. It additionally has high warm and substance strength. The anatase gem structure is utilized for creation of photo- catalysts. Under light, it can help separate unsafe gases and natural toxins by means of photograph catalysis. The anatase structure can likewise be utilized in the decay of car fumes and sewage treatment. The rutile precious stone structure exceeds expectations at UV retention, under the joint activity of UV beams and oxygen, the Nano titanium dioxide has solid bactericidal powder.

1.3. Carbon Nanotubes

A carbon nanotube is a cylinder formed material, made of carbon, having a distance across estimating on the nano meter scale [4]. A nano meter is one-billionth of a meter, or around multiple times littler than a human hair. Carbon nanotubes can be envisioned as an altered

type of graphite. Graphite is shaped from numerous layers of carbon atoms that are bonded in a hexagonal shape in sheets, with bonds between the sheets and solid bonds inside them. A CNT can be thought of as a sheet or sheets of graphite that have been folded up into a cylinder structure. CNT can be single walled nanotubes (SWNT), as though a solitary sheet had been moved up, or multiwall (MWNT), comparable in appearance to various sheets moved together [4].

2. REVIEW OF LITERATURE

R. Sakthivel and N. Balasundaram (2016) have studied on the influence of Nano-Silica on different properties of concretes acquired by replacing the concrete with different dosages of Nano-Silica. Nano-Silica is utilized as an partial replacement for concrete in the scope of 2.5%, 3%, and 3.5% for M25 blend. Specimens are casted utilizing Nano-Silica concrete. Results demonstrate that the concrete, by utilizing Nano-Silica powder, had the option to build its compressive quality. The density is diminished contrasted with standard blend of concrete. The replacement of concrete with 3% Nano-Silica brings about higher quality and decrease in the porousness than the controlled cement. The replacing of concrete with Nano-Silica over 3% brings about the decrease of different properties of Nano-Silica concrete.

S. Prasath et al. (2107) investigated about the utilization of nano silica and silica in concrete. Nano silica and silica rage are profoundly pozzolanic nature. To improve the mechanical properties of concrete for M30 and M40 with the utilization of silica (5%, 7.5 %, 10 % and12. 5 %) and nano silica (1%, 2%, 3%, and 4%) as the fractional substitution of concrete were contemplated. Consumption of steel in normal concretes ceaselessly developing and causes issue. This influences the exhibition and toughness of concrete auxiliary components. The concrete under goes physical obstruction to the forceful condition for the fortifying steel in light of its high alkalinity. The erosion of strengthening steel in standard concrete happen because of absence of value control in blending, arranging and combination an entangling of air in the concrete, bringing about dependability penetrable concrete. At the point when the structures are presented to destructive condition, untimely disappointment of R.C sections because of erosion prompts extreme basic disappointment. So as to beat this circumstance to an extent, Corrosion resistance for traditional and nano silica and silica were concentrated by utilizing corrosion technique.

G. Yamini and S. Siddiraju (2016) have studied the application of fine particles of nano silica application in concrete significance of nano silica, the nano silica fabricating way, the assurance of compressive, split, flexural quality at and contrasting the outcomes with controlled concrete of M30 grade. In this exploratory methodology the concrete is incompletely replaced by means of 20% and 30% of Fly Ash and Nano-Silica through 1.5%, 3.0% and 4.5% by utilizing weight. The idea of blended Fly Ash and Nano-Silica on compressive quality, Split, flexural of M30 evaluation of concretes examined. The adaptation of different investigation consequences of concrete composed with extents of Fly Ash and Nano-Silica shows the equivalent pattern. Based absolutely at the investigate influences, it might be found that concrete sorted out with 20% Fly Ash and 3.0% Nano-Silica expansion has improved qualities contrasted with the control concrete. The characteristics of concrete arranged utilizing Fly Ash and Nano-Silica can be ascribed to the successful molecule packing.

S. Sanju et al. (2016) investigated the influence of consolidating nano particles, for particles, nano Al_2O_3, nano Fe_2O_3 and nano SiO_2 on mechanical and strength properties of concrete. Nano particles were included three distinct measurements of 0.5%, 1% and 1.5% of weight of the cementitious material into the solid blend. Investigation on nano replaced concrete were allowed to 28 days of water curing to acquire the mechanical properties, for

samples, compressive quality and split tensile. Rapid Chloride Penetration Investigation (RCPT) and water ingestion investigation were explored for acquiring the toughness properties of concrete specimens. Combined blend of nano Al_2O_3 + nano SiO_2 and nano SiO_2 + nano Fe_2O_3 were likewise considered to contemplate the influence of the nano particles. Investigation after effects of the study demonstrated that combined of nano particles demonstrated to build the molecule packing by diminishing porous pores and makes interfacial change zone to be denser which improved the quality and durability properties of concrete.

Jitendra Patil and Umesh Pendharkar (2016) carried experimental work on nano material for development industry is underscored and audits of ongoing turns of events and current situation with the utilization of nano alumina, nano titanium dioxide, nano zinc oxide and nano-silica for sustainable development of concrete industry. This would protect the natural sources with the decrease of waste material. Just a restricted measure of nano products make it to the building site of today, as a result of this absence of mindfulness and the way that nano sized products are regularly too costly to even think about resulting in competitive products.

B. B. Das and Arkadeep Mitra (2014) conducted the study on nano technology utilization in the solid similarity with the constructional structures like that of huge structures and scaffolds, which have been thought to infringe upon colossal masses of land, prompting the annihilating of homes of untamed life and placing pressure in the restricted stores of vitality. The authors explains the practical use of nano based materials like carbon nanotube, electrochromic windows, sandviknanoflex™, nanowires, titanium dioxide, nanoceramic covering, nanocrystalline materials, nanosilica, nanocomposites, MMFX2 steel, nanometals, nanofibres, nanomyte™ retouch MW, nanocement, which could be utilized for giving particular or numerous elements of possible fortification, consumption obstruction, protection, fire security, temperature resistance, lessening cooling loads, contamination control, UV beam retention, lighting, when utilized as a piece of building materials.

C. Divya and P. Harish (2018) suggested nano materials to improve the manageability and durability of concrete and it has the mechanical properties and noteworthy addition in cementitious material. His research summarize up the influence of nano silica expansion on mechanical properties of cement. It gives the current improvement of utilization of nano-silica in engine and concrete by utilizing Ordinary Portland Concrete and Blended Cement. The nano silica is accessible in 10-50 nm as molecule size. The 17nm molecule size is utilized for the entire work. This paper point is to examine the mechanical properties of the samples utilizing the nano silica by substitution of the concrete. The proportion in weight of the nano concrete concerning typical concrete. The mortar sample size is 70.6 mm X 70.6 mm X 70.6 mm. The cubes shape size is 150 mm x 150 mm x 150 mm was kept up and water concrete proportion 0.40 was kept up all through the work. The 0%, 1.5%, 3.5%, 5.5% and 7.5% of nano silica ought to be replacement with weight of the concrete.

Deepika Rana et al. (2018) studied the mechanical properties of concrete, for Compressive quality and usefulness of M20 and M30 evaluations of concrete with the utilization of Nano silica (0%, .5%,1%, 1.5%, 2%, 2.5%) as partial substitution of concrete specimens to be casted and cured for 28 days in standard condition, after this relieving period investigation to ascertain the mechanical properties of Nano silica concrete are done and the outcomes were contrasted and the Normal cement concrete (NCC).

Apurva A. Fursule and V. S. Shingade (2017) studied about the mechanical properties of concrete utilizing reused nano silica particles for M20 and M30 grade of concrete. The fine aggregates was replacement with reused aggregates as extents of 0%, 20%, 30% and 40% and nano silica 0%, 1%, 2%, 3% and 4%. Blend configuration was proportioned (1:2.71:3.64)

with water concrete proportion 0.53 for M20 and (1:2.04:2.94) with water concrete proportion 0.45 for M30 evaluation of concrete. By substitution of reused aggregate as fine aggregate we can see the utilization of common and natural sources.. The outcomes show that mechanical properties of concrete with increment in reused aggregates and nano silica dosages. The outcomes exhibited that the compressive quality, flexural quality and split elasticity by substitution of fine aggregate by reused aggregate utilizing nano silica.

3. PROPERTIES OF MATERIALS

The physical properties of nano particles are presented in table 1 and the chemical composition of nano particles are likewise referenced in the table 2, 3 and 4. The concrete utilized in the examination conventional Portland concrete 53 evaluation and explicit gravity is 3.1 and standard consistency is 32% according to IS 4031. The fine and coarse total utilized in the examination are max 4.75 mm and 20 mm and its particular gravity esteems are 2.31 and 2.41 separately according to IS 2386: 1963.

Table 1 Properties of Nano materials [5]

Properties	**Sio_2**	**Al_2o_3**	**Tio_2**	**Fe_{2O3}**
morphology	porous	spherical	spherical	spherical
colour	White	White	White	Reddish brown
Purity	99.5%	99.5%	99.5%	99.5%
Particle size	50 – 80- nm	30 – 50 nm	10 – 20 nm	90 – 100 nm
Specific gravity	2.1	3.9	4.26	3

Table 2 Chemical Composition of SiO_2 [5]

Chemical composition	**Al**	**Fe**	**Mg**	**Ca**
Nano Sio_2	<0.02%	<0.05%	<0.1%	<0.08%

Table 3 Chemical Composition of Al_2o_3 [5]

Chemical composition	**Cao**	**Fe_2O_3**	**Mgo**	**Ca**
Nano Al_2o_3	<0.017%	<0.035%	<0.01%	<0.05%

Table 4 Chemical Composition of TiO_2 [5]

Chemical composition	**S**	**Si**	**Mg**	**Al**
TiO_2	<0.05%	<0.02%	<0.01%	<0.01%

4. REACTION MECHANISM

The pozzolan characterizes that the siliceous and aluminous materials that itself has an almost no cementitious material worth however that will , in finely separated structure within the sight of dampness artificially respond with calcium hydroxide at normal temperatures to frame compound having cementitious properties. The hydration of concrete improvement the calcium silicate hydrate and calcium hydroxide are discharged inside the hydration of two principle parts of concrete in particular tricalcium silicate and dicalcium silicate [6]. The job of nano particles wil go about as fillers in the voids or void spaces and all around scattered nano particles will go about as a nucleation or crystallization focuses of the hydrated products, in this way expanding the hydration rate, i.e., nano particles will helped towards the development of littler size CH precious stones and homogeneous groups of C-S-H structure [6]. They improved the structure of the progress zone among totals and glue and the impact of

nano particles on the mechanical quality advancement of cementitious materials, the expansion of nano particles to Portland concrete (PC) glues was found to expand the compressive strength to a degree that was reliant on the nano molecule content, water-to-cover weight proportion (w/b), and relieving time. The nano particles can improve the filler impact and furthermore the high pozzolanic activity of fine particles increments considerably the amount of C-F-H gel.

It can improve the microstructure in the interfacial progress zones and subsequently the estimation of C-F-H gel brings about diminishing the water penetrability. The point of the use of ultra-fine added substances (nano particles) in cementitious frameworks is to improve the attributes of the plastic and solidified material. The Nano particles have a filler impact by topping off the voids between the concrete grains with the correct creation; the higher pressing thickness brings about a lower water request of the blend and it. It likewise adds to quality improvement because of the decreased fine porosity. Likewise representing its durability properties, results show that expansion of nano particles improves strength execution of the concrete. Creating of nano modified concrete will bring about better regarding quality, strength and maintainability. The incomplete substitution of concrete by a mineral admixture called Metakaolin will acquire both better and economy [7]. Concrete blends are changed with expansion of admixtures and nano particles, which improve the microstructure just as reduction the calcium hydroxide focus by consuming it through a pozzolanic reaction. The resulting change of the microstructure of concrete composites improves the mechanical properties, strength and builds the life service properties contributing to sustainably built environment.

5. EXPERIMENTAL WORK

The blend proportion for control specimens was planned according to IS 10262-2009 with various nano particles, ordinary portland cement, metakaolin, coarse aggregate, fine aggregate, super plasticizer and water. The nano particles specimens were casted by substitution of nano particles and furthermore mix of various nano particles and mineral admixtures samples for various evaluations of concrete at various ages of curing period [8]. The nano material concrete samples are casted various tests for mechanical and strength properties of concrete. The nano particles are fused in concrete in various dosages and further more with mix of mineral admixtures are likewise used in exploratory work. The concrete samples like cubes, cylinders, prisms are casted in various cross sections of standard way according to codal arrangements IS 516:1959. The concrete samples are tested at various times of curing period and test outcomes are compared with the ordinary concrete.

Figure 1 Metakaolin

Figure 2 Nano silica

Figure 3 Nano alumina

Figure 4 Nano iron

6. RESULTS AND DISCUSSIONS

6.1. Workability

The workability studies on the nano material concrete represents that the percentage of nano particles are increased beyond the permissible value the slump, compaction factor and vee bee test values are increasing and decreasing for different water cement ratios. The workability test conducted on concrete by replacing the nano particles shows that the slump is increased at different w/c ratios compared to conventional concrete [9]. The compaction factor and vee bee test values are also better compared to conventional concrete at various w/c ratios. The addition of nano particles and combination of mineral admixtures also reducing the water cement ratios.

Table 5 Slump values for different w/c ratios [9]

w/c ratio	Normal concrete (NC) (mm)	Nano titanium (NT) (mm)	Nano zinc (NZ) (mm)	Nano alumina (NA) (mm)
0.5	65	69	71	74
0.6	78	83	86	85
0.7	92	97	101	104
0.8	108	115	123	124

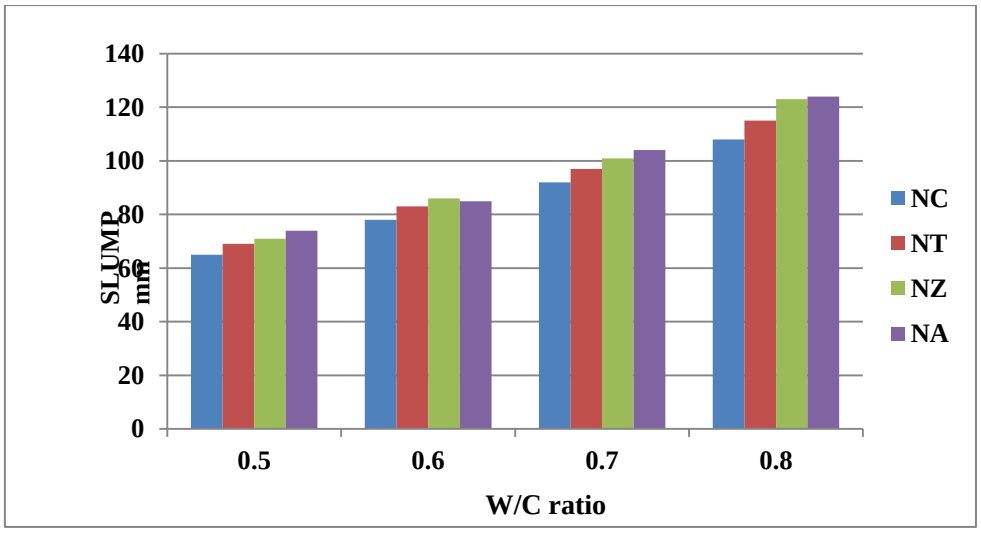

Figure 5 Slump variation for different nano materials at different w/c ratios

Table 6 Compaction factor test values for different w/c ratios [9]

w/c ratio	Normal concrete (NC)	Nano titanium (NT)	Nano zinc (NZ)	Nano alumina (NA)
0.5	0.88	0.89	0.90	0.93
0.6	0.89	0.90	0.93	0.94
0.7	0.90	0.93	0.94	0.95
0.8	0.93	0.94	0.95	0.96

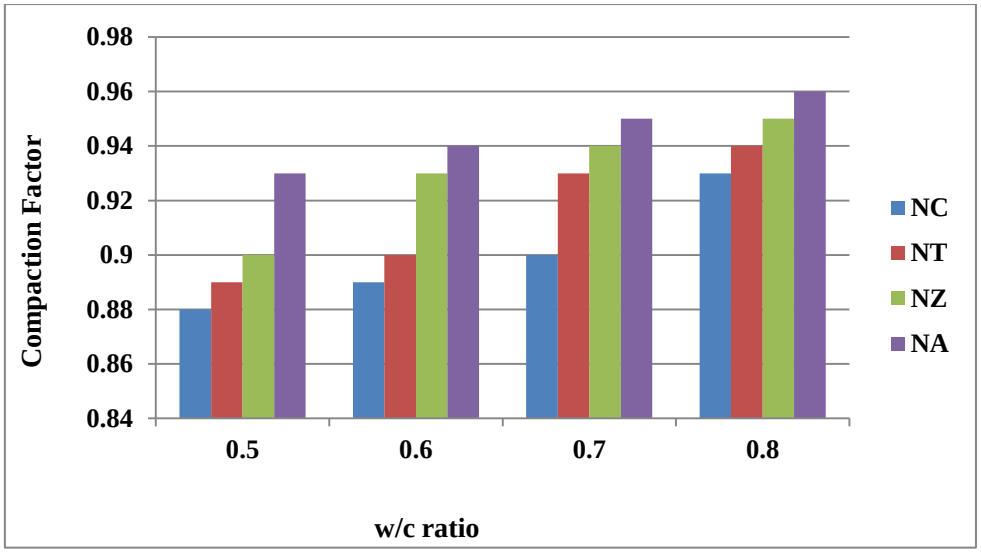

Figure 6 Compaction factor variation for different nano materials at different w/c ratios

Table 7 Vee bee test values for different w/c ratios [9]

w/c ratio	Normal concrete (NC) (Sec)	Nano titanium (NT) (Sec)	Nano zinc (NZ) (Sec)	Nano alumina (NA) (Sec)
0.5	25	21	20	19
0.6	17	15	14	17
0.7	9	8	6	6
0.8	5	3	3	3

6.2. Mechanical Properties

6.2.1. Compressive Strength

The compressive strength test was performed by the codal provisions i:e IS 516:1959 on specimens of cubes 150mmx150mmx150mm later 28 days of curing. The impact of nano particles like nano silica , iron, alumin, zinc and titanium and further more other mineral admixtures utilized are metakaolin, lime and pozzolan are fused in the concrete blends and test outcomes shows preferred outcomes over the traditional concrete[10]. The nano materials additionally consolidated in binary combination with mineral admixtures at various level of nano materials and mineral admixtures replaced in the concrete and the test outcomes are likewise shows preferable outcomes over ordinary concrete. The nano particles and mineral admixtures are replaced more than as far as possible outcomes in diminishing in quality [11]. The primary explanation because of the way that he amount of nano particles present in the blend was higher than the sum required to combined with the freed lime during the procedure of hydration therefore prompting abundance silica draining out and causing an inadequacy in quality. The compressive strength values for different nano particles incorporated in traditional concrete mentioned in the below table 9 and values are represented in the graphically manner in fig 7 which shows the variation of strength in different impact of nano particles in concrete. The nano particles induced in conventional concrete in different combinations results different variation results can be compared with traditional concrete [12]. The mix proportions are tabulated in table no 8 for the above concrete mixes.

Table 8 Mix proportions of concrete specimens[7]

Sample	Cement + metakoalin (kg/m^3)	SP	W/C	NT	NZ	NF	NA
C	580	1.5	0.25	-	-	-	-
NT	580	1.5	0.25	1.5		-	-
NZ	580	1.5	0.25	-	1.5	-	-
NF	580	1.5	0.25	-	-	1.5	
NA	580	1.5	0.25	-	-	-	1.5

C- Normal Concrete NT – Nano titanium, NZ – Nano zinc, NA – Nano alumina, NF – Nano iron

Table 9 Compressive strength values for different nano particles induced in normal concrete [7]

Sample	Compressive strength (Mpa)
Normal concrete (C)	92.3
Nano titanium (NT)	113.3
Nano zinc (NZ)	110.9
Nano iron (NF)	119.0
Nano alumina (NA)	143.1

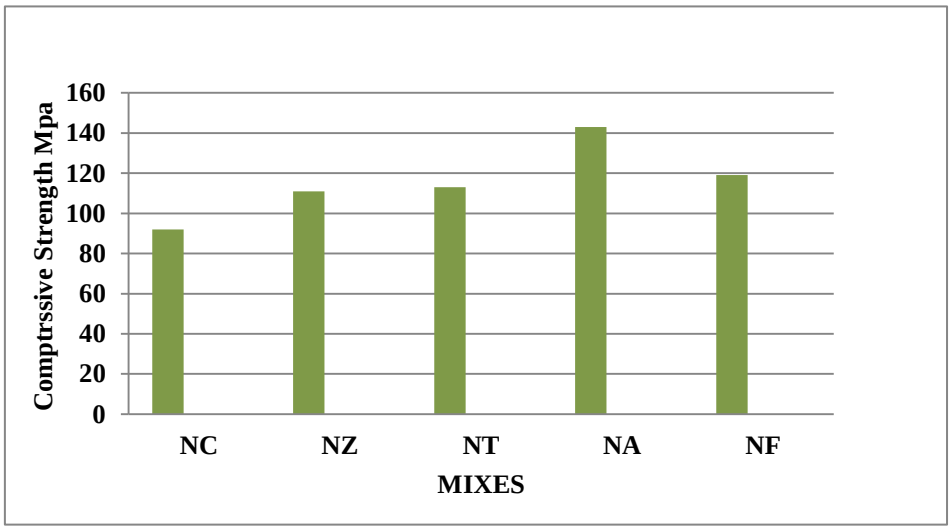

Figure 7 Strength variation for different nano materials at different w/c ratios

6.2.2. Split Tensile Strength

The split tensile test was performed by the codal arrangement i:e IS 516:1959 on cylindrical specimens of 150 mm diameter and length of 300 mm later 28 days of curing water. The nano materials and other mineral admixtures mixes shows preferable outcomes over the traditional concrete [13]. The binary combination of nano particles like nano silica and nano iron such a mix shows preferable outcomes over the other nano particles mixes [14]. The ideal degree of expansion of nano particles shows better outcomes and furthermore the significant economy. The split tensile on cylinders are led the test outcomes are same compared with compressive stregth of concrete. This is because of more arrangement of C-S-H gel in light of denser packing in transition zone. The split tensile strength results exhibits that nano alumina and nano iron show better improvement compared to other nano particles. The mix proportions are tabulated in table no 8 for the concrete mixes.

Table 10 Split tensile strength values for different nano particles induced in normal concrete[7]

Sample	Split Tensile Strength (Mpa)
Normal concrete (C)	6
Nano titanium (NT)	6.4
Nano zinc (NZ)	6.8
Nano iron (NF)	7.2
Nano alumina (NA)	7.4

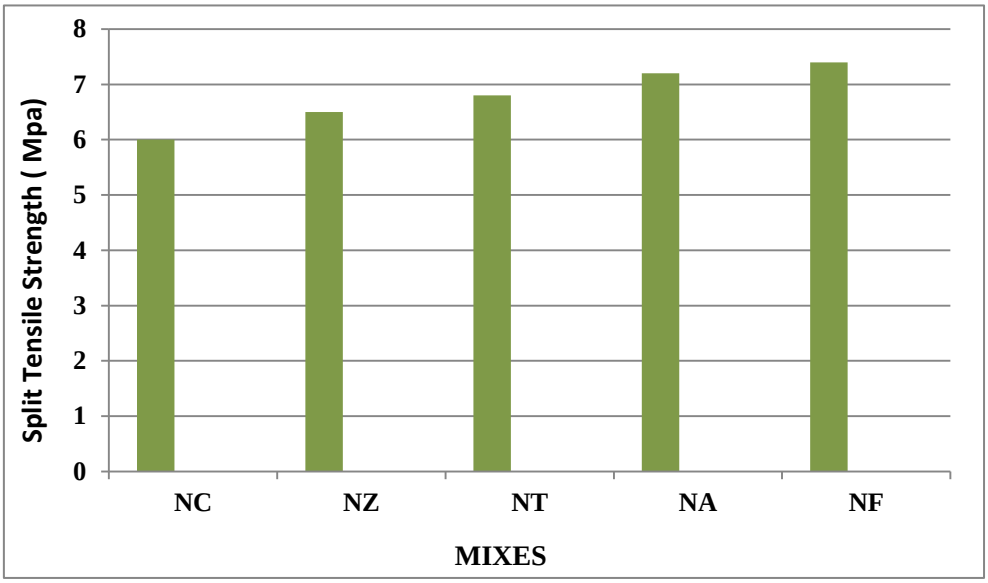

Figure 8 Split tensile strength variation for different nano materials at different w/c ratios

6.2.3. Flexural Strength

The flexural test was conducted according to the codal provision i:e IS 516:1959 on prism specimens of 100 mm x 100 mm x 500 mm of dimensions are tested later 28 days of curing period of water. The nano materials and other mineral admixtures combinations shows satisfactory results than the normal concrete [15]. The binary combination of nano particles like nano iron, silica such a combination shows better results than the other nano particles combinations. The optimum level of addition of nano particles shows better results and also the considerable economy [16]. The limiting values for different nano materials shows different results with different mineral admixtures dosages the results may vary and the excess dosage also results in reduce of strength. The combination should be in a optimum dosage it will be better results [17].

6.2.4. Scanning Electron Microscope Analysis

The microstructure of the concrete samples with and without the addition of nano particles SEM (scanning electron microscope) investigation was adopted. The specimens for SEM were taken from the wrecked pieces acquired in the wake of testing for the compressive quality of the samples. These sections were dried at room temperature and afterward analyzed at quickening voltages running from 20 to 25 kV by a SEM investigation through higher amplification [18]. The micrographs of samples without and with the expansion of nano particles individually. From the micrograph pictures it could be seen that the concrete samples with no addition of nano particles was fiber matrix which has huge number of voids and lean microstructure. In any case, while in the samples containing nano particles denser microstructure was seen with the greater part of the voids being filled off by the nano particles because of fast preparing of C-S-H gel in nearness of unique nano particle. Likewise the

Calcium hydroxide precious stones was diminished and a minimal arrangement of hydration products was seen by using this micrograph [18].

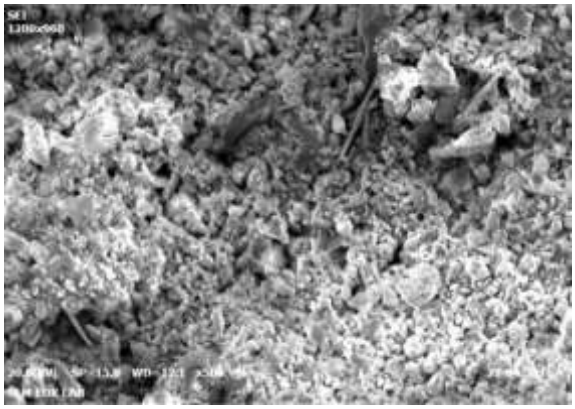

Figure 9 SEM micrograph of concrete without Nano particles[18]

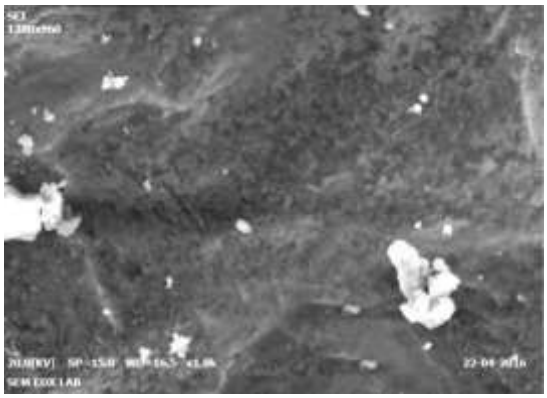

Figure 10 SEM micrograph of concrete with Nano particles[18]

6.3. Durability

6.3.1. Water Absorption

Water absorption test was done according to ASTM C 642-06 on cubes of size 100 mm x 100 mm following 28 days of curing water. The consequences of water absorption test results it was obvious that mix of nano particles had more prominent decrease in water permeation among adding of individual nano particles [18]. This could be because of lesser size of particles (<20 NM) in powerful filling of gel pores present in the concrete samples. It could be construed from the test esteems that for various nano particles altogether diminished the water absorption by various dosages in contrast with control samples, which was because of filling of pores at nano scale and densification bringing about decrease of penetrable pores present in the concrete samples[18]. The mix of nano particles and mineral admixtures makes ITZ denser packing which will brings about better improvement in water retention. The particles of nano impact on concrete will reduce the porosity and water absorption of samples. The concrete specimens with nano particles will exhibit less percentage of water absorption ie: 0.4% compared to traditional concrete. The mix proportions are tabulated in table no 8 for the concrete samples.

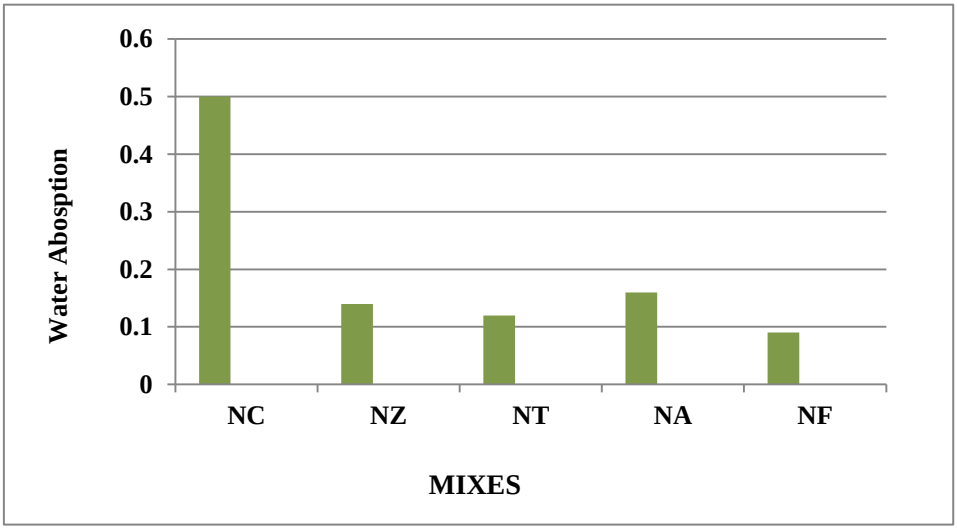

Figure 11 Water absorption (%) variation for different nano materials at different w/c ratios

6.3.2. Rapid Chloride Permeability Test

The chloride permeability test was done according to ASTM C-1202 on cube samples of size 100 mm x 50 mm following 28 days of curing water. The test consequences of rapid chloride permeability test on account of the sample containing adding of nano particles indicated better upgrades regarding protection from saturation of chloride particles[18]. The chloride particle vulnerability dependent on charge passed (ASTM C1202). From the perceptions it was noticed that diverse paired mix of nano particles are with lower charge entry than the control. It demonstrates that chloride permeability of the blends with adding of nano particles generally declined because of less number of voids. It was likewise noticed that nano particles radically decreased the entry of current in the sample which was because of viable filling off of microstructure by all the nano particles in the concrete. Along these it can be tends to be accounted for that adding of nano particles lessens the chloride permeability there by expanding the durability of concrete [18]. The impact of nano particles on concrete will reduce the chloride penetration in various samples compared to normal concrete. The 20 to 80 percentage of variation can be shown in the concrete samples. The mix proportions are tabulated in table no 8 for the concrete mixes.

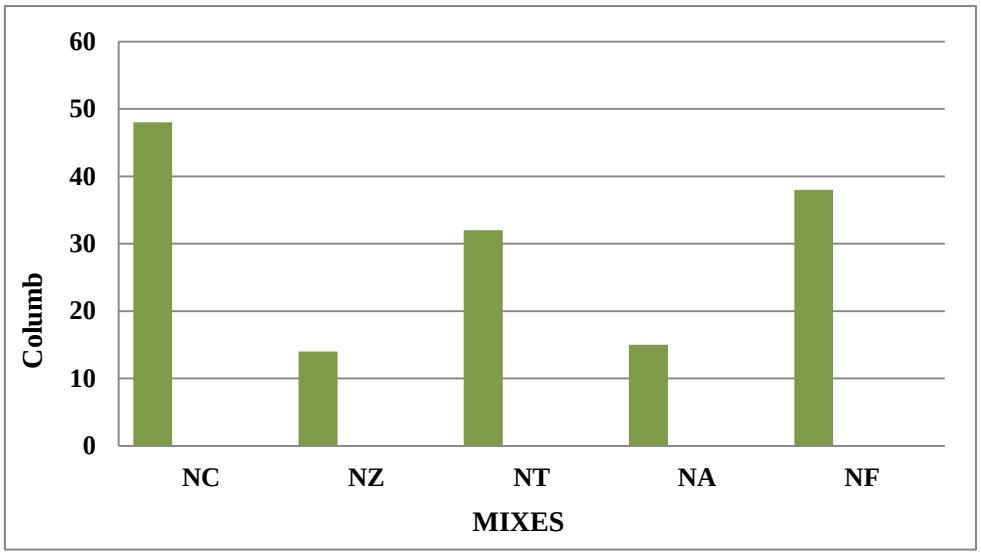

Figure 12 Rapid chloride penetration variation for different nano materials at different w/c ratios

7. CONCLUSION

The slump of nano concrete increases compared to conventional concrete. The compaction factor increased slightly at different water cement ratios. Vee bee time is also decreased at different water cement ratios. The impact of nano particles like nano iron, alumina, titanium and zinc in concrete builds the mechanical and durability properties of concrete. The fuse of nano alumina in lime metakaolin binder results C-A-S-H mixes and it go about as a filler to help micro structure and have a positive impact in the development of these mixes [9]. The utilization of huge amount of cement produces increasing carbon emissions. The adding of nano silica protection from porousness was additionally higher in concrete. Nano materials can increase the performance and density of the concrete. It is suggested that further examinations on the twisting quality and long term durability trial of the nano material concrete ought to be done. The nano materials can fill voids of the C-H-S gel structure prompting a denser concrete. The nano materials respond with calcium hydroxide precious stones delivering C-S-H gel and close to nano particles go about as a portions in the concrete glue which makes the size of calcium hydroxide gems little. Nano silica is by all accounts

ready to control calcium filtering and colloidal scatterings were much more successful diminishing the impacts of the degradation than the dry ones. The nano particles are littler which fills in the pores present in the middle of concrete and total creation it progressively durable to saline and acidic condition. The compressive strength of concrete at first increased up to 3% of Nano-Silica and with further increment in the Nano-Silica dosages the strength of concrete declines. Nano concrete should control the carbon dioxide discharge from the earth which is demonstrated with the guide of the use of fly ash concrete instead of normal concrete. RCPT results shows that control sample and nano concrete specimens are under low chloride porousness. Also with of 1% of nano Al_2O_3,1% nano Fe_2O_3 and 1.5% nano SiO_2 there was perceptible improvement in quality properties of concrete with that of control concrete and also with 1% and 1.5 % will be their ideal level for nano Al_2O_3, nano Fe_2O_3 and nano SiO_2 individually. Also there was an observable constructive outcome that every one of the individual nano particles in improving the quality and strength properties of concrete. Microstructure examination utilizing SEM investigation affirmed that there was denser pressing of C-S-H gel, decrease in $Ca(OH)_2$ precious stones and improved pore structure of solid example with the expansion of nano particles.

REFERENCES

[1] G. Yamini, Dr. S. Siddiraju, (2016) "An Experimental Research on Strength Properties of Concrete by the Influence of flyash and Nanosilica as a Partial Replacement of Cement", International Journal of Civil Engineering and Technology (IJCIET), Volume 7, Issue 3, May–June, pp. 306–315.

[2] R. Sakthivel, Dr. N. Balasundaram, (2016) "Experimental Investigation on Behaviour of Nano Concrete", International Journal of Civil Engineering and Technology (IJCIET), Volume 7, Issue 2, March-April, pp. 315–320.

[3] S. Prasath, Dr. S. Senthil Selvan, E. Balaji, (2017) "Experimental Study of Nano Silica And Silica Fume Concrete Column Subjected To Corrosion", International Journal of Civil Engineering and Technology (IJCIET), Volume 8, Issue 3, March, pp. 708–719.

[4] Mani.M, Dr. G. Nandini Devi, (2017) "Study on Behaviour of Nano Concrete" International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 6, Issue 5, September- October, pp.239-244.

[5] Abdul Rahim and Sandanu. R. Nair, (2016) "Influence of Nano-Materials in High Strength Concrete", Journal of Chemical and Pharmaceutical Sciences, Issue 3: August, pp.15-22.

[6] Anwar M. Mohamed, (2016) Influence of Nano materials on flexure behavior and compressive strength of concrete", HBRC Journal, (12), pp.212-225.

[7] A. H. Shekaria, M.S. Razzaghib, (2011), "Influence of Nano Particles on Durability And Mechanical Properties of High Performance Concrete", The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction, Procedia Engineering 14 pp. 3036–3041.

[8] Salomaa, Amrinsyah Nasutionb, IswandiImranb, Mikrajuddin Abdullah, (2015) "Improvement of concrete durability by nanomaterials",The 5th International Conference of Euro Asia Civil Engineering Forum (EACEF-5), Procedia Engineering 125, pp. 608 – 612.

[9] JitendraPatil, Dr. Umesh Pendharkar, (2016) "Study of Effect of Nanomaterials as Cement Replacement on Physical Properties of Concrete", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 01, Jan, pp.300-308.

[10] B. B. Das and Arkadeep Mitra, (2014) "Nanomaterials for Construction Engineering-A Review", International Journal of Materials, Mechanics and Manufacturing, Vol. 2, No. 1, February pp.41-46.

[11] C. Divya, P. Harish, (2018) "Experimental Investigation on Nanosilica and the Behaviour of Ordinary Portland Cement and Blended Cement and its Effects on Properties", International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 07, July, pp. 1649-1657.

[12] Deepika Rana, Dr. G. P. Khare, Mr. Dushyant Kumar Sahu, (2018) "Experimental Study of Strength Property of Concrete Using Nanosilica", International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 01, Jan, pp.391-394.

[13] Apurva A. Fursule, Prof. V. S. Shingade, (2017) "Experimental Study of Mechanical Properties of Concrete using Recycled Aggregate with Nano Silica", International Research Journal of Engineering and Technology (IRJET),Volume: 04 Issue: 08, Aug, pp.950-953.

[14] Thallapaka Vishnu Vardhan Reddy, K. Rajasekhar and Seelanani Janardhana, (2015) "Study And Performance of High Strength Concrete Using with Nano Silica and Silica Fume", International Journal of Civil Engineering and Technology (IJCIET) Volume 6 Issue 11, Nov, pp. 184-196.

[15] L.P Singh, D. Ali, I. Tyagi, U. Sharma, R. Singh, P. Hou, (2019) "Durability studies of Nano engineered fly ash concrete", Construction and Building Materials 194, pp. 205-215.

[16] Bashar S. Mohammeda, Mohd Shahir Liewa, Wesam S. Alaloula, Veerendra kumar C. Kheda, CheahYit Hoonga, Musa Adamua,b, (2018)"Properties of nano-silica modified pervious concrete", Case Studies in Construction Materials, 8, pp. 409-422.

[17] Kalpana Kumaria, R.Preethaa, D. Ramachandranb, Vinita Vishwakarmab, Rani. P. Georgec, C. Sundaramurthya, U. Kamachi Mudalic, C. Sivathanu Pillaia, (2016) "Recent Advances in Nano Science and Technology 2015 (RAINSAT2015)", Materials Today: Proceedings 3, pp.2387–2393.

[18] S Sanju, S Sharadha, J Revathy, (2016) "Performance on the Study of Nano Materials for the Development of Sustainable Concrete" International Journal of Earth Sciences and Engineering, Volume 09, No. 03, June, pp. 294-300.

[19] H. Eskandaria, M. Vaghefib, K. Kowsaric, (2015), "Investigation of Mechanical and Durability Properties of Concrete Influenced by Hybrid Nano Silica and Micro Zeolite", 5th International Biennial Conference on Ultrafine Grained and Nanostructured Materials, UFGNSM15, Procedia Materials Science , 11, pp.594 – 599.

[20] Hamid eskandri - nadaaf, aliziaei-nia, (2018) "Simultaneous effect of nano silica and micro silica on corrosion behaviour of reinforcement in concrete containing cement strength grade of C 525", 11th International Conference Interdisciplinary in Engineering, INTER-ENG 2017, 5-6 October, Procedia Manufacturing 22, pp. 399–405.

[21] N. B. Singh, Mukesh Kumar, (2018) "Effect of nano materials on the properties of geo polymer concrete and mortars", Materials Today Proceedings 5, pp. 9035–9040.

[22] Qinyong Ma, Ying Zhu, (2017) "Experimental research on the micro structure and compressive and tensile properties of Nano silica concrete containing basalt fibers", Underground space 2, pp. 175-181.

[23] M. Sivakumara, M. V. L. R. Anjaneyulub, (2016), "Fatigue characteristics of nano-clay modified bituminous concrete", 11th Transportation Planning and Implementation Methodologies for Developing Countries, TPMDC 2014, 10-12 December 2014, Mumbai, India, 17 pp.124 – 133.

[24] Yu Su, Jun Li, Chengqing Wu, Pengtao Wu, Zhong-Xian Li, (2016), " Influences of nano-particles on dynamic strength of ultra-high performance concrete", Composites part B91, pp.595-609.

[25] Maria Stefanidoua, Eirini- Chrysanthi Tsardakaa, Eleni Pavlidoub, (2017), "Influence of nano-alumina in lime pozzolan and lime-metakaolin binders", 13th International Conference on nanosciences & nanotechnologies, 4, pp.6908-6922.

[26] A. M. Said, M. S. Zeidan, M. T. Bassuoni, Y. Tian, (2012), "Properties of Concrete incorporating nano-silica", Construction and building materials 36, pp.838-844.

[27] Mohamed Amin, Khaled Abu el-hassan, (2015)"Effect of using different types of nano materials on mechanical properties of high strength concrete", construction and building materials 80, pp. 116-124.

[28] Hongjian Du, Suhuan Du, Xuemei Liu, (2014), "Durability performances of concrete with nano-silica", construction and building materials 73, pp.705-712.

[29] Sudipta Naskar, Arun Kumar Chakraborty, (2016) "Effect of nano materials in Geopolymer concrete", perspectives in science. 8, pp.273-275.

[30] Sujing Zhao, Wei Sun, (2014), "Nano mechanical behavior of a green ultra high performance concrete", construction and building materials, 63, pp. 150-160.

[31] Rahini, Kannayiramoorthi, Noorul Hakkeemsubuhudeen, Manivannan, Venkatesan, (2017) "Experimental Study on Behaviour of Nano Concrete", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 6, Issue 3, March, pp. 4438-4443.

[32] Amritha Pattali Biju Mathew, (2017) "An Experimental Investigation on Strength Properties of Concrete Containing Micro-Silica and Nano- Silica", International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 06 , June, pp. 1692-1694.

[33] Mohd Mufasshir Alam Shah, E. Balaji, Prof. G. Augustine Maniraj Pandian, (2016) "Experimental study on mechanical properties of high strength concrete using Nano-Silica", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 04, Apr, pp.455-459.

[34] S. Tanveer Hussain, K. V. S. Gopala Krishna Sastry, "Study of Strength Properties of Concrete by Using Micro Silica And Nano Silica", IJRET: International Journal of Research in Engineering and Technology, pp.103-108.

[35] Mr. L. Ranjith Kumar, Q. Roger, P. Santhosh, K.Gowtham, E. D. Jothi Rajan, (2016) "Durability Study Of Concrete Using Nano-Silica", International Journal of Advanced Research in Civil, Structural, Environmental and Infrastructure Engineering and Developing, Volume: 2 Issue: 2, Apr, pp.155-164.

[36] A.Ayesha1, (2017) "Properties of High Strength Concrete Using Nano Silica and Micro Silica", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 14 Issue 6 , Ver. I (Nov. - Dec.), pp. 23-26.

[37] Saloma, AmrinsyahNasution, Iswandi Imran and Mikrajuddin Abdullah, (2013) "Experimental Investigation on Nanomaterial Concrete", International Journal of Civil & Environmental Engineering IJCEE-IJENS, Vol: 13 No:03, june, pp.15-20.

[38] Myriam Marie Delcasse, Nirmith .S. Kumar, Ashwith .S, (2016) "Experimental Study on the Mechanical Properties of Concrete using Micro Silica and Nano Silica - A Step Towards Sustainability", International Journal of Engineering Research & Technology (IJERT),Vol. 5 Issue 11, November, pp.436-439.

[39] J. Esmaeili, K. Andalibi, (2013) "Investigation of the effects of nano-silica on the properties of concrete in comparison with micro-silica", International Journal of Nano Dimension, Int. J.Nano Dimens. 3(4), Spring, pp. 321-328.

[40] Pranay Lanjewar, Anjali Jaiswal, Ayushman Jain, Bhagyesh Dhomne. Dameshwari, Thakre, Parikshit Matale, Ritesh Wankhede, (2017) "Experimental Study on the Strength and Durability of Nano- Concrete", International Journal of Innovative and Emerging Research in Engineering Volume 4, Issue 3, pp.170- 175.

[41] Jugal A. Mistry, Dr. Indrajit N. Patel, Mrs. Jagruti Shah, (2015) "Effect of Nano Silica on Compressive Strength of High Volume Fly ash Concrete", International Journal of Advance Engineering and Research Development Volume 2,Issue 5, May, pp.8-12.

[42] P. Janani , S. Ganeshkumar, M. Harihananth, (2016) "Mechanical Properties of Nano Silica Concrete", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5 Issue 3, March, pp.3496-3502.

[43] Sabir Shafi Lone, Megha Gupta and Geeta Mehta, (2016) "Comparative Study of Nano-Silica Induced Mortar, Concrete and Self-Compacting Concrete – A Review", Indian Journal of Science and Technology, Vol 9(44), November, pp.1-7.

[44] B. Sarath Chandra Kumar and P. Saha (2011), "Contribution of Flyash to the properties of Mortar and Concrete" participated in "International Conference on Advances in Civil Engineering" in International Journal of Earth Sciences and Engineering (ISSN 0974-5904), Volume 04, Issue 06, pp 1017-1023.

[45] B. Sarath Chandra Kumar and K. Ramesh (2017), "Experimental Study on Metakaolin and GGBS based Geopolymer Concrete", International Journal of Engineering and Technology (IJET), (ISSN 2319-8613), Volume 9, Issue 02, pp. 341-349.

[46] B. Sarath Chandra Kumar, K. Ramesh and P. Poluraju (2017), "An Experimental Investigation on Flexural Behavior of GGBS and Metakaolin based Geopolymer Concrete", ARPN Journal of Engineering and Applied Sciences, (ISSN 2321-1814), Volume 12, Issue 07, pp. 2052-2062.

[47] Sujit Kumar, Puru Deep Gautam, B. Sarath Chandra Kumar (2019), "Effect of Alkali Activator Ratio on Mechanical Properties of GGBS based Geopolymer Concrete", International Journal of Innovative Technology and Exploring Engineering (IJITEE), (ISSN 2278-3075), Volume 08, Issue 12, pp. 947–952.