ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

An Experimental Investigation on Strength Properties of Concrete Replacing Natural Sand by M-Sand Using Silica Fume as a Admixture

P Lakshmaiah Chowdary
Assistant Professor,
BITS College,
Adoni, Kurnool (DT), AP, India.

P Ramu
M.Tech, PG Scholar,
Computer Aided Structural Engineering,
BITS College, Adoni, Kurnool (DT), AP, India.

ABSTRACT:
Sand which is a naturally available fine aggregate and which is one of the main ingredient of concrete, requires a suitable substitute because of following reasons: Government has laid many rules and regulations on quarrying and transportation of sand, Continuous quarrying lays impact on environment. This has increased the basic cost of sand by a lot. As a result of this, the cost of production of concrete has also been increased drastically. Because of all the above reasons, it is important for us to partially or completely replace the sand by a suitable material. It would be economical if we use a byproduct in and around as fine aggregate. Cement is also main ingredient of concrete, cement industry produces more about 6% of all carbon dioxide emission.

So it is important for us to partially replace the cement by Silica Fume as an admixture. Natural sand was replaced with M-Sand by six proportions that is 0%, 20%, 40%, 60%, 80% and 100% and Silica Fume is used in place of OPC with four proportions that is 0%, 10%, 20%, 30% with same aggregate binder ratio of 2.5 and various water binder ratios of 0.30, 0.35 and 0.40 evaluating its compressive strength, split tensile strength and flexural strength for 7days and 28 days Now a day's concrete field using new and advanced technology's we can reduce the usage of sand in concrete that is we can use manufactured sand as fine aggregate in concrete for reducing the cost of concrete and to save the environment by pollution.

The manufactured sand is waste product formed by stone quarries, granite quarries. As consumption of coarse aggregate increases the quarries will be increases. This is a waste product and it will pollute the nature. The properties of manufactured sand is nearly equal to the sand hence the usage of manufactured sand in concrete as affine aggregate we can control the pollution and disposal problem also solved. By using manufactured sand as a fine aggregate in concrete we can easily reduce cost of construction. Normally the M.S available in crystalline form with some amount of powder, hence it will effect on the strength. Therefore it is necessary for wash the powder. If M.S will set in Zone II then the properties of manufactured sand will be same as to the natural sand. First super plasticizer was used in 1960-70's in Japan.

Super plasticizer performs like dispersing-agent hence we can call it as water reducing agent. It is more helpful in high performance concrete. By using super plasticizer in HPC we can reduce the water content for better strength and workability. Normally super plasticizer will be used for reduce the water content in concrete mix and better workability of concrete mix and getting a good compaction and give a smooth finishing. It also reduces the water content up to 25 to 30% (by weight of cement). The quantity of water required will be more, when the mineral admixtures are used in HPC it will effect on the strength so that by using optimum percentage of super plasticizer in concrete instead of water we can easily control the workability.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

I.INTRODUCTION:

HPC can be defined as aconcrete-mix made with appropriate materials (SP, Silica fume, Manufactured Sand and other admixtures) combined to provide excellent performance in some properties off concrete that is high strength, high density, impermeability, toughness and good resistance to prevailing environmental agents etc. The concrete made based on the necessity of satisfying the criteria proposed to be overcome over the limitations over a conventional concrete can be said as High performance concrete. Since 1980's high performance concrete is mostly used as important material. They give high strength in compression more than 60Mpa obtained by adding a mixture of cement, with mineral admixture and super-plasticizers. The addition of mineral admixtures to the concrete gives better workability and durability. This admixture also gives good compactness to the cement paste. Silica-fume and super-plasticizers are used to achieve workability of the concrete. The field of concrete technology is undergoing vast changes in the present days. Many different types of concrete are revolutionizing the construction industry.

•The objectives of this experimental studyare to find out theaction of concrete-mixby SILICA FUMES as a mineral admixture produced by using M-SAND in quantities.
•To evaluate the workability, properties of concrete i.estrength of compression, split and flexural for 7 days and 28 days curing.

The aim of this experiment studies is to find out theproperties of concrete by using Manufactured-sand in place of river sand. The percentage of Silica fume varies with (0%, 10%, 20% and 30%) weight of cement and replacing the natural sand with different percentages of manufacturedsand (0%, 20%, 40%, 60%, 80% and 100%) is studied here. The mechanical properties of concrete are determined and compared. Also to find out properties of high strength concrete in different water binding ratios such as 0.30, 0.35 and 0.40 with constant aggregate binder ratio i.e 2.0.

II.RELATED WORK:

A subsequenton HPC with different admixturessome of the important research works carried out by great personalities has been given below.

1. T. Shanmugapriya1, R. N. Uma: In their paper entitled with "investigation of normal sand was replaced with artificial sand and OPC was replaced with micro silica". The OPC will be replaced with micro silica by 1.50percent, 2.50percent then 5.0percent. The natural sand will be replaced by artificial sand by varying proportions of 20percent (i.e. 0 percent to 100pecent). From this investigation the compression test value will be increased by 20pecent then flexural test value will be increased by 15percent. The maximum result will be obtained for 50percent artificial sand used with 5percent micro silica used in concrete.

2. T. Subbulakshmi, B. Vidivelli:In their paper entitled "To find the harden properties of concrete by using robo sand using in place of sand". The natural sand was replaced with quarry dust with varying proportions of 0 percent, 50percent and 100percent then cured for 3, 7, 14, 21, 28, and 60 days. The strength will be gradually increasing up to 28 days then remains constant. 50percent of quarry dust with sand give maximum strength when compared with nominal mix.

3. T. Shanmugapriya, R. N. Uma: In their paper entitled "Experimental investigation on partially and fully replacement of manufactured sand by sand as fine aggregate in HPC with using micro silica as an admixture". From the investigations results, up to 50% of using M-Sand as a F.A in HPC with 5% of M.S give higher values i.e. the compressive strength will increases up to 18.88percent and flexural strength will be increases up to 13.2percent for 28 days curing.

4. Manikundana K U, K. Utaya, Satya N: In their paper entitled "Experimental investigation on strength of compression and strength of flexural of HPC with

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

replacing FA by quarry dust". The grade of concrete is M70. From the obtained results of 7days and 14 days of compressive strength and flexural strength gives higher values for nominal mix concrete when compared with quarry dust mixed concrete. But 28 days of test results give higher value for quarry dust mixed concrete when compared with nominal mix concert. From this result we concluded that earlier age of nominal concrete will be high when compared with quarry dust mixed concrete.

5. Puneeth G T,Mamatha A: In their paper entitled "An Experimental Investigation on theperformance of ConcretebyFractional Replacingof Cement by Micro Silica thenF.Aby Manufactured Sand".Concrete specimen incorporated with 15% micro silica and 50% manufactured sand was found to be good in compression which has compressive strength of 23.9% more than that of the conventional concrete when checked for 28days curing period.

6. Mani kandhan.K.U, Sathya kumar.N, Sakthivel.R In their paper entitled "Effect of replacing of River-sand by manufactured-sand in HPC." Here the fine aggregate replaced with manufactured sand and the cement will be replaced with micro silica (15percent by the weight of cement) to fill the void and with water reducing agent that is super plasticizer also used (1.2percennt by the weight of cement) for better workability. Based on the results earlier age strength will be high for conventional concrete when compared with manufactured sand and micro silica mixed concrete. Later that is at the age of 28days of curing the strength will be high for manufactured and micro silica mixed concrete when compared with conventional concrete for both compressive and flexure. From the above results this HPC will be used in bridges, flyovers and high rise buildings.

7. Priyadharshini, A.Krishnamoorthi, Adhiparasakthi Engineering College, Melmaruvathur: In their paper entitled "Find out the properties of HPCby using stone dust as Fine aggregate. This experiment based on the robo sand that is the sand were replaced by robo sand with different proportions. Also the OPC was replaced by micro silica and with addingsteel fibres with different percentages i.e 0percent, 0.5percent, 1.0percent, and 1.5percent. The M60 grade concrete will be designed by using ACI method. By using S.F the compressive strength will be increases and by using steel fibres, tensile strength will be increases.

III. MATERIALS USED IN CONCRETE:

In Conventional concrete and high performance concrete same components used such as OPC, river sand, pebbles, H2O. But in HPC, super plasticizer and mineral admixture like silica fume are added with various proportions. The Martials are given below. Selection of the type of cement will depend on concrete properties like strength, durability also overall needs of concrete. In concrete, cement-content greater than 500 kg/m3 may increase the shrinkage and can be dangerous. The volume of cement can be reduced up to 350kg/m3 with addition of admixture like pozzolanic materials, metakaolin, flyash, silica fume etc. With increasing in cement workability will be decreases and concrete mix will be sticky. In this experiment work, UltraTech OPC-43 cement used agreeing to Indian Standard 8112-1989. The basic tests to be done as per Indian Standard 4031-1988.

Properties of Materials	Result
Spec. gra.	3.08
Fineness	4percent
Normal-consistency	28%
Initial Setting Time of cement	90mins
Final Setting Time of cement	9 hrs 30mins

Table: Properties of cement (OPC 43)

Fig.: OPC 43 grade cement

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Silica Fume (Grade 920 D):

It is also called as Micro Silica (M.S). It is a by-product of Ferrosilicon alloy. It is collected when the smoke comes from the operation of furnace. It mainly contains raw quartz, raw coal, and raw woodchips. By using M.S, alkalisilica reaction will be reduces and it give good workability and smooth surface finishing. By name it shows that the average approximate size of the partial is 10-6. HPC is very economical as compared with nominal mix concrete. It mainly used in high-rise buildings, bridges etc. In earlier ages, concrete which gives 6000-7000psi it is to be considering as HPC. But now a days strength increases up to 15000-16000psi. It is non-crystalline type. By using silica fume in concrete it increases durability, it decreases the permiabilty of concrete and reduces the voids in concrete. It will resist the chloride attack, sulphates attack,acid attack and nitrate attacks. For this experiment M.S was collected from ELKEM'S South Asia privet limited Mumbai. Elkem's silica fume grade 920D agreeing to ASTM-C-1240. Normally it is in the form of dry. Normally Silica fumes specific gravity is 2.4 and density of silica fume is 640kg/m3.

fig.: Silica Fume

ITEM	ASTM-C124O	ACTUAL ANALYSIS
Si02	Minimum 85pecent	90.2%
L0i	Maximum 6percent	52.7%
Moisture content	Not more than 3percent	0.2%
Pozz act index	105% min	127%
Specific surface area	>15 m2/g	22 m2/g
Bulk density	550-700 kg/m3	604 kg/m3
+ 45 microns	10% max	0.2%

Table: Properties of Silica fume

The sand will be collected in local available sources. The used sand in this project belongs to the Zone-II as per Indian Standard 383-1970 codal provision. Following table shows the properties of sand.

Fig.: Sand

Now a day's concrete field using new and advanced technology's we can reduce the usage of sand in concrete that is we can use manufactured sand as fine aggregate in concrete for reducing the cost of concrete and to save the environment by pollution. The manufactured sand is waste product formed by stone quarries, granite quarries. As consumption of coarse aggregate increases the quarries will be increases. This is a waste product and it will pollute the nature. The properties of manufactured sand is nearly equal to the sand hence the usage of manufactured sand in concrete as affine aggregate we can control the pollution and disposal problem also solved. By using manufactured sand as a fine aggregate in concrete we can easily reduce cost of construction. Normally the M.S available in crystalline form with some amount of powder, hence it will effect on the strength. Therefore it is necessary for wash the powder. If M.S will set in Zone II then the properties of manufactured sand will be same as to the natural sand. We collected manufactured sand in local stone crusher Nemkal village, Ballari. The properties of M.S are given below.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Fig.: Manufacturedsand

IS-Sieve Designation	Weight Retained	% Wt. Retained	% Passing	Cumulative % Passing
4.75mm	68	0.68	93.20	6.80
2.36mm	94	0.94	83.80	16.20
1.18mm	160	1.60	67.80	32.20
600 microns	200	2.00	47.80	52.20
300 microns	240	2.40	23.80	76.20
150microns	190	1.90	4.80	95.20
Pan	48	0.48	---	---
				Sum=278.8
Fineness Modulus F.M=$\frac{\text{Total Cumulative \% Passing}}{100}=\frac{278.8}{100}$= 2.78				

Table : Sieve Analysis of M-Sand

IV. METHODOLOGY:

Standard dimensions of cubes are 10cm x l0cm x 10cm, concrete Cylinderof dimension diameter of 15cm and 30cm height and concrete prism or beam of dimensions 500mm x 100mm x 100mm were casted with three varying mix proportions of i) 0.30, ii)0.35 and iii) 0.40 and were cured form7day's and 28day's. These cured concrete cubes, cylinders and beams are tested as per IS: 516-1959. 1. Material properties of ingredients like specific gravities of cement, the fine aggregate and coarse aggregate, M-Sand, Silica-fume were determined in Concrete Lab. Moisture contents and water absorptions of F.A and C.A were also determined in concrete Lab. 2. By Absolute volume method the quantity of materials required are calculated, the detailed calculation will be shown below. 3. Six cubes, three cylinders and three beams were casted with plain concrete using normal ingredients like cement, coarse aggregate and fine aggregate and water and cured for 7 and 28 days, same for water binding ratio of 0.3, 0.353& 0.4 for better workability super plasticizer will be used. 4.

Six cubes, three cylinders and three beams were casted using concrete where cement content was partially replaced by Silica-fume by variation of 0%, 10%, 20% and 30% and sand will be replaced by M-Sand by various proportions i.e20%, 40%, 60%, 80% and 100% then cured for 7days and 28days, with differentwater binding ratios of 0.3, 0.35 & 0.4 and constant aggregate binder ratio of 2.0. 5. The concrete cubes ofsteps 3 and 4 were tested in compression testing machine and the compressive strengths of the cubes of the step 4 are compared with that of cubes of the step 3. 6. The cylinders of steps 3 and 4 were tested in tensile testing machine and the tensile strengths of the cylinders of the step 3 are compared with that of cylinders of the step 4. 7. The concrete prisms of steps 3 and 4 were tested for flexural strengths and the flexural strengths of the concrete prisms of the step 3 are compared with that of concrete prisms of the step 4. The present study deals with experimental investigations in which binding material is moderately replacing with silica fume of 10%, 20% and 30% andnormal-sand wassubstituted by M-Sand with varying proportion of 20%, 40%, 60%, 80% and 100%.

The below sample calculation of design shows the quantity required for one cubic meter of concrete for aggregate bind ratio of 2.0 and w/b ratio of O.35 and 0 % silica fume with 0% m-Sand.

A/B =	2.00	Sp.gr of Water =	1.00
W/B =	0.35	Sp.gr of Cement =	3.08
Cement =	1.00	Sp.gr of Silica fume=	2.40
Silica fume =	0.00	Sp.gr of C.A =	2.7
Natural Sand =	1.00	Sp.gr of F.A =	2.5
M-sand =	0.00	Sp.gr of M-sand =	2.6

Absolute volume of 50 kgs cement bag

$$\text{Cement} = \frac{50\times1}{\text{Sp.gr.of cement}\times1000} = \frac{50\times1}{3.08\times1000} = 0.0162\ m^3$$

$$\text{Silica fume} = \frac{50\times0}{\text{Sp.gr. of silica fume}\times1000} = \frac{50\times0}{2.4\times1000} = 00$$

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Water: $\frac{50\times0.3}{\text{Sp.gr.of water}\times1000}=\frac{50\times0.35}{1\times1000}$ = 0.0175 m³

Coarse aggregates: $\frac{50\times0.6\times2}{\text{Sp.gr. of CA}\times1000}=\frac{50\times0.6\times2}{2.7\times1000}$ = 0.0222 m³

Fine aggregates = $\frac{50\times0.4\times2}{\text{Sp.gr. of FA}\times1000}=\frac{50\times0.6\times2}{2.5\times1000}$ = 0.0160 m³

M-Sand = $\frac{50\times0}{\text{Sp.gr. of MS}\times1000}=\frac{50\times0}{2.6\times1000}$ = 00

Total Volume of concrete = 0.0162 + 0.00 + 0.0175 +0.0222 + 0.0160 + 0.00

= 0.0720 m3

Material per cubic meter (m³) of concrete:

Cement = $\frac{50\times1}{\text{Total volume}}=\frac{50\times1}{0.0720}$ = 694.869 Kg/m³

Silica fume = $\frac{50\times0}{\text{Total volume}}=\frac{50\times0}{0.0720}$ = 00

Water = $\frac{50\times0.3}{\text{Total volume}}=\frac{50\times0.35}{0.0720}$ = 243.204 lits

Coarse aggregates = $\frac{50\times0.6\times2}{\text{Total volume}}=\frac{50\times0.6\times2}{0.0720}$ = 833.843 kg/m³

Fine aggregates = $\frac{50\times0.4\times2}{\text{Total volume}}=\frac{50\times0.6\times2}{0.0720}$ = 555.895 kg/m³

M-Sand = $\frac{50\times0}{\text{Total volume}}=\frac{50\times0}{0.0720}$ =00

Sl.N0.	Materials	Abs. vol. of 50 kg cement bag (cubic m)	Material/m3 of concrete (kg)
1	Cement	0.0162	694.869
2	Silica fume	0.0000	0.000
4	Water	0.0175	243.204
5	C.A	0.0222	833.843
6	F.A	0.0160	555.895
7	M-sand	0.0000	0.000
Total volume =		0.0720	

Table : Detailed Calculation: Material per cubic meter of Concrete

Similarly mix design as to be calculated according to their proportions with 3 different water/binding that is 0.3, 0.35 &0.40 and the aggregate binding ratio 2.0 is to be kept constant for all water binding ratios. The following table shows that the material per cubic meter of concrete in kilograms.

Water/Binder = 0.30 and Silica-Fume = 0%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	719.88	754.65	762.71	835.34	882.52	935.35
SF	0.00	0.00	0.00	0.00	0.00	0.00
Water	215.96	226.39	266.95	250.60	264.76	280.60
C.A	863.86	905.58	915.25	1002.41	1059.02	1122.42
F.A	575.90	482.98	366.10	267.31	141.20	0.00
M-sand	0.00	120.74	244.07	400.96	564.81	598.62
S.P in lt (0.5%)	3.60	3.77	3.81	4.18	4.41	4.68

Table :Water/Binder = 0.3 & S.F = 0%

Water/Binder = 0.30 and Silica-Fume = 10%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	643.63	674.50	708.48	746.07	787.87	834.63
SF	71.51	74.94	78.72	82.90	87.54	92.74
Water	214.54	224.83	236.16	248.69	262.62	278.21
C.A	858.17	899.34	944.64	994.76	1050.49	1112.84
F.A	572.12	479.65	377.86	265.27	140.07	0.00
M-sand	0.00	119.91	251.91	397.90	560.26	741.90
S.P in lt (0.5%)	3.58	3.75	3.94	4.14	4.38	4.64

Table :Water/Binder =0.3 & Micro Silica = 10%

Water/Binder = 0.30 and Silica-Fume = 20%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	568.38	595.45	625.24	658.16	694.74	735.62
SF	142.09	148.86	156.31	164.54	173.68	183.90
Water	213.14	223.29	234.46	246.81	260.53	275.86
C.A	852.56	893.18	937.85	987.23	1042.10	1103.43
F.A	568.38	476.36	375.14	263.26	138.95	0.00
M-sand	0.00	119.09	250.09	394.89	555.79	735.62
S.P in lt (0.75%)	5.33	5.58	5.86	6.17	6.51	6.90

Table :Water/Binder =0.3 & Micro Silica = 20%

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Water/Binder = 0.30 and Silica-Fume = 30%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	494.10	517.48	543.18	571.56	603.08	638.27
SF	211.76	221.78	232.79	244.95	258.46	273.54
Water	211.76	221.78	232.79	244.95	258.46	273.54
C.A	847.03	887.10	931.16	979.82	1033.84	1094.17
F.A	564.69	473.12	372.46	261.28	137.85	0.00
M-sand	0.00	118.28	248.31	391.93	551.38	729.45
S.P in lt (0.9%)	6.35	6.65	6.98	7.35	7.75	8.21

Table :Water/Binder = 0.3 &Micro Silica =30%

Water/Binder = 0.35 & Micro Silica=0%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	694.87	727.21	762.71	801.85	845.22	893.56
SF	0.00	0.00	0.00	0.00	0.00	0.00
Water	243.20	254.52	266.95	280.65	295.83	312.75
C.A	833.84	872.65	915.25	962.22	1014.27	1072.27
F.A	555.90	465.41	366.10	256.59	135.24	0.00
M-sand	0.00	116.35	244.07	384.89	540.94	571.88
S.P(0.4)	2.78	2.91	3.05	3.21	3.38	3.57

Table :Water/Binder=0.35 & Micro Silica=0%

Water/Binder=0.35 &Micro Silica=10%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	621.41	650.14	681.65	716.38	754.83	797.65
SF	69.05	72.24	75.74	79.60	83.87	88.63
Water	241.66	252.83	265.09	278.59	293.55	310.20
C.A	828.55	866.85	908.87	955.17	1006.44	1063.53
F.A	552.36	462.32	363.55	254.71	134.19	0.00
M-sand	0.00	115.58	242.37	382.07	536.77	709.02
S.P (1%)	2.76	2.89	3.03	3.18	3.35	3.55

Table :Water/Binder=0.35 & Micro Silica=10%

Water/Binder=0.35 &Micro Silica=20%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	548.88	574.09	601.72	632.15	665.82	703.29
SF	137.22	143.52	150.43	158.04	166.46	175.82
Water	240.13	251.16	263.25	276.57	291.30	307.69
C.A	823.32	861.13	902.58	948.23	998.74	1054.93
F.A	548.88	459.27	361.03	252.86	133.16	0.00
M-sand	0.00	114.82	240.69	379.29	532.66	703.29
S.P (1.9%)	2.74	2.87	3.01	3.16	3.33	3.52

Table :Water/Binder=0.35 & Micro Silica=20%

Water/Binder=0.35 &Micro Silica=30%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	477.26	499.03	522.89	549.14	578.17	610.44
SF	204.54	213.87	224.10	235.35	247.79	261.62
Water	238.63	249.52	261.44	274.57	289.08	305.22
C.A	818.15	855.48	896.38	941.39	991.15	1046.47
F.A	545.44	456.26	358.55	251.04	132.15	0.00
M-sand	0.00	114.06	239.03	376.55	528.61	697.64
S.P (2.3)	2.73	2.85	2.99	3.14	3.30	3.49

Water/Binder=0.35 & Micro Silica=30%

Water/Binder=0.40 & Micro Silica=0%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	671.54	701.70	734.69	770.94	810.95	855.34
SF	0.00	0.00	0.00	0.00	0.00	0.00
Water	268.62	280.68	293.88	308.38	324.38	342.14
C.A	805.85	842.03	881.63	925.13	973.14	1026.41
F.A	537.23	449.09	352.65	246.70	129.75	0.00
M-sand	0.00	112.27	235.10	370.05	519.01	547.42
S.P (0.35)	2.69	2.81	2.94	3.08	3.24	3.42

Water/Binder = 0.40 & Micro Silica=0%

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Water/Binder=0.40 &Micro Silica=10%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	600.67	627.48	656.78	688.96	724.45	763.80
SF	66.74	69.72	72.98	76.55	80.49	84.87
Water	266.97	278.88	291.90	306.20	321.98	339.47
C.A	800.90	836.63	875.71	918.61	965.94	1018.40
F.A	533.93	446.20	350.28	244.96	128.79	0.00
M-sand	0.00	111.55	233.52	367.44	515.17	678.93
S.P (0.9%)	2.67	2.79	2.92	3.06	3.22	3.39

Water/Binder=0.40 & Micro Silica=10%

Water/Binder= 0.40 &Micro Silica=20%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	530.67	554.20	579.91	608.13	639.22	673.67
SF	132.67	138.55	144.98	152.03	159.81	168.42
Water	265.34	277.10	289.96	304.06	319.61	336.84
C.A	796.01	831.30	869.87	912.19	958.84	1010.51
F.A	530.67	443.36	347.95	243.25	127.84	0.00
M-sand	0.00	110.84	231.97	364.88	511.38	673.67
S.P(1.3)	2.65	2.77	2.90	3.04	3.20	3.37

Water/Binder=0.4&Micro Silica=20%

Water/Binder=0.40 &Micro Silica=30%						
M-sand	0%	20%	40%	60%	80%	100%
Cement	461.52	481.86	504.06	528.41	555.24	584.93
SF	197.80	206.51	216.03	226.46	237.96	250.69
Water	263.73	275.35	288.04	301.95	317.28	334.25
C.A	791.18	826.04	864.11	905.85	951.84	1002.74
F.A	527.45	440.55	345.64	241.56	126.91	0.00
M-sand	0.00	110.14	230.43	362.34	507.65	668.50
S.P(1.5)	2.64	2.75	2.88	3.02	3.17	3.34

Water/Binder=0.40 & Micro Silica=30%

IV. RESULTS AND DISCUSSION

Testing on Fresh concrete:Slump Test:

The experiment is carried out to know the workability of the concrete. The dimensions of the slump cone is 300mm height, 100mm dia at top and 200mm dia at bottom side.

Fill the concrete in funnel in 3 layers by using standard 16mm size diameter tamping rod. Then slowly lift the funnel vertically above and measure the slump using scale.

Fig. : Slump Cone Test

% of M S	% of S.F			
	0	10	20	30
0	80	90	75	85
20	70	70	70	80
40	75	85	60	90
60	85	90	65	80
80	80	80	80	80
100	80	60	80	75
SP %	0.50	1.2	1.7	2.1

Table : Slump Value and % of SP for W/B = 0.30

% of M S	% of S.F			
	0	10	20	30
0	60	60	30	40
20	70	90	30	30
40	50	70	40	50
60	70	70	50	30
80	90	60	30	40
100	80	65	40	30
SP %	0.5	0.9	1.5	1.9

Table : Slump Value and % of SP for W/B = 0.35

% of M S	% of S.F			
	0	10	20	30
0	60	70	40	20
20	90	80	40	30
40	70	75	30	30
60	70	70	40	50
80	80	70	30	30
100	70	80	30	40
SP %	0.4	0.8	1.35	1.7

Table : Slump Value and % of SP for W/B = 0.40

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Strength tests (Harden Concrete):

After 7 days and 28 days the cube, cylinder and prisms removed from the curing tank, allow for dry. Testing will be done as per IS 516-1959, the tests are, Compressive strength: This test will be done using 100mm*100mm*100mm cubes.

$$\text{Compressive strength} = \frac{\text{Load (p)}}{\text{Area (A)}} \text{ X1000}$$

Where, P =Applied Load in N

A = Area of cubes = 100X100 mm2

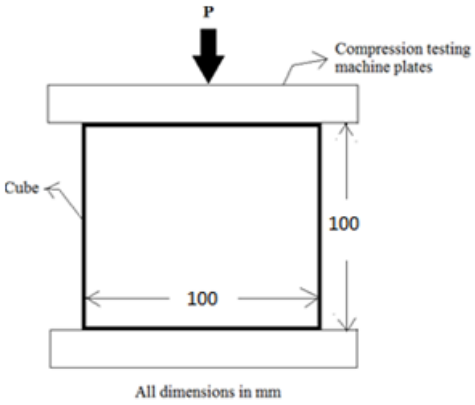

Fig: Compressive test on cube

0% of Silica-Fume		7 days Compressive strength in Mpa			28 days compressive strength in Mpa		
W/B Ratio		0.3	0.35	0.40	0.30	0.35	0.40
Sand	M.Sand						
100%	0%	44.22	43.11	41.55	53.55	52.44	50.72
80%	20%	45.33	43.77	42.06	55.26	53.55	52.33
60%	40%	47.11	45.66	43.17	58.55	57.07	54.11
40%	60%	50.66	47.36	45.24	59.88	58.44	57.66
20%	80%	47.33	45.22	43.72	57.42	56.42	54.43
0%	100%	45.11	43.88	42.24	54.36	53.17	52.11
10% of SF		7 days Cubes strength in Mpa			28days cubes strength in Mpa		
W/B Ratio		0.3	0.35	0.40	0.30	0.35	0.40
Sand	M.Sand						
100%	0%	50.44	49.11	46.72	59.33	56.62	53.17
80%	20%	52.36	50.32	48.66	61.11	58.11	55.68
60%	40%	55.33	52.11	49.88	63.78	61.14	57.88
40%	60%	58.67	54.88	52.04	66.82	63.92	60.18
20%	80%	55.04	52.33	50.77	63.55	60.04	57.11
0%	100%	51.55	50.62	47.44	60.24	57.06	54.55
20% of SF		7 days cube strength in Mpa			28 days cube strength in Mpa		
W/B Ratio		0.3	0.35	0.40	0.30	0.35	0.40
Sand	M.Sand						
100%	0%	42.44	40.88	38.22	50.77	48.24	47.05
80%	20%	43.77	41.22	39.77	52.92	50.33	48.14
60%	40%	45.33	43.55	41.44	55.06	52.76	51.04
40%	60%	48.11	45.66	43.77	57.62	55.06	52.55
20%	80%	45.77	43.02	40.88	54.84	51.92	50.33
0%	100%	42.88	40.92	39.44	51.33	48.66	48.02
30% of SF		7 days cube strength in Mpa			28 days cube strength in Mpa		
W/C		0.3	0.35	0.40	0.30	0.35	0.40
Sand	M.Sand						
100%	0%	40.22	39.06	36.47	46.56	44.32	41.88
80%	20%	42.64	40.11	37.55	47.92	46.27	43.11
60%	40%	43.92	42.06	39.77	50.36	49.06	45.66
40%	60%	45.77	43.77	41.88	53.44	52.22	49.17
20%	80%	43.82	42.04	40.66	51.11	49.44	46.77
0%	100%	41.36	40.62	37.33	47.66	45.24	42.08

Table: Compression Strength of concrete cubes contains Silica fumeof 0%, 10%, 20% and 30% With M-Sand.

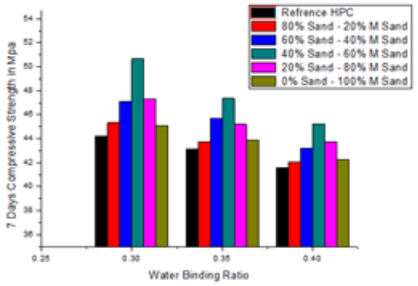

Chart 1: 7 Days Compression Strength of HPC containing 0% Silica fume with 0%, 20%, 40%, 60%, 80% of sand and 100%, 80%, 60%, 40%, 20%, 0% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

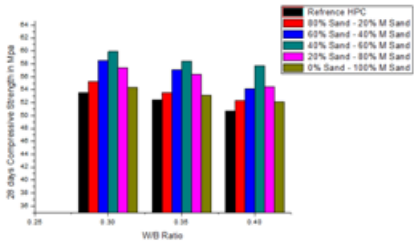

Chart 2:28 Days Compression Strength of HPC containing 0% Silica fume with 0%, 20%, 40%, 60%, 80% of sand and 100%, 80%, 60%, 40%, 20%, 0% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

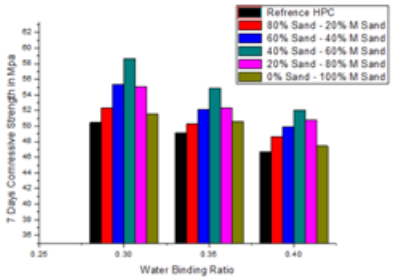

Chart 3:7 Days Compression Strength of HPC containing 10% Silica fume with 0%, 20%, 40%, 60%, 80%, 100% of sand and 0%, 20%, 40%, 60%, 80%, 100% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

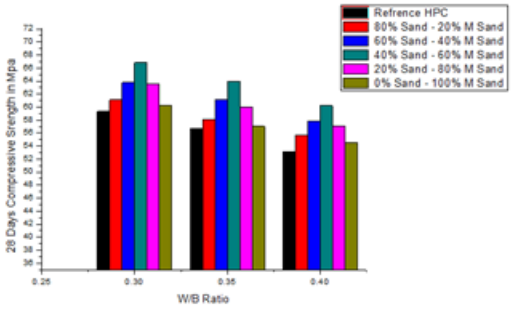

Chart 4:28 Days Compression Strength of HPC containing 10% Silica fume with 0%, 20%, 40%, 60%, 80%, 100% of sand and 0%, 20%, 40%, 60%, 80%,100% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

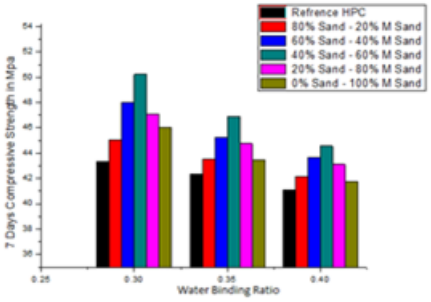

Chart 5:7 DaysCompression Strength of HPC containing 20% Silica fume with 0%, 20%, 40%, 60%,80%, 100% of sand and 0%, 20%, 40%, 60%, 80%, 100% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

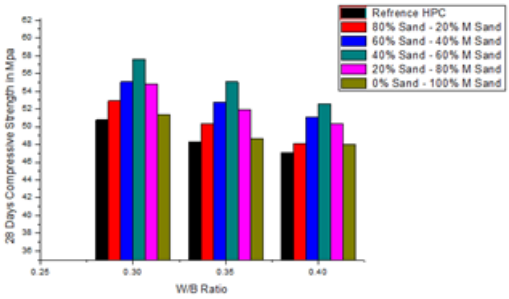

Chart 6:28 Days Compression Strength of HPC containing 20% Silica fume with 0%, 20%, 40%, 60%, 80%, 100% of sand and 0%, 20%, 40%, 60%, 80%, 100% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

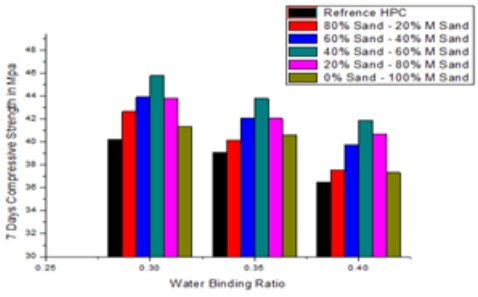

Chart 7:7 Days Compression Strength of HPC containing 30% Silica fume with 0%, 20%, 40%, 60%, 80%, 100% of sand and 0%, 20%, 40%, 60%, 80%, 100% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

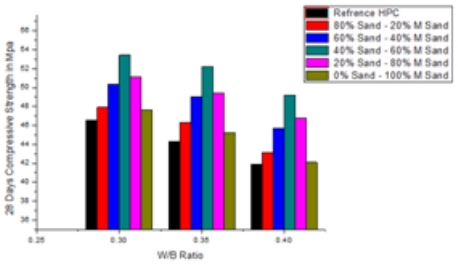

Chart 8:28 Days Compression Strength of HPC containing 30% Silica fume with 0%, 20%, 40%, 60%, 80%, 100% of sand and 0%, 20%, 40%, 60%, 80%, 100% of M.Sand with 0.30, 0.35, 0.40 water Binding ratio.

V.CONCLUSION AND FUTURE WORK:

Following conclusions can be made on studies conducted on the Experimental investigation on strength properties of concrete replacing natural sand by m-sand using silica fume as an admixture

1. The compressive strength increases with increase in percent in percentage of M-Sand. It is observed at 60% the strength is maximum. Further increase in M-Sand percentage, the strength decreases.

2. It is observed that we can use up to 60% of M-Sand in place of river sand which increases 14.57% of compression strength for 7 days and 11.28% of compression strength for 28 days when compared with nominal HPC.

3. Based on the observation we can use upto 10% of Silica Fume in place of Cement which increases 14.06% of compression strength for 7 days and 10.80% of compression strength for 28 days when compared with nominal HPC.

4. Mix with 60% M-sand and 10% Silica fume gives maximum compression strength for water binding ratio of 0.30 i.e. 24.08% and 24.78% higher compression strength than the nominal HPC for 7 days and 28 days respectively.

5. The strength of HPC increases with increase in percentage of silica fume. At 10% the value observed are maximum. Further increase in silica fume decreases the strength.

6. As water binding ratio increases the compression strength of concrete goes on deceases. From this experiment we got maximum results for 0.30 water binding ratio.

7. As increasing in silica fume content consumption of water will be more as compared to the nominal HPC.

8. The split tensile strength obtained at 60% replace of sand with M-Sand which increases 12.25% of Split tensile strength for 7 days and 10.12% of Split tensile strength for 28 days when compared with nominal HPC.

9. The split tensile strength obtained at 10% replace of cement with silica fume which increases 6.73% of Split tensile strength for 7 days and 7.85% of Split tensile strength for 28 days when compared with nominal HPC.

10. The split tensile strength obtained for the mix of 60% M-sand and 10% Silica fume gives maximum Split tensile strength for water binding ratio of 0.30 i.e. 19.47% and 22.10% higher Split tensile strength than the nominal HPC for 7 days and 28 days respectively.

11. The flexural strength obtained at 60% replace of sand with m-Sand which increases 13.93% of Flexural strength for 7 days and 10.07% of Flexural strength for 28 days when compared with nominal HPC.

12.Based on the observation we can use up to 10% of Silica Fume in place of Cement which increases 9.09% of Flexural strength for 7 days and 8.25% of Flexural strength for 28 days when compared with nominal HPC.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

13. The flexural strength obtained for the mix of 60% M-sand and 10% Silica fume gives maximum Flexural strength for water binding ratio of 0.30 i.e. 18.91% and 16.51% higher Flexural strength than the nominal HPC for 7 days and 28 days respectively.

REFERENCES:

1. Mehta, P. K. (1983). Mechanisms of Sulphate Attack on Portland cement Concrete- Another Look. Cement and Concrete Research, 13(3), 401-406.

2. Joseph Davidovits (1987), "Ancient and modern concretes: What is the real difference?" Concrete International, pp.23-28.

3. Davidovits, J. (1994b). Properties of Geopolymer Cements. In Kiev (Ed.), First International Conference on Alkaline Cements and Concretes (pp. 131-149). Kiev, Ukraine: Kiev State Technical University.

4. Davidovits, J. (1988b). Geopolymer Chemistry and Properties. Paper presented at the Geopolymer '88, First European Conference on Soft Mineralogy, Compiegne, France.

5. Davidovits, J. (2005). Green-Chemistry and Sustainable Development Granted and False Ideas About Geopolymer-Concrete. Paper presented at the International Workshop on Geopolymers and Geopolymer Concrete (GGC), Perth, Australia.

6. Rangan, B. V., Hardjito, D., Wallah, S. E., & Sumajouw, D. M. J. (2005a). Fly ash based geopolymer concrete: a construction material for sustainable development. Concrete in Australia, 31, 25-30.

7. Xu, H., & Deventer, J. S. J. V. (2000). The geopolymerisation of alumino-silicate minerals. International Journal of Mineral Processing, 59(3), 247-266.

8. Davidovits, J. (1999, 30 June - 2 July 1999). Chemistry of Geopolymeric Systems, Terminology. Paper presented at the Geopolymere '99 International Conference, Saint-Quentin, France.

9. Davidovits, J. (1988c). Geopolymers of the First Generation: SILIFACE-Process. Paper presented at the Geopolymer '88, First European Conference on Soft Mineralogy, Compiegne, France.

10. Davidovits, J. (1988d). Geopolymeric Reactions in Archaeological Cements and in Modern Blended cements . Paper presented at the Geopolymer '88, First European Conference on Soft Mineralogy, Compiegne, France

11.Joseph Davidovits (1978), "Ancient and modern concretes: What is the real difference?" Concrete International, pp.23-28.

12. Joseph Davidovits, (1991). Geopolymers: Inorganic Polymeric New Materials. Journal of Thermal Analysis, 37, 1633-1656.

13. M.S Shetty (1982), "Concrete technology theory and practice" page.no 599, S.Chand & company ltd

14. J. Davidovits, "Geopolymers: Inorganic Polymeric New Materials", J. Therm. Anal., Vol. 37, 1633-1656, 1991.

15. Haradjito, D.,Wallah, S.E., Sumajiouw, D.M.J and Rangan, B.V. (2004a), Prpperties of Geopölymerconcrete with fly ash as source material : Effect of mixture composition. Seventh CANMET / ACI Int. Conf. on Recent Advances in Concrete Technology. May 26-29th 2004 : 1-10.

16. Haradjito, D.,Wallah, S.E., Sumajiouw, D.M.J and Rangan, B.V. (2004b) Fly ash based Geopölymer concrete material for sustainable development. Invited Paper for Concrete World Conf. ACI India chapter Mumbai. Dec 2004.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

17. Hardjito.D, Wallah, S.E, Sumajouw, D.M.J. and Rangan, B.V. "On the development of fly ash based Geopolymer concrete". ACI Materials Journal – Nov-Dec (2004c) Title no 101-MT, pp 457-472.

18. J.Davidovits and M. Davidovics (1988) "Geopolymer room temperature ceramic matrix for composites", Ceram. Eng. Sci. Proc. 9, 842-853.

19. A. Palomo, A. Macias, M. T. Blanco and F. Puertas (1992) Physical, chemical and mechanical characterization of geopolymers, Proc of the 9th Internatl Congress on the Chem of Cem, 505-511.

20. Davidovits, J. "High – Alkali Cements for 21st Century Concretes". Concrete Technology, Past, Present and future, Proceedings, V. Mohan Malhotra Symposium, 1994. Editor: P.Kumar Mehta ,ACI SP – 144. P. 383-397.