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Research Article

Strength of Concrete by Partially Replacing the Fine aggregate using M-Sand

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Abstract: Cement concrete is the most extensively used material for construction of different types of structures components such as buildings, bridges and shell roofs and also for precast products such as pipes, poles, sleepers, ect. Concrete is defined as any solid mass made with the use of a cementing medium; the ingredients generally comprise sand, gravel, cement and water. Concrete has been in use as a building material for more than two hundred years. Its success and popularity may be largely attributed to (i) durability under hostile environments (including resistance to water), (ii) ease with which it can be cast into a variety of shapes and sizes, and (iii) its relative economy and easy availability. Super plasticizers in concrete confer some beneficial effects such as acceleration, retardation, air entrainment, water reduction, plasticity ect., M-sand is as fine aggregate partially. Cost vice M-sand is better than normal river sand. In this present experimental investigation M_{25} concrete is used as control mix with M-sand and super plasticizer and glass fiber in various percentages. Strength of modified concrete is compared with normal concrete. The results show that the significant improvement in the strength and workability of modified concrete.
K**eywords:** M-sand, compressive strength, replacement, glass fibers, strength & testing of concrete, Super plasticizer

INTRODUCTION

Concrete is a building material composed of cement, sand as fine aggregate, crushed rock as coarse aggregate and water. High Performance Concrete (HPC) is defined as a concrete meeting special combination of performance and uniform characteristics that cannot always be achieved routinely using conventional constitutions, and normal mixing, placing and curing practices [1-2]. At an early stage of development in the 1980s, the High-Performance Concrete (HPC) was regarded as a concrete that had many advantages engineering properties such as high strength, high modulus of elasticity, high workability, low permeability, etc., Now a days, Normal River sand is the main demand in construction field. In this experimental investigation M-sand is partially replaced as fine aggregate with normal river sand. M-sand is better than river sand in cost. It comes from the crushed stone, so we can get that easily. Super plasticizer also used to improve one or more aspects of concrete performance. More samples were prepared and tested for compressive strength.

Mix Proportions and Samples Preparation:

The concrete mix is designed as per IS 10262-1982, IS 456-2000 and SP 23[3-6]. Standard cast iron moulds of size 150x150x150mm are used in the preparation of cubes. The moulds have been cleaned to remove dust particles and applied with mineral oil on all sides before the concrete is poured into the mould. Glass fiber 25g is added with the concrete mixture. The super plasticizer is mixed with the constituents of concrete at the time of adding water. Thoroughly mixed concrete is filled into the mould and compacted in three equal layers. Excess concrete is removed with trowel after proper compaction and top surface is smoothened. Overdose may also cause increase in air entrainment, which will tend to reduce the strength of the mix. After casting, the specimens are stored in the laboratory with room temperature for 24 hours from the time to addition of water to the ingredients. After this period, the specimens are removed from the moulds, immediately submerged in the clean and fresh water tank. The specimens are cured for 28 days. Samples were tested for 7, 14 and 28 days compressive strength. Ultra sonic Pulse Velocity test was taken in 7 days.

Properties of Materials:

Cement: The Ordinary Portland Cement (OPC) conforming to IS 8112 is used in this experiment.

Aggregates: The aggregate consists of both fine and coarse components. The Locally available river sand from karur, India, and the M-sand from manakadavu, Tirupur district, was used as fine aggregate in the concrete design mix. The basic tests for fine aggregates such as specific gravity, water absorption and fineness modulus were

found. The grain size distribution curve for normal river sand and M-sand.

The coarse aggregate used in the experimental investigation is a mixture of 20mm size aggregates. The aggregates are angular in shape and free from dust. The basic tests for coarse aggregates such as specific gravity, water absorption and fineness modulus were found. The results of sieve analysis of coarse aggregate are shown in **Table-2.**

Water: Water should be free from sewage, oil, acid, strong alkalis or vegetable matter, clay and loam. The water used in the concrete is potable (referred from IS 456-2000) and is satisfactory to use. Water sample collected from bore well.

Table 1: **properties of water**

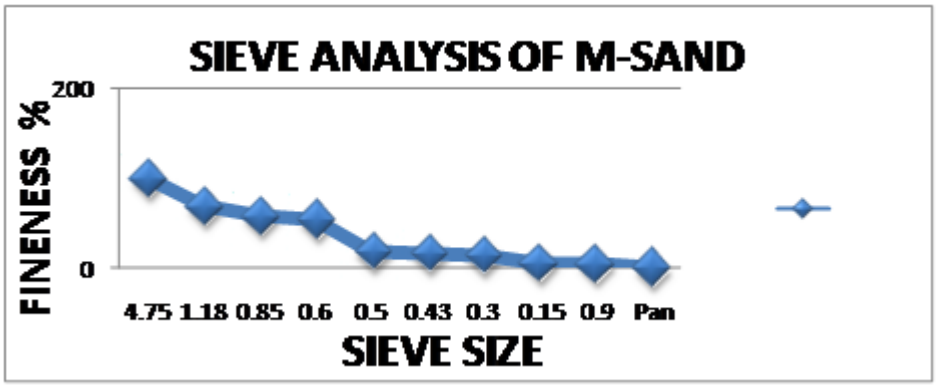
S.NO	PARAMETER	RESULTS	LIMITS AS PER IS 456-2000
1	pH	6.8	6.5-8.5
2	Chlorides(mg/l)	50	2000(PCC) 500(RCC)
3	Alkalinity(mg/l)	9	<25
4	Organic solids(mg/l)	52	200
5	Inorganic solids(mg/l)	126	3000

Super Plasticizer: Super Plasticizers are the most recognized category of water reducing admixtures having a remarkable plastering action on concrete and produce substantial enhancements in workability. A super plasticizer is a material other then water, aggregates and cement used as an ingredient of concrete and added immediately before or during the mixing. Super plasticizers are used where a delay in transportation or placing is required, or when high ambient temperatures cause rapid slump loss. It facilitates production of high quality concrete. The super plasticizers enable quicker placing and compaction of concrete. They also minimize the risk of segregation and bleeding; thus aids pumping of concrete.

Table 2: **Fineness of M-Sand Which Retained In the Sieve**

SIEVE SIZE	PERCENTAGE OF FINENESS
4.75mm	100
1.18mm	68.5
0.85 mm	57.5
0.60 mm	53.3
0.50 mm	18.3
0.43 mm	16.3
0.30 mm	14.3
0.15 mm	5.3
0.90 mm	4.3
Pan	0

Chart 1: Fineness of M-Sand Which Retained In the Sieve



Mix design:

Table 3: **Mix Design for Replacement of F.A, C.A and Silica Fume**

S No	Mix ID	Mix ratio	Replacement of SF	Cement Kg/m^3	F.A Kg/m^3	C.A Kg/m^3	Water (lit)	S.P (ml)	Glass fiber (gm)
1	Normal	25	0	20	12	18	10	25	250
2	M-Sand	25	6	20	12	18	10	25	250
3	M-San	25	6	20	12	18	10	25	250

Objectives:

The specific objectives of the present investigations are as listed below.

- To obtain a mix proportion for M_{25} concrete using M-Sand and to quantify the optimum usage of M-Sand.
- To introduce Glass fibers in percentages and to quantify the optimum usage of Glass fibers in replacement to cement.
- To study the combined effect of using Glass fibers and M-Sand in such concretes.

Experimental procedure:

The present investigations are aimed to study the properties of Concrete where in the river sand is replaced in percentages of M-Sand .The properties of the materials for producing the concrete with the properties of fresh concrete such as the Compressive strength of concrete has been evaluated at different stages of the work [7].

The specimen of standard cube of (150mm x 150mm x 150mm) was used to determine the compressive strength of concrete. Three specimens were tested for 7, 14 & 28 days with each proportion of M-sand replacement. The constituents were weighed and the materials were mixed by hand mixing. The mixes were compacted using vibrating needle. The specimens were remolded after 24 h, cured in water for 7,14 & 28 days, and then tested for its compressive as per Indian Standards.

Results and discussion:

Compressive strength of concrete:

The test was carried out conforming to IS 516-1959 to obtain compressive strength of concrete at the age of 7, 14 and 28 days. The cubes were tested using Compression Testing Machine (CTM) of capacity 200KN. The results of conventional concrete and concrete with M-Sand are presented in tables and figures below

Table 4: Compressive strength of 7 – days for normal and M-Sand concrete

Sample. No	Load at failure in conventional concrete	Compressive strength in 7 days (N/mm^2)	Loads at failure in addition of M-sand and SNP	Compressive strength in 7 days (N/mm^2)
1.	310	13.77	450	20
2.	295	13.11	445	19.77
3.	300	13.33	460	20.44
	AVG	13.40	**AVG**	20.07

Chart 2: Compressive strength of 7 – days for normal and M-Sand concrete

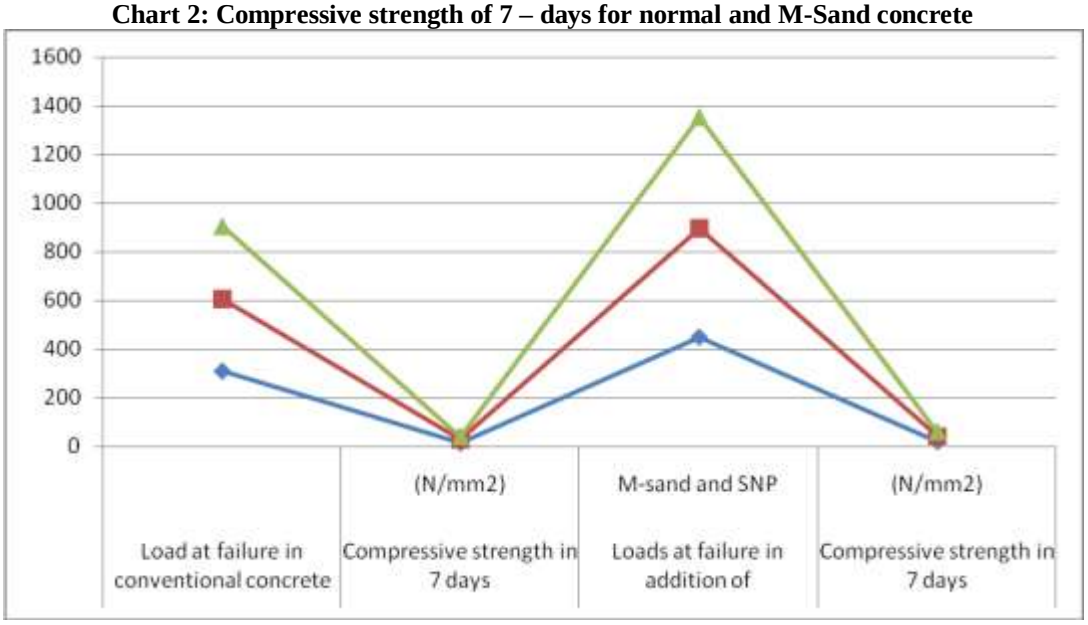


Table 5: Compressive strength of 14– days for normal and M-Sand concrete

S.NO	Load at failure in conventional concrete	Compressive strength in 14 days (N/mm^2)	Loads at failure in addition of M-sand and SNP	Compressive strength in 14 days (N/mm^2)
1.	420	18.66	540	24
2.	470	20.88	590	26.22
3.	490	21.77	610	27.11
	AVG	**20.43**	**AVG**	**25.78**

Chart 3: Compressive strength of 14 – days for normal and M-Sand concrete

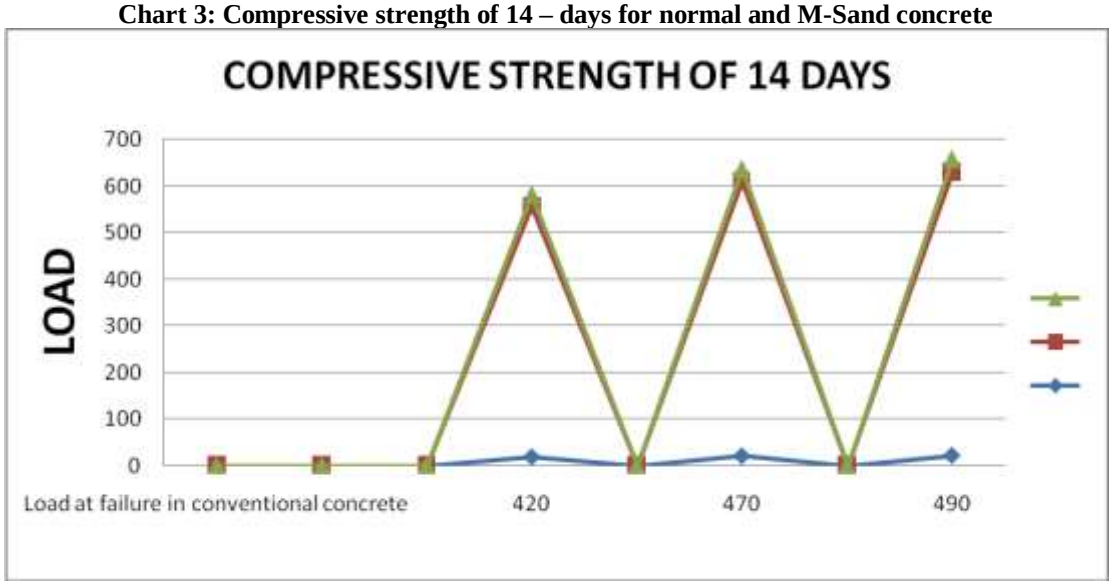


Table 6: Compressive strength for normal and M-Sand concrete at 28 – days

Sample. No	Load at failure in conventional concrete (KN)	Compressive strength in 28 days (N/mm^2)	Loads at failure in addition of M-sand and SNP (KN)	Compressive strength in 28 days (N/mm^2)
1.	600	26.66	685	30.44
2.	535	23.77	630	28
3.	585	26	655	29.11
	AVG	25.48	AVG	29.18

Chart 4: Compressive strength for normal and M-Sand concrete

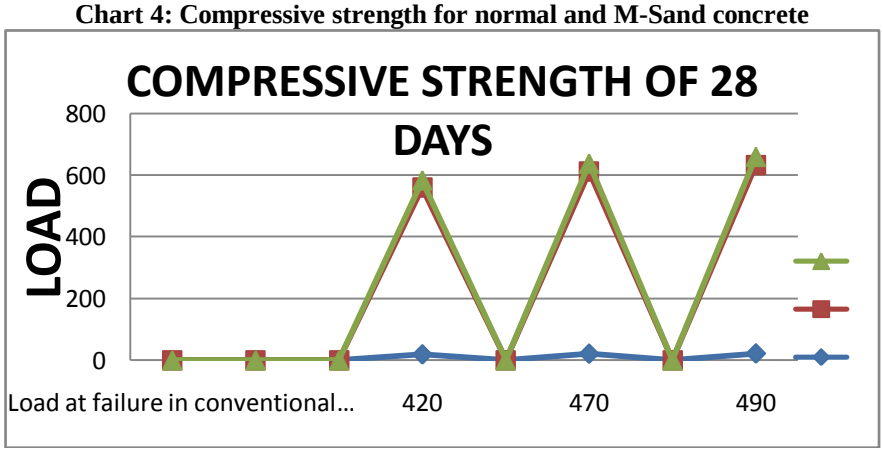


Table 7: M-Sand Concrete 7- Days

Sample. No	Loads at failure in addition of M-sand and SNP (KN)	Compressive strength in 7 days (N/mm^2)
1.	450	20
2.	445	19.77
3.	460	20.44
	AVG	20.07

Chart 5: M-Sand Concrete 7- Days

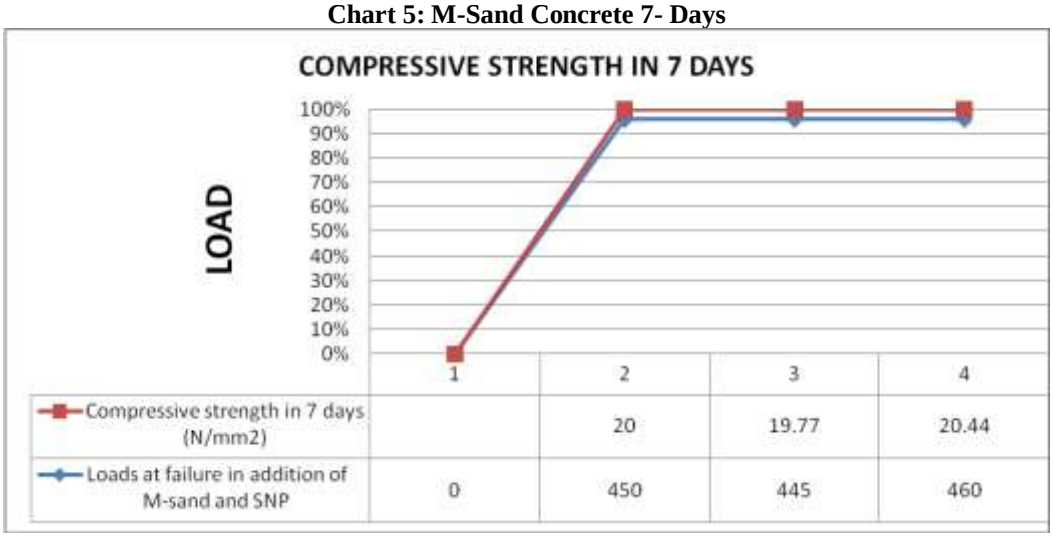


Table 8: Normal Concrete 7- Days

Sample. No	Load at failure in conventional concrete	Compressive strength in 7 days (N/mm^2)
1.	310	13.77
2.	295	13.11
3.	300	13.33
	AVG	13.40

Chart 6: Normal Concrete 7- Days

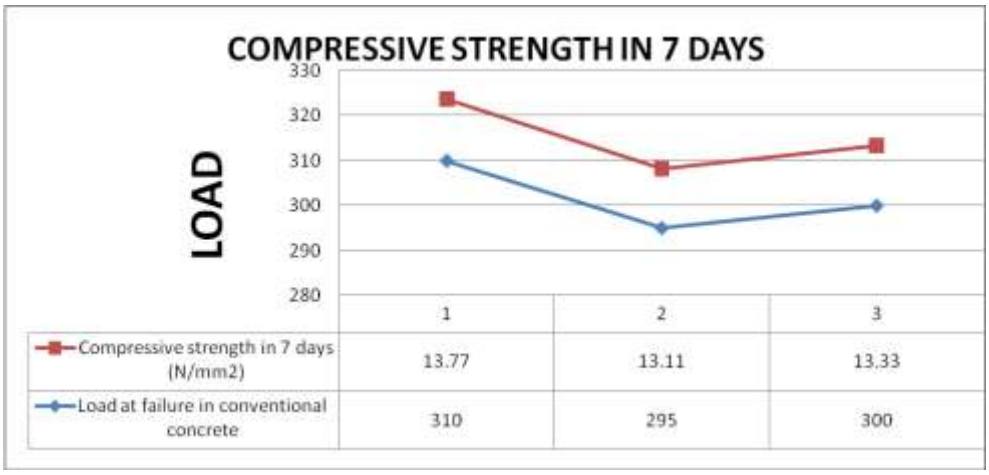


Table 9: M-Sand Concrete 14 – Days

Sample. No	Load at failure in conventional concrete (KN)	Compressive strength in 14 days (N/mm^2)
1.	420	18.66
2.	470	20.88
3.	490	21.77
	AVG	**20.43**

Chart 7: M-Sand Concrete 14 – Days

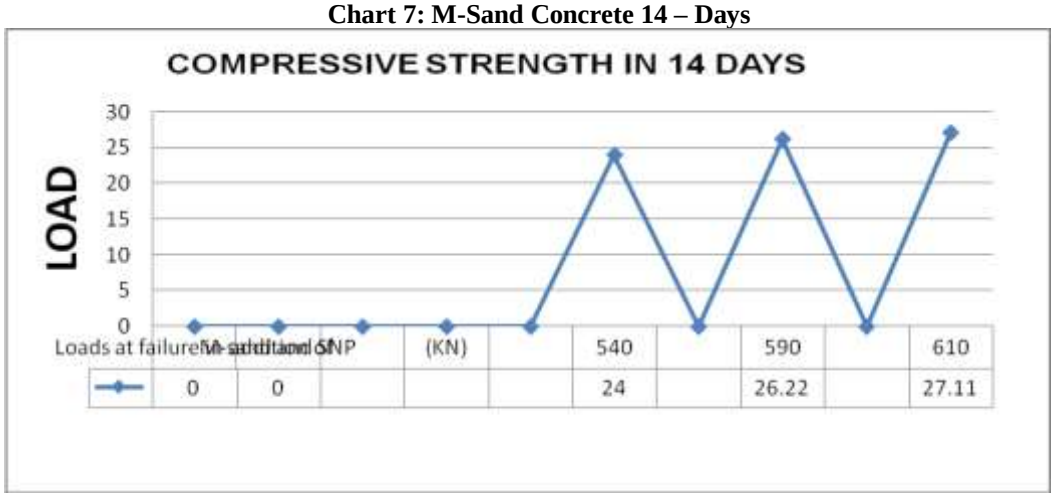


Table 10: NORMAL CONCRETE 14 – DAYS

Sample. No	Load at failure in conventional concrete (KN)	Compressive strength in 14 days (N/mm^2)
1.	420	18.66
2.	470	20.88
3.	490	21.77
	AVG	**20.43**

Chart 8: Normal Concrete 14 – Days

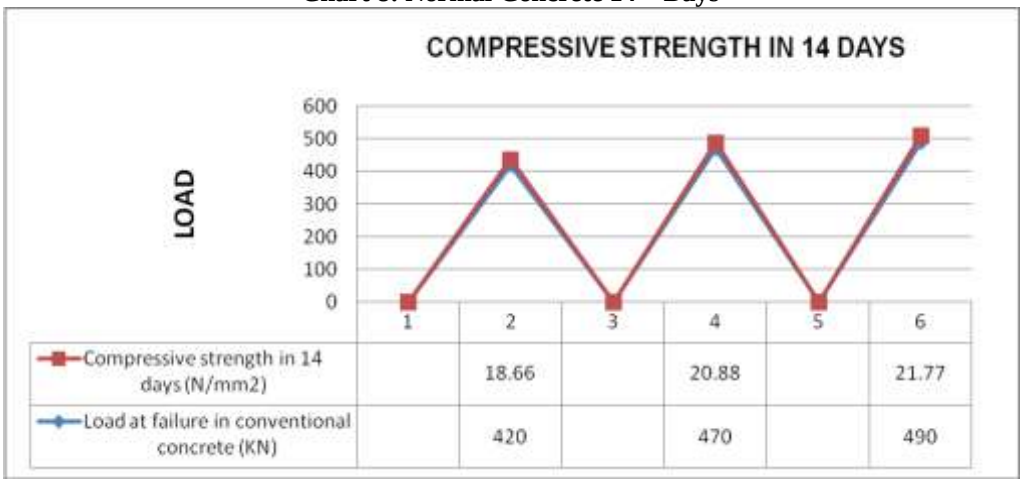


Table11: M-Sand Concrete 14 – Days

Sample. No	Loads at failure in addition of M-sand and SNP (KN)	Compressive strength in 14 days (N/mm^2)
1.	540	24
2.	590	26.22
3.	610	27.11
	AVG	**25.78**

CHART 9: M-Sand Concrete 14 – Days

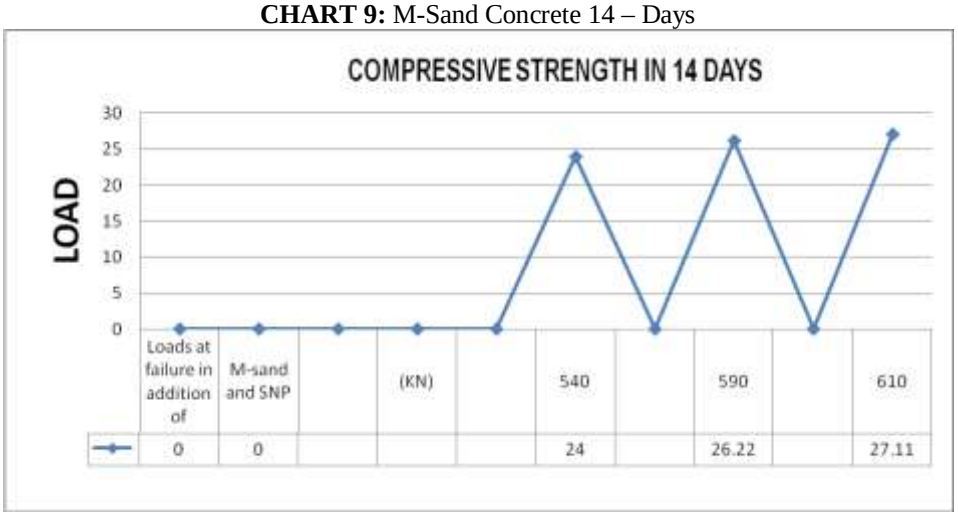


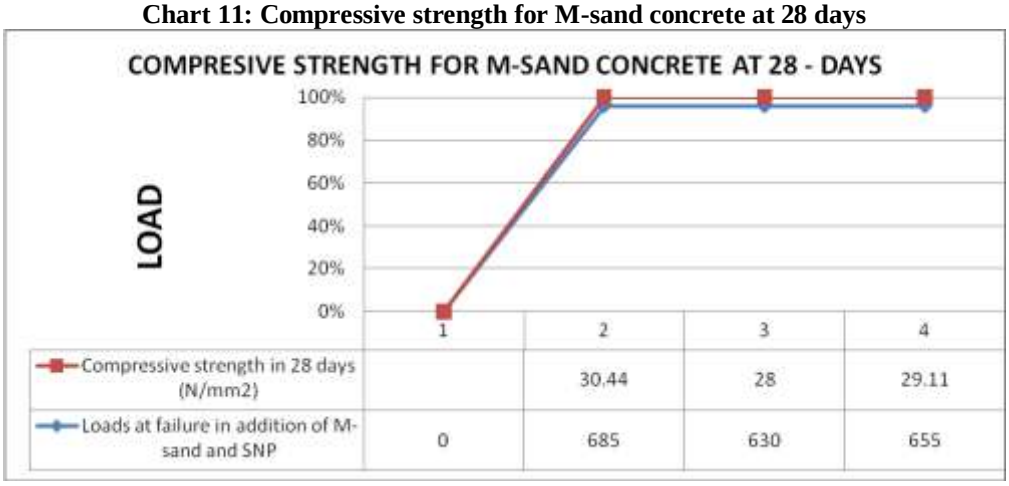
Table 13: Compressive strength for m-sand concrete at 28 days

Sample. No	Load at failure in conventional concrete (KN)	Compressive strength in 28 days (N/mm^2)
1.	600	26.66
2.	535	23.77
3.	585	26
	AVG	25.48

Table 14: Compressive strength for normal at 28 days

Sample. No	Loads at failure in addition of M-sand and SNP (KN)	Compressive strength in 28 days (N/mm^2)
1.	685	30.44
2.	630	28
3.	655	29.11
	AVG	29.18

Chart 11: Compressive strength for M-sand concrete at 28 days



The materials used in this study satisfied the standard requirements. Test results of M-Sand were Satisfactory. Comparison of the test result of standard conventional concrete cubes and concrete cast using M Sand and glass fibers indicated that the strength is increased in M-sand concrete.

Conclusions:

Following are the conclusions derived from the study,

- M Sand is satisfying the requirements of fine aggregate such as strength, gradation, shape, Angularity etc.
- M-Sand can be produced to fall in the desired Zone according to our requirement. This can definitely ensure the quality of concrete.
- Compressive strength obtained for conventional concrete cubes and concrete cast using M Sand and glass fibers indicates that the strength properties of M Sand are adequate.
- The dwindling sources of natural sand and its high cost could encourage the adoption of M-sand by 50% replacement of natural sand.

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