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Influence of M-Sand for Self-Healing Concrete

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Abstract – The concrete is heavily used as construction material in modern society. With the growth in urbanization and industrialization and its demand is increased day by day .In order to minimize the negative impact of concrete, The use of m-sand as supplementary to the usual materials. Our deals with the partial replacement of fine aggregate by m-sand and also we reduce the crack in concrete by using bacteria (bacillus pasteurii) in concrete. The substituent to natural sand by m-sand of 15%, 30% and 50% percent is to be studied for material and strength properties.100% cement concrete mix is of M30 and water cement ratio is 0.4. The strength will be tested during the period of 7 days, 14 days, 21 days respectively. We will compare replaced with the conventional about the strength and durability of the concrete and we use chemical protector as calcium lactate.

Index Terms – M-sand-manufacture sand, M30-Mix proportion.

1. INTRODUCTION

1.1. General

Construction technology has seen a rapid change over time. Many typical structure can be constructed with in a month of duration using advanced construction techniques. Though it is proven that construction can be done economically without using concrete. Concrete is a construction material that consists of cement, aggregate, water and admixtures. Concrete solidifies and hardens after mixture and placement due to a chemical process known as hydration. The water reacts with cement, which bonds the other components together and eventually creating a stone material. It is used to make pavement, architectural structure, foundation, overpasses, parking structure, ect..,those concrete are rigid material with high compressive strength and weak in tensile strength. Reinforcing bars are used to improve the tensile strength. Fresh concrete is a freshly mixed material which can be molded into any shape. The relative quantities of cement, aggregate ,and water mixed together control the properties of concrete in the wet state as well as in the hardened state. The strength of concrete mainly depends on water cement ratio. If the water cement ratio increases than too much the bleeding of concrete takes place and the strength of concrete also reduced.

Generally the high performance concrete usually contains ordinary Portland cement. The use of different type of sub products into the cement based materials has become a common practice in the concrete industry.

1.2.Bacteria:

Chemical precursor to be used for bio-concrete. It is the special type of concrete which is invented by a group of microbiology under the head of Henk Jonkers. It is also termed as self-healing concrete. Bacterial concrete is a special type of concrete it has the ability to repair itself autonomously. one another advantage of bacterial concrete is that the introduction of bacteria in concrete also helps in enhancing the properties of concrete in both natural and laboratory conditions. Since 1980's a lot of articles can be found related to bacterial concrete and many processes were proposed for preparing the bacterial concrete. The basic advantages of MICCP by the bacteria in concrete are the increase in strength, low maintenance cost of the concrete structure, resistance to freeze thaw, high carbonation which can help in decreasing the porosity and permeability, and increase in resistance towards chloride attack 17-25.These reaction products are able to completely seal cracks provided that crack widths are small. Larger sized cracks can only be partially filled due to the limited amount of non-reacted cement particles present, thus resulting in only a thin layer of hydration products on the crack surface. With respect to crack-sealing capacity, a process homologous to secondary hydration of cement particles is the process of carbonation. This reaction is also expansive as ingress atmospheric carbon dioxide (CO_2) reacts with calcium hydroxide particles present in the concrete matrix to various calcium carbonate minerals. From the perspective of durability, rapid sealing of particularly freshly formed surface cracks is important as this hampers the ingress of water and other aggressive chemicals into the concrete matrix.

1.3. M-sand

M-sand is also termed as Manufactured sand.It is produced from the hard granite rocks which is crushed by machine. M-sand is cubical in shape.Cost is low compare to river sand. For aggregate produces concrete aggregate are end products while for concrete manufacturers, aggregates are raw materials to be used for concrete production. The quality of aggregates can be influenced while raw materials, gravel or rock may have characteristics which can"t be modified by the production process. One extremely important factor is consistent supply of course, fine aggregate. In this regard a course aggregate produced by crushing basaltic stone and river sand is the major natural source of fine aggregate in our country. Therefore, looking for a viable alternative for natural sand is a must. One alternative used as replacement is the use of M sand.

1.4 Objective of the research work

The objective or the present work is to study the effect of partial replacement of fine aggregate and coarse aggregate by m-sand and partial replacement of cement by bacteria and calcium lattes. The replacement is done at different levels of percentage that is aggregate are replaced by 50% of m-sand by 0%,10%,20%,50%. M_{25} concrete grade mix is initially designed without replacement and subsequently materials are replaced partially at different levels of percentages. The sample are to be tested for their strength characteristics. Certain objective of the work are follows:

1.To determine the strength properties of concrete.

2.To resist the easy damage.

3.To use m-sand and bacteria and calcium lattes.

2. LITERATURE REVIEW

1.Sagura R, Jagadeesan R.2011..,studied on ‘‘Experimental Study on Mechanical Properties of M-Sand Concrete by Different Curing Methods’’ Concrete is widely used composite construction material consist of cement, fine aggregate and coarse aggregate. One of the constituent materials of concrete especially, the fine aggregate plays an important role for imparting better performance of concrete in its fresh and hardened state. The shortage of the resources of natural sand(NS), have the possibility for the use of M-Sand performance and durability requirements. Curing plays a major role in developing the concrete microstructure and pore structure. Using M25 grade of concrete cubes, cylinder and prism were casted for NS and MS. The specimens were allowed for air curing, standard moist curing, membrane curing and with Super-Absorbent Polymer (SAP) at different proportions of 0.2%, 0.3% and 0.4% by weight of cement and the various mechanical properties were studied. Aggregates occupy 65 to 80% of the total volume of concrete and affect the fresh and hardened properties of concrete. Out of the total composition of aggregate, the fine aggregate consumes around 20 to 30% percent of the volume. The limiting resources of natural sand avail the possibility for the use of manufactured sands.

Inference

From this paper we take M-sand with different proportions. The specimen were attain for curing of standard moisture and for air curing. Here we take 0.4% of water cement ratio. We use M25 grade concrete.

2.T. Shanmugapriya, R. Uma 2012.., studied on “Optimization of partial replacement of M-SAND by natural sand in high performance concrete with silica fume” and concluded that for M25 grade concrete. This paper present the optimization of partial replacement of manufactured sand by natural sand with silica fume in High Performance Concrete (HPC). Concrete mixes were evaluated for compressive strength and flexural strength. The ordinary Portland cement was partially replaced with silica fume by 1.5%, 2.5 %, and 5% and natural sand was replaced with manufactured sand by four proportions (I e 0%, 10%, 20%, 50%). However, further additions of manufactured sand caused reduction in the strength. The optimum percentage of replacement of natural sand by M-sand is 50%.The results also revealed that increase in percentage of partial replacement of silica fume, increased the compressive and flexure strength of High Performance Concrete. The cheapest and the easiest way of getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade which would be free from all impurities is known as Manufactured sand. Concrete made with crushed stone dust as replacement of natural sand in concrete can attain the same compressive strength, comparable tensile strength, modulus of rupture and lower degree of shrinkage as the control concrete. From Literature Review it is observed that compressive and split tensile strength of M30 grade concrete increased by replacing 30% of natural sand with M-Sand.

Inference

From this paper we take M-sand is partially replaced with natural sand. We make test comparison b/w ordinary concrete and M-sand (partially) concrete. The proportion of mixing of M-sand is (15%, 30% & 50%).We make certain test to identified its strength.

3.Nimithavijayaraghavan.., 2013studied on "Study of compressive strength of concrete by partial replacement of M-sand with Natural sand" and concluded that m-sand has a potential to provide an alternative to fine aggregate and helps in maintaining the surrounding every bit well as economical balance. The compressive strength properties of concrete containing m-sand at 0%,5%,10%,15%,20%,25% of fine aggregate. The result obtained for 28 days of compressive strength confirms that the optimal percentage for replacement of m-sand with natural sand is about 10%.

Inference

Here we take m-sand for concrete to identify the compressive strength for (7, 21, 28) days respectively. We use fine aggregate as natural sand & M-sand of various proportions.

4.Umamaheswaran.V, C. Sudha, P. T. Ravichandran and P. R. Kannan Rajkumar.2013..,studied on''Use of M Sand in High Strength and High Performance Concrete''concrete in the construction industry is increasing rapidly. Mineral admixtures such as Ground Granulated Blast furnace Slag (GGBS), Metakaolin, Silica fume and Alccofine are become unavoidable in high strength concrete because of their effects easing rapidly. Mineral admixtures such as Ground Granulated Blast furnace Slag (GGBS), Metakaolin, Silica fume and Alccofine are become unavoidable in high strength concrete because of their effects in hardened concrete properties. Replacing the Ordinary Portland Cement (OPC) by mineral admixtures is retaining the natural resources for future generation. Concrete is a widely used construction material for various types of structures due to its structural stability and strength. All the materials required for producing such huge quantities of concrete come from the earth's crust. Thus it depletes its resources every year creating ecological strain. On the other hand human activities on the earth produce solid waste in considerable quantities including industrial wastes. Amongst the solid waste the major ones are bacteria, GGBS, silica fume and demolished construction materials. These solid wastes can be used as a mineral admixture which is used in the production of High Performance and High strength concrete. based super plasticizer. The Compressive strength, flexural strength and split tensile strength at various curing periods such as 28 and 56 days.

Inference

For higher strength we take m-sand. In which we mainly used to show the strength variation b/w ordinary concrete and m-sand concrete. The curing takes place of (7 , 21 & 28)days.

3. STUDY OF MATERIAL PROPERTIES

The properties of materials used for making concrete mix are determined in laboratory as per relevant codes of practice .Different materials used in present study were cement, coarse aggregate and fine aggregate, in addition of m-sand.The aim of studying of various properties of materials is used to check the appearance with codal requirements and to enable an engineer to design a concrete mix for a particular strength. The description of various materials which were used in this study is given below**.**

3.1 Ordinary Portland cement

Although all materials that go into concrete mix are essential, cement is very often the most important because it is usually the delicate link in the chain. The function of cement is first of all to bind the sand and stone together and second to fill up voids between sand and stone particle to from a compact mass. It constitutes only about 20% of the total volume of concrete mix; it is active portion of building medium and is the only scientifically controlled ingredient of concrete. Any various in its quality affects the compressive strength of concrete mix. Ordinary Portland cement is most important type of cement and fine powder produced by grinding Portland cement clinker. The OPC classified into three grades, namely 33 grade,43 grade,53 grade depending upon the strength of 28 days. It has been possible to upgrade the qualities of cement by using high qualities limestone, modern requirements, maintaining better particle size distribution, fine grinding and better parking, Generally use of high grade cement offer many advantage for making stronger concrete. Ordinary Portland cement (OPC) of 43 grade (Ambuja cement) was used throughout the course of the investigation. It was fresh and without any lumps. The cement as determined from various tests confirming to Indian standards IS 8112:1989 as stored to prevent deterioration in its properties due to contact with moisture. The various tests conducted on cement are initial and final setting time, specific gravity, fineness and compressive strength.

3.2 Aggregates

Aggregates constitute the bulk of concrete mixture and give dimensional stability to concrete. To increase the density of resulting mix, the aggregate frequently used in two or more size. The fine aggregate is to assist the cement paste to hold the coarse aggregate particles in suspension. This action promotes plasticity in the mixture and prevents the possible segregation of paste and coarse aggregate, particularly when is necessary to transport the concrete some distance from the mixing plants to placement. The aggregate provide about 75% of the body of concrete and hence its influence is extremely important. They strong, durable and economical. The must be proper shape, clean, hard, strong,well graded.

3.2.1.Coarse aggregate:

The aggregate which is retained over IS sieve 4.75mm is termed as coarse aggregate. The coarse aggregate may be of following types:

1.Crushed graves or stone obtained by crushing of gravel or hard stone.

2.Uncrushed graves or stone resulting from the natural disintegration of rocks.

3.Partially crushed gravel obtained of product of blending of above two types.

The normal maximum size is gradually 10-20mm; however particle size up to 40mm or more have been used in self compacting concrete. Regarding the characteristics of difference type of aggregate crushed aggregates tent to improve the strength because of interlocking of angular particles, while rounded aggregates improved the flow because of lower internal friction. Locally available coarse aggregate having the maximum size of 20mm was used in this work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS:383-1970. Specific gravity and other properties of coarse aggregates are give in table.

3.2.3 Specific gravity of coarse aggregate:

Specific gravity is used in design calculation of concrete mixes. With the specific gravity of each constituent known, its weight can be converted into solid volume and hence a theoretical yield of concrete per unit volume can be calculated. Specific gravity of aggregate is also required to be considered when we deal with light weight and heavy weight concrete.

Table 3.1 specific gravity of coarse aggregates

S. No	Description	Trial-I	Trial-II
1.	Weight of empty pycnometer(W_1)	0.680	0.680
2.	Weight of pycnometer+coarse aggregate(W_2)	1.308	1.310
3.	Weight of pycnometer +coarse aggregate+ water(W_3)	1.915	1.922
4.	Weight of pycnometer+water(W_4)	1.527	1.527
5.	Specific gravity (G)	2.62	2.68

Specific gravity (g) $=(w_2-w_1)/(w_4-w_1)-(w_3-w_2)$

Characteristics	Value
Colour	Grey
Shape	Angular
Maximum size	20 mm
Specific gravity	2.65
Water absorption,%	0.5%

Specific gravity (g) = (2.62+2.68)/2=2.65

Table 3.2 Properties of coarse aggregates

3.2.2Fineness modulus(sieve analysis)

The sieve analysis is conducted to determine the particle size distribution in a sample of aggregate, which we call gradation. The consists of the simple operation of dividing aggregate into fractions, each consisting of particle of the same size. The sieve used for the test has square opening, sieve are described by the size of their opening as ,80mm ,63mm ,50mm, 40mm, 25mm,16mm, 12.5mm,10mm, 6.3mm, 4.75mm, 3.35mm, 2.36mm,1.70mm, 1.18mm, 850μm, 600 μm, 300 μm, 212 μm, 150 μm, 75 μm. All sieve are mounted in frames one above the other in ascending order. The sieve used for coarse aggregate are of size 80mm, 40mm, 20mm,10mm, 4.75mm, 3.35mm, 2.36mm,1.70mm, 1.18mm,850μm, 600 μm.

The sieve analysis on coarse aggregate was carried out as per IS 2386 (part I)-1963 and results are presented in Table 3.3.

Table 3.3 Sieve analysis of coarse aggregate:

S.No	Aperture size(mm)	Weight soil retained (kg)	Percentage of weight retained	Cumulative % retained	% of coarse aggregate
1.	80	0.00	0.00	100	0.00
2.	40	0.00	0.00	100	0.00
3.	25	0.90	1.8	98.2	1.8
4.	20	1.307	26.4	73.6	28.2
5.	12.5	3.397	67.94	32.06	96.14
6.	10	0.132	2.64	97.36	98.78

7.	4.75	0.061	1.22	98.78	100
8.	Pan	0.00	0.00	0.00	
	Total	**5.00**		**SUM**	323.92

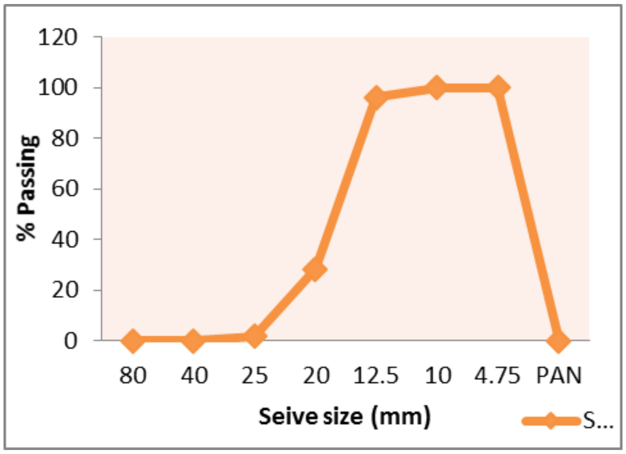


fig 3.1 Fineness Modulus Graph for Coarse Aggregate

3.2.3 Crushing strength on aggregate:

Dimension of mould = 15.10cm

Height of mould $= (\pi x(15.1)^2)/(4x13)$

$= 2328.02cm^3$

Table 3.4: Crushing strength on aggregat

Calculation:

Total percentage:

= (16+14)/2 = 15%

S. No	Total weight of aggregate (W_1)g	IS sieve 2.36mm passing materials (W_2)g	Aggregate crushing value (W_2/W_1)x100g
1.	2500	400	16.00
2.	2500	350	14.00

3.2.4 Water absorption test:

Table No.3.5: water absorption test

S.No	Weight of oven dry specimen(g)	Weight of standard specimen(g)	Weight of water observed $W_3=W_2-W_1$g	% of water absorption $=W_3/W_1$x100g
1.	200	210	10	5%
2.	200	210	10	5%

Calculation:

To find $W_3 = W_2-W_1$ = 210-200 = 10g

% of water absorption;$=W_3/W_1$x100g = 5%

3.2.5Loss angle abrasion test on coarse aggregate

Table No.3.6 Abrasion test

Description	% of loss angle test(or) abrasion test
Let the original weight of aggregates (W_1) g	5000g
Weight of aggregate retained on 1.7mm IS sieve after test (W_2) g	4785g
Loss in weight due to wear (W_1-W_2) g	215 g
% of wear	((W_1-W_2)/w)x100 (5000-4785)/5000)x100 4.3%

3.2.6 Impact test on coarse aggregate

Table 3.7 Impact test on coarse aggregate

S.No	Details of sample	Trial-I	Trial-II
1.	Total weight of aggregate sample filling the cylinder	440	370

	measure (W_1)g		
2.	Weight of aggregate passing 2.36mm sieve test(W_2)g	80	84
3.	Weight of aggregate retained 2.36mm sieve (W_3)g	360	286
4.	(W_1-W_2+W_3)	0	0
5.	Aggregate impact value (W_2/W_1)x100	18.18	22.70

Calculation: = (18.18+22.70+21.02)/3 = 20.63

3.3 Fine aggregate:

The aggregate most of which pass through 4.75mm IS sieve are termed as fine aggregates. The fine aggregate may be of following types:

1.Natural sand , i.e fine aggregate produced by crushing hard stone.

2.Crushed stone sand, i.e fine aggregate produced by crushing natural gravel.

3.Crushed gravel sand, i.e fine aggregate produced by crushed natural gravel.

According to size, the fine aggregate may be described as coarse, medium and fine sand. The sand was sieved through 4.75mm sieve to remove any particle greater than 4.75mm and conforming to grating zone II. It was coarse sand light brown in color. Sieve analysis of fine aggregate are tested as per IS:383-1970 and result are shown in table.

Table.3.8 Sieve analysis test for M- sand

Aperture size(mm)	Weight soil retained (kg)	Percentage of weight retained	Cumulative % retained	% of natural sand
4.75	0.005	0.5	99.5	0.5
2.36	0.122	12.2	87.8	12.7
1.18	0.314	31.4	68.6	34.1
0.600	0.357	35.7	64.3	69.8
0.300	0.100	10	90	79.8
0.150	0.094	9.4	90.6	89.2
Pan	0.018	1.8	98.2	91
Total			**SUM**	377.1
			FM	3.77

Calculation:

Total cumulative/100 = 377/100

Fines modulus = 3.77

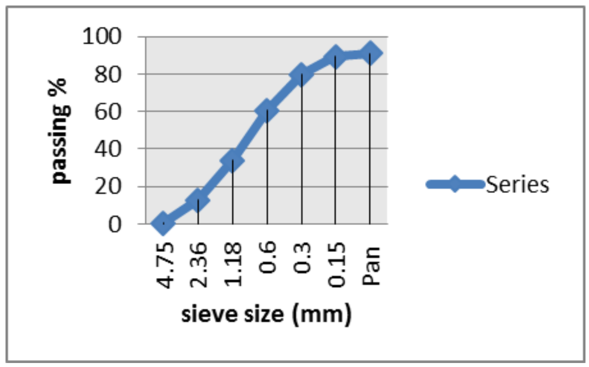


fig 3.2 Graph for M-sand

Table 3.9. Specific gravity of natural sand

Description	Trial-I	Trial -II
Weight of empty pycnometer(W_1)	0.657	0.657
Weight of pycnometer+coarse aggregate(W_2)	1.472	1.489
Weight of pycnometer +coarse aggregate+ water(W_3)	1.985	1.990

Weight of pycnometer+water(W_4)	1.527	1.527
Specific gravity (G)	2.28	2.36

Specific gravity (g) $=(w_2-w_1)/(w_4-w_1)-(w_3-w_2)$

Specific gravity (g) = (2.28+2.36+)/2

(G) = 2.32

Table 3.10 Specific gravity of M-Sand

Description	Trial-I	Trial-II
Weight of empty pycnometer(W_1)	0.658	0.658
Weight of pycnometer+coarse aggregate(W_2)	1.361	1.372
Weight of pycnometer +coarse aggregate+ water(W_3)	1.921	1.934
Weight of pycnometer+water(W_4)	1.527	1.527
Specific gravity (G)	2.27	2.32

Specific gravity (g) $= (w_2-w_1)/(w_4-w_1)-(w_3-w_2)$
Specific gravity (g) = (2.27+2.32)/2
(G) = 2.295

Table :3.11Sieve analysis test for natural sand

Aperture size(mm)	Weight soil retained (kg)	Percentage of weight retained	Cumulative % retained	% of natural sand
4.75	0	0	100	0
2.36	0	0	100	0
1.18	0.092	9.2	90.8	9.2
0.600	0.307	30.7	69.3	39.9
0.300	0.044	4.4	95.6	44.3
0.150	0.040	4.0	96	48.3
Pan	0.026	2.6	97.4	50.9
Total	500.00		**SUM**	192.6

Calculation :

Fine modulus = total cumulative % / 100

= 192.6/100

= 1.926 %

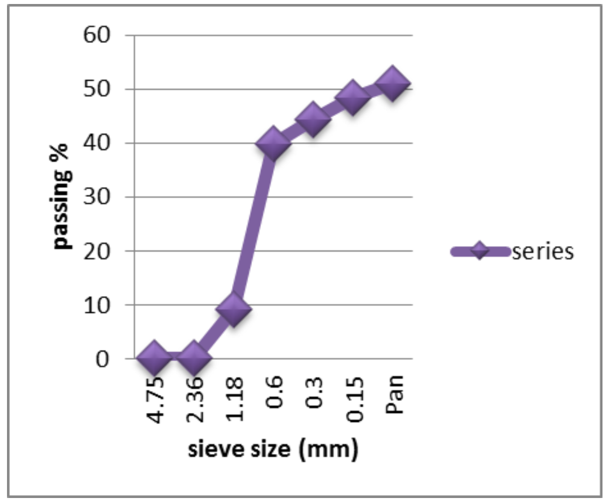


fig 3.3 Graph for natural sand

3.2.3Water

Generally, water that is suitable for drinking is satisfactory for use in concrete. Water from lakes and streams that contain marine life also usually is suitable.. Water from such sources should be avoided since the quality of the water could change due to low water or by intermittent tab water is used for casting. The portable water is generally considered satisfactory for mixing and curing of concrete in material testing laboratory. This was free from any detrimental contamination and was good potable quality.

CONCRETE MIX	SLUMP VALUE (MM)
Normal	94
15%	85
30%	80
50%	72

4. TEST METHODS

The procedure of method used for testing cement, coarse aggregate , fine aggregate and concrete are given below:

4.1Slump cone test

Slum is a measurement of concrete's workability, or fluidity. It's an indirect measurement of concrete consistency or stiffness.

A slump test is a method used to determine the consistency of concrete. The consistency, or stiffness ,indicate how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirement for the finished quality.

Type of Slump.

1.Collapse slump
2.Shear slump
3.True slump

Collapse slump

In a collapse slump the concrete collapses completely. A collapse slump will generally mean that mix is too wet or that it is a high workability mix, for which slump test is not appropriate

Shear slump

In a shear slump the top portion of the concrete shear off slips slide ways

If one half of the cone slides down and inclined plane the slump is said to be a shear slump

1. If a shear or collapse slump is achieved a fresh sample should be taken and the test is repeated
2. If the shear slump persists as may the case with harsh mixes this is an indication of lack of cohesion of the mix

True slump

In a true slump the concrete simply subjected keepings more or less to than shape.

1. This is the only slump which is used in various test.
2. Mix of stiff consistence have a zero slump so that in the rather dry range no variation can be detected between mix of different workability However in a lean mix with a tendency to hardness a true slump easily change to the shear slump type or even to collapse and widely different values of slump can be obtained in different samples from the same mix thus the slump test unreliable for lean mixes.

Table 4.1 Test on slump value

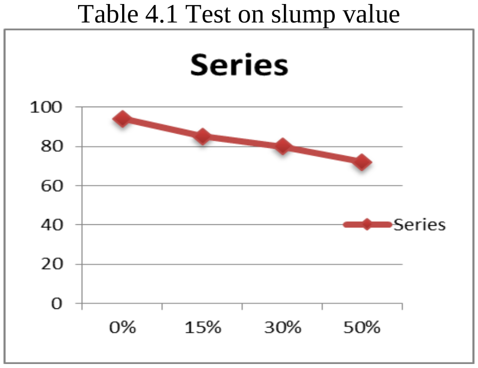


fig 4.1 Graph for slump cone test

Compaction test on concrete

It is a test that is used to determine the compacting factor of the prepared concrete mix.

Table 4.2: compaction test on concrete

S. NO	Description	Compaction factor
1	Normal	93
2	15 %	86
3	30 %	79
4	50 %	68

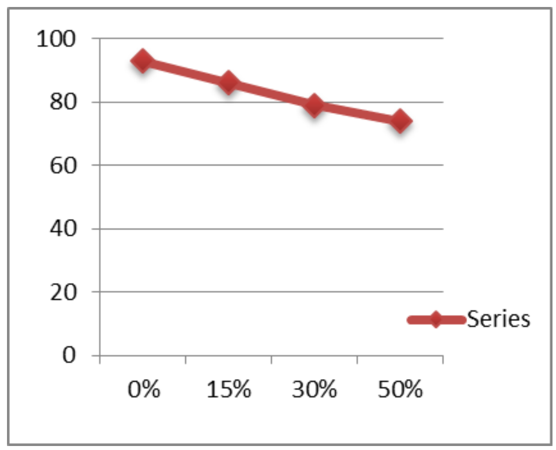


Fig 4.2 Graph for compaction test on concrete

5. MIXED DESIGN (M_{30})

Table 5.1The mix proportion then becomes

Water	Cement	Fine aggregate	Coarse aggregate
186kg	456kg	513.86 kg/m^3	670.13 kg/m^3
0.40	1	1.125	1.46

Table 5.2 Mix proportion with m-sand:

Mix	Water	Cement	Fine aggregate	Coarse aggregate	m-sand
0%	0.4	1	1	3	0

10%	0.4	0.90	0.5	1.5	0.5
20%	0.4	0.80	0.5	1.5	0.5
50%	0.4	1	0.5	1.5	0.5

6. RESULTS AND DISCUSSION

6.1Compressive strength of concrete:

Cube specimens of size 150 mmx 150 mmx 150 mm were taken out from the curing tank at the ages of 7, 21and 28 tested.

$F_c = P/A$

Where,

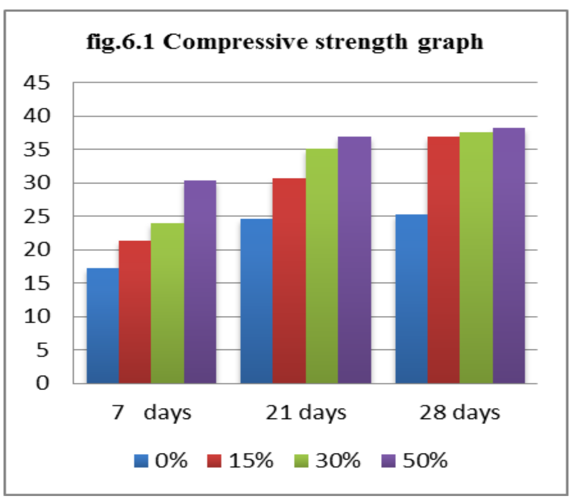
F_c = compressive strength (N/mm^2)

P = ultimate load (KN)

A = load area (150mm x 150mm)

Table 6.1: Compressive strength of concrete measurement

S.NO	**Mix**	**Compressive strength of N/mm^2**		
		7 days	**21 days**	**28 days**
1	0%	17.33	24.66	25.33
2	15%	21.33	30.66	36.88
3	30%	24.00	35.11	37.55
4	50%	30.44	36.88	38.22



6.2Split tensile strength of concrete

This test was performed on universal testing machine (UTM).The magnitude of tensile stress (T) acting uniformly to the line of action of applied loading is given by formula.

$T_{sp}=2P/\pi DL$

Where,

T=split tensile strength in MPa

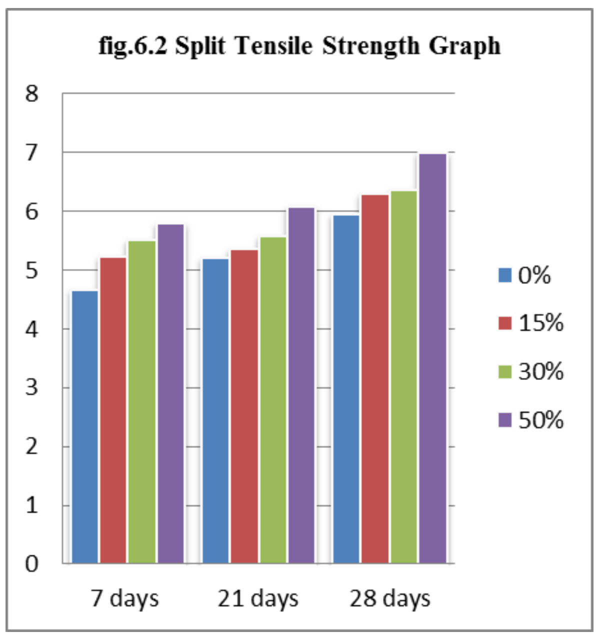
P=applied load

D=Diameter of concrete cylinder sample in mm.

L=length of concrete cylinder sample in mm.

Table 6.2: Split tensile strength of concrete measurement

S.NO	**Mix**	**Split tensile strength of N/mm^2**		
		7 days	**21 days**	**28 days**
1	Normal	4.67	5.02	5.58
2	15%	5.23	5.37	6.29
3	30%	5.52	5.58	6.36
4	50%	5.80	6.08	7



6.3FLEXURAL STRENGTH TEST

The result of flexural strength test conducted on concrete using m-sand.

The use of M-sand reinforcement concrete is Compare to convention concrete by added 0%, 15%, 30%,50% m-sand with per weight of cement.

Flexural strength,

Fb = PL/bd^2

Where,

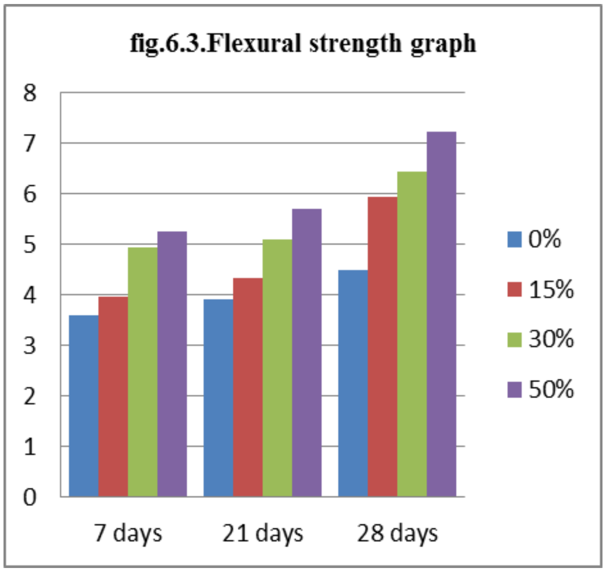
P = Maximum Load,

L = Span of Specimen,

B = Width of specimen,

Table 6.3: Flexural strength of concrete measurement

S.NO	Mix	Flexural strength of N/mm^2		
		7 days	21 days	28 days
1	Normal	3.60	3.93	4.50
2	15%	3.96	4.35	5.95
3	30%	4.95	5.10	6.45
4	50%	5.25	5.70	7.23



7. CONCLUSION

Influence of m-sand for self-healing concrete with effect of different bacteria on the strength and water absorption characteristics of concrete'' The concrete structures have various durability issues due to the different physiological conditions and it results to give high strength about 50% of replacement of m-sand Bacterial concrete is a special type of concrete it has the ability to repair itself autonomously. One another advantage of bacterial concrete is that the introduction of bacteria in concrete also helps in enhancing the properties of concrete in both natural and laboratory conditions.

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