

BEHAIOUR OF CONCRETE WITH MANUFACTURED SAND AS FINE AGGRIGATE

Bhasme Pratit S.¹, Bogar V.M.², Shinde D.M.³

1- Research Scholar, Applied Mechanics Department,

2- Government College of Engineering, Karad, Maharashtra, (India)

*3- Assistant Professor, Applied Mechanics Department, Government College of Engineering
Structural Engineer, Hind Consultancy Services, Kadegaon, Sangli, Maharashtra, (India)*

ABSTRACT

The exponential growth in infrastructural development in India demand huge quantity of natural sand for concrete work. Limited natural sand resources cause environmental problems and hence it leads for government restrictions on sand quarrying resulting in scarcity and significant increase in its cost. A few alternatives have been developed in the industry to bank out of which manufactured sand is one of them. Manufactured sand is found to be the most suitable one to replace natural sand. This paper puts forward the applications of manufactured sand as an attempt towards sustainable development. It will help to find viable solution to the declining availability of natural sand and to maintain eco-balance. The purpose of this research is to experimentally investigate properties of concrete with manufactured sand by replacing natural sand. The investigation is carried out using compression test.

Key Words: *Compressive strength, Manufactured sand, Rebound hammer, Split tensile test, Rebound hammer*

LIINRTODUCTION

Increase in demand and decrease in natural resources of fine aggregate for the production of concrete has resulted in the need to identify new source of fine aggregate. Due to increased construction in the forthcoming years, it is expected that fine aggregates required to produce rich mix of concrete will become more scarce and uneconomical. Therefore, manufactured sand offer a viable alternative to natural sand. Natural sand has been used in all constructions activities. The main source of natural sand is riverbeds. However, natural sand is slowly and consistently becoming scarce. Environmental concerns are also being raised against uncontrolled extraction of natural sand, with arguments mostly relating to protecting river beds against erosion and the importance of natural sand acting as filter for ground water. Also, problems like landslide may arise due to it. As government is restricting and in some places banning the extraction of natural sand from river, sand mafias are becoming more powerful increasing the crime rate. The use of manufactured sand will be one of the most preferred alternatives for natural sand. Increasing use of manufactured sand is very essential in production of

concrete. Although, manufactured sand is being used in market but there is lack of knowledge about it amongst the builders and contractors in construction industry as they doubt the quality of concrete produced using it.

II. RESERCH SIGNIFICANCE

The main objective of the present work is to study the properties of concrete with 100% manufactured sand with constant water-cement ratio 0.5. Manufactured sand can be used as fine aggregate, but it has to satisfy the technical requisites. On this research on concrete with manufactured sand is scarce, so this paper investigates the concrete with manufactured sand.

III. MATERIALS

Aggregate-

Coarse aggregate (CA I = 10mm and CA II = 20mm) are used, which is manufactured from locally available rock.

Fine aggregate i.e. manufactured Sand is available from local sources. Summary of material properties were presented in tables below:

Table No.1 Summary of Material Properties

Property	Manufactured sand	Coarse aggregate
Specific Gravity	2.84	2.76
Fineness Modulus	2.97	-
Water Absorption	5.7%	2.9%
Surface texture	Smooth	Smooth

Cement

Ordinary Portland cement of 53 Grade conforming to IS 8112 -1989

IV. EXPERIMENTAL PROGRAMME

Mix design was done for M₂₅ concrete as per the Indian standard code specifications (IS 10262-2007). The mix proportion is 1:2.24:3.84. Details of quantities of ingredients of concrete mix is shown in TABLE No-2. Testing of hardened concrete plays an important role in controlling and confirming the quality of cement concrete works.

Table No.2 Quantities of Ingredients of Concrete Mix (kg per m ³)	
Cement (kg)	336
Fine Aggregate (kg)	752.64

Coarse Aggregate (kg)	1290.24
Water (kg)	168

Compressive strength

The specimen of standard cube of (150mm x 150mm x 150mm) are used to determine the compressive strength and of concrete. Three specimens were tested for 7,14,28 days with replacement of 100% manufactured sand.

Split Tensile Test

Splitting tensile strength is an indirect method used for determining the tensile strength of concrete. Tests are carried out on 150mmx300mm cylinders conforming to IS 5816: 1976 to obtain the splitting tensile strengths at the age of 7,14, 28 days.

Totally 12 cubes and 12 cylinders were cast. The constituents were weighed and the materials were mixed by hand mixing. The mixes were compacted using Table vibrator. The water cement ratio (W/C) adopted was 0.5. The specimens were demoulded after 24 h, cured in water for 7,14 & 28 days and then tested for its compressive strength and split tensile strength as per Indian Standards.

V.RESULTS AND DISCUSSION

Table No.3 Test results of sieve analysis of manufactured sand

Sieve Designation	Manufactured sand	Grading Limits for Zone II Sand (IS 383)
4.75mm	92.30	90-100
2.36mm	85.10	75-100
1.18mm	64.10	55-90
600 μ	40.50	35-59
300 μ	12.70	8-30
150 μ	7.80	0-10

Cube Compressive Strength

All cube samples with 100% Manufactured Sand were tested to determine the 7 days,14 days and 28 days compressive strength using a 200 Ton Compression Testing Machine. The compressive strength test on cubes is conducted as per standards. The test results are tabulated in Table.

Table No.4 Test Results of Compressive Strength

Sample No.	Age of specimen	Identification Mark	Maximum load (Ton)	Compressive Strength(MPa)	Avg. Compressive Strength(MPa)
1.	7 days	C1	51	20.16	20.813 > 16.25(IS

2.		C2	44	19.18	recommended)
3.		C3	53	23.10	
1.	14 days	C1	55	23.98	24.123 > 22.5(IS
2.		C2	56	24.41	recommended)
3.		C3	55	23.98	
1.	28 days	C1	91	39.66	36.180 > 24.75(IS
2.		C2	80	34.87	recommended)
3.		C3	78	34.01	

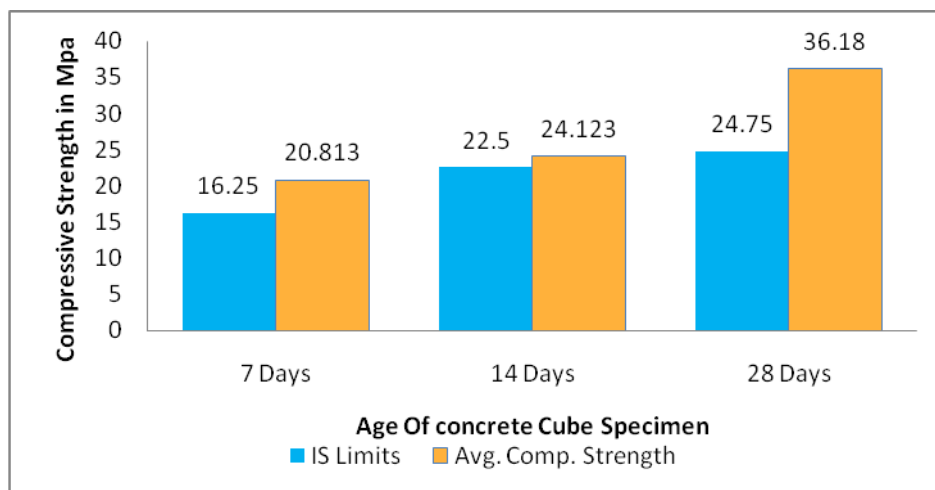


Fig.1 Compressive Strength for different Age of concrete



Fig.2 Compressive Strength Test of concrete

Split Tensile Strength

All cylinder samples with 100% Manufactured Sand were tested to determine the split tensile strength after 7 days, 14 days and 28 days using a 200 Ton Compression Testing Machine. The tests were conducted as per standard specifications. The test results are tabulated in Table.

Table No.5 Test Results of Tensile Strength

Sample No.	Age of specimen	Identificatin Mark	Dia of specimen(mm)	Depth (mm)	Tensile Strength (MPa)	Avg. Tensile Strength(MPa)
------------	-----------------	--------------------	---------------------	------------	------------------------	----------------------------

1.	7 days	S1	150	300	2.981	2.899 > 2.82(IS recommended)
2.		S2	150	300	2.497	
3.		S3	150	300	3.219	
1.	14 days	S1	150	300	3.745	3.5140 > 3.32(IS recommended)
2.		S2	150	300	3.329	
3.		S3	150	300	3.468	
1.	28 days	S1	150	300	3.745	3.7453 > 3.48(IS recommended)
2.		S2	150	300	3.884	
3.		S3	150	300	3.607	

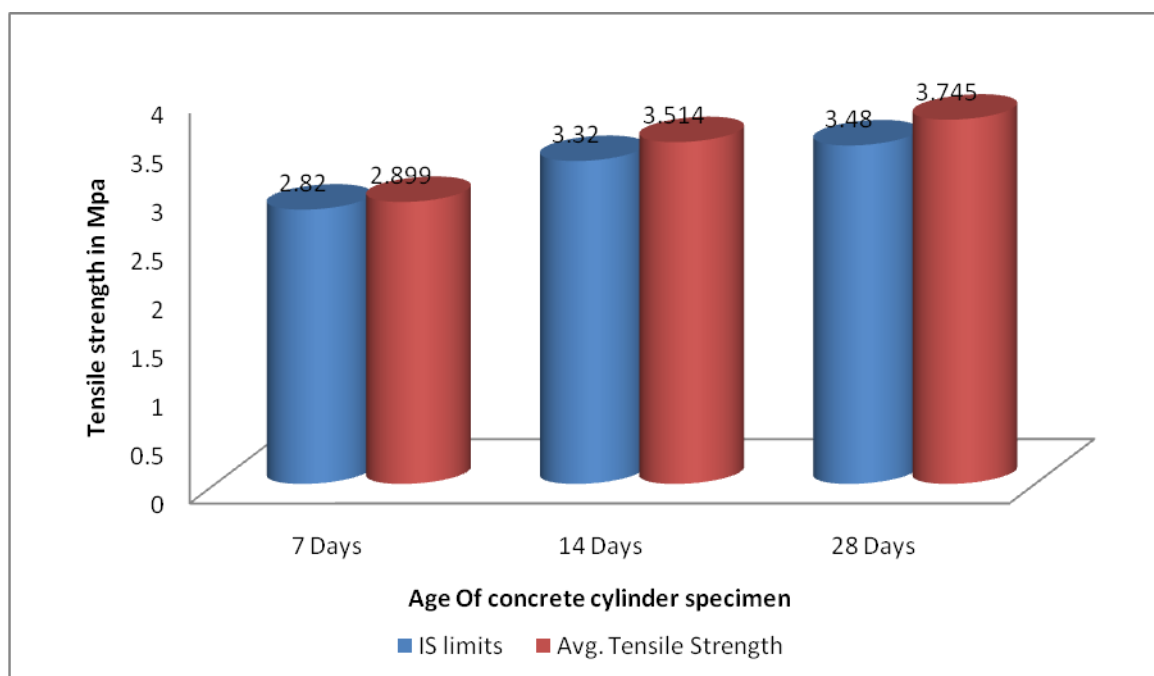


Fig.3 Tensile Strength for different Age of Concrete



Fig.4 Split Tensile Test

VI.CASE STUDY –STRENGTH EVALUTION WITH REBOUND HAMMER TEST

Site Location-Opp.to Bank of India, Tadasar –Kadegaon Road,Kadegaon As per owner's requirement the site were designed with M₁₅ mix proportion.

The rebound hammer is one of the most popular non-destructive testing methods used to investigate concrete. Its popularity is due to its simple operating procedures.

The procedure of this test is as A steel hammer impacts, with a predetermined amount of energy, a steel plunger in contact with a surface of concrete, and the distance that the hammer rebounds is measured.

The test was performed again after 28 days when the concrete had gained sufficient strength in the Month of February 2018. The site was dry and the weather conditions were quite favorable. The test readings were as follows:

Table No.6 Rebound Hammer Test Results

Location	Point Reading			Average	Position	Graph cube strength(Mpa)
Beam 1	24	26	25	25	H	17
Beam 2	26	25	27	26	H	18
Beam 3	24	27	24	25	H	17
Slab 1	18	20	21	20	V	15
Slab 2	22	21	18	21	V	18
Slab 3	20	19	21	20	V	16
Column 1	22	25	24	23	H	15
Column 2	23	27	26	25	H	18
Column 3	26	24	25	25	H	18



Fig.5 Rebound Hammer Test

VII.CONCLUSION

The effect of concrete with 100% replacement by Manufactured sand on Compressive strength and Split Tensile Strength with constant water-cement ratio are studied. Results are compared with Indian Standard code.

1. Compressive strength of concrete with Manufactured sand is marginally higher (10 –20%) when compared with standard.
2. Tensile strength of concrete with Manufactured sand is marginally higher (3 –9%) when compared with standard.
3. Rebound hammers test the surface hardness of concrete, which cannot be converted directly to compressive strength but it can only be used as rough indication of concrete strength in absolute terms.

The Manufactured sand found to have good gradation and nice finish this has been resulted good cohesive cement concrete. Manufactured sand has a potential to provide alternative to natural sand and helps in maintaining environmental as well as economical balance.

Further study can be conducted on concrete with 100% manufactured sand for its mechanical, durability, structural and micro-structural properties of concrete.

REFERENCES

- [1.] Manasseh Joel, "Use of Crushed Granite Fine as Replacement to River Sand in Concrete Production" *Leonardo Electronic Journal of Practices and Technologies*, dec-2010, Issue-17, pp.85-96
- [2.] B.V.VenkataramaReddy, "Suitability of Manufactured sand as fine aggregate in mortar and concrete" *CSIS project: CP 6597/0505/11-330* 5th July 2011, pp-1-16
- [3.] Priyanka A. Jadhav, Dilip K. Kulkarni, "Effect of replacement of natural sand by manufactured sand on the properties of cement mortar" *International Journal of civil and structural engineering*, Volume 3, No 3, March 2013, pp-621-628
- [4.] G.N.Karugu, Manguriu, C.K. Oyawa, Manguriu, W.O. Abuodha, Mulu P.U., "Partial replacement of natural river sand with crushed rock sand in concrete production" *Global Engineers & Technologists Review*, Vol.3 No.4 (July 2013) pp-8-14
- [5.] M. Adams Joe, A. Maria Rajesh, P. Brightson, M. Prem Anand, "Experimental Investigation on The Effect Of M-Sand In High Performance Concrete" *American Journal of Engineering Research*, Volume-02, 2013, Issue-12, pp-46-51
- [6.] Karan Verma, P.S. Pajgade, "Effect of partial replacement of natural sand with crushed sand along with supplementary cementing materials" *International Journal of Research in Engineering and Technology*, Volume: 04 Issue: 01, Jan-2015, pp-288-293

- [7.] Praveen Kumar K, Radhakrishna, “Strength and workability of cement mortar with manufactured sand”*International Journal of Research in Engineering and Technology*, Volume: 04 Special Issue: 01, Feb-2015, pp-186-189
- [8.] T. Shanmugapriya, R.N. Uma, “Optimization of partial replacement of M-sand by natural sand in high performance concrete with silica fume”*International journal of engineering science and emerging technology*, June 2012, vol-3, pp-73-80.
- [9.] Rajendra P. Mogre, Dr. Dhananjay K. Parbat, “Behavior of polypropylene fiber reinforced concrete with artificial sand”*International Refereed Journal of Engineering and Science* Volume 1, Issue 2, October 2012, pp-37-40
- [10.] IS:456-2000 – “Plain and Reinforced concrete-Code of practice”*Bureau of Indian Standards*, New Delhi, India.
- [11.] IS:383-1970(2002) – “Specifications for fine and coarse aggregate from natural sources for concrete”*Bureau of Indian Standards*, New Delhi, India.
- [12.] SP 23:1982-Indian standards handbook on concrete mixes.
- [13.] IS:2386 – “Method of tests for aggregate for concrete”*Bureau of Indian Standards*, New Delhi, India.
- [14.] IS:516-1959(2004) – “Methods of tests for strength of concrete”*Bureau of Indian Standards*, New Delhi, India.
- [15.] IS:12269-2013 – “Specifications for 53 grade Ordinary Portland Cement”*Bureau of Indian Standards*, New Delhi, India.
- [16.] IS:10262-2009 – “Concrete Mix Proportioning-Guidelines”*Bureau of Indian Standards*, New Delhi, India.