

Experimental Study on Strength of Concrete by Replacement of Fine Aggregate with Robo Sand

T Venkata Narasimha Reddy¹ | P Lakshmi Narayana Subrahmanyam¹ | G Suresh¹ | G Manoj¹ | J Lakshmi Sudha¹

¹Department of Civil Engineering, Godavari Institute of Engineering & Technology (A), Rajahmundry, AP, India.

To Cite this Article

T Venkata Narasimha Reddy, P Lakshmi Narayana Subrahmanyam, G Suresh, G Manoj and J Lakshmi Sudha, "Experimental Study on Strength of Concrete by Replacement of Fine Aggregate with Robo Sand", International Journal for Modern Trends in Science and Technology, Vol. 06, Issue 04, April 2020, pp.:158-162.

Article Info

Received on 07-March-2020, Revised on 03-April-2020, Accepted on 08-April-2020, Published on 12-April-2020.

ABSTRACT

In present days the construction industry in the India is facing one of the major problems that is natural fine aggregate. Excavation of fine aggregate from river because they effect on environment and changing the river direction Cement, sand and aggregate are basic needs for any construction industry. Sand is a prime material used for preparation of mortar and concrete and which plays a major role in mix design. Now a day's erosion of rivers and considering environmental issues, there is a scarcity of river sand. The non-availability or shortage of river sand will affect the construction industry; hence there is a need to find the new alternative material to replace the sand, such that excess river erosion and harm to environment is prevented. Many researchers are finding different materials to replace sand and one of the major materials is Robo sand using different proportion of this robo sand along with sand the required concrete mix can be obtained. Replacement of fine aggregate with robo sand by and also finding the compressive Strength of that concrete cube. In This Project presents are view of the different alternatives to sand in preparation of concrete. this present experimental study a comparative study has been carried out to check the usability of robo sand in place of fine aggregate. This can be used as an alternative to fine aggregate in concrete. In the present investigation workability and strength of concrete was evaluated by replacement of natural sand by Robo sand in proportions of 0%,25%, 50%, 75%, and 100% is studied for M30 grade concrete cubes, cylinders and beams. Slump cone method is taken for finding workability. For strength parameters for each grade of concrete Cubes, Cylinders and beams were casted and tested at the age of 7,14 and 28 days

KEYWORDS: Compressive Strength, Flexural strength, River sand, Robo sand, Split tensile strength.

Copyright © 2014-2020 International Journal for Modern Trends in Science and Technology
All rights reserved.

I. INTRODUCTION

1.1 GENERAL:

Concrete is a mixture of 60 – 65% aggregates like sand, gravel, and crushed stone, 15 – 20% water, and only 10 – 15% cement. When mixed, the cement and water harden, binding the

aggregates into the solid mass we call concrete. Concrete is one of the most widely used man- made construction material in the world. Robo sand is the alternative material used as fine aggregate to produce concrete. Optimal quality of Robo sand for M30 grade of concrete has been

worked out, which can replace the Fine aggregate in order to get better strength. Concrete is made of Portland cement, water, cement and aggregates. Portland cement is hydraulic cement that hardens in water to form a water resistant compound. The hydration products act as binder to hold the aggregate Together to form concrete. The setting and hardening of concrete are the outcome of chemical and physical developments that take place between Portland cement and water called hydration.

1.2 ROBOSAND:

Robo Sand is also called as manufactured sand obtained by crushing natural granite stone. Robo Sand is defined as a crushed granite aggregate produced by crushing natural granite stone. The perfect substitute for river sand is Robo Sand. River sand is one of the basic ingredients in manufacture of concrete. River sand has become expensive and scarce. Therefore looking alternate to the river sand. The crusher dust is known as Robo sand can be used as alternative material to the river sand. Robo sand possesses similar properties as that of river sand, hence accepted as a building material. Robo Sand or M-Sand was used as replacement of fine aggregate. Robo Sand is a result of crushed stone, here the stones are crushed into smaller granular size of river sand granules and washed to remove the fine rock dirt to improve the quality as per IS: 2386-1975.

1.3 PROPERTIES OF ROBO SAND

Table: 1 properties of robo sand

S	PROPERTY	VALUE
1	Grading of robo	ZONE II as per IS
2	Specific gravity	2.69
3	Fineness	2.81
4	Silt modulus	Absent
5	Surface moisture	0.9%
6	Water absorption	2.27%

1.4 PRESENT STUDY: In the present investigation we design mix for M30 has been calculated using IS 10262-2009 for both conventional concrete and Robo sand concrete.. Tests were conducted on cubes, cylinders and beams to study the strength of concrete by using Robo sand and the results were compared with the Natural Sand Concrete. During the present study, 0%,25% 50%, 75% and 100% of traditional fine aggregate was replaced with Robo sand. Compression, split and flexural

strengths were found after 7 days and 28days of curing.

1.5 OBJECTIVES OF PROJECT

The main objective is to encourage the use of these products as construction material in building Objectives of Project

- To evaluate the workability characteristics in terms of slump for M30 grades of concrete by replacing the fine aggregates with robo sand by percentages of weight i.e., (0%, 25%, 50%, 75%,100%).
- To evaluate percentage increase in compressive strength, flexural strength and split tensile strength, for M30 grades of concrete with robo sand.
- To evaluate the difference of performance between natural sand and Robo sand.

II. LITERATURE REVIEW

Misra (1984) studied the effect of complete replacement of sand with crushed sand (fine sand passing through 75 μ). The percentage of water required to produce mortar of same consistency is high for Robo sand as compared to river sand of same grading and same mix

Sahu Kumar and Sachan (2003): - investigated the suitability of crushed stone dust waste as fine aggregate for concrete. Test results indicated that crushed stone dust waste can be used effectively to replace natural sand in concrete. Concrete made with this replacement can attain the same compressive strength, comparable tensile strength, modulus of rupture and lower degree of shrinkage as the control concrete.

Ilangovanaet al. (2008) studied the feasibility of usage of Robo Sand as hundred percent substitutes for natural sand in concrete.to study the strength of concrete made of Robo Sand and the results were compared with the natural sand Concrete. It is found that the compressive, flexural strength and Durability Studies of concrete made of Robo Sand are nearly 10% more than the conventional concrete.

Mr Shaik Mohammed Siraj (2017) "Cemebiner Concrete using Robo Sand "studied use of cemebinder as an admixture in varying proportion of 0%, 1%, 5%, 8%, 10% by weight of cement. The grade M25 was designed as per BIS 10262:2009-2009. It was found out that the compressive strength of the conventional M20 grade concrete was 28.36 N/mm² and the highest strength attained using cemebinder increased

significantly to about 37.61 N/mm². The usage of cement as an admixture in concrete only enhances the overall performance of concrete, but if it is used in excessive percentage it has adverse effects.

III. METHODOLOGY AND MATERIAL USED

3.1 Methodology

Concrete specimens were casted using 0%, 50%, 75% and 100% of replacement fine aggregate with Robo sand. Cubes of standard size 150mm were casted and tested for 7 and 28 days compressive strength. Standard cylinders of size 150mm x 300mm (diameter x height) were casted and tested for 7 and 28 days for split tensile strength. Also standard beams of size 500mm x 100mm x 100mm (length x width x height) were cast and tested for 28 days for flexural strength and observed the percentage of water absorption in both Robo Sand and Natural sand.

3.2 MATERIALS USED

The materials used in research are:

- 1) Portland cement (53 grade)
- 2) Fine aggregate (4.75 mm down)
- 3) Coarse aggregate (20 mm down)
- 4) Robo sand

Cement: Ordinary Portland cement of 53 grade conforming to Indian Standard IS 12269-1987 was used throughout the experimental program. Cement must develop the appropriate strength. It must represent the appropriate rheological behavior. Generally same types of cements have quite different rheological and strength characteristics, particularly when used in combination with admixtures and cementing material.

Fine Aggregate: Fine aggregate (sand) used for this entire investigation for concrete was river sand conforming to zone-II of IS: 383-1970. Fine aggregate normally consists of natural, crushed, or manufactured sand. The physical properties of fine aggregate like specific gravity, gradation and fineness modulus are tested in accordance with IS :2386.

Coarse Aggregate: Coarse aggregate crushed granite of 20 mm down size has been used as coarse aggregate. The physical properties of coarse aggregate like specific gravity, Bulk density, impact value, gradation and fineness modulus are tested in accordance with IS: 2386. Robo sand Robo Sand is a fine aggregate that is produced by

crushing stone, gravel, or slag. Used for aggregate material less than 4.75 mm that is processed from crushed rock or gravel and intended for construction use.

Robo sand: is a material of high quality, in contradiction to non-refined surplus from coarse aggregate production. The water, which is used for making concrete and for curing, should be clean and free from harmful impurities such as oil, alkali, acid, etc., in general, the water, which is fit for drinking should be used for making concrete.

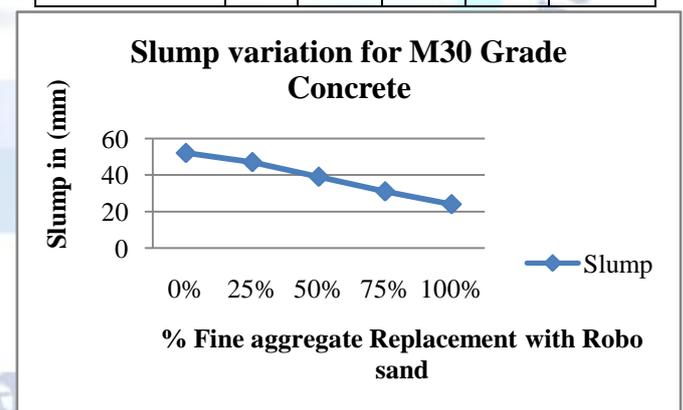
IV. RESULTS AND DISCUSSIONS

4.1 Workability in Terms of Slump

Slump study is conducted with and without admixture. It can be observed that as the percentage of the replacement of fine aggregate with robo sand increases the slump is decreasing as the water absorption capacity of robo sand is more compared to river sand hence the workability also decreases.

Table: 2 slumps for M30 grade concrete with different replacement percentages of fine aggregate by robo sand with and without admixture

Grade of concrete	M30				
% Replacement of Robo sand	0%	25%	50%	75%	100%
Slump in mm	52	47	39	31	24



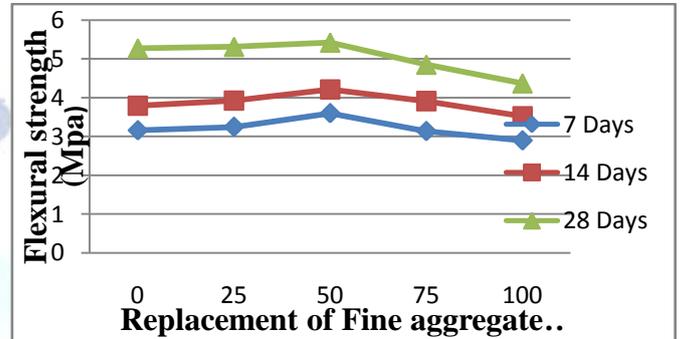
Graph: 1 Variation of slumps for M30 grade concrete with different replacement percentages of fine aggregate by robo sand with and without admixture

4.2 COMPRESSION STRENGTH

Table: 3 compression strength of concrete

S.NO	MIX DESIGNATION	REPLACE MENT OF CONCRET E	COMPRESIVE STRENGHT N/mm2		
			7 DAT YS	14 DAYS	28 DAYS
1	NOMINAL MIX	0	22.5	27.1	37.5
2	25R	25	22.6	33.12	36.62
3	50R	50	28.33	35.42	42.74
4	75R	75	27.61	33.72	39.5
5	100R	100	26.32	32.56	37.81

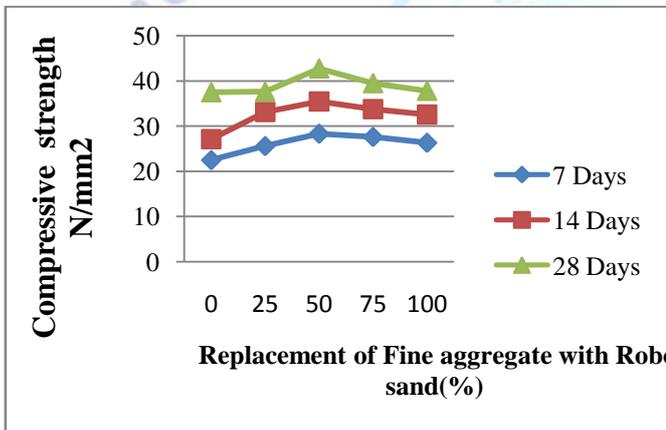
4	75R	75	2.93	3.6	4.15
5	100R	100	2.72	3.32	3.71



Graph: 3 Variation of split tensile strength

Table: 5 Flexural strength

S.N O	MIX DESIGNATI ON	REPLACEME NT OF CONCRETE	FLEXURAL STRENGHT N/mm2		
			7 DATY S	14 DAY S	14 DAY S
1	NOMINAL MIX	0	3.16	3.79	5.27
2	25R	25	3.25	3.92	5.31
3	50R	50	3.6	4.24	5.42
4	75R	75	3.14	3.91	4.85
5	100R	100	2.9	3.52	4.37

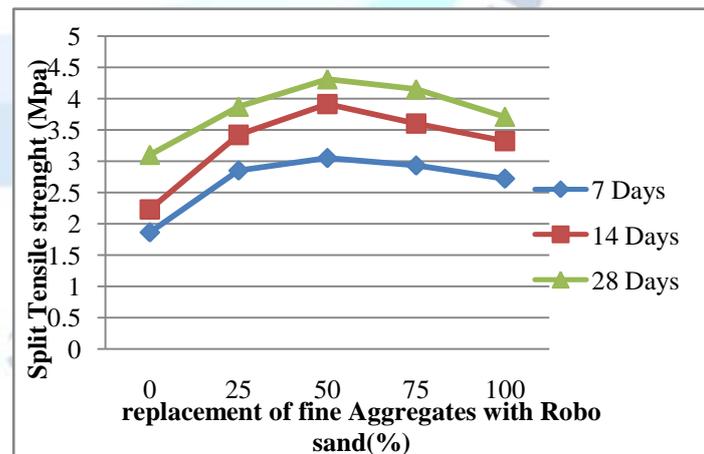


Graph 2 variation of compressive strength of concrete

4.3 SPLIT TENSILE STRENGTH

Table 4: split tensile strength

S. NO	MIX DESIGNATION	REPLACE MENT OF CONCRET E	SPLIT TENSILE STRENGHT N/mm2		
			7 DAT YS	14 DA YS	28 DA YS
1	NOMINAL MIX	0	1.86	2.23	3.1
2	25R	25	2.85	3.42	3.87
3	50R	50	3.05	3.91	4.31



Graph: 4 Variation of Flexural strength

By this tables and graphs shows that there is an increase in compressive strength, split tensile strength, flexural strength with 0%, 25%, 50%, 75%, 100% replacement of sand with Robo sand

and it decreases with after 50% replacement in M30 grade of concrete.

V. CONCLUSION

- The slump values of concrete with robo sand were observed to be relatively less when compared to conventional concrete. As robo sand had more water absorption capacity compared to the river sand. Therefore, workability of concrete decreases significantly with the increase of robo sand percentage in concrete.
- The compressive strength of concrete specimens made with 50% replacement of river sand by Robo sand gives higher strength of 12% to 13% as compare to reference mix.
- The split tensile strength of concrete specimens made with 50% replacement of river sand by Robo sand gives higher strength of 28% to 29% as compare to reference mix.
- The flexural strength of concrete specimens made with 50% replacement of river sand by Robo sand gives higher strength of 2% to 4% as compare to reference mix.
- By replacement of natural sand with Robo sand, the cost of the construction can be reduced to 10% per cum. higher results than the normal conventional concrete.
- The strength of the Robo sand concrete is comparatively 8-12% more than that of similar mix of conventional concrete.

FUTURE SCOPE OF WORK

- Replacing natural sand with different % of manufactured sand so that clear variation of strength can be plotted as well as optimum amount can also be determined.
- Conducting investigation for M40, M50 and also for high strength concrete
- Conducting chloride penetration test and water absorption tests on concrete ensure adequate durability

Suitability of manufactured sand must be ascertained for plastering.

REFERENCES

- [1] Misra. V. N., 1984, Indian Concrete Journal, August, vol. 58(8), pp. 219 -223.
- [2] A.K.Sahu, Sunil kumar and A.K.Sachan, Crushed stone waste as fine aggregate for concrete, The Indian Concrete Journal, January 2003pp845-847.
- [3] Ilangovana. R., Mahendrana. N. and Nagamani. K., 2008, ARPJ journal of Engineering and Applied Sciences,3(5), pp. 20 - 26.
- [4] Sirajet. al, (2017) "Cemibinder Concrete using Robo Sand" International Journal of Civil Engineering, Vol. 4 Issue 4.
- [5] IS: 8112-1989. Specification for 43 grade ordinary Portland cement. Bureau of Indian Standard as, New Delhi.
- [6] IS: 383-1970. Specification for coarse and fine aggregates from natural sources for concrete. Bureau of Indian standards, New Delhi. Study on Properties of Concrete using Robo sand as Fine Aggregate (IJSTE/ Volume 4 / Issue 3 / 008)
- [7] IS: 2386-1963 Part I to VIII. Indian standard Methods of test for aggregate for concrete. Bureau of Indian standards, New Delhi.
- [8] IS: 1199-1959. Indian standard methods of sampling and analysis of concrete. Bureau of Indian standards, New Delhi.
- [9] IS: 516-1959. Indian standard methods of test for strength of concrete. Bureau of Indian standards, New Delhi.
- [10] IS: 10262-2009 and SP 23: 1982. Recommended guidelines for concrete mix. Bureau of Indian standards, New Delhi.