iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4051

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Study of Effect on Compressive Strength by Replacing Natural Sand with Crushed Sand

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Abstract: ***The quantity of concrete is consumed by construction industry all over the world. In India the conventional concrete is produced by using natural sand obtained from river bed as fine aggregate. But now as the use of concrete has increased all over the world. Simultaneously use of natural sand has also increased and as the consumption of sand has increased the required quality of sand is not available and also posses the environmental problem and hence government restrictions on sand quarrying resulting in scarcity and significant increased in its cost. so an attempt has been made to discuss the properties such as workability tensile strength and compressive strength of concrete prepared by replacing natural sand with artificial sand at different replacement level 10%, 20%, 30%, 40%, 50%, 60%, 70%, 90%, 100%).Aim of project is to study the strength and durability performance of concrete made with natural sand and artificial sand.***
Keywords: Natural Sand, Crushed Sand, Concrete, Compressive , Strength and Tensile Strength

I. INTRODUCTION

In the last 15 years it has been clear that availability of natural sand is decreasing. Environmental concern are also been rising against uncontrolled extraction of natural sand. The argument is mostly in regards of protecting the natural river bed against erosion and importance of having natural sand as a filter for ground water. In today's competitive world the demand of natural sand is not going to decreasing, the only best possible way to reduce its extraction is find another alternative for it.

The global consumption of natural sand is very high, due to the extensive use of concrete . In general, the demand of natural sand is quite high in developing countries to satisfy the rapid infrastructure growth, in this situation developing country like India facing shortage in good quality natural sand . Particularly in India , natural sand deposits are being depleted and causing serious threat to environment as well as the society. Increasing extraction of natural sand from river beds causing many problems, loosing water retaining sand strata, deepening of the river courses and causing bank slides, loss of vegetation on the bank of rivers, exposing the intake well of water supply schemes, disturbs the aquatic life as well as affecting agriculture due to lowering the underground water table etc are few examples. Conventionally concrete is mixture of cement, sand and aggregate. Properties of aggregate affect the durability and performance of concrete, so fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river or pit sand. Now-a-days good sand is not available it is transported from one place to another so it is need of the time to find substitute to natural river sand. Because of limited supply the cost of natural river sand has sky rocketed and its consistence supply cannot be guaranteed.

Now a day's sand is becoming a very scarce material, in this situation research began for inexpensive and easily available alternative material to natural sand. However, scarcity in required quality is the major limitation in some of the above materials. Now a day's sustainable infrastructural growth demands the alternative material that should satisfy technical requisites of fine aggregate as well as it should be available abundantly. For the purpose of experimentation concrete mix are designed for M20 & M25 grade by replacing natural sand with artificial sand at different replacement levels of 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% Approximately 80% of total volume of concrete is the main matrix of concrete or mortar. When fine particle are in proper proportion, the sand will have fewer voids. In this situation research began for inexpensive and easily available alternative material to natural sand. Under this circumstances use of natural sand is inevitable. For the purpose of experimentation we are going design concrete mixes of M20 & M25 grade by replacement of natural sand to artificial sand.

A. Objectives

1) To study the influence of artificial sand on the compression and tensile strength of concrete.
2) To determine the strength of concrete for grades M20 & M25.
3) Optimum use of artificial sand that can be use in construction

4) To determine various strength of concrete, various property of concrete
5) To make our structure in an economical cost without compromising the strength.

B. Advantage of Crush Sand

1) Crush sand is easily available in villages, and cities
2) Crush sand has a property same as that of Natural River sand i.e. it can be useful for construction as its size, shape is as required.
3) Crush sand is cheaper than that of natural river sand.
4) Crush sand contains no organic impurities.
5) No wastage in crush sand since Sand is already sieved in the required size (below 4.75 mm).
6) Crush sand does not harm to the environment in any way as natural sand provide harm causing bank slides, loss of vegetation on the bank of rivers etc

II. MATERIAL USED

A. Natural Sand

The natural sand used for experimentation should be locally available near the construction site .The specific gravity of this sand was found to be 2.6. natural sand is sieved through 4.75 mm sieve and passing sand used for experimental work.

Fig: River sand

B. Crushed sand

Crushed sand used for experimentation work is having specific gravity 2.83. In our research work crushed sand is obtained from Jaysingpur crusher, Sangali - kolhapur road , Kolhapur.

TABLE: Specimen prepared with different variation of crushed sand.

Properties	Natural sand	Crushed sand
Sp. Gravity	2.60	2.83
Silt Content	10%	0%

Fig. Crushed Sand

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
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C. Cement

Ordinary Portland cement of 43 grades satisfying all the requirements used in making the concrete in the experimental work.

Table: Physical properties of cement

Physical properties	Values of OPC
Standard consistency	32.5%
Sp gravity	3.15
Initial setting time	>30 min
Final setting time	<600 min

Fig: Cement

D. Coarse Aggregate

Coarse aggregates of 20mm size obtained from local quarry site were used for the experimentation. The specific gravity of coarse aggregate is 2.76. The coarse aggregate are sieved through IS sieve of 20 mm . Collect the aggregate of 20 mm size. These aggregate should be angular & and free from organic impurities.

Fig: Coarse Aggregate

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III. TEST CONDUCTED ON SAND

A. Sieve analysis of sand

A sieve analysis is commonly used procedure in civil engineering to assess the partical size distribution of granular material. Sieve analysis can be performed on any type of organic or non organic granular material including natural sand, crushed sand, clay down to a minimum size depending on exact method. By using sieve analysis the sand having size less than 4.75 mm.

Fig: Sieve Analysis.

B. Specific Gravity of Sand

Specific gravity is defined as the ratio of the weight of a unit volume of aggregate to the weight of an equal volume of water. Specific gravity expresses the density of the solid fraction of the aggregate in concrete mixes as well as to determine the volume of pores in the mix.

[Specific Gravity (S. G) = (density of solid) / (density of water)]

Fig : Specific gravity by pycnometer

IV. METHODOLOGY

A. Quantity Calculation

1) Cement = 187.2Kg

2) Fine Aggregate

Natural sand =115.17Kg

Crushed sand=140.78Kg

3) Course Aggregate =330.1 Kg

4) Water = 72.8 litre

B. Procurement of Material

1) Cement

2) Fine Aggregate

Natural sand

Crushed sand

3) Course Aggregate
4) Water

C. Casting of Specimens:
1) Cube = 66

V. EXPERIMENTAL WORK

A. Material Used

In our experiment we use Ordinary Portland Cement of 43 grades available in local market of standard brand. We use fine aggregate as locally available natural Sand and artificial sand**.** We use water is preparation of mortar which is least expensive but most important ingredient of concrete. The water which is used for making concrete should be clean and free from harmful impurities such as Oil, Alkalies, Acids, etc. In general the water which is fit for drinking should be used for making concrete. And crush sand use in that of size less than 4.75mm.

B. Casting

For the casting, the cast iron moulds are clean of dust particles and applied with oil on all sides before concrete is poured in the moulds. The moulds are place on a level platform. The well mixed concrete is filling, allow to flow and settle itself in the moulds. Excess concrete was removing with trowel and top surface is keep level and smooth. In this Total number of 66 cubes we have to cast.

Fig: casting of cubes

C. Curing

After that the specimens are cured in mould for 24 hours. After 24 hours, all the specimens are demould and kept in curing tank for 28 days. After 28 days all specimens are kept in atmosphere for 1day for constant weight. And then testing is carrying out on them.

Fig: curing of cubes

D. Testing on block

We perform following test for prepare blocks.

E. Compressive Test

Out of many test applied to the concrete, this is the important test which gives an idea about all the Characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. For cube test specimens cubes of 15 cm X 15 cm X 15 cm are prepared. This concrete is poured in the mould and tempered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of this specimen should be made even and smooth. These specimens are tested by compression testing machine after 28 days curing.

Fig: comp. Strength on cube specimen

VI. QUANTITY OF MATERIAL REQUIRED

A. For 1 meter cube concrete:

1) M20

a) Density of cement =1400

b) Density of coarse aggregate = 1600

c) Density of fine aggregate =1120

Content	Volume per meter cube
Cement	0.27 cubic meter
Sand	0.41 cubic meter
Coarse Aggregate	0.82 cubic meter

2) M25

a) Density of cement =1400

b) Density of coarse aggregate = 1600

c) Density of fine aggregate =1120

Content	Volume per meter cube
Cement	0.38 cubic meter
Sand	0.38 cubic meter
Coarse Aggregate	0.75 cubic meter

VII.MATERIAL & RESULTS

A. *For M20 Grade Concrete*

Table: Quantity of Material

Sr. No.	% of replacement	Cement	Aggregate	Natural sand	Crushed sand	Water
1	10	7.95	18.60	11.96	1.33	4
2	20	7.95	18.60	10.63	2.66	4
3	30	7.95	18.60	9.30	3.96	4
4	40	7.95	18.60	7.97	5.33	4
5	50	7.95	18.60	6.64	6.64	4
6	60	7.95	18.60	5.33	7.97	4
7	70	7.95	18.60	3.96	9.30	4
8	80	7.95	18.60	2.66	10.63	4
9	90	7.95	18.60	1.33	11.96	4
10	100	7.95	18.60	0	13.30	4

B. *Result*

Table: Compressive Strength of Concrete Block

Sr. NO.	% of replacement	Curing period	Compressive Strength			Average strength
			1	2	3	
1	10	28	23.80	24.65	24.15	24.20
2	20	28	23.3	22.90	22.95	23.05
3	30	28	24.15	24.70	24.35	24.24
4	40	28	24.85	24.45	25.40	24.90
5	50	28	25.35	25.05	24.90	25.10
6	60	28	25.15	25.65	25.25	25.35
7	70	28	24.95	25.75	27.75	25.15
8	80	28	24.30	25.45	24.96	24.90
9	90	28	24.05	24.55	24.30	24.30
10	100	28	21.85	22.60	21.00	22.05

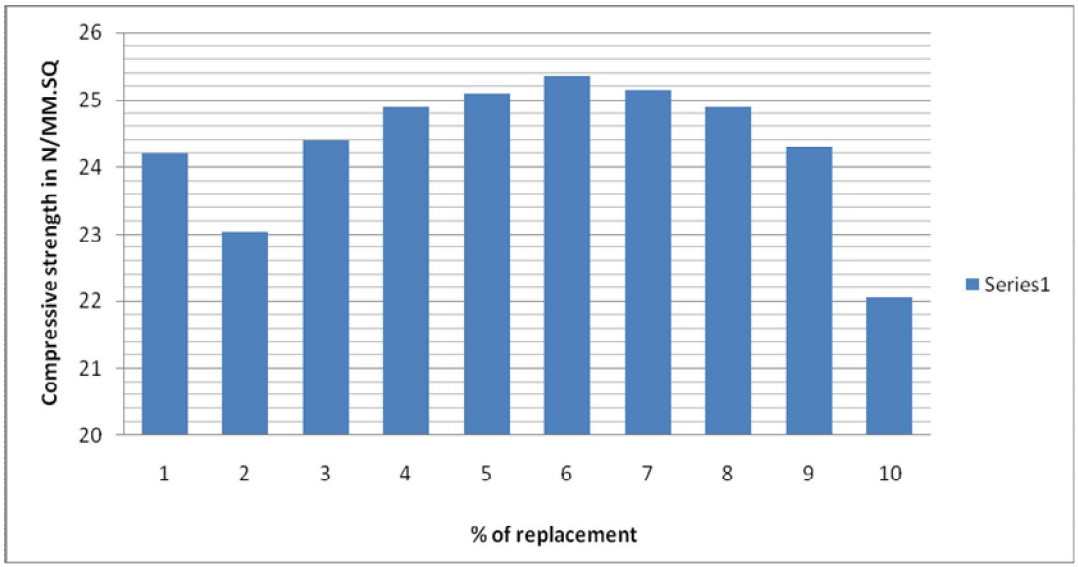

Fig: Compressive strength of cube

C. For M25 Grade Concrete

Table: Quantity of Material

Sr. No.	% of replacement	Cement	Aggregate	Natural sand	Crushed sand	Water
1	10	10.77	17.01	11.08	1.23	3.28
2	20	10.77	17.01	9.85	2.46	3.28
3	30	10.77	17.01	8.62	3.69	3.28
4	40	10.77	17.01	7.39	4.92	3.28
5	50	10.77	17.01	6.155	6.15	3.28
6	60	10.77	17.01	4.92	7.39	3.28
7	70	10.77	17.01	3.69	8.62	3.28
8	80	10.77	17.01	2.46	9.85	3.28
9	90	10.77	17.01	1.23	11.07	3.28
10	100	10.77	17.01	0	12.31	3.28

D. Result

Table: Compressive Strength of Concrete Block

Sr. No.	% of replacement	Curing period	Compressive strength			Average strength
			1	2	3	
1	10	28	31.05	31.70	31.45	31.40
2	20	28	31.95	32.65	32.30	32.30
3	30	28	32.80	32.05	33.25	32.70
4	40	28	31.70	31.65	32.65	32.00
5	50	28	33.15	32.75	33.25	33.05
6	60	28	33.45	33.90	33.45	33.60
7	70	28	33.10	34.45	34.30	33.95
8	80	28	33.00	33.50	33.40	33.30
9	90	28	31.80	32.25	31.95	32.00
10	100	28	31.50	31.55	30.15	31.10

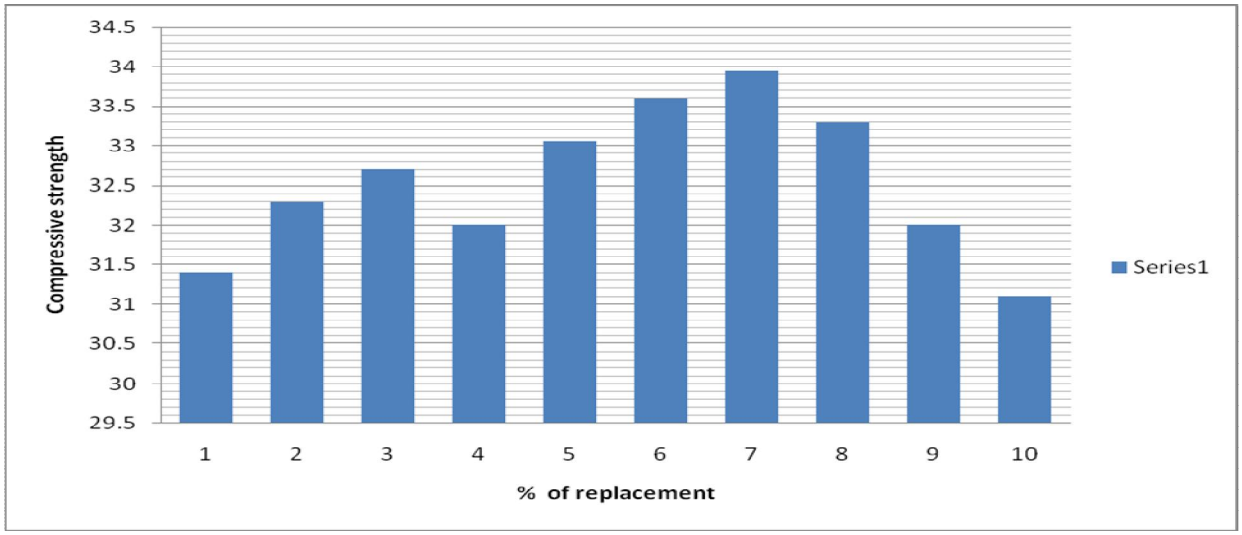

Fig: Compressive strength of cube

VIII. CONCLUSION

A. For M20 Grade of concrete

1) When replacement of river sand with crushed sand by10% to 20% the compressive strength decreases.
2) When replacement of natural sand with crushed sand by 30% to 60% compressive strength increases.
3) When the replacement of river sand with crushed sand by 70% to 100% compressive strength decreses.

B. For 25 Grade of concrete

1) When replacement of river sand with crushed sand by 10% to 30% the compressive strength increases.
2) When replacement of natural sand with crushed sand by 40% compressive strength decreases.
3) When the replacement of river sand with crushed sand by 50% to 70% compressive strength increases.
4) When the replacement of river sand with crushed sand by 70% to 100% compressive strength decreases.

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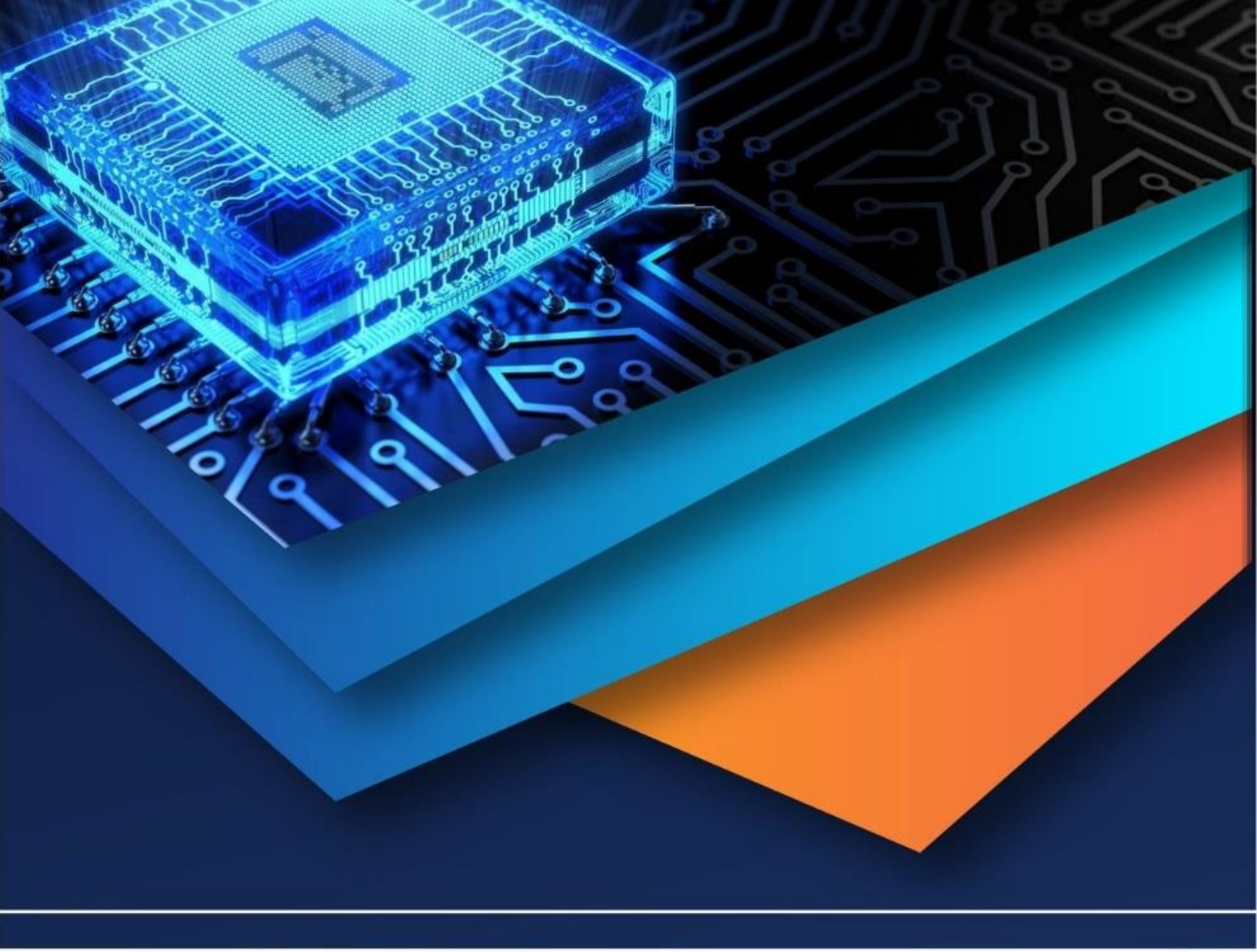

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