Feasibility Of Artificial Sand In Concrete

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Abstract

The paper Present the study of replacement of natural sand with artificial sand in concrete conventionally concrete is a mix of cement sand and aggregate there is a large variation in the strength of concrete due to variation in strength of aggregate use there is a scarcity of natural sand due to heavy demand in construction activities which forces to find suitable substitute the chipset and easy way of getting substitute for natural sand is sand which is produced from quires tone by crusher prepared specially so as to get cubical, smooth textured, well graded particles of fine aggregate is called artificial sand . This paper present the physibility of artificial sand in concrete for the purpose of experimentation concrete mixes are design for m20 and m25 grades by 0 to 100 % with increment of 20 % replacement of natural sand by artificial sand. Compressive and tensile test are conducted to study the strength of concrete for above replacement.

1. Introduction

We cannot imagine the structures without concrete. Concrete is a main constituent of the Civil Engineering structures. It is becoming the backbone of infrastructural development of whole world. Concrete has capacity to enhance its properties with the help of other suitable constituents.

The main disadvantages of concrete are as follows -

- Brittleness
- Very low tensile strength
- Less resistance to cracking
- Heavy mass (density)
- Plastic and drying shrinkage.
- Permeability and bleeding of water

Approximately 80% of total volume of concrete is made up of aggregates. Aggregates characteristics (size, shape, texture, grading) influence the workability, finish ability, bleeding, and segregation of fresh concrete and durability of hardened concrete. Fine aggregates may be one of the following types; Natural sand, crushing natural gravels, crushing hard stones (artificial sand).

With natural sand deposits the world over drying up, there is an acute need for a product that matches the properties of natural sand in concrete. In the last 15 years, it has become clear that the availability of good quality natural sand is decreasing. With a few local exceptions, it seems to be a global trend. Existing natural sand deposits are being emptied at the same rate as urbanization and new deposits are located either underground, too close to already built-up areas or too far away from the areas where it is needed, that is, the towns and cities where the manufacturers of concrete are located. Environmental concerns are also being raised against uncontrolled extraction of natural sand. The arguments are mostly in regards to protecting riverbeds against erosion and the importance of having natural sand as a filter for ground water. The above concerns, combined with issues of preserving areas of beauty, recreational value and biodiversity, are an integral part of the process of most local government agencies granting permission to aggregate producers across the world. This is the situation for the construction industry today and most will agree that it will not change dramatically in the foreseeable future.

Test were conducted on cube and cylinder by replacing natural sand 0% , 20%, 40%, 60% 80% and 100% by artificial sand for M20 and M25 grades of concrete.

2. Literature Review

The consumption of cement content, workability, compressive strength and cost of concrete made with Quarry Rock Dust were studied by researchers Babu K.K.et.al , Nagaraj T.S.et.al, and Narasimahan et.al. The mix design proposed by Nagaraj et.al shows the possibilities of ensuring the workability by wise combination of rock dust and sand, use of super plasticizer and optimum water content using generalized lyse Rule.

M. R. Chitlange in 2010 study shows that mixes with artificial sand as fine aggregate gives consistently higher strength than the mixes with natural sand. The sharp edges of the particles in artificial sand provide better bond with cement than the rounded particles of natural sand resulting in higher strength. The excessive bleeding of concrete is reduced by using artificial sand.

R. Ilangovana1, N. Mahendrana1 and K. Nagamanib2 states that the Physical and chemical properties of quarry rock dust is satisfied the requirements of code provision in properties studies. Natural river sand, if replaced by hundred percent Quarry Rock Dust from quarries, may some times give equal or better than the reference concrete made with Natural Sand, in terms of compressive and flexural strength studies

Priyanka A. Jadhava and Dilip K. Kulkarni The effect of concrete with partial replacement of manufactured sand on the properties of normal strength concrete with water cement ratio of 0.45 and 28 day's compressive, split tensile and flexural strength of 20Mpa (2900 psi) and workability (slump and compacting factor) were studied. The effect of percentage replacement of manufactured sand on strength property and workability were evaluated and compared with reference mix of 0% replacement of natural sand by manufactured sand.

P.T.Santhosh Kumar1 and K.K.Sajeevan2 Even though concrete with CSFA has a reduced 28 day compressive strength than river sand (Table 1), it can be adopted for construction, as the strength obtained from CSFA is considerably more than that predicted by Fig. 47 of SP: 23- 1982. Also, IS: 383- 1970 permits the use of CSFA as fine aggregate if it confirms to the requirements in Table 4 of this code.

P.Aggarwal investigated that the bottom ash which falls into the furnace bottom can act as an alternative to natural sand as the Compressive strength of bottom ash concrete containing 50% bottom ash is acceptable for most structural applications since the observed compressive strength is more than 20 MPa at 28 days.

Mark James Krinke concludes that with the addition of a superplasticiser a concrete mix containing manufactured sand is capable of not only achieving a workability similar to that of natural sand, however to achieve this workability, dosages as high as 2.36 percent were required. The additional cost of these large amounts of super plasticiser in the concrete mix makes the manufactured sand concrete mix less economical to produce then a natural sand control mix. However with the declining availability of natural sands suitable for use in concrete, the use of concrete mixes containing 100 percent manufactured sand or high percentages of manufactured sands in the aggregate blend may become a lot more common.

It is seen from above studies there a variation in strength enhancement of concrete made from artificial sand to encourage the use of locally available artificial sand promotes to study to check it suitable replacement percentage in the concrete.

3.Material:

3.1. Cement

Ordinary Portland cement of 43 grades confirming to IS 12269-1987 was used. The physical properties are tabulated as shown below

TABLE I
PROPERTIES OF PORTLAND CEMENT(43 GRADE)

No.	Property	Value
1	Specific gravity	3.12
2	Fineness m3/ Kg	315
3	Normal Consistency	37%
4	Initial setting time	180 minute
5	Final setting time	220 minute
6	Soundness	1.5 mm
7	7 days compressive strength	33.25 MPa

3.2. Fine Aggregate

Natural sand obtained from the river and normally available in the market was used. The artificial sand obtained from the local crusher was used. The physical properties of natural and artificial sand are listed below. The sieve analysis details are given in table 3. Both types of fine aggregate are confirming to zone II of IS 383-1970.

TABLE II
PROPERTIES OF NATURAL AND ARTIFICIAL SAND

Property	Natural Sand	Artificial
Specific Gravity	2.6	3.05
Bulk Density kn/m3	15.60	17.62
Fineness Modulus	2.78	3.05

TABLE III
SIEVE ANALYSIS DETAILS OF NATURAL AND ARTIFICIAL SAND

IS Sieve	Percentage Passing	
	Natural Sand	Artificial Sand
4.75 mm	96.2	95
2.36 mm	88.4	78
1.18 mm	65.8	55
600 micron	47.1	40
300 micron	19.6	20
150 micron	5	12

3.3. Coarse Aggregate

Crushed natural rock stone aggregate of nominal size 10 mm and 20 mm mixed aggregate are used. The physical properties of these coarse aggregated are listed below.

TABLE IV
PROPERTIES OF COARSE AGGREGATE

No.	Property	Value
1	Specific Gravity	3.10
2	Bulk density kn/m3	16.10
3	Fineness Modules (20 and 10) mm	7.57

TABLE V
SIEVE ANALYSIS OF COARSE AGGREGATE

IS Sieve	Percentage Passing
40 mm	100
20 mm	60
10 mm	30
4.75 mm	00
2.36 mm	00
1.18 mm	00
600 micron	00
300 micron	00
150 micron	00

TABLE VI

QUANTITY OF MATERIAL (FOR MIX)

SR. NO	GRADE OF CONCRETE	M 20
1	Cement kg/m3	360.84
2	Fine aggregate kg/m3	651.70
3	Coarse Aggregate(10 mm and 20 mm) kg/m3	1210.30
4	Water liter /m3	180.42
5	Water cement ratio	0.50
6	Cement aggregate ratio	1 :5.16
7	Compaction factor	0.89

4. Experimentation

The characteristics were followed by concrete mix test programme will investigate initially . The physical

Characteristics of material used that is cement natural sand, artificial sand and course aggregate.

The exact amount of concrete ingredients were weighed and mixed thoroughly in laboratory concrete mixer till the consistent mix was achieved. The workability of fresh concrete was measured in terms of compaction factor . The standard cube of 150 mm size is steel mould and cylinder of 150 mm. diameter and 300 mm. length compacted on vibrating table. Six cubes and six cylinders with varying percentage of natural and artificial sand were cast for testing. The average strength was calculated the acceptance criteria using IS 456 – 2000 is followed and the average values are illustrated in tables.

5. Conclusion

From the above result following conclusion are drawn.

It is observed that replacement of natural sand with 60 % to 80% by artificial sand is found feasible.

For M20 grade of concrete the percentage increase in compressive strength and tensile strength by 29.44% and 5.39 % respectively by replacing natural sand. .Hence artificial sand can be recommended as a good and competitive substitute for natural sand.

It can be seen that mixes with artificial sand as a fine aggregate gives better strengths than mixes of natural sand due to sharp ages of the particle in artificial sand provide better bond with cement than rounded particle of natural sand .

The purchase cost of artificial sand is about 60% to 70 % to that of natural sand. Hence artificial sand concrete may be chipper than natural sand concrete.

The test result obtained from well plant and carefully performed experimental programmed considering technical, environmental and commercial factors.

TABLE VII
RESULT OF COMPRESSIVE STRENGTH & SPLIT TENSILE STRENGTH (M 20 GRADE)

Sr. No	Percentage of Artificial sand	Percentage of Natural sand	Compressive. Strength N/mm2		Split Tensile strengthkN/mm2	
			7 Day	28 Day	7 Day	28 Day
1	00	100	26.21	31.58	0.83	1.67
2	20	80	26.69	31.85	0.67	1.76
3	40	60	27.69	32.29	1.34	1.76
4	60	40	27.70	40.88	1.25	1.79
5	80	20	27.70	39.11	1.17	1.50
6	100	00	26.54	35.15	1.25	1.55

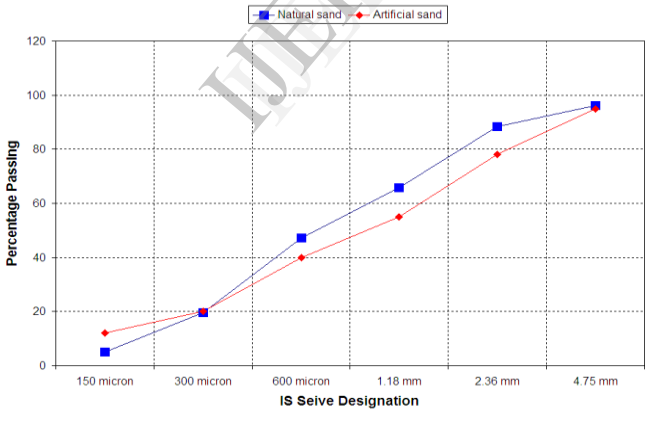

Figure1 Sieve Analysis of Natural and Artificial Sand

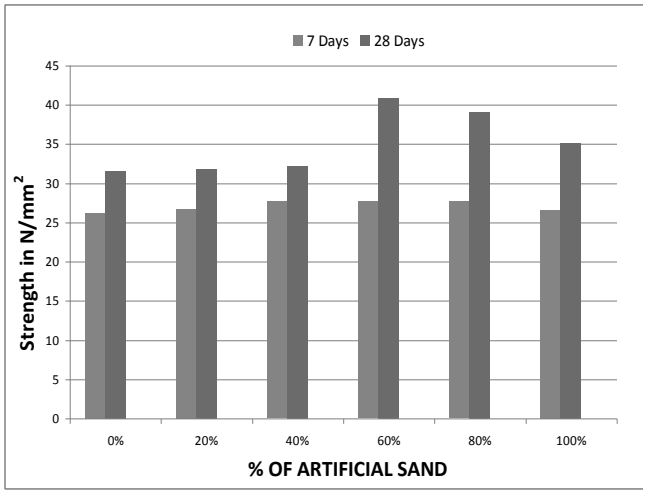

Figure 2 Graphical Representation of Compressive Strength of Concrete For M20 Grade

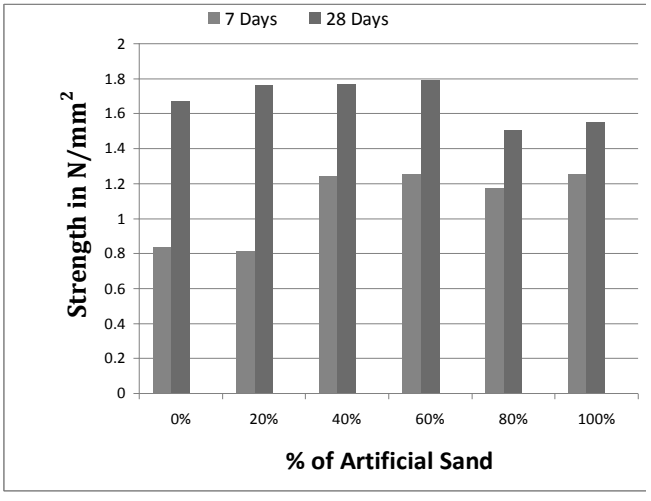

Figure 3. Graphical Representation Of Split Tensile Strength Of Concrete For M20 Grade

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