Study Of Artificial Sand as Fine Aggregate For M-20 Manufactured Concrete in High Strength Construction

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Abstract: Concrete is versatile material of construction everywhere the globe. The natural sand is widely used as a fine aggregate. Due to the large demand the resources of natural sand are almost exhaust hence to meet demand of fine aggregate it has been impose to use artificial sand to keep the quality of concrete intact with artificial sand there is need to study properties of concrete by replacing natural sand with artificial sand. Primary aim is that to low the cost of construction by use of artificial sand aggregates. Secondary aim is to replace successful natural sand by artificial sand aggregates. To get optimum compression strength of concrete by the used of varied proportion of natural sand and artificial sand aggregates. In this project compressive strength of concrete have been studied by replacing natural sand with artificial sand with 25%,50%,75%,100%. Out of these better mix proportion is identified on the basis of compressive strength. It has been found that with use of artificial sand the workability of concrete reduces drastically with intern reduces the compressive strength of concrete due to poor compaction. It has been found that concrete with replacement 75% of natural sand with artificial sand gives better result as compare to concrete with natural sand.

Key Words: — ***M-20 grade, artificial sand, natural sand, compressive strength, concrete.***

I. INTRODUCTION

The study was conducted with aim to present state-of-the-art knowledge regarding production and utilization of artificial sand. The overall objective is to develop a technology platform for the shift from natural to manufactured aggregates based on hard rock. This includes knowledge of resource management, cost effective production, use of manufactured aggregates in concrete and mix design concepts for concrete [1]. There is the heavy demand and shortage of natural sand in the growing infrastructure activities. It is necessary to find out cheap and good quality of material. It is possible to replace natural sand by artificial sand. In last 15 years it has been clear that availability of natural sand is decreasing. Environmental concern is also been rising against uncontrolled extraction of natural sand [2]. 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.

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Artificial sand is substitute of river sand for construction purposes and produced from hard granite stone crushing. The scarcity of natural sand due to such heavy demands in growing construction activities have forced to find the suitable substitute [3]. One of the cheapest and the easiest way getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade. Few authors carried out studies on the compressive strength studies of concrete made of manufactured sand(M-sand)/artificial sand in varying proportions were higher than those of conventional concrete by using natural sand as fine aggregate ([4], [5],[6]-[7],[8]). However, it was found that workability of the concrete mixes decreased with an increase in percentage of M-sand as fine aggregate [9]. The study revealed the more water requirement for concrete when M-sand replaced against natural sand and it's advisable to use admixture to maintain desired workability.

For the purpose of experimentation concrete mix is designed for M20 grade concrete with 50% natural, 50% artificial sand and other with 25% natural, 75% artificial sand. A comparison of control mixes concrete M-sand concrete to compressive strength of M20 concrete with concrete of various replacements of natural sand to manufactured sand is studied in this paper along with the workability of concrete. An attempt has been made to find optimal percentage replacement

of fine aggregate with M-sand to get maximum strength.

II. PERSONALITY ASSESSMENT THEORY

2.1 General requirement of artificial sand

All the sand particles have higher crushing strength and without any organic impurities. The surface texture of the particles should be smooth with rounded edges as shown in Fig. 1. Silt in sand should not be more than 2% for crushed sand [10].

Fig. 1 (a) Natural sand (b) Artificial sand

2.2 Production and process manufacturing

The process of M20 manufacturing involves aggregate crushing, primary crushing, cone crusher and Vertical shaft Impactors. (V.S.I.) [11, 12].

2.2.1 Primary crusher:

The first step of crushing is mostly done by large crusher or some time also large gyrators. The primary step is not the most decisive for the quality of crushed concrete aggregates.

2.2.2 Cone crusher:

The cone crusher can be said to be the most determinant factor in the process, doing the volume of the reduction work in most quarries. The choice and operation of cone crusher(s)in a quarry is also (for a "traditional" quarry design) the key to materials quality. In order to start making optimized products in an early part of the process, some modem quarries are using large cones already as C2 instead of the more flake producing gyrators.

2.2.3 VSI crusher:

It incorporates three crushing types and it can be operated 720 hours continuously. Nowadays, VSI crusher has replaced hammer crusher, roller crusher, roller ball mill, becoming the mainstream equipment in sand making business.

2.2.4 Casting of Concrete specimens:

The mix proportion as obtained by following the guidelines of IS: 10262-1982 [3] was used in making the concrete mixes in the form of cubes and slab panels for study of compressive strength. The concrete cubes of 150 mm side and slab panels of 500x300x50mm size were cast by replacing the natural sand at replacement levels of 25%, 50%, 75% and 100% using artificial sand as the compositions presented in Table 1. The workability of the concrete so prepared was studied by conducting slump test as per the standard procedure given in IS: 1199–1959[4]. Standard cube specimens were cast using the procedure described in IS: 516–1959 and were immediately covered with wet cloths and kept there for 24 hours and then released in water tank for 28 days curing [13].

2.2.5 Testing of Specimens:

After 28 days curing period, the concrete cube specimens cast by replacing natural sand with artificial sand at different replacement levels were tested under a compression testing machine (Figure 2) following the procedure given in IS:516–1959 [5].

Fig.2. Cube testing machine

III. MATHEMATICAL MODEL

The M-20 grade concrete blocks were manufactured adopting the composition as mentioned in Table 1.

Table.1. Composition of M-20 grade of concrete

M-20 grade of concrete	100% Natural soil (M1)	100% Artificial sand (M2)	50% Natural sand and 50% Artificial sand (M3)	25% Natural sand and 75% Artificial sand (M4)
Cement	2.5 kg	2.5 kg	2.5 kg	2.5 kg
Natural Sand	3.75 kg	-	1.875 kg	0.94 kg
Artificial Sand	-	2.75 kg	1.875 kg	2.8125 kg
Aggregate	7. 5kg	7.5 kg	7.5 kg	7.5 kg

IV. Result And Discussion

The motivation for this seminar is the increasing miss balance between the need for aggregates in the society and the availability of traditionally suitable geologic sources. A strong need is realized for developing and implementing technology that can enable the use of alternative resources, reduce the need for transport and present zero waste concepts for the aggregate and concrete industry. Aggregate producers are faced with constant demands for higher quality aggregates and, at the same time, have to take environmental issues into account [14].

The manufactured concrete block was labelled and evaluated for its strength and quality attributes. Concrete after properly curried for 7 days and 28 days are taken from the curing tank and exposed for few hours for natural conditions and then tested in 2 tonne capacity concrete compressive testing machine [15]. The compressive strength of various mixes of M20 grade presented in Table 2 and Fig. 4.

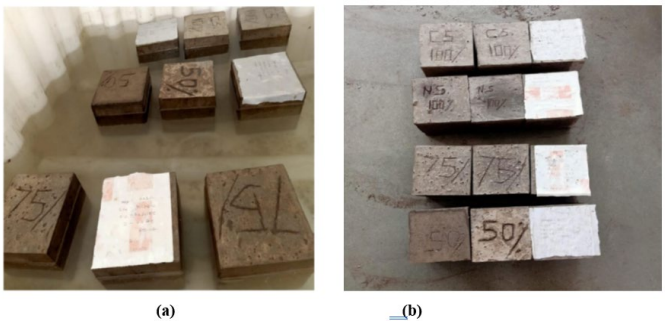

Fig.3. M-20 grade blocks: (a) Curing of blocks (b) Finished block

Table.2. Compressive strength of manufactured M-20 blocks

Sr. No.	M-20 grade concrete block	Compressive Strength N/mm²	
		7 days	28 days
1	M1	23.90	31.95
2	M2	19.10	34.15
3	M3	21.06	33.25
4	M4	23.80	33.06

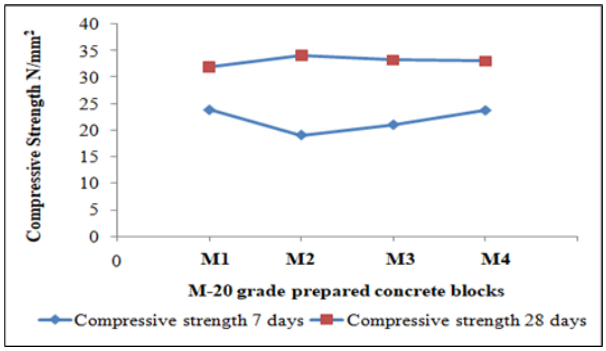

Fig.4. Compressive strength at 7 days and 28 days

V. Conclusion

All the artificial sand particles should have higher crushing strength. The surface texture of the particles was smooth. The edges of particles are grounded. The ratio of fines below 600 microns in sand should not be less than 30%. There should not be any organic impunity. Silt in sand should not be more than two percentage and total limit of 5 %. In crushed stone sand the permissible limit of fines below 150 microns may be up to 20 %. This does not affect the 5 % permissible limit. The compressive strength of all mixes increased with age from 7 days to 28 days. Current investigation revealed that compressive strength decreases at 28 days for concrete beyond 70% replacement of natural sand by M-sand. On the other hand, compressive strength decreases at 28 days for concrete with admixture for beyond 75% replacement of natural sand by M-sand. Hence, for achieving maximum strength of M20 concrete, the optimum replacement of natural sand up to 75% permissible with admixture and beyond 75% replacements of natural sand also yields the better strength than the natural sand.

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