

An Experimental Study on the Concrete Prepared with Natural and Artificial Sand

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Abstract: Artificial sand also called manufactured sand or crushed sand, the prepared by crushing rocks, stones or larger aggregates into small size particles in the quarry. Recent years, with the decrease of natural sand, the market of artificial sand shows great potential and vitality. The huge demand of the construction market has encouraged the development of the artificial sand market rapidly. Natural sand is worn out particles of rocks and are of various grades or sizes depending upon the amount of wearing. At present good sand is not readily available, it is transported from a long distance. Those resources are also exhausting very rapidly. So, it is a need of the time to find some substitute to natural sand. The Artificial sand produced by proper machines can be a better substitute to natural sand. Well graded sand is expected in the concrete. When fine particles are in proper proportion, the sand will have fewer voids. The cement quantity required will be less. Such sand will be more economical. Demand for manufactured sand for making concrete is increasing day by day as natural sand cannot meet the increasing demand of construction area. Natural sand takes number of years to form and is not replenishable. Because of its inadequate supply, the cost of Natural sand has increased and its steady supply cannot be assured. Under these situations use of Artificial sand becomes unavoidable. Natural sand in many parts of the country is not graded properly and has excessive silt and organic impurities and these can be harmful to durability of concrete whereas Artificial sand has no silt or organic impurities. In the present paper an attempt has been made to experimentally study the compressive strength of concrete cubes prepared with natural and artificial sand.

Keywords: Natural sand, Artificial sand, compressive strength, slump value.

I. INTRODUCTION

Natural or River sand are weathered and worn out particles of rocks and are of various grades or sizes depending upon the amount of wearing. When fine particles are in proper proportion, the sand will have fewer voids. The cement quantity required will be less. Such sand will be more economical. Demand for manufactured fine aggregates for making concrete is increasing day by day as river sand cannot meet the rising demand of construction sector. Natural river sand takes millions of years to form and is not replenishable. Because of its limited supply, the cost of Natural River sand has sky rocketed and its consistent supply cannot be guaranteed. Under these circumstances use of Artificial sand becomes inevitable. River sand in many parts of the country is not graded properly and has excessive silt and organic impurities and these can be detrimental to durability of steel in concrete whereas Artificial sand has no silt or organic impurities. However, many people in India have doubts about quality of concrete when manufactured or artificial sand are used. Artificial sand has been regularly used to make quality concrete for decades in India and abroad.

II. NATURAL SAND AGAINST ARTIFICIAL SAND

Concrete is the most widely material of construction all over the world. A huge 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 the riverbeds as fine aggregate. One of the important ingredients of conventional concrete is natural sand or river sand, which is expensive and scarce. However, due to the increased use of concrete in almost all types of construction works, the demand of natural or river sand has been increased. To meet this demand of construction industry, excessive quarrying of sand from river beds is taking place causing the depletion of sand resources. The scarcity of natural sand due to such heavy demands in growing construction activities have forced to find the suitable substitute. One of the cheapest and the easiest ways of getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade. The positive use of artificial sand will conserve the natural resources for the sustainable development of the concrete in construction industry. The choice of fine aggregate, whether it is manufactured or natural sand, can greatly impact the fresh concrete properties of a mixture such as the workability, pumpability, and finishability. Natural sand has an ideal shape for use as fine aggregate in concrete. The natural sand particles are well-rounded and are usually nearly spherical. Spherical particles decrease the percentage of voids within the concrete mixture so no

additional paste is required to fill these voids. Well-shaped natural sands are ideal for workability of mixtures. Natural sand does not require more water to enhance the workability of the mixture so the amount of bleed water in the concrete will not be increased.

III. PROBLEMS REGARDING NATURAL SAND

The huge quantity of concrete is consumed by construction industry all over the world. In India, the conventional concrete is produced by using natural sand, cement, coarse aggregate and water. One major challenge facing the civil engineering community is to involving the use of high performance, environmentally friendly materials produced at reasonable cost. In the context of concrete, which is the predominant building material, it is necessary to identify less expensive substitutes. Now-a-days sand is not readily suitable, it should be transported from long distance. Those resources are also exhausting very rapidly.

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 few years, it has become clear that the availability of good quality natural sand is decreasing. With few local exceptions, it seems to be a global trend also dwindling sand sources poses the environmental problem and hence government restrictions on sand quarrying resulted in shortage and significant increase in its cost. So, it is need of the time to find some substitute to natural river sand.

IV. SUITABILITY OF ARTIFICIAL SAND IN CONCRETE

Sand is a major material used for preparation of mortar and concrete and plays a most important role in mix design. In general consumption of natural sand is high, due to the large use of concrete and mortar. Hence the demand of natural sand is very high in developing countries to satisfy the rapid infrastructure growth. The developing country facing shortage of good quality natural sand and particularly in India, natural sand deposits are being used up and causing serious threat to environment as well as the society. Rapid extraction of sand from river bed causing so many problems like losing water retaining soil strata, deepening of the river beds and causing bank slides, loss of flora on the bank of rivers. Due to shortage of river sand in India so therefore the need to find an alternative concrete and mortar aggregate material to river sand in construction works has assumed greater importance now a days. Researcher and Engineers have come out with their own ideas to decrease or fully replace the use of river sand and use recent innovations such as artificial sand. There are some issues with Artificial Sand. The stake holders of construction industry agree that the river sand, which is available today, is deficient in many respects. It does content very high silt fine particles. Presence of other impurities such as coal, bones, shells, mica and silt etc. makes it inferior for the use in cement concrete. The decay of these materials, due to weathering effect, shortens the life of the concrete. At this time the Government have put ban on lifting sand from River bed. Transportation of sand damages the roads. Removing sand from river bed impact the environment, as water table goes deeper & ultimately dry.

V. GENERAL REQUIREMENTS OF ARTIFICIAL SAND

All the sand particles should have higher crushing strength. The surface texture of the particles should be smooth. The edges of the particles should be grounded. The ratio of fines below 600 microns in sand should not be less than 30%. There should not be any organic impurities. Silt in sand should not be more than 2%, for crushed sand. In Artificial sand the permissible limit of fines below 75 microns shall not exceed 15%.

VI. ENVIRONMENTAL ISSUES

Due to burrowing of the sand from river bed reduces the water head, so less percolation of rain water in ground, which result in lower ground water level. The roots of the tree may not be able to get water. The rainwater flowing in the river contents more impurities. Erosion of nearby land due to excess sand lifting. Disturbance due to digging for sand & lifting, Destroys the flora & fauna in surrounding areas. The connecting village roads will get badly damaged due to over- loading of trucks, hence, roads become problem to road users and also become accidents prone. Diminishing of natural river beds resulting in not availability for future generations.

VII. EXPERIMENTAL STUDY

Experimental study was carried out for concrete of grade M20. Table 1 to 3 shows various tests carried out on Coarse aggregates, Natural sand and Artificial sand. Workability properties are shown in Table 4, which indicate that for natural sand slump is more. Table 5 and Figure1 shows the results obtained for compressive strength of concrete.

TABLE 1 LABORATORY TESTS ON FINE AND CORSE AGGREGATE

Sr. No.	Test on Cement	Value
1	Fineness of Cement	7.70 %
2	Consistency test	33 %
3	Specific gravity	3.17

TABLE 2 LABORATORY TESTS ON FINE CORSE AGGREGATE

Sr. No.	Parameter	Natural Sand	Artificial sand
1	Fineness Modulus	3.33	2.83
2	Moisture content	0.95 %	0.33 %
3	Silt Content	2.00 %	2.00 %
4	Specific gravity	2.57	2.51
5	Water absorption	0.800 %	0.3 %

TABLE 3 LABORATORY TESTS ON COARSE AGGREGATE

Sr. No.	Parameter	Value
1	Size of aggregate	20 mm
2	Impact value	7.50 %
3	Crushing value	6.70 %
4	Abrasion value	3.00 %
5	Moisture content	0.88 %
6	Specific gravity	2.60
7	Water absorption	0.5 %

TABLE 4 WORKABILITY TEST OR SLUMP CONE TEST VALUE

Sr. No.	Concrete includes	Slump observed	Remark
1	Natural Sand	33	Range: Low (25-75)
2	Artificial Sand	22	Range: Very Low (0-25)

TABLE 5 COMPRESSIVE STRENGTH FOR M20 GRADE N/mm²

Sr. No.	Sand used	7 days	14 days	28 days
1	Natural Sand	15.5	20.1	24.8
2	Artificial Sand	12.3	17.4	21.1

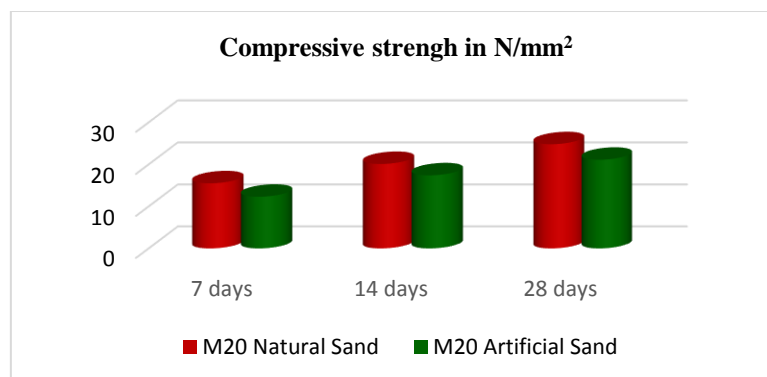


FIGURE 1 COMPRESSIVE STRENGTH N/mm²

VIII. CONCLUSION

Compressive strength of concrete with Natural sand shows more compressive strength than concrete with Artificial sand. Workability of concrete with Natural sand is satisfactory than concrete with Artificial sand. However, both concrete values are in limit prescribed by bureau of Indian standard. Since, there is severe shortage of river sand, huge limitations

on quality of river sand, high cost, greater impact on road damages and environmental effects, The Construction Industry shall start using the Artificial sand to full extent as alternative, reduce the impacts on environment by not using the river sand. The Government shall come out with strategy on Sand to encourage the industry people to set up more no of aggregate crushing units across the all-region to meet the sand requirements of the Construction Industry. The replacement of natural sand with artificial sand will help in conserving the natural resources of sand and maintain the ecological balance of the nature.

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BIOGRAPHY



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