

EXPERIMENTAL STUDY ON STRENGTH PARAMETRES OF CONCRETE WITH REPLACEMENT OF FINE AGGREGATE BY ROBO SAND

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Abstract—Concrete is the most widely used composite construction material. Fine aggregate plays a very important role for imparting better properties to concrete in its fresh and hardened state. Generally, river sand was used as fine aggregate for construction. Due to the continuous mining of sand from riverbed led to the depletion of river sand and it became a scarce material. Also, saminging from river bed caused a lot of environmental issues. As a substitute to river sand, Robo sand has been used.

In this present experimental study a comparative study has been carried out to check the usability of Robo sand in place of natural sand. This study involves determination of some major properties of concrete like compressive strength, split tensile strength, flexural tensile strength.

Based on proposed studies, quality of Robo sand is equivalent to natural sand in many respects, such as cleanliness, grading, strength, angularity, specific gravity. Conclusion have been arrived that Robo sand produced from VSI(vertical shaft impactor) is a suitable and viable substitute to river sand and could be effectively used in making concrete which provides adequate strength and durability for the concrete.

In the design of concrete structures, concrete is taken into account by taking its compressive strength, Split tensile strength and flexural strength values. The compressive strength, Split tensile strength and flexural strength value of the concrete made of Robo sand is observed to be very nearer to the strength of the concrete made of natural sand in the present investigation, there by 100% replacement is reasonable.

Index Terms—Fine Aggregate , Robo Sand

I. Introduction

This chapter contains the general information about Robo sand ,its origin, need of Robo in construction. It also includes the exact meaning of Robo sand ,crushed dust, process of manufacturing by various machinery.

Natural sands are weathered and worn out particles of rock and are of various grades or size depending on the accounting of wearing. The main natural and cheapest resource of sand is river. Dams are constructed on every river hence these resources are erasing very fast. Now a day's good sand is not readily available, it should be transported from long distance. Those resources are also exhausting very rapidly.

Sand is the one of main constituents of concrete making which is about 35%of volume of concrete used in construction industry. Natural sand is mainly excavated from river beds and always contain high

percentage of in organic materials, chlorides, sulphates, silt and clay that adversely affect the strength, durability of concrete & reinforcing steel there by reducing the life of structure, when concrete is used for buildings in aggressive environments, marine structures, nuclear structures, tunnels, precast units, etc. Fine particles below 600 microns must be at least 30 % to 50% for making concrete will give good results. Normally these particles are not present in river sand up to required quantity. Digging sand, from river bed in excess quantity is hazardous to environment. The deep pits dug in the river bed, affects the ground water level. The sand in the mortar does not add any strength but it is used as an adulterant for economy and with the same it prevents the shrinkage and cracking of mortar in setting. The sand must be of proper gradation (it should have particles from 150 μ to 4.75 mm in proper proportion). When fine particles are in proper proportion, the sand will have less voids. The cement required will be less when there will be less void in sand. Such Sand will be more economical. Only sand Robo by V.S.I. Crusher is cubical and angular in shape. Sand made by other types of machines is flaky, which is troublesome in working. There is no plasticity in the mortar. Hence the mason are not ready to work with machine made crushed stone sand. For the same reason inferior river sand may be used. Manufacturing sand from jaw crusher, cone crusher, roll crusher often contains high percentage of dust and have flaky particle. Flaky and angular particles may produce harsh concrete, and may result in spongy concrete. There is standard specification for Fine aggregates (Sand). It is divided in four gradations. Generally known as Zone I, Zone II, Zone III and Zone IV. There is sieve Designation for each grade. Gradation is made as per the use of the sand. V.S.I can produce any zone of sand. But in case of natural sand quality varies from location to location without any control

Robo sand:

“Robo sand is defined as a purpose made crushed fine aggregate produced from a suitable source material. Production generally involves Crushing, Screening and possibly Washing, separation into discrete fractions, recombining and blending.

At the beginning Robo sand produced (by Jaw crusher, cone crusher, roll crusher, hammer mill) contains flaky and elongated particles. But now Robo sand produced from V.S.I (vertical shaft impactor) is a suitable and viable substitute to river sand and could be effectively used in making concrete which provides adequate strength and durability for the concrete

Having cubical shape, it effectively provides good bonding in concrete. Grading of Robo sand can be controlled i.e required zone of sand can be obtained. Robo sand can be produced with zero fines. As it doesn't contain silt and clay, setting properties of cement are not altered. For big projects where large quantity of aggregate is required, Plants are established near the site so that the cost of transportation can be reduced.

Need for Robo sand :

The Civil engineers, Architects, Builders, Contractors agree that the natural sand, which is available today, is deficient in many respect. It does not contain the fine particles, in proper proportion as required. 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 work. Now a days, Government have put ban on dragging sand from river bed.

Due to dragging 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. In some places it may be up to 600 ft deep. The roots

of the tree may not be able to get water. The water flowing in the river may be covered with sand so it is less exposed to Sun. In the absence of sand, more water gets evaporated due to direct sunlight. The rain water flowing in the river contains more impurities. when it passes through sand bed it gets filtered. (In water supply schemes the water is filtered in sand bed only) If there is no sand in river-bed, water will not be filtered. Such water may be harmful for drinking purpose. Reduced water level in ground, may result in draught, even scarcity of drinking water, so Government have to supply water by tanker. Which is more expensive compared to the royalty collected for sand.

Vastu Shastra:

Now a day's Vastu Shastra is more popular, followed by so many persons for constructing a house. As per Vastu shastra the Building material must be free from traces of human body or animal body. The River sand contains bones of human beings and animals. The shells are also one kind of bone. It is not easy to take out all such things present in the river sand. The best solution or this is to use Robo sand of good quality.

Cost:

Enormous growth of infrastructure in the country resulting in increased use of river sand. Therefore, scarcity of sand effecting the cost of sand and hence cost of construction. Considering all the above facts, need for Robo sand has increased drastically. Therefore, it is necessary to replace natural sand in concrete by an alternate material either partially or completely without compromising the quality of concrete.

Market name for Robo sand.

It is being called in the market with different names like Artificial sand(as it is artificially produced), Robo sand(as it produced first by the company named Robo silicon ,pvt, limited) ,crushed sand (as it is produced from crushing),Rock sand (as the origin is rock)

Difference between Natural sand, Robo sand and crushed dust:

There is an ambiguity between the natural sand is river sand, the two Robo sand and Crushed dust. The actual meaning is given below which illustrates that the two are entirely different. Crushed dust is the waste product produced from the stone quarries. The main aim of the stone quarry is to produce coarse aggregate(80mm-4.75mm according to IS 383:1997) .The waste from these plants contain lot of fines(passing through 75 μ) along with flaky and elongated particles of size ranging from 4.75mm to 75 μ . If properly treated this can be used for producing Robo sand . But treating this waste is an expensive work. Nutshell, it is a by product. Robo sand is purposefully made from parent rock but it doesn't contain fines(silt ,clay),instead it contains uniformly graded cubical particles of size ranging from 4.75mm-150 μ .

Manufacturing process:

Vertical Shaft Impactor principle is used for crushing bigger particles, for shaping the crushed metal (giving better shape of the particle) and for crushing fines aggregates below 4.75 mm. It is best machine Impactor is of cubical shape. Such sand can be used for all types of construction work, Concreting, Plastering etc and is better substitute to river sand. V.S.I. Crushers is a most economical machine for Crushing Stone in Cubical shape and manufacturing artificial sand. In this machine the

particles are thrown at a high speed, those particles colloid with each other and shatter in cubical particles. An Anvil ring, Shelf ring (pigeon hole ring) are provided to get the particles edges grounded.

The wear cost is a very important criteria in crushing process. Wear cost of other crushing machines such as Roll crushers, Cone crushers, H.S.I(Horizontal Shaft Impactor) is very high compared to V.S.I. Crushers. It is about four to five times more that of VSI crusher. Rotopactor is a most economical machine for manufacturing artificial sand. In this machine the stone are thrown at a high speed, those particles colloid with each other and shatter in cubical particles. Anvils or Shelf ring (pigeon hole ring) are provided. A rubbing action of particles over pigeon ring, grounds the sharp edges and make the texture smooth.

In these machine, a specially designed pigeon ring is provided which uses the residual kinetic energy in the particle and makes it revolve and role and rub with each other in a circular path. This makes the shape of the particles very good, and smooth. The sand Robo can be of very fine to course grade as per the requirement of the work. The sand manufacturing process is dry. The process requires very less water that too only to settle down the residual dust particles in colloidal state, emitted from the outlet. This machine can allow, slightly wet grit for crushing. Other machines, Cone crusher, H.S.I.

could not use wet material, as it clogs the machine. V.S.I. crushers and Rotopactors are more efficient and more economical in operation. Due to constant development and research our machines are very sturdy and requires very less maintenance. It is the result of our efforts for constant development the wear cost of our machine is least.

Manufacturing process involves the following three steps:

1. Crushing by VSI crusher.
2. Screening.
3. Washing.

Crushing of stones in to aggregates by VSI, then fed to Rotopactor to crush aggregates into sand to required grain sizes (as fines).

Screening is done to eliminate dust particles and Washing of sand eliminates very fine particles present within. The end product will satisfy all the requirements of IS:383 and can be use din Concrete & construction

The VSI Plants are available capacity up-to 400TonPer Hour (TPH). Only, sand Robo by VSI crusher/ Rotopactor (shown in the fig1,fig2) is cubical and angular in shape. Sand made by other types of machines is flaky, which is troublesome in working. The Jaw crushers are generally used for crushing stones in to metal/aggregates. Robo sand from jaw crusher, cone crusher, roll crusher often contain higher percentage of dust and have flaky particle

II. METHODOLOGY**Table Test Results of Cement**

S.NO	Characteristics	Test results	IS:12269-1897 specifications
01	Initial setting time (minutes)	35min	>30 minutes
02	Final setting time (minutes)	230min	<600 minutes
03	Consistency	30%	-
04	Specific gravity	3.0473	3.15
05	Fineness (IS sieve no 9)	3.5%	<10%

Table No 3.3.2 A) Sieve analysis for fine aggregate (Natural sand) Wt taken=1000gm

S.NO	Sieve no:	Wt retained on each sieve	% of wt retained	Cumulative % of wt retained	Cumulative % of passing
01	10 mm	00	00	00	100
02	4.75 mm	10	01	01	99
03	2.36 mm	10	01	02	98
04	1.18 mm	140	14	16	84
05	600 μ	215	21.5	37.5	62.5
06	300 μ	535	53.5	91	09
07	150 μ	70	07	98	02
08	75 μ	20	02	100	00

III. EXPERIMENTAL STUDY

3.1 Non-Destructive Tests

In Non-destructive test, the sample is not destroyed and this test is very useful in determining the strength of existing buildings or structures. The Non-destructive tests conducted on concrete are as follows:

1. Rebound Hammer test
2. Ultrasonic pulse velocity test

3.2 Rebound Hammer test

Rebound hammer for in situ evaluation of compressive strength of grade of concrete.



Fig – 4.2.1A) Rebound hammer



Fig – 4.2.1A) Rebound hammer

Ultra sonic pulse velocity apparatus for the detection of cracks in the concrete



Fig – 4.2.1 B) Ultra sonic pulse

Destructive Tests

In destructive test a sample is made and then destroyed to find out the strength of concrete.

The destructive tests conducted on concrete are as follows:

1. Compressive strength test

2. Tensile strength test
3. Flexural strength test

The tests adopted in this study are only the destructive tests. These tests are done by using Universal Testing Machine (UTM).

Table Compressive strength of M40 grades of concrete at 7 and 28 days

S.no	Concrete Type	Days	Cube-1	Cube-2	Cube-3	Average	
						Load (KN)	Stress (Mpa)
01	Natural sand	7	930	1200	820	983.33	43.7
02		28	960	1200	1000	1053	46.8
03	Robo sand	7	850	900	920	890	39.56
04		28	900	1050	1300	1083	48.51

IV. Result Analysis

COMPRESSIVE STRENGTH

In this section, the main concern is to study the compressive strength of concrete containing two different types of fine aggregate (natural sand and robo sand). Control specimens are concrete with 100% replacement of fine aggregate (natural sand with robo sand)

Cubes with the size of 150 x 150 x 150 mm were tested at the ages of 7 and 28 days. The results of the compressive strength test are shown in Table No.- 4.4.1 .



V. CONCLUSIONS

- 100% replacement is reasonable where there is low workability requirement. And where there is high workability requirement, partial replacement can be made keeping in view the strength and economy.
- Strength criteria can be fully ascertained with 100% replacement of natural sand with Robo sand.
- MAY 2016 The Andhra Pradesh Government is seeking to encourage use of Robo sand, a natural sand substitute for use in the construction sector.
- For big projects like highways, establishing a plant leads to economy as they require large amount of fine aggregate.
- River beds can be safeguarded by reducing the excavations for natural sand

ENVIRONMENTAL CLEARANCE

- Referring to the difficulties faced in providing new sites for quarrying, she said that the Government has applied for environmental clearance for 15 locations and expects to apply for clearances for 49 other sites.

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