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COMPARATIVE ANALYSIS BETWEEN NATURAL SAND AND CRUSHED SAND (ARTIFICIAL SAND, M-SAND)

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Abstract

The issue of global environment safety is very imperative paramount in every organization in today's world. Like every good effort it should begin with small measures and actions taken in the favor of the betterment of the society and the mother Earth. Continuous expansion of business and infrastructure has given rise to the ever increasing demand of constructional materials majorly concrete. Concrete being the most used constructional material around the globe is in demand on a very extensive scale. Use of artificial sand should be promoted in the countries where need of fine aggregates are very high and on a very frequent basis

When compared with the natural sand the properties are near similar but there is a very evident reduction in cost. In preliminary test results the quality of the crushed sand is found to be superior. Through this we will craft approximation whether natural sand can be entirely replaced by the crushed sand. At the end of this project we will soon be submitting the detail report about the topic.

Keywords : Casting, testing, curing, replacement, strength.

1. INTRODUCTION

In recent times construction industry is at its peak due to the growing population. Everyday there is a plan or execution of constructional work throughout the globe. "Does this have an adverse effect on the environment?" question remains unanswered whenever asked no matter what maybe the circumstances. We indeed cannot answer the question to the fullest as we all are aware that what might be the closest answer. All we can do best is continue to be to the path to find new alternatives for the problems we are about to face due to this environment crisis or we say we are already facing most of them.

As of now construction industry is the biggest industry on our planet millions of people around the globe are connected to this stream and are on the serious voyage to accomplish what man hasn't till now. Buildings, road, bridges, canals, retaining structures

even island as we speak is now within the control of humans to be built within the calculated time and estimated resources. In connection to this fact we can estimate that construction is almost connected to every human on this planet.

2.LITRATURE REVIEW

1. **Sanjay Mundra & P.R.Sindhi (2016)** :- Study investigates the use of crushed rock sand as viable alternative to Natural River sand that is being conventionally used as fine aggregate in cement concrete. Various mix designs were developed for different grades of concrete based on IS, ACI and British codes using Natural River sand and crushed rock sand. In each case, the cube compressive strength test, and beam flexure tests were conducted.

The results of the study show that, the strength properties of concrete using crushed rock sand are nearly similar to the conventional concrete. The study has shown that crushed stone sand can be used as economic and readily available alternative to river sand and can therefore help to arrest the detrimental effects on the environment caused due to excessive mining of river sand.

2. **Farid Ben meriou(2015)** :- Concrete itself as a mixture of water, cement, sand and aggregate in addition with admixtures.as the natural sources of aggregates are different the strength shows variation. There is shortage of natural sand due to heavy demand indifferent construction activities such as residential, commercial, bridges etc.it is very needful to find suitable substitute. The cost effective & simplest way to getting substitute to natural sand is by crushing natural stone to get manufactured sand i.e. M-sand of desired size & shape which would free from all deleterious materials.

Now a day V.S.I. crusher is a cheapest machine for crushing stone in cubical shape & manufacture M-sand.in Maharashtra every city or town does not have V.S.I. crusher so artificial sand i.e. M-sand is not available at everywhere so we want to combine natural sand with artificial sand. For the purpose of testing concrete mixes are designed for M20 with 50% natural sand & 50% crushed sand and also all natural sand replaced by M-sand.to evaluate strength the compressive strength is taken on compressive testing machine.

3. **Anil Kumar Sahu and A.K.Sachan** :- Investigated the suitability of crushed stone dust waste as fine aggregate for concrete . Test results indicated that crushed stone dust waste can be used effectively to replace natural sand in concrete. Concrete made with this replacement can attain the same compressive

strength, comparable tensile strength, modulus of rupture and lower degree of shrinkage as the control concrete.

4. **Tahir Çelik & Khaled Marar** :- Crusher dust is a fine material formed during the process of comminution of rock into crushed stone or crushed sand. This dust is composed by particles which pass 75 µm BS sieve. Effects of dust content in aggregate on properties of fresh and hardened concrete are not known very well. An experimental study was undertaken to find out the effects of various proportions of dust content on properties of fresh concrete and hardened concrete.

5. **D.S.Prakash Rao & V.G.Kumar (2004)** :- Stone crusher dust, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete. Investigations on the use of stone crusher dust in concrete as an alternative to river sand are presented in this paper. The tests conducted pertain to concrete with river sand of strength 28.1 MPa, and that with granite stone crusher dust of strength 32.8 MPa. Tests on the strengths of concrete, and on the flexural behaviour of RC beams under two-point loading were conducted. Failure loads and cracking patterns of the beams with sand and with crusher dust as fine aggregates were compared. The investigations indicate that stone crusher dust has a good potential as fine aggregate in concrete construction. Crusher dust not only reduces the cost of construction but also helps reduce the impact on the environment by consuming the material generally considered as a waste product with few applications.

6. **B. Menadia, S. Kenaia, & J. Khatibb**:- In recent years, there is a growing interest in the use of crushed sand obtained from limestone quarries in some countries where riversand is not widely available. The fines content is usually high in crushed sand which can adversely affect concrete properties. The influence of fines in crushed sand on physical and mechanical properties of concrete has been widely investigated. The results proved that upto 15% of fines content in crushed sand could be used without adversely affecting concrete strength. However, little work has been done so far on the effect of fines in crushed sand on the durability of concrete. This paper examines the influence of limestone fines in crushed sand on concrete properties. Properties include strength, water, gas and chloride-ion permeability and capillary water absorption. Four different cement types were used while maintaining a constant water/cement ratio.

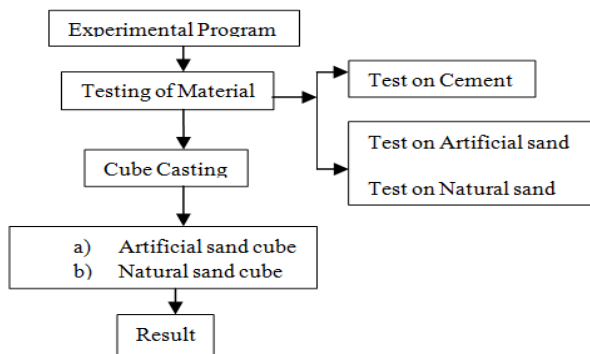
7. **B Balapgol, S A Kulkarni & K M Bajoria** :- This paper presents the results of an experimental study on strength and durability of concrete with crushed basalt stone fine aggregates as a substitute to diminishing natural sand. The strength and durability properties of concrete viz. compressive strength, flexural strength and permeability of hardened concrete

were investigated. An experimental study was performed to observe the performance of concrete incorporating crushed basalt stone fine aggregates replacing the natural sand. The test results indicate that the performance of concrete with crushed basalt stone fine aggregates were excellent. The compressive strength of concrete for different grades increased from 8 % to 26 %, the flexural strength was increased from 1 % to 5 % and coefficient of permeability was decreased significantly. The test results indicated that strength and

durability of concrete would be better with crushed sand replacing natural sand.

3.METHODOLOGY

M30 grade of cement used in mixture of concrete with suitable w/c ratio for casting a cube for testing purposes for days 7/14/21 days for getting the test results .As per the below chart the process is followed,the before test on aggregates is carried out for better results and variations .



PROVISION OF ADMIXTURE

Dosage of Admixture i.e. Plasticizer will be 1% to the weight of cement.

Plasticizer used is Shell Con 300, PCE Based Admixture,

For - M30 Grade of concrete

Purpose – To increase the compressive the strength and decrease the workability i.e. Slump

Manufacturer - Supreme Bitumen India Pvt. Ltd. (Butibori, Nagpur)

4.MATERIAL USED

Cement :-

Ordinary Portland cement of 53 grade available in local market is utilized in the investigation. The cement utilized different properties have been tested as per IS:4031- 1988 and found confirmation to different specifications as per IS:12269-1987.

Coarse aggregate :-

The machine is used as a coarse aggregate with crushed annular granite metal of an average size of 20mm. It should be free of dust-free, clay particles, organic matter etc., The coarse aggregate with different properties are tested as shown in table. The coarse aggregate grading

or particle size distribution showed nearly an average size of 20mm as per IS:383-1970.

Fine aggregate :-

The locally available natural sand and machinemade Manufactured sand are utilized as fine aggregate. It is supposed to be free of clay, slit, organic impurities and so on., The sand is being tested for different properties like specific gravity, bulk density etc., In accordance with IS:2386-1963. The fine aggregate distribution of the examination or particle size demonstrates that it is near evaluating zone II or IS:383- 1970.

River sand (rs):-

The natural fine aggregate is the river sand which is the most commonly utilized natural material for the fine aggregates that is utilized, but the recent social factors that created a shortage of the material created a great problem in the construction sector. For the studied the river sand of zone II is utilized in all the references.

Manufactured sand (ms):-

M-Sand confirming to zone II as per IS:383-1970 is utilized. It was tested as per Indian Standard Specification. The manufactured sand utilized, is brought from local supplier.

Water:-

Water utilized for mixing and healing must be clean must be free of harmful volumes of oils, acids, alkalis, salts, organic materials or other materials. Concrete may be deleterious. Versatile water is utilized for blending just as curing of concrete as prescribed in IS:456-2000.

5.Preliminary Testing of Material used in concrete mix design

Materials used for mix design of concrete have to be tough and durable. Along with this certain physical

☐ Curing of cubes



☐ Casting cubes

1.SLUMP TEST

The workability is one of the concrete’s parameters that disturb the strength and durability and finished surface appearance. Concrete workability is based on the water cement ratio and the water ingestion limit if the aggregates. If additional water results in bleeding or aggregate segregation. The test for concrete workability is performed by the Indian Standard IS 1199-1959 which allows the test procedure to use different cases in which we used slump cone tests to estimate concrete workability. We estimated the concrete cone status for different water cement ratios and recorded the values for normal concrete. Then the same procedure is performed with sand being completely replaced by the concrete with river sand, M-Sand and Quarry Dust Sand.

properties has to be known as they are vital and has to be used during the commencement of design procedure.

Following properties of aggregate has to be known Sieve Analysis, Specific gravity, Dry loose bulk density (DLBD), Bulkage or Moisture content. Sieve Analysis of crushed and natural sand is done using IS sieve set starting from 10 mm sieve size to 150 micron. Sieve analysis is the most important part as zone of sand is determined by sieve analysis

☐ Specimen cubes



☐ Cubes taken out from mould after 7/14/28 days

2.COMPRESSIVE STRENGTH

At the beginning, i.e. at 7 days the concrete’s strength made of manufactured sand and quarry sand is less than that of common sand. But as the days of curing increases, the concrete’s strength of cubes made of M-Sand and Quarry sand are found more or less equal. As compressive strength is the main property of the concrete that is considered in design, we can replace of natural sand by either manufactured sand and quarry sand completely in making concrete. The results obtained for compressive strength for 28 days study period for complete reinstatement of sand by each of two M-sand and quarry sand

3.SPLIT TENSILE STRENGTH

Similar to compressive strength, the flexural strength and split tensile strength were also higher for the complete replacement of sand either with quarry dust and M-sand. The development in compressive strength, tensile strength split and flexibility for M-Sand is perhaps due to the sharp edges which provide stronger bond with cement compared to river sand in rounded shape

4. FLEXURE STRENGTH OF CONCRETE

Flexure strength, also referred to as rupture module, or bending strength, or transverse rupture strength is a property of materials, explain as the stress in a material close to it results in a bending test. The flexure strength is the highest stress accomplished within the material at its moment of yield

1) Result:

Strength

For M20 grade of concrete it was found that crushed sand was not able to archive targeted strength higher than that of natural sand.

For M30 and M40 grade of concrete, it increased in the strength of concrete with a dozes of 1% admixture (with cement) thus it can be concluded that with dozes of 1% of admixture to the weight of cement there is an increase in strength and target characteristics strength can be achieved.

2) Material Requirements:

Cement- Requirement of cement in concrete made by crushed sand is relatively high.

Fine Aggregate- Requirement of fine aggregate was relatively less when concrete was design using crushed sand.

Coarse aggregate - Both the aggregate of 10 mm and 20 mm size where less in quantity when crushed sand was used as fine aggregate in concrete.

Water- W/C ratio was maintained equal for both types of fine aggregate, but it was found concrete made that crushed sand was more workable.

Admixture- Provision of admixture was introduced in crushed sand concrete so as to achieve proper value of slump and increase characteristic strength.

3) Cost:

Apart from cement and admixture or other constituent of cement are required less in quantity when conquered to natural, hence it can be concluded that concert made of crushed sand is economical.

As of now use of admixture was 1% to the weight of cement.

Below is the cost analysis of admixture

7.CONCLUSIONS

Following details contains initial conclusions of the compressive test on cubes held for 7 days and 14 and 28 days of Curing.

1. Strength achieved by natural sand was rapid as compared to crushed sand whereas the strength of natural sand seen in m20 grade of concrete is lower. After the introduction of admixture in M30 and M40 grade of concrete strength was relatively higher.
2. Cement requirement in concrete made by natural sand need lesser quantity of cement (OPC) whereas cement demand was higher in concrete made with natural sand.
3. Sand requirement in concrete made with natural sand is lower than the quantity required in crushed sand.
4. If compared with rates crushed sand cost almost 75% less than natural sand.
5. Since the crushed sand has higher strength than natural sand, coarse aggregate of 10mm and 20mm size is relatively lower in quantity in concrete made with crushed sand.
6. Use of admixtures in recent times is recommended and practiced on a very large scale. Use of admixture in concrete made with crushed sand is highly recommended so as to attain high strength within required duration.
7. Overall expenditure on concrete making is less when crushed sand is used.
8. Quality control of concrete made with crushed sand can be handled better. Use of crushed sand has to controlled with adequate and balanced weight batching as a result the quality of such quantity is better than that made using natural sand.

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