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EXPERIMENTAL STUDY ON CONCRETE USING TREATED SEA SAND AS FINE AGGREGATE

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Abstract: Due to the scarcity of river sand which is commonly used as fine aggregate in the construction, it is necessary to find an alternative for the river sand. The main aspect of this project is to utilize the sea sand as fine aggregate in concrete for construction after the removal of chloride content from the sea sand. Chloride content present in the sea sand affects the load carrying capacity of the reinforcement and makes the structure less durable. The sand washing technique can be used to eliminate the chloride content in the sea sand which causes excessive corrosion in the structure. The motive of the project is use the sea sand to increases the durability and workability of concrete. Thus, this investigation mainly focused on the strength variations in the concrete for conventional concrete and sea sand concrete from the different test results. The concrete cubes and cylinders were cast and then the compressive strength, split tensile strength could be tested after curing duration for 7, 14 and 28 days. The scope of the project is used Treated sea sand as fine aggregate in concrete.

Index Terms **- Treated sea sand, water, compressive strength, split strength**

I. INTRODUCTION

In construction field, all the buildings are basically constructed using concrete. The river sand act as an important raw material in the concrete. To meet the ever-rising demand for fine aggregate in the construction industry, sea sand can be used. Since sea sand is available in abundant quantity, it can be used as an alternative for river sand. Researchers say that using sea sand as a replacement for river sand would reduce the bonding between cement and sand because of enormous amount of silt content present in the sea sand. To avoid this problem and to attain well graded grain size, the sea sand should need to be treated. This project aims to comparative study of treated sea sand and conventional concrete. the strength of M30 grade concrete in which fine aggregate is replaced with TSS of 20%, 30%, 60% and by river sand partially and 100% completely replaced.

II. OBJECTIVE OF STUDY

The main objective of this project is to utilize the sea sand as fine aggregate in concrete for construction after the removal of chloride content from the sea sand by using sand washing process.

1) To study the practical utilization of sea sand as fine aggregate by partially and completely.
2) To determine the compressive spilt tensile strength of concrete with the different percentages of the TSS.
3) The sea sand is replaced accordingly 20%, 30%, 60% and by river sand partially and 100% completely replaced.
4) To determine the optimum percentage of sea sand replacement in the concrete.

III. LITERATURE REVIEW:

Keishiro iriya et, al (April 2012) Early strength of sea water and unwashed sea sand concrete (total chloride ion content: around 4.5 kg/m3) is high, and long-term strength is also retained at a high level. For a construction project on an isolated island, the use of sea water and unwashed sea sand contributes to 'production for local consumption,' reduces the construction and material transportation cost, and reduces the CO2 emissions.

S.Athira, et,al(April-2015)"Apart from concrete work, the sea sand may also be used for other constructional works like reclamation and filling during the highway project works. As per the American concrete institute and American coastal department, each individual uses 200 kg of sand annually. So next to water and cement, the need for sand is essential, particularly in civil industry. In the construction industry, 1/3 part is occupied by fine aggregate in the total concrete volume, and without it, concrete production is less possible. The amount of moisture content present in sea sand is nearly about 10% of weight of the total sea sand. It affects the mix ratio while developing the concrete mix design. Hence moisture level must be considered and has to be eliminated from sea sand using water elimination devices like hot air oven.

B.Subashini,et,al(march-2016) Partial mixing of purified sea sand and the river sand attains adequate strength at 28 days. The replacement of river sand by sea sand overcomes the future demand in the requirement of the river sand in construction. The purified sea sand has more strength than the unpurified sea sand and river sand. Hence, it is proved that the corrosion is controllable. The project concluded that the removal of salt content from sea sand is mandatory for improving the workability and durability of any construction works.

R.Mahendran, et,al.,(May-2016) "experimental study on concrete using sea sand as fine aggregate" Said, Sand has become a very important mineral for the expansion of society. Not only, is it used for glass but more so for making concrete, filling roads, reclamations and building sites. The research reported here is on offshore sand, which was considered the most viable of the alternatives for river sand, with respect to availability, ease of extraction, environmental impact and cost.

S.Priyadharshini,et,al(march-2017) Here they done the project on the use of a sea sand in the improvement field with the removing of salt content present in the sea sand. Once treatment has been done on sea sand using that sand various test has been conducted on sea sand and fully mix is done for purified sea sand to fulfil required strength at 28 days. The pure sea sand has higher amount of salt content than the untreated ocean sand. Hence, it is showed that the amount of corrosion is decreased. This proved that removal of salt substance from the ocean sand is required for get the workability and strength of concrete.

M.Bhuvaneswari,et, al(April-2018)compressive and split tensile test are carried out to study the strength variations in concrete From the test results it can be concluded that, The compressive strength of concrete is increased by replacing 30% of sea sand by river sand and % increased as 1.1 times than cc. But the tensile strength of the concrete increased in 20% replacement.

IV.MATERIALS AND PROPERTIES

4.1 GENERAL

The properties of the materials play an important role in concrete. therefore, choosing the correct property of a material is necessary for satisfying the required characteristics of concrete. The tests are carried out to investigate the various properties of the materials that influence the characteristics of the concrete.

4.2 CEMENT

Cement is a binder, a substance that sets and hardens and can bind other materials together. Though all cement conforming to various IS code are suitable, selection of cement should be based on their compressive strength, fineness and compatibility with other ingredients. cements of various strength are available. The strength of cement decides the target strength of concrete. Fineness or particle size of Portland cement affects rate of hydration, which is responsible for the rate of the strength gain. Approximately 95% of cement particles are smaller than 45 microns with the average particle size about 15 microns. here OPC 53 grade cement is used.

4.3 COARSE AGGREGATE

Coarse-grained aggregates will not pass through a sieve with 4.75 mm openings (No. 4).
Those particles that are predominantly retained on the 4.75 mm (No. 4) sieve and will pass through 3-inch screen, are called coarse aggregate. The coarser the aggregate, the more economical the mix. Larger pieces offer less surface area of the particles than an equivalent volume of small pieces. Use of the largest permissible maximum size of coarse aggregate permits a reduction in cement and water requirements.
Using aggregates larger than the maximum size of coarse aggregates permitted can result in interlock and form arches or obstructions within a concrete form. That allows the area below to become a void, or at best, to become filled with finer particles of sand and cement only and results in a weakened area.

4.4 FINE AGGREGATE

4.4.1 RIVER SAND

Locally Available Free of debris River bed sand is been used. Among Various characteristics, the most important one is its grading coarse may be preferred as Fine aggregate, increase the water demand of concrete and very fine sand may not be essential as it usually has larger content of thin particles in the form of cement. The sand particles should also pack to give minimum void ratio, higher voids content lead to requirement of more mixing of water. Properties such as void ratio, gradation, specific gravity and bulk density has to be assessed with optimum cement content and reduced mixing of water. The specific gravity 2.45 and fineness modulus of river sand is 2.95 %.

4.4.2 TREATED SEA SAND

Sea sand: Sea sand is collected from Kadapakkam Beach near Cheyyur in chengalput district, Tamilnadu, India. A main constituent in sea sand is quartz (SiO_2), generally formed by volcanic eruptions. SiO_2 is extremely hard in nature and do not consist of any carbon content in it. Additionally, sea sand also contains calcite ($CaCO_3$), which has carbon atom. In this experimental investigation, sea sand comes under zone III because of the value of fineness modulus is 2.33% and specific gravity is found to be 2.45.

4.5 WATER

Water is one of the most important elements in construction but people still ignore quality aspect of this element. The water is required for preparation of mortar, mixing of cement concrete and for curing work etc during construction work. The quality and quantity of water has much effect on the strength of mortar and cement concrete in construction.The water used for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth and other substances that may be deleterious to bricks, stone, concrete or steel. Potable water is generally considered satisfactory for mixing. The pH value of water should be not less than 6.
Physical and chemical properties of ground water should be tested along with soil investigation and if the water is not found conforming to the requirements of IS: 456-2000, it should not be used. The water found satisfactory for mixing is also suitable for curing. However, the water used for curing should not produce any objectionable stain or unsightly deposit on the surface. The presence of tannic acid or iron compounds in water meant for curing is objectionable. Sea water should not be used for mixing or curing.

4.5.1 Quantity of Water for One Bag Mix

• Approximate 32 liters of water is required where the ratio 1:2:4 of cement concrete is used.
• Approximate 30 liters of water is required where the ratio 1:1.5:3 of cement concrete is used.

V MIX DESIGN

Concrete mix design is the process of finding the proportions of concrete mix in terms of ratios of cement, sand and coarse aggregates. For e.g., a concrete mix of proportions 1:2:4 means that cement, fine and coarse aggregate are in the ratio 1:2:4 or the mix contains one part of cement, two parts of fine aggregate and four parts of coarse aggregate.

Table No 1: Mix Proportion

Water	Cement	Fine Aggregate	Coarse Aggregate
150 litres	375Kg/m3	856.32Kg/m3	1143.74 Kg/m3
0.40	1	2.28	3.04
Mix Design for M30 Grade Concrete = 1 : 2.28: 3.04			

VI.RESULTS AND DISCUSSIONS

6.1 COMPRESSIVE STRENGTH TEST:

Compression testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time. Compressive strength or compression strength is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression (being pushed together), whereas tensile strength resists tension (being pulled apart). In the study of strength of materials, tensile strength, compressive strength, and shear strength can be analysed independently.

For each mix, mortar cube of size 70mm X 70mm X 70mm was prepared. Then it was cured for 7 days and 28 days. After curing, cube was removed from the curing tank. Wipe test machine platens with dry cloth. Place the test cube centrally on the test cube. Lower the top pattern on to the cube and ensure a uniform seating by section. Gently rotating the platen as it is brought to bear on the cube. Make sure that test machine is set to the correct loading and pointers are read as zero. Apply the load without shock continuously. Record the maximum load the cube can sustain. Compressive strength can be calculated by using the following formula, ff_{cc} is the compressive strength of concrete (N/mm^2),P is the maximum load applied (kN) and A is the cross-sectional areas of the sample.

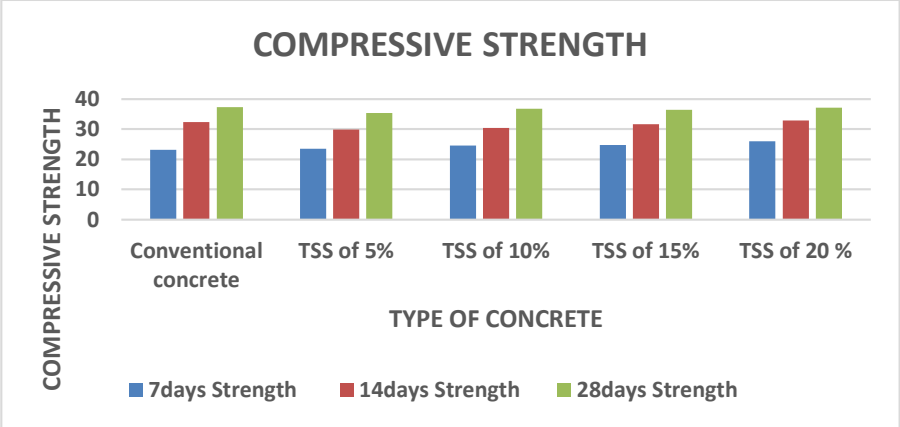
$$ff_{cc} = \frac{P}{A} \qquad (1)$$

The specimens containing different percentage of aggregates were tested using the above tests and the following result is been obtained.

Table 2 Compressive Strength Test Results

Concrete Type	**7days** (N/mm^2),	**14days** (N/mm^2),	**28days** (N/mm^2),
Conventional concrete	23.11	32.31	43.32
TSS of 5%	23.52	29.82	36.42
TSS of 10%	24.56	30.42	38.72
TSS of 15%	24.72	31.63	39.41
TSS of 20 %	25.92	32.96	37.11

Figure 1.Compressive strength results



6.2 SPLIT TENSILE STRENGTH

Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. The splitting tensile strength of the specimen as follows:

$$T = 2P/\pi LD \qquad (2)$$

Where,

T =Splitting tensile strength (N/mm^2),

P = Maximum applied load, N

L = Length, mm

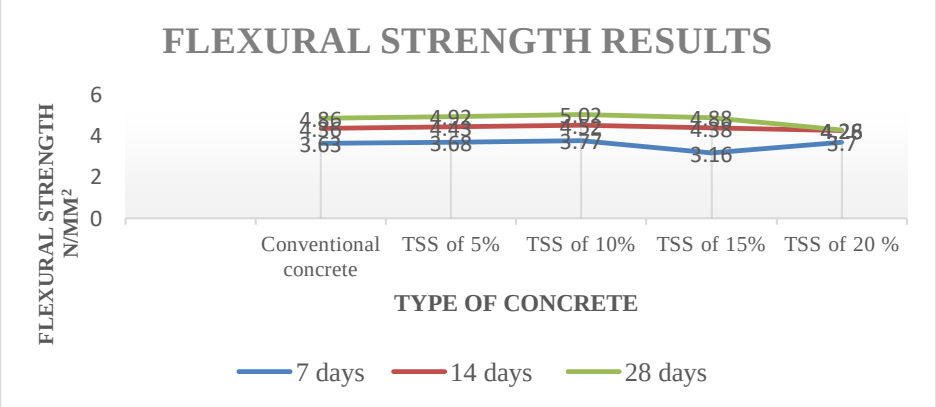
D = Diameter, mm

The specimens containing different percentage of aggregates were tested using the above tests and the following result is been obtained.

Table 3. Flexural Strength for Beams

Concrete Type	7 days (N/mm2)	14 days (N/mm2)	28 days (N/mm2)
Conventional concrete	3.63	4.36	4.86
TSS of 5%	3.68	4.43	4.92
TSS of 10%	3.77	4.52	5.02
TSS of 15%	3.16	4.38	4.88
TSS of 20 %	3.7	4.26	4.28

Figure 2. Flexural strength results



7 CONCLUSIONS

The following are the conclusions drawn from the study on Treated sea sand concrete.

1.The strength attained from TSS concrete is much similar to Conventional concrete, Hence it can used for future purposes.

2.According the values from compressive strength test, it is concluded that the concrete with 15% of treated sea sand is optimum, beyond which the strength of the TSS concrete decreases.

3.From the above test results, it is found that TSS concrete has better workability which is helpful in mixing and placing of concrete and it is found that slump value and compaction factor value increases by increasing TSS percentage. The weight loss due to acid attack and sulphate attack of TSS concrete is lower than conventional concrete.

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