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Experimental Analysis and Study of Sea Water and Sea Sand Concrete

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Abstract: Concrete is one of the major construction material used in the construction now a day. It is a composite material containing cement, coarse aggregate, fine aggregate and water. In the future, fresh water will be very difficult to get and obtain. It is said that in 2024 half of the mankind will live in the areas where fresh water is not enough. Also, UN and WMO are predicting 5 billion people will be in short of even drinking water. The depletion of natural sand deposits and illegal sand mining is a common issue on these days. Extraction of river sand as fine aggregate affect negatively on river ecosystems, navigation and flood control. This paper presents an experimental critical review of existing studies based on the effects of using sea-sand and/or seawater as raw materials of concrete on the properties of the resulting concrete, short and long term strength as well as durability. It has been shown by some researchers that concrete made with sea water and sea sand develops its early strength faster than that of ordinary concrete, but the former achieves a long term strength similar. Attempts were made to over come the problems of using sea water and sea sand in concrete by adding some suitable material. The samples are from cochin, by the means of laboratory tests to assess the compatibility of modifying the samples. Compressive strength, flexural strength and tensile strength test was conducted on the various concrete specimens with various proportion for the comparison analysis. The effort of improving this technology saves fresh water and river, reduces water scarcity.
Keywords: Concrete, Sea sand, Sea Water, Slag Cement, GGBS

I. INTRODUCTION

In the year of 2016, the amount of cement produced in the world reached 4.20 billion tonnes and the estimated concrete production was around 25 billion tonnes. The production of aggregates (including both coarse and fine aggregate) reached about 40 billion tonnes in the year 2015. The consumption of huge amounts of raw materials, mainly river sand and freshwater, in concrete production has raised very serious environmental issues. The depletion of natural sand deposits and illegal sand mining is a common issue these days. Extraction of river sand as fine aggregate impacts negatively on river ecosystems, navigation and flood control. Similarly, the consumption of a great amount of freshwater poses a great challenge due to water shortage in many parts of the world. Besides sand and water, consumption of the other main constituents of concrete, has also caused major environmental concerns, but the present discussion is mainly concerned with alternative solutions for sand and water. The need of desalted sea sand and sea water cause to extra huge production cost. The direct use of both sea-sand and seawater without desalting in concrete production is particularly implemented for marine and coastal projects, for which the supplies of freshwater and river sand are limited where. Several studies agree that in comparison with concrete mixed with fresh water, concrete mixed with sea water increases early age strength and reduces setting time. The concrete produced with seawater using blast furnace slag cement and a low water cement ratio increases the resistance towards chloride penetration. Sea water can be used instead of fresh water where it is not available such as isolated islands and coastal areas. As a result, the topic of seawater sea sand concrete or sea sand seawater concrete has attracted the attention of us. The purpose of this project is to study about the use of sea-sand and seawater as raw materials for concrete to replace river sand and freshwater. In general, concrete cast with seawater but ordinary fine aggregate is referred to as seawater concrete, while concrete cast with sea-sand but freshwater is referred to as sea sand concrete.

The demand for manufactured fine aggregates is increasing highly as river sand cannot meet the rising demand of construction sector. The limited supply capacity of natural sea sand cannot meet the supply guarantee needs. Under this circumstances the manufactured sand is impossible. In many countries sea sand has been used for making cement concrete since long time ago, naturally, its technology depends on the research achievement and specific conditions of each country. Therefore, studying the differences in properties of both river and sea sand will give an idea whether sea sand can be altered in such a way that it can be used as a substitute for the depleting river sand. Removing process of river sand from river bed has environmental impacts. The discussions presented in this report have clearly indicated that sea-sand and sea-water structures are most attractive in marine/coastal construction, where steel corrosion is a major concern and access to river sand and freshwater is limited but sea-sand and huge amount of sea water are easily available, mainly in island and costal area where fresh water availability is low.

Similar to the exploration of other resources that have a limited supply or may disturb the eco-system on the earth, the extraction of sea-sand may generate some environmental concerns as well. It is very useful in temporary structure.

A. Most existing research has focused on the effect of chloride ions in sea-sand and seawater on the properties of the resulting concrete, but there has been very limited research on the effects of other chemicals on the short- and long-term properties of concrete, such as the effect of so4 in sea water on the performance of ssc. Much more research is needed in this area.
B. More research is needed to gain a fuller understanding of this durability enhancement mechanism in ssc which has a much higher chloride ions content than ordinary concrete.

II. OBJECTIVES

This work involved the practical study of compressive strength of concrete made using sea sand as fine aggregate and sea water as replacement of water. In this study the sea sand and sea water sample was taken from different places in Ernakulam.

A. To study the practical utilization of sea sand as fine aggregate partially or completely
B. To study the effect of using sea sand and sea water as raw material in concrete.
C. To study the effect of slag.
D. To determine the compressive strength, flexural strength and tensile strength.

III. CEMENT

A. Slag Cement

Slag cement has been used in concrete projects in the United States for over a century. Earlier usage of slag cement in Europe and elsewhere demonstrates that long-term performance is enhanced in many ways. Based on these early experiences, modern designers have found that these improved durability characteristics help further reduce life-cycle costs and lower maintenance costs. IS 12089:1987 code is specified the slag and Portland cement mixing. Using slag cement to replace a portion of Portland cement in a concrete mixture is a useful method to make concrete better and more consistent. Among the measurable improvements are:

1) Better concrete workability
2) Easier and smooth finish
3) Higher compressive and flexural strengths
4) Lower permeability
5) Improved resistance to aggressive chemicals
6) More consistent plastic and hardened properties
7) Resistance to chloride

B. Ground-Granulated Blast-Furnace Slag (GGBS or GGBFS)

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. Ground granulated blast furnace is highly cementitious and high in CSH (calcium silicate hydrates) which is a strength enhancing compound which increases the strength, durability and appearance of the concrete.

IV. MATERIAL TEST AND TEST RESULTS

The Sea Water Sample Is Collected From 3 Different Places In Cochin. Sample No 1: Puthu Vypin, Sample No 2: Fort Kochi And Sample No 3: Cherai. in Order To Determine The Properties Of Sample Various Laboratory Tests Are Conducted. References Are Done From Various IS Codes.

A. pH Test

The test is done using a pH meter.

1) Connect the electrodes to pH meter
2) Prepare 7.0 pH and 4.0 pH buffer solution using buffer tablets (1 tablet in100 ml distilled water)
3) Wash the electrode with distilled water and dry (just blot) it with tissue paper
4) Dip the electrodes in 7.0 pH buffer solution.
5) Keep temperature knob at 25°C position. Set the function switch to pH position. The meter will give some reading near 7.0 pH. Use standardize control to make the reading test 70

6) Remove the 7.0 pH solution. Wash and dry the electrodes as instructed earlier.
7) Dip the electrodes in the 4.0 pH buffer solution. See the digital display. It reads near 4.0 pH.
8) Now use slope control (on back side of the instrument) to adjust the pH reading to 4.0 The meter is now standardized
9) To measure the pH of an unknown solution. immerse the electrodes in that solution and directly
10) Read its pH value.
11) Each time the electrodes must be washed and dried as instructed above.
12) During idle, keep the function selector in check position.
13) Handling: Electrode shall be rinsed between samples with distilled water. Never wipe or rub an electrode with tissue paper. Just blot the end.
14) Storage: Always keep the pH electrode moist. It shall be stored in a solution of 4M KCL or 4.0 pH buffer solution or store in tap water. The values are obtained in table I

TABLE I
pH Determination

Sample No	pH	
	Trial 1	Trial 2
1	7.6	7.5
2	7.9	7.5
3	7.8	7.8

B. *Specific Gravity of Fine Aggregate*

Objective is to determine the specific gravity of a given sample of fine aggregate.

1) *Reference:* IS: 2386 (Part III) - 1963.
2) *Apparatus:* Pycnometer of about 1L capacity having a metal conical screw top with a 6mm hole at its apex, A 1000-ml measuring cylinder, A balance of capacity not less than 3 kg, well-ventilated oven, Filter papers and funnel, etc.
3) *Procedure:* A sample of about 500 g shall be placed in the tray and covered with distilled water at a temperature of 22 to 32°C. Soon after immersion, air entrapped in or bubbles on the surface of the aggregate shall be removed by gentle agitation with a rod. The sample shall remain immersed for 24 1/2 hours. The water shall then be carefully drained from the sample. by decantation through a filter paper. any material retained being return& to the sample. The fine aggregate including any solid matter retained on the filter paper shall be exposed to a gentle current of warm air to evaporate surface moisture. The saturated and surface-dry sample shall be weighed (weight W1). The aggregate shall then be placed in the pyranometer which shall be filled with distilled water. Any trapped air shall be eliminated by rotating the pyranometer on its side, the hole in the apex of the cone being covered with a finger. The pyranometer shall be dried on the outside and weighed (weight W2):

The contents of the pycnometer shall be emptied into the tray, care being taken to ensure that all the aggregate is transferred. The pyranometer shall be refilled with distilled water to thesame level as before, dried on the outside and weighed (weight W3) The water shall then be carefully drained from the sample by decantation through a filter paper and any material retained returned to the sample. The sample shall be placed in the oven in the tray at a temperature of 100 to 110°C for 24 f 12 hours, during which period it shall be stirred occasionally to facilitate drying. It shall be cooled in the air-tight container and weighed (weight W).

Calculation

Specific gravity, apparent specific gravity and water & absorption shall be calculated as

Follows

Specific gravity = w1/(w1-(w2-w3))

W1-weight of saturated surface

W2- weight in g of pycnometer containing sample and filled with distilled water

W3- weight in g of pycnometer with distilled water only, and

W -weight in g of oven-dried sample.

Result is the Specific Gravity of a given sample of fine aggregate is founded in table II

IS Specification: as per IS2386 PART III specific gravity of fine aggregate should be between 2.5 and 2.8.

TABLE II. Specific Gravity Analysis

Material	Specific gravity
Slag Cement	2.9
Sea sand	2.72
M sand	2.75
Course aggregate	2.84

C. Specific Gravity of Coarse Aggregate

Objective is to determine specific gravity of coarse aggregate.

1) *Reference IS 2386 PART III:*1963
2) *Apparatus:* A wire basket of not more than 6.3 mm mesh, A stout watertight Apparatus container in which the basket may be freely suspended, well-ventilated oven, An airtight container of capacity similar to that of the basket, etc.
3) *Procedure:* A sample of 2 kg of the aggregate larger than 10 mm size shall be thoroughly washed 10 remove finer particles and dust, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22°C to 32°C with a cover of at least 5 cm of water above the top of the basket.

Immediately. after immersion the entrapped air shall be removed from the sample by lifting the basket containing it 25 mm above the base of the tank and allowing it drop 25 times at the rate of about one drop per second. The basket and aggregate sal remain completely immersed during the operation and for a period of 24 + 1/2 hours afterwards

The basket and the sample shall then be jolted and weighed in water at a temperature of 22°C to 32 C (weight WI) . The basket and the aggregate shall then be removed from the water and allowed drain for a few minutes, after which the, aggregate shall be gently emptied from basket on to one of the dry clothes, and the empty basket shall be returned to the water and weighed in water (weight W2).The aggregate placed on the dry cloth shall be gently surface dried with the cloth, transferring it to the second dry cloth when the first will remove no further moisture. The aggregate shall then be weighed (weight W4). The aggregate shall then be placed in the oven in the shallow tray, at a temperature of 100 to 110°C and maintained at this temperature for 24 + 12 hours. It shall then be removed from the oven, cooled in the airtight container and weighed (weight Wd).

a) *Calculation*

Specific gravity shall be calculated as

Specific gravity = wd/(wd-w)

W- Weight of saturated aggregate in water (W1 -W2)

W- Weight of the saturated surface - dry aggregate in air

Wd-Weight: of oven dry aggregate in air.

WI-Weight of aggregate and basket in water

W- Weight of empty basket in water

b) *Result*

The Specific Gravity of a given sample of coarse aggregate is founded in table II

IS Specification: As per IS 2386 part III specific gravity of coarse aggregate should be between 2.6 and 2.8

D. Chloride Test

Chloride in the form of chloride (Cl-) ion is one of the major inorganic anions in water and wastewater. (Average estimate of excretion: 6 g of chlorides/person/day; additional chloride burden due to human consumption on wastewater: 15 mg/L).

1) *Apparatus*

a) Burette
b) Pipettes
c) Erlenmeyer flask.

2) *Reagents*

a) Chloride free distilled water.
b) Potassium chromate indicator solution.
c) Standard silver nitrate solution (0.0141 N)
d) Aluminium hydroxide suspension.
e) H.O. (Hydrogen peroxide).
f) H.SO / NaOH.

3) Procedure

a) Take 100 mL of sample (V) or a suitable portion diluted to 100 mL.

b) If the sample is coloured, add three mL of aluminium hydroxide suspension. mis, allow to settle, filter. wash and collect the filtrate.

c) If sulphide. sulphite or thiosulphate is present, add one mL of 1O. and stir for one minute.

d) Bring this sample to a pH range of 7 to 10 by adding H.SO, or NaOH as required.

e) Add I mL of potassium chromate indicator solution.

f) Titrate this against standard silver nitrate titrant to a pinkish yellow end point. Note down the volume (V1)

g) Repeat the procedure for blank (distilled water) and note down the volume (V2).

Chloride in mg/L=((V1-V2) ×N×35.45×1000)/V

V1-mL. of titrant for sample

V2-mL. of titrant for blank.

V-Volume of sample in mL.

N-Normality of silver nitrate solution

TABLE IIII. Chloride Determination

Sample No	Trial No	Volume Of Sample	Burette Reading		Volume Of Titrant (Ml)	Mean Vol	Chlorid Mg/L
			Initial	Final			
1	1	1	0	47	47	47.5	22333.5
	2		0	46	46		
2	1	1	0	51	51	51.5	24318.7
	2		0	52	52		
3	1	1	0	49	49	48.5	22829.8
	2		0	48	48		

From the test result Table II and Table III the sample from Puthu vypin has the less chloride content and the place is suitable for fine aggregate collection. The site is suitable for collection, easy to transportation and here the sample contain least impurities. The sea water and sea sand from Puthu Vypin is selected for the further process.

E. Sieve Analysis

1) C Reference: IS 2386 (Part I)-1963, IS 383:1970 IS 460:1962 The sieve analysis is conducted to determine the particle size distribution in a sample of aggregate, which we call gradation.

2) Apparatus: Test Sieves conforming to IS : 460:1962 Specification of 4754.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron, Balance, Gauging, Trowel, Stop Watch, etc. Procedure.

a) Take 1 kg of sand from the laboratory sample.

b) Arrange the sieves in order of IS Sieve no 480, 240, 120, 60, 30 and 15. Keeping sieve no 480 at the top and i 5 at the bottom and cover the top.

c) Keep the sample in the top sieve no. 480.

d) Carry out the sieving in the set of sieves for not less than 10 minutes.

e) Find the weight of sample retained in each sieve. Values are obtained in Table V and Table VI

TABLE IIIV. Sieve Analysis Reference

Is Sieve Designation	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

TABLE V
Sieve Analysis For Zone III(Sea Sand)

IS Sieve	Weight retained on sieve	Percentage of weight retained	Percentage of weight passing
4.75	0	0	100
2.36	0	0	100
1.18	1	0.1	99.9
600	277	27	72.9
300	590	59.4	13.5
150	115	11.59	1.91

TABLE VI
Sieve Analysis For Zone II (M Sand)

IS Sieve	Weight retained on Sieve	Percentage of weight retained	Percentage of weight passing
4.75	0	0	100
2.36	145	14.5	85.5
1.18	297	29.7	55.8
600	197	19.7	36.1
300	156	15.6	20.5
150	121	12.1	8.4

V. MIX DESIGNS

A. Sea Sand And Normal Water

Mix design is based on the guidelines given in Indian standard IS 10262:2009 for concrete mix proportioning. Here mix design for M sand and Sea-sand are separately done based on zone of fine aggregate as described on table 3 IS 10262 : 2009.

Sea sand and normal water

Mix design for the combination of sea sand and normal water with the addition of slag.

1) Design Stipulations For Proportioning

a) Grade designation : M 25
b) Type of cement : Portland slag cement
c) Max. nominal size of agg. : 20 mm
d) Minimum cement content : 320 kg/m3
e) Maximum water cement ratio : 0.55
f) Workability : 75 mm-100mm (slump)
g) Exposure condition : Mild
h) Degree of supervision : Good
i) Type of agg. : Crushed angular agg.
j) Maximum cement content : 450 kg/m3
k) Chemical admixture : Not used

2) Test Data For Materials

a) Cement used : 43 grade
b) Specific gravity of cement : 2.95
c) Specific gravity of:
i) Coarse aggregate : 2.84
ii) Fine aggregate : 2.725
d) Water absorption:
i) Coarse aggregate : 0.806 percent
ii) Fine aggregate : 1.0 percent

e) Free (surface) moisture:

i) Coarse aggregate : Nil

ii) Fine aggregate : Nil

f) Sieve analysis of Fine aggregate: Conforming to grading Zone III of Table 4 of is 383(from Table V)

3) Target Strength For Mix Proportioning

f'ck = fck + 1.65 s

where

f'ck = target average compressive strength at 28 days,

fck = characteristic compressive strength at 28 days, and

s = standard deviation.

From Table 1, standard deviation, s =4 N/mm2

Therefore, target strength =25 + 1.65 x 4 =31.6 N/mm2

4) Selection Of Water-Cement Ratio

From Table 5 of IS 456, maximum water-cement ratio = 0.55

Based on experience, adopt water-cement ratio as 0.5

0.5 < 0.55, hence O.K.

5) Selection Of Water Content

From Table 2, maximum water content = 186 litre (for 25 to 50 mm slump range)

for 20 mm aggregate

Estimated water content for 100 mm slump = 186 + (3/100) X186

=191.58 litre

6) Calculation Of Cement Content

Water-cement ratio = 0.5

Cementitious material content = 191.6/0.5 = 383.2 kg/m3

From Table 5 of IS 456,

minimum cement = 300 kg/m3

383.2 kg/m3 > 300 kg/m3 hence, O.K.

7) Proportion Of Volume Of Coarse Aggregate And Fine Aggregate Content

From Table 3 IS 10262:2009,

For Nominal maximum size of aggregate = 20 mm,

Zone of fine aggregate = Zone III from Table V

And For w/c = 0.5

Volume of coarse aggregate per unit volume of total aggregate = 0.64

Note 1: For every ±0.05 change in w/c, the coarse aggregate proportion is to be changed by 0.01. If the w/c is less than 0.5 (standard value), volume of coarse aggregate is required to be increased to reduce the fine aggregate content. If the w/c is more than 0.5, volume of coarse aggregate is to be reduced to increase the fine aggregate content. If coarse aggregate is not angular, volume of coarse aggregate may be required to be increased suitably, based on experience.

Note 2: For pump able concrete or congested reinforcement the coarse aggregate proportion may be reduced up to 10%.

Hence,

Volume of coarse aggregate per unit volume of total aggregate = 0.64 x 90% = 0.576

Volume of fine aggregate = 1 – 0.576 = 0.424

8) Mix Calculations

The mix calculations per unit volume of concrete shall be as follows:

a) Volume of concrete = 1 m3

b) b) Volume of cement =(Mass Of Cement)/(Specific Gravity Of Cement) X 1/1000
= 383.2/ (2.95 x 1000)
= 0.129 m3

c) Volume of water = (Mass Of Water)/(Specific GravityOf Water) X 1/1000
= 191.6/ (1 x 1000)
=0.1916 m3

d) Volume of all in aggregate = [a- (b +c)]
= 1-(0.129 +0.1916)
= 0.6794 m3

g) Mass of coarse aggregate = f x Volume of coarse aggregate x Specific gravity of coarse aggregate x 1000
= 0.6794 x 0.576 x 2.84 x 1000
=1111.38 kg

h) Mass of fine aggregate = f x volume of fine aggregate x Specific … gravity of fine aggregate x 1000
= 0.6794 x 0.424 x 2.725 x 1000
= 784.9 Kg

9) Quantity Of Materials Required For 1 M3 Concrete

Weight of cement required = 383.2 kg
Weight of fine aggregate required = 784.9 kg
Weight of coarse aggregate required = 1111.38 kg
Quantity of water required =191.6 kg

10) Volume Of Specimens

Volume of 1 cube = 0.15 x 0.15 x 0.15 = 0.003375 m3
Volume of 3 cubes = 3 x 0.003375 = 0.010125 m3
Volume of 1 cylinder = π/4 x 0.152 x 0.3 = 5.3 x 10-3 m3
Volume of 1 beam = 0.1 x 0.1 x 0.5 = 0.005 m3
Total volume = 0.020425 m3
20% extra = 0.02451 m3

11) Quantity Of Materials Required For Specimens

Weight of cement required = 9.39 kg
Weight of fine aggregate required = 19 kg
Weight of coarse aggregate required = 27 kg
Quantity of water required = 4.7 kg

B. Sea Sand And Sea Water

Mix design for the combination of M sand and sea water with the addition of slag.

1) Design Stipulations For Proportioning

a. Grade designation : M 25
b. Type of cement : Portland slag cement
c. Max. nominal size of agg. : 20 mm
d. Minimum cement content : 320 kg/m3
e. Maximum water cement ratio : 0.55
f. Workability : 75 mm-100mm (slump)
g. Exposure condition : Mild
h. Degree of supervision : Good
i. Type of agg. : Crushed angular agg.

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j. Maximum cement content : 450 kg/m3
k. Chemical admixture : Not used

2) Test Data For Materials

a) Cement used : 43 grade
b) Specific gravity of cement : 2.95
c) Specific gravity of:
1) Coarse aggregate : 2.84
2) Fine aggregate : 2.755
e) Water absorption:
1) Coarse aggregate : 0.806 percent
2) Fine aggregate : 1.0 percent
f) Free (surface) moisture:
1) Coarse aggregate : Nil
2) Fine aggregate : Nil
g) Sieve analysis of Fine aggregate : Conforming to grading Zone II of Table 4 of is 383

3) Target Strength For Mix Proportioning

f'ck = fck + 1.65 s
where
f'ck = target average compressive strength at 28 days,
fck = characteristic compressive strength at 28 days, and
s = standard deviation.
From Table 1, standard deviation, s =4 N/mm2
Therefore, target strength =25 + 1.65 x 4 =31.6 N/mm2

4) Selection Of Water-Cement Ratio

From Table 5 of IS 456, maximum water-cement ratio = 0.55
Based on experience, adopt water-cement ratio as 0.5
0.5 < 0.55 , hence O.K.

5) Selection Of Water Content

From Table 2, maximum water content = 186 litre (for 25 to 50 mm slump range)
for 20 mm aggregate
Estimated water content for 100 mm slump = 186 + (3/100) X186
=191.6 litre

6) Calculation Of Cement Content

Water-cement ratio = 0.5
Cementitious material content = 191.6/0.5 = 383.2 kg/m3
From Table 5 of IS 456,
minimum cement = 300 kg/m3
383.2 kg/m3 > 300 kg/m3 hence, O.K.

7) Proportion Of Volume Of Coarse Aggregate And Fine Aggregate Content

From Table 3 IS 10262:2009,
For Nominal maximum size of aggregate = 20 mm,
Zone of fine aggregate = Zone III from Table VI
And For w/c = 0.5
Volume of coarse aggregate per unit volume of total aggregate = 0.62

Note 1: For every ±0.05 change in w/c, the coarse aggregate proportion is to be changed by 0.01. If the w/c is less than 0.5 (standard value), volume of coarse aggregate is required to be increased to reduce the fine aggregate content. If the w/c is more than 0.5, volume of coarse aggregate is to be reduced to increase the fine aggregate content. If coarse aggregate is not angular, volume of coarse aggregate may be required to be increased suitably, based on experience.
Note 2: For pump able concrete or congested reinforcement the coarse aggregate proportion may be reduced up to 10%.
Hence, Volume of coarse aggregate per unit volume of total aggregate = 0.62 x 90% = 0.558
Volume of fine aggregate = 1 – 0.558 = 0.442

8) Mix Calculations

The mix calculations per unit volume of concrete shall be as follows:

a) Volume of concrete = 1 m3

b) Volume of cement =(Mass Of Cement)/(Specific Gravity Of Cement) X 1/1000
= 383.2/ (2.95 x 1000)
= 0.129 m3

c) Volume of water = (Mass Of Water)/(Specific GravityOf Water) X 1/1000
= 191.6/ (1 x 1000)
=0.1916 m3

d) Volume of all in aggregate = [a- (b +c)]
= 1-(0.129 +0.1916)
= 0.6794 m3

g) Mass of coarse aggregate = f x Volume of coarse aggregate x Specific gravity of coarse aggregate x 1000
= 0.6794 x 0.558 x 2.84 x 1000
=1076.65 kg

h) Mass of fine aggregate = f x volume of fine aggregate x Specific … gravity of fine aggregate x 1000
= 0.6794 x 0.442 x 2.755 x 1000
= 827.31 Kg

9) Quantity Of Materials Required For 1 M3 Concrete

Weight of cement required = 383.2 kg
Weight of fine aggregate required = 827.31 kg
Weight of coarse aggregate required = 1076.65 kg
Quantity of water required =191.6 kg

10) Volume Of Specimens

Volume of 1 cube = 0.15 x 0.15 x 0.15 = 0.003375 m3
Volume of 3 cubes = 3 x 0.003375 = 0.010125 m3
Volume of 1 cylinder = π/4 x 0.152 x 0.3 = 5.3 x 10-3 m3
Volume of 1 beam = 0.1 x 0.1 x 0.5 = 0.005 m3
Total volume = 0.020425 m3
20% extra = 0.02451 m3

11) Quantity Of Materials Required For Specimens

Weight of cement required = 9.39 kg
Weight of fine aggregate required = 21 kg
Weight of coarse aggregate required = 26 kg
Quantity of water required = 4.7 kg Sea Water Sample Is Collected From 3 Different Places In Cochin. Sample No 1: Puthu Vypin, Sample No 2: Fort Kochi And Sample No 3: Cherai. in Order To Determine The Properties Of Sample Various Laboratory Tests Are Conducted. References Are Done From Various IS Codes.

VI. STRENGTH TESTS

A. Compressive Strength Of Cube

The test determine the compressive strength of concrete specimens prepared and to verify the strength requirements as desired in the mix design and stipulated in the IS code.

1) *Reference:* IS 316:1959
2) *Apparatus:* Compression testing machine
3) *Specimens:* 6 cubes of 15 cm size, Mix: M20 or above
4) *Procedure*

i) Remove the specimen from water after specified curing time and wipe out excess water from the surface.
ii) Take the dimensions of the specimen to the nearest 02 mm.
iii) Clean the bearing surface of the testing machine.
iv) Place the specimen in the machine such a manner that the load shall be applied to the opposite sides of the cube as cast.
v) Align the specimen centrally on the base plate of the machine.
vi) Rotate the movable portion gently by hand so that touches the top surface of me specimen.
vii) Apply the load gradually without shock and continuously at the rate of 140 kgicr minute till the specimen fails.
viii) Record the maximum load and note any unusual features in the type of failure.

5) *Calculations*

Range Calculation Size of the cube = 15 cm x 15 cm x 15cm

Area of m if the specimen (calculated from the mean size of the specimen) 225 cm2.

Characteristic compressive strength (fck) at 28 days = Expected maximum load =fck x area x f.s = Range to be selected

Compressive strength = Maximum load at failure/Average area of bed face. Is Specification As per IS 456:2000 the compressive strength of different grades of concrete is shown in Table 2 Grades of Concrete (Clause 6.1, 92.2. 15.1.1 and 36.1).Values are obtained in Fig 1.

B. Split tensile strength of concrete

The test determine the compressive strength of concrete cylinders

1) *Reference:* IS 516:1959 IS 456:2000
2) *Apparatus:* Compression testing machine, cylinder moulds of 150mm diameter and 300mm height.
3) *Specimen:* cylinders of 150 mm diameter and 300 mm height size Mix: M20 or above.
4) *Procedure*

i) Cast the cylinder and cure for 28 days.
ii) Take Out the specimen from the curing tank.
iii) Wipe out the excess water from the surface of specimen.
iv) Place the specimen vertically on the platform of compression testing machine.
v) Apply the load continuously and uniformly without shock at the rate of 315 kN min. and continue the loading until the specimen fails
vi) Record the maximum load taken.

5) *Calculations:* Range Calculation Characteristic compressive strength at 28 days obtained maximum load = maximum load at failure/average area of bed face. Values are obtained in Fig 2

C. Flexural Strength Of Concrete

The test is used to find the flexural strength of concrete (modulus of rupture).

Reference: IS 516:1959 IS 456:2000

Apparatus: Flexural testing machine

The bed of testing machine should be provided with two steel rollers, 38 mm in diameter, on which the specimen is to be supported and these rollers shall be so mounted that the distance from centre is 40 cm.

Specimens: The standard size is 15 cm x 15 cm x 70 cm alternatively, if the largest nominal size of the aggregate does not exceed 19 mm, specimens 10 cm x 10 cm x 50cm may be used.

Procedure

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Take out the specimen from curing tank. Wipe out excess water from the surface. Mount the supporting rollers and loading device in the machine.
Place the specimen on the supports in such a manner that the load is applied to the upper most surface as east in the mould along two lines 13.3 cm apart.
Align the axis of the specimen and the axis of the loading device.
Apply load without shock continuously increasing at a rate such that the extreme fibre stress increases at approximately 7 kg/cm /minute (180 kg/ mm),
Increase the load until the specimen fails, Record the maximum load.
Note down the appearance of the fractured laces of the concrete beam. No 1: Puthu Vypin, Sample No 2: Fort Kochi And Sample No 3: Cherai. in Order To Determine The Properties Of Sample Various Laboratory Tests Are Conducted. References Are Done From Various IS Codes. Values are obtained in Fig 2

VII. FINAL TEST RESULTS AND CONCLUSIONS

A. Strength Test Result Analysis

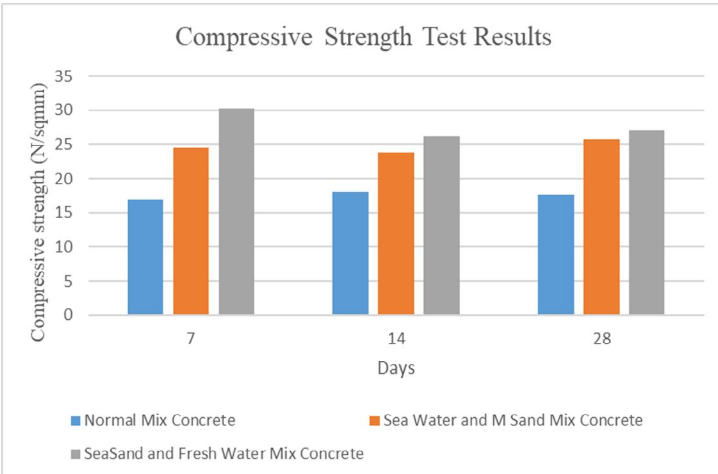

Fig. 1 A Graphical Representation of Compressive test Analysis Upto 28 days

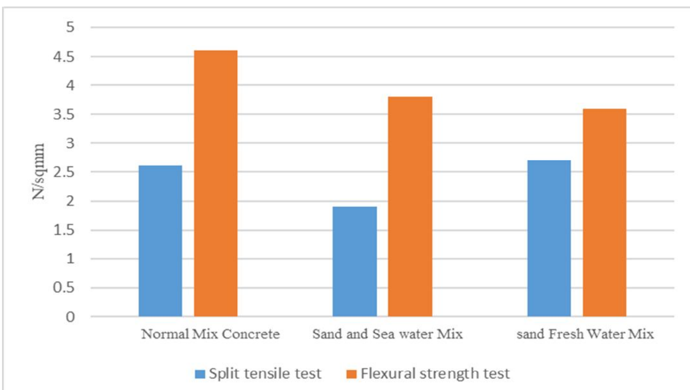

Fig2.. Split Tensile and flexural Strength analysis after 28 days

The main benefit of using sea sand and sea water in concrete can replace river sand and fresh water. Also its useful in coastal area and island area because of its easily availability. The slag cement reduces the durability problem and other unwanted chemical actions. Specific gravity of slag cement is more than normal cement. pH value is shown the sea water is in safe limit. Sea sand zone is obtained as zone III and specific gravity is obtained approximately same as M sand. The chloride value of sea water is obtained as very high compared to fresh water. From the test results only small strength reduction in both mixes compared to conventional concrete as per Fig 1. In case of flexural strength sea sand and fresh water mix shows the maximum value as per fig 2. Both Sea sand and sea water is very useful in the construction of temporary structures.

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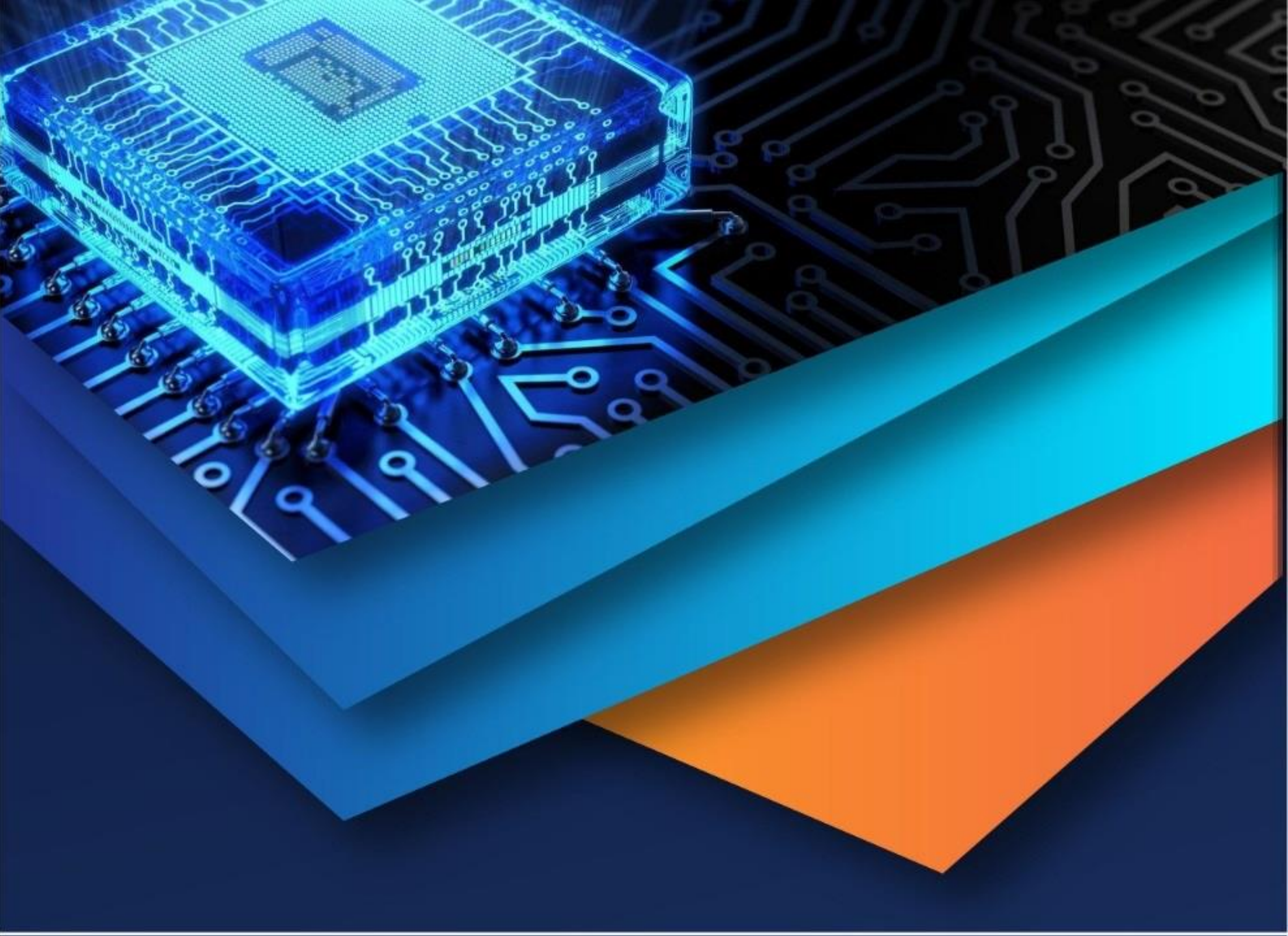

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