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Effect of Artificial Fine Aggregate and Natural Fine Aggregate Available in Haveri District on Strength of Concrete

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Abstract:
This project presents the effect of the use of artificial sand as fine aggregate in concrete as substitutes to natural sand. The experimental work is mainly concerned with the study of mechanical properties like compressive strength, split tensile strength and flexural strength of concrete by full replacement of natural sand by artificial sand as fine aggregate. Tests were carried out on cubes, cylinders and unreinforced beams to study the mechanical properties of concrete sing artificial sand and compared with conventional concrete.

Keyword: Artificial sand, compressive strength, flexural strength, split tensile strength.

1. INTRODUCTION

Concrete is the most widely used construction material because of its flow ability in most complicated from i.e.it is ability to take any shape while wet and its strength development characteristics when it hardens. Now a day, in construction of roads, buildings, dams, canals etc., cement concrete plays an important role. Fine aggregate play a very important role in controlling the properties of fresh concrete. They help to improve cohesiveness of fresh concrete, improve workability and prevent segregation and bleeding of concrete. Soils are generally stabilized to increase their strength and durability or to prevent erosion and dust formation in soils. The main aim is the creation of a soil material or system that will hold under the design use conditions and for the designed life of the engineering project. The properties of soil vary a great deal at different places or in certain cases even at one place; the success of soil stabilization depends on soil testing. Various methods are employed to so fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river or pit sand. River sand is becoming a very scare material sand mining from our river becomes objectionable. Is has now reached a stages where it is killing all our rivers of our country from total depth. So use of the artificial fine aggregate in concrete has increased rapidly in last few years because of more reduction in natural fine aggregate in river due to tremendous excavation. And also band on excavation from river form court.
Waste pebble is used to manufacture the artificial sand. Pebble means the waste material which is found on the river bank, this mineral are the waste product which are left out after purifying the natural sand on all river bed. This waste product is not used since the natural sand mining started. The pebble is in huge quantity. Stabilize soil and the method should be verified in the lab with the soil material before applying it on the field.

2. LITERATURE REVIEW: Shyam Prakash *et al.* (2007): Says that manufactured sand satisfies the requirements fine aggregates such as strength, gradation, shape angularity. It is also possible to produce manufactured sand falling into the desired grade. They say that the mechanical properties of manufactured sand depend upon the source of its raw material, i.e., parent rock. Hence the selection of the quarry is very important to quality fine aggregate.

Mahendra R Chitlange *et al.* (2010): Experimentally proved that due to addition of steel fiber to natural sand concrete and manufactured sand concrete there is a consistent increase in flexural and split tensile strength whereas there is only a marginal rise in compressive strength.

Dr.S.Elavenil, B Vijaya: Focused on Manufactured Sand, A Solution And An Alternative To River Sand And In Concrete Manufacturing. Manufactured sand has been use in concrete manufacturing in India, the percentage of its contribution is still very negligible in many parts of the country. Except in Kerala and in some pockets in Southern and Western India, real processed manufacture sand is not available and this makes manufacturing of good quality of concrete very difficult. The application of concrete meeting the specification is of paramount importance, to ensure construction of durable R.C.C. structure. Hence durable concrete covers and bears the responsibility of sustaining the entire R.C.C. structure throughout it service life. A well processed manufactured sand as partial or full replacement to river sand is the need of the hour as a long term solution in Indian concrete industry until other suitable alternative fine aggregate are developed.

3. OBJECTIVES

- To assess conventional concrete.
- To study the influence of artificial sand on the mechanical properties of concrete and compare the result with that of concrete produced using selected river sand.

- To clear doubts about quality and properties of concrete when artificial sand used as fine aggregate.
- The Construction Industry shall start using the manufactured sand to full extent as alternative; reduce the impacts on environment by not using the river sand.
- The Govt. Shall come out with, Policy on Sand – encourage the industry people to set up more no of Sand crushing Units across the all Districts, States to meet the sand requirements of the Construction Industry.

MATERIALS TO BE USE:
The properties of various materials used in making the concrete (M20) are discussed in the following sections.

* Cement
* Sand(Natural and Artificial sand)
* Aggregate
* Water

CEMENT: Ordinary Portland cement of 43grade satisfying all the requirements of our projects.

FINE AGGREGATE (Natural): Sand consists of fine angular or rounded grains of silica. Sand is commonly used as the fine aggregate in cement concrete. Which are from Udhgattii, Irani, Beluru.

Functions:

* It fills the voids existing in the coarse aggregate.
* It reduces shrinkage and cracking of concrete.
* By varying the proportion of sand can be prepared economically for any strength of concrete.
* It helps in hardening of cement by allowing by allowing water through voids.

MANUFACTURED FINE AGGREGATE: Waste pebble is used to manufacture the artificial sand. Pebble means the waste material which is found on the river bank, this mineral are the waste product which are left out after purifying the natural sand on all river bed. This waste product is not used since the natural sand mining started. The pebble is in huge quantity.

Requirements:

* 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.

COARSE AGGREGATE:
Crushed stone aggregates of 20mm down size were used for our project.

WATER: Water fit for drinking is generally considered fit for making concrete. Water should free from acid, oils, alkalis, vegetables or other organic impurities.

4. PRELEMINARY TESTS:
Cement: Normal consistency test = 32%

1. Setting time test = initial setting time 39mint
   = final setting time 589 mint
2. Specific gravity = 3.15

Fine aggregate:

1. Specific gravity test:
   - Udhgatti =2.43
   - Belur =2.45
   - Irani =2.4
   - Artificial =2.4
2. Water absorption=1.0%

Coarse aggregate:

1. Specific gravity test = 211.60
2. Water absorption test = 0.60%

Test conducted on concrete:

1. Workability test
   - Udhgatti =1.0cm
   - Belur =1.1cm
   - Irani =1.0cm
   - Artificial =1.0cm

FINENESS MODULUS:

Belur fine aggregate	3.68
Udhgatti fine aggregate	3.5
Irani fine aggregate	2.93
Artificial fine aggregate	2.85

1. Slump test

Trail no	Slump value	Average slump value
1	24	24
2	24	
3	24	

2. Compaction factor:

Trail	Compaction factor value	Average compaction value
1	84.84	84.83
2	84.80	
3	84.84	

3. Vee- bee consistometer

Trail	Time in seconds	Average time in seconds
1	4	4
2	4	
3	4	

Test for hardened concrete:

After the specimens taken out from the curing tank, they are allowed for 24 hours to dry up. The three strength tests were conducted, they are:

- Compressive strength test using 150mm x 150mm x 150mm **cube**.
- Tensile strength test using 150mm x 300mm **cylinder**.
- Flexural strength test using 100mm x 100mm x 500mm **beam**.

5. MIX DESIGN FOR M-20 GRADE CONCRETE:

5.1 STIPULATIONS FOR PROPORTIONING:

1. Grade designation : M-20
2. Type of cement : OPC 43 (IS 8112-1989)
3. Maximum nominal size of aggregate: 20mm (Table-5 of IS-456-2000)
4. Minimum cement content: 320 Kg/m^3
5. Maximum water cement ratio: 0.45 (Table-5 of IS-456-2000)
1. Workability : 50mm slump
2. Type of aggregate : Crushed angular
3. Maximum cement content: 450 Kg/m^3
4. Chemical admixture type: nil

5.2 TEST DATA FOR MATERIALS:

Cement used : OPC 43 grade
Specific gravity
a) Cement : 3.15
b) Coarse aggregate : 2.6
c) Fine aggregate : 2.58
Water absorption
a) Coarse aggregate : 0.6%
b) Fine aggregate : 1.0%
Free (surface) moisture
a) Coarse aggregate : Nil
b) Fine aggregate : Nil
Sieve analysis
a) Coarse aggregate: conforming to table 2 of IS-383-1970
b) Fine aggregate: conforming to Zone 2 of table 4 IS-383-1970

5.3 TARGET STRENGTH FOR MIX PROPORTIONING:

$F_{ck} = f_{ck} + 1.65 \times S$

F_{ck} = Target average compressive strength @ 28 days f_{ck}= Characteristic compressive strength @ 28 days S = Standard deviation

From table of IS: 10262-2009 for M-20 grade concrete S = 4.6

F_{ck}= 20+1.65x4.6

F_{ck}= 27.59 N/mm^2

5.4 SELECTION OF WATER CEMENT RATIO:

From table 5 of IS-456-2000
For M-20 = 0.45

5.5 SELECTION OF WATER CONTENT:

From table 2 of IS-10262-2009 for 20mm nominal size of aggregate maximum water content 186 kg [25-50mm slump volume]
Water content = 186 kg

5.6 CALCULATION OF CEMENT CONTENT:

W/C = 0.45

Cement content = $\frac{\text{Water Content}}{\text{W/C}}$

= 186/0.45

Cement Content = 413.35 kg

From table 5 of IS-456-2000

Minimum Cement content for 'severe' exposure condition = 320 kg/m^3

Cement content: 413.33 kg/m^3 > 320 kg/m^3

Hence ok

5.7 PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT:

From Table 2 of IS: 10262-2009

Volume of coarse aggregate corresponding to 20mm size aggregate:

W/C of 0.5 – 0.6

In present case = W/C = 0.45

The volume of coarse aggregate required to be increased & to decrease the volume of Fine aggregate content

As W/C lowered by 0.05 the proportion of coarse aggregate increased by 0.01 (@ the rate of -/+ 0.05 change of w/c)

Corrected volume of coarse aggregate = 0.62+0.01

= 0.63

Corrected volume of fine aggregate= 1.00 – 0.63

= 0.37

5.8 MIX CALCULATION:

This mix calculation per unit volume of concrete shall following:

a. Volume of concrete = 1.00m3(assume)

b. Volume of cement = $\frac{\text{Mass of cement x 1/1000}}{\text{Sp.Gr of cement}}$ = 0.131 m^3

= $\frac{413.33 \times (1/1000)}{3.15}$

= 0.131 m^3

c. Volume of water = $\frac{\text{Mass of water x 1/1000}}{\text{Specific Gravity of water}}$

= 186/1x1/1000

= 0.186 m^3

d. Volume of all in aggregate

d = Volume of concrete – (Volume of cement + volume of water)

= 1.0 – (0.131+0.186)

d = 0.683m3

e. Mass of coarse aggregate = d x corrected volume of coarse aggregate x Specific Gravity of course aggregate x1000

= 0.683 x 0.063 x 2.60 x 1000

= 1118.75kg

f. Mass of fine aggregate

= d x corrected volume of fine aggregate x Specific Gravity of fine aggregate x 1000

= 0.683 x 0.37 x 1000 x 2.58

A= 652.0kg

5.8 MIX PROPORTION:

Cement	= 413.33 kg/ m^3
Water	= 186.0kg /m^3
Fine aggregate	= 652.0 kg / m^3
Coarse aggregate	= 1118.7 kg/ m^3
W/c	= 0.45

5.9 DESIGN RATIO:

The design ratios of fine aggregates used in concrete are as follows:

PLACE	DESIGN RATIO	CEMENT	SAND	AGG
UDHGATTI	1:1.485:2.70	1	1.485	2.70
BELURU	1:1.500:2.70	1	1.500	2.70
IRANI	1:1.467:2.70	1	1.467	2.70
ARTIFICIAL SAND	1:1.487:2.70	1	1.487	2.70

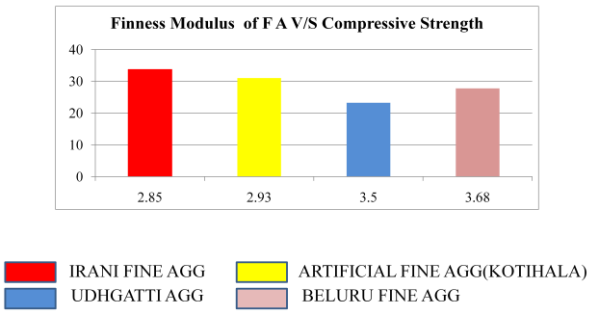
6. CONCRETE TEST RESULTS:

6.1 COMPRESSIVE STRENGTH

Table.1. compressive strength of concrete using different sand

SL NO	PLACE OF FINE AGG.	SPECIMEN	AVG COMPRESSIVE STRENGTH ,N/MM^2
1	IRANI	CUBE	23.25
2	ARTIFICIAL		27.75
3	UDHGATTI		31.02
4	BELUR		33.71

COMPRESSIVE STRENGTH GRAPH

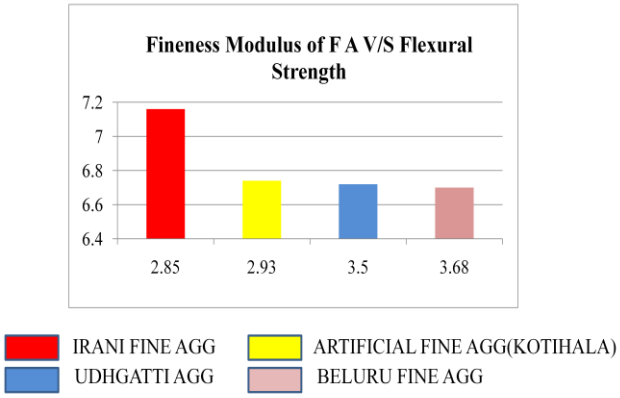


6.2 FLEXURAL STRENGTH:

Table.2. Flexural strength of concrete using different sand

SL NO	PLACE OF FINE AGG.	SPECIMEN	AVG FLEXURAL STRENGTH ,N/MM^2
1	IRANI	BEAM	6.72
2	ARTIFICIAL		6.70
3	UDHGATTI		6.74
4	BELUR		7.16

FLEXURAL STRENGTH GRAPH



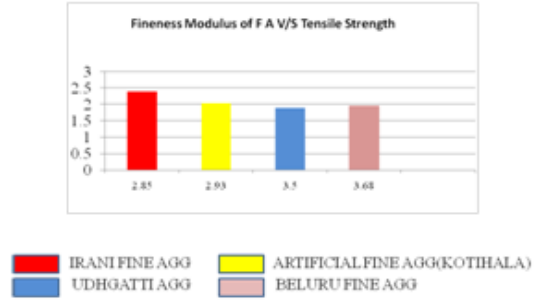
6.3 TENSILE STRENGTH:

Table.3. tensile strength of concrete using different sand

SL NO	PLACE OF FINE AGG.	SPECIMEN	AVG TENSILE STRENGTH ,N/MM^2
1	IRANI	CYLINDER	2.4
2	ARTIFICIAL		2.03
3	UDHGATTI		1.89
4	BELUR		1.96

Below graph shows the comparison b/w the fineness modulus and tensile strength

TENSILE STRENGTH GRAPH



7. CONCLUSION:

[1] It is observed that strength is maximum when used natural fine agg at Irani fine aggregate.

[2] It is observed that strength of artificial fine agg is little less when compare with Irani fine aggregate.

[3] It is observed that Irani and artificial fine aggregates having good strength and workability.

[4] It is observed that Irani and artificial fine aggregates used in concrete good in Compression, Tensile and Flexure strength.

[5] It is observed that artificial fine aggregate not much differs from natural fine aggregates.

[6] Considering, the acute shortage of river sand, huge short coming on quality of river sand, high cost, greater impact on road damages and environmental effects, The Construction Industry shall start using the manufactured sand to full extent as alternative, reduce the impacts on environment by not using the river sand.

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