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Alteration of Natural Sand By Crushed Pebble Sand (Part-II: Partial replacement)

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Abstract: **Fine aggregate plays a main role in the preparation of both concrete and mortar in construction work. Continues extraction of fine aggregate from stream causes natural issues. To conquer those issues the utilization of option materials has obtained an incredible significance. Generally we are widely using quarry stone dust (Manufactured sand) has as an alternative for natural sand which does not produce sufficient strength. In this project we used the crushed pebble sand which is produced by crushing the pebbles or quartz stone as an alternative material. Compression test was led on mortar blocks of each and the quality of individual sand was resolved. A positive change was identified and improvement in strength while using pebbles sand was observed.**

I. INTODUCTION

Cement, sand, aggregate and water are the ingredients of concrete required for any construction industry. Sand or fine aggregate plays a major role in the preparation of both concrete and mortar in construction work. This is mainly derived from the river banks and their consumption is high due to the development of infrastructure. Continuous extraction of sand from river causes environmental issues, the depleting of river sand deposits and an increase of the price of the material. To overcome these problems the usage of an alternative material has acquired a great importance. Fly ash, quarry dust or limestone, filtered sand, copper slag, M-sand (manufactured sand), GGBS, glass powder and demolished rocks are some of the alternatives used in partial or whole replacements of river sand. The places where the pebbles are largely found must be identified and can be used to replace the river sand since they give much positive results when compared to other alternative materials. Sustainable infrastructural growth requires the alternative material which satisfies both the technical requisites and availability of fine aggregate in larger amount. The reuse of the pebbles will help to save cost, conserve limited resources and ultimately protect the environment.

II.EXPERIMENTAL SETUP:

The evaluation and replacement of pebble sand for river sand are done by using mortar cube testing. For each river sand, M-sand and pebble sand separate mortar cubes of surface are 50cm^2 are casted. The cubes are prepared by 1:3 cement mortar with the water cement ratio of 0.5.After 24 hours the cubes are demoulded and they are cured for 7 days and 24 days. For each kind of fine aggregate three specimens are casted. First set is taken for compressive test for 7 days curing and second set is for 28days curing.

I.No	Description	Remarks
R0	Pure river sand	Replacement of river sand by pebble sand
R1	10% Replacement	
R2	20% Replacement	
R3	30% Replacement	
R4	40% Replacement	
R5	50% Replacement	
M0	Pure M sand	Replacement of M-sand by pebble sand
M1	10% Replacement	
M2	20% Replacement	
M3	30% Replacement	
M4	40% Replacement	
M5	50% Replacement	

MATERIALS:

Raw materials required for the concreting operations of present work are cement, fine aggregate, river pebbles and water.

A. Cement:

Cement is used as binding material in the concrete where the strength and durability are significant important. The ordinary Portland cement of 53 grades conforming to IS: 12269-1987 is used to manufacture the concrete. Also some tests were conducted such as consistency test, setting time test, specific gravity test.

Property	IS Code (IS 8112:1989)
Specific gravity	3.12
Consistency	33
Initial setting time	Not less than 30 minutes
Final setting time	Not greater than 600 minutes

B.Water:

Water plays an important role in mixing, laying, and compaction, setting and hardening of concrete. Water influences the strength

development and durability of concrete. Ordinary drinking water can be used for preparing concrete. Guidance of examine the suitability of the available water for construction can be obtained from the following specified data in IS 456-2000.The pH value of water should be generally not be less than 6.

C.River sand:

It consists of small angular or grounded grains of silica(SiO_2) and is formed by decomposition of sand stone under the effect weathering agencies. The size which is less than 4.75mm is called fine aggregate. River sand is used as fine aggregate conforming to the requirements if IS383.Before using that it must be properly cleaned by sieving and washing to eliminate the impurities.

D. Pebble stone:

Fig 1: River pebble

Pebble is a small rounded block of stone that has usually been smoothed and shaped by water flowing action. Pebbles are extremely hard natural stone. A rock made predominantly of pebble is termed a conglomerate. The pebbles come under quartzite group in geological properties.

III. PHYSICAL PROPERTIES:

Physically they are very hard, compact, fine grained, equi-granular homogenous rocks of metamorphic nature.

Physical properties of pebbles:

1) Hardness-7 to 8 on Mohr's scale.
2) Density-1.6 to 2.3 kg/cm^3
3) Compressive strength-90 to 140 N/mm^2
4) Porosity-low to very low(0.38%)
5) Water absorption- 1% to 2%
6) Weather impact-resistant
7) Modulus of rupture-16-40 N/mm^2
8) Shape-rounded
9) Colour-white, grey, reddish

IV.CHEMICAL COMPOSITION

1) Silica(SiO_2)-95% to 98%
2) Iron(Fe_2O_3)-0.5% to 1.5%
3) Alumina(Al_2O_3)-1% to 1.5%
4) Soda(Na_2O) and Potash(KrO)-less than 1 %
5) Lime(CaO)-less than 0.5%
6) Magnesia(MgO)-less than 0.5%

They are highly resistant to acids, alkalise and thermal impact. Insolubility in acids and alkalise is about 97%.

V. RESOURCE STUDY FOR PEBBLES

Resource study is conducted in and around the Karur district. It is noted that from the inspection there are plenty of river pebbles are discharged from the river sand sieving plants as a waste. The waste river pebbles are not used for any purposes. So it is dumped at the sides of roads, waste lands and near the sieving plants. Also it is available as a free source. If we crush these pebbles in the crushes then it is produced as a pebble sand by only the crushing cost.

Fig 2: River sand sieving plant

Fig 3: Dumped waste pebble

A. Varieties of pebbles:

1) River side pebbles
2) Silica pebbles

3) Coloured flint pebbles
4) Tumbled pebbles
5) Beach pebbles

B. Properties of pebble sand:

- Specific gravity=2.76
- Fineness modulus=3.2(coarse sand)
- Uniformity co-efficient=3.53
- Co-efficient of curvature=2.45
- Zone-I (As per IS:383-1970)

C. Cost analysis:

Cost of river sand for 1 unit= Rs.4500.00

Cost of M-sand and pebble sand for 1 unit= Rs.2500.00

Cost saving while using pebble sand= 45%

V. MECHANICAL PROPERTIES

A. Compressive strength test:

The compressive strength of cubes are tested by using the compressive testing machine at 7 days and 28 days. The average test result values are tabulated and the comparative studies were made on both kind of samples.

B. Compressive strength values for cement mortar cubes are:

i. River sand replaced with pebble sand

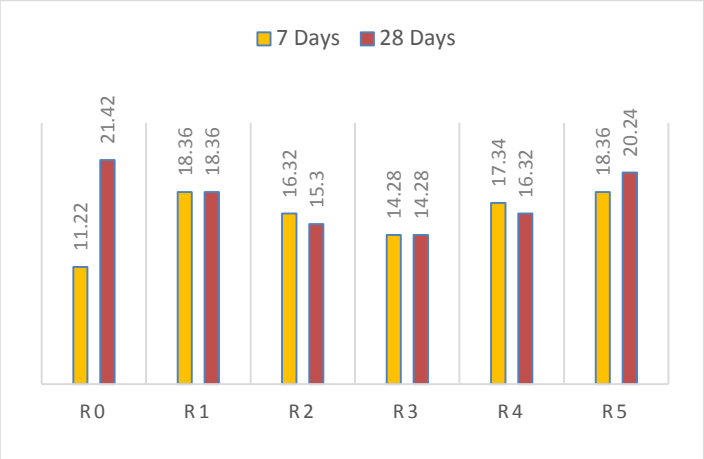
I.No	Comp. stress in N/mm²	
	7days	28 days
RO	11.22	21.42
R1	18.36	20.40
R2	16.32	15.30
R3	14.28	14.28
R4	17.34	16.32
R5	18.36	16.32

ii. M-sand sand replaced with pebble sand

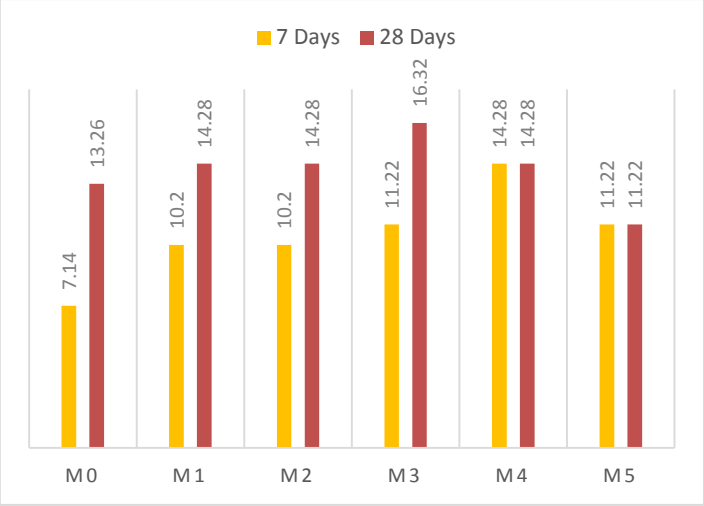
I.No	Comp. stress in N/mm²	
	7days	28 days
M0	7.14	13.26
M1	10.20	14.28
M2	10.20	14.28
M3	11.22	16.32
M4	14.28	14.28
M5	11.20	11.22

C. Graph:

1. Compressive strength of river sand replaced with pebble sand mortar cubes



2. Compressive strength of M-sand replaced with pebble sand mortar cubes



V. CONCLUSION

Based on these research investigations the following observations were made:

1. For full replacement the strength of pebble sand is equal to the river sand.
2. Replacement of river sand with pebble sand is suitable above 50% of replacement.

3. Replacement of M-sand with pebble sand is suitable from 30% to 40% range.
4. The cost saving is about 45% while using pebble sand instead of river sand without reduction in strength.
5. There is a large amount of availability of pebbles in river sand sieving plants.
6. No cost is needed for getting sieved pebbles from sieving plants. Only the crushing cost is needed for manufacturing the pebble sand.
7. The cost saving is about 45% while using pebble sand instead of river sand without reduction in strength.
8. So the cost of pebble sand is equal to the M-sand but strength is more than M-sand.
9. So pebble sand is more suitable material for construction than the M-sand and it reduces the use of river sand without compromising the strength.
10. By reducing the use of river sand, there is reduction in the environmental related issues.

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