EXPERIMENTAL INVESTIGATION OF ENTIRE REPLACEMENT OF FINE AGGREGATE AND PARTIAL REPLACEMENT OF CEMENT BY CRUSHED RIVER PEBBLES

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Abstract

Fine aggregate plays a vital role in the composition of both concrete and mortar in construction work. Continues extraction of fine aggregates from stream origin natural issues. Generally we are widely using quarry sand (M-sand) has an alternative material. In this paper we used the pulverized pebble sand which is produced by crushing the pebbles is one of substitute material. Crushed river pebbles have a cementitious property also. So, we use partial replacement of cement by river crushed pebbles. The motive of this study is to explore the probability of using crushed pebbles as fine aggregate entire and partially replacement of cement. Basic mix was chosen for M_{20} grade of concrete. The test results indicate the waste can be used effectively to fully replace natural sand in concrete. This investigation reveals that the partial replacement of pulverized pebbles in cement gives approximately same compressive, flexural and tensile strengths as that of conventional concrete. Hence usage of pulverized pebbles as replacement material will be a economical method of manufacturing concrete.

Key Words: crushed pebbles, fine aggregate replacement, concrete strength, compressive, tensile, flexural

I.INTRODUCTION

Cement is a composite material which is widely used in all over the world. The strength of concrete depending upon the characteristic of materials like fine aggregate fully and partially replacement of cement.,coarseaggregate,water. Fine aggregate is the most important ingredient of concrete that the requirement is increasing day by day, but the source is low. A pebble is the part of river sand, but it couldn't use as fine aggregate for the reason of large size. We have an idea to use crushed pebbles as fine aggregates and cement.

A. Pebble

Fig-1 Pebbles

A pebble is a constituent fragment of a clastic rock with a particle size of 2 to 64 millimetres based on the Krumbein phi scale of sedimentology. Pebbles are generally considered larger than granules (2 to 4 millimetres diameter) and smaller than cobbles (64 to 256 millimetres diameter). A rock made primarily of pebbles is termed a conglomerate. Due to erosion effect these rock fragments gets naturally tumbled with flowing river water from mountains towards planes, making its surface smooth. Pebble appliance are among the premature known man-made artifacts,

dating from the Palaeolithic session of human history.

Fig-2 Sieve Test

B.Classification of pebbles:

1) River side pebbles
2) Silica pebbles
3) Coloured flint pebbles
4) Tumbled pebbles
5) Beach pebbles

C. MATERIALS TO BE USE:

The properties of various materials used in making the concrete (M20) are discussed in the following sections.

- ✓ Cement (Partially Replacemend)
- ✓ Sand(River side pebbles)
- ✓ Aggregate
- ✓ Water

D. PROPERTIES OF CEMENT

Cement is used as binding material in the concrete where the strength and durability are significant important. Cement is being partially replaced with 10% of silt.. Cement comes in various types and chemical compositions. “Ordinary Portland Cement” 43 Mega Pascal grade of cement is used for concrete. The properties of cement were determined as per the IS 8112:1989 and results are given in the table 1.

Table -1: Properties of cement

Properties	Values
Compressive strength	43 Mpa
Fineness	5%
Initial setting time	30 minutes
Final setting time	10 hour
Specific gravity	3.15

E. FINE AGGREGATE

It consists of small angular or grounded grains of silica and is formed by disintegration of sand stone under the effect physical weathering and chemical weathering agencies. The size which is not more than 4.75mm is called fine aggregate. Crushed Pebble sand is used as fine aggregate conforming to the requirements if IS383.Before using that it must be properly sieved and checked its amount of weightage used.The specific gravity and water absorption were found to be 2.73 and 2.5% respectively, with sieve analysis data and fineness modulus value of sand confirms to grading zone I as per IS:383-1970.

F. Properties on Fine Aggregate

- ✓ Size
- ✓ Fineness modulus
- ✓ Specific gravity
- ✓ Bulking

Table -2: Properties of fine aggregate

Properties	Values
Size	Passing through 4.75mm sieve
Fineness modulus	2.27
Specific gravity	2.65
Bulking	8.8%

G. PROPERTIES OF PEBBLES

Pebbles are a rounded block of stone that has generally been smoothed and shaped by water flowing action. Pebbles are especially hard natural stones. A rock made mainly of the pebble is termed a conglomerate. The pebbles come under quartzite group in geological properties. The pebbles are crushed using compaction machine. The pebbles are transferred into the mold. Then they are crushed with applying 700KN load. After they took out from the crushing machine. Then crushed pebbles are sieve by using sieve set. The pebbles are passing through IS 4.75mm and retain on 120-micron sieve. The chemical properties of pebbles are silica (Sio_2) -95% to 98%., Iron (Fe_2O_3)-0.5% to 1.5%., Alumina (Al_2O_3)-1% to 1.5%., Soda (Na_2O_3) and Potash (KrO)-less than 1%., Lime (CaO)-less than 0.5%., Magnesia (MgO)-less than 0.5%.

Table -4: Properties of Pebbles

Properties	Values
Size	Passing through 4.75mm Sieve
Hardness	7 to 8 on Mohr's scale
Specific gravity	2.62
Density	1.6 to 2.3 kg/cm2

I. PROPERTIES OF COARSE AGGREGATE

The material retained on 4.75mm sieve is termed as coarse Aggregate. Crushed stone and natural gravel arethe common materials used as coarse aggregate for concrete. Coarse aggregate are obtained by crushing various types of granites, schist, crystalline and lime stone and good quality sand stones. When high performance concrete is essential, very fine grained granite conceivably is the best aggregate. Concrete made with sand stone aggregate give trouble due to cracking because of high degree of shrinkage.

For coarse aggregate crushed 20mm, normal size graded aggregate was used. The specific gravity and water absorption were found to be 2.85 and 1.0% respectively. The grading of aggregate should be conformed to the requirement as per IS: 383-1970. Fineness modulus of coarse aggregate is given in the table. Aggregates should be chemically inert strong, hard, durable and limited porosity.

H. Properties of Coarse aggregate

- ✓ Size
- ✓ Fineness modulus
- ✓ Specific gravity
- ✓ Bulking

Table 3 Properties of the Coarse aggregates

Properties	Values
Size	Passing through 22 mm sieve and retained in 20 mm sieve
Fineness Modulus	4.16
Specific gravity	2.7
Bulking	5.52%

II.EXPERIMENTAL SETUP

The mould specification, preparation of mould, the method of casting and curing are discussed below

Table 5 Size of Specimens

S.No	Specimen	Size (mm)
1.	Mortar	75X75X75
2.	Cube	150X150X150
3.	Cylinder	150 Dia & 300 Height

A. CONCRETE DRYING

The water causes the hardening of concrete through a process called hydration. Hydration is a chemical reaction in which the major compounds in cement form chemical bonds with water molecules and become hydrates or hydration products.

Concrete does not dry, it cures. A 28 day cure is generally specified. It is desirable to keep the surface of the concrete wet or damp after it initially sets up and prevent dry out which ends the curing process and limits final strength. The process of cement "hardening" is a chemical reaction.

B. TEST SETUP

Testing of concrete plays an important role in controlling and confirming the quality of cement concrete. Cube & Cylinder is tested for its strength characteristics.

The following tests are conducted

- ✓ Compressive Strengh Test
- ✓ Split Tensile Strenght Test
- ✓ Flexural Strenght Test

C.TEST RESULTS AND COMPARISION

The determination of compressive strength, split tensile strength, flexural strength of concrete specimens are evaluated all the details of results can be expressed.

D.Results on compressive strength of cube

The compressive strength of cube has to be determined the values are denoted and tabulated as given below,

Fig-3 Compressive strength of cube

Table – 6 Result on Compressive Strength of Cube

Cube	Compressive Strength in (KN/m^2)		
	7 days	14 days	28 days
100% of Sand	9.5	18.9	28
100% of Pebbles	4.4	9.7	26.1
50% of Sand & 50% of Pebbles	7.4	15.5	25.3

E.Result on split tensile strength of cylinder

The split tensile strength of cylinder has to be determined the values are denoted and tabulated as given below,

Fig-4Tensile test on cylinder

Table -7 Tensile Strength of Cylinder

Cylinder	Split Tensile Strength in (KN/m^2)		
	7 days	14 days	28 days
100% of Sand	1.5	2.4	3.1
100% of Pebbles	0.8	1.8	3.0
50% of Sand & 50% of Pebbles	1.1	2.1	2.9

F. Result on flexural strength of beam

The flexural strength of beam has to be determined the values are denoted and tabulated as given below.

Fig 5 flexural strength of beam

Table - 8 Result on Flexural Strength of Beam

Beam	Flexural Strength in (KN/m^2)		
	7 days	14 days	28 days
100% of Pebbles	2.775	4.968	10.788

III.CONCLUSION

The mechanical properties such as compressive strength, Tensile Strength, Flexural Strength of 100% replaced of sand without adding admixture of concrete is decreased compare than 0% replace of sand. Physical properties of the specific gravity of sand and crushed pebbles are comparatively less difference. The color of sand and crushed pebbles are relatively same

appearance. The compressive strength, Flexural Strength, Tensile Strength of concrete for the grade of M20 with crushed pebbles as the fine aggregate was found to be comparable with the concrete made with riverbed sand. Crushed pebbles can be effectively used in plain concrete in place of fine aggregate. We can use crushed pebbles partially or entirely for the replacement of sand in concrete.

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REFERENCES

[1] IS: 8112 – 1989, Specifications for 43 grade ordinary Portland cement, Bureau of Indian standard, New Delhi.

[2] IS: 10262 – 2009 and SP: 23:1982Recommended Guidelines for concrete mix. Bureau of Indian standard , New Delhi.

[3] IS: 383-1970, Specification for Coarse and Fine aggregate from natural sources for concrete.Bureau of Indian standard ,New Delhi.

[4] A Study on the Strength of Concrete Using Crushed Stone Dust as Fine Aggregate (2015) _ Er.Lalit Kumar, Er.Arvinder Singh. Published on International journal For Research in Applied Science & Engineering Technology (IJRASET).

[5] Experimental Investigation On Partial Replacement Of Fine Aggregate By Using River Crushed Stone (2014) _ D.Karthick, N.Balasubramanniam, K.S.Navaneethan. Published on International journal For Research in Applied Science & Engineering Technology (IJRASET).

[6] Alteration of Natural Sand by Crushed Pebbles Sand (2016) (part -1: Full Replacement) _ R.Sivakumar, D.Maduvanthi. Published on International journal For Research in Applied Science & Engineering Technology (IJRASET).

[7] Experimental Investigation on the Effect of Replacement of Sand by quarry Dust in Hollow Concrete Block for Different Mix Proportions (2014) _H.S.Sureshchandra, G.Sarangapani, and B.G.Naresh Kumar Published oInternational Journal of Environmental Science and Development (IJESD).