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EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE USING CRUSHED PEBBLES BY REPLACEMENT OF FINE AGGREGATE

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Abstract - *In recent years fine aggregate plays a main role in the preparation of both concrete and mortar in construction work. . Generally we are widely using quarry sand (Manufactured sand) has as an alternative for natural sand. In this project we used the crushed pebble sand which is produced by crushing the pebbles is one of the alternative material. The purpose of this study is to investigate the possibility of using crushed pebbles as fine aggregate fully with different grades of concrete composite. The suitability of crushed pebbles waste as a fine aggregate for concrete has been assessed by comparing its basic properties with that of conventional concrete. Basic mix was chosen for natural sand to achieve M25 grade concrete. The equivalent mixes were obtained by replacing natural sand by crushed pebbles partially and fully. The test results indicate the crushed pebbles waste cannot be used effectively to fully replace natural sand in concrete. In the experimental study of strength characteristics of concrete using crushed pebbles as fine aggregate it is found that there is no increase in compressive strength, flexural strength and tensile strength of concrete when compared with natural sand.*

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

1. 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 cement, fine aggregate, coarse aggregate, admixtures, 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 aggregate.

1.1 Pebbles

Pebble is a rock fragment which is smaller than a cobble. They are rounded and/or elliptical in shape, having diameter between 10mm to 150 mm. Due to erosion effect these rock fragments gets naturally tumbled with flowing river water from mountains towards planes, making its surface smooth. A beach composed chiefly of surface pebbles is commonly termed a shingle beach. This type of beach has armoring characteristics with respect to wave erosion, as well as ecological niches that provide habitat for animals and plants. Inshore banks of shingle (large quantities of pebbles) exist in some locations, such as the entrance to the River Ore, where the moving banks of shingle give notable navigational challenges.

Pebbles come in various colors and textures and can have streaks, known as veins, of quartz or other minerals. Pebbles are mostly smooth but, dependent on how frequently they come in contact with the sea; they can have marks of contact with other rocks or other pebbles. Pebbles left above the high water mark may have growths of organisms such as lichen on them, signifying the lack of contact with seawater

Fig -1 : Pebbles

1.2 Sources of pebbles

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2. MATERIALS AND METHODS

The concrete with M25 grade mix is used with the following ingredients:

Cement, Fine aggregate (sand), Coarse aggregate (20mm metal), Pebbles

The properties of these used materials are discussed below.

2.1 Properties of cement

Cement is the most important constituent of concrete, it forms the binding medium for the discrete ingredients made out of naturally occurring raw materials and sometimes blended or inter-ground with industrial wastes. 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

2.2 Properties of fine aggregate

Aggregate smaller than 4.75mm size is called as fine aggregate. Natural sands are generally used as fine aggregate. Sea shore sand may contain chlorides, which may cause efflorescence and may cause corrosion of reinforcement. Angular grained sand produces, good and strong concrete because it has good interlocking property, while round grained particle of sand do not afford such interlocking. River sand was used in preparing the concrete as it was locally available in sand quarry. 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.

Specific gravity of the fine aggregate and coarse aggregate are given in the table 2.

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%

2.3 Properties of coarse aggregate

The material retained on 4.75mm sieve is termed as coarse Aggregate. Crushed stone and natural gravel are the 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 strength concrete is required very fine grained granite perhaps 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. The properties of the fine aggregates are in table 3.

Table -3: Properties of coarse aggregate

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

2.4 Properties of pebbles

A pebble is a small rounded block of stone that has usually been smoothed and shaped by water flowing action. Pebbles are extremely hard natural stones. A rock made predominantly of 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 in to mold. Then they are crushed with applying 700KN load. After they took out from machine. Then pebbles are crushed this is through passing the sieve. The pebbles' passing through IS 4.75mm and retain 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/cm^2

Fig -2 : Crushing Process of Pebbles

3. 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.	Cube	150x150x150
2.	Cylinder	150dia & 300 height
3.	Beam	700 x 150 x 150

Fig-3 : Specimen Casting after proper compaction

3.1 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.

3.2 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,

1. Compressive strength test,
2. Split tensile strength test,
3. Flexural strength test.

Fig -4 : Compressive strength setup

Fig -5 : Split tensile strength setup

Fig -6 : Flexural strength setup

4. 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.

4.1 Results on compressive strength of cube

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

Table - 6 Result on Compressive Strength of Cube

Cube	Compressive Strength in KN/m²		
	7 days	14 days	28 days
100% of Sand	9.5	18.9	28
100% of Pebbles	4.4	9.7	16.1
50% of Sand & 50% of Pebbles	7.4	15.5	25.3

4.2Result 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,

Table - 7 Result on Split Tensile Strength of Cylinder

Cylinder	Split Tensile Strength in KN/m²		
	7 days	14 days	28 days
100% of Sand	1.5	2.4	3.1
100% of Pebbles	0.8	1.4	2.1
50% of Sand & 50% of Pebbles	1.1	2.1	2.9

4.3 Result on flexural strength of beam

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

Table - 8 Result on Flexural Strength of Beam

Beam	Flexural Strength in KN/m²		
	7 days	14 days	28 days
100% of Sand	3.551	5.848	10.966
100% of Pebbles	1.775	3.968	6.788
50% of Sand & 50% of Pebbles	3.133	5.535	10.131

4.4 Comparison

4.4.1 Comparison on compressive strength of cube

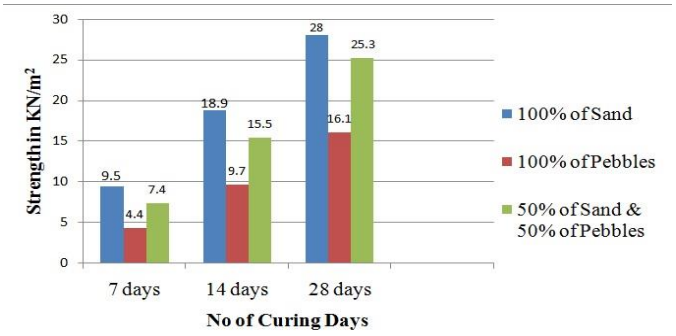

Chart – 1 Comparison on Compressive Strength of Cube

4.4.2 Comparison on split tensile strength of cylinder

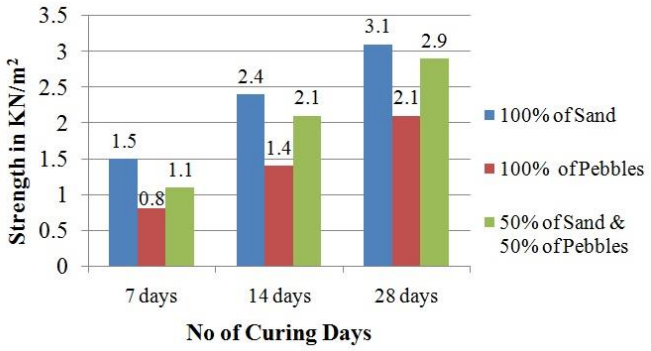

Chart -2 Comparison on Split Tensile Strength of Cylinder

4.4.3 Comparison on flexural strength of beam

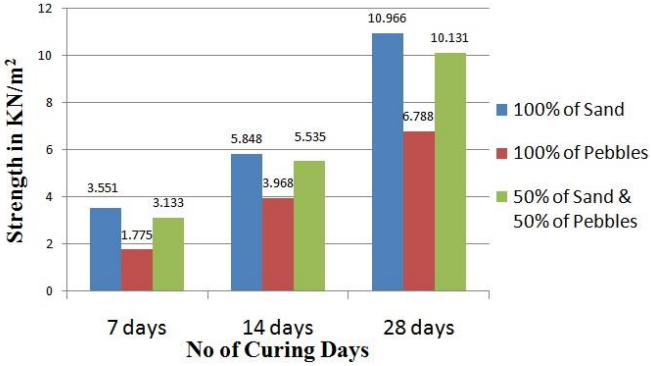

Chart - 3 Comparison on Flexural Strength of Beam

5. 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 as 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 grade of M25 with crushed pebbles as fine aggregate were found to be comparable with the concrete made with river bed sand. Crushed pebbles cannot effectively be used in plain concrete in place of fine aggregate. We can use crushed pebbles partially for the replacement of sand in concrete.

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BIOGRAPHIES

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