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Replacement of River Sand by Crushed Sand and its Effect on Concrete Parameters

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Abstract – *In concrete, aggregates are inert filler material which plays the vital role on its compressive strength and workability. Scarcity of river sand affecting the construction industry on vital scale, to avoid this alternate approach has been taken to replace the natural sand with crushed or manufactured sand. The aim of research work is to investigate the effect on compressive strength as well as workability of concrete when river sand was replaced by crushed sand and up to which extent replacement of river sand is significant in accordance with standards and observed that beyond 70% replacement of river sand compressive strength is not increased and slump value crosses the specified control limit.*

Key Words: Compressive,Concrete,Crushed,Replacement, Slump,Strength,Workability

1. INTRODUCTION

Concrete is a composite material composed of fine and coarse aggregate bonded together with water in proportions that hardens over time. Aggregates are generally thought of as inert filler within a concrete mix, but a closer look reveals the major role and influence aggregate plays in the properties of both fresh and hardened concrete. Changes in gradation, maximum size, unit weight, and moisture content can all alter the character and performance of your concrete mix. Generally river sand used as fine aggregate in concrete but due to administrative reason sand mining is restricted and scarcity of sand arises which effects the construction project sites and also financial aspect. To cope up the production shortage of river sand quarry dust and crushed sand used as alternative of river sand in concrete construction industry, such as building materials, road development materials, aggregates, bricks, and tiles. Utilization of quarry dust in concrete is recommended particularly in regions where sand is not easily available (Dehwah [1]). The suitability of quarry dust as a sand replacement material shows that the mechanical properties are improved and also elastic modulus. The compressive strength achieved optimum by replacing fine aggregate with quarry dust in ratio of 60 : 40 as done by Hmaid Mir and further Ukpata and Ephraim [3] identified the flexural and tensile strength properties compared with those for normal concrete. Hence, concrete proportion of lateritic sand and quarry dust can be used for construction provided the mixture of lateritic sand content is reserved below 50%. Both flexural strength and tensile strength are increased with increase in lateritic content and Kronlof [4] found that that fine aggregate powder sharply reduces the water requirement in super plasticised concrete and increased strength at constant workability due to improved particle packing. Better workability is observed due to a consistent mix and increased durability because of decreased porosity

The present research work mainly deals with the influence of different replacement proportion of sand with crushed stone dust on the compressive strength and workability of concrete.

1.1 Concrete material and its properties

Cement: Portland Pozzolana cement fly ash (20% flyash) based is used and tests was conducted as per IS 4031-1988.The properties of cement is shown in Table1

Table -1: Properties of Cement

S.No	Test	Result	ACCEPTANCE CRITERIA AS PER IS 1489 (PART 1): 2015
1	Fineness	0.7%	10% max
2	Initial setting time	130 min	30 min
3	Final setting time	215 min	600 minutes max
4	Soundness test	0.55%	10% max
5	Strength test (at 28 days)	56.7 MPa	33 MPa min

Couse Aggregate and Fine Aggregate: Source of aggregate is excavated hard rock of sandstone. The single sized 20mm and 10mm aggregates are graded in 55:45 ratios respectively to obtain a graded aggregate of 20mm nominal size confirming to standards. The fine aggregate is river sand

crushed sand meeting the gradation requirement of zone-II as per IS: 383-2016 having Fineness Modulus of 2.59 and further ratio of river sand and crushed sand has been altered. These other properties of aggregates refer to the mechanical properties of aggregate required to confirm with IS: 383-2016. The test is performed as per the IS: 2386 – 1963 and properties is shown in table 2.

Table -2: Properties of Aggregates

S.No	Test	Result	ACCEPTANCE CRITERIA AS PER IS 1489-2015
1	Combined flakiness and elongation	10.5%	40%
2	Crushing value	16.5%	30%
3	Aggregate Impact value	21.5%	45%
4	Aggregate abrasion value	26.7%	50%

1.2 Site trial mix design (Control Sample)

Concrete mix design of M 25 grade of concrete was done at site in accordance with IS: 10262:2009 and ingredient details and strength is illustrated in Table 3

Table -3: Mix Design Ingredients

Grade of Concrete	M25
Water-Cement Ratio	0.47
Cement (Kg)	333
River Sand (Kg)	810
Crushed Sand (Kg)	0
Coarse Aggregate (Kg)	572
Fine Aggregate (Kg)	468
Water (Litres)	156
Plasticizer (Kg)	2
Slump Value (mm)	100
Compressive Strength in 28 days (Mpa)	31.32

1.2 Casting and testing of concrete cubes

Concrete cubes of size 150mm x 150mm x 150mm is casted as per Indian Standard IS: 516-1959 and concrete compressive strength is evaluated as per IS: 516-1959 and further slump of green concrete is also evaluated as per IS: 1199-1959.

2. EXPERIMENTAL PROCEDURE AND DATA

The test has been conducted in accordance with IS code to evaluate the compressive strength of concrete and its workability at every incremental percentage replacement of river sand with crushed sand by keeping all other factors constant like water-cement ratio, plasticizer, coarse aggregate and results of the same is illustrated in Table 4 and obtained values graph of compressive strength and workability with respect to percentage replacement of river sand by manufactured sand is plotted accordingly to study the effect on workability and on compressive strength as shown in Figure 1, Figure 2 and Figure 3

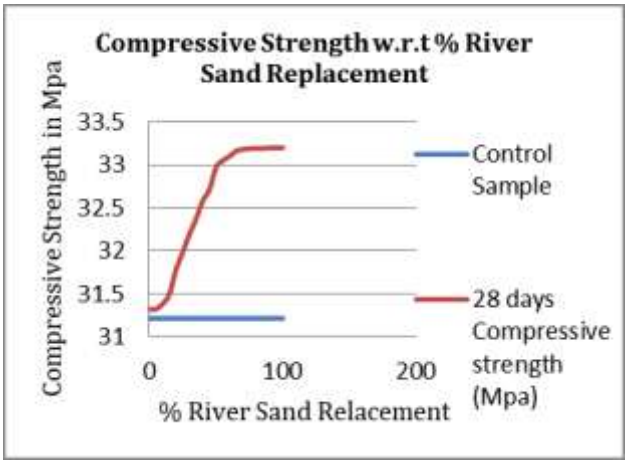

Figure -1: Compressive Strength v/s River Sand Replacement

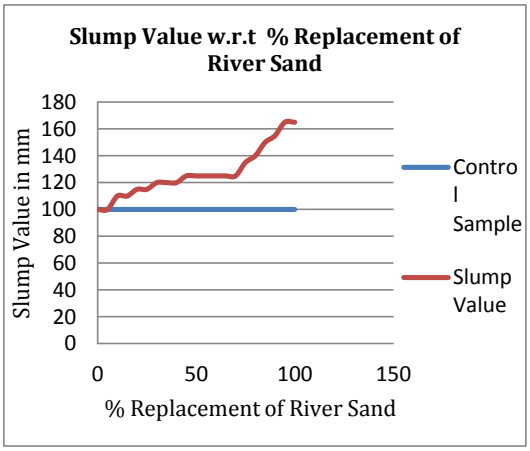

Figure -2: Slump Value v/s River Sand Replacement

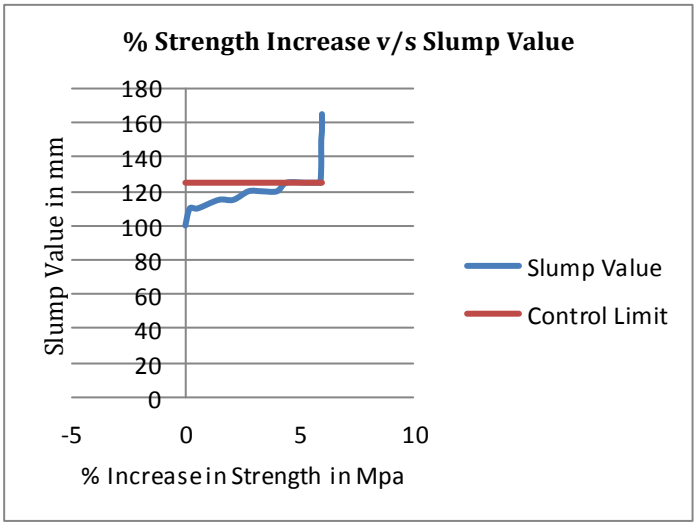

Figure -3: Variation of % Strength and Slump Value

3. CONCLUSION

It has been observed that compressive strength of concrete has been increased up to 6% when sand replaced by crushed sand in totality and subsequently slump value is also increases. It has been also observed that on 70% replacement of river sand, compressive strength of concrete has increased up to 5.94% and slump value is with in control limit as specified in IS 4926 and on further replacement of sand is not having much effect on compressive strength but subsequently increases the workability of concrete.

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