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Experimental Investigation of Partially Replaced Fine Aggregate with Sandstone Powder in Concrete

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Abstract: *Huge quantity of concrete is consumed by construction industry all over the world. In India, the conventional concrete is produced using natural river sand from river beds as fine aggregate. Increase scarcity of sand and reduce sources of river sand. So focus to alternative material. One of the alternative material is using sandstone powder in concrete partially replacement of natural river sand. The sandstone powder is collected from irrigation well. Substitution of normal sand by sandstone powder will serve both solid waste minimization and waste recovery. This study focuses to experimental investigation of concrete using sandstone powder. From laboratory experiments, it was revealed that concrete made of sandstone powder gained about 11.91% higher strength than that of the concrete normal sand.*

Key words: **Sandstone powder, sand, concrete, compressive strength.**

1. INTRODUCTION

Concrete is the most widely used composite material today. The constituents of concrete are coarse aggregate, fineaggregate, binding material and water. The function of the fine aggregate is to assist in producingworkability and uniformity in the mixture. The river deposits arethe most common source of fine aggregate. Now-a-days thenatural river sand has become scarce and very costly. Hence weare focused to think of alternative materials. The Sandstone powder maybe used in the place of river sand fully or partly.A comparatively good strength is expected when sand isreplaced partially or fully with or without concrete admixtures. It is proposed to study the possibility of replacing sand with available sandstone powder without sacrificing the strength and workability of concrete.

2. MATERIALS USED

In this study, 43 grade ordinary Portland cement conforming to IS 8112- 1989 is used. Natural river sand belonging to zone III as per IS 383-1970 is used in this investigation. Crushed stone of 20mm maximum size has been used as coarse aggregate. Portable water was used for mixing and curing.Sieve analysis is a practice or procedure used to assess the particle size distribution of granular material. Here sieve analysis test done with river sand vs sandstone powder. The finess modulus of river sand and sand stone power was 2.75 and 2.6 chart.1 show sieve analysis test graph and thus the result was fine aggregate obtained zone III sand.

2.1 Sandstone Powder

Sandstone is one of the most common type of sedimentary rock. Sandstone functions as an aquifer and as a reservoir for oil and gas. Sandstone is collected from the irrigation water storage well. Sandstone sometimes known as arenite. It is a clastic sedimentary rock composed mainly of sand-sized minerals or rock grains.

Fig.1 sandstone powder

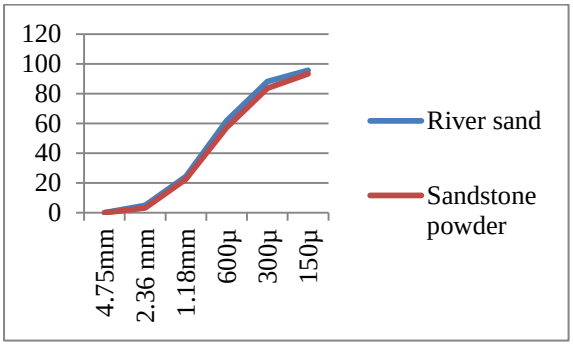

Chart.1 sieve analysis river sand Vs sand stone powder

Table-1 Material properties

Material	Properties
Cement	Initial setting time - 30minutues Final setting time- 8 hours Consistency- 30% Specific gravity – 3.05
River sand	Specific gravity -2.6 Finess modulus – 2.75 Free moisture – 1.4
Sandstone powder	Specific gravity – 2.75 Finess modulus – 2.6 Free moisture – 1.4
Coarse aggregate	Specific gravity - 2.68 Water absorption – 0.5

3. EXPERIMENTAL INVESTIGATION

3.1 MIX PROPORTIONING

The mix proportion for concrete of M20 grade was carried out. The mix proportion obtained and the quantity of materials required for one cubic meter of concrete is presented in Table .2.

Table-2: Mix Proportion of Sandstone powder concrete

Materials	Quantity of materials / m^3 of concrete	Mix proportion
Cement	360 kg/m^3	1
Fine aggregate(River sand+ sandstone powder)	584 kg/m^3	1.62
20 mm Coarse aggregate	1223.8kg/m^3	3.4
Water	180.42 kg/m^3	-
W/C ratio	0.50	0.50

Casting and Curing Of concrete

The concrete specimens are casted and cured for 7 days and 28 days. The concrete specimens have dimensions of 150mm x150mm x 150mm cubes for compressive strength test at 7 days and 28 days and 150mm x 300mm cylinders for split tensile strength test at 28 days.

4. RESULTS AND DISCUSSIONS

4.1 Compressive strength

The result of compressive strength with replacement of sandstone powder for 7 days and 28 days plotted in table 3 and its graphical representation is shown chart.2. From the results, compressive strength of concrete with 50% replacement of sandstone powder have the highest 7 days and 28 days strength which reaches 22.67Mpa and 24.43Mpa respectively.

Table-3: Compressive Strength Test Result

Specimen details	Specimen No.	Compressivestrengthat (N/mm^2)	
		7 days	28 days
100% sand+0% sandstone powder	-	14.62	21.83
75% sand+25% sandstone powder	I	20.35	22.00
50% sand+50% sandstone powder	II	22.67	24.43
25% sand+75% sandstone powder	III	19.25	20.23

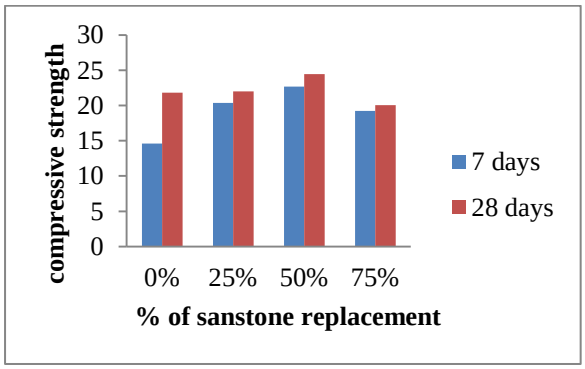

Chart. 2 Compressive Strength of concrete

4.2Split Tensile strength

The tensile strength of specimen was determined in 28 days. The maximum tensile strength attained in 50% replacement of sandstone powder which 2.5Mpa.The split tensile strength test result shows table 4 and chart.3.

Table-4: Tensile strength test result

Specimen details	Specimen No.	Tensilestrength at 28days(Mpa)
100% sand+0% sandstone powder	-	1.7
75% sand+25% sandstone powder	I	2.0
50% sand+50% sandstone powder	II	2.5
25% sand+75% sandstone powder	III	1.8

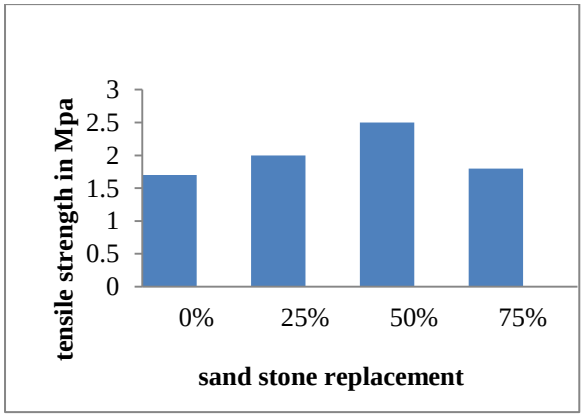

Chart.3 Tensile Strength of concrete

4.3 Flexural strength

The flexural strength of concrete specimen determined in 7 days and 28 days. The maximum strength attained in 50% replacement of sandstone powder which is 3.13 and 3.14Mpa. The flexural strength of cement concrete with different percentage of sandstone powder is given in table.5 and its graphical representation shown in chart.4.

Table-5: Flexural Strength Test Result

Specimen details	Specimen No.	Flexural strength at (N/mm²)	
		7 days	28 days
100% sand+0% sandstone powder	-	2.73	3.27
75% sand+25% sandstone powder	I	2.8	3.32
50% sand+50% sandstone powder	II	2.98	3.52
25% sand+75% sandstone powder	III	2.91	3.46

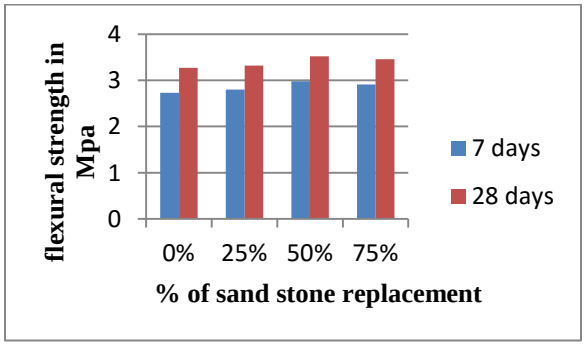

Chart.4 Flexural Strength of concrete

5. CONCLUSION

From the above results the compressive strength of sand stone powder concrete 11.91% greater than river sand concrete.

Tensile strength of sand stone powder concrete 47.06% greater than river sand concrete when the sand stone powder replaceable 50% of river sand concrete.

Finally comparing the flexural strength the sand stone powder concrete is greater than river sand concrete.

The compressive strength, tensile strength and flexural strength values of 75% replaceable sand stone powder are reduce as compared to 50% but more than conventional concrete. So replaceable of sand stone powder up to 50% is safe.

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