

Experimental Studies on Partial Replacement of Shabath Waste as Coarse and Fine Aggregate

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ABSTRACT: The emerging demand of construction materials made us to utilize recycled materials in concrete as replacement of aggregates. Utilization of natural resources and preservation of environment is the essence of any development. An attempt has been made to save the environment and utilize the waste material as partial replacement of coarse and fine aggregate in this project. The problem arising from continuous technological and industrial development is the disposal of waste material. The cost of construction and effective disposal of waste can be achieved by the proper study of materials and their properties. If some of the waste materials are found suitable in concrete making, the waste materials can be safely disposed. In this paper, an attempt has been made to assess the suitability of shabath waste in concrete making. Concrete increasing use of local aggregate exploited from the environment. The issue of natural coarse and fine aggregate depletion has been addressed by who highlighted that the natural resource decreases while the demand for coarse and fine aggregate to be used in concrete production is still high. An experiment has been carried out for M₃₀ concrete using Shabath waste as partial replacement of coarse aggregate and fine aggregate. Shabath is the slate rock which is metamorphic rock of greenish blue color and is used for the flooring of corridors. Shabath waste cutting stones were partially replaced as coarse aggregates in 20%, 30% and 40% respectively and the waste dust was partially replaced as fine aggregate by 25%, 50%, 75% and 100% respectively. Conventional concrete cubes and cylinders are casted and tested for 7 days. The results are discussed in detailed. The compressive strength 7.46% and split tensile strength 6.45% greater for 30% replacement of shabath waste stone as coarse aggregate when compared with the conventional concrete. The compressive strength 5.97% and the split tensile strength 5.1% greater for 25% replacement of shabath waste dust as fine aggregate. 30% of shabath rock was found to be optimum replacement of coarse aggregate and 25% of shabath waste dust was found to be optimum replacement of fine aggregate.

KEYWORDS: shabath waste; partial replacement.. coarse aggregate, fine aggregate

I. INTRODUCTION

Concrete production achieves innovations in substitution of different materials in the place of Natural coarse and the fine aggregates. Due to the depletion of the natural sources of the aggregates and due to the difficulty of the dumping of waste cutting stones the aggregates are replaced. The Shabath waste is used as the partial replacement of coarse and fine aggregate. Shabath is the slate rock which is metamorphic rock of greenish blue color and is used for the flooring of corridors. Various percentages of shabath waste stone and the shabath dust were partially replaced as coarse aggregate and the optimum percentage of replacement is determined.

The objectives of this study are manifold and they are as follows:

- To decrease the dumping waste aggregates by replacing with the natural aggregates..
- To study the mechanical properties of concrete by partial replacement of shabath waste as coarse and fine aggregate. .

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- To determine the optimum percentage of partial replacement of shabath waste as coarse and fine aggregate.

II. REVIEW OF LITERATURE

Vrious literatures were collected from year 2010 to 2015 and their experimental work results and conclusions are explained.

Raminder singh et al (2015), concluded that the compressive strength of the concrete increases at the 10% of partial replacement of cement with the waste marble powder and upto 30% of partial replacement of coarse aggregate with tile aggregate. The compressive strength decreases by the increased replacement level from 10% to15% for waste marble powder and 30% to 455% of tile aggregates [1].Veera Reddy (2010), concluded that the replacement of coarse aggregate by ceramic scrap in excess of 20%, leads to the reduction of strength below the conventional concrete [2]. T.Sekar et al (2011), studied the partial replacement of ceramic insulators and glass insulators as coarse aggregate and suggested that the compressive strength of concrete cubes made with ceramic insulators and the glass insulators were found to be 16% and 24.34% lesser than that of conventional concrete [3].Iqbal et al (2013), conducted the study on the partial replacement of Over burnt brick ballast as coarse aggregate and concluded that the 14.75% increase in compressive strength for 20% replacement of over burnt brick ballast aggregate [4].Sanjay kumar patro (2015) reviewed the properties of fresh and hardened concrete using agro wastes as partial replacement of aggregates and concluded that oil palm shell contributed to higher shear strength compared to the conventional concrete. Modulus of rapture of oil palm shell behaves similar to the conventional concrete. The Periwinkle shell gives more than 20Mpa compressive strength by 75% of replacement [5].Krishna et al (2013) conducted the studies on partial replacement of quarry dust as fine aggregate and concluded that 50% of replacement showed that the water cement ratio increased to 1.6 at which the slump cone failed completely. The optimum percentage of the replacement of sand with quarry dust is 55% to75% in case of compressive strength [6].Karugu et al (2013) conducted the experiment on the partial replacement of natural river sand with crushed rock sand and concluded that compressive strength was increased to 6% with 20% of replacement of stone crushed sand for M₂₀ grade concrete. The split tensile strength and the flexural strength with 20% of crushed rock sand results the 10.1% and 16.7% increase compared to conventional concrete. The beam deflection reduced to 50% with 20% of crushed rock sand [7].

III. METHODOLOGY

In this experimental methodology was followed .At first the materials are collected and the preliminary tests are conducted on materials. Based on the preliminary tests concrete mix was designed and for particular grade concrete the specimens were casted, tested and the results were concluded. The methodology adopted for this study is as shown in Figure 1.

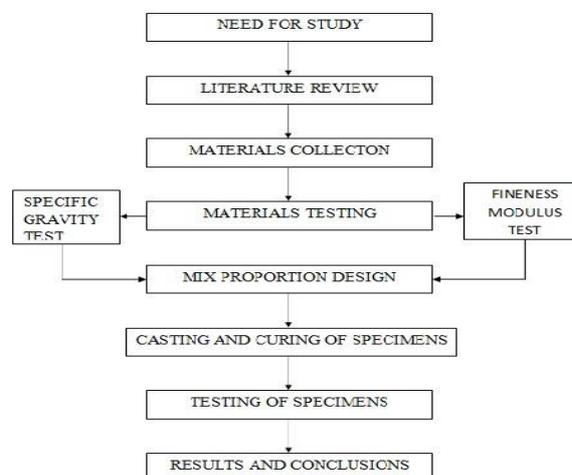


Fig.1. Experimental methodology

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IV. EXPERIMENTAL PROGRAMME

A) Materials Used

Cement: Ordinary Portland cement of grade 53 is used in this experiment.

Fine aggregate: River sand which is free from impurities and size less than 2.6mm is used. The specific gravity and the fineness modulus is 2.65 and 2.97.

Coarse aggregate: The aggregate size of 20mm, crushed angular shape and free from dust is used. The fineness modulus and the specific gravity is 2.8 and 6.3. The impact value is 7.12% respectively.

Shabath Waste Stone : The shabath waste cutting stones are collected from cuddapah region and the stones are manually crushed into the maximum size of 20mm. The specific gravity and fineness modulus is 2.71 and 6.1. The impact value is 14.6% respectively.

Shabath waste dust: The shabath waste dust are collected from cuddapah region which is free from impurities and size less than 2.6mm is used. The specific gravity and the fineness modulus of the dust is 2.67 and 2.76.

The physical and the chemical properties of the Shabath stone are discussed in Table1 and Table2 respectively. Figure 2 shows the shabath waste source.

Table1. Physical properties of shabath rock

Density	2.65 kg/cm ³
Modulus of rupture	22 to 34 N/mm ²
Compressive strength	28 to 36 N/mm ²
Specific gravity	2.7 to 2.8
Porosity	Low to very low
Water absorption	1.1%
Weather impact	Resistance
Corrodibility	0.4 to 0.7%
Hardness	4 on Mohr's scale

Table2. Chemical properties of shabath waste

SiO ₂	55%-65%
Iron	4-8%
Alumina	15-20%
Soda	2-4%
Lime	0.5-1%
Magnesia	0.5-3%
TiO ₂	0.4-0.5%
Loss on ignition	3-4%



Fig 2. Shabath waste source manual cutting and preparation of aggregate

B) Mix Proportion

M₃₀ grade of concrete was adopted with water cement ratio of 0.45. The mix was designed as per IS 10262 – 2009 [8] and IS 456 – 2000[9]. The mix ratio of M₃₀ is 1:1.69:2.8.

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C) Casting and Curing

Eights sets of specimens were casted such as one set consists of specimens with conventional concrete three sets consists of specimens replaced with shabath waste stones as coarse aggregate in percentages of 20%,30% and 40% respectively and the another set consists of specimens replaced with shabath waste dust as fine aggregate in percentages of 25%,50%,75% and 100% respectively. Each set consists of 3 cubes and 3 cylinders. After casting the specimens curing will be done for 7 days and the respective tests will be conducted on the specimens. The dimension of the cube is (150x150x150)mm³ and the dimension of the cylinder is (300x150Ø) mm³.

The casting and the quantity details are shown in Table3.

Table3. Casting and quantity details

	CC	WS 20	WS 30	WS 40	WD 25	WD 50	WD 75	WD 100
Cubes	3	3	3	3	3	3	3	3
Cylinders	3	3	3	3	3	3	3	3
Coarse aggregate in kg	33.8	27.04	23.7	20.3	33.8	33.8	33.8	33.8
Fine aggregate in kg	19.6	19.6	19.6	19.6	14.7	9.8	5.1	0
Cement in kg	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Shabath waste stone (SWS) in kg	0	5.76	9.1	12.5	0	0	0	0
Shabath Waste Dust (SWD) in kg	0	0	0	0	4.9	9.7	14.6	19.4
Water cement ratio	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Slump value in mm	98	95	89	87	95	92	88	85

V. RESULTS AND DISCUSSIONS

The compression test and the split tensile test were conducted on cubes and cylinders respectively after seven days of curing .The compression and the Split tensile strength values are discussed in Table4.

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Table4. Behavioural strength of concrete after 7 days of curing

Specimens	COMPRESSION STRENGTH IN N/mm ²	SPLIT TENSILE STRENGTH IN N/mm ²
CC	18.6	1.89
WS 20	19.5	1.94
WS 30	20.1	2.08
WS 40	19.68	1.98
WD 25	19.6	2.01
WD 50	18.8	1.92
WD 75	18.2	1.84
WD 100	17.6	1.72

Effect on Compression:

The maximum compressive strength of concrete with 30% replacement of aggregate has been found to be 7.46% greater than the conventional concrete whereas the maximum compressive strength of concrete with 25% replacement of fine aggregate has been found to be 5.97% respectively. The compressive strength gradually decreases to 2.08% with 40% of replacement of coarse aggregate when compared to the 30% of replacement of coarse aggregate. The compressive strength gradually decreases to 4.08% with 50% replacement of fine aggregate when compared with the 25% of replacement of fine aggregate. The compressive strength keeps on decreasing to 2.15% and 5.3% for 75% and 100% replacement of fine aggregate compared with the conventional concrete. The compressive strength graphs for the partial replacement of coarse and fine aggregate with shabath waste after seven days of curing the compression test was conducted and the results are explained in bar graphs form shown in Fig2 and Fig3.

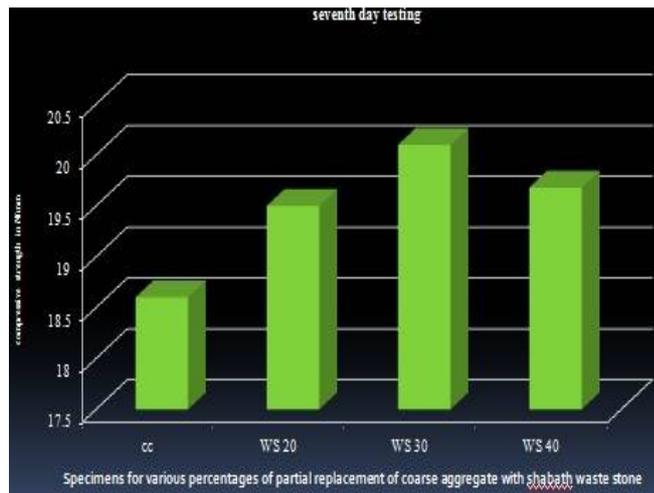


Fig3. Compressive strength of cubes for partial replacement of coarse aggregate with shabath waste stone

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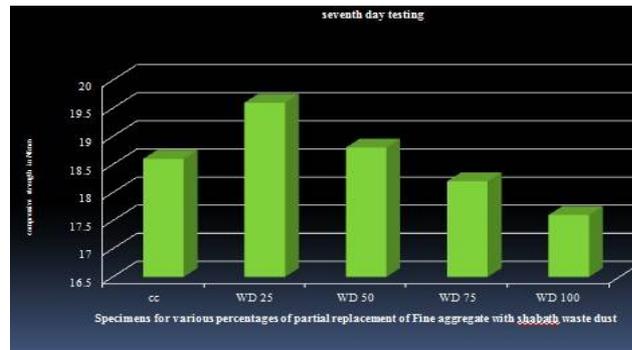


Fig4. Compressive strength of cubes for partial replacement of coarse aggregate with shabath waste dust.

Effect on Tension:

The ultimate split tensile strength of concrete with 30% replacement of coarse aggregate was found to be 6.45% when compared with the conventional concrete and gradually decreases to 1.49% for 40% replacement of coarse aggregate when compared with 30% replacement of coarse aggregate. The maximum split tensile strength of concrete with 25% replacement of fine aggregate was found to be 5.1% when compared with the conventional concrete whereas the value decreases to 4.47% for 50% replacement of fine aggregate when compared to 25% replacement of fine aggregate. The Split tensile strength values keeps on decreasing to 2.64% and 8.9% for 75% and 100% of replacement of fine aggregate when compared to the conventional concrete. The split tensile strength graphs for the partial replacement of coarse and fine aggregate with the shabath waste as shown in Fig 4 and Fig 5.

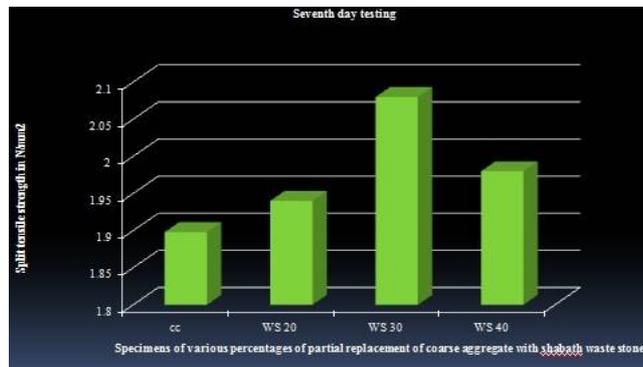


Fig 5. Split tensile strength of cylinders for partial replacement of coarse aggregate with shabath waste stone.

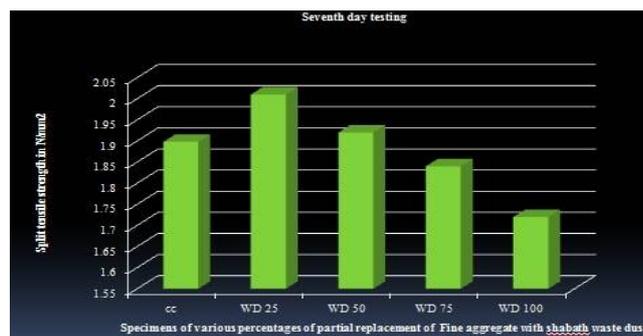


Fig6. Split tensile strength of cylinders for partial replacement of fine aggregate with the Shabath waste dust.

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VI.SUMMARY AND CONCLUSION

The following conclusions drawn based on results.

The ultimate compressive strength for partial replacement of coarse aggregate with shabath waste stone be achieved by 30% is found to be 7.46% greater than the conventional concrete value whereas the maximum compressive strength for partial replacement of fine aggregate with shabath waste dust be achieved by 25% is found to be 5.97% greater than the conventional concrete value. The maximum split tensile strength for partial replacement of coarse aggregate with shabath waste stone be achieved by 30% is found to be 6.45% greater than the conventional concrete value whereas the maximum split tensile strength for partial replacement of fine aggregate with shabath waste dust be achieved by 25% is found to be 5.1% greater than concrete value. Therefore 30% replacement of shabath waste stone as coarse aggregate achieves good strength whereas 25% replacement of shabath waste dust as fine aggregate achieves good strength.

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