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Property of Recycled Concrete Made by Stone Dust and Ceramic Waste

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Abstract:- Concrete is second largest material use in construction industry after water, therefore concrete is vital construction material it is also a big cause of construction and demolition waste generation, increase in carbon foot print and conventional aggregate source depletion. Ceramic waste is waste generated from tiles, wash basin, and other porcelain waste that is not reused and stone dust is produced when rock is disintegrated into coarse aggregate. This study consist of experimental investigation of properties of concrete made by using stone dust and ceramic waste in various proportions as fine aggregate. The significance of the study is to determine the optimum value of waste that can replace the fine aggregate to make Green concrete, to reduce conventional source depletion and accumulation of solid waste by utilization of stone dust and ceramic waste.

Keywords:-
RAC*- Recycled aggregate concrete* ***, RA****- Recycled aggregate* ***, CW****- Ceramic waste,* ***SD****- Stone dust*

I. INTRODUCTION

Concrete is made by basically four ingredients water, binding materials (like cement or lime), fine aggregate, and coarse aggregate, from these four fine aggregate and coarse aggregate are chemically inert in nature so these can be easily replaced with any inert material to make sustainable concrete or green concrete. Replacement of conventional construction material by ceramic waste have three advantages it save the conventional resource which are depleted chronologically [6][7], save the cost of construction because construction scrap waste is too cheaper then conventional material, and also reduced the solid waste accumulation which is also a very big problem.

Building scrap consist of many kind of solid waste like broken concrete from slabs beams and columns, broken bricks from masonry, wooden waste, ceramic waste etc. ceramic waste are broadly categoried as red paste ceramic waste and white paste ceramic waste. The red paste ceramic waste consist of material like brick tile and brunt clay martial and white paste ceramic waste consist of porcelain material like china clay material. Ceramic waste can be good option to replace conventional fine aggregate due to its inert nature, less water absorption and good specific gravity. This study consist of experimental investigation of conventional fine aggregate replacement with 100% stone dust , then stone dust partially replace by ceramic waste as 10%, 15%, 20%, and 25% for strength and durability properties of concrete.

II. LITERATURE REVIEW

A. Ceramic waste and properties-

- *Amr S. El- Dieb (2018) -*

They studied chemical composition of ceramic waste material by X-ray method, ceramic waste mainly composed by silica (SiO_2) and alumina(Al_2O_3) these two mineral present in 80% of ceramic waste. They found chemical composition of ceramic waste generated by construction and demolition waste is Lime (CaO) 1.70% , silica(SiO_2) 68.60%, Alumina (Al_2O_3) 24.5% , Magnesium oxide (MgO) 2.50% , Iron tri-Oxide(Fe_2O_3) 0.80%, Sulphur tri-oxide 0.12% and Loss of ignition is 1.78%. This chemical composition shows SiO_2 and Al_2O_3 composition is more than 85%, Silica and Alumina is inert material by nature so they can easily replace by any inert material lime is also a constituent, lime have great binding and strengthening capacity.

- *F.P. Torgal and s. Jalali (2011)*

In this study ceramic waste is categoriese in two type one is white paste ceramic waste and second is red paste ceramic waste, waste consist material like brick tile and brunt clay martial and white paste ceramic waste consist porcelain material like china clay material.

B. Stone dust and properties-

- *Gaber and Wahab (2019)*

Stones or rocks are classified in 3 basic categories on the basis of chemical properties as following as Siliceous rocks - These rocks contain high percentage of silica present, these are very hard and durable like Basalt, sand stone and quartzite etc., Argillaceous rocks - These rock mineral contains high percentage of clay Alumina, these have varying properties, Calcareous rocks - These rock minerals contain high percentage of calcium. Most of metamorphic rocks are in this category. Stone dust consist with varying properties with respect to origin rock.

C. Solid waste accumulation and recycling of aggregate-

- *Musaeeia and Nuriana(2019)-*

In this study recycled aggregate concrete is made by ceramic waste and waste carpet fibers, strength and durability test is performed on this recycled concrete. In this experimental research work 0%, 20%, 40%, and 60% replacement of ceramic coarse aggregate with conventional coarse aggregate is done and waste carpet fibers is used 1% (by volume), workability slump and density fresh concrete properties are found in decreasing trend but harden properties as compressive, Spilt tensile, and flexure strength are in

increasing trend, maximum result found at 40% replacement of ceramic coarse aggregate with conventional coarse aggregate as 28day compressive, split tensile and flexure strength increased by 13%, 15% and 3% respectively and in control mix of concrete waste carpet addition gives 21% increment in compressive strength.

➢ *Sarvesh P.S Rajput(2018)-*

In this study fine aggregate replace by stone dust as 0%, 20%, 40%, 60%, 80%, 100% and compressive strength trend is increasing with respect to replacement of stone dust as fine aggregate.

III. METHODOLOGY

This study is based on experimental investigation approach to determine the optimum proportion of ceramic waste and stone dust utilized as fine aggregate in concrete.

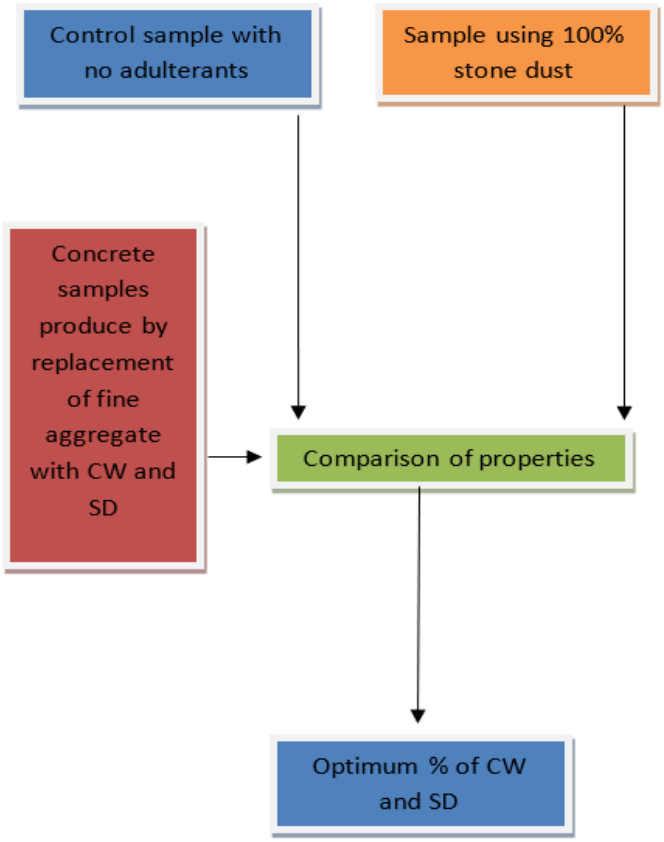

Fig-1 (Methodology)

A. Material and Sample-

➢ *Cement-*

OPC(43G) cement is used which possesses all satisfactory parameters such as fineness, consistency, initial and final setting time, and specific gravity justify by experiment.

B. Fine aggregate-

➢ *Conventional fine aggregate-*

Conventional fine aggregate river sand (zone-II) is used.

➢ *Stone dust* –

Stone dust of Fineness modulus 3.10 abstracted from crusher waste in stone mining industry is used.

➢ *Ceramic waste-*

Ceramic waste (Brocken Tiles) is collected from building waste and converted into fine aggregate in laboratory by impact and abrasion.

➢ *Coarse aggregate-*

20 mm granite stone is used as conventional coarse aggregate.

C. Nomenclature of the samples-

RAC-0 (Control)	Recycled aggregate concrete zero replacement (normal concrete)
RAC-C0	Recycled aggregate concrete made with stone dust with 0% ceramic waste
RAC-C10	Recycled aggregate concrete made with 90% stone dust with 10% ceramic waste
RCA-C15	Recycled aggregate concrete made with 85% stone dust with 15% ceramic waste
RAC-C20	Recycled aggregate concrete made with 80% stone dust with 20% ceramic waste
RAC-C25	Recycled aggregate concrete made with 75% stone dust with 25% ceramic waste

Table 1 Nomenclature

➢ *Concrete design specification-*

Concrete designed as M-25 which must have characteristic strength of 25N/mm^2 and target mean strength of 31.6 N/mm^2 by IS 10262:2019, In the concrete mix the ratio of cement: fine aggregate: coarse aggregate was 1:1.58:2.95 and w/c ratio was 0.45 .

➢ *Specification and size of sample-*

For compressive strength test 150x150x150mm Mould is used and 3 specimen of each sample taken.

IV. RESULTS

Fresh concrete properties –

Workability results measured with slump cone as following-

Name of sample	Slump Value (mm)
RAC-0	37
RAC-C0	34
RAC-C10	33
RAC-C15	31
RAC-C20	29
RAC-C25	27

Table 2: Slump value

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Workability is decreasing gradually with the increase in ceramic content as shown in the bar chart-

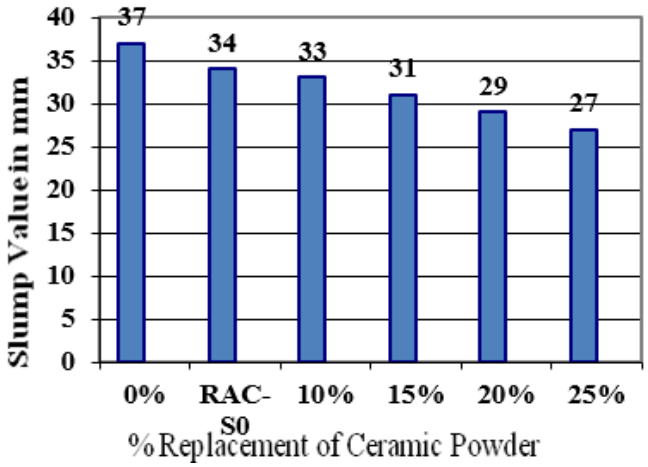

Fig 2 Slump Value of concrete mix

Hard concrete test-

14 days compressive strength test results are shown in the table-3

Name of sample	Compressive strength(N/mm^2)
	14 Days
RAC-0	31.0
RAC-C0	30.25
RAC-C10	32.5
RAC-C15	33
RAC-C20	33.05
RAC-C25	30.95

Table 3: Compressive Strength of Cubes

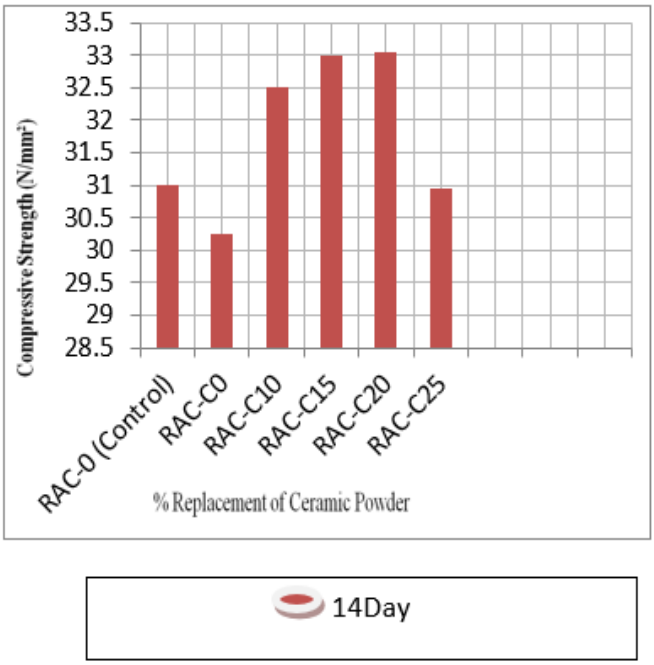

Fig 3 Compressive Strength of Cubes

V. CONCLUSION

Recycled concrete using ceramic waste and stone dust with conventional fine aggregate gives tri-directional sustainability as conserving conventional resource of aggregate, produce resistance to solid waste accumulation leads solid waste pollution from construction and demolition waste, and economical in nature due to utilization of waste in concrete.

Complete replacement of sand by stone dust decreases compressive strength (14days) by 2.42% and 3mm slump decrease in workability test but all values fall under permissible limit.

Partial replacement of stone dust by ceramic waste gives increase in compressive strength up to 20% replacement. at 20% ceramic waste content compressive strength is 6.61% more then control sample.

Workability is reduce with respect to replacement of stone dust.

So, replacement of stone dust gives significant improvement in strength at 20% (optimum value) but show decrease in workability.

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