**EXPERIMENTAL STUDY OF CONCRETE ON PARTIAL REPLACEMENT OF CEMENT WITH RICE HUSK ASH AND PARTIAL REPLACEMENT OF FINE AGGREGATE WITH GRANITE DUST**

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**ABSTRACT**

Sustainable construction development requires efficient use of natural resources by recycling the waste products. The production of concrete is not eco-friendly and therefore alternate, environmentally sensitive materials are identified for use in concrete. The waste products generated by industries in various forms like rice husk, rice husk ash, granite fines, quarry dust, fly ash, copper slag, steel slag etc. can be used as resource saving concrete structures and also will contribute a solution to the growing problem of waste disposal.

There are some projects which uses either rice husk or granite fines as partial replacement in concrete. In this project we use both rice husk ash (RHA) and granite fines (GF) as partial replacement of cement and fine aggregate respectively in concrete to assess its mechanical properties. The percentage replacement of cement with RHA is 5%, 10% & 15% and the percentage replacement of GF is 30% & 50%. As RHA is used in greater percentages, the slump value was found to be less and hence superplastisizer has been used to enhance the workability of concrete. The concrete has been tested for compressive strength, split tensile strength and flexural strength of concrete with various mix proportions of RHA and GF as mentioned earlier. Reinforced concrete beam has been casted and tested for control concrete and optimum concrete and has been compared with their load deflection behavior. All the test results have been discussed and concluded.

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1. **INTRODUCTION**

In this regard attempt has made to know the utilization of fine granite dust. In this project Rice Husk Ash (RHA) and granite dust were used in concrete for the replacement of cement and fine aggregate respectively. Rice Hush Ash contains 90-95% SiO2, 1-3 % K2O and < 5% unburnt carbon. This experimental investigation was performed to evaluate the strength properties of concrete in which cement and fine aggregates were partial replaced with Rice Husk Ash (RHA) and Granite Dust (GD). Slump test, Compressive strength, Split Tensile test, Flexural Strength, Load deflection Behaviour of controlled beam were conducted.

1. **METHODOLOGY**

**2.1 Objectives of Study**

1. To study different strength properties of Granite Dust and Rice husk Ash concrete with age in comparison to control concrete.
2. To study the relative strength development with age of Granite Dust and Rice husk Ash concrete with control concrete of same grade.

**2.2 Methodology**

* Tested the material properties as per IS **– 383-1980** procedures.
* Mix design for concrete proportion has been developed as per **IS 10262-1982.**
* Casted and cured the concrete specimens as per IS procedures.
* The characteristic strength of hardened concrete specimen was tested as per

 **IS 456-2000**

* Finding the optimum strength of optimum replacement.
* Compare the result of conventional concrete and partial replacement concrete.
1. **MODELING AND ANALYSIS**

**3.1 Cement -**Cement is a binding material used in the preparation of concrete .It binds in the coarse aggregate and fine aggregate with help of water, to a monolithic matter. And also it fills the fine voids in the concrete. There are two intrinsic requirements for any cement in the concrete mix design.

**3.2 Properties of Aggregates -**The aggregate used in manufacturing of concrete should be free from debris, fungi and chemical attack. It place a vital role in concrete, so it should be durable, angular and sharp edges then only it gives a rich mix concrete and good workability. Then well graded aggregates are controlled the maximum voids and minimizing the cement content and it leads to good concrete with high strength, economy, low shrinkage and greater durability. The grading of an aggregate is expressed in terms of percentage by weight retained or passing percentage through a series of sieves taken in order of 4.75mm, 2.00mm, 1.00mm, 0.600mm, 0.425mm, 0.300mm, 0.150mm, pan for fine aggregate and 20mm, 12.5mm, 10mm, 4.75mm, 2.00mm, pan for coarse aggregate.

**3.3 Properties of Water -** Water is an important ingredient of concrete as it actively participates in the chemical reactions with cement. The strength of cement concrete comes mainly from the binding action of the hydration of cement get the requirement of water should be reduced to the required chemical reaction of un-hydrated cement as the excess water would end up in only formation undesirable voids (or) capalirreies in the hardened cement paste in the hardened cement paste in concrete.

**3.4 Rice Husk Ash** - India is a major rice producing country. Rice milling generates a by-product know as husk. This surrounds the paddy grain. During milling of paddy about 78 % of weight is received as rice, broken rice and bran. Rest 22 % of the weight of paddy is received as husk and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion or by gasification. Rice husk is an agricultural residue which accounts for 20% of the 700 million tons of rice produced annually worldwide. About 20 million tons of RHA is produced annually. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. Lots of ways are being thought of for disposing them by making commercial use of this RHA. Rice husk is one of the most widely available agricultural wastes in many rice producing countries around the world. Burning of RH in ambient atmosphere leaves a residue, called rice husk ash. For every 1000 kgs of paddy milled, about 220 kgs (22 %) of husk is produced, and when this husk is burnt in the boilers, about 55 kgs (25 %) of RHA is generated. Rice husk removal during rice refining, creates disposal problem due to less commercial interest. The produced partially burnt husk from the brick kiln when used as a fuel also contributes to the problem of disposal and efforts are being made to overcome this environmental issue by utilizing this material as a supplementary cementing material. The chemical composition of rice husk ash is found to vary from one sample to another due to the differences in the type of paddy, crop year, climate and geographical conditions.

**3.5 Granite Dust -** Granite dust powder which is a by-product of granite processing factory was studied by many researchers for its use in concrete and mortar production as sand replacing or cement replacing material. Most of the researches showed positive results and benefits. However as the by-product i.e. the powder differs chemically depending on the parent granite rocks which depends on the locality, degree of metamorphism and other factors; and also as the physical characteristics of the by-product depends on the polishing work, it is necessary to conduct similar research in our country to incorporate it in concrete and cement production for reduction of environmental pollution and sustainable use of natural resources. Granite is a mixture of angular particles; colour can range from white to red to black and colors in between, ranging in size from pebbles to boulders. It is odorless and not flammable. Respirable dust particles containing silicon dioxide may be generated by handling granite. It is defined in common commercial practice to include almost any hard (harder than glass or steel), crystalline stone that accepts a high polish that is not granite, limestone, travertine, sandstone or other softer, common stone. It usually contains small quantities of mica or hornblende, and minor accessory minerals may be present. Depending on the feldspar present, granite may be pink, dark gray, or light gray.

**3.6 Concept of Mix Design -** The relationships between aggregate and paste which on the two essential ingredients of concrete. Workability of the mass is provided by the lubricating effect of the paste and it is influenced by the amount and dilution of paste. The strength of concrete is limited by the strength of paste, since mineral aggregate with rare exceptions. Since the proposition of concrete or governed to a considerable extend by the quality of paste, it is helpful to consider more closely the structure of the paste. The fresh paste is a suspension, not a solution of cement in water. The strength of concrete varies as an inverse function of the w/c ratio. Since the quality of water required also depends upon the amount of paste, it is important that as little paste as possible should be used. There is no standard method of designing concrete mixes incorporating hypo-sludge. Hence the method of mix design proposed by IS 10262 -1982 was employed to design the natural aggregate concrete and partial; replacement aggregate to obtain the mixes. The purpose of mix propositioning is to produce the required properties in both plastic and hardened concrete.

**3.7 Casting and Curing Of Specimens -** For ordinary concrete, fine aggregate and cement were weighted and mixed thoroughly: the coarse aggregate was then added and mixed with the above. The required amount of water was added and mixed thoroughly to get uniform concrete mass. And compacting the concrete in the mould by hand compaction as per IS procedures.For preparing the specimens for determine the compressive strength, of standard size were used. The fresh concrete was filled in the mould. Care should be taken to see that the concrete was compacted perfectly. All the moulds were DE molded after 24 hours of casting and cured. They were tested on 7, 14 and 28th day, as per IS 456-2000.

1. **RESULTS AND DISCUSSION**

**Table :** **Compressive strength of various mixes at 7,14 & 28 days (mean value)**

|  |  |  |
| --- | --- | --- |
| **S.NO** | **NAME Of MIX** | **COMPRESSIVE STRENGTH (N/mm²)** |
| **7 DAYS** | **14 DAYS** | **28 DAYS** |
| 1 | N1 | 21.42 | 25.1 | 33.3 |
| 2 | N2 | 23.7 | 28.3 | 36.1 |
| 3 | N3 | 23.02 | 29.9 | 35.6 |
| 4 | N4 | 28.3 | 31.5 | 40.2 |
| 5 | N5 | 26.1 | 28.9 | 38 |
| 6 | N6 | 22.4 | 25.3 | 32.7 |
| 7 | N7 | 20 | 21.42 | 28.9 |

# COMPRESSIVE STRENGTH - The compressive strength of concrete specimen increases from N2 to N4. N5 to N7 specimen shows decrease in compressive strength. So, the optimum strength at 7th ,14th &28th day occurred at 10% and 30% replacement of RHA and granite fines respectively.

**Comparison of load - deflection behaviour of N1 and N4 mix beam**

1. **CONCLUSION**

From the test results the following conclusions are made,

* + - * As the percentage of RHA and Granite fines are increased, the slump value decreased.

Hence super plasticizer had been used to enhance the workability

* + - * From the compressive strength, split tensile strength and flexural strength test results, N4 (RHA 10% & GF 30%) mix is identified as optimized concrete.
			* The compressive strength test result of mix N4 on 28th day showed 32% increase in strength when compared with control mix (N1) .
			* The split tensile strength test result of mix N4 on 28th day showed 33% increase in strength when compared with control mix.
			* The flexural strength test result of mix N4 on 28th day showed 50% increase in strength when compared with control mix.
			* In RCC beams, when compared to N1, mix N4 gives lesser deflection. The ultimate load of mix N4 is 46 kN which is 10% higher than N1 mix. Ductility ratio of mix N4 shows 20% increase than mix N1.
			* On Whole it is concluded that both RHA and GF can be utilized in concrete at 10% replacement of RHA with cement and 30% replacement of GF with fine aggregate.
			* Effective utilization of RHA and GF in concrete can save natural resources and hence can help to keep our environment safe.
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