"STUDY ON THE COMPRESSIVE STRENGTH OF CONCRETE CUBES BY THE PARTIAL REPLACEMENT OF FLY ASH, RICE HUSK ASH AND STEEL CHIPPINGS"

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Abstract— concrete is the premier construction material across the world and the most widely used in all types of civil engineering works, including infrastructure, low and high rise buildings, environment protection and local/domestic development. Concrete is a manufactured product essentially consisting of cement, aggregates, water and admixture(s). Reuse of agricultural wastes and industrial by-products for building materials has been gaining popularity in the recent years.In this project an attempt has been made to know the variation in the compressive strength of concrete by the replacing 30% of Fly ash by weight of cement, 20% of Rice husk ash by weight of concrete and 1%, 1.5%, 2% of steel chippings by weight of fine aggregate. Tests were conducted on the constituents of concrete such as cement, fine aggregate, coarse aggregate, and for Fly ash and rice husk the specifications were available from Raichur power plant and local brick factory from where the rice husk was obtained.Compression tests were conducted on the concrete cubes after curing in for 3, 7, 14, 28days. The compressive strength of normal concrete cubes and replaced materials were compared, and results were tabulated.

Keywords— Compressive Strength, Slump, Fly Ash, Rice husk Ash, Steel Chippings.

1 INTRODUCTION

The cost of building materials nowadays is so high in some parts of the world; particularly in developing countries where only the government, industries, business cooperation and few individual can afford it. This high and still rising cost can however be reduced to a minimum by use of alternative building materials that are cheap, locally available and bring about a reduction in the overall dead weight of the building. Some industrial and agricultural products that would otherwise litter the environment as waste or at best be put into only limited use could gainfully be employed as building material.

Engineering in developing countries like our nation India, has always been and is still limited by three predominant factors; the availability of suitable power (electricity supply), the strength of the materials with which it is economically practical to work and the cost of procuring or producing the materials. Admitted in recent years, it would appear that progress in the development of highly efficient and enormous powerful sources has out stripped the development in materials that is required to cope fully with the handling of such power. The predominant factor holding back further development is still in all cases the limitation imposed by the mechanical and physical properties of currently available materials.

Nowadays, clay bricks are considered one of the most important building materials used to construct walls for buildings. Due to the unsustainable mining of clay soil for clay brick making, cement bricks have been introduced into the industry providing more alternatives. However, the production of cement bricks consumes an enormous amount of cement. Besides, the production of cement is not environmentally friendly.

The manufacturing of cement is not only a high energy consuming process, but the production of each tonne of cement releases approximately 1 ton of carbon dioxide (CO_2) into the environment due to the calcinations of the raw materials and the combustion of fuels.

In light of the economic benefits, conservation of natural resources, energy saving and environmental friendliness, the use of alternative materials from waste products has become the main focus of engineers and researchers.

2 OBJECTIVE

- Conducting preliminary test on concrete constituents.
- Designing mixed proportion of M30 concrete for 20% replacement of Rice husk ash and 30% replacement of fly ash.
- Casting of concrete cubes of size 150 mmx150 mmx150mm.
- Testing of cubes (Compression test for 3,7,14 and 28 days strength).

- Comparison of compressive strength of cubes for different age of curing.
- Comparison of compressive strength of normal concrete with concrete replaced by RHA, FA and steel chippings.

3. MATERIAL USED

3.1 Cement
Ordinary Portland cement (OPC) is tested according to BIS specifications to determine is various physical properties.

3.2 Coarse aggregate
Quarried and crushed stone are used as coarse aggregates. The specific gravity, water absorption test of coarse aggregate of 20mm and down size was found according to the norms of Indian standards and are used for all concrete mixes.

3.3 Fine aggregate
Locally available river sand is used as fine aggregate. The specific gravity of the aggregate is found according to the B.I.S specification and is used throughout in preparing the required mix of concrete. Sieve analysis of the fine aggregates was also carried out as per the B.I.S specifications to determine the fineness modulus and grading zone.

3.4 Rice husk ash
RHA produced after burning of rice husk, it has high reactivity and pozzolonic property. The Indian standard code of practice for plain and reinforced concrete IS 456-2000 recommends use of RHA in concrete but does not specify quantities. Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature. As per study by Houston D.F (1972). RHA produced by burning rice husk between 600-7000c temperatures for 2 hours

3.5 Steel chippings
Steel chippings are the waste steel that are generated from Lathe machines. It is generally recycled by steel industries. The size of the steel chippings is 20mm - 50mm in length, and thickness of 0.1mm-0.5mm.

3.6 Fly ash
Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of power generation facilities.Whereas bottom ash is, as the name suggests, removed from the bottom of furnace. In the past fly ash was generally released into the atmosphere via the smoke stack, but pollution control equipment mandated in recent decades now require that it be captured prior to release.

4. TESTS CONDUCTED:

4.1 TEST CONDUCTED ON FRESH CONCRETE

4.1.1 Slump test
Slump test is used to determine the workability of fresh concrete. The test measures consistency of concrete in that specific batch. It is performed to check consistency of freshly made concrete. Consistency refers to the ease with the test is popular due to the simplicity of apparatus used and simple procedure. Test values of slump is as shown in table 1

S. No.	Particulars with % of material used	w/c ratio	Slump value
1	20% RHA	0.4	33
2	30% Fly ash	0.4	35
3	1%Steel chippings	0.4	48
4	1.5%Steel chippings	0.4	42
5	2% Steel chippings	0.4	38

Table: 1 Values of Slump

4.2 TESTS ON HARD CONCRETE:

4.2.1 Compression test
The conventional cured specimens were removed from the tank and its surface is cleaned with cotton waste. They were tested in a Compression Testing Machine. The cubes were tested for the required age and value of compressive strength was calculated.

Compressive strength= P / A× 1000

Where,

P = Load in kN

A = Area of cube surface

4.3 EXPERIMENTAL RESULTS
The variation of normal concrete vs Fly ash, Rice husk ash, 1% steel , 1.5% steel and 2% steel are shown in Fig 1 to 5.

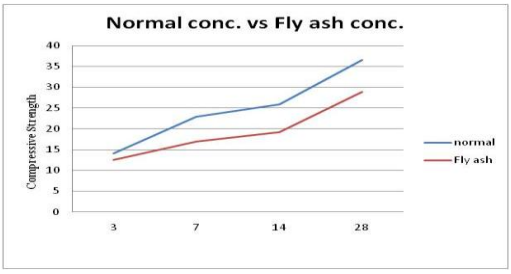


Fig.1. compressive strength of normal concrete and Fly ash concrete.

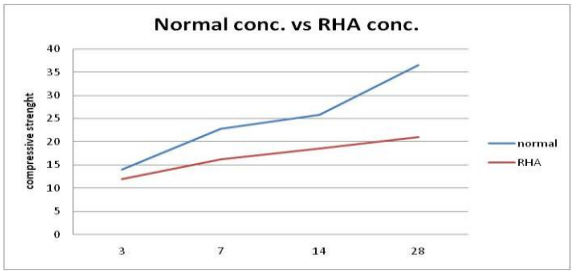


Fig 2. Compressive strength of normal concrete and RHA concrete.

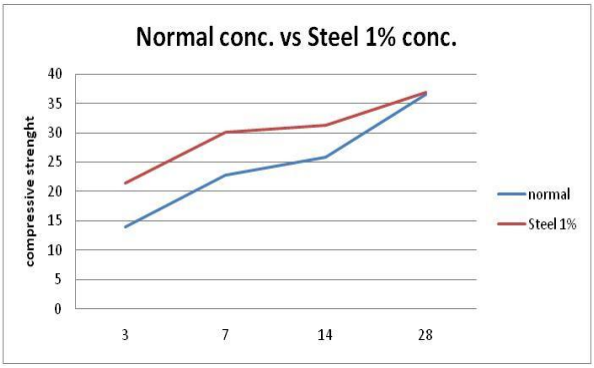


Fig 3: compressive strength of normal concrete and concrete with 1% steel by weight of fine aggregate.

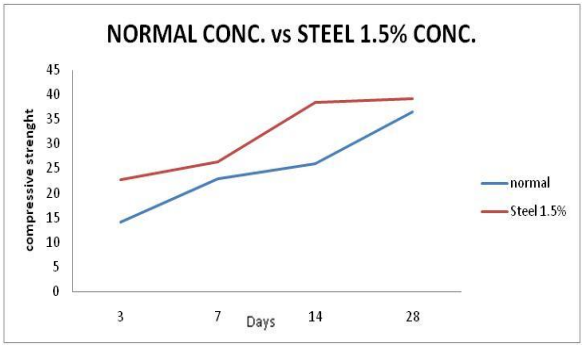


Fig 4: compressive strength of normal concrete and concrete with 1.5% steel by weight of fine aggregate

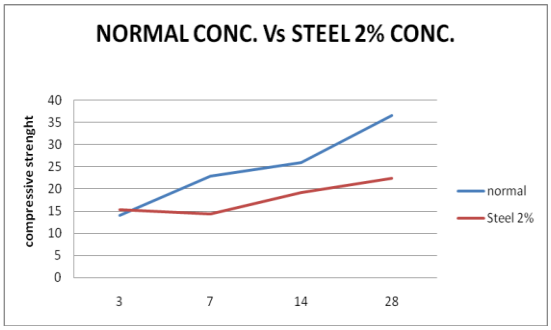
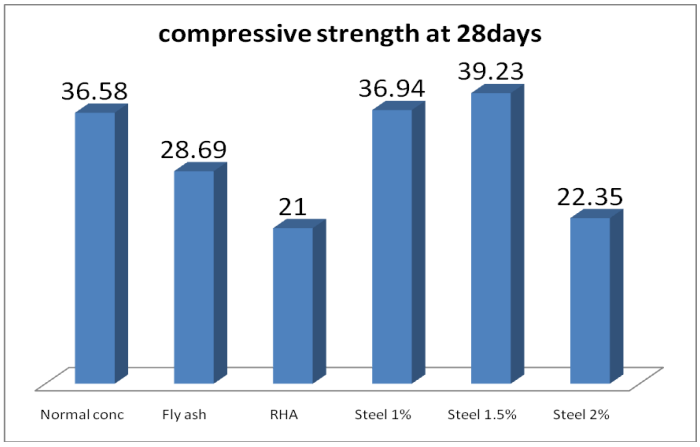


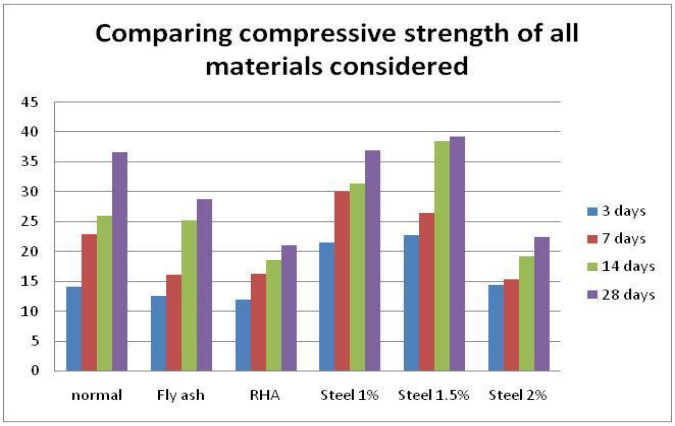
Fig 5: compressive strength of normal concrete and concrete with 2% steel by weight of fine aggregate

4.4 SUMMARY

On the basis of test results the compressive strength was found 15%-20% lower than that of normal concrete when cement is replaced by 20% rice husk ash.

days	Normal MPa	Fly ash MPa	RHA MPa	Steel 1% MPa	Steel 1.5% MPa	Steel 2% MPa
3	14.05	12.56	1.94	21.43	22.67	14.33
7	22.87	16.09	6.23	30.045	26.4	15.31
14	25.93	25.26	8.52	31.4	38.54	19.1
28	36.58	28.69	21	36.94	39.23	22.35





5. CONCLUSIONS

On the basis of test results, following conclusion can be drawn:

1. The compressive strength was found 15%-20% lower than that of normal concrete when cement is replaced by 20% rice husk ash.
2. Concrete requires approximate increase in water cement ratio due to increase in percentage of RHA. Because RHA is highly porous material.
3. It was found that rice husk when burned produced amount of silica (more than 80%). For this reason it provides excellent thermal insulation.
4. Rice husk ash contains more silica and hence we prefer rice husk ash use in concrete than silica fume to increase the strength.
5. The compressive strength was found 10%-20% lower than that of normal concrete when cement is replaced by 30% fly ash.
6. Concrete requires approximate increase in water cement ratio due to increase in percentage of fly ash. Because fly ash is highly porous material.
7. The workability of fly ash concrete has been found to increase with increase in the increase of percentage replacement.
8. Fly ash is a very fine powder and tends to travel far in the air. When not properly disposed, it is known to pollute air and water, and causes respiratory problems when inhaled.
9. When it settles on leaves and crops in fields around the power plant, it lowers the yield. The conventional method used to dispose of both fly ash and bottom ash is to convert them into slurry for impounding in ash ponds around the thermal plants. This method entails long-term problems.
10. The compressive strength was found 20%-30% higher than that of normal concrete when cement is replaced by 1% steel chippings.

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5. The concrete mix is designed as per IS 10262 – 2009 [11] and IS 456-2000. The properties of materials are tested as per IS 383:1970.