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EXPERIMENTAL STUDY ON SHEAR BEHAVIOR OF RCC BEAM BY PARTIAL REPLACEMENT OF CEMENT BY RICE HUSK ASH AND MARBLE POWDER

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Abstract - *The increasing population in our country demand for rapid rate of construction. For providing shelter and affordable accommodation, low cost construction plays an essential role. However, in low cost construction of residential buildings, the feasibility of easily available cheap building material is of prior importance. To overcome this problem, new construction materials, which are inexpensive and requires less energy consumption for production need to be developed. One such material taken from past studies is rice husk ash(RHA) which is a by-product of agriculture. Rice husk ash having rich pozzolanic properties and marble powder is another such cheap material, with excellent binding properties as those exhibited by cement. This is an experimental study to examine the effect of RHA and MP as a substitute for cement in concrete. The cubes were cast to find out the compressive strength and the optimum value by using M40 grade concrete. The study concluded that, When cement is replaced by 10% Rice husk ash and 5% Marble Powder (15%), compressive strength of RHA-MP concrete is more than the conventional one. The percentage variation for this optimum mix compared with the conventional one were found to be 49%. Two RCC beams were cast by using this optimum value i.e. for testing the shear capacity which are designed as per IS 456:2000. From the results it is observed that, the ultimate shear capacity for the RHA - MP beams are higher than compared with control beams. The percentage variation for initial cracking load and ultimate shear load for the beams tested (i.e. control beam compared with RHA - MP mix beam) were found to be 20% and 16%. The percentage reduction of ultimate crack width for the beams tested (i.e., control beam compared with RHA - MP mix beam) is found to be 44 %. The ductility ratio is also higher for RHA - MP beam as compared to normal beam. The variation in ductility ratio for beams is 14% .*

Key Words*: *Rice husk ash, Marble powder

1.INTRODUCTION

Concrete is an essential material which is widely used in the construction of infrastructure such as buildings, bridges, highways, dams, and many other facilities. To provide the needs and changes, large amounts of materials are needed for the construction of buildings, houses, roads and infrastructures required for decent living. The production of ordinary Portland cement produces approximately 7% of the total greenhouse gas emitted to the atmosphere. Rice husk has been considered as a waste material and has generally been disposed of by dumping or burning, although some has been used as a low-grade fuel. Nevertheless, RHA has been successfully used as a pozzolana in commercial production in a number of countries including India. RHA has the potential as a cheap cementing material since rice husks are essentially waste material having high silica (SiO2) content, highly porous morphology, lightweight, angular and have a very high external surface area. Its absorbent and insulating properties are useful to many industrial applications, and the ash has been the subject of many research studies. RHA use in the civil construction field may be a best solution to its disposal as waste on the environment. . The objectives of this work are too carried out with Mix design M40 and to find the effect of RHA with various percentages along with Marble Powder on compressive strength, effect of RHA with various percentages along with Marble Powder on shear capacity and flexural capacity of concrete beams.

2. LITERATURE REVIEW

Kartini & Mahmud (2008) reported on the ―Improvement on Mechanical Properties of Rice Husk Ash Concrete with Super plasticizer‖. Without super plasticizer RHA concrete attained lower compressive strength than that of the control due to the higher amount of water for similar workability. RHA concrete improves the durability of concrete. It is concluded from the paper that by adding super plasticizer to the RHA mixes, higher replacement levels are possible. Concrete containing up to 30%RHA can attain strength of 30 N/mm2 at 28 days.

DaoVan & PhamDuy (2008) presented several key properties of high strength concrete using RHA. RHAs obtained from two sources: India and Vietnam. It is concluded that Rice husk is an abundant waste generated from agriculture product in Vietnam. Investigations in manufacturing high quality RHA in Vietnam is necessary.

Zemke & Woods (2009) recommended to use rice husk ash substitution for Ordinary Portland Cement up to 30%. This

will decrease the weight of the finished project, decrease the cost, and dispose of the rice husk ash waste product. This is the best option where rice production is prevalent, including most of Asia especially Asia.

Maurice & Godwin (2009) investigated the effects of partially replacing OPC with RHA . It is concluded that Adding RHA to concrete resulted in increased water demand, increase in workability and enhanced strength compared to the control sample. This results show that an addition of RHA from 5-10% will increase the strength.

3. MATERIALS USED

Cement **-** Cement is used in the present experimental study was obtained from local market of Kottayam (Kerala) India. Cement is used in the experimental work is OPC of 53 grades conforming to IS: 12269-1987. Table 1 shows properties of cement.

Table -1: Properties of cement

Test results for cement			
Sl no:	**Properties**	**Obtained values**	**Requirements per IS: (IS 4031-1988)**
1	Fineness	9%	Part1
2	Soundness	1 mm	Part 3
3	Setting Time: a) Initial b) Final	a) 40 min b)5hour40min	Part5
4	Compressive Strength: a) 7 days b) 28 days	a)25N/mm^2 b)35N/mm^2	Part 6 (IS 12269 1987)
5	Standard Consistency	29%	Part4

Rice Husk Ash - Rice Husk Ash is used in the present experimental study was obtained from local market of Changanassery. The colour of RHA is Grey, silica 90% and specific gravity is 2.3 which are given by supplier.

Marble Powder- Marble Powder used in the present experimental study was obtained from Marble industry near Nagampadam, Kottayam.

Aggregate- Aggregate is used in the present experimental study was obtained from local market of Kottayam. The specific gravity and fineness modulus of coarse aggregate are found 2.65 and 6.428 respectively and similarly specific gravity and fineness modulus of fine aggregate are 2.85 and 2.54 respectively.

Super plasticizer **-** Ceraplast 300 admixture is used in this study obtained from local market of Kottayam.

Design Data:

Characteristic Compressive Strength required at the end of 28 days=40 N/mm^2
Maximum size of Aggregate= 20mm (Angular)
Type of Exposure= Moderate
Degree of Workability= 0.90 (compacting factor)
Degree of Quality Control= Good
Type of exposure = moderate
Super plasticizer = CERAPLAST 300

A nominal mix of 40 grade of concrete is prepared with the cement content 422.2 kg/m3 and water-cement ratio is 0.35. The proportion 1: 1.80 : 2.77 was adopted for the present study. After designing of M40 mix five trials have been done.

4. OBJECTIVES OF PRESENT STUDY

- To determine the optimum replacement of cement by rice husk and marble powder.
- To study the shear and flexural behaviour of beam.

5. MIX PROPORTIONING

In this study, concrete cubes, cylinders, beams have been prepared using 10%, 20% & 30% RHA with 5% MP. For this quantities of materials have been calculated. Super plasticizer is also used in making concrete. The maximum value of compressive strength is found out between 10% - 20% RHA & 5% MP in concrete.
Further, making trial between 10-20% i.e. 10, 15, 20% and the optimum value of RHA in concrete is found out. Table 5 shows quantity of material for different percentage of RHA & MP in concrete.

Table 2. Quantity of material for different % of RHA+MP in Concrete

Mix no	RHA	MP	Cement	Water	Sand	C A	S P
1	5%	5%	422.2 w/c=0.35	147.1	762.5	1169.53	1%
2	10%	5%	422.2 w/c=0.35	147.1	762.5	1169.53	1%
3	15%	5%	422.2 w/c=0.35	147.1	762.5	1169.53	1%

6. RESULTS AND DISCUSSIONS

Compressive Strength of Concrete

The maximum value of compressive strength is found out between 10-20% RHA-MP in concrete. So it is decided to make cubes and beams with 10, 15, 20% RHA keeping 5% MP constant to know the % of RHA and MP for maximum compressive strength and shear capacity.

Table 3. Compressive strength of cubes

Specimen	7 days	28 days
Conventional	28	43.68
RHA&MP(5+5 %)	30.2	44.23
RHA&MP(10+5)%	32.8	45.8
RHA&MP(15+5)%	31.65	43.72

The maximum value of compressive strength is found out in 15% (i.e., 10% RHA & 5% MP)

First crack and ultimate cr ack in beams

Table 4. First crack and ultimate crack

Specimen	First crack (kN)	Ultimate crack(kN)
Control beam	112	180
RHA - MP beam	135	210

Crack width

Table 5. Result for crack width

Specimen	Crack width (mm)		% Variation	
	First crack	Ultimate crack	First crack	Ultimate crack
Control beam	0.05	0.18	50	38
RHA - MP beam	0.03	0.1		

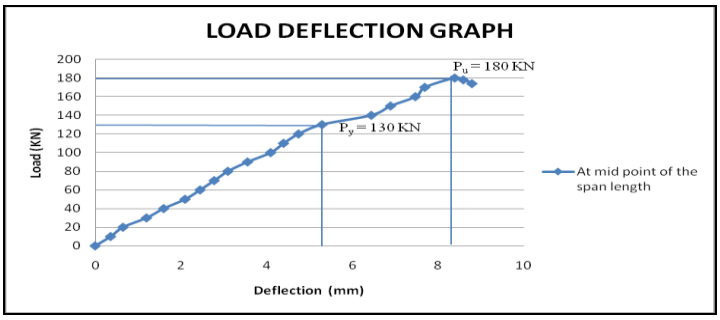
Crack pattern

Crack pattern for control beam

Crack pattern for RHA & MP mixed beam

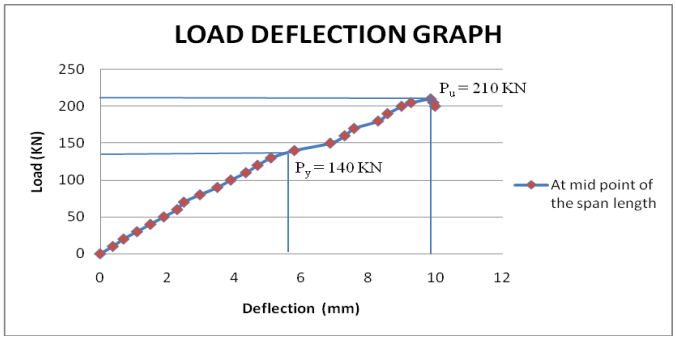
Load - deflection graph

a) control beam



Load deflection graph for control beam

b) RHA - MP beam



Load deflection graph for RHA & MP beam

Ductility ratio

Table 6. Result for ductility ratio

Specimen	Ultimate deflection (mm)	Deflection at yield point (mm)	Ductility ratio
Control beam	8.42	5.3	1.58
RHA - MP beam	9.87	5.82	1.69

Percentage variation in ductility ratios is 7% i.e,. control beam compared with RHA - MP beam.

3. CONCLUSIONS

From this experimental study the following conclusions were drawn

- Addition of RHA and MP in concrete improves the properties of concrete. The Optimum content of RHA-MP is found to be 10% RHA+5% MP.
- For M40 mix concrete with replacement of 15% (10% RHA 5% MP), the compressive strength increases.
- For beams the shear capacity and flexural capacity of optimum mix is increased compared to the normal mix.
- comparing control beam with RHA - MP beam, the percentage variation of initial load and ultimate load in shear beams were found to be 20% and 16% and similarly for flexural beams it is 15% and 24.3%.
- The crack propagation of RHA - MP beam is less compared with control beam.
- The percentage variation of crack width in shear failure beams (i.e, conventional concrete and optimum mix) is 44 %.
- The percentage variation of crack width in flexural failure beams (i.e, conventional concrete and optimum mix) is 38 %.
- The ductility ratio is also increased in optimum mix compared with the normal concrete

4. ACKNOWLEDGEMENT

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