Design of Concrete Mix & Effect of Rice Husk in Performance of Concrete

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ABSTRACT - Concrete can be viewed as the most generally utilized construction material accessible these days since it can be prepared from locally accessible material and furthermore as a result of its flexibility in dealing with and placing. In spite of all of its preferences, with regards to achieving the desired strength, concrete is the most capricious material experienced ever. Broad research work and experiences gained over the years have demonstrated that quality and durability of concrete depend mostly on the properties of its constituents, and at the same time mix design, technique for preparation, placement, curing condition and so forth have their impact on it.

In designing concrete mix, the most broadly utilized and most famous strategies are the ACI technique and BS method. In India, present practices demonstrate the adoption of these techniques utilizing the locally accessible materials. Above all, these strategies essentially utilize stone as coarse aggregate, while, here in India, a less expensive substitute, crushed brick aggregate, known as "khoa" is broadly utilized. It is seen that no appropriate rule is provided for using this lightweight aggregate as a substitute for stone in the design strategies.

Past studies demonstrated that planning concrete mixes by ACI strategy, utilizing broken brick aggregate, give abnormal results. Sponsored by the parametric review and broad research information, past researchers reasoned that the ACI strategies for mix design fails in appropriate proportioning of fine aggregate content, requiring change of the strategy for brick aggregate. The target of the present research is to check the consistency of the ACI strategy of mix design, utilizing both stone chips and block chips as coarse total. In the present research, a connection between the strength parameter of stone chips and brick chips were developed and the mix proportions were determined as needs be to accomplish desired strength.

In any case, the utilization of these concretes with generally low strength is ending up noticeably day by day. These days, concretes are intended to force extraordinary properties inside themselves as the construction demands. Concrete can be designed to oppose cold or heat, to be very workable (flowing) or to withstand enormous level of compressive force. The remainder of these hybrid concrete types has a name of 'High Strength Concrete' and has redefined the concrete practice. This report likewise incorporates a brief outline on 'High Strength Concrete.

Keywords – Concrete Mix, Rice Hulk.

I. INTRODUCTION

Concrete is a material that truly frames the basis of our present-day history. It is by a wide margin the most broadly utilized development material today. We can scarcely discover any part of our day by day experience that does not depend specifically or in a roundabout way on concrete. We may live, work, study, or play in solid structures to which we roll over solid streets and scaffolds. Our products might be transported by trucks going on cement superhighways, via trains that keep running on rails bolstered on solid sleepers, by boats that field at solid wharfs in harbors secured by solid embankments, or via planes landing and taking off on concrete runways. Water for drinking and raising harvests is

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put away behind gigantic solid dams and is conveyed by frameworks of cement conduits, courses and pipes. The water accordingly put away may likewise be utilized to create electric power. On the other hand, power can be produced by consuming coal in power stations worked from cement, or by tackling the energy of the iota inside enormous fortified solid weight vessels.

The different one-of-a-kind properties of concrete have denoted its prevalence over numerous other development materials. The flexibility and mouldability of solid, its high compressive quality, and the revelation of fortifying and pre-focusing on systems, which compensated for its low rigidity, have contributed to a great extent to its broad utilize. The inexpensiveness, strength, restrictive imperviousness to climate, fire, water and erosion, make concrete an especially reasonable and one-of-a-kind material for street building, extensions, structures and dams, for the establishments, outline work, floors and tops of vast structures of assorted types and for structures in collieries and mechanical plants. Subsequently it has substantiated itself helpful for shape the premise of present-day building and affecting emotional effect of innovation.

Concrete has the one-of-a-kind refinement of being the main development material really fabricated on the site, utilizing locally accessible materials, with its capacity to be thrown to any craved shape and arrangement. This is a critical trademark that can counterbalance the majority of its deficiencies. Nonetheless, this preferred standpoint is related with a few variables that must be considered all together that the solid satisfies its prerequisites both in the new and the solidified state.

II. MATERIALS AND METHODOLOGY

Physical Properties of RHA

Specific gravity of the RHA was measured (for the purpose of performing hydrometer analysis) to be 1.96.

Mix Ratio	Density (Kg/m³)	at different curing periods	
Lime: RHA	3days	7 days	28 days
100:0	2260	2199	2147
80:15	2239	2178	2158
60:20	2195	2168	2149
50:40	2179	2138	2094
40:40	2163	2136	2076
30:75	2138	2098	2047
20:85	2133	2074	2033
0:100	2133	2045	1925

Water cured concrete samples

The results of density tests for samples cured in water at room temperature

Mix Ratio	Density (Kg/m³)	different curing periods	
Lime: RHA	3days	7 days	28 days
80:15	2240	2254	2266
60:20	2198	2226	2239
50:40	2178	2195	2227
40:75	2137	2179	2220
30:85	2139	2147	2222
20:80	2134	2138	2210

From all the two curing conditions analyzed, it is shown that as the amount of RHA was increased in the concrete mixes, there was a slight decrease in density. This can be attributed to the fact that the RHA used had a slightly lower specific gravity value than the lime.

Compressive Strength of lime: RHA concrete at optimal mix

The relationship between characteristic strength, mean strength and standard deviation as discussed in chapter three and is given by equation (3.8). Assuming there is a probability that only 1 in 20 of the strength values will fall below the minimum strength, the probability factor becomes 1.64 and the relationship between characteristic strength, mean strength and standard deviation is given by equation (3.9).shows results of density and 28 day compressive strength of 27 concrete cubes samples made with the identified optimal blend of Lime: RHA and cured in water at room temperature. The binder: sand: ballast was 1:2:4

28 Day Compressive Strength and Density of the optimal Lime: RHA Concrete

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Cube	Density	compressive	Cube	Density	Compressive
1	2218	12.5	15	2218	11.5
2	2357	13.3	16	2380	9.6
3	2356	12.5	17	2333	10.3
4	2333	12.6	18	2287	9.7
5	2356	11.3	19	2284	9.8
6	2284	12.5	20	2307	11.1
7	2333	11.4	21	2286	11.5
8	2353	8.4	22	2331	10.3
9	2262	10.7	23	2309	10.7
10	2262	9.9	24	2379	10.2
11	2309	8.9	25	2330	11.4
12	2343	10.8	26	2307	10.9
13	2309	10.8	27	2327	11.3
14	2309	10.9			

The average density of the optimal Lime: RHA concrete can be said to be within the range for normal weight concrete. It can therefore be concluded that even though the workability of the concrete was very low, the final degree of compaction was not affected by the stiffening caused by addition of RHA as indicated by the density results.

The 28 day compressive strength obtained with a binder (optimal): sand: ballast mix proportion of 1:2:4 respectively is approximately 10N/mm².

intervals	Mid	Frequency	%
8.8-9.5	9.15	2	7.45
9.5-10.2	9.85	5	18.56
10.2-10.9	10.55	8	29.64
10.9-11.6	11.25	7	25.95
11.6-12.3	11.95	4	14.858
12.3-13	12.65	1	3.721

RHA concrete

Tensile Strength of lime: RHA concrete at optimal mix

Table 4.20 shows results of density and 28 day tensile strength of 27 concrete cylinder samples made with the 30%:70% Lime: RHA optimal blend and cured in water at room temperature. The binder: sand: ballast was 1:2:4

Cylinder No.	Density 3 (Kg/ m)	Tensile strength(N/mm²)	Cylinder No.	Density (Kg/	Compressive strength(N/mm²)
1	2386	1.65	15	2443	1.65
2	2367	1.332	16	2457	1.26
3	2348	1.64	17	2227	1.64
4	2198	1.612	18	2179	1.34
5	2443	1.63	19	2348	1.64
6	2179	1.62	20	2169	1.544

28 day tensile strength and density of the optimal Lime: RHA concrete

III. TENSILE STRENGTH OF PPC CONCRETE

Table 4.22 shows results of density and 28 day tensile strength of 27 concrete cylinder samples made with Portland Pozzolanic Cement and cured in water at room temperature. The binder: sand: ballast was 1:2:4 at a constant water/cement ratio of 0.5.

Average Density	2465 kg/m^3
Mean compressive strength	2.18 N/mm^2
Standard Deviation	0.20 N/mm^2
Characteristics Compressive strength	2.5 n/mm^2

4.10 Setting Times and Mortar Compressive Strength of Optimal Lime: RHA mix

Table 4.23, Table 4.24 and Figure 4.18 show the results of setting times and mortar compressive strength of the optimal lime: RHA blend respectively Table 4.23: Setting Times of optimal Lime: RHA binder (30%Lime + 70%RHA)

Mix Ratio	Setting Time (Min)	
Lime: RHA	Initial	Final
30:70	286	1486

Table 4.24: Mortar compressive strength of optimal Lime: RHA binder (30%Lime + 70%RHA)

Lime: RHA Mix Ratio	Age (Days)	Mortar Compressive Strength (N/mm²)
30:70	2	3.10
	3	3.25
	7	5.48
	14	7.12
	28	7.09

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Water cured concrete samples

The results of density tests for samples cured in water at room temperature

IV. CONCLUSIONS

The following conclusions were made during this study;

From the results of chemical composition tests it can be concluded that the RHA studied is a good pozzolanic material for use in concrete production, with a combined percentage of Silica (SiO2), Iron Oxide (Fe2O3,) and Alumina (Al2O3) of more than 70%.

That consistency or workability of lime: RHA concrete reduces with increase in the quantity of RHA in the mix. The slump of the optimal lime: RHA concrete was found to decrease by about 75%.

That the hardened state density of lime: RHA concrete reduces slightly with increase in the quantity of RHA in the mix.

The optimal lime: RHA cement can be used to produce normal weight concrete with a wet average density of 2313Kg/m^3.

RHA greatly improves the compressive strength of lime irrespective of the curing regimes adopted. Compressive strength of lime: RHA concrete generally increase with increased amount of RHA until the optimum is reached then it starts to reduce.

The optimum Lime: RHA blend in terms of concrete compressive strength varies depending on the curing condition. For concrete samples cured in air the optimal blend was found to be 50% lime with 50% RHA while for water cured concrete samples the optimal blend was found to be 30% Lime and 70%RHA.

Water curing of lime: RHA concrete gives rise to concrete of higher compressive strength than air curing. Because of this an optimal blend of the lime: RHA binder of 30% Lime with 70%RHA and with moist curing is recommended.

The optimal Lime and RHA mix of 30% and 70% respectively, when used as binder for concrete production with a binder: sand: ballast mix proportion of 1:2:4 respectively and cured in water produces concrete with a mean compressive strength of 10.83 N/mm², a standard deviation of 1.05 N/mm², and a characteristic compressive strength of 9.11 N/mm². The compressive strength of optimal lime: RHA concrete is about half that of PPC concrete.

The tensile strength of the optimal lime: RHA concrete cured in water was found to be 1.49 N/mm² which is within acceptable percentage of the compressive strength and is about two thirds of that of PPC concrete.

The optimal Lime: RHA binder has an initial setting time of 285 minutes with a final setting time of1485 minutes indicating that the binder takes a longer time to reach the peak hydration temperature as compared to PPC cement. This means that the hydration of the binder is very low compared to that of PPC cements.

Even though the optimal binder does not meet the required mortar compressive strengths for pozzolanic cements [28], the strengths achieved are quite significant for certain structural applications. The 28 day mortar compressive of 7.07 N/mm^2 is good enough for structural applications such as masonry mortar, floor screed, plaster, mass concrete, stabilized soil blocks and concrete masonry blocks for use in low cost housing.

Lime: RHA binder can be used to produce a less expensive concrete compared to PPC cement. The cost of optimal lime: RHA binder is approximately one quarter of that of PPC cement. The cost of optimal Lime: RHA concrete was found to be less than half the cost of an equivalent grade of concrete made using PPC cement.

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increase in the percentage volume fraction from 0.25 to 0.75. [16]

[11] Krishna et al. (2012) stated that applications of Rice Husk Ash as repair mortars, coatings and soil stabilization. Rice Husk Ash contributes significantly to a green building. [10]

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[13] Nair et al. (2013) studied that the incorporation of Rice Husk Ash in concretes results in improved compressive strength and flexural strength. Rice Husk Ash-High strength concrete showed a reduction in density compared with conventional concrete. [3]

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