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Experimental And Anaytical Study On Flexural Strength Of Concrete With Rha And Metakaolin

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Abstract: This paper emphasizes on providing a formula for determination of flexural strength of Standard Concrete when Rice Husk Ash (RHA) and Metakaolin are used as partial replacement for Ordinary Portland Cement (OPC) in concrete. OPC was replaced with these mineral admixtures at 5%, 10%, 15% and 20% by weight. 0% replacement served as the control. Flexural test was carried out on hardened 150x150x700 mm concrete beam at 28 days curing in water. Similar model of the beam was simulated in ANSYS Workbench to compute the flexural strength analytically.

Keywords: Rice Husk Ash, Metakolin, OPC, Flexural Strength, ANSYS

I. INTRODUCTION

IS 456:2000 provides an empirical formula for computing the flexural strength of a standard concrete cube. Concrete being the most versatile and used construction material on earth facing the scarcities of its prime constituent i.e. cement. Use of cement as a binding material not only imposes limitation on compressive strength of concrete but also leads to excessive heat of hydration, increases potential chloride attacks, adds to cost, reduces durability of concrete and structure as a whole.Use of Mineral admixtures has been practiced recently in order to overcome these effects. Mineral admixtures used in this paper are Rice Husk Ash (RHA) and Metakolin. It is not suitable to use the same formula for Admixture replaced concrete. Thus, it is important to derive a precise formula for determining the flexural strength of Admixture replaced concrete.

II. METHODOLOGY

Department of Environment (DOE) Method is used to design the M40 concrete. Trials as 5%, 10%, 15% and 20% replacement of Metakolin and RHA with OPC are designed. The design mix includes 130Kg of fly ash as a constant ingredient in all the mixes.

The proportions for trial mixes are presented in the tables below.

Table 1: Mix Design for M40 (Standard Concrete)

M40	1 CUM (kg)	0.05 CUM (kg)
Cement	400	20
Flyash	130	6.5
C/Sand	453.72	22.69
C.A 1	504.86	25.24
C.A 2	757.28	37.86
Water	180	9
Admixture	5.3	0.265

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Table 2: 5% Replacement of OPC with RHA/ Metakaolin

M40	1 CUM (kg)	0.05 CUM (kg)
Cement	393.5	19.675
Flyash	130	6.5
RHA/Metakaoli N	6.5	0.325
C/Sand	644	32.2
C.A 1	440	22
C.A 2	640	32
Water	182.4	9.12
Admixture	5.3	0.265

Table 3: 10% Replacement of OPC with RHA/ Metakaolin

M40	1 CUM (kg)	0.05 CUM (kg)
Cement	387	19.35
Flyash	130	6.5
RHA/Metakaoli N	13	0.650
C/Sand	644	32.2
C.A 1	440	22
C.A 2	640	32
Water	182.4	9.12
Admixture	5.3	0.265

Table 4: 15% Replacement of OPC with RHA/ Metakaolin

M40	1 CUM (kg)	0.05 CUM (kg)
Cement	380.5	19.025
Flyash	130	6.5
RHA/ Metakaolin	19.5	0.975
C/Sand	644	32.2
C.A 1	440	22
C.A 2	640	32
Water	182.4	9.12
Admixture	5.3	0.265

Test Beams:

The size of beam specimens is 150 x150 x700 mm. The beam specimens were cast and tested with and RHA and Metakolin for normal conditions. 8 Nos of beam specimens were cast.

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Testing

The specimens prepared for testing were cured properly and tested as per flexural test procedures in digital Flexural testing machine of 200 KN capacity. The test results are reported in table for control.

Sr. No.	Admixture	Replacement (%)	Avg. load (N)	Flexural Strength (N/mm2)
1	RHA	5	37989.1	5.46
2	Metakolin	5	37708.7	5.43
3	RHA	10	37697.7	5.43
4	Metakolin	10	39427.4	5.69
5	RHA	15	36989.2	5.32
6	Metakolin	15	39444.9	5.68
7	RHA	20	34600.2	4.96
8	Metakolin	20	39026.9	5.63

- SIMULATION IN ANSYS

A similar model of the concrete beam was created in ANSYS. The properties of OPC, RHA and Metakaolin were entered in the engineering data sources section. The two point loading system was simulated as it is carried out in the real world. Spaceclaim being a very effective tool was adopted for drafting. The whole operation was carried out in ANSYS Workbench 16 (Multiphysics). The following figure shows the model generated using Spaceclaim. Fatigue tool could not be used as there were no failure curves available as it is for structural steel. To analyze the failure of beam, ultimate load obtained from experimental flexural test were used. Equivalent (Von Mises) stress was found out using analytical solutions. Nodal forces and displacements are the only way in which this type of analysis can be carried out. The following figure shows the beam in Mechanical.

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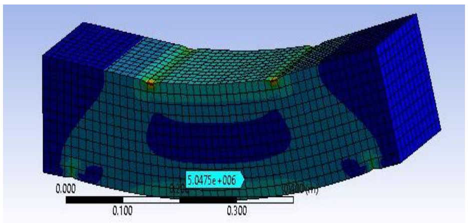
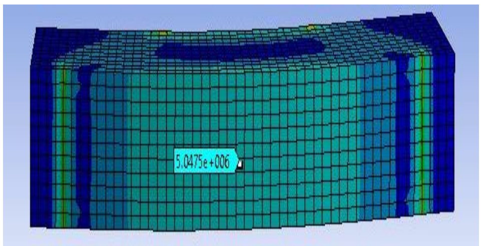


The tables provide information on the input data. Table: ANSYS Result

Sr. No.	Admixture	Replacement (%)	Avg. load (N)	Flexural Strength (N/mm2)
1	RHA	5	37989.11	5.49
2	Metakolin	5	37708.74	5.44
3	RHA	10	37697.78	5.44
4	Metakolin	10	39427.47	5.69
5	RHA	15	36989.22	5.33
6	Metakolin	15	39444.94	5.7
7	RHA	20	34600.25	4.99
8	Metakolin	20	39026.96	5.63

Table: ANSYS Result

The aim of the project was to closely simulate the experimental conductance in ANSYS. Experimentally it is observed that failure of the beam is caused at somewhat middle portion of the beam at bottom. Using probe function stress at the bottom of the beam was obtained as shown.



IV. CONCLUSIONS

The results obtained experimentally and analytically are very close and hence can be justified. IS 456 has suggested for as 0.7*sqrt (fck). Through our project we are proposing such empirical equation for RHA and metakaolin concrete. On the basis of statistical data carried out by us fcr for RHA and metakaolin concrete can be taken as 0.75*sqrt (fck). As the use of such modified concrete is increasing day by day such an equation will aid the consultants to design beams more effectively and economically.

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