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Influence of Fresh Concrete Properties on the Mechanical Properties of Hardened Concrete

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***Abstract:** Characteristics of hard concrete such as compressive strength are significantly affected by freshly prepared concrete properties. The properties of fresh concrete affect the future performance of structures. Compressive strength is found to be major parameter indicating condition of any concrete structures. In this work affect of basic properties such ratio of cement to aggregate; water to cement ratio, workability and density of fresh concrete on the compressive strength is evaluated and a regression model is developed.*
***Keywords:** Concrete, Strength, Density, Workability, Modeling.*

I. INTRODUCTION

In the present research influence of ratio of cement to aggregates, water cement ratio, workability and concrete cover on the in-situ strength of concrete structure is evaluated. Tests conducted are weighing the cement and aggregates, testing the properties of cement and aggregates, proportioning of ingredients, determination of water cement ratio, determination of workability by slump cone method, test of hardened concrete blocks after 28 days of curing for testing the condition of prepared concrete through compressive strength test.

II. LITERATURE REVIEW

Several researchers evaluated the strength of concrete and developed a mathematical relationship using the experimental values. Aldalton et al. (2012) [1] investigated the usability of artificial neural network to estimate the compressive strength of such concrete. The parameters considered for the ANN inputs are the amounts of steel fiber, water, water–cement ratio, cement, pumice sand, pumice gravel, and super plasticizer.

Mozerrela et al. (2006) [2] demonstrated utility of neural networks (NN) to forecast the compressive strength and slump of concrete. Model has been developed trained and tested using the available test data of 187 different concrete mixes of HSC collected from the literature.

An artificial neural networks study has been carried out by Bilim et al. (2009) [3] to predict the compressive strength of ground granulated blast furnace slag concrete. A data set of a laboratory work, in which a total of 45 concretes had been produced, has been utilized in the ANNs study.

A fuzzy polynomial neural network to predict the compressive strength of concrete has been developed by Zarandi (2008) [4], the proposed model is a combination of fuzzy neural networks and polynomial neural networks. An artificial neural network has been presented to predict a 28-day compressive strength of a normal and high strength self compacting concrete and high performance concrete with high volume fly ash by Prasad et al. (2009) [5].

A new approach is developed to obtain the FRP-confined compressive strength of concrete using a large number of experimental data by applying artificial neural networks by Naderpour et al. (2010) [6]. Having parameters used as input nodes in ANN modeling such as characteristics of concrete and FRP, the output node was FRP-confined compressive strength of concrete.

Hoła and Schabowicz (2005) [7] presented the neural identification of the compressive strength of concrete on the basis of non-destructively determined parameters. Basic information on artificial neural networks and the types of artificial neural networks most suitable for the analysis of experimental results are given.

Bilgehan and Turgut (2010) [8] presented an approach enables to practically find concrete strengths in the existing reinforced concrete structures, whose records of concrete mixture ratios are not available or present. Thus, researchers can easily evaluate the compressive strength of concrete specimens by using UPV values.

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III. EXPERIMENTAL PROGRAM AND RESULTS

In the present research influence of cement aggregate ratio, water cement ratio and slump value of the fresh concrete over the compressive strength of concrete has been investigated. Following tests conducted have been conducted

1) Weighing the cement and aggregates
2) Testing the properties of cement and aggregates
3) Proportioning of ingredients
4) Preparing cubes of different water cement ratio
5) Determination of workability by slump cone method
6) Compression test of hardened concrete blocks

Condition and performance of RC structures mainly influence by compressive strength of concrete which significantly influenced by cement to aggregate ratio. In the present research several cement to aggregate ratios have been considered such as 1:2, 1:3: 1: 4.5, 1:6, 1:9 and 1:12. Also, six different w/c ratios have been considered which are 0.4, 0.44, 0.48, 0.52 0.56 and 0.60. Obtained Experimental results were presented in Table 1.

Table 1- Experimental Results

Concrete Sample	Weight (kg) of			Cement/ Aggregate	Water/ Cement	Workability (Slump vaulue in MM)	Density (kg/m3)	compressive Strength
	Cement	Aggregate (Fine + coarse)	Water					
C1	1	2	0.4	0.50	0.4	90	2298	31.2
C2	1	2	0.4	0.50	0.4	91	2301	30.9
C3	1	2	0.4	0.50	0.4	90	2303	30.6
C4	1	2	0.45	0.50	0.45	92	2306	30.4
C5	1	2	0.45	0.50	0.45	94	2308	30.1
C6	1	2	0.45	0.50	0.45	94	2311	29.8
C7	1	2	0.5	0.50	0.5	96	2313	29.5
C8	1	2	0.5	0.50	0.5	95	2316	29.3
C9	1	2	0.5	0.50	0.5	97	2318	29.0
C10	1	2	0.55	0.50	0.55	101	2321	28.7
C11	1	2	0.55	0.50	0.55	103	2323	28.5
C12	1	2	0.55	0.50	0.55	100	2326	28.2
C13	1	2	0.6	0.50	0.6	107	2329	28.0
C14	1	2	0.6	0.50	0.6	110	2331	27.7
C15	1	2	0.6	0.50	0.6	109	2334	27.5
C16	1	3	0.4	0.33	0.4	86	2336	27.8
C17	1	3	0.4	0.33	0.4	87	2339	27.6
C18	1	3	0.4	0.33	0.4	86	2341	27.3
C19	1	3	0.45	0.33	0.45	88	2344	27.1
C20	1	3	0.45	0.33	0.45	90	2347	26.9
C21	1	3	0.45	0.33	0.45	90	2349	26.6
C22	1	3	0.5	0.33	0.5	92	2352	26.4
C23	1	3	0.5	0.33	0.5	91	2354	26.1
C24	1	3	0.5	0.33	0.5	93	2357	25.9
C25	1	3	0.55	0.33	0.55	97	2359	25.7
C26	1	3	0.55	0.33	0.55	99	2362	25.4
C27	1	3	0.55	0.33	0.55	96	2365	25.2
C28	1	3	0.6	0.33	0.6	103	2367	25.0
C29	1	3	0.6	0.33	0.6	106	2370	24.7
C30	1	3	0.6	0.33	0.6	105	2372	24.5
C31	1	4.5	0.4	0.22	0.4	84	2375	21.6
C32	1	4.5	0.4	0.22	0.4	85	2378	21.3
C33	1	4.5	0.4	0.22	0.4	84	2380	21.2

C34	1	4.5	0.45	0.22	0.45	86	2383	21.0
C35	1	4.5	0.45	0.22	0.45	87	2386	20.8
C36	1	4.5	0.45	0.22	0.45	87	2388	20.6
C37	1	4.5	0.5	0.22	0.5	89	2391	20.4
C38	1	4.5	0.5	0.22	0.5	88	2393	20.2
C39	1	4.5	0.5	0.22	0.5	90	2396	20.0
C40	1	4.5	0.55	0.22	0.55	94	2399	19.8
C41	1	4.5	0.55	0.22	0.55	96	2401	19.6
C42	1	4.5	0.55	0.22	0.55	93	2404	19.4
C43	1	4.5	0.6	0.22	0.6	100	2407	19.3
C44	1	4.5	0.6	0.22	0.6	102	2409	19.1
C45	1	4.5	0.6	0.22	0.6	101	2412	18.9
C46	1	6	0.4	0.17	0.4	81	2415	16.2
C47	1	6	0.4	0.17	0.4	82	2417	16.1
C48	1	6	0.4	0.17	0.4	81	2420	15.9
C49	1	6	0.45	0.17	0.45	83	2423	15.8
C50	1	6	0.45	0.17	0.45	85	2425	15.6
C51	1	6	0.45	0.17	0.45	85	2428	15.5
C52	1	6	0.5	0.17	0.5	87	2431	15.3
C53	1	6	0.5	0.17	0.5	86	2433	15.2
C54	1	6	0.5	0.17	0.5	88	2436	15.0
C55	1	6	0.55	0.17	0.55	91	2439	14.9
C56	1	6	0.55	0.17	0.55	93	2441	14.7
C57	1	6	0.55	0.17	0.55	90	2444	14.6
C58	1	6	0.6	0.17	0.6	97	2447	14.5
C59	1	6	0.6	0.17	0.6	99	2449	14.3
C60	1	6	0.6	0.17	0.6	98	2452	14.2
C61	1	9	0.4	0.11	0.4	75	2455	11.8
C62	1	9	0.4	0.11	0.4	75	2457	11.6
C63	1	9	0.4	0.11	0.4	76	2460	11.4
C64	1	9	0.45	0.11	0.45	78	2463	11.2
C65	1	9	0.45	0.11	0.45	78	2466	11.0
C66	1	9	0.45	0.11	0.45	80	2468	10.8
C67	1	9	0.5	0.11	0.5	80	2471	10.5
C68	1	9	0.5	0.11	0.5	81	2474	10.3
C69	1	9	0.5	0.11	0.5	81	2476	10.1
C70	1	9	0.55	0.11	0.55	85	2479	10.0
C71	1	9	0.55	0.11	0.55	85	2482	9.8
C72	1	9	0.55	0.11	0.55	89	2485	9.6
C73	1	9	0.6	0.11	0.6	89	2487	9.4
C74	1	9	0.6	0.11	0.6	90	2490	9.2
C75	1	9	0.6	0.11	0.6	90	2493	9.0

IV. REGRESSION ANALYSIS BETWEEN DENSITY AND COMPRESSIVE STRENGTH OF CONCRETE

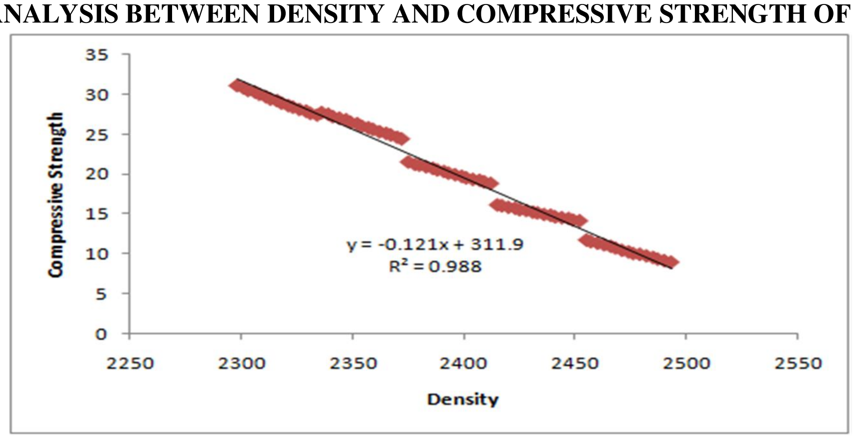

Figure 1 - Graph between density and strength

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By regression analysis it has been found that compressive strength of concrete decreases with the increase in density of concrete for all the proportions of aggregates (cement/aggregate), as more dense concrete reflects good quality of concrete.

S= - 0.121***D** + 311.9

Where S= Compressive Strength in MPa and D= Density of concrete in Kg/m^3

V. DISCUSSION AND CONCLUSIONS

In the present work affect of fresh concrete properties such as cement to aggregate ratio, water to cement ratio, slump value and density on the compressive strength has been evaluated. Out of several significant characteristics compressive strength has been selected for this study and analysis. Following are the conclusions of research:

1) With the increase in water cement ratio from 0.4 to 0.6 compressive strength and slump value of concrete decreases and density ingresses.
2) Compressive Strength decreases continuously with the increase in water cement ration from 0.4 to 0.6. It has been also observed that Slump value and Density increases with increase in water cement ratio from 0.4 to 0.6. However, several other factors are also responsible for the variation of these three significant properties of concrete.
3) Compressive strength of concrete decreases with the increase in density of concrete for all the proportions of aggregates (cement/aggregate), as more dense concrete reflects good quality of concrete.
   S= - 0.121***D** + 311.9
   Where S- Compressive Strength in MPa, and D- Density of concrete in Kg/m^3
4) Higher slump values results in low compressive strength for all cement to aggregate ratio.

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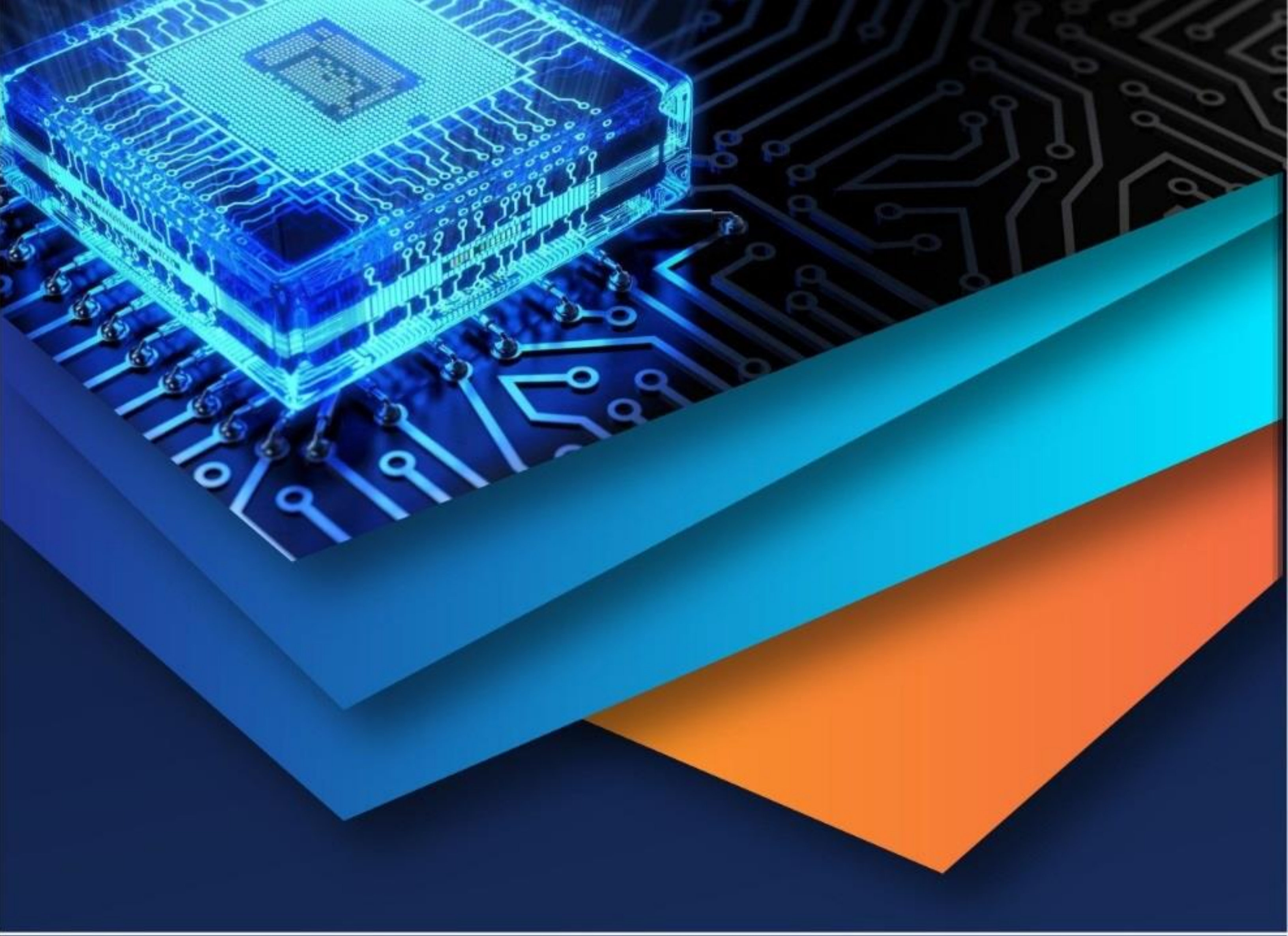

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