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DEVELOPING AN IMPERICAL METHOD OF MIX DESIGN FOR HIGH STRENGTH CONCRETE USING LOCAL MATERIALS

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ABSTRACT

The present research aimed to developed for High Stength Concrete mix design using local materials and method for Normal Strength Concrete.

As the trend of high strength concrete increases in all over the world it is strong need to investigate the factor enhancing the compressive strength of concrete at least economical expenditure. To makes economical use of high strength concrete in Chhattisgarh a mix design for high strength concrete was developed. In this research work nine mixes designed and other six mix were selected from directly to different research papers to achieve a compressive strength up to 100 Mpa fifteen mix ratios by weight were selected with 0.30, 0.32, and 0.35 water cement ratio Gelenium 140 Superplasticizer was use to improve the workability of concrete mix. Locally available coarse and Fine aggregate were used with Portland Pozzolana Cement (43 Grade). But low W/C ratio make concrete mixes significantly less workable to compensate for reduced workability the effects of the use of S.P. in concrete for early Strength and loss of workability are highlighted. In compatibility with P.P.C. with respect to dosage are also observed. Finally a glance on overcomes slump problems is deal in the process.

In this research work the design mixes developed for High Strength Concrete due to Existing mix design method of Normal Strength Concrete such as Bureau of Indian standard (BIS), Department of Environmental (DOE), and American Concrete Institute (ACI) methods applicable for HSC.

KEYWORDS: High Strength Concrete, Mix Design Methods, Local Material, Super Plasticizers

INTRODUCTION

In Chhattisgarh region is felt keeping in view of infrastructural developments the Requirements of High strength concrete Moreover in the construction sector for high rise and multistoryed buildings Moreover high strength concrete by using locally available Coarse aggregate, Fine aggregate, and Portland Pozzolana cement with mineral and chemical admixtures with varying properties of these materials has been presented in the project work.

OBJECTIVES OF THE STUDY

The objectives of this study are to explore for High Strength Concrete due to Existing mix design method of NSC with locally available material in Durg Chhattisgarh region

- Study of available method for High Strength Concrete
- For three locations Nandani,Salood and Mudipar quarry in Durg

- To find the specific gravity and water absorption for all the locations
- Mix Design for Grade M-50,M-60 and M-70 for High strength concrete with locally available materials of Chhattisgarh region
- Limitations of admixtures as additive, if any
- Classifications, uses and precautions in use of admixtures
- Dosages and its effects
- Analytical Study

SCOPE OF WORK

This research work is exploring to develop High Strength Concrete using locally available material. We are using methods of Normal Strength Concrete. No any Cementitious materials have been used.

SIGNIFICANCE OF STUDY

The significance of this study is to appreciate explain the basic similarities and differences in IS, BS and ACI methods of concrete mix design by experimental work. The purpose of developing the High strength concrete by functional equation method used but it depends on grading of aggregate and grade of Cement and its affects the properties of Concrete

RESEARCH METHODOLOGY

- Study of research papers, analysis, to find methods following by others researchers and get guidance from their work
- Study of various codes for H.S.C. developments
- The research is aimed to develop mixes used IS Code: 10262 (2009), ACI and British Standard code for standard for High Strength Concrete.

EXPERIMENTAL PLAN WERE DEVELOPED

- M-50, M-60, M-70 grade concrete mixes were designed and tested for workability and compressive strength for 7 days and 28 days which will required to develop nine mixes.
- M-50, M-60, M-70 grade concrete the mixes were obtained directly from research papers and such six mixes have to be selected
- A suitable superplasticizer have to be selected.
- Doses of the superplasticizer were experimentally to be designed.
- The results obtained for in total 15 mixes will guide the procedure for develops mix design of H.S.C. using locally available material.
- Functional Equation developed for Mix Design

- Mixes of different grade M-50,M-60,M-70 to be developed, tested and analysed

EXPERIMENTAL WORK

The whole experimental work was carried out in the concrete lab of Bhilai Institute of Technology, Durg using the basic ingredients of concrete - *coarse and fine aggregates, water and cement, with use of water chemical admixture Super plasticizer*.

Coarse Aggregate

Locally available coarse aggregate obtained from *Nandini quarry, Sellud quarry & Mudipar quarry*, consisting of natural crushed rock of nominal maximum size 20 mm and down with the existing grading, as supplied to construction sites was used.

- **Fine Aggregate:** Fine aggregate consisting of *natural sand* obtained from *Tandula River*, as supplied to the construction site was used.
- **Cement:** *Portland Pozzolana Cement*, conforming to IS 455: 1989, *make – P.P.C.* was used for the experimental work.
- **Super Plasticizer:** Glenium 140 (polycarboxylic ether polymers)

1. Specific Gravity of Ultra-Tech Cement (PPC)

Specific gravity of Kerosene, Sk = 0.81

Specific gravity of Cement, Sc = 2.75

2. Specific Gravity and Water Absorption of Coarse aggregate

Specific gravity = 2.62

Water absorption (% of dry weight) = 0.57

SELECTION OF SUPERPLASTICIZER

Deciding doses of admixture a separate cubes with 0.2, 0.4, 0.6, & 0.8% of superplasticizer(Gelenium-140) by mass of cement has been taken and for M-50 grade of concrete.

Table 1: Constituents of Different Mixes

	M-50	M-50	M-50	M-50
Cement	425	398.6	372	345
Water	147.60	138.50	130.20	120.14
sand	646	646	661	676
Coarse aggrgate	1256	1286	1317	1347

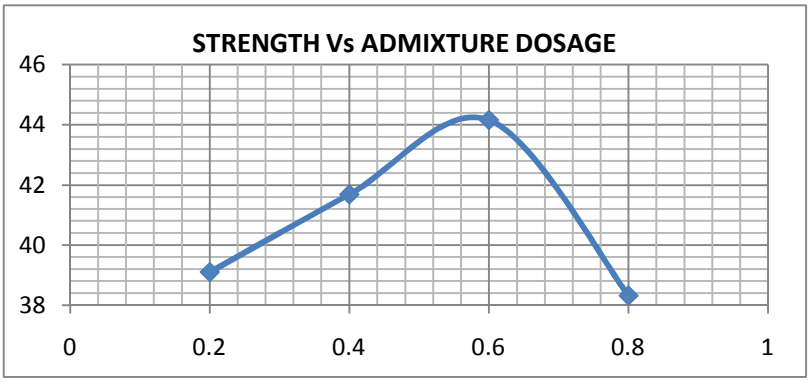
Key Admixtures Used for Mix Design

Gelenium 140 as Super Plasticizer have been used and tested for its doses in M-50 Grade of Concrete.

Results and Observations

Table 2: Concrete Admixture Dosage vs Compressive Strength in 28 Days for Trial Mixes

S. No.	Grade of Concrete	w/c Ratio	Admixture Dose in % By Weight of Cement	Slump Observed (mm)	Compressive Strength Observed for	
					7 Days in N/mm^2 (Average of 2 Cubes)	28 Days in N/mm^2 (Average of 2 Cubes)
1	M-50	0.35	0.2	00	38.66	39.11
2			0.4	15	41.55	41.69
3			0.6	35	43.22	44.16
4			0.8	40	35.11	38.33



Using Super Plasticizer – Gelenium 140

Figure 1: Plot of Compressive Strength of Conventional Concrete vs Admixture Dosage of Trial Mixe

As per the lab test on chemical admixture (super plasticizer) found 0.6% Super Plasticizers reducess maximum water content upto 30% and also gives maximum workability and higher strength. So for all purpose the 0.6% of dose of Super Plasticizers have been used

Developing Concrete Mix Design as Per Available Method

Table 3: Designed Mix Proportion by Different Methods

S. No.	Mixes	Cement in Kg	F.A.in Kg	C.A. in Kg	W/C Ratio	Water in ml	Chemical Gelenium ACE-30 in ml
1	M1	1	1.74	3.18	0.35	350	5.24
2	M2	1	1.52	2.9	0.32	320	5.24
3	M3	1	1.41	2.7	0.3	300	5.24
4	M4	1	2.18	2.65	0.34	340	5.24
5	M5	1	1.91	2.42	0.31	310	5.24
6	M6	1	1.74	2.27	0.29	290	5.24
7	M7	1	1.82	3.45	0.35	350	5.24
8	M8	1	1.63	3.1	0.32	320	5.24
9	M9	1	1.46	2.9	0.3	300	5.24
Mix Proportion as Per Literature Review							
10	M10	1	1.58	2.38	0.35	350	5.24
11	M11	1	1.08	1.88	0.3	300	5.24
12	M12	1	1.51	2.6	0.3	300	5.24
13	M13	1	0.75	1.5	0.3	300	5.24
14	M14	1	1.17	1.88	0.28	280	5.24
15	M15	1	1.35	2.19	0.29	290	5.24

Table 4: The Results of the Experimental Work are Summarized in the Following

S. No.	Mix Designation	W/C Ratio	Water Content kg/m3	F.A. Content kg/m3	C.A. Content kg/m3	Cement Content kg/m3	Super Plasticizer Doses in ml	Work-ability	Av.Cube Compressive Strength	
								Slump (mm)	At 7 Days (N/mm^2)	At 28 Days (N/mm^2)
1	M11	0.35	136.16	687	1225	394	2064.56	0	27.33	34.2
2	M12	0.32	136.47	658	1225	431	2258.44	0	26.22	41.78
3	M13	0.3	136.25	650	1236	460	2410.4	0	31.78	41.5
4	M21	0.35	132	858	1040	392	1886.4	0	32	39.3
5	M22	0.32	132.6	823	1040	429	2064.56	0	36	42.8
6	M23	0.3	133	798	1040	458	2200.8	0	32	41
7	M31	0.35	126	656	1243	360	2054.08	0	30	34.4
8	M32	0.32	125	644	1221	394	2247.96	0	26.44	43.33
9	M33	0.3	125	616	1222	420	2399.92	0	45.1	50.66
10	MR1	0.35	162.75	735	1110	465	2436.6	0	38.7	40.3
11	MR2	0.3	165	595	1035	550	2882	0	41.8	41.4
12	MR3	0.3	125.1	625	1085	417	2185.08	0	40	46.4
13	MR4	0.3	195	487.5	975	650	3406	0	35.6	42.6
14	MR5	0.28	162.4	680	1190	580	3039.2	0	49.3	54
15	MR6	0.29	145	675	1105	500	2620	0	50.7	42.4

Results and Analysis

This table gives the outcome of experimental work carried out in Laboratory. This results can be used to develop a approximate method of mix designing of High Strength Concrete (HSC) using mathematical tools in (M.S. Excel)

From the experimental test results the following graphs showing variation of compressive strength with respect to various influencing parameters have been developed shown as below

Compressive Strength Result

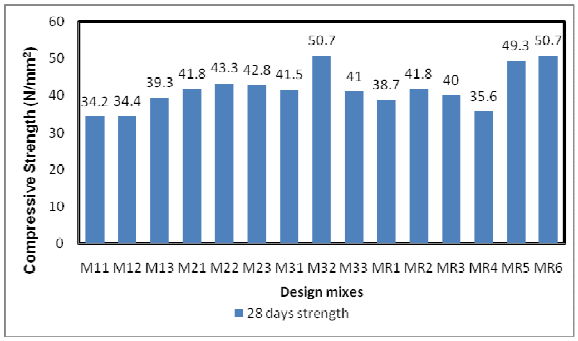


Figure 2: Graphical Representation of Strength obtained for mixes

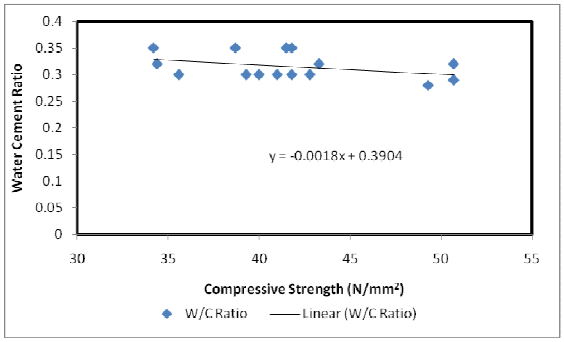


Figure 3: Plot of compressive strength and concrete vs w/c ratio of trial mixes

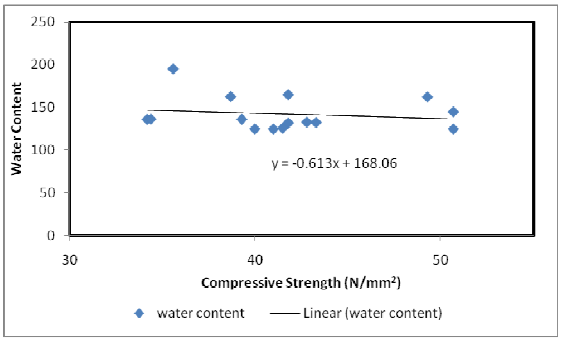


Figure 4: Plot of Compressive Strength vs Water Content of Trial Mixes

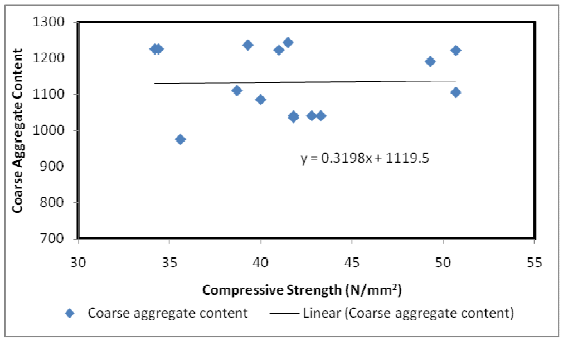


Figure 5: Plot of Compressive Strength vs Fine Aggregate Content of Trial Mixes

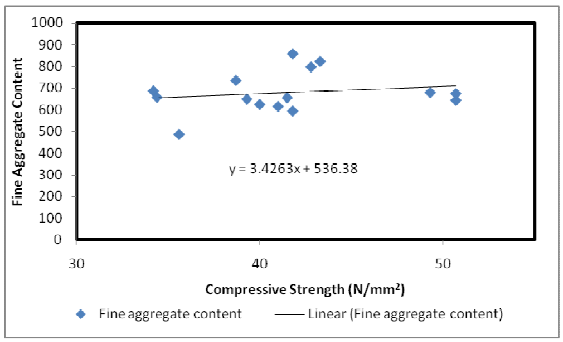


Figure 6: Plot of Compressive Strength vs Coarse Aggregate Content of Trial Mixes

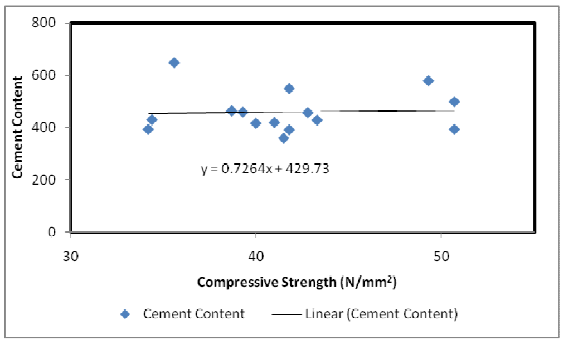


Figure 7: Plot of Compressive Strength vs Cement Content of Trial Mixes

From the experimental work carried out in laboratory. The functional formula to determine the parameters for High Strength Concrete mix design are:

a. Water Cement Ratio

y = -0.0018x + 0.3904 Where y is w/c ratio and x is Compressive strength

b. Water Content

y = -0.613x + 168.06 Where y is water content and x is Compressive strength

c. Fine Aggregate Content

y = 3.4263x + 536.38 Where y is F. A. content and x is Compressive strength

d. Coasrse Aggregate Content

y = 0.3198x + 1119.5 Where y is C. A. content and x is Compressive strength

e. Cement Content

y = 0.7264x + 429.73 Where y is Cement content and x is Compressive strength

The above equation have been used for developing M-50, M-60 and M-70 mixes. There proportions are tabulated in Table 5

Table 5: Proportion of Functional Equation Mixes

S. No.	Mix Designation	Proportion	W/C Ratio	Water Content kg/m3	F.A. Content kg/m3	C.A. Content kg/m3	Cement Content kg/m3	Super Plasticizer Doses in ml
1	ME1-50	1:1.52:2.43	0.3	137.41	708	1135	466	2441.84
2	ME2-60	1:1.57:2.40	0.28	131.28	742	1139	473	2478.52
3	ME3-70	1:1.61:2.37	0.26	125.15	776	1142	481	2520.44

CONCLUSIONS

From the experimental work, following points can be concluded :

The experimental work was conducted to developed High Strength Concrete using locally material of compressive strength 50, 60 and 70 N/mm2. The properties investigated were workability and compressive strength. The existing method, namely IS Code, DOE and ACI- modified method have some limitations and hence cannot be directly used for designing HSC mixes.

- According to these results Super Plasticizers, for high-strength concretes by decreasing the w/c ratio as a result of reducing the water content by 20–30%.
- Out of fifteen mixes only one mix has achieved 28 days strength more than 50 Mpa the proportion of the mix is 1:1.17:1.88

Conclusion from New Developed Method

- The concrete mix with the above developed mixes were made in Laboratory and tested for workability 7 days and 28 days and found approximate satisfactory results.
- Mathmetical equation developed are giving approximate satisfactory results to improve more lab work with different higher grade mixes should be done and the Mathmetical equation can be modified for H.S.C.

FURTHER SCOPW OF THE WORK

- This study has some limitation like the developed High Strength Concrete Mixes using available materials from selected of lime stone
- For further study on the same topic “Effect of Grading of Coarse aggregate and Grade of Cement on the properties of concrete may be done ”.
- The method for developing H.S.C. mix design can be changed by of different uses Cementitious materials
- The further study can be done to explore te effect of PPC, PSC Cements
- Further work can be done using doses of Super Plasticizers
- Source of aggregate may be varied like granite, basalt, quartzite etc can be changed

CONTRIBUTION TO PRACTICAL FIELD

This study expects contribution to the practical field as:

An Approximate method of mix desings for High Strength Concrete using functional equation developed for field engineers.

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