Experimental Study on Compressive Strength of Concrete with the Variation of Cement Content using Super Plasticizer (WRs)

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Abstract- *In this paper we focus on the experimental study on compressive strength of concrete with the variation of cement paste(w/c) using super plasticizer. This paper investigates that lower strength with higher w/c ratios and higher strengths with lower w/c ratios. As the super plasticizers is used, the water content can be reduced upto 20% or more but there is no guidelines given in IS-CODE 10262. So the purpose of this study to investigate the compressive strength of concrete cube at constant slump and direction for the use of percentage of super plasticizers(Wrs). In concrete mix, by changing the cement content or water content, the magnitude changes in concrete strength depends on now water cement ratio is changed.various super plasticizers are used to reduce water content at different levels of mixing of concrete. Super plasicizers are also called high range water reducers which can be used to increase workability more than with traditional plasticizers. We know that water cement ratio is same as 0.43 and when we decrease the quantity of cement then the water cement ratio will be changed, so we want that water can be reduced to some extent so that water cement ratio will remain same with the help of super plasticizers, and by doing this cement quantity will be saved. So the project cost is low and our project is economical.*

As part of study, The cubes are casted at water-cement ratio of 0.43, 0.41,0.39 and0.38and with PPC Cement along with Super plasticizers (WRs) with different percentages of water reduction. A total of 84 concrete cubes were tested after 28 days at various percentages of super plasticizers(WRs). For each mixture, 150x150x150mm concrete cubes have been casted and tested in laboratory.

Keywords- Water Cement Ration, Super Plasticizers, Compressive Strength, Workability, Slump.

I. INTRODUCTION

Super plasticizer is used to reduce the water content . As strength of concrete depends upon the strength of cement paste. Also water cement ratio gives the strength of concrete is only dependent upon water cement ratio provided the mix is workable. Compressive strength is also one of the most important properties of concrete in which strength is determined as per water cement ratios. Super plasticizers are used for the reduction of water content to give the project cost low and economical in use. Various kinds of plasticizers are used such as sulphonated malanie- formaldehyde condensates, acrylic polymer, modified lignosulphonates, polycarboxylate ester. They work to disperse the cement particles. In this paper the super plasticizers used is modified lignosulphonates (viscocrete). Super plasticizes are more powerful agent as compared to other dispersing agents. Super plasticizers are used in various structures such as deep beams, thin walls of water retaining.

II. LITERATURE REVIEW

In the study of Prashant Kumar Sahu et al [1] the workability of concrete can be increased by addition of water reducing agent. However, very high dosages of water reducing agent tend to impair the cohesiveness of concrete.

F. U. A. Shaikh et al [2] concluded NS adversely affects the workability of cement pastes more than those containing NC, regardless of superplasticizer types and mixing methods.

Ping-Kun Chang et al [3] Concluded For concrete pastes with the same W/C ratio, greater specific gravity will result in higher concrete strength.

L. Agullo et al [4] Concluded the flow times determined using the Marsh cone test yield a satisfactory indication of the relative fluidity of the cement paste.mineral admixtures with higher water demand, such as micronized diatomites, leads to higher superplasticizer saturation dosages than with silica fume.

Ezgi Yurdakul et al [5] concluded that: Approximately 1.5 times more paste by volume of is required than voids between the aggregate to obtain a minimum workability. The use of water- reducing admixtures provides little benefits.The result of SCM would help improve

workability, long-term strength and durability in portland cement concrete(PCC) pavements.

Sanjeev kumar et al [6] Concluded that Increase in compressive and splitting-tensile strength was noticed in cement-CNT composites having CNT content of 0.5% by weight of cement.

Sand or popovics et al [7] concluded that the paste strength depends on its total porosity andporosity is a function of the water-cement ratio.S N R Shah et al [8] concluded that the highest compressive strength was obtained .

III. EXPERIMENTAL DETAILS

Firstly, the materials have been collected for the testing. Then various initial tests have been performed on the material. In which PPC 43 grade cement manufactured by PPC was used for casting the specimens. And normal consistency is 32%.The specific gravity of cement was 3.15. The initial setting time were found as 43 minutes and final setting time is 610 minutes. The compressive strength of cement cube after 7 days and 28 days is 19 Mpa and 39 Mpa respectively . The fine aggregate used is locally available coarse sand whose specific gravity is 2.61 also fineness modulus is 2.85 and lies in zone II. The locally available crushed aggregate , mainly quartzite in mineralogical composition of maximum nominal size of 20mm is used as coarse aggregate whose specific gravity is 2.656 also fineness modulus is 2.92. Potable water is used in the present study in all operations. And the super plasticizer used is viscocrete. And mix designing at different water cement ratio such as 0.43, 0.41, 0.39, 0.38 is done with different water reduction range at constant slump(100mm).

IV. MIX PROPORTIONS

A total of 28 trial concrete mixes were casted with the moulds used for cubes, 150 mm x 150 mm. The cement, coarse and fine aggregate and superplasticizer were mixed thoroughly with the help of mechanical mixer. There are four different w/c range are taken 0.43,0.41,0.39 and 0.38 with the variation of water reduction 0% to 42%. was taken to vary 3 cubes are made for each set various were produced for testing, according to IS-CODE-10262. Grade of concrete used M-25.The detailed results are in table 1.1.

Table 1.1 Experimental results of the work

	W/C	reduction	water	Net water	Cement	required SP	plasticizer (min)	paste without admixture	paste content (min)	Plasticizer % (ml)	increse in coarse	Coarse agg(min)	Fine (min)
1	0.43	0	197.2	197	458.51	0.2	0.79	34.2719	34.35	13.34	0.63	1103	627.12
2	0.43	3	197.2	191	444.76	0.2	0.77	33.2438	33.32	12.94	0.63	1120.3	605.24
3	0.43	6	197.2	185	431	0.2	0.74	32.2156	32.29	18.8	0.63	1137.6	614.59
4	0.43	9	197.2	179	417.25	0.2	0.72	31.1875	31.26	18.2	0.63	1154.9	623.94
5	0.43	12	197.2	174	403.49	0.4	1.39	30.1593	30.3	35.2	0.63	1171.1	632.67
6	0.43	15	197.2	168	389.73	0.4	1.34	29.1311	29.27	34	0.63	1188.4	642.04
7	0.43	18	197.2	162	375.98	0.4	1.3	28.103	28.23	32.8	0.63	1205.8	651.42
8	0.41	9	197.2	179	437.6	0.2	0.75	31.8336	31.91	19.09	0.64	1151.2	611.29
9	0.41	12	197.2	174	423.17	0.2	0.73	30.7841	30.86	18.46	0.64	1169	620.74
10	0.41	15	197.2	168	408.75	0.4	1.41	29.7347	29.88	35.66	0.64	1185.6	629.55
11	0.41	18	197.2	162	394.32	0.4	1.36	28.6852	28.82	34.4	0.64	1203.4	639.01
12	0.41	21	197.2	156	379.89	0.6	1.96	27.6358	27.83	49.71	0.64	1220.1	647.89
13	0.41	24	197.2	150	365.47	0.8	2.52	26.5863	26.84	63.77	0.64	1236.9	656.82
14	0.41	27	197.2	144	351.04	0.8	2.42	25.5368	25.78	61.25	0.64	1254.9	666.33
15	0.39	12	197.2	174	444.87	0.2	0.77	31.4731	31.55	19.41	0.64	1164.5	607.73
16	0.39	15	197.2	168	429.71	0.4	1.48	30.4001	30.55	37.49	0.64	1181.6	616.62
17	0.39	18	197.2	162	414.54	0.6	2.14	29.3272	29.54	54.25	0.64	1198.7	625.56
18	0.39	21	197.2	156	399.38	0.6	2.07	28.2542	28.46	52.26	0.64	1217.1	635.15
19	0.39	24	197.2	150	384.21	0.8	2.65	27.1813	27.45	67.04	0.64	1234.4	644.16
20	0.39	27	197.2	144	369.04	0.8	2.55	26.1083	26.36	64.39	0.64	1252.8	653.78
21	0.39	30	197.2	138	353.88	0.8	2.44	25.0354	25.28	61.75	0.64	1271.2	663.4
22	0.38	24	197.2	150	394.32	0.8	2.72	27.5023	27.77	68.8	0.64	1232.6	671.09
23	0.38	27	197.2	144	378.75	0.8	2.61	26.4166	26.68	66.09	0.64	1251.3	681.28

24	0.38	30	197.2	138	363.19	0.8	2.5	25.331	25.58	63.37	0.64	1270	691.47
25	0.38	33	197.2	132	347.62	0.8	2.4	24.2454	24.49	60.65	0.64	1288.7	701.65
26	0.38	36	197.2	126	332.06	0.8	2.29	23.1598	23.39	57.94	0.64	1307.5	711.84
27	0.38	39	197.2	120	316.49	1	2.73	22.0742	22.35	69.03	0.64	1325.2	721.52

V. MEASURING CUBE COMPRESSIVE STRENGTH

At the age of 28 days, concrete cubes were tested. the compressive strength of the three cubes cast from the same concrete mix and tested at the same timewere averaged to give one cube strength result.

Table 1.2 Experimental results of the work

S. NO.	W/C RATIO	WATER REDUCTION %	COMPRESSIVE STRENGTH(MPa)
1	0.43	0	30.81
2	0.43	3	25.29
3	0.43	6	21.96
4	0.43	9	26.4
5	0.43	12	27.91
6	0.43	15	31.63
7	0.43	18	32.95

S. NO.	W/C RATIO	WATER REDUCTION %	COMPRESSIVE STRENGTH(MPa)
1	0.41	9	28.04
2	0.41	12	29.57
3	0.41	15	32.07
4	0.41	18	32.76
5	0.41	21	33.16
6	0.41	24	33.78
7	0.41	27	34.3

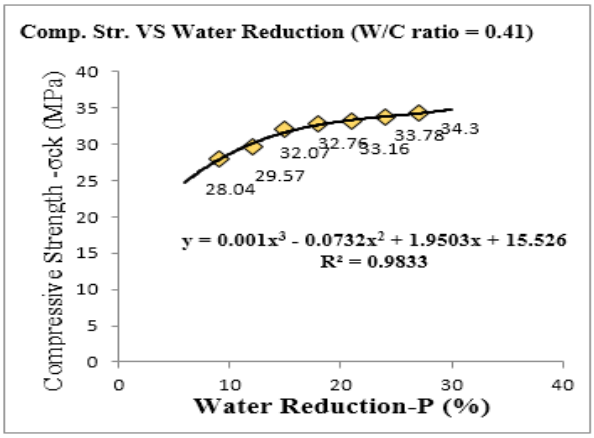

Figure 2.1 Experimental Results

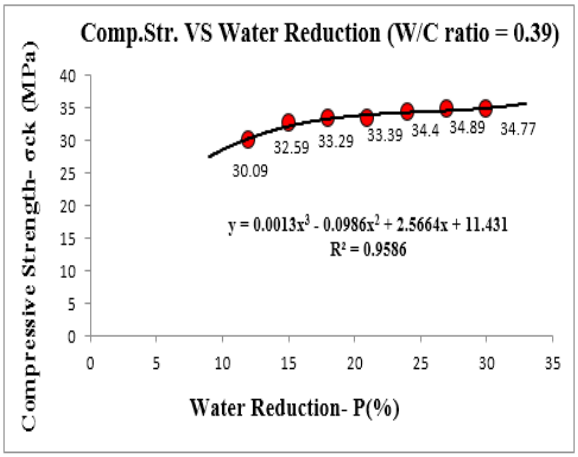

Figure 2.3 Experimental Results

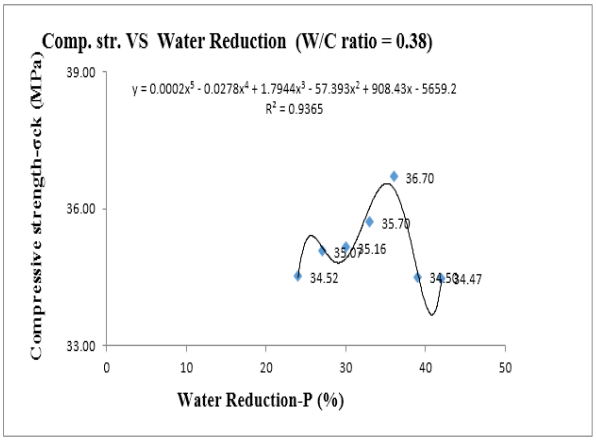

Figure 2.3 Experimental Results

VI. CONCLUSION

For the series of tests conducted on super plasticizers . Mix designing at different water cement ratio such as 0.43, 0.41, 0.39, 0.38 is done with different water reduction range at constant slump(100mm). From the above discussion it could be concluded that for any w/c ratio, compressive strength decreases upto 6% of water reduction. Also it is evident that increasing water reduction results in a increase of compressive strength upto 36% of and then decreases up to 42% and at some time it will give constant value. Also equations are generated as per study for direction of using the super plasticizers for different w/c ratios. Though as part of study we have worked on M25 concrete but the observations compelled us to conclude that a strength of M30 can be reached which is eventually cost effective by 2%.

REFERENCES

[1] Prashant Kumar Sahu1 P L Tamrakar, july 2015, Effect of Water Reducing Agent to Improve the Workability and Strength of Concrete.

[2] F. U. A. Shaikh and S. W. M. Supit , 2016,Effects of Superplasticizer Types andMixing Methods of Nanoparticles onCompressive Strengths of Cement Pastes.

[3] Ping-Kun Chang ,2003,An approach to optimizing mix design for properties of high-performance concrete.

[4] L. Agullo, B. taoralles-carbonary R. Gettu and A.Aguado,1999, Fluidity Of Cement Pastes With Mineral Admixtures And Superplasticizer- A Study Based On The Marsh Cone Test.

[5] Ezgi Yardakul Ph.D., Peter C taylor, Ph.D.P.E.,Halil Ceylan, Ph.D and faith bektas, Ph.D, 2013, Effect Of Paste-To-Voids Volume Ratio On The Performance Of Concrete Mixtures.

[6] sanjeev kumar, F.ASCE, Prabir kolay ,M.ASCE, Sunil Malla and Sanjay Mishra,2012, effect of multiwalled carbon nanotubes on mechanical strength of cement paste.

[7] Sandor Popovics, Ph.D., P.E., F.ASCE and Janos Ujhelyi, Ph.D,2008,Contribution to the Concrete Strength versus Water-Cement Ratio Relationship.

[8] S N R Shah, Muammad aslam, S A Shah, Raja Oad,july,2014, Behaviour Of Normal Concrete Using Superplasticizer Under Different Curing Regimes.

[9] Fouad Faroug, Janusz Szwabowski, And Stan Wild, 1999, Influence Of Superplasticizers On Workability Of Concrete.

[10] H.H.C. Wong and A.K.H. Kwan,2008, Rheology Of Cement Paste: Role Of Excess Water To Solid Surface Area Ratio.

[11] IS : 4031(PT4)1988 Method Of Physical Test For Hydraulic Cement : Part 4 Determination Of Consistency Of Standard Paste (First Revision March 2000).

[12] IS : 5513-1976 Specification Of Vicat Appratus(Second Version).

[13] IS 383:1970 Specification For Coarse And Fine Aggregates From Natural Source Feb- 97 For Concrete (Second Version).

[14] IS 456-2000 Code Of Practice For Plain And Reinforced Concrete (Third Revision) Aug 2000.

[15] IS 10262-1982 Recommended Guideline For Concrete Mix Design Jan-99.