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EFFECT OF SUPER-PLASTICIZER BS FUTURA PCX 107 ON PPC CEMENT FOR M25 GRADE OF CONCRETE

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***Abstract*— Plasticizers and Super-plasticizers are well known as water reducing agent. More specifically the super-plasticizer has the abilities to reduce high range water requirement in concrete. Apart from the quality of water reducing, they also affect other properties of concrete to a certain limit. BS FUTURA PCX 107 a Sodium Naphthalene Formaldehyde, Melamine or Lignosulphate based technology super-plasticiser as per EN 206-1 is added to the concrete mixture to expand its functionality. It is immensely appropriate to check the impact of these admixtures when blended with concrete mixture to get positive outcomes.**

This study was performed to quantify the advantages of the above super-plasticiser on the characteristic strength and the standard deviation of the concrete strength for the Mix designed proportion with a slump of 25-50mm. The study was performed on 40 of cubes out of which 20 were formed with super-plasticizer and 20 were formed without super-plasticizer. After 28 days, hardened concrete cubes were tested on Compression testing machine (CTM) and then the cube-strength were analysed. The analysis confirms that the effect of super-plasticizer was as desired.

***Keywords*— Superplasticizer, Concrete, Characteristic Strength, Mix-Design and Frequency Distribution.**

I. INTRODUCTION

Nowadays the super-plasticizers are used in most of the concreting work for the enhancement of the properties of the fresh concrete mix as well as hardened concrete mix. It is a challenge for an engineer to use a suitable admixture or super-plasticizer to enhance the properties of concrete. These challenges in today's time are defeated by judiciously adding admixtures such as plasticizer and super plasticizers in concrete. This unanticipated increment sought after of concrete has come up by numerous drawbacks and disadvantages in concreting. Plasticizer / super - plasticizers give high performance concrete with low water cement ratio. Various brands of admixtures are accessible in the market, despite the fact that these admixtures conform to the codal arrangements it is critical to check the impact of these admixtures when blended with concrete.

The selected superplasticizer BS Futura PCX 107 was proposed to be used along with Ultratech PPC cement for this study. Its effect was desired for the quality construction work. This study was performed to check the quality of the concrete made up of the locally available 20mm coarse aggregate (Well graded) and Sand (Zone II) as per IS383-1970 along with above mentioned cement and superplasticizer.

II. EFFECTS ON FRESH MIXED CONCRETE

The materials used in this experiment were cement, aggregates, super - plasticizer (BS FUTURA PCX 107) and water. The mix design performed for the given slump of 25-50mm was as following:

TABLE NO: I
MIX PROPORTION WITHOUT SUPERPLASTICISER BY WEIGHT

Cement	Fine Aggregate	Coarse Aggregate	Water	w/c ratio
380 kg	704.8 kg	1159 kg	186 kg	0.49
1	1.85	3.05	0.49	0.49

TABLE NO: II
MIX PROPORTION WITH SUPERPLASTICISER BY WEIGHT

Cement	Fine Aggregate	Coarse Aggregate	Water	w/c ratio	Superplasticizer content
380 kg	817.8 kg	1041 kg	146 kg	0.36	0.5%
1	2.15	2.74	0.36	0.36	0.5%

The above mix ratio was used for the test to make two sets of 20 cubes each. The first major advantage of the superplasticizer was on the Slump of the two sets of concrete mix prepared. In first case slump was only 28mm when no superplasticizer was used. while in the second case the slump was observed to be 43mm. It was also observed that the uniformity of mix was easily observed in the set with superplasticizer. Similarly, during pouring and compacting the concrete in the mould of size 150mm*150mm*150mm, it was observed that the concrete mix with superplasticizer was provided a smooth surface on the top without any segregation, while it was hard to have a smooth surface in the concrete mix without superplasticizer due to stiff mixing of the ingredients.

TABLE NO: III
LIST OF RESPECTIVE CUBE CRUSHING STRENGTH FOR THE SET OF CONCRETE WITHOUT SUPERPLASTICIZER

Cube No.	Peak Load (kN)	True Area (mm^2)	Reduction* (mm^2)	Net Area (mm^2)	Strength (N/mm^2)	Round Off (N/mm^2)	Frequency
1M25NS	602.7	22500	0	22500	26.79	27	4
2M25NS	497	22500	200	22300	22.29	22	1
3M25NS	609.5	22500	0	22500	27.09	27	4
4M25NS	556.7	22500	0	22500	24.74	25	6
5M25NS	596.4	22500	0	22500	26.51	27	4
6M25NS	545.6	22500	0	22500	24.25	24	1
7M25NS	578.9	22500	352	22148	26.14	26	6
8M25NS	575	22500	0	22500	25.56	26	6
9M25NS	560.1	22500	0	22500	24.89	25	6
10M25NS	581.7	22500	196	22304	26.08	26	6
11M25NS	589.5	22500	0	22500	26.20	26	6
12M25NS	576.1	22500	138	22362	25.76	26	6
13M25NS	591.3	22500	0	22500	26.28	26	6
14M25NS	607.5	22500	0	22500	27.00	27	4
15M25NS	570.2	22500	0	22500	25.34	25	6
16M25NS	553.2	22500	0	22500	24.59	25	6
17M25NS	649.7	22500	0	22500	28.88	29	1
18M25NS	559.4	22500	0	22500	24.86	25	6
19M25NS	623.1	22500	0	22500	27.69	28	1
20M25NS	562.3	22500	300	22200	25.33	25	6

(*The area due to broken corners)

TABLE NO: IV
LIST OF RESPECTIVE CUBE CRUSHING STRENGTH FOR THE SET OF CONCRETE WITH SUPERPLASTICIZER

Cube No.	Peak Load (kN)	True Area (mm^2)	Reduction* (mm^2)	Net Area (mm^2)	Strength (N/mm^2)	Round Off (N/mm^2)	Frequency
101M25WS	589.5	22500	0	22500	26.20	26	14
102M25WS	634.4	22500	0	22500	28.20	28	1
103M25WS	591.3	22500	0	22500	26.28	26	14
104M25WS	577.8	22500	0	22500	25.68	26	14
105M25WS	581.9	22500	0	22500	25.86	26	14
106M25WS	583.9	22500	0	22500	25.95	26	14
107M25WS	599.9	22500	0	22500	26.66	27	2
108M25WS	567.9	22500	0	22500	25.24	25	2
109 M25WS	586.4	22500	0	22500	26.06	26	14
110M25WS	578.3	22500	138	22362	25.86	26	14
111M25WS	591.7	22500	0	22500	26.30	26	14
112M25WS	587.1	22500	0	22500	26.09	26	14

113M25WS	585.5	22500	0	22500	26.02	26	14
114M25WS	592.1	22500	0	22500	26.32	26	14
115M25WS	593.4	22500	0	22500	26.37	26	14
116M25WS	560.8	22500	0	22500	24.92	25	2
117M25WS	605.3	22500	0	22500	26.90	27	2
118M25WS	548.8	22500	0	22500	24.39	24	1
119M25WS	583.9	22500	0	22500	25.95	26	14
120M25WS	581.7	22500	0	22500	25.85	26	14

(*The area due to broken corners)

III. EFFECTS ON HARDENED CONCRETE

After 28 days the cubes were taken for the crushing test on compression testing machine. The two sets of 20 numbers of cubes were crushed separately and the crushing strength of each set is tabularised in Table III for concrete mix without superplasticizer and Table IV for concrete mix with superplasticizer. Each cube in both sets were given a number coding for the ease of testing. Further the tables have an additional column in which the strength was mathematically rounded off to zero decimal places for the construct the frequency distribution curve.

In the calculation of the net area of the cubes which resisted the crushing load, the reduction due to broken corners of the cubes were considered. The area of mould was considered as **true area** and the broken corners were measured and reduction was done to get the true compressive strength of the concrete. The results of Compression test of the concrete cubes are tabularised in table no. III and IV.

It was also observed that lesser voids were present in the cube set with superplasticizer as compared to that of without superplasticizer, which represent that better compaction was possible in the concrete when the superplasticizer was used in the concrete.

IV. FREQUENCY DISTRIBUTION CURVES OF CONCRETE

For the compressive strength of the concrete mix of the two set as given in Table III and Table IV, the frequency distribution curve was plotted to compare the variation of the magnitude of the compressive strength of the concrete. For this the frequency of the round-off value of the compressive strength of the cubes as calculated in the last column was used.

To plot the curve the excel was used, with the data as given in Table V given below. It was observed that the frequency of single value of compressive strength was highest in case of concrete mix with superplasticizer. While it is also observed that in the case of concrete mix without superplasticizer, the characteristic strength of the concrete cubes as per IS456 may be found as 24 MPa instead of design characteristic strength of 25 MPa, (the characteristic strength is that strength below which not more than 5 percent of the test result is expected to fall). But the Cubes with superplasticizer exactly follow the definition of characteristic strength as per IS456 and can be termed as 26 MPa instead of the design characteristic strength of 25 MPa.

TABLE NO: V
FREQUENCY DISTRIBUTION OF THE VALUE OF COMPRESSIVE STRENGTH OF THE TWO SET OF CUBES

Strength in MPa	**Set of Mix with No Superplasticizer**	**Set of Mix With Superplasticizer**
	No of Cubes	**No of Cubes**
23	1	0
24	1	1
25	6	2
26	6	14
27	4	2
28	1	1
29	1	0

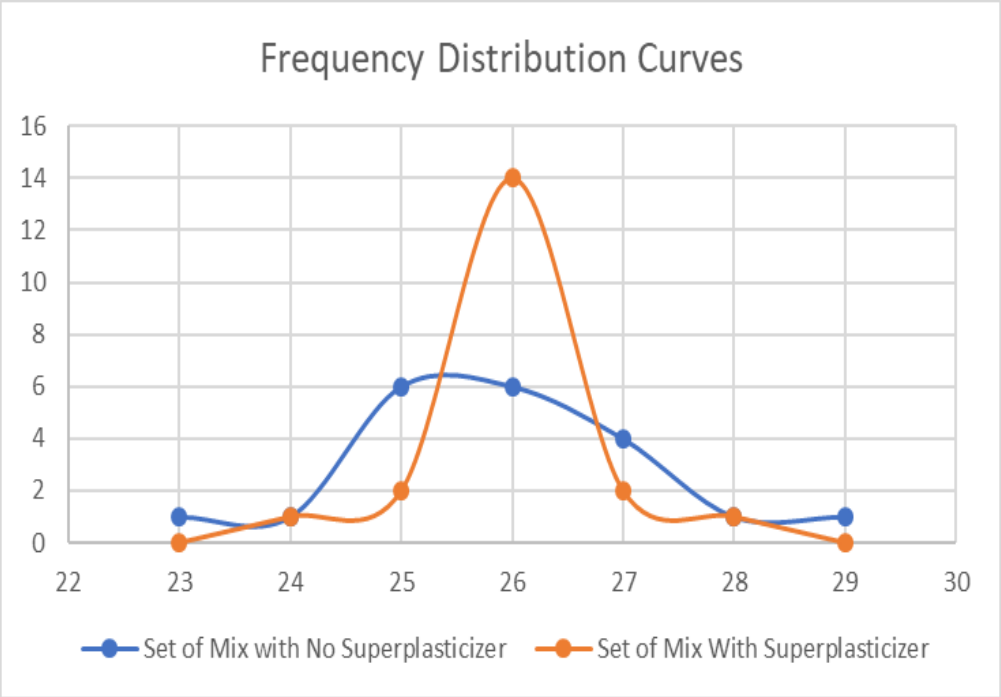

Fig. 1 The Frequency Distribution Curve of the results of the compressive strength of the concrete cube of two set

V. CONCLUSIONS

Following can be concluded from this study that for the grade of M25 concrete made up of Ultratech PPC cement as used in this study along with the superplasticizer BS Futura PCX 107 as per EN 206-1 is advantageous at same slump of range 25-50mm as compared to the concrete made up of Ultratech PPC cement without superplasticizer.

Advantage in fresh mix of concrete:

1. Better Workability can be attained in the fresh concrete.
2. Better mixing of ingredient of the fresh concrete is possible.
3. Considerable reduction in Segregation.

Advantage in hardened concrete:

1. Better finishing can be possible in the concrete.
2. Reduced voids on the surface in contact with mould/shuttering.
3. Uniformity of the strength of the fresh concrete is possible when concreting is done in a mass.
4. Slight enhancement of the strength was also observed.

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