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Experimental Study on Strength of High-Performance Concrete

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Abstract:

High performance concrete nearly always features a high strength than traditional concrete.This paper presents study the effect of performance of HPC using poly-carboxylic ether (PCE base) is introduced as two admixturesandconsiders a best admixture which is used for neighbourhood cement to improve the quality and different properties, that is employed for various tall structures and flyovers which is built now a days. The materials cement of 43 Grade, sand of Zone -II, Coarse aggregates – 10mm, 20mm , Super plasticizers (chemical admixtures) as sulphonated Hydro carbon gas, Oxide fume as mineral admixture were utilized.The HPC mix, grade M50 & M150 grade concrete is designed as per Indian standards and study several preliminary trials were done to check workability and compressive strength. Then average compressive strength for HPC mixes at 7 & 28 days for cluster mixes & cluster pair of mixes have been compared.

Keywords **—High performance concrete, Polycarboxylic ether**

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I. INTRODUCTION

High-performance concrete (HPC) exceeds the properties and constructability of traditional concrete. Traditional and unique materials will not be used to construct these particularly designed concretes that must meet a variety of performance requirements. Special combining, placing, and solidifying practices is also required to supply and handle superior concrete. in depth performance tests ar typically needed to demonstrate compliance with specific project desires. superior concrete has been primarily utilized in tunnels, bridges, and tall buildings for its strength, durability, and high modulus of snap. it's conjointly been utilized in concrete repair, poles, parking garages, and agricultural applications. Characteristics of high-performance concrete are developed for specific uses and situations; some of the attributes that may be required includes:

- High strength
- High early strength
- High modulus of snap
- High abrasion resistance
- High sturdiness and long life in severe environments
- Low porousness and diffusion
- Resistance to chemical attack
- High resistance to frost and warmer scaling harm
- Toughness and impact resistance
- Volume stability
- Ease of placement
- Compaction while not segregation
- Inhibition of microorganism and mildew growth

High Performance concrete works intent on be economical, although it's initial price is beyond that of typical concrete as a result of the employment of

High Performance concrete in construction enhances the service lifetime of the structure and also the structure suffers less harm which might cut back overall prices.

II. LITERATURE REVIEW

The present pattern of utilization of superlatives in solid innovation may strike as to some degree perturbing to numerous. We had high quality cement, hyper plasticizer, and super plasticizers, extremely receptive Pozzolana, and now ultra-elite cement. It is hard to envision any solid being made and utilized, which is definitely not expected to perform to the degree; ultra-elite cement is not another material of development. It is hard to envision any solid being production and utilized, which is not expected to perform. The main contrast is the level of execution, which is higher than customary. Routine Portland bond cement is discovered insufficient in regard of:

- Durability in extreme environs (Shorter administration life and require upkeep)
- Time of development (longer discharge time of structures and slower pick up of quality)
- Energy retention limit (for seismic tremor safe structures)
- Repair and retrofitting occupations

A. American state expertise with HPC

Texas has used HPC on 2 completely different bridges. They're the Louetta Road bridge in Houston and also the U.S. sixty seven Bridge in town. the chief director of the American state Department of Transportation (TxDOT), Wes Heald, says there have been many factors in victimisation HPC within the style. Two main factors were internal control and quality assurance (QC/QA). Another issue he states is cooperation between the DOT and universities, contractors, fabricators, and researchers. cooperation is significant to form certain every cluster is doing their job properly and also the HPC meets specifications. Heald conjointly states that HPC is additional sturdy than typical concrete. sturdy and water-repellent bridge decks shouldn't harm from scaling, freeze-thaw action, shrinkagecracking, or reinforcement deterioration. This resistance to wreck is predicted to extend the lifetime of the bridge and cut back rehabilitation and maintenance prices over the life time of the bridge

B. New Hampshire expertise with HPC

New Hampshire's 1st HPC structure is Route 104 stretching over the new watercourse. This bridge is found in city, NH. the target of victimisation HPC in a very bridge structure was to reduce maintenance and to prolong the life-span of the bridge. To accomplish their objective, they needed to style a upper deck that was extremely water-repellent, freeze-thaw resistant, and freed from cracks. To check their style, a shot pour of five yd3 was placed to simulate the particular pour. Traditional finishing and solidifying strategies were used. This trial pour conjointly helped in determinative the workability of the particular combine, and created certain correct instrumentation was being employed. This project was terribly successful and LED to the development of a upper deck with no shrinkage or cross cracking

III. METHODOLOGY

The main objective of this investigation is to develop a combination style procedure, for HPC by varied the proportion of oxide fume (0 to 25%) at constant indefinite quantity of super plasticizers and different ingredients, literature offered on HPC and ACI code strategies. Experiments were done out on HPC victimisation on top of procedure for M60 concrete to get smart workability and bring home the bacon mechanical properties of the combo style and to seek out the optimum proportion of oxide Fume. Hence the current investigation additional stress is given to check strength characteristics of HPC victimisation mineral and chemical admixtures like oxide fume and Super softener, for achieving the higher composite and conjointly to extend use of oxide fume to keep up ecology and conjointly encourage the employment of oxide fume.

A. Choice of Materials

The following three reticular steps are required for the assembly of High-Performance Concrete:

- Selection of appropriate ingredients for concrete having the specified physical science properties, strength etc
- Determination of relative quantities of the ingredients so as to supply sturdiness.
- Careful internal control of each section of the concrete creating method.

*1) **Cement:*** Physical and chemical characteristics of cement play an important role in developing strength and dominant physical science of contemporary concrete.

TABLE I
PROPERTIES OF CEMENT

Property	**Result**
Normal Consistency	32%
Setting Time Initial Final	 105 min 375 min
Specific Gravity	3.14
Fineness of cement (By 90 micron sieve)	2% retained
Compressive Strength	36 N/mm^2 58 N/mm^2

2) ***Fine Combination:***Coarser sand is also most well liked as finer sand as it will increase the water demand of concrete.

TABLE 2
PROPERTIES OF FINE COMBINATION

Sieve Size	**Weight retained in Sieve (grams)**	**% Retained**	**Cumulative %retained**	**% passing**
10mm	-	-	-	100
4.75mm	55	5.5	5.5	94.50
2.36mm	90	9.0	14.5	85.50
1.18mm	143	14.3	28.8	71.2
600 microns	204	20.4	49.2	50.80
300 microns	312	31.2	80.4	19.60
150 microns	178	17.8	98.2	1.80
Pan	18	1.8	100	0

3) ***Coarse Combination:***The coarse combination is that the strongest and least porous part of concrete. Coarse combination in cement concrete contributes to the heterogeneousness of the cement concrete and there's weak interface between cement matrix and combination surface in cement concrete.

TABLE 3
PROPERTIES OF COARSE COMBINATION

Coarse Aggregate	Specific gravity	Bulk Density (kg/m^3)	Water absorption (%)
4.75mm	55	5.5	0.52

*4) **Water:***Water is a crucial ingredient of concrete because it actively participates within the chemical reactions with cement.

*5) **Chemical Admixtures:***Plasticizers and super plasticizers facilitate to disperse the cement particles within the combine and promote quality of the concrete combine. Retarders facilitate in reduction of initial rate of association of cement, so contemporary concrete retains its workability for a extended time.

6) ***Mineral Admixtures:***Mineral admixtures like ash and oxide fume act as puzzolonic materials in addition as fine fillers, thereby the microstructure of the hardened cement matrix becomes denser and stronger. the employment of oxide fume fills the area between cement particles and between combination and cement particles.The ash (FA), the bottom coarse furnace scoria (GGBS) and also the oxide fume (SF) has been used wide as supplementary cementations materials in high performance concrete. These mineral admixtures, generally ash and oxide fume (also known as condensed oxide or small silica), cut back the porousness of concrete to greenhouse emission (CO2) and chloride-ion penetration while not a lot of modification within the total body.

IV. EXPERIMENTAL STUDY

A. Materials Used

Ordinary cement of forty three grade, confirming to IS 8112:1989, and domestically offered watercourse sand as fine combination (zone-II) confirming to IS-383-1970 and coarse aggregates (10 millimetre thirty first, and 20mm sixty nine by weight) were utilized in the current investigation. The properties of fine combination and coarse combination are bestowed in Table one and a couple of severally. Properties of cement are shown in Table. Super plasticizer (Chemical admixture) suphonated hydrocarbon gas CONPLAST SP 430 confirming to BIS 9103-1999 is employed as possible agent. oxide fume (Mineral admixture) get from ELKEM INDIA(P) LTD, Confirming to ASTMC-1240 in densified type is employed.

B. Combines Proportions of HPC

The trial combine proportions of the concrete are shown in Table.

TABLE III
MIX PROPORTIONS OF CONCRETE (KG/m^3)

Nomenclature	w/b	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)	water (Kg)	Super plasticizers (Kg)	Silica fume (Kg)
HPC1	0.29	511	773	1044	143	5.11	0
HPC2	0.29	486	773	1044	143	5.11	25.55
HPC3	0.29	461	773	1044	143	5.11	51.10
HPC4	0.29	436	773	1044	143	5.11	76.65
HPC5	0.29	411	773	1044	143	5.11	102.20
HPC6	0.29	386	773	1044	143	5.11	127.75

C. Specimen Preparation

In this project about 6 mix design concrete specimens were prepared with oxide fume replacement of 0%, 5%, 10%, 15%, 20% & 25% with cement at a 0.29% w/b magnitude relation. For all these mixes (cement + oxide fume) cementitious matrix to coarse combination and fine combination was maintained with the magnitude relation of 1:1.40:1.89. The slumps that are formed are measured are as shown in the below table 3.5 and it is observed that the slum values are decreasing as the oxide fume will increase.

TABLE 4
SLUMP VALUES FOR 6 SPECIMENS

S.no	Replacement Level	Slump
1	0	96
2	5	84
3	10	75
4	15	69
5	20	65
6	25	57

These 6 specimens i.e., cubes of (size 150X150X150mm) & cylinders of (size 150X300mm) were casted & cured for 7 and 28 days. After 7 and 28 days these cubes were tested for compressive strength & cylinders for compressive strength. The results are as shown in the below tables.

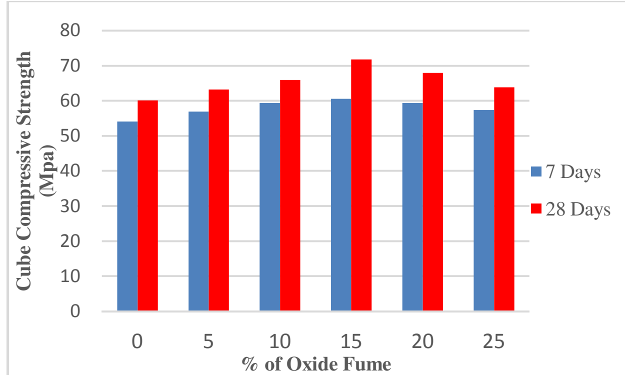

Fig. 1Cube Compressive Strength for 7 & 28 days

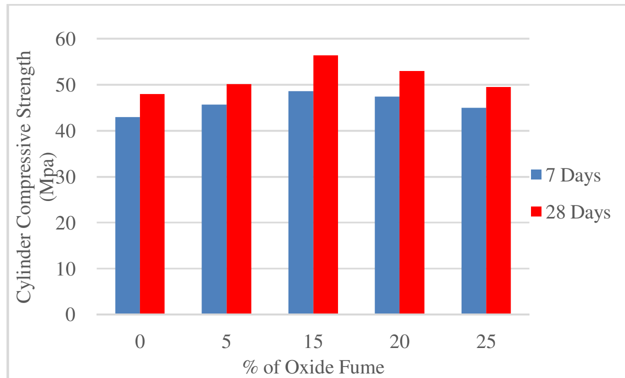

Fig. 2 Cylinder Compressive Strength for 7 & 28 days

V. RESULTS AND DISCUSSION

Mix design for M50 grade concrete and M150 grade concrete.

TABLE 5
MIX DESIGN FOR M50 GRADE CONCRETE

Material	SSD Mix for $1m^3$	Moisture	Absorption	Corrected Mix	For $0.025m^3$
W/c	0.35	-	-	-	-
Cement	515	-	-	820	12.88
River Sand	420	3 %	2.93 %	425	10.34
CrushSand	420	1.80 %	3.25%	416	10.38
10 mm Aggregate	468	0.35 %	1.81 %	456	11.65
20 mm Aggregate	596	0.45 %	1.65 %	555	14.57

Water	170	-	-	180	4.51
Admixture (2 %)	4.30	-	-	4.25	0.3

TABLE 6
MIX DESIGN FOR M150 GRADE CONCRETE

Material	SSD mix for 1m3	Moisture	Absorption	Corrected Mix	For 0.025 m^3
W/C	0.15	-	-	-	-
Cement	812	-	-	812	22.54
Micro Silica	92	-	-	95	2.42
Fly ash	166	-	-	166	4.3
GGBS	164	-	-	168	4.3
River Sand	1168	2%	3%	1154.8	27.24
Water	178	-	-	196.2	4.45
Admixture	13	-	-	13	0.40

A. *Results of Compressive Strength*

The average compressive strength results were found for all the eight HPC mixes for 7 and 28 days, which are shown in the below tables. The compressive strength values are compared for different mix designs i.e., 1F1 consists of 25% Fly ash, 1S1 consists of 35% slag & 1F2 consists of 20% ash,5% oxide fume& 1S2 consists of 30% slag and 5% oxide fume. In the same way 2F1 consists of 20% Fly ash, 2S1 consists of 30% slag & 1F2 consists of 15% ash,5% oxide fume& 1S2 consists of 25% slag and 5% oxide fume. Therefore 1F1, 1S1, 2F1& 2S1 are one component mix & 1F2, 1S2, 2F2 & 2S2 are combination of mixes

TABLE 7
COMPRESSIVE STRENGTH RESULTS FOR HPC MIXES AT 7 AND 28 DAYS

Mix Design	7 Days Compressive Strength (Mpa)	28 Days Compressive Strength (Mpa)
1F1	38	44.9
1F2	35	50.33
1S1	42.73	51.76
1S2	45.32	54.64
2F1	36.3	43.08
2F2	37.86	45.58
2S1	40.67	44.73
2S2	42.32	48.02

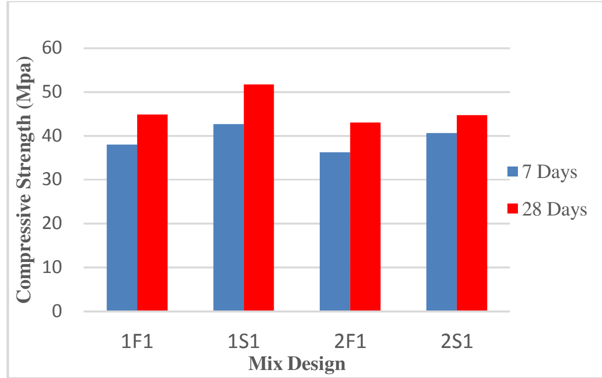

Fig. 3 Compressive Strength for 7 and 28 days cluster one mixes

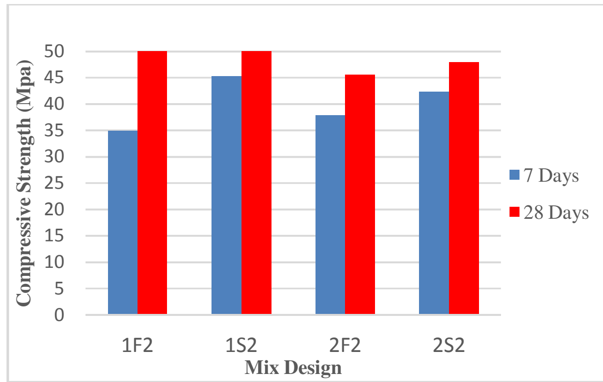

Fig. 3 Compressive Strength for 7 and 28 days cluster combination of mixes

VI. CONCLUSIONS

From the experimental study, it can be explained that in the double framework, silica fume builds the super plasticizer request at a consistent workability because of its high surface range and its solid proclivity for multi-layer adsorption of super plasticizer atoms. The Poly-carboxylic Ether (PCE base) additive allows for more efficient use of the large amount of cementing materials in high-quality cement, as well as the use of the least amount of water when creating material proportions. Fly ash diminishes the substance of water request by supplanting bond and furthermore makes the solid more sparing. It also regulates the temperature at which cement hydrates. Dosage of admixture also plays an important role. The use of an admixture, such as a poly-carboxylic based plasticizer, reduces the amount of water used in cement while also making the solid workable. The proportion of ether bonds will decrease when the measures are increased, which will help to improve quality.

REFERENCES

[1] Yangtez Liang Ping-Kun (2004), "An approach to optimize combine style for properties of High Performance Concrete",Cement and Concrete analysis, Vol.34 pp. 623-629.
[2] S.P Gautam, Vikas srivastava and V.C Agarwal, "use of glass wastes as in fine aggregate in concrete", journal of artificial intelligence research vol. 1(6) November (2012).
[3] Dr. T.V.S. Vara Lakshmi, Prof. S. Adiseshu (05 February 2016), "A Study on Preparing Of High Performance Concrete Using Silica Fume and Fly Ash".
[4] Bakharev T. , Sanjayan J.G. ,Cheng Y.B.,(1999), "Effect of Elevated Temperature Curing on Properties of Alkali-Activated Slag Concrete",Cement and Concrete Research,Vol. 30,pp.1791- 1799.
[5] Fehling, E.; Schmidt, M.; Walraven, T.; Leutbecher, T.; Frohlich, S. Ultra High Performance Concrete UHPC Fundamentals, Design, Examples. First Edition, 2014, 188 p.
[6] M.IqbalMalik,Sajad Ahmad "study of concrete involving use of waste glass as partial replacement of fine Aggregate",IOSR journal of engineering VOI.3,Issue 7 July(2013).
[7] A text book on "Concrete technology" By M. S. Shetty.
[8] IS 2386 – Methods of testing Aggregates reprinted in 1997.
[9] IS 516-1959: standard methods for testing strength of concrete.
[10] IS 3812 Specification of Fly ash for use as pozzolona and admixture in Portland cement in concrete.
[11] IS 383 1970 – Indian Standard specification for Coarse and fine aggregates.
[12] IS 12269-1987 standard specification for ordinary Portland cement of 53 grade.