UTILIZING METAKAOLIN, SLAG, AND SILICA FUME IN THIS STUDY OF HIGH PERFORMANCE CONCRETE ON M80 GRADE CONCRETE

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ABSTRACT

extreme performance Concrete is defined as concrete that satisfies special performance and uniformity standards that cannot be met by normal fabric, common mix, put, and cure procedures. A novel composite material has been advanced and taken a step ahead in this examination, which includes a brief assessment of its strength and durability on concrete results of the M80 grade. We create binders.

Power, long-term durability, and serviceability are crucial regulating criteria for HPC (High Performance Concrete). According to Indian General Code IS, 60Mpa is the compressive electrical concrete pressure of 456-2000. Grades M80 and M90, among others, are regarded as High Performance Concrete (HPC). In this paper mineral admixtures specifically Fly Ash, Silica Fume, Slag& Metakaolin contributed through diverse reputed industries are used. In this challenge paintings, a brief evaluateoffered on "a study of high performance concrete by using admixture like metakaolin,slag,silica fume on m80 grade concrete ". i actually have extensively utilized brilliant plasticizer namely varaplast sp125 manufactured by "akarsh specialties in chennai". I used these super plasticizers in order to achieve lower water- cement ratio and to achieve good workability when we go for High Strength Concrete such as M80. I have compared the combinations of various percentages of admixtures in M80. I presented the combination represented these results in the form of BAR CHARTS and GRAPHS.

The strength tests include compressive, split tube tensile and flexural tests for cubes, cylinders and beams. And durability tests include Acid-Alkali attack tests and Rapid permeability chloride tests were conducted and the test results were presented in graphs and bar charts.

INTRODUCTION

Concrete is a robust and long-lasting substance. Concrete with reinforcement is the most often utilized building material worldwide. The term "High Performance Concrete" refers to concrete that has undergone extensive testing and research to increase its workability, strength, and durability while also providing exceptional performance. Beyond the conventional mix concrete and creation tactics, quite a variety of substances are being combined to create goods.

HISTORICAL BACKGROUND

However the concrete of high strength is consider forinnovative material which is developing in USA, having the compressive strength 34MPa. 62mpa concrete was being developed in

1970's. the reactive concrete is also having the compressive strength of 250mpa. It is completely based on pozzolanic materials.

HIGH PERFORMANCE CONCRETE

High Performance Concrete (HPC) is to give performance characteristics for set of materials used and exposure conditions depending on the requirement of cost, life period and durability.The factor for durability of concrete is >80. As Henry G. Russell, who is Consulting engineer and previous chairman of the American Concrete Institute's high overall performance concrete committee, "All excessive- electricity concrete is high overall performance concrete, however now not all excessive performance concrete is high-strength concrete" High Performance Concrete (HPC) is a product which includes materials with distinctive special residences compared

to the traditional concrete and production methods.

NEED OF HIGH PERFORMANCE CONCRETE

- To reduce the column sizes and increasing available space byconstructing of high-rise buildings
- To construct long-term bridges and to increases the durabilityof bridge decks.
- For satisfying the needs of applications like durability,modules of elasticity, flexural strength.

MATERIAL PROPERTIES OF HIGH PERFORMANCECONCRETE MIX

Optimum concrete mix is obtained by selecting the locallyavailable material.

The basic concepts needs for High-performance concrete are: Aggregates- These are durable and strong. Generally small sizecoarse aggregates are used for higher strength concrete. Thesand should be of Coarser than that authorized with the aid ofASTM DC 33(fitness modulus greater that 3.2

Admixtures- Obtaining Finish potential with mixes containing silica fume often calls for splendid plasticizers. Typically, excessive-range water-reducing admixtures (HRWRA) are used. Concrete for bridge decks commonly encompass water- lowering admixtures (WRA).

Cementitious Materials- HPC nowadays employs blendedcements that encompass silica fume, fly ash, and floor granulated blast-furnace slag (GGBF slag or slag cement). These cementitious materials can exceed 25% of the whole cement by using weight. Typical HPC today can encompass 5% to fifteen% silica fume, 50% to sixty five% slag cement (as an awful lot as 80% in mass concrete), and as much as 50% fly ash. Silica fume contributes to power and durability; fly ash and slag cement bring about better finish potential, reduced permeability, and extended resistance to chemical attack. According to Jan R. Prusinski of the slag Cement Association, “HPC mixtures are frequently proportioned to gain lowpermeability. Lower concrete permeability gives corrosion resistance for boosting steel by means of decreasing the fee of chloride ion migration into the concrete”. More importantly for the contractor, Prusinski adds, “ Slag cement improves the workability, region capability and consolidation of concrete, ensuing in better completing”. W/C ratios range from zero.23 to zero.35. These low w/c ratios are handiest plausible with pretty

big dosage of excessive variety water decreasing admixtures (or terrific plasticizers) The cementitious materials content may be commonly round 415kg/m3 but now not greater than about 650 kg/

DISADVANTAGES OF HIGH PERFORMANCECONCRETE

The use of excessive strength concrete ends in a reduction within the pass segment and hence can bring about an growth in severity of the problems consisting of Decrease in stiffness; an evaluation of the fee of boom of the modulus of elasticity of the concrete,with the energy of the concrete shows that this charge is drastically decrease than one.

Thus, using excessive energy concrete will lead to members with quite more slenderness and smaller stiffness. This will call for greater cautious to attention to the “balance problems” (Bulking of person individuals or stability of the structure asan entire). Problems created by means of volumetric changes (Shrinkage and creep) require protection, especially forcolumns of tall narrow homes that could go through speedy and high intensity fluctuations in axial forces, as in the case of server abnormal loadings.

In this case the concrete can undergo significant cracking even if the whole members is not under a net tension. This cracking can significantly decrease the shear resistance of such columns. Problems created by the face that the bond strength does not increase at the same rate as that of the compression strength of the concrete.

This can lead to serious problems, particularly at the beam- column joints, when Using high strength concrete is followed by using excessive energy steel.

APPLICATION OF HIGH PERFORMANCECONCRETE

Some specific applications of high Performance concrete in various situations have been discussed below.

BUILDINGS

The maximum not unusual utility of high strength concrete isin multi storied homes.

For concrete homes of regular low strength concrete, the potential number of storeys is restricted through the huge columns and shear partitions. The variety of storeys is limited with the aid of the big columns and shear partitions. The variety of storey can Be improved by means of using excessive electricity concrete inside the production of these columnsAnd shear partitions.

The maximum low in cost columns and shear walls are the ones with the smallest pass sectional areas and the minimal percent of metal. Thus, using high power concrete, collectively with high yield strength metallic, appears to be very attractive for the economical factor of view. The maximum within your means columns and shear walls are those with the smallest move sectional regions and the minimal percent of metal.

Thus, the usage of high strength concrete, collectively with high yield power steel, appears to be very attractive for the low-priced factor of view. Since d 1972, extra than 20 homes in Chicago were built with columns having design compressive strength of sixty two Mpa. Other packages were said in Toronto, New York, Houston, Minneapolis and Melbourne, Australia.

LITERATURE REVIEW

Many works have been done to explore the benefits of using pozzolanic materials in making and enhancing the properties of concrete.

1) M.H.Shehata and M.D.A. Thomas, studied the ternary cementitious blends of fly ash, silica fume and Portland cement, offers the important benefits over binary blends or even more will increase over undeniable Portland cement.

2) Sandor Popovics and Jan Bijen studied the structures ofPortland cement-fly ash – silica fume in concrete and concluded numerous beneficial effects to addition of silica fume to the fly ash cement mortar within the form of power, workability and ultra sonic velocity take a look at results.

3) C.S. Poon and L. Lam, Y.L. Wong, of their studied entitled Effect of silica fume and fly ash on fracture behaviors and compressive of concrete had concluded that boom in power residences of concrete via adding distinct percentages of silica fume and fly ash.

4) TahirGonen and SalihYazicioglu studied the affect of binary and ternary combo of mineral admixtures on lengthy and quick term performances of concrete and concluded that many advanced concrete homes in fresh and hardened states.

5) Tommy Nantung and Mateusz Radlinski, Jan Olek in their experimental paintings entitled the Effect of mixture composition and initial curing conditions at the scaling resistance of ternary concrete have finding the impact of different proportions of components of ternary blend of binder mix on scaling resistance of concrete in low temperatures.

6) M.I. Russeli, P.A.M. Basheer S.A. Barbhuiya, J.K. Gbagbo, studied the properties of fly ash concrete modified with silica fume and hydrated lime concluded that addition of lime and silica fume which improves the early days compressive power and long term energy development and durability of concrete.

7) Silvio Delvasto, Erich Rodriguez Susan Bernal, Ruby De Gutierrez, carried the Research paintings in Performance of an alkali-activated slag concrete that are bolstered with the metal fibers. The conclusion is advanced AASC gift better compressive strengths over OPC reference concretes. Splitting tensile strengths boom in both OPCC and the AASC concretes with the incorporation of fibers at 28 curing days.

8) Faisal Shalabi, Ibrahim Asi, HishamQasrawi carried the Research work the usage of of low CaO unprocessed steel slag in concrete as first-rate mixture. The conclusion is regarding the compressive and tensile strengths of concrete metallic slag are extra fine for concretes of low strengths.

9) S. Kenai, E.H.Kadri, F. Rouis, O.Boukendakdji, carried Research paintings in Effect of slag on rheology of sparkling self-compacted concrete. The conclusion is slag can produce topself-compacting concrete.

10) Qunshan Ye, Yongchun Chen Shaopeng Wu, YongjieXue carried Research work in Utilization of metallic slag as aggregates for stone mastic asphalt (SMA)combos. The end is check roads are show outstanding

performances after 2- yearsservice with abrasion and friction coefficient of 55BPN and surface texture intensity of 0.Eight mm.

PURPOSE

In this paper i planned to conduct the lab investigation using mineral and chemical admixtures in different proportions, grade of concrete is,

M80

The tests were conducted for the concrete are as follows:

- Compressive strength
- Type of cracking
- Durability

TEST PROGRAM

The cubes are having the dimensions 150mm x 150mm x150mm of standard sizes. These are constant for all the specimens. The Cubes are tested in compression testing machine which is having maximum capacity of 400 tons.

MATERIALS USED IN PRESENT PROJECT ANDTHEIR PROPERTIES

In the present investigation the following materials were used:

Zuari-53 grade cement conforming to IS: 12269 – 1987.

Fine aggregate and coarse aggregate conforming to IS: 383 -1970.

Admixtures.

CEMENT

Cement is binding material which is the combination of raw materials called calcareous and argillaceous materials. Zuari- 53 grade ordinary Portland cement conforming to IS: 12269 were used in concrete

AGGREGATES

For coarse aggregate, crushed granite rock of 20mm maximumsize was used. For fine aggregate Natural sand fromSwarnamukhi River in Srikalahasti was used. The individualaggregates are blend to obtain the desired combined grading **ADMIXTURES**

Introduction:-

The addition of chemical compounds to concrete on the stageof mixing for change of the houses of the combination is calledadmixtures. Admixtures are chemical substances which mightbe introduced to concrete at the mixing degree to adjust anumber of the houses of the combination. Admixtures should never be appeared alternatively for desirable mix layout,precise workmanship, or use of proper materials.

FLY ASH

The combustion of coal by using flue gases, results thecollection of electrostatic precipitator. The most widely usedmineral admixture is fly ash over the world. Extensive researchhas given the benefits that can be achieved by utilization of flyash. At present all over the world high volume of fly ashconcrete is very much preferred. The generation of quality offly ash from various plants to more extent & not to be use. Fly ash is the most widely used mineral admixture all over theworld. The quality of fly ash generated from different plantsvary from one another to a large extent and hence they are notready to be used in concrete further processing is necessarilydone.

SILICA FUME

Silica fume, also referred as micro silica or condensed silica flume, is some other cloth that is used as synthetic mineral admixtures Silica fume as an admixture has opened a new development in concrete era. The utilization of incredible plasticizer with silicafume has been the spine of present day

high performance concrete. It should be noted that silica fume by itself,doesn't contribute to strength. However it produces theproperty of strength being fine pozzolanic material.

MIX DESIGN

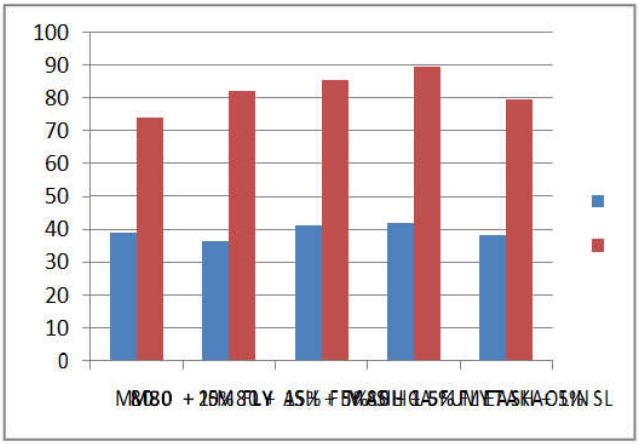
MIX DESIGN FOR PRESENT INVESTIGATION.

In the present work the Indian, Standard Method (Is METHOD) has been used to get propositions for high strength concrete. The concrete mix design for M80 and M90 were carried out according to Indian standard recommendation method is 10262-2009.

TEST RESULTS AND DISUSSIONS

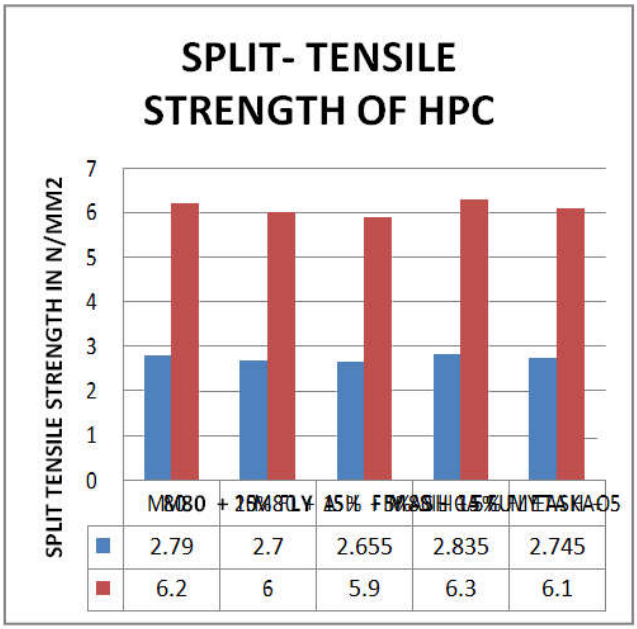
COMPRESSIVE STRENGTH FOR 7 DAYS AND 28DAYS

S.No	rade of concrete	Compressive strength Of 7 days(Mpa)	Compressive Strengthof 28 days (Mpa)
1.	M_{80}	39.00	74.00
2.	M_{80}+FLYASH 20%	36.40	82.00
3.	M_{80}+FLYASH 15%+SILICA FUME 5%	41.00	85.30
4.	FLYASH15%+META KAOLIN 5%	42.00	89.30
5.	M80+FLY ASH 15%+SLAG 5%	38.2	79.6



TENSILE TESTS FOR 7 DAYS AND 28 DAYS

S.No	rade of concrete	Split- tensile strengthOf 7 days (Mpa)	Split- tensile Strengthof 28 days (Mpa)
1.	M_{80}	2.79	6.2
2.	M_{80}+FLYASH 20%	2.7	6.0
3.	M_{80}+FLYASH 15%+SILICA FUME 5%	2.655	5.9
4.	M_{80}+FLYASH 15%+METAKAOLIN5 %	2.835	6.3
5.	M80+FLY ASH 15%+SLAG 5%	2.745	6.1

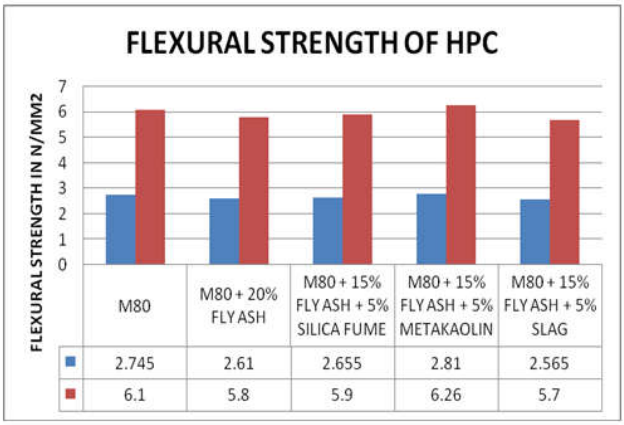


FLEXURAL STRENGTH TEST

Prismatic specimens 100×100×500 mm were tested according to IS: 516(1959). The results for flexural strength of prisms for 7days and 28days are given in table. A primary problem in designing concrete for use in highway programs is the flexural strength of concrete.

Its expertise is useful within the layout of pavement slabs and airfield runway as flexural tension is critacle in these instances.The flexural electricity or the modulus of rupture of concrete isan indierect degree of the tensile energy. The value of modulusof rupture depends upon the scale of the beam and exceptionally at the association of loading.

S.No	Grade of concrete	Flexuralstrength Of 7 days (Mpa)	Flexuralstrengthof 28 days (Mpa)
1.	M_{80}	2.745	6.1
2.	M_{80}+FLYASH 20%	2.61	5.8
3.	M_{80}+FLYASH 15%+SILICA FUME 5%	2.655	5.9
4.	M_{80}+FLYASH 15%+METAKAOLIN5 %	2.81	6.26
5.	M80+FLY ASH 15%+SLAG 5%	2.565	5.7



CONCLUSIONS

The water to cement ratio in high performance concrete mix designs is kept low. Super plasticizers must be kept in place to preserve the appropriate workability. Super plasticizer percentage rises together with the proportion of mineral admixtures in the mixture to achieve the desired strength. In the case of various combinations The highest compressive strength for M80 grade concrete at 89.3 Mpa is achieved by replacing cement with 15% fly ash and 5% Metakaolin as mineral admixtures. Mineral admixtures including fly ash, micro silica, metkaolin, and slag are also very useful for achieving high power. High overall performance concrete has a wide range of applications in construction, including precast, pre stressed bridges, multi-story buildings, bridges across rocky coastlines, and other constructions. To affect this change, we should revive the designing to systems through encouraging use of high strength concrete. As soon as micro crack seems, surprising failure is found in excessive energy concrete cubes.

FUTURE WORK

This investigation is also carried for different W/C ratios for different mineral and chemical admixtures, also for different concrete grades. Flyash and Metakaoin combinations are proved to be the most effective among all the mineral admixtures as it contributes to achieve very high compressive strength. Silica fume and flyash

combination proves to be the most effective among all the mineral admixtures as it contributes to achieve high durability even in severe exposure condition. It is suggest that the study of permeability of concrete for the estimation of concrete durability may be extended.

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