STUDY ON HIGH PERFROMANCE CONCRETE USING SILICAFUME AND SUPERPLASTICIZER

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Abstract --*This paper presents the study of effect of performance of HPC using mineral admixture i.e.silica fume .with M-70 grade of IS cube specimen .We partially replaced cement by weight of binder with silica fume replacement with percentages of 5% ,7% and 9% . We used Conplast SP430-Sulphonated Naphthalene Polymers as a super plasticizer for better workability for top performance concrete. Dosage for supe r plasticizers is same 1% for all mix proportions. Also, we've investigated compressive strength ,split lastingness and flexural strength for all different cases. The HPC mix, grade M70 concrete is supposed as per Indian standards "Guide for selecting proportions for top strength concrete with Pozzolana Portland cement and other cementitious materials".*
Index Terms— high performance concrete, mineral admixtures, super plasticizers, etc.

I. INTRODUCTION:-

HPC could also be a construction material which is getting utilized in increasing volumes in recent years because of its future performance and better rheological, mechanical and durability properties than CC. HPC possess invariably high strength, reasonable workability and negligible permeability.matchup to CC, preparation of HPC requires lower water binder (w/b) ratio and better cement content. the durability attributes of concrete are given importance, which makes High Strength Concrete (HSC) into HPC. HSC refers to concretes of grade above M60. High strength and better peresistance properties become reality for CC by reducing porosity, in homogeneity, micro cracks in concrete and thus the transition zone. this is often often how HPC is evolved.

The HPC allows the use of reduced sizes of structural member, higher building height in congested areas and early removal of formwork. the use of HPC in prestressed concrete construction makes greater span-depth ratio, early move of prestress and application of service loads. Low permeability qualities of HPC reduce the danger of corrosion of steel and charge of aggressive chemicals. This allows the use of HPC in marine/offshore structures,nuclear power plants, bridges and places of utmost and adverse climate . Eventually HPC reduces maintenance and repair cost.

II . SIGNIFICANCE AND OBJECTIVES

According to nevillie "HPC could also be a concrete to satisfy determined purpose and no special mystery about it, no unusual ingredients or special equipments possesses to used. Butto understand the behavior of concrete and may , to provide a concrete mix within closely controlled tolerances".The aim of this investigation are to develop a clarify mix design procedure, specially for HPC by varying the share replacement of cement by silica fume (0-15%) at a unbroken dosage of super plastisizer, recommended by IS 10262:2019 code method of mix design procedure and available literatures on HPC. Investigations were administered on the above procedure to provide HPC in mixe for M70 grade using 12.5 mm and 20 mm maximum size of aggregates to determine workability and thus the mechanical properties of the designed mixe and to hunt out an optimum cement replacement by SF.Hence within this investigation more emphasis is given to study the HPC using silica fume and superplasticizer so on reach better concrete composite and also to encourage theincreased use of silica fume to require care of ecology.

III. REVIEW OF LITERATURE

Suresh kumar .A (2018): He investigated the likelihood of developing high performance concrete (HPC) by using micro silica with water cement ratio as 0.35.He designed for M70 Grade concrete. When cement is replaced with 10%by silica fume the 28days compressive strength is observed as 61.33mpa. And whereas for split tensile it is15.59% higher & for flexural if it's 22.80% higher.

R.M.Karthikeyan (2017) : within the present study the combination Design for M60 grade concrete and is completed consistent with ACI211.4R. the varied mix proportions of the concrete are done. By replacing cement with 40% & 50% of ash and 10% of Silica fume & metakaolin high strength concrete is obtained. Where as 50% replacement of ash and 10% of silica fume with cement gave better compressive strength that's 64.3Mpa.

Dr.Moslih Amersalih(2018): He investigated to guage the compressive strengths & durability properties of HPC which contains micro silica and ash as partial replacement of OPC. The cubes were casted for M70 grade concrete with the 30% of 21 ash , 7%of micro silica and 25% of ash and micro silica, it's a binary mixture which has shown the great performance in concrete. But it's been reported that the utilization of ash & micro silica because the practical replacement the water absorption has increased. Using of 30kg/m of micro silica and 126kg/m ash has achieved the high compressive strength result, the micro silica with 7%replacement features a tremendous effect to resist the chloride penetration. Use of ash with 30% to twenty which is mixed with 5% of micro silica has shown the low chloride ion permeability.

Jafar shafaghat (2019): during this paper the micro silica is employed by replacing in cement. He used the RPRAC i.e, reactive powder reactive aggregate concrete and hydraulic cement clinker as sand replacement. the combination is meant for M100 grade. Where the compressive strengths has increased to 169.4%&122.9% for28 & 60days where he concluded that the replacement level is optimized to 64%by weight of powder.

A Parvathy Karthika(2018): during this paper She analyzed the performance of concrete with various combinations during which the cement is partially replaced with ash i.e. 30% and Alccofine of grade 1203 with micro fine silica as 0, 4, 8, 12 % respectively. He casted cubes for M60 grade used M Sand as fine aggregate. The result shown that the water absorption and permeability decreases with the increasing Alccofine content. The concrete mix proportion which consists 30% ash and 12% Alccofine is best among all other combinations.

IV. EXPERIMENTAL PROGRAM

Experimental investigations are administered on the HPC specimens to work out the workability and strength related properties like compressive strength, split tensilestrength, flexural strength of the concrete.

A. Materials Used

Silica fume as mineral admixture in dry congeled form obtained from ELKEM INDIA (P) LTD, Mumbai conforming to ASTMC-1240. Super plasticizer (chemical admixture) supportedsulphonated naphthalene formaldehyde condensate- CONPLAST SP 430 compatible to BIS: 9103-1999 and ASTM C-494.

B. Mix Design for HPC

Since there aren't any specific methods for mix design found suitable for HPC, a clarify mix design procedure, is formulated by IS 10262:2019 method for concrete mix design and thus the available literatures on HPC using SF.

1) Calculation of binder contents

The binder or cementitious list per m2 of concrete is calculated from the w/b ratio and thus the number of water content per m3 of concrete. Assuming the share replacement of cement by SF(0-15%), the SF content is obtained from the whole binder contents. The remainingbinder content consists of cement. The cement content so calculated is verified against the minimum cement Experimental Investigation on High Performance Concrete Using Silica Fume and Superplasticizer

2) Moisture adjustments

The actual amounts of CA, FA and water content are calculated after allowing necessary corrections for water absorption and free (surface) dampness content of aggregates.The volume of water included within the liquid plasticizer is calculated and subtracted from the starting mixing water

3) Unit mass of concrete

The mass of concrete per unit content is calculated by adding the masses of the concrete ingredients.

4) Selection of water- binder (w/b) ratio

The water binder ratio for the design average compressive strength is chosen from figure IS10262 – 2019 w/C ratio

5) Trial mix proportion

Because of many assumptions underlying the forgoing conceptual calculations, the trial mix proportions must be checked, if necessary the mixture proportion should be modifiedto meet the required workability and strength criteria, by adjusting the half replacement of cement by SF, % dosage of super plasticizer solid statisfied of binder, air content and unitweight by means of laboratory trial mixes to optimize the mix proportion. Fresh concrete should be tested for workability, unit weight and air content. Specimens of hardened concrete should be tested at the determined age.

6) Mixer Proportions and Casting of Specimens

Mix proportions are arrived for M70 grade of concrete supported the above formulated mix design procedure by replacing 0, 5%, 7% ,and 9% of the mass of cement by SF and thus the fabric requirements perm^3 of concrete . The ingredients for the numerous mixes are weighed and mixing was carried out employing a drum type mixer and casting were exhausted steelmoulds for concrete cubes 150mm size, cylinders 150mmx300mmand beams 100mmx100mmx500mm.Curing was done under water for various wanted periods.

V. TESTS ON FRESH AND HARDENED CONCRETE

Workability tests like slump test, compaction factor test test were administered for fresh concrete as per IS specifications, keeping the dosage of super plasticizer as constant at 1% by weight of binder. For strongest concrete cube compression strength test on150mm size cubes at the age of 1 day, 7 days, 14 days, 28 days curing were administered using 3000kN capacity compression testing machine as per IS 516-1956 Also compression strength evaluation and split tensile strength on 150mmx300mm cylinders and flexure evaluation on 100mmx100mx500mm beams were administered on 28 days cured specimens as per IS specifications. The stress- strain diagram for HPC is obtained using compressometer fitted to cylinders during cylinder compressive strength test.

VI. DISCUSSIONS AND CONCLUSIONS

Based on the investigations administered on HPC mixes the following conclusions are drawn.

1.High performance concrete(HPC) was designed by using recommendations of IS10262:2019 method of mix design. High performance concrete (HPC) are often developed with 5%,7%,9% replacement of cement with Silica fume to achieve desired high strength of M70 grade.

2. silica fume chosen for the study has high pozzolanic index and strength activity index. These indices confirm that siica fume chosen has high reactivity. The fresh high performance concrete mixture with the utilization of SP and therefore the incorporation of silica fume provided a far better workability than the OPC one.

3.The HPC designed with less cement and water contents obtained higher long-term compressive strength and lower water absorption rate than the OPC or conventional concrete.

4.This study is primarily focused on the properties of materials used, mix proportion of High Performance Concrete, making of concrete specimen, curing and testing of harden concrete.On performing the varied tests the physical properties of the specimens are studied and therefore the following conclusions are arrived.

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