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Review Paper on Experimental Study of Ultra High Strength Concrete(UHSC)

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ABSTRACT*- This papers cover the study of high Strength concrete upto 150 MPA .High Strength concrete now a days widely used for construction of high rise building, bridges, tunnels, under water constructions for increasing its durability and Strength. In this project we will first design concrete mix of M60,M80,M100,M120 ,M150by using special type of super plasticizer and admixture like metakaonin and allcofine.. After completion of design of concrete mixture we will cast of M60, M80,M100,M120,M150 cubes ,beams and cylinder. After 3,7, 28 days of casting we will take the compressive Strength , flexural Strength and split tensile Strength .After analysis of results we will study weather M60,M80,M100,M120,M150 will achieve Strength as per design of concrete mix..*
KEYWORDS*-Compressive Strength of UHSC, Flexural Strength, Durability, ultra-high Strength reinforced concrete, UHSC, UHPRC, Reactive Powder Concrete.*

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"I. INTRODUCTION"

Ultra-high Strength concrete (UHSC) is a novel construction material exhibiting enhanced mechanical and durability properties, which can lead to economical construction through reducing the cross-sections of structural members with associated materials savings and lower installation and labor costs (Tang 2004). The relatively high initial cost of UHSC has restricted its wider use in the construction industry. However, ongoing research and investigations are filling knowledge gaps in order to commence innovative UHSC having reduced initial cost. Furthermore, the development and wide acceptance of an UHSC design code provisions should encourage stakeholders in the construction industry to implement large scale applications. This becomes even more relevant with the more recent push by organizations such as the American Concrete Institute, which identified using high-Strength steel reinforcement in concrete as a top research priority. Combining UHSC and high-Strength steel is expected to yield unique structures in the near future. UHSC potential applications include tall structures, rehabilitation works, structural and non-structural elements, machine parts and military structures. Lighter weight structures owing to smaller crosssections can be made using UHSC. Therefore, UHSC can be effectively utilized in the precast concrete industry. Moreover, UHSC was widely used in pedestrian footbridges and highway bridges. For example, the first UHSC footbridge in Canada was constructed in 1997. In the United States, Wapello County Mars Hill was the first highway transportation bridge constructed with UHSC in 2006. In the Kinzua Dam Stilling Basin, UHSC was used for rehabilitation and Strengthening purposes. Furthermore, architecturally and aesthetically appealing structures can be made using UHSC (Schmidt et al. 2004, 2012; Fehling et al. 2008). Table 1 summarizes some of the existing UHSC applications around the world. In the present study, an extensive review of literature on UHSC properties was conducted and summarized in tabular representation for a user friendly access to this scattered information.

Concrete is the most widely used construction material in India with annual consumption exceeding 100 million cubic meters. It is well known that conventional concrete designed on the basis of compressive Strength does not meet many functional requirements such as impermeability, resistance to frost, thermal cracking adequately. Conventional Portland cement concrete is found deficient in respect of:
Durability in severe environs (Shorter service life and require maintenance)
Time of construction (longer release time of forms and slower gain of Strength)
Energy absorption capacity (for earthquake-resistant structures)
Repair and retrofitting jobs.
High Strength concrete (HSC) successfully meets the above requirement.

High Strength H concrete is a concrete mixture, which possess high durability & high Strength when compared to conventional concrete. This concrete contains one or more of cementious materials such as fly ash, silica fume or ground granulated blast furnace slag & usually a super plasticizer. High Strength concrete (HSC) is a specialized series of concrete designed to provide several benefits in the construction of concrete structures that cannot always be achieved routinely using conventional ingredients , normal mixing & curing practices. High Strength concrete should have at least one property like high Strength, high durability, acid resistance, self-compaction, low permeability to water as compared to normal concrete, to qualify as high Strength concrete. Material technology has evolved concrete today into an engineered material with several new constituents.

"II. LITERATURE REVIEW"

J. Chena et. al.[1] (2017).

The author studied on Production of high- Strength concrete by addition of fly ash microsphere and condensed silica fume. With reference to the packing model of concrete materials, addition of fly ash microspheres (FAM) to fill the voids between cement grains, followed by addition of condensed silica fume (CSF) to further fill the voids between FAM would reduce the water content to achieve the desired flowability. This could allow the adoption of lower water/cementitious materials (W/CM) ratio to produce High Strength Concrete (HSC). This study was aimed to evaluate the effects of FAM and CSF on the packing density of cementitious materials and the flowability and Strength of cement paste. The results showed that the addition of FAM and CSF can increase the packing density, thereby enhancing flowability and Strength Strength concurrently. From the experimental investigations presented in this paper, the following conclusions can be drawn the addition of FAM and/or CSF can more substantially increase the flow spread at low W/CM ratio than at high W/CM ratio. Correlations of the flow spread to the WFT yielded very high R2 values of well above 0.9, indicating that the WFT principally governs the flow ability of cement paste. On the other hand, at the same WFT, the flow spread is higher at higher FAM content and marginally lower at higher CSF content.

Wojciech Kubissaa et. al.[2] (2017).

The author studied on Ecological high Strength concrete. In this paper the authors present the possibility to utilize two waste materials to produce high Strength concrete (HSC). To prepare the mixes, Recycled Concrete Aggregate (RCA) of 4-16 mm fraction and Class F fly= ash (from coal burning power plant) were used. Concretes with RCA were mixed with 300 kg/m3 of different types of cements and Supplementary Cementing Materials (SCM). The concrete sample specimens were tested for mechanical properties and for some properties which are related to durability. After 28 days compressive Strength values up to 59.5 MPa and after 90 days 71.8 MPa were achieved. Besides we obtained good values regarding those properties, which significantly influence the durability of reinforced concrete structures. The conclusion are in the paper it has been shown that it is possible to produce a high quality concrete with a targeted 55 MPa mean compressive Strength at the age of 28 days and of more than 60 MPa after 90 days. Good durability influencing properties could be measured at the same time by the usage of coarse RCA of an average quality and by simultaneous addition of Class F fly ash as SCM.

Swati Choudhary et. al.[3] (2014).

Author studied on the High Strength concrete (HSC) has immensely increased due to utilization of large quantity of concrete, thereby leading to the development of infrastructure Viz., Buildings, Industrial Structures, Hydraulic Structures, Bridges and Highways etc. This paper includes the detailed study on the recent developments in High Strength Concrete, stressing more on the earthquake prone areas. It highlights the advantages and importance of High Strength concrete over conventional concrete and also includes effect of Mineral and Chemical Admixtures used to improve Strength of concrete. The behavior of SIFCON is also discussed briefly. The alternative for the HSC is also recommended.

Viatceslav Konkov et. al.[4] (2013).

The author studied on Principle Approaches to High Strength Concrete Application in Construction. Designing high Strength concrete compositions, optimal application of this material as in the field of erecting unique buildings and constructions, so in largescale construction, are discussed in the article. Requirements to high Strength concrete are set; the existing practice of its application in modern construction is described. Constantly growing standards as for physical and mechanical properties of buildings and constructions erected so for their maintenance, including issues of safety and ecological matters, determine increasing requirements to functional characteristics of construction materials. At the same time, concrete has the leading position among these materials taking into account its variety and usage scale. The world annual production of concrete exceeds 4 billiards cubic meters of ready mix and precast concrete of different application area. The conclusion are High Strength and Ultra High Strength Concrete is a very promising building material which seriously changes philosophy of approaches to vision of what we want and what we can expect from core building material. It has become to be treated as material which can simultaneously achieve various goals set by high standards of modern customers to unique buildings and constructions and to objects of large-scale construction not only in terms of Strength, but also in terms of safety, life quality, decreasing all types of resources (energetic, labor, material, financial) as at the stage of building, so, especially, at the stage of maintenance.

Yves F. Houst et.al.[5] (2008).

The author studied on Design and function of novel superplasticizers for more durable high Strength concrete. In this article we shall describe our quest and ultimate success in furthering our understanding of the action of superplasticizers on the rheology of cement and concrete. By specifically producing superplasticizers with varied architectures, we have been able to show the important structural features of the macromolecules that lead to a successful superplasticizer or water reducing agent. Using both non-reactive model MgO powders, three different types of cement blends, the adsorption behaviour and the effect on the rheological properties of these two important superplasticizer families have been used to further develop a conceptual model for superplasticizer-cement behaviour. We shall briefly describe the adsorption of the polymers onto the different surfaces and their influence on surface charge and rheology and the influence of the various ionic species found in cement pore solutions that may influence polymer-cement affinity. The key factors are shown to be the effective adsorbed polymer thickness and the induced surface charge which can be influenced by the polymer architecture, the pore solution composition and the initial particle surface charge.

Ping-Kun Chang et .al.[6](2004).

The author studied on An approach to optimizing mix design for properties of high- Strength concrete Laboratory and in situ test results reveal that the densified mixture design algorithm (DMDA) can be used to produce high- Strength concrete (HSC) of good durability and high workability. The water-to-solid (W/S) weight ratio is known to have significant influence on the volume stability of concrete. This paper discusses Strength of f Vc>56 MPa, slumps of 230–270 mm, effect of the W/S ratio on the development of Strength and durability of HSC at both fresh and hardened states. In addition to the water-to-cement (W/C) ratio and water-tobinder (W/B) ratio, the W/S ratio also has a significant effect on the Strength of concrete. The utilization of fly ash and slag has been proven beneficial to the rheology of HSC in enhancing its Strength development and durability. The conclusion are the DMDA has proved to be capable of producing HSC with slumps of 230–270 mm and Strength of f Vc > 56 MPa while avoiding water bleeding and segregation of aggregate. The use of domestic pozzolanic materials and strong water reducing agent also contributes to the high Strength and workability of concrete.

Y.N. Chana et . al .[7] (2000).

The author studied on the Compressive Strength and pore structure of high- Strength concrete after exposure to high temperature up to 80˚C. The experimental program was carried out to study the mechanical properties and pore structure of high- Strength concrete (HSC) and normal-Strength concrete after exposure to high temperature. After the concrete specimens were subjected to a temperature of 80℃, their residual compressive Strength was measured. The porosity and pore size distribution of the concrete were investigated by using mercury intrusion porosimetry. Test results show that HSC had higher residual Strength, although the Strength of HSC degenerated more sharply than the normal-Strength concrete after exposure to high temperature. The changes in pore structure could be used to indicate the degradation of mechanical property of HSC subjected to high temperature. The results and conclusions are summarized as although the Strength of HSC degenerated more sharply than the conventional concrete with the increase of exposed temperature, the HSC had higher residual Strength. The variation of pore structure, including porosity and pore size distribution, could be used to indicate the degradation of mechanical properties of HSC subjected to high temperature.

Kevin J. Folliard et. al .[8] (1997).

The author studied on properties of high Strength concrete containing shrinkage-reducing admixture. The effects of a recently developed shrinkage-reducing admixture on high Strength concrete properties are described. High- Strength concrete mixtures containing silica fume were cast with and without shrinkage-reducing admixture. The mechanical properties, drying shrinkage, and resistance to restrained shrinkage cracking were investigated. The results show that the shrinkage-reducing admixture effectively reduced the shrinkage of high-Strength concrete. This paper has summarized the results of a study on the effects of a recently developed shrinkage-reduced admixture on high- Strength concrete. The conclusion are The use of SRA in high Strength concrete was found to significantly reduce drying hrinkage and restrained shrinkage cracking in laboratory ring specimens. The effectiveness of SRA in reducing shrinkage was observed despite a very short (24-hours) moist-curing period. However, proper curing should remain an essential component in concrete field applications, and this improved curing would also increase the efficacy of SRAs in reducing shrinkage and subsequent cracking.

Chong Hu et .al.[9] (1996).

The author studied on the rheological properties of fresh high- Strength concrete were investigated with a new rheometer for concrete. It was found that, in a steady state, this category of concrete, without or under vibration, behaves as a Bingham material, and can be characterized by the shear yield stress (in Pa) and the plastic viscosity (in Pa.s). For the tested concretes, vibration reduced the yield stress to about half that without vibration, but little influenced the plastic viscosity. A new method for characterizing the evolution of workability is presented, which emphasizes an increase of the shear yield stress versus time. The thixotropy of concrete was confirmed, and it was noted in particular that the yield stress of a concrete after a resting period, called resting yield stress, can be several times that of the concrete in a steady state. The dilatancy of concrete was observed in some tests. Several factors influencing this phenomenon are discussed. Finally, a model is proposed for estimating the plastic viscosity of high Strength concrete from the mixture proportions. The high- Strength concrete (HSC) has been widely used for the last decade. With super plasticizer, this concrete has a better compactness, owing to the reduction of water The silica fume used in certain cases increases even more the concrete compactness by filling of some inter grain voids. Some rheological properties of fresh high- Strength concrete are discussed in this paper. The following conclusions have been drawn from the experimental results measured with the BTRHEOM rheo meter: Common fresh HSC (slump value over 10 cm) without heavy segregation and in a steady state, either without or under vibration, seems to be a Bingham material. The evolution of the workability of concrete can be described by the evolutions of the yield stress and of the plastic viscosity, and determined by their combined effect according to the particular application. In the first hour, the viscosity of HSC is nearly constant.

F.P. Zhou et. Al.[10] (1995).

The author studied on the effect of coarse aggregate on elastic modulus and compressive Strength of high Strength concrete. A set of high Strength concrete mixes, of low water/cement ratio and fixed mortar composition, containing six different types of aggregates of constant volume fraction, has been used to check moduli of elasticity at 7, 28 and 91 days, The results have shown that, apart from the aggregates of very low and very high modulus, concrete modulus at 28 days can be predicted quite well by well-known models. Increase in modulus thereafter is slight. For the wide range of coarse aggregate stiffness used, combined with a single, high Strength, low water/cement ratio mortar. The conclusion may be drawn Cube Strength (about 90 N/mm2 at 28 days with normal aggregates) is drastically reduced, as expected, by the weaker aggregates and is also reduced (by about 9%) by the stiffer (steel) aggregates.

Ultra-High Strength Concrete Mixtures Using Local Materials

Srinivas Allenal and Craig M. Newtson2

This paper presents the development of high Strength concrete (UHSC) using local objects. UHSC blend rates were developed using local materials to UHSC can be made more affordable for a wide variety of applications. Specifically, local sand with a maximum size of 0.0236 in. (600 um), with local I/II type cement and silica smoke was used in this study. Each of these visual options looks like development of UHSC sustainability. Two compounds (one with fiber and one without fiber) recommended as UHSC blends. Maximum compression Strength obtained in this study it was 24,010 psi (165.6 MPa) for UHSC with steel threads and 23,480 psi.(161.9 MPa) for UHSC without fibers. Pressure and flexibility is obtained from UHSC blends developed for this work compared to UHSC capabilities presented in books. Producing this new item with local materials reduces it material costs, improve stability, and produce machine performance similar to products already packaged, available for sale.

Effect of silica fume on mechanical properties high-Strength concrete:

M. Mazloom a,", A.A. Ramezanianpourb, J.J. Brooks c

This paper presents the results of experimental work on short- and long-term mechanical properties of high-Strength concrete containing different levels of silica fume. The aim of the study was to investigate the effects of binder systems containing different levels of silica fume on fresh and mechanical properties of concrete. The work focused on concrete mixes having a fixed water/binder ratio of 0.35 and a constant total binder content of 500 kg/m3. The percentages of silica fume that replaced cement in this research were: 0%, 6%, 10% and 15%. Apart from measuring the workability of fresh concrete, the mechanical properties evaluated were: development of compressive Strength; secant modulus of elasticity; strain due to creep, shrinkage, swelling and moisture movement. From the results presented in this paper, using concrete containing 0-15% silica fume, the main conclusions are:

In concrete mixtures with a constant slump of 100±10 mm, those incorporating higher silica fume replacement levels tended to require more dosages of superplasticiser. The compressive Strength of concrete mixtures containing silica fume did not increase after the age of 90 days. The modulus of elasticity-compressive Strength relationship was similar to that of the ACI method. The modulus of elasticity at unloading the creep specimens. Silica fume did not affect the total shrinkage; however, as the proportion of silica fume increased, the autogenous shrinkage of high-Strength concrete increase.

Production of high Strength concrete using high volume of Industrial by-products

1.Papayianni, E. Anastasiou

The increased natural resource consumption has evolved into a major international problem with severe environmental, social and financial consequences. The use of secondary materials in concrete is still largely limited to low-Strength concrete products such as base courses for roads and 80% of the produced fly ashes and slags end up inlow-value applications. In the present report, the use of industrial by-products in concrete production regards both binder and aggregate substitution. High-calcium fly ash (HCFA) or ladle furnace slag (LF slag) were used as alternative binders and electric are furnace (EAF slag) as alternative aggregates. In order to produce a concrete with high volume of industrial by-products, cement substitution with alternative binders (HCFA or LF slag) is combined with the use of EAF slag as aggregate.

EFFECT OF TEMPERATURE ON THERMAL OF HIGH STRENGTH CONCRETE

Kodur, V.K.R.; Sultan, M.A

The thermal conductivity of siliceous aggregate HSC is generally higher than that of carbonate aggregate HSC. The effect of steel fibre-reinforcement on the thermal conductivity of HSC is very small. The type of aggregate has significant influence on the specific heat of HSC at elevated temperatures. Generally, the carbonate aggregate concrete has higher specific heat in the 600°C to 850°C range. The influence of steel- fibre reinforcement on the specific heat of the concrete is very small in the temperature range investigated.

The thermal expansion of siliceous aggregate HSC is higher than that of carbonate aggregate concrete in the 20°C to 800°C temperature range. The thermal expansion of HSC is not significantly affected by the presence of steel-fibre reinforcement at temperatures up to approximately 800°C. Based on the studies presented in this paper, the following conclusions can be drawn: The type of aggregate has significant influence on the thermal properties of HSC at elevated temperatures. The presence of carbonate aggregate in HSC increases fire resistance.

The thermal properties, at elevated temperatures, exhibited by steel fibre-reinforced HSC, are similar to those of plain HSC. The proposed relationships for thermal properties can be used as input data for modelling the behaviour of structural members exposed to fire.

High-Strength Concrete at High Temperature

An Overview" Long T. Phan

Mechanical property specimens were made from three HSC mixtures (named mixture I to III) and one NSC mixture (named mixture IV), using ASTM type I portland cement, crushed limestone and natural river sand. Table I lists information on the mixture. proportion and properties of fresh and hardened concrete used in the NIST test program Results indicate that there is a complex relationship between the Strength measured at elevated temperature and the residual Strength measured at room temperature.

HSC mixture with the lowest w/em of 0.22 sustained, on average, the lowest loss in relative Strength (about 20 % compared with about 30% for w/cm-0.33 and 0.57).Overall, the presence of silica fume had no statistically significant effect on the relative Strength loss. There was, however, some dependence on test condition. For the unstressed test condition, mixtures III and IV without silica fume had less Strength loss than mixtures I and II with silica fume. For the other test conditions, the presence of silica fume had no overall statistically significant effects.

Blast-resistant characteristics of ultra-high Strength concrete and reactive powder concrete

Na-Hyun Yi a, Jang-Ho Jay Kim a,, Tong-Seok Han a, Yun-Gu Cho b, Jang Hwa Lee c

Recent advances in nanotechnology research have been used to improve durability, servabil service, and high-performance concrete safety (UHSC). In addition, improvements in concrete Strength have allowed for a stable structure size and weight,greatly reduced, which in turn results in lower costs and improved aesthetic value. Among the many UHSCs currently available on the market, they represent mostly high Strength concrete (UHSC) and active powder concrete (RPC). Or UHSC and RPC have it pressures greater than 100 MPa, the safety of which is compromised due to the possibility of ultra-brittle failure behavior and cost effectiveness to performance. The explosion-resistant force in the UHSC and the RPC was tested to determine the feasibility of using the UHSC and RPC in secret facilities that are at risk of terrorist attacks or the effects of the attack. The flow of slump, is depressing Strength, solid power separation, elastic modulus, and flexibility Strength tests were performed. Additionally, ANFO explosion tests were performed on UHSC and RPC certified panels. Happened and displayed .Pressures, as well as massive displacement and residual and types of rebar and concrete measured. Explosive injuries and modes of failure of reinforced panel templates were recorded. Oursthe results showed that UHSC and RPC have better resistance to explosion than conventional power concrete. The results of the study are discussed in detail.

The effect of curing conditions on compressive Strength of ultra high Strength concrete with high volume mineral admixtures

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In this study, refined fly ash (FA), pulverized granulated blast furnace slag (PS) and silica fume (SF) were quantified with the installation of Portland Cement (PC). The PC was replaced by the FA or PS by the stated standards. Basalt and quartz powder were used as an aggregate in mixtures. Three different healing methods (standard, autoclave and steam curing) have been used in specimens. Test results show that high-Strength concrete can be obtained with high-volume mineral mixtures. These are the pressing force. Mixtures are over 170MPa. It seems that these compounds can be used for the production of active concrete (RPC) and so on changes.

The effect of fibre distribution characteristics on the flexural Strength of steel fibre-reinforced ultra high Strength concrete

Su Tae Kang Bang Yeonl.ee "Jin-KeunKim Yun YongKim

Fibre distribution characteristics were evaluated to investigate their effect on the flexural Strength of steel fibre-reinforced ultra high Strength concrete in conjunction with the direction of placement. For this purpose, an image processing technique developed in this study was employed. Flexural tests were carried out to quantify the effect of fibre distribution characteristics on flexural Strength. It was found that the image processing technique developed in this study could quantitatively evaluate the fibre distribution property by the use of the distribution coefficient, the number of fibres in a unit area, the packing density of the fibre image, and fibre orientation. It was also found that the fibre distribution characteristics were dependent on the direction of placing Fibre distribution characteristics were revealed to strongly affect the ultimate flexural Strength, while hardly affecting the first cracking Strength. The validity of the current test results was verified through comparison with a theoretical model of flexural Strength. fibres in a unit area, the packing density of the fibre image, and fibre orientation. It was also found that the fibre distribution characteristics were dependent on the direction of placing Fibre distribution characteristics were revealed to strongly affect the ultimate flexural Strength, while hardly affecting the first cracking Strength. The validity of the current test results was verified through comparison with a theoretical model of flexural Strength.

Utilization of fibers in ultra-high performance concrete: A review

JihaoGong YuweiMa JiyangFu JieHu XiaoweiOuyang Zuhua Zhang Hao Wang

Fibers are essential to Strengthen the mechanical properties of ultra-high performance concrete (UHSC), especially tensile and flexural Strength. This paper conducts a systematic review on the influence of fibers with different textures and geometries on the properties of UHSC from the following perspectives: (1) the bonding mechanism of steel fibers with the UHSC matrix; (2) the effect of fiber shape, fiber orientation, and steel fiber hybridization on the microstructure, failure mode, mechanical properties, auto genous shrinkage, and durability of UHSC; (3) the reinforcement mechanism of synthetic fibers (polyvinyl alcohol fibers (PVA), polypropylene fibers (PP). polyethylene fibers (PE)), mineral fibers (basalt fibers, wollastonite fibers), and carbon fibers in UHSC and their effect on UHSC performance; (4) the use of hybrid fibers and their synergistic effect on the mechanical performance and shrinkage of UHSC. Finally, further trends in fiber research in UHSC are discussed in this paper.

Ultra high performance concrete: recent applications and research

With advances in concrete technology, ultra high performance concrete (UHSC) has become a new focus for researchers and the concrete industry. UHSC is characterized by high compressive Strength and excellent durability, resulting in lighter construction and longer service life. Researchers have taken different approaches to achieve ultra- high Strength and related other improved performances. As a result, several types of UHSC are available today, such as reactive powder concrete (RPC), compacted small particle concrete (DSP), special industrial concrete (BSI), macro defect-free concrete (MDF), self-compacting concrete (SCC).), Compact Reinforced Concrete (CRC), etc. Here is a general description and scope of their use. In addition, research at RMIT in Modified Reactive Powder Concrete and Very High Strength (VHSC) and Ultra High Strength Concrete (UHSC) is briefly outlined.

Reactive Powder Concrete: Durability and Applications

Miguel Ángel Sanjuan and Carmen Andrade

Reactive Powder Concrete (RPC) is a high-performance concrete (UHSC) developed years ago by Bouygues to build strong, durable and sustainable structures. Some differences can be highlighted between RPC and High Performance Concrete (HSC); that is, RPC exhibits higher compressive and flexural Strength, higher toughness, lower porosity, and lower permeability compared to HSC. Microstructural observations confirm that silica fume improves fiber-matrix interface properties, particularly in fiber pull-out energy. This article reviews the published literature on RPC and offers a comparison of RPC and HSC. Therefore, some potential applications of RPC can be deduced. For example, some examples of bridge applications and structural repairs are given. Experimental measurements of air permeability, porosity, water absorption, carbonation rate, corrosion rate, and resistivity evidence the superior performance of RPC over HSC. When these ultra-high-performance, concretes are reinforced with discontinuous short fibers, they show better performance in tensile setting.

Mechanical Properties of Ultra High Performance Concrete
PrabhatRanjanPrem, B.H.Bharatkumar, Nagesh R Iyer

A research program is conducted for evaluation mechanical properties of Ultra High Performance Concrete, target compressive Strength at the age of 28 days higher than 150 MPa. The methodology for developing such a mix was explained. The material properties, mixture design and curing mode are determined. Material properties are understood by studying stress behavior of UHSC cylinders under uniaxial compressive load. Load mouth opening displacement-crack (cmod) UHSC beams, bending Strength and fracture energy were evaluated using third point stress test. Compressive Strength and split tensile Strength results are intended to determine pressure and tension behaviour. The residual Strength parameters are shown graphically explaining flexural properties, toughness of concrete. Durability studies have also been conducted to compare the effect of fiber with that of a control mixture For all studies, the mechanical properties were evaluated by changing the percentage and aspect ratio of steel fibers The results reflected this higher aspect ratio and fiber volume caused drastic changes in cube Strength, cylinder Strength, post peak response, load-cmod, fracture energy, flexural Strength, split tensile Strength, residual Strength and durability. As for null application of UHSC in India initiative is being taken understand the mechanical behavior of UHSC which will be vital for longer operation in commercialization for structural applications.

The effect of supplementary cementitious material systems on dynamic compressive properties of ultra-high performance concrete paste
WeitanZhuang Shaohua Li Qingliang Yub

Supplementary cementitious materials (SCMs) have been widely used as a replacement for cement in UHSC, bringing the benefits of reducing CO2 emissions and reducing construction costs. However, the effect of SCM on the dynamic compressive properties of ultra-high-performance concrete (UHSC) paste has not been well understood. Here, the process ability, pore structure, quasi-static compressive Strength and dynamic compressive properties of UHSC paste with different SCM systems are comprehensively studied. Results show that replacing cement with ground granulated blast furnace slag (GGBS) and limestone powder (LP) increases workability. With a substitution rate of 10% LP, the M2 microstructure becomes denser. With further increasing replacement of GGBS and LP, the porosity increases, while the quasi-static compressive Strength and dynamic compressive properties tend to decrease, but the extent is limited. Compressive properties such as dynamic compressive Strength, dynamic increase factor (DIF), maximum strain and toughness are highly dependent on strain rate. The applicable DIF model for UHSC is determined at a strain rate of 53.9 170.7 s-1. The fractal dimension increases with the growth of GGBS and LP. Additionally, a positive linear relationship is observed between the fractal dimension and the denary logarithms of the strain rate.

Development of high performance lightweight concrete using ultra high performance cementitious composite and different lightweight aggregates
Jian-XinluPeiliangShenHafiz AsadAliChiSunPoon

In order to reduce the self-load of concrete structures, this study developed high- performance lightweight aggregate concrete (HPLAC) by combining the use of high- performance cementitious composite (UHSC) and different types of aluminosilicate lightweight aggregates (LWA). The physicochemical properties of two types of LWA (ie. expanded clay and expanded shale) affecting HPLAC were processed and compared. The compositional distribution and micromechanical properties in the interfacial regions of the paste and LWA were revealed by elemental mapping and nanoindentation. The results showed that the incorporation of clay LWA or shale LWA into HPLAC resulted in similar density and thermal conductivity values, while the use of shale LWA induced lower water absorption and higher HPLAC Strength compared to clay LWA due to the fine pore structure and higher prozolanic activity of the former. The internal curing effect provided by the pre-moistened shale LWAs was more effective in increasing binder hydration, and Al dissolution from the shale LWAS further dignified the interfacial bond to form a dense rim surrounding the LWAS, leading to improved micromechanical properties at the interface surface. The X-ray CT results showed that the adoption of UHSC was beneficial for preventing the segregation of LWA and steel fibbers' in HPLAC. Based on the physicochemical interactions of LWA, the synergistic use of UHSC and pre-wetted shale LWA was able to produce HPLAC with high structural efficiency, good thermal insulation, low auto genus shrinkage and permeability.

Functionally graded ultra-high performance cementitious composite with enhanced impact properties
P.PL M.J.C.Sluijsmans H.J.H.Brouwers "Q.L.Yu

This study develops functionally graded ultra-high-performance cementitious composite beams by applying the composite concepts of ultra-high-performance concrete (UHSC), two-stage concrete (TSC) and slurry-infiltrated fibrous concrete (SIFCON). A functionally graded composite beam (FGCB) is fabricated with a bottom layer of SIFCON and a top layer of TSC, and both layers are synchronously cast using UHSC slurry. The new FGCB concept is designed towards more economical and high performance structural systems, namely excellent flexural and impact resistance, low cement consumption and high steel fiber utilization efficiency. Fresh and hardened properties of UHSC slurry, flexural and impact properties of FGCB are measured. The results show that the designed FGCB has excellent bending properties and impact resistance without showing any interfacial bonding problem. The fiber utilization efficiency of the designed FGCB is very high compared to traditional UHSC and SIFCON beams. 30 mm medium hook-ended steel fibers show the best utilization [17:55, 08/07/2023] Avi: efficiency compared to 13 mm short straight and 60 mm long 5D steel fibers, and 3% medium fibers is optimal for FGCB construction. The resistance of FGCB at low impact velocity is well linearly correlated with its static flexural Strength.

"III. PROBLEM STATEMENT"

Present study focused on Design of High Strength Concrete (HSC) upto 120 MPa. The investigation aims at determining mechanical properties of high Strength concrete & compare with the results in the code & literature.

"IV OBJECTIVES OF STUDY"

The main objectives of the present work are , 1. To understand the basic guidelines for designing HSC mix proposed by Different Codes and papers published in the literature. 2. To investigate the properties of materials used for making HSC. 3. To arrive the concrete mix proportioning for concrete of Strength in the range of 60 MPa to 120 MPa. 4. To investigate mechanical properties of HSC and compare with the results in the code and literature.

"V. METHODOLOGY "

The methodology of the present work are,
1. Literature survey is carried out for designing concrete mix.
2. Collect the materials to prepare the concrete of Strength 60 MPa to 120 MPa.
3. Trials are made for achieving the proposed Strength by casting Cubes and Cylinders. The
4. Strength test may be made at the age of 3, 7, and 28 days.
5. Once the proportioning of concrete ingredients is decided for the Strength, the cubes, cylinders and beams are cast to assess the compressive and tensile Strength of concrete.
6. The results obtained may be compared with the results in the literature and new equations may be proposed for tensile Strength, in terms of its compressive Strength.

"VI. SCOPE OF THE STUDY"

Currently conventional concrete is used widely for residential, commercial & public buildings. But if we consider the important structures such as bridges, high rise commercial complex or under water constructions, Strength of concrete plays an vital role in overall life of structure, overall stability of structure & durability of structure as well. It is therefore very essential to design the concrete having high Strength by adding different admixtures and by adopting suitable IS mix design procedure.

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