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DEVELOPMENT OF ULTRA-HIGH PERFORMANCE FIBRE REINFORCED DUCTILE CONCRETE

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ABSTRACT:

Concrete is one of the flexible materials which are commonly used in the construction work which is transform into any virtual form. The amazing flexible quality makes it valuable. The aesthetics of modern & ever growing architecture for the development of geometries & material is done in the suit of engineering design. It has fragile quality which is the major ruin of the concrete. This fragile nature of the concrete is due to the high budding of solitary crack which may cause to unmanageable breakdown of the sample.

With the help of FRC (fiber reinforce concrete), property of concrete has been improved through the addition of short fibers discrete into the concrete mix. In recent period researchers are generally research on the PVA fibre which is one of the evolving section of FRC. High tensile property gives the power to concrete as it has familiar young modulus, efficient pricing and little diameters (Yang, Zhou, Xing & Xiang 2013). When the cementitious matrix has been put into the pressure, cracking of cementitious mix is started at the point of dispersed short fibre in filling the gap of matrix and reduce tensile pressure through making bridge between it.

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KEY WORDS: Fiber, Reinforced, Ductile, Concrete, Mixture, Performance.

INTRODUCTION: The performance, durability and life of the structure can be improved through the Ultra High-Performance Fiber Reinforced Concrete (UHPFRC). In the cenentitious composists three kind of development has been found which plays a vital part in the market such as it improve the ductility, increase power and enhance efficiency. it can be possible through granular packing optimization, genesis of FRC and good understanding with the material matrix. In this study model of concrete flow and pressure through the development of the self compact concrete and there after the UHPFRC and UHPC are considered.

To maintain a high level of transportation capacity on the highways two components are plays important role such as durability and strength of highway bridges. In Wisconsin the normal life of concrete structure is 40 to 50 years. But the uncoated rebar needs to change after thirty years in bridge decks reinforced. Aging, deicing, deteriorating due to deformation and pressure and other damaging factors are the main components of bridges, highways, and other transportation structure. The average age of bridges throughout the United States in 42 years indicating that many are reaching the end of their lifetime and will require replacement in the near future. It is estimated that over two hundred million trips are taken every day over bridges that are deemed to be structural deficient. Additionally, the need to accommodate larger amounts of traffic is leading to the construction of newer bridges. The need for construction of newer bridges and repair or replacement of existing bridges reduces the traffic flow. Commuters and freight travel across these bridges daily, and if they are delayed, the economic costs are significant.

REVIEW OF LITERATURE: In this paper we will observe that a cementitious matrix that includes arbitrarily oriented & dispersed small fibers all over is known as fibre reinforced concrete (FRC). In addition to the tensile and flexural properties of plain concrete being enhanced by, a reduction in crack propagation and improved ductility and toughness is an outcome of the fibre enclosure. " The fibre range available to be incorporated into the cement matrix includes steel fibres, glass fibres, carbon fibres, polyethylene (PE) fibres, polypropylene (PP) fibres, and polyvinyl alcohol (PVA) fibres. Steel fibres, polyethylene fibres and polypropylene fibres are commonly used in the construction industry; however it is PVA fibre that has in the recent years attracted much interest in the research and development sector of fibre reinforced concrete.

A particular section of ultra high performance fiber reinforced concrete is known as ECC's (Engineered Cementitious Composites) that exhibits properties of high ductility (Li

2003), good crack power & high strength capability due to the allowance damage hardening. When tensile stresses are imposed on the matrix with a low fraction volume of fibres, generally less than 2% of the concrete volume, "the ultimate tensile strength and strain capacity could be as high as 5 MPa and 4%, respectively.

Fiber reinforced concrete Oriented small fibers & randomly dispersed added in the cementitious mix is known as Fibre reinforced concrete (FRC). In addition to the tensile and flexural properties of plain concrete being enhanced by, a reduction in crack propagation and improved ductility and toughness is a result of the fibre inclusion. It can be stated that three main aspects like toughness, ductility and tensile strength are enhanced with the addition of fibres into the brittle composite. Fibres give the strength to matrix material by filling the strain and providing power incorporation related to fiber pull out and de bonding. Multiple cracking helps to enhance the flexibility of the compound.

RESEARCH OBJECTIVES: The concept of PVA fiber in cmentitious matrix is used. this study will undertake the effect of hollow microsphere addition to the PVA-ECC. With the addition of PVA fibre, this research aims at further developing an ultra-high performance reinforced ductile concrete through replacement of fraction volume by low weight hollow glass microsphere additive. However the addition of microspheres into the composite may negatively impact the fibre / matrix interface whereby there is potential for the strain-hardening characteristic of the ECC to be reduced or converted to strain-softening. "This may be related to the smooth surface of the hollow glass microspheres and the reduction of chemical bond between the PVA fibre and the matrix due to the removal of cement. However, when creating standard PVA-ECC's, it is a requirement that the surface of the PVA fibre is coated with an oily substance in order to reduce the bond between the fibre and matrix, otherwise the bond will be to strong whereby fibre rupture will occur prior to strain- hardening being achieved. Hence, there is potential to eliminate the need of surface coating the PVA fibre when adding microspheres to the mix, since these microspheres may reduce the PVA fibre chemical bond similar to that of surface coating". The research will aim at creating a Lightweight PVA-ECC without the need of prior surface coating of the fibres, in the hope that the composite is still capable of achieving stain-hardening whereby compressive strength, strain capacity and flexural strength are adhered whilst also maintaining, if not improving, the quality of energy absorption & compressive strength in the composite is the result of microsphere additions. The research shall also investigate the behaviour and characteristics of the ultra-high performance PVA-ECC when exposed to different loading conditions. FRCs with 6 mm fibres and volume fractions ranging 1.5% with hollow microspheres ranging from 0-15% are investigated to find out mechanical properties i.e. compressive strength of small and large cylinders, flexural strength.

METHODOLOGY: The key aim of the study is to build the ultra-high performance, fibre reinforced ductile concrete. The PVA fibres are used for the research work. Hollow microspheres are also used to develop a new type of concrete. The compressive power & flexural power of the new developed material has been investigated in concrete lab. Further to the literature review on fibre reinforced concretes, engineered cementitious composites, polyvinyl alcohol fibres and glass hollow microspheres; physical samples of Lightweight PVA-ECC's with hollow glass microsphere additives have been created and tested under external loading conditions.

In order to achieve the objectives, hollow microspheres are added to the PVA fibre to remove the necessity of covering the surface of PVA fibre with oily substance. These hollow microspheres may decrease chemical bond as of surface coating. Samples were produced by mixing all the components together. The first stage involved the preparation of mix designs. The second stage attempted to make beams, small and large cylinders and kept for curing. The third stage looked into characterization of design such as flexural strength and compression strength by performing test in the lab.

The last stage evaluated the properties such as stress, strain and putting all the data on the graphs and did comparison of the graphs. The results analysed and reported on in order to find out the nature, property and of lightweight PVA- ECC when exposed to these loadings. Below is the methodology of carrying out these tests and analysis of results.

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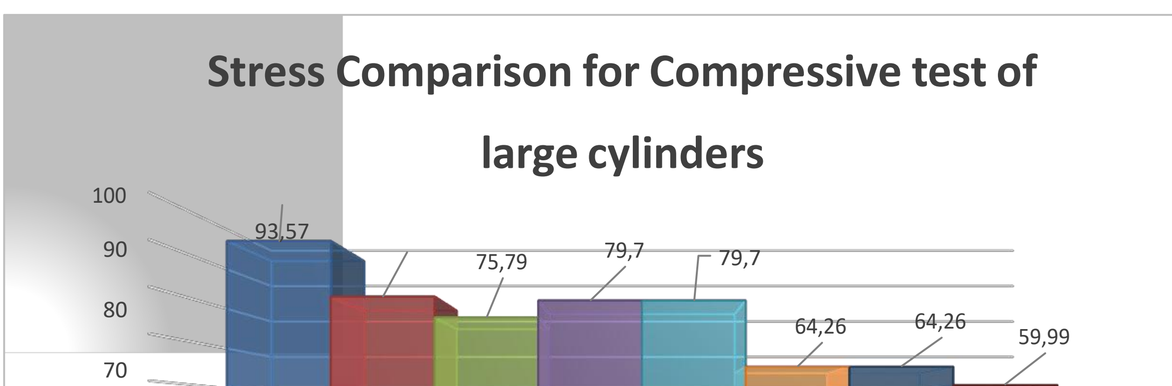
ANALYSIS: During the experiment, load is starting to apply on concrete specimen. At peak volume where concrete reaches its max ability to carry loads and cracks, for this load volume stress is equal to f_C. At this point, strain is equal to İc, it's the strain that corresponds to the strain at the moment of peak volume.

However, when concrete gets out of the elastic zone, and after it's cracking point it has the ability to continue to carry loads, ability that we want to increase. During this discharge zone, although load and stress decrease, strain can continue to increase since concrete hasn't lost completely its consistency.

Compressive test results for large cylinders

Mix Design	**f_C (MPa)**	**ε_C (%)**	**ε_{max} (%)**
D1	93.57	3.00	3.07
D2	80.62	4.10	4.29
D3	75.79	2.48	2.76
MD1	79.70	2.47	3.63
MD2	64.26	2.73	2.93
MD3	64.26	2.73	2.93
MD4	64.26	2.73	2.93
MD5	59.99	2.11	2.53



CONCLUSION:

Noticeable development has been made in concrete technology during the last two decades. One of the significant advances in the 20th century was the development of a new generation of highly cementitious based composite material known as Ultra-High Performance „ductile" Concrete (UHPdC) with compressive strength over 150 MPa and flexural strength over 30 MPa and remarkably improvement in durability similar to natural rocks. Since the first introduction of UHPdC in 1994 by Richard and Cheyrezy, extensive research and development on this material has been undertaken by numerous research groups and engineers worldwide in hopes to promote UHPdC as an ultimate sustainable construction material for the future.

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