iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** V **Month of publication:** May 2021

DOI: https://doi.org/10.22214/ijraset.2021.34703

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

A Literature Review on Development and Performance Assessment of High Performance Concrete with Silica Fume and Glass Fiber

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Abstract: ***Concrete is a tensionweak building material, which is often crack ridden connected to plastic and hardened states, drying shrinkage. Glass-Fibre Reinforced Concrete (GFRC) is a material made of a cementatious matrix composed of cement, sand, water and admixtures, in which short length glass fibres are dispersed. GFRC has advantage of being light weight and thereby reducing the overall cost of construction there by bringing economy in construction, fire resistance and good appearance. The inclusion of silica fume in glass fibre reinforced concrete reduces the environmental pollution and improves the workability and durability properties of concrete. The present paper outlines the experimental investigation conducted on the use of glass fibre with structural concrete and silica fume and also on strength aspect of concrete.***
Keywords: Seismic Loading, Offset, Tall Structure, Torsion

I. INTRODUCTION

A. Overview

Concrete is that the most generally used construction material within the world, mainly thanks to its favourable features like durability, versatility, satisfactory compressive strength, cost effectiveness and availability. Concrete being the most construction material, it's being employed in various applications and also the strength of concrete varies below 60 MPa. just for special application the concrete grade are often increased to 60 MPa and above. These special applications of HPC can not be achieved only by ordinary Portland cement (OPC). it's achieved not only by reducing water cement ratio but also by replacement of cement by some mineral admixture like silica fume, fly ash, glass fibres and also with chemical admixtures. The term HPC is employed for concrete mixture which possess high workability, high strength, high modulus of elasticity, low permeability etc. Substantial reduction of quantity of blending water is that the fundamental step for creating HPC within the range below 0.3 (w/c ratio). The initial interest within the use of silica fume was mainly caused by the strict enforcement of pollution control measures in various countries to prevent the discharge of fabric into the atmosphere. Silica fume could be a pozzolanic material which may be a by-product of silicon smelting process. Silica fume is thought to supply high strength concrete and is employed in two different ways: as a cement replacement so as to cut back cement content and as an additive to enhance concrete Properties. Therefore utilisation of silica fume along with ash produces a motivating alternative and might be termed as high strength and high performance concrete. the utilization of glass fibres in concrete increases the mechanical properties like compressive strength, enduringness. Also flexural behaviour is increased to some extent. It also possesses the flexibility to cut back plastic shrinkage in concrete. the target of this work is to review the behaviour of HPC with silica fume, ash and glass fiber. Hence within the present work the effect of silica fume & ash on development of HPC and therefore the quantity of glass fiber required to regulate crack.

II. LITERATURE REVIEW

S. Durai et al (2013) presented the effect of silica fume and glass fibre in High Performance Concrete (HPC). In this study, High Performance Concrete mixes with silica fume of 0%, 10%, and 20% with addition of glass fibre of diameter 14μ and 12mm length at various percentages as 0%, 0.3%, and 0.6% by the volume of cement on M75 grade of concrete. The mix proportions of concrete had a constant binder of 0.26 and super plasticizer was added based on the required degree of workability. For each mix standard sizes of cubes, cylinders and prisms as per Indian Standards were cast and tested for compressive strength, split tensile strength and flexural strength at the age of 28 days. The addition of silica fume shows early strength gaining property and that of glass fibre control the cracking due to shrinkage. The results are satisfactory for the use of 10% silica fume and 0.3% glass fibre in producing High Performance concrete.[1]

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Vaishali Ghorpade, et.al. High performance concrete (HPC) has been used in various structures all over the world since last two decades. Recently a few infrastructure projects have also seen specific application of high-performance concrete. The development of high performance concrete (HPC) has brought about the essential need for additives both chemical and mineral to improve the performance of concrete. Most of the developments across the work have been supported by continuous improvement of these admixtures. Hence variety of admixtures such as fly ash, rice husk ash, stone dust have been used so for. Also different varieties of fibers have below tried as additions. Hence, an attempt has been made in the present investigation to study the behavior of Glass fibers in High Performance Concrete. To attain the set out objectives of the present investigation, an aggregate binder ratio of 2.0 has been chosen and cement has been replaced partially with Silica fume in four different percentages viz. 0, 10, 20 and 30%. Glass fibers by 0, 0.5, 1.0, and 1.5 % to produce High Performance Concrete. Hardened Glass fiber Reinforced High Performance Concrete (GFRHPC) is tested for Compression, split tension and flexural strengths. This investigation concluded that 10% of silica fume and 1.0% of glass fiber volume which can be used for giving maximum possible compressive strength and split tensile strength at any age for glass fiber reinforced high performance concrete.[2]

Akash Kumar Patel, et.al. In the world, concrete is most widely used construction material they are made in any form and shape. The strength and durability of concrete can be changed by making appropriate changes in its ingredient like cementation material, aggregate and water and by adding some special ingredient like silica fume and Glass fiber. They are produced better strength in concrete. The presence of micro cracks in the mortar aggregate produce weakness in concrete they can be removed by inclusion of silica fume with Glass fiber. They are composite material can be introduced into its resist crack growth. The aim of this paper is to study the behavior of M-35 grade of concrete to determine the compressive strength by partially replacement of cement by mineral admixture such as silica fume and also added Glass fiber. Cement was partially replaced by silica fume in 10% by weight of cement and glass fibers in 1%, 2%, and 3% .The tests were performed according to Bureau of Indian standards. The results thus obtained were compared and examined with respect to the control specimen. It was found that addition of glass fiber in concrete they give variation in strength. From the study they concluded that compressive strength reduces when cement replaced by silica fume. As silica fume percentage increases compressive strength and split tensile strength decreases. It has been observed that the increase in compressive strength for M-35 grade of concrete at 7 and 28 days are observed to be more at 1%. We can likewise utilize the waste product of glass as fiber.[3]

S. Hemalatha, et. al. The study work is focused on strength and durability characteristics of Glass fiber reinforced concrete. As per IS:10262-2009 designed by M40 grade of Concrete and conplats as a super plasticizer and water cement ratio 0.40. The performance of Cement Concrete with varying percentage of Glass Fiber adding like 0.33%, 0.66%, 1%, 1.33%, 1.66%, 2%. The strength and durability properties of Glass Fiber Reinforced Concrete compared to Control Concrete. Based on experimental investigation addition of Glass Fiber in plain concrete increases the strength and durability characteristics. From this study concluded that initially addition of Glass Fiber in the plain concrete the strength characteristics like compressive, flexural and split tensile strength is gradually increased. Finally certain percent addition of Glass Fiber attain that gradually decrease in strength. Maximum compressive, flexural and split tensile strength is attaining in 1.0% addition of Glass Fiber. So adding Glass Fiber up to 1.0% only not exceeds the limit. The durability characteristics gradually increased based on the addition of Glass Fiber.[4]

Parameswararao Gairuboina, et.al. stated that, Since advent of civilization various types of cementitous materials have been used for construction practices. The arrival of Ordinary Portland Cement (OPC) changed the construction activities completely.from olden days concrete suffers from low tensile strength, limited ductility and little resistance to cracking. To overcome these weaknesses a new variety of concrete is desired. Therefore here is an experimental study proposing changes to the conventional concrete to increase fire resistance, increase crack resistance, increase ductility and flexural strength by partial replacement of silica fume to the cement and introducing fibers in the preparation of the concretefor M30 grad of concrete. Literature review suggest that a very few r search work was reported on the concrete made with glass fibers and Silica fume combining HPC and FRC. In this connection an experimental investigation was carried out to determine the compressive, split tensile and flexural strengths with the use of glass fibers and Silica fume in concrete. The glass fibers were added by 0.5%,1.0%,1.5% and 2.0% by volume and cement was replaced by Silica fume in three different percentages of 5%,7.5%,10%,12.5%,15% and 17.5%.by weight of cement..Glass fiber Reinforced Concrete (GFRC) is tested for Compression, split tension and flexural strengths. Therefore . The results of this study indicates the improving of compressive strength ,flexural strength and tensile strength exhibited the highest improvement with 10% and 15% silica fume replacement and glass fiber at 1% respectively.[5]

Swapnil Bhoir et.al. The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Concrete being the most important and widely used material is called up onto possess very high strength and sufficient workability properties.

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Researchers all over the world are attempting to develop high performance concretes by using fibres, silica fume, fly ash and other admixtures in concrete up to certain proportions. In the view of the global sustainable developments, it is imperative that fibres like Glass, and silica fume provides improvement in tensile and compressive strength. This paper features use of Fly Ash, Silica Fume and Glass Fibre and its influences on the properties of M60 grade of fresh and hardened concrete. In this study, High Performance Concrete mixes with fly ash of 20-30%, with addition of silica fume 10% and glass fibre 0-0.3% by volume of cement. An attempt has been made here to find the strength parameters of concrete made with partial replacement of cement by Fly Ash, Silica Fume and Glass Fibres.[6]

S. Durai, et.al. presents that,This paper presents the effect of silica fume and glass fibre in High Performance Concrete (HPC). In this study, High Performance Concrete mixes with silica fume of 0%, 10%, and 20% with addition of glass fibre of diameter 14µ and 12mm length at various percentages as 0%, 0.3%, and 0.6% by the volume of cement on M75 grade of concrete. The mix proportions of concrete had a constant binder of 0.26 and superplasticizer was added based on the required degree of workability. For each mix standard sizes of cubes, cylinders and prisms as per Indian Standards were cast and tested for compressive strength, split tensile strength and flexural strength at the age of 28 days. The addition of silica fume shows early strength gaining property and that of glass fibre control the cracking due to shrinkage. The results are satisfactory for the use of 10% silica fume and 0.3% glass fibre in producing High Performance concrete.[7]

III.CONCLUSIONS

A. From the above reviews conclusion can be drawn that inclusion of glass fibre in specific dose achieve better workability, concrete volume stability and appropriate mechanical properties.

B. Significant increases in compressive, split tensile and flexural strength with the use of glass fibre in various grade of concrete after 28 days of specimens have been observed.

C. GFRC can be proved as effective supplementary structural material with reduced density and has good durability properties.

D. From literature review observed for scope of using supplementary cementing material to make environment friendly concrete.

E. Based on literature review durability and mechanical properties of GFRC with silica fume as supplementary cementing material can be studied as scope of this project.

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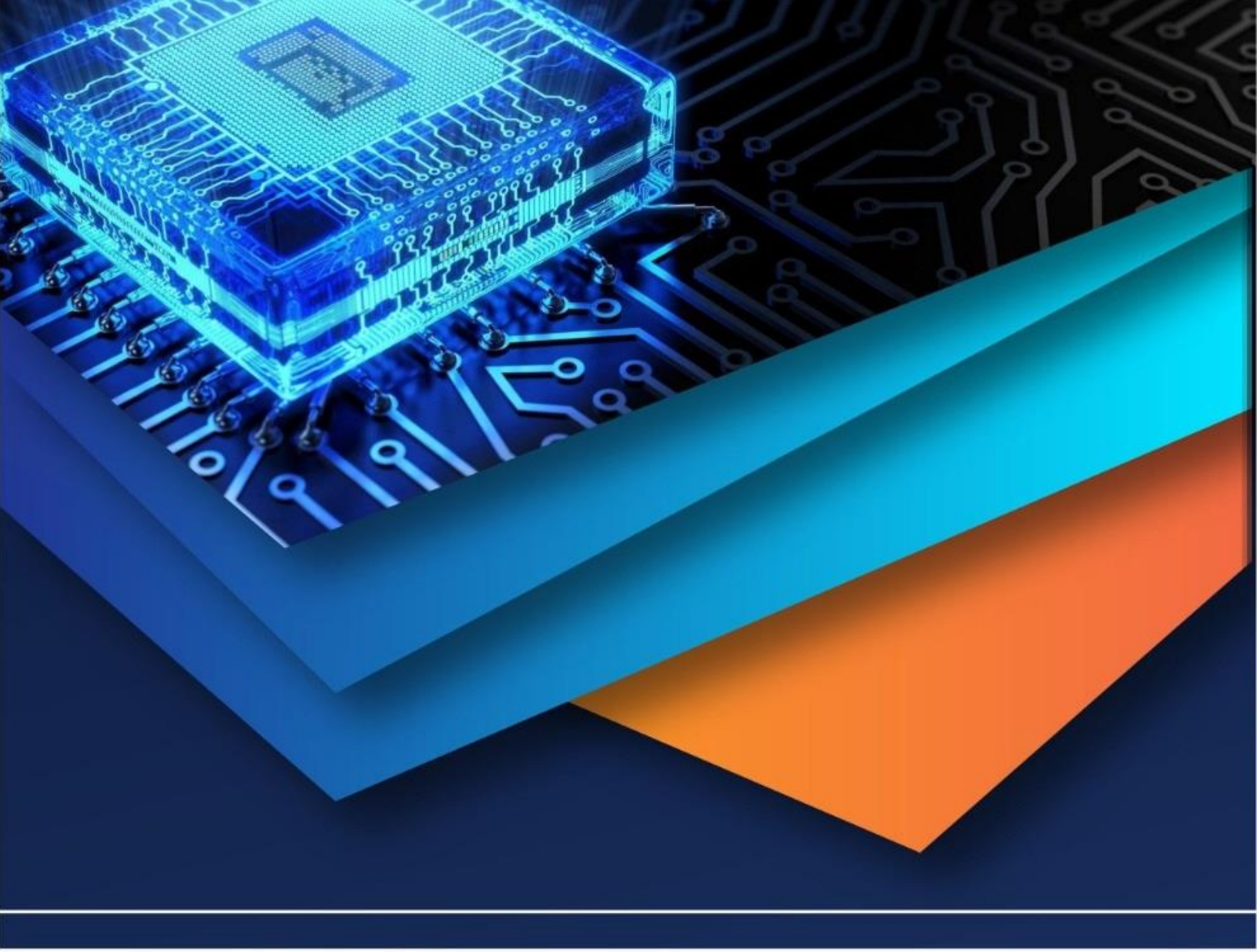

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