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A REVIEW PAPER: TEMPERATURE EFFECT ON ELASTICITY OF CONCRETE CONTAINING GGBFS

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***Abstract*— Concrete is second most consumed material after the water. As the pollution is increasing and the environmental sustainability is affected due to cement manufacturing industries so the researchers are seeking for other materials to reduce the consumption of cement. This Review paper focuses on the literature survey of various characteristics of concrete. From the study of literature papers, it has observed that chemical composition of GGBS material is suitable for blending with Portland cement.**

Keywords— **Ground Granulated Blast Furnace Slag (GGBS), Blast Furnace Slag (BFS), Elevated Temperature, Modulus of Elasticity.**

I. INTRODUCTION

Concrete is the world's most used material after water with around six billion tons of concrete being produced every year. However, pollution and environmental sustainability are at risk in terms of losses due to removal of raw materials and CO2 emissions during cement production. Researchers were pressured to reduce cement consumption by partially replacing cement with supplementary materials. This material can occur naturally, industrial waste or its by-products are low energy. When calcium hydroxide is combined, this pozzolonic material exhibits cementitious properties. Fly posh, silica fume, metakaolin, ground granulated blast furnace slag (GGBS) are the most commonly used pozolans.

This has been proven by natural researchers that the performance of concrete will partially improve as well as reduce construction costs. The waste materials like fly ash, metakaolin, ground granulated blast furnace slag, silica fume, etc. will reduces the construction cost by replacing cement. Amongst the various methods that are used to improves the durability of concrete, and to achieve high performance concrete. Now a days GGBS is a relatively new approach; the main problem is with its fineness and high-water requirement when mixed with OPC. The current paper focuses on exploring modulus of flexibility and other characteristics of concrete using GGBs subject to different elevated temperatures. Ground granulated blast furnace slag (GGBS) is a by-product of blast-furnace used to make iron. The slag of the blast furnace is fed a controlled mixture of ferrous-metal, limestone and coke and it operates at a temperature of about 1,500C. Iron-metal coke When lime is melted in a blast furnace, two products are formed - molten iron and molten slag in molten slag are pale in colour and float on the molten iron head. Molten slag contains silicates and alumina from the original ferrous metal with some oxides of limestone. The process of granular slag involves cooling the molten slag by high-pressure water jets. This slag dissolves rapidly and usually forms granular particles not larger than 5 mm. Rapid cooling of slag prevents the formation of large crystals and the resulting granular material contains about 94% non-crystalline calcium-alumina silicates. The granular blast furnace is further processed by drying the slag and then grinding it in a vertical roller mill or ball mill to form a fine powder, which is GBS. The production of GGBS requires less intensive energy than the energy required for the production of Portland Pozzolana cement. Replacing GGBS with Portland Pozzolana Cement will significantly reduce Cao gas emissions. GGBS is an environmentally friendly building. It can be used to replace 20% to 80% of Portland cement used in concrete**. *Some properties of GGBS are as follows*-** i) The Concrete with GGBS cement is set more slowly in cement content than concrete with normal Portland cement, but gains strength over longer periods of production.

ii) As a result, it is less hydration and easier to avoid low temperature rise and cold joints, but can also affect the construction schedule that requires quick setting. iii) GGBS concrete lasts longer in plastic than Portland cement concrete, which allows the contractor a smoother finish. iv) Higher coefficient temperatures can significantly improve the early aging strength of GGBS concrete.

II. HISTORY OF USING GGBS IN CONCRETE

Following are the summary of previous studies conducted by researchers on the subject:

1. **Newman John and Choo (1968)** recorded that Ground Blast Furnace Slag is a very reactive pozzolanic material. In the presence of water, it reacts with calcium hydroxide to form stable and insoluble cementitious hydrates. This pozzolanic reaction reduces the efficiency and

permeability of the cement paste and makes it more durable and stronger. The use of GGBS improves sulfate resistance, acid seed resistance, freezing and melting resistance as it is possible to partially replace cement in a properly designed concrete mix. And it also increases the resistance to the penetration of chloride ions and removes the alkali silica reaction.

2. **Fulton (1974)** they examined the performance of concrete with GBGS in more detail and also suggested that the increased content of cementitious material paste with GBBS and increased consistency of the paste indicate higher efficiency.

3. **Mayusel and Rose (1982)** reported that the demand for water for general testing is generally 3% to 5% lower than concrete with GGBS for studies related to test mixtures.

4. **Hogan and Meusal (1981)** they experiment on the development of strength properties and durability of concrete, and it is reported that the compressive strength and elastic strength-enhanced characteristics of concrete with GGBS can be wide. Compared to Portland Pozzolana cement concrete, the use of ground granulated blast furnace slag (GGBS) generally decreases at the age of 1 to 3 days and increases at a subsequent age of 7 days and beyond.

Below are some examples of GGBS that have been used in construction. A} In 1968, World Trade Centre, New York (about 40% replacements). B} In 1948, Airfield Pavement of Minneapolis Airport (35 % replacement). C} In 2005, Georgia Aquarium (worlds one of the largest aquariums), (20% to 70% replacements). D} In 2006, Detroit Metro Terminal Expansion (30% Replacement). E} In 1992, Tsing Ma Bridge, Hong Kong (59%-65% replacement).

III. LITERATURE REVIEW

1. **Rafat Siddique and Deepinder Kaur (2011)**.
This paper based on the study of mechanical properties of concrete replaced by GGBS material up to 60%. Then concrete was subjected to elevated temperatures of 100, 200 and 350 ºC. For this purpose, ordinary concrete with a grade of M-35 with GGBFS is used. Measures were taken for compressive strength, split tensile strength, mass loss and modulus of elasticity. This investigation developed some important information about the properties of concrete at temperatures up to 350 ºC during 1 hour of exposure. From the test result, following conclusions had made A} The compressive strength of the concrete mix decreased due to the increase in GGBFS content at normal as well as temperatures of 100, 200 and 350 ºC. B} The Modulus of elasticity of concrete decreases with increases in GGBS content after 40% replacement of cement.

2. **Mohd Shariq and Jagdish Prasad (2013).** They studied the static modulus of elasticity of plain concrete and GGBS concrete. In this paper they determined the static modulus of elasticity at the age of 3, 7, 28, 56, 90, 150 and 180 days for twelve concrete mixes using the cylindrical specimens of plain and GGBFS concrete. The amount of GGBS was used as 20%, 40% and 60%. The conclusions derived from the study are described are as follows: A} The static modulus of elasticity of GGBFS based concrete is less than that of plain concrete for all substitutions of cement and all mixtures by GGBFS.

3. **K.G. Hiraskar and Chetan Patil (2013)** In the present study, the authors have studied how blast furnace slag was used in local industries to find utility as an approximate aggregate in concrete making. Replacing all or part of the BFS will benefit the environment. In this experimental study M30 grade concrete were used by replacing 0, 50, 75 and 100 percent replacement of Coarse aggregate with Blast Furnace Slag. Concrete are allowed 7, 28 and 60 days of curing. After that Compressive strength test, Flexural strength tests and Split tensile test were adopted for all the mixes. From the results, it has concluded that the compressive strength of concrete increased by increasing percentage of Blast furnace slag. Also, Flexural strength and Slit tensile strength were increased by increasing Blast furnace slag.

4. **Rakesh Kumar Patra, Bibhuti Bhusan Mukharjee (2017).** In this existing study, they attempt to explore alternative sources of micro-community by examining the effect of investing in granulated blast furnace slag (GBS) instead of incorporating natural fines on the properties of the concrete mix. In this present study the Flexural, Compressive strength, and Spit tensile strength of concrete were investigated by replacing Natural fine aggregate with Granulated Blast Furnace Slag (GGBS) by 20%, 40% and 60% of GBS at 7, 28 and 60 days of curing days. After test results were found. From the results it has concluded that Compressive strength, Flexural and Split tensile strength of concrete was increased by increases in GBS content.

IV. CONCLUSION

The Following are findings from above literature review papers:

a) The static-modulus- of elasticity of GGBS based concrete is lower than that of conventional concrete by GGBFS for all substitutions of cement for all ages and for all mixtures.
b) Compressive strength of concrete decreased with the increase in GGBFS content at Normal as well as 100 ºC, 200 ºC and 350 ºC temperatures.

c) By using BFS based concrete the compressive strength of concrete increased by increasing percentage of Blast furnace slag. Also, Flexural strength and Slit tensile strength were increased by increasing Blast furnace slag.
d) From Granulated Blast Furnace Slag, the Compressive strength, Flexural and Split tensile strength of concrete was increased by increases in GBS content.

V. REFERENCE

[1] Siddique- R, Kaur D, 2012 "Properties. of concrete containing ground granulated blast furnace slag (GGBFS) at elevated temperatures*" Journal of Advanced Research, Vol. 3, Pg. 45–51.*

[2] Shariq M, Prasad J, Abbas H, 2013 "Effect of GGBFS on age dependent static modulus of- elasticity of concrete" *Construction and Building Materials Vol. 41 Pg. 411–418.*

[3] Hiraskar K and Patil C, 2013 "Use of Blast Furnace Slag Aggregate in Concrete" *International Journal of Scientific & Engineering Research, Volume 4, ISSN 22295518*

[4] Swamy RN, Bouikni A, 1990 "Some engineering properties of slag concrete as influence by mix proportioning and curing" *ACI Mater J 87(3), Pg. 210–20.*

[5] Pascale G, Leo AD, 1984 "Assessment of elastic modulus of concrete and its influence on structural design" *Cem Concr Res 14(5) Pg. 705–16.*

[6] GGBF S - Wikipedia, the free encyclopaedia.

[7] Venu Gopal C, Gokulnath V, 2017 "Par tial Replace ment of Cement with GGBS in Concrete*" International Journal of Advance Research, Ideas and Innovations in Technology" ISSN: 2454-132X, Volume3, Issue5.*

[8] Verma A, Venkat Rao M, et al, 2019 "Study on Strength Characteristics of Ground Gran ulated Blast Furnace Slag Modified Fiber Reinforced Concrete*" International Journal of Engineering Research and Application, Vol. 9,Issue 10, Page. 71-74*

[9] Kodur V, 2015 "Properties of Concrete at Elevated Temperatures" *Hindawi Publishing Corporation, ISRN Civil Engineering Volume 2014, Article ID 468510, pages 15.*

[10] Husain A, Ahmad J, et al 2016, "Effects Of Temperature On Concrete" *International journal of Advance Research in Science and Engineering, Vol. 5, Issue No. 03.*

[11] Kulkarni K, Narayan K, et al, 2013 "Effect Of Elevated Temperatures On Physical And Residual Strength Properties Of Hpc" *International Journal of Scientific & Engineering Research Volume 4, Issue 5, May-2013.*

[12] Ajmera C. and Mundhada A, 2018 "Effect of High Temperatures on Concrete/ RCC: A Review" *International Journal of Engineering Research & Technology, Vol. 7 Issue 03, March-2018.*