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Notice for the PhD Viva-Voce Examination

Ms Gowram Iswarya (Registration Number: 1982304), PhD scholar at the School of Engineering and Technology, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Thursday, 20 June 2024 at 11.00 am in the CDI Conference Room, Block V, Bangalore Kengeri Campus, Bengaluru 560074.

Title of the Thesis	:	**Performance Investigation of the High Strength Concrete Using Natural Zeolite with Industrial Waste Materials**
Discipline	:	**Civil Engineering**
External Examiner (Outside Karnataka)	:	**Dr Dipti Ranjan Biswal** Associate Professor School of Civil Engineering Kalinga Institute of Industrial Technology KIIT Road, Patia, Bhubaneswar, Odisha -751024
External Examiner (Within Karnataka)	:	**Dr Radha Krishna** Professor and Head R V College of Engineering Mysore Road, Bengaluru Karnataka -560059
Supervisor	:	**Dr Beulah M** Associate Professor Department of Civil Engineering School of Engineering and Technology CHRIST (Deemed to be University) Bangalore Kengeri Campus Bengaluru - 560074 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 12 June 2024

ABSTRACT

Concrete is used in the construction of various structural elements. High Strength Concrete (HSC) production for huge infrastructure projects is challenging. The manufacture of cement significantly causes global carbon dioxide (CO2) emissions. Modifications have been made to cement concrete problems to minimize CO2 emissions and Ordinary Portland Cement (OPC) consumption. This research focuses on developing HSC blended with Natural Zeolite (NZ) and by-products of industries like Silica Fume (SF), Fly Ash (FA), and Metakaolin (MK) to enhance concrete quality, sustainability, and performance. Partial replacement of OPC with 5% NZ and industrial waste materials in 5%, 10%, and 15% amounts to produce M60 grade HSC mixes. In the laboratory, 1,200 concrete specimens were tested for mechanical properties for 3, 7, 28, 60, and 90 days, as well as durability tests such as the Rapid Chloride Penetration Test (RCPT) for 28 days and the acid attack test for 60 days. Mix M3 (85% OPC + 5% NZ + 10% MK) exhibited the highest compressive strength at 72 MPa, split tensile strength at 5.3 MPa, and flexural strength at 9.4 MPa for 90 days curing period, attributed to its low porosity. The reactive silica (SiO2) and alumina (Al2O3) in the mix transformed calcium hydroxide (Ca(OH)2) into calcium silicate hydrate (C-S-H) gel and aluminate compounds. This process improved the microstructure of the hardened concrete, resulting in increased imperviousness. The study also includes the effect of these industrial waste materials on Zeolite concrete by microstructure analysis.

The mathematical models were developed using SPSS software to predict the durability and mechanical properties of all the concrete mixes based on the laboratory data, considering parameters like mix proportions and curing days. The developed model can be used for various types of HSC with pozzolanic material to predict the mechanical properties and durability characteristics of the HSC with high accuracy and R2 values (95% for flexural strength of concrete with NZ and MK). In contrast, finite element analysis simulates concrete behaviour under varying loads and pre-defined parameters. Comparing laboratory experimental data with ANSYS numerical values indicated the best mechanical property results, with an acceptable compressive strength difference of 0.002%. The study analyses numerical simulation accuracy and finds experimental and numerical differences.

Keywords: High Strength Concrete, Pozzolanic Material, Natural Zeolite, Fly Ash, Metakaolin, Silica Fume, Mechanical Properties, Durability Properties, Regression analysis.

Publications:

1. **Gowram, Iswarya,** Beulah, M., "Experimental and Analytical Study of High-Strength Concrete Containing Natural Zeolite and Additives." Civil Engineering Journal 8, no. 10 (2022): 2318-2335.
2. **Gowram Iswarya.,** & Beulah, M. "Mathematical Modeling for Evaluating the Mechanical Properties of High Strength Concrete with Natural Zeolite and Additives." Mathematical Modelling of Engineering Problems, 10(3), (2023): 781-789.
3. **Iswarya, Gowram,** and M. Beulah. "Use of zeolite and industrial waste materials in high strength concrete – A review." Materials Today: Proceedings 46 (2021): 116-123.