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## Notice for the PhD Viva-Voce Examination

Mr Sudhir M R, Registration Number: 2270173, PhD Scholar at the Department of Civil Engineering, School of Engineering and Technology, CHRIST (Deemed to be University) will defend his PhD thesis at the public viva-voce examination on Tuesday, 24 February 2026 at 10.15 am in the CDI Conference Hall, Block V, Bangalore Kengeri Campus, CHRIST (Deemed to be University), Bengaluru - 560074, Karnataka, India.

<b>Title of the Thesis</b>	:	<b>Experimental and Analytical Investigation of Composite Columns for Uniaxial Compressive Strength and Concrete Fracture Parameters</b>
<b>Discipline</b>	:	<b>Civil Engineering</b>
<b>External Examiner - I</b>	:	<b>Dr Lakshmi Varaprasad M</b> Associate Professor Department of Civil Engineering National Institute of Technology (NIT) Silchar Cachar, Silchar Assam - 788010
<b>External Examiner - II</b>	:	<b>Dr Shreelaxmi Prashant</b> Associate Professor Department of Civil Engineering Manipal Institute of Technology (MIT) Manipal - 576104, Udupi Karnataka
<b>Supervisor</b>	:	<b>Dr Beulah M</b> Associate Professor Department of Civil Engineering School of Engineering and Technology Bangalore Kengeri Campus CHRIST (Deemed to be University) Bengaluru - 560074 Karnataka, India.

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.

**Place:** Bengaluru  
**Date:** 10 February 2026



**Registrar**

## ABSTRACT

In recent years, the repair, rehabilitation, and retrofitting of the structures have emerged as critical challenges in civil engineering practice and research. This growing focus is largely attributed to several key factors: the realization that initial design loads may have been underestimated; the increasing demand for higher load-carrying capacities due to changes in usage or updated code requirements; the presence of structural vulnerabilities resulting from inadequate detailing; and the progressive deterioration of materials over time, including corrosion and other age-induced degradation mechanisms. These issues necessitate the development and implementation of effective strengthening strategies to ensure the continued safety, functionality, and resilience of aging infrastructure. In the above cases, strengthening is provided by replacing abortive components, decreasing spans, enlarging elements, providing additional bracing, or adding external reinforcement. External reinforcement is provided through carbon fibre reinforced polymer (CFRP) composites and near-surface mounting (NSM) laminates. This research examines the composite column's strength characteristics strengthened by CFRP and NSM techniques by experimentation and statistical modelling. The study also presents an applicable computational framework involving Extreme Gradient Boost (XG Boost), an ensemble machine learning (ML) approach supported by SHapley Additive exPlanations (SHAP) interpretations. The fracture behaviour and toughness characteristics of concrete represent a complex and evolving area within the field of material mechanics, where comprehensive understanding is still developing. Fracture mechanics has gained prominence as a theoretical framework to interpret empirical design approaches, establish consistent safety margins, evaluate service performance, and analyse structural failure. Fracture in any material involves an energy-driven process encompassing the initiation of microcracks, their localisation, and the eventual propagation of a macrocrack leading to complete material separation. The material's toughness reflects the amount of energy required for this process. To better understand the fracture response of concrete, significant research has been focused on experimental and analytical exploration of its heterogeneous microstructure. These investigations aim to predict and rationalise the fracture mechanisms inherent in concrete, thereby enabling the optimisation and enhancement of its performance. In this context, the present study examines the fracture behaviour of concrete by experimentally determining fracture parameters across multiple concrete grades and notch configurations, supplemented by statistical analysis and modelling using genetic algorithm.

*Keywords: Concrete, composite columns, fracture parameters, experimentation and statistical, genetic algorithm based and machine learning modelling.*

### Publications:

1. **Sudhir, M. R.**, and M. Beulah. "Multigene Genetic Programming Based Prediction of Concrete Fracture Parameters of Unnotched Specimens." *Civil Engineering Journal* 9, no. 2: 393-410, 2023.
2. **M. R. Sudhir** and M. Beulah. "Experimental Investigation of Uniaxial Compressive Behaviour of Composite Columns without and with Full and Partial CFRP Wraps." *Practice Periodical on Structural Design and Construction (ASCE)* 29, no. 3: 04024019, 2024.
3. **Sudhir, M. R.**, and M. Beulah. "Mathematical Modelling of Concrete Fracture Energy of Notched Specimens Using Experimental Evidence." *Iranian Journal of Science and Technology, Transactions of Civil Engineering*, 49(4), 3403-3416., 2024.