



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

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Programme of Study : Ph.D.

Thesis Title: **RELIABILITY ANALYSIS AND PERFORMANCE-BASED CODE CALIBRATION FOR BLAST RESISTANT PANELS SUBJECTED TO AIR AND CONTACT BLAST**

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SHORT ABSTRACT

Blast threats call for an evolution of design approach for protective structure that can address both resiliency and sustainability aspects of construction. Blast resistant design is performed based on the empirical design charts, where the blast loading is simply characterized by charge weight and stand-off distance. These empirical formulations assume either a spherical free air blast or a hemispherical surface blast and do not account for variation in charge shape, orientation, point of detonation. The peak overpressure and its duration is applied on the structure uniformly which is non-uniform in case of contact blast. Therefore, while facing a contact blast problem, which is directly placed on a structure these empirical design charts are not much helpful. A multilevel Performance-based Design (PBD) framework is developed for slabs/walls of Protective structure subject to different blast loading to improve the present Blast resistant design approach in Code provisions which is currently based on ultimate strength of the structure only. The present research develops probabilistic deflection-based capacity and air blast demand models for three performance levels associated with four damage states of reinforced Normal Strength Concrete (NRC) and reinforced Ultra-High Strength Concrete (UHSC) slabs/walls of protective structures. It also investigates the NRC and UHSC Panel under contact blast and presents the probabilistic capacity and demand models for three performance levels of damage. For this, a set of data is generated through experimental design of numerical modeling and simulations that are carried with the help of commercial simulation software package LS-DYNA. The influence of blast on slabs/walls of protective structures is modeled using a validated Finite Element (FE) approach on a square panel arrangement. Validations are in close agreement with the previous experiments available. Fragility estimates are developed for effect of air and contact blast on NRC and UHSC panel to show the consistency of the developed FE model and probabilistic formulations. Hazard curves are also established for mass of blast charge and stand-off distance to determine the distribution of the dataset. The reliability-based code calibration is performed for the development of PBD Load and Resistance Factors at the three performance levels based on the established probabilistic models and hazard curves; which circumvents the limitations of present Code provisions. The developed Load and Resistance Factors for Code provisions can be used for the design of NRC and UHSC panel when subject to air and contact blast without performing exhaustive analysis and/or experiments. A High Strength Concrete (HSC) matrix is also developed in reference with earlier studies in site with locally available materials under uncontrolled conditions for show the feasibility of adopting high strength concrete in practical field. The High Strength Concrete developed is then used in a blast resistant building frame and ground floor slab with analysis and simple design with SAP software.