



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

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**SHORT ABSTRACT**

Recent years have seen rapid urbanization and substantial economic growth, resulting in a concentration of population in smaller urban areas. This population growth has led to a notable increase in the construction of highrise buildings. Especially in regions prone to earthquakes, the multistoried Reinforced Concrete (RC) frame buildings are provided with RC structural walls, commonly known as shear walls, to enhance the lateral strength and lateral stiffness of the buildings. Thus, a detailed understanding of the seismic behaviour of these structural walls is imperative when evaluating the seismic performance of those highrise buildings. In the context of seismic performance evaluation for any structure, one of the major aspects is the assessment of its seismic vulnerability, established by employing fragility relationships that associate distinct seismic intensity levels with the relevant seismic response parameters.

The main objective of the thesis is to conduct a thorough seismic fragility assessment of a reinforced concrete (RC) frame building with structural walls using finite element modelling. Initially, an appropriate Engineering Demand Parameter (EDP) for the RC wall-frame structure has been chosen, as prior research had not specified one. The concept of fragility is inherently associated with uncertainty originating from different sources. The study attempts to accurately characterize and quantify the record-to-record variability and the uncertainty due to random structural capacity parameters. Thereafter, analyses have been carried out on isolated slender RC wall specimens to develop predictive expressions for estimating lateral drift levels at different damage state thresholds utilizing Genetic Programming.

The study integrates findings on key fragility parameter selection, uncertainty analysis, and damage state definitions to estimate fragility for the examined building typology. It highlights the significant impact of both epistemic and aleatory uncertainties on fragility relationships. The research develops and assesses fragility relationships for both a specific RC wall-frame structure and the entire RC wall-frame building, using scalar and vector-valued IMs. Additionally, a streamlined procedure has been introduced for deriving reliable fragility estimates with fewer ground motion records, while ensuring consistency with estimates from a complete record set.

Essentially, the study on seismic fragility assessment provides insights into the performance of RC wall-frame buildings across varying seismic demands. It addresses key questions in fragility assessment, particularly for RC wall-frame building typologies, such as incorporating uncertainty sources in seismic analysis, choosing between a representative frame or the entire structure, using single or multiple IMs for reliable fragility estimates, and reducing computational complexity while maintaining efficiency. This numerical framework can serve as a useful tool for future research on deriving fragility estimates for different structural components and systems exposed to various hazards.