INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	NIRANJAN BORAH
Roll Number	:	186104024
Programme of Study	:	Ph.D.

Thesis Title: Development of Seismic Source Zonation Maps, Seismic Hazard Maps (Using Multiple Approaches) and GMPE for North East India

Name of Thesis Supervisor(s)	:	Dr. Abhishek Kumar
Thesis Submitted to the Department/ Center	:	Department of Civil Engineering
Date of completion of Thesis Viva-Voce Exam	:	09/04/2024
Key words for description of Thesis Work	:	Seismicity, Clustering, Seismic Hazard, Seismic Source zone, Kernel Density, Paleo Earthquake, GMPE

SHORT ABSTRACT

The region of North East India (NE India) exhibits a notable high occurrence of seismic activity. The history of the past devastating earthquakes in the region clearly shows the need for a preparation plan to mitigate the disaster caused by EQs. For EQ disaster mitigation, seismic hazard levels within the region are required to be estimated. However, incomplete earthquake data poses considerable challenges to understanding seismic hazards in the region. This thesis aims to address this gap through a comprehensive analysis to enhance seismic hazard analysis in NE India. The study performed the delineation of seismic source zones using clustering techniques and spatial analysis based on past EQ locations and seismicity parameters. This process allows us to achieve a better understanding of seismic activity distribution in the region. The present work conducted probabilistic seismic hazard analyses (PSHA) using traditional and kernel-based methodologies considering these source zones. While performing the Kernel-based PSHA, the present work utilized information about the past paleo EQs along with their uncertainties related to locations and magnitudes. The results highlighted varying seismic hazard levels across NE India, with the eastern region of Manipur and the southern region of Nagaland exhibiting the highest hazard due to significant past earthquake occurrences and the size of seismic events. On the other hand, certain areas in Sikkim, Arunachal Pradesh, and Assam showed comparatively lower seismic hazard levels. Further, the present work performed the deaggregation of seismic hazard levels focusing on key cities in NE India, explaining the contributions of different seismic sources and different magnitudes of EQs to the overall hazard level. It was found that the contributions of strong EQs are mainly controlling the seismic hazards in the region. Additionally, this thesis presents a ground motion prediction equation (GMPE) designed for Northeast India. This GMPE is developed based on regional parameters and synthetic ground motions, allowing for the prediction of ground motion levels across different soil conditions. Validation against regional records confirms the efficacy of the proposed GMPE, instilling confidence in its utility for seismic risk assessment and engineering design purposes in the region. Overall, this thesis provides valuable insights into the region's seismic hazard scenery by combining methodologies for seismic source zonation, probabilistic seismic hazard assessment, and ground motion prediction. The findings can be utilized for urban planning, infrastructure development, and disaster preparedness efforts to develop resilience in the face of seismic events in Northeast India.