INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Traditional Assam-type wooden houses are popular housing systems in the seismically active north-eastern Himalayan region of India. These have performed exceptionally well during the past several earthquakes on contrary to RC structures. Apart from its high seismic resilience, the housing system has a number of features that are uniquely different from other traditional wooden houses, e.g., its construction methodology, timber framing system, special type of connection between framing members, light-weight walls and roof, and good wall-to-frame connections that contribute to their earthquake safety. In spite of having excellent earthquake-resistant features, the Assam-type houses have not received due attention and seismic performance has not been studied so far. Therefore, a maiden attempt has been made to evaluate the seismic behavior of Assam-type houses scientifically. To evaluate the seismic behavior, full-scale frames of a single-story Assam-type house were tested under quasi-static cyclic and monotonic lateral loads. The influence of timber framing members, connections, openings (window, door) and infills (*Ikra* panels) of the frame specimens was studied to get deeper insights into the lateral-load behavior. Results showed excellent behavior in terms of high lateral drift and ductility capacity without any significant drop in the lateral strength. The physical and mechanical properties of materials used in timber framing and infill (*Ikra*) panels of the house were experimentally evaluated under relevant loading conditions to scientifically study their behavior and understand their contribution in the global lateral load carrying capacity of Assam-type houses.

The behavior of seven different connections generally provided in Assam-type houses were also evaluated under relevant loading conditions to assess the performance and contribution of the different connections on the overall lateral load behavior. The primary connections of the timber frame hardly suffered any significant damage under the lateral loading, and the performance was found to be much superior compared to the behavior of connections in other vernacular houses. Experimental results were used to develop to the simplified (macro) as well as detailed (micro) finite element models to predict the lateral load behavior of frames of Assam-type houses. While the macro modelling was found to be very effective in estimating the lateral strength of the frames, the micro modelling was found to satisfactorily simulate even the damage accumulated in different members.

Further, to ascertain their seismic behavior, the dynamic behavior of traditional Assam-type houses was evaluated on full-scale single-storey 3D house specimen using a large number of recorded and synthetic ground motions with increasing PGA amplitude under shake table tests. The specimen exhibited excellent behavior without any significant damage even under extreme level of shaking. Since the house specimen did not suffer significant damage under dynamic loads, a quasi-static test was carried out on the same house specimen after the shake table test to evaluate its lateral load carrying capacity. The experimental results showed very high deformability and ductility capacity of the house. Results obtained in the experimental study were finally used to develop an empirical regression model for estimation of the lateral strength of Assam-type housing frame and the entire house. Finally, construction guidelines for Assam-type houses were made to further improve the seismic performance. The extensive experimental study on Assam-type wooden housing can be used to scientifically convince the local people, who have started constructing reinforced concrete buildings without fully understanding their construction and design aspects, to again adopt the practice of construction of such houses. This, in turn, may reduce the seismic risk in the region by controlling the construction of informally constructed reinforced concrete buildings.