

Protection of Vulnerable Building Stock from Earthquake: NDMA's initiatives

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India is vulnerable to a wide range of natural hazards, one of which is earthquakes. Approximately 58.6% of the country's land is affected with different levels of severity as EQ zone II, III, IV & V (Kumar, 2015). These areas are home to approximately 80% of India's population.

Earthquakes in the recent past in India caused widespread damage, resulting in the loss of lives and property. These damaging earthquakes have exposed the high vulnerability of the existing building stock, owing primarily due to not following earthquake resistant features specified in Indian Standards and Building Codes, absence of regulatory mechanism, and lack of proper monitoring of adhering to building bye-laws. Generally in the event of an earthquake, unreinforced masonry buildings and non-engineered buildings show poor performance due to the inherent brittleness, lack of tensile strength, and lack of ductility which means the lack of properties provided by the steel reinforcements in reinforced masonry. More than 70% of the building stock is masonry construction and even a moderate earthquake can devastate these buildings, resulting in a massive death toll.

Demolition and replacement of the enormous building stock are neither feasible nor practical because of its volume and expectation to meet out shelter problems. BMTPC's Housing Vulnerability Tables based on Census 2011 of each state show that India has a large stock of seismically unsafe buildings (BMTPC, 2019). Earthquakes are not the major cause of loss of lives, it is often the buildings and built environment that put people at risk i.e. becomes a phenomenon of a natural disaster being transformed into a man-made disaster. Even in the current situation, many buildings with no earthquake resistance features are being added to this stock each year. Hence, earthquake risk is high due to the hap-hazard construction of non-engineered buildings.

The primary goal for addressing this issue should be to avoid loss of life due to the collapse of buildings and structures during any seismic event. As a result, there is a critical need to take mitigation measures to ensure a safe built environment. Hence there is a need to identify the weak links in the various typologies through seismic evaluation methods such as condition assessment, visual survey, and some Non-Destructive Test (NDT) and accordingly suggest cost-effective retrofitting options to strengthen existing buildings against probable future earthquakes.

The aim of the seismic evaluation is to determine the seismic capacity and vulnerability of buildings during an earthquake to determine the amount of retrofitting required. Seismic retrofitting is defined in IS 13935: 2009 as “Many existing buildings do not meet the seismic strength requirements of present earthquake codes due to original structural inadequacies and material degradation over time or alterations carried out during use over the years. Their earthquake resistance can be upgraded to the level of the present day codes by appropriate seismic retrofitting techniques”. Retrofitting aims at increasing the lateral resistance of the building. Retrofitting is important but it is a technical extensive, time-consuming, and cost exhaustive exercise. One way to promote it is through government initiatives. Simultaneously, Urban Local Bodies (ULBs) and Panchayati Raj Institutions (PRIs) should ensure seismically safe construction by enforcing Techno-legal regime and training manpower (Engineers, Architects, masons, bar-benders, etc.) on earthquake construction practices and retrofitting.

As part of its responsibility under DM Act of 2005, NDMA has taken various measures for earthquake resistant construction with the help of various agencies in order to reduce the losses due to earthquakes. The following are projects that NDMA has completed or is currently working on in relation to the subject:

- (i) **Home Owner's guide for Earthquake & Cyclone safety (2019)**, provides details to those who are constructing a house or who are buying a flat in multi-storey buildings, which are made of either masonry or reinforced concrete (RC)
- (ii) **A Primer on Rapid Visual Screening (RVS) Consolidating Earthquake Safety Assessment Efforts in India (2020)**, can be referred to as a base document to visually examine a building and identify features that affect the seismic performance.
- (iii) **Simplified Guidelines for Earthquake Safety (2021)**, provides minimum requirements that have to be complied with while constructing a earthquake resistant house.
- (iv) **Pilot Project to improve earthquake Resiliency of Masonry Lifeline Structures and upcoming constructions (Ongoing)**: The project aims to improve the earthquake resilience of lifeline structures in the states of Tripura, Uttarakhand, and North Delhi Municipal Corporation (NDMC), which includes retrofitting of selected masonry lifeline buildings, construction of technology demonstration unit and capacity building of engineer, bar benders, and carpenters. The main objectives of the scheme are:

- Structural safety audit of selected lifeline masonry buildings.
- Retrofitting of selected lifeline masonry buildings.

- Construction of Technology Demonstration Units to showcase the earthquake-resistant technology (one each in the project States/UT).
- Capacity Building-Training of engineers, masons, bar-benders, and artisans.
- Awareness generation of masses by promotion of IEC materials