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# Preparedness and Mitigation for Earthquakes: Are We Ready?

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**Abstract**

Earthquake is one of the most destructive natural disasters on the planet. Earthquake effects can cover hundreds of thousands of square kilometres, causing damage to structures or infrastructure facilities, causing hundreds of thousands of people to die or be injured, and disrupting the social and economic functioning of the affected area. Typically, the effects will increase significantly as the population and structures or infrastructure facilities grow. Meghalaya witnessed the great earthquake that occurred on June 12, 1897, at 17:15 local time, as one of the most horrific day in human history, as the day is marked with the most powerful earthquake recorded in human history, with an estimated moment magnitude of 8.2-8.3. It resulted in approximately 1,542 human casualties and catastrophic infrastructure damage. With this incident, Meghalaya must be prepared to deal with disasters that originate not only in our country but also in neighbouring countries. Lessons from the 1897 Assam/Meghalaya earthquake have shown that earthquakes can have significant effects even at a greater distance due to the long period component of shear waves. As a result, earthquake preparedness and mitigation are required to reduce damage and loss of life and property, as well as to find a solution for mitigating the effects.

**Key words:** Preparedness, Mitigation, catastrophic, damage, liquefaction, landslides and earth ruptures.

## Introduction

A disaster is an unexpectedly negative or unfortunate extreme event that causes horrific damage to humans, plants, and animals. In such an instantaneous manner, disasters occur unpredictably and without discrimination. It is difficult to adjust and predict because these events, whether natural or man-made, always exceed the tolerable magnitude or go beyond certain limits. As a result, many people are killed, property is destroyed, and income is lost.

These occurrences aggravate natural environmental processes, resulting in disasters for human society, such as sudden tectonic movements resulting in earthquakes and volcanic eruptions, continued dry conditions resulting in prolonged droughts, floods, atmospheric disturbances, celestial body collisions, and so on (Joshi, 2008).

Disasters and civilizations have always coexisted. Many infrastructure and permanent assets have been created as a result of development initiatives and rapid technological advancement. Material development gradually separated man from nature on the one hand, while increasing the vulnerability of the human population on the other. The progressive increase in disaster-related loss of life, property, and environmental damage prompted the international community to reconsider disaster management in a new light, one that crosses international boundaries, anticipates potential threats, and allows disasters to be addressed from the outset.

Almost every day, newspapers, radio, and television stations broadcast reports on disasters that have struck various parts of the world. But what exactly is a disaster? The term disaster comes from the French word "desastre," which combines two words: "des" (bad) and "aster" (star). As a result, the term refers to a 'Bad or Evil star'. The United Nations defines disaster as "a serious disruption of the functioning of a community or society resulting in widespread human, material, economic, and environmental losses that exceed the affected community/ability society's to cope using its own resources" (UNDP). A disaster is caused by a combination of hazards, vulnerability, and insufficient capacity or risk-mitigation measures. A disaster occurs when a hazard strikes a vulnerable population, causing damage, casualties, and disruption.

With the United Nations' climate summit, COP27, only a month away, natural disasters and their costs remain at the forefront of lawmakers' and activists' minds. As extreme weather events become more common as a result of climate change, those costs rise. Floods in India and Nigeria, drought in Uganda, and earthquakes in Afghanistan were among the worst disasters of 2022.

Earthquake preparedness is a collection of actions taken at the individual, organizational, and societal levels to reduce the effects of an earthquake. Preparation measures can include everything from securing heavy objects, structural modifications, and stockpiling supplies to having insurance, an emergency kit, and evacuation plans (Joffe et al, 2016).

Preparedness can include survival measures, preparation to improve survival in the event of an earthquake, or mitigating measures to reduce the impact of an earthquake. Common emergency preparedness measures include stockpiling food and water and educating people on what to do in the event of an earthquake.

Preparedness begins in an individual's daily life and includes items and training that would be useful in the event of an earthquake. Individual preparedness is followed by family preparedness, community preparedness, and finally business, non-profit, and governmental preparedness. Some organisations combine these levels. Businesses are encouraged to have a Disaster Recovery Plan as part of their business continuity planning.

Preparedness can also include psychological preparedness: resources are intended to help both community members affected by a disaster and disaster workers who serve them.

**Building design and retrofitting**

Seismic codes in earthquake-prone areas may include specific requirements designed to increase the earthquake resistance of new buildings. Older buildings and homes that are not up to code can be modified to make them more resistant. Elevated motorways and bridges also use modification and earthquake resistant design.

Building codes are not intended to make buildings earthquake proof in the sense that they will sustain no damage. The goal of most building designs is to reduce earthquake damage to a building so that occupants' lives are not jeopardised, and thus tolerance of some limited damage is accepted and considered a necessary trade-off. Implementing earthquake-resistant furniture can be a supplement or precursor to retrofitting.

Earthquake modification techniques and modern building codes are intended to prevent total building destruction in earthquakes measuring no more than 8.5 on the Richter scale. Although the Richter scale is used, one of the most important factors to consider in building resiliency is the intensity of localised shaking.

A multi-hazard approach, in which communities prepare for multiple hazards, is more resilient than a single hazard approach and is gaining popularity (Scawthorn et al, 2006).

Despite efforts to raise public awareness, levels of preparedness remain generally low (Joffe et al, 2013). There are various methods for promoting disaster preparedness, but they are rarely well documented and their effectiveness is rarely tested (Verrucci et al, 2016). Hands-on training, drills, and face-to-face interaction have been shown to be more effective at changing behaviour. Digital methods, such as educational videogames, have also been used (Joffe et al, 2019).

**Earthquake Preparedness measures.**

Nobody knows when or where an earthquake will occur, but you can prepare yourself and your family in advance. Make an earthquake preparedness plan and practise earthquake safety today.

**Earthquake Mitigation measures.**

Earthquake mitigation measures are typically designed to reduce both casualties and damage in the event of future earthquakes. The following are examples of common earthquake mitigation measures:

- Structural mitigation measures that improve a building's ability to withstand seismic forces. Structural measures include strengthening the building elements that support the structure and resist lateral forces from wind and earthquakes, such as foundations, columns, load-bearing walls, floor diaphragms, roof diaphragms, and the connections between these structural elements.
- Non-structural mitigation measures such as parapets, chimneys, non-load bearing walls, fire sprinkler systems, HVAC systems, suspended ceilings and lights, windows, water heaters, furnaces, air conditioners, and emergency generators to restrain, brace, anchor, or otherwise improve the seismic resistance of non-structural building components.
- Non-structural mitigation measures to restrain, brace, or anchor building contents, particularly tall and/or heavy items that, if they fall, pose a risk to life, such as bookcases, file cabinets, storage shelves, computers, monitors, televisions, and others.

- Replacement of an existing building with significant seismic deficiencies with a new building up to code. Replacement is typically more expensive than retrofit, but it may be appropriate if retrofit costs are high, particularly if the existing building is in poor overall condition, requires non-seismic repairs, is nearing the end of its useful life, is functionally obsolete, or has other deficiencies such as being inefficient.
- Replacement with a new building on a different site may be appropriate if an existing site is also subject to other natural hazards, such as tsunamis or floods, or significant anthropogenic hazards, such as proximity to a major hazmat site.
- Design and construction of a new facility must meet seismic standards higher than those mandated by building codes, particularly for structures that could be used as emergency shelters.
- Practising drop, hold, and cover drills, which, while they may lessen injuries from falling objects, are not a replacement for other mitigation measures for structures with significant structural seismic flaws and that could potentially collapse during major earthquakes.
- Creating a map of the nation's vulnerabilities, informing the public about vulnerability risks, and teaching them how to minimise the negative effects of disasters.
- Modifying the types of homes and building designs in the most vulnerable areas, and discouraging the development of high-rise structures, sizable industrial facilities, and sprawling urban centres there.
- Lastly, requiring major construction projects in vulnerable areas to use light materials and earthquake-resistant designs.

**Conclusions**

In recent years, disasters and the damage they cause have increased dramatically. The number of natural and man-made disasters has steadily increased over the last decade. Methods and tools for cost-effective and long-term interventions have an impact on disaster management policy responses. Nonetheless, responsible institutions must play a critical role in disaster management.

Meghalaya lacks long-term, inclusive, and coherent institutional arrangements to address disaster issues with long-term benefit. Because disasters are always viewed in isolation from the processes of mainstream development and poverty alleviation planning, integrated planning between disaster management, development planning, and environmental management institutions is almost non-existent.

The lack of a centralised authority for integrated disaster management, as well as a lack of coordination within and among disaster-related organisations, is to blame for less effective and efficient disaster management. Non-structural elements such as local people's knowledge and capacities, as well as related livelihood protection issues, are frequently undermined because state-level disaster preparedness and mitigation measures are heavily weighted towards structural. Finally, a greater capacity of the individual/community and environment to face disasters would significantly reduce the impact of a hazard.

**Way forward for earthquake preparedness**

In high-risk seismic zones, a special earthquake management department must be established. In the hilly region, the traditional Khasi house model must be promoted. Offering tax breaks to people who build earthquake-resistant structures. A single point of contact for various divisions of response must be established in order to improve coordination. Training and capacity building of the local population is required.

Empowering village and municipal corporations in earthquake management and response would be an efficient way to accomplish this. Coordination with other departments to mitigate earthquake after effects. The fund and technical expertise must be supplemented by state governments.

To localise research and programs, research and development centres must be established in states like Uttarakhand and other high-risk areas. For high-risk prone states, para-diplomacy in disaster relief can be a useful tool for cooperation.

Even though we cannot stop natural earthquakes from happening, we can greatly reduce their effects by identifying risks, erecting safer structures, and disseminating information on earthquake safety. We can lessen the risk of earthquakes caused by humans by being prepared for natural quakes.

Indigenous earthquake-resistant housing technologies have emerged in various parts of the world to help people survive earthquakes safely. Other critical factors addressed by these technologies include the availability of local construction materials, the functionality of building designs, and the safety of occupants from weather extremes.

A great deal of knowledge about the characteristics of materials and structural components is needed, as well as appropriate analytical techniques, in order to assess strength, stability, and the likelihood of a future earthquake. In the near future, the following fundamental studies are preferred:

- The development of more practical techniques for analysing traditional native buildings.
- Dynamic response measurements to help with period of vibration and damping characteristics estimation.
- Material and structural strength tests;
- Chemical and other necessary tests to evaluate the properties of the materials used in the past and their long-term compatibility.

The need for such studies for particular societies and communities with typical building typologies and traditional construction methods is also necessary to prevent uncertainty in the decision-making process during the reconstruction phases following an earthquake.

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## PHOTOS COLLECTIONS ON EARTHQUAKE SCENERIO IN MEGHALAYA 1897.

Figure 1. Meghalaya Earthquake hazard Map (Source: State Disaster Management Authority, Meghalaya).

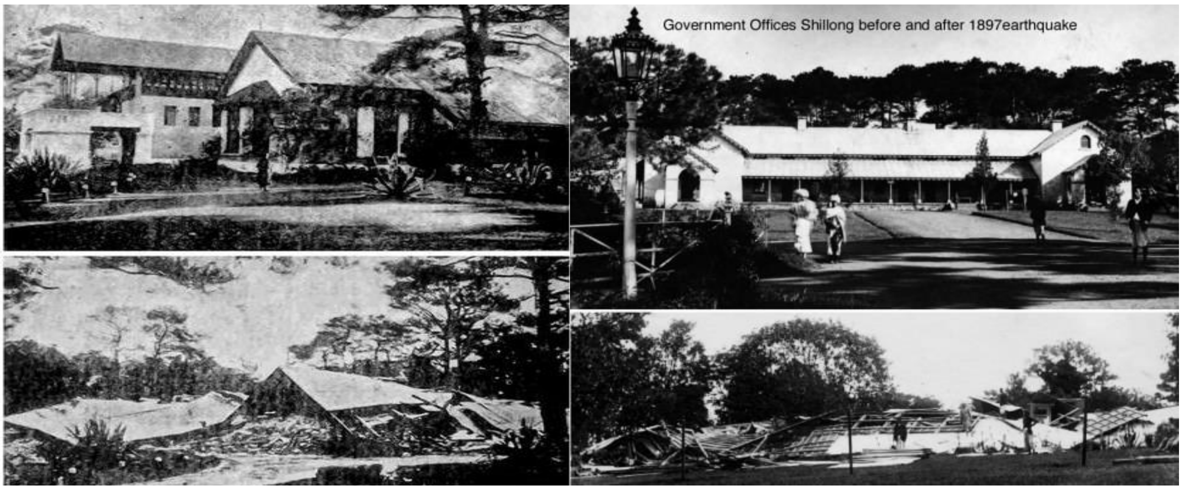


Figure 2. The Government House in Shillong before and after the 1897 earthquake (Oldham 1899)

Figure 3. Shillong Church before and after the Earthquake 1897 (Oldham 1899)

Figure 4. The Shillong Bazaar before and after the earthquake 1897 (Oldham 1899).

Figure 5. Shillong bridge toward Dawki: Impact of Earthquake 1897

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## RECOMMENDED HOUSE TYPE FOR EATHQUAKE PRONE AREAS

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