



## **PREVENTIVE AND MITIGATION MEASURES**

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When earthquake strikes a building is thrown mostly from side to side, and also up and down along with the building foundation the building structure tends to stay at rest, similar to a passenger standing on a bus that accelerates quickly. Building damage is related to the characteristics of the building, and the duration and severity of the ground shaking. Larger earthquakes tend to shake longer and harder and therefore cause more damage to structures<sup>1</sup>.

For better understanding of all the possibilities of earthquake risk reduction, it is important to classify them in terms of the role that each one of them could play. Therefore, in the pre-earthquake phase, preparedness, mitigation and prevention are concepts to work on. Post-disaster, immediate rescue and relief measures including temporary sheltering soon after an earthquake until about 3 months later and re-construction and re-habilitation measures for a period of about six months to three years need to follow<sup>2</sup>.

### **Structural<sup>1</sup>**

No buildings can be made 100% safe against earthquake forces. Instead buildings and infrastructures can be made earthquake resistant to certain extent depending upon serviceability requirements. Earthquake resistant design of buildings depends upon providing the building with strength, stiffness and inelastic deformation capacity which are great enough to withstand a given level of earthquake-generated force. This is generally accomplished through the selection of an appropriate structural configuration and the careful detailing of structural members, such as beams and columns, and the connections between them.

There are several different experimental techniques that can be used to test the response of structures to verify their seismic performance, one of which is the use of an earthquake shaking table (a shaking table, or simply shake table). This is a device for shaking structural models or building components with a wide range of

simulated ground motions, including reproductions of recorded earthquakes time-histories.

### **Nonstructural<sup>3</sup>**

For getting the structural measures implemented with due earnestness, honesty of purpose and sense of compulsion host of non-structural measures in the form of policies guidelines and training have to be provided.

- Policy decisions about construction of structures with due approval from specified authorities have to be taken. The building codes etc have to be suitably formulated/amended and appropriately detailed and legal implications properly stated.
- Guidelines both for earthquake-resistant constructions as well as for retrofitting have to be formulated with specifications about site selection, foundation, construction, materials and workmanship making involvement of specialist architects, trained engineer and masons mandatory.

The guidelines have to be formulated for the concerned authorities about land use planning, monitoring of construction work and controlling of settlements in hazard prone areas to avoid fatalities and loss of property.

### **Seismic Retrofitting<sup>1</sup>**

Seismic retrofitting is the modification of existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes. With better understanding of seismic demand on structures and with our recent experiences with large earthquakes near urban centres, the need of seismic retrofitting is well acknowledged.

### **Pre-Disaster Preventive Measures<sup>2</sup>**

#### **Long-term measures**

- Re-framing buildings codes, guidelines, manuals and byelaws and their strict implementation. Tougher legislation for highly seismic areas.
- Incorporating earthquake resistant features in all buildings at high-risk areas.
- Making all public utilities like water supply systems, communication networks, electricity lines etc. earthquake-proof. Creating alternative arrangements to reduce damages to infrastructure facilities.
- Constructing earthquake-resistant community buildings and buildings (used to gather large groups during or after an earthquake) like schools, dharamshalas, hospitals, prayer halls, etc., especially in seismic zones of moderate to higher intensities.
- Supporting R&D in various aspects of disaster mitigation, preparedness and prevention and post-disaster management.
- Evolving educational curricula in architecture and engineering institutions and technical training in polytechnics and schools to include disaster related topics.

### **Medium term measures**

- Retrofitting of weak structures in highly seismic zones.
- Preparation of disaster related literature in local languages with dos and don'ts for construction.
- Getting communities involved in the process of disaster mitigation through education and awareness.
- Networking of local NGOs working in the area of disaster management.

### **Post-Disaster Preventive Measures<sup>2</sup>**

- Maintenance of law and order, prevention of trespassing, looting etc.
- Evacuation of people.
- Recovery of dead bodies and their disposal.
- Medical care for the injured.
- Supply of food and drinking water.
- Temporary shelters like tents, metal sheds etc.
- Repairing lines of communication and information.

- Restoring transport routes.
- Quick assessment of destruction and demarcation of destroyed areas, according to the grade of damage.
- Cordoning off severely damaged structures that are liable to collapse during aftershocks.

## **Do's and Don'ts<sup>4</sup>**

### **Before an earthquake**

- Know well seismic zonation of our area, get your house evaluated for retrofitting (if any) and ensure expert civil engineer's help in making your house earthquake resistant.
- Pick couple of safe meeting places that are easy to reach. Practice Drop, Cover and Hold on in each safe place at least once a month.
- Prepare an emergency kit and place it in a safe place. It should contain all necessary items for your protection and comfort, sufficient for at least three days.
- Till date prediction of earthquake is not possible. Don't listen to or spread rumours.

### **During an earthquake**

- Don't panic; stay calm and keep others clam, take necessary action.
- Protect yourself, drop to the floor, take cover under a sturdy desk or table and hold on it so that it doesn't move away from you. Wait there until the shaking stops.
- Stay away from glass windows, heavy furniture and anything that could fall, such as lighting fixtures or other similar items.
- If you are on the upper floor of the building, don't jump from windows or balcony. Do not try and run out of a building, you may be hit by falling debris. Stay inside till the shaking stops and check if it is safe to go outside.

- If you are outdoors, find a clear spot away from buildings, trees, electrical lines and narrow streets. Drop to the ground and stay there until the shaking stop.
- If you are in a vehicle, pull over to a clear location, stop and stay there with your seatbelt fastened until the shaking stops. Avoid bridges, flyovers or ramps that might have been damaged by earthquake.
- If in costal area, move to higher ground and check tsunami warning.
- If you are in a hilly areas be alert and move away from slopes in case of landslides and falling rocks.

### **After an earthquake**

- Check up: radio, TV, online updates, social network for emergency information and safety guidance.
- Watch out for fallen power lines or broken gas lines and stay out of damaged areas.
- Don't enter partially damaged buildings. Strong aftershocks can cause further damage to the buildings and weak structures may collapse.
- Don't use your two-wheeler/car to drive around the area of damage. Rescue and relief operations need the road for mobility.
- Anticipate aftershocks, if shaking lasts longer than usual.
- Leave a message stating where you are going if you must evacuate your residence.
- Evaluate damages and repair any deep cracks in ceiling, beam, column and foundation with the advice of an expert.

### **References**

<sup>1</sup> [http://www.saarc-sadkn.org/earthquake\\_prevention.aspx](http://www.saarc-sadkn.org/earthquake_prevention.aspx)

<sup>2</sup> <http://admis.hp.nic.in/himachal/home/HomeGuards/pdfs/MEASURES%20FOR%20EARTHQUAKE%20RISK%20REDUCTION.pdf>

<sup>3</sup> [http://disastermgmt.bih.nic.in/bsdma%20plan/2.%20DISASTER%20MITIGATION%20%20\(Sec-II\).pdf](http://disastermgmt.bih.nic.in/bsdma%20plan/2.%20DISASTER%20MITIGATION%20%20(Sec-II).pdf)

<sup>4</sup> <http://nidm.gov.in/PDF/IEC/EQ-14.pdf>