

# SELF ASSESSMENT OF EARTHQUAKE DAMAGEABILITY OF RESIDENTIAL BRICK BUILDINGS IN NCT OF DELHI (also in NCR)

**Dear Citizen of Delhi State,**

You have been hearing through various media that Delhi lies in Seismic Zone IV of the Seismic Zoning map of India. But what is seismic zone IV and how will it affect your residential house, if the postulated earthquake ever happens? The purpose of this communication is to make you aware of what could happen to your building in such an earthquake.

In seismic zone IV a maximum earthquake Intensity of VIII on MSK Intensity Scale is likely to occur. In terms of building damage, Intensity VIII is stated to cause the following types of damage:-

Areas of Uttarakhand and many areas in Saurashtra are also placed in Seismic Zone IV where MSK Intensity VIII has actually occurred during 1991 Uttarkashi earthquake, 1999 Chamoli earthquake and the 2001 Kachchh earthquake resulting in wide spread loss of life and property due to collapse of masonry buildings.

In Delhi State, as per 2001 census, there are 1.2 lakh *kutchha* houses and 31 lakh brick masonry buildings. Those buildings which are in East Delhi constructed on old Yamuna bed may be shaken more heavily and suffer larger damage.

## MSK Intensity VIII

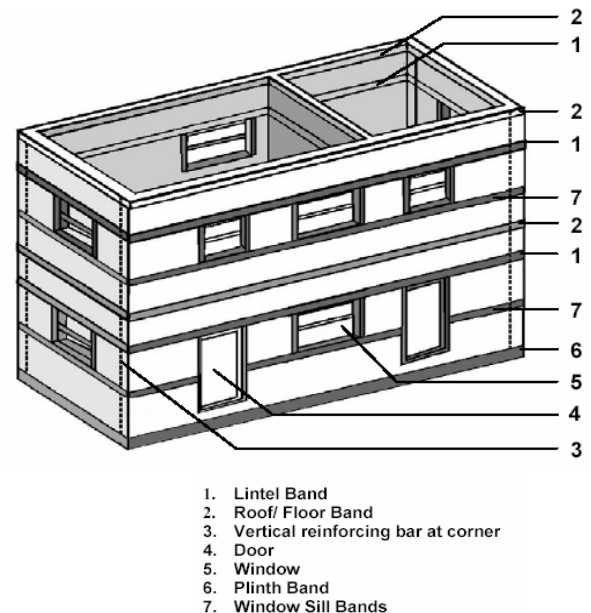
Most *kutchha* buildings constructed using clay walls may be totally destroyed. Most masonry buildings constructed using brick walls with *mud* mortar may also be destroyed. But those constructed using good cement mortar may only have heavy cracking.

Buildings constructed in sandy soil with high water table are liable to more severe damage than in other areas.

From the above you could get a general idea of behavior of *your* building during a future probable earthquake. However, if you want to have more specific

information about your brick building you can do the assessment yourself as explained below:-

- A single or two storeyed building using one brick (9 inch.) thick walls will be relatively safer than the three storeyed building. The fourth storey, if added, will be very unsafe, and will make the lower storeys also more vulnerable.
- Use of half – brick (4½ inch.) thick load bearing walls will make the storey very unsafe and, if used in 3<sup>rd</sup> or 4<sup>th</sup> storey, it may have a catastrophic failure.
- Too many window openings in a wall make it weaker, and use of smaller size piers less than 18 inches (45 cm) between them will increase the damageability even higher. To check this aspect, you should measure the combined width of all the openings in a wall and compare with the length of the wall. In a three or four storey building, the combined width of the openings should be less than one third the length of the wall, in two storeyed less than 42% and in one storey not more than 50%. The width of the brick pier between two consecutive openings should be more than two brick length or 18 inches (45 cm).



**Fig.:- Essential elements for earthquake safety of masonry buildings**

- The earthquake safety of the building depends upon the strength of the mortar used, stronger the mortar safer the building. Minimum mortar specified for safety is 1:6 cement-sand mortar (1 part cement by 6 parts of sand). Lime-Surkhi or lime –cinder mortar is much weaker.

- The most important seismic safety elements are the horizontal *seismic bands* provided at the plinth level and the lintel level of doors & windows in all external & internal walls. These *bands* ensure integral action of the four walls of every room and also increase the strength against earthquake forces many fold as compared with the ordinary buildings. Those buildings which have already provided such bands will suffer much less cracking and damage under earthquakes than those without the *bands*.
- Another safety measure is the provision of vertical reinforcing bars at every corner and T – junction of the rooms starting from the foundations going through all the storeys into the top roof slab.

- 1 Longitudinal reinforcements
- 2 Lateral ties
- 3 Vertical reinforcement at corners

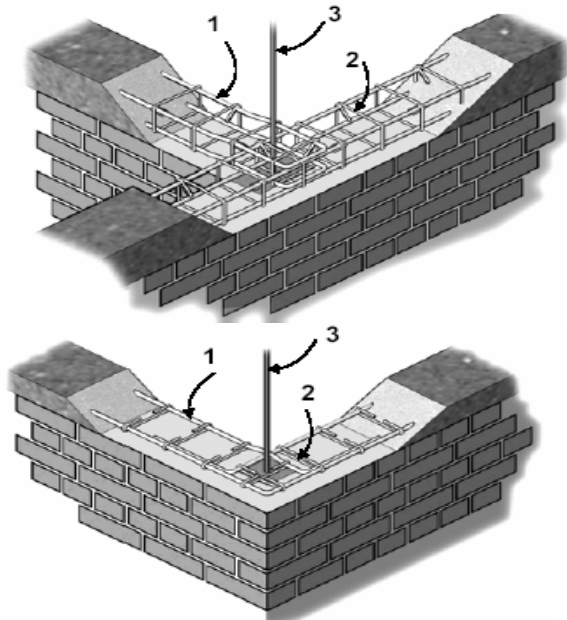


Fig.:- Providing vertical reinforcing bar at corner and T - junction

Experience in actual earthquake shows that those buildings in which the *horizontal seismic bands* and the *vertical reinforcing bars* were provided in accordance with the Indian standard Building Code IS: 4326, did not suffer heavy damage nor destruction. Rather, cracking if at all occurred was of very minor nature. Hence, in such buildings all inmates were saved even from injuries of any kind and there was no loss of internal elements and belongings.

Therefore, the easiest approach for assessing the earthquake safety of your house will be to check the following:-

- 1) Number of stories,
- 2) Thickness of the load carrying walls in each storey,
- 3) The mortar used for construction in each storey,
- 4) The number and size of openings in every wall, and ratio to the length of wall,
- 5) Whether any horizontal seismic bands have been provided in each storey, and,
- 6) Whether vertical reinforcing bars have been installed at each corner of the room.



An earthquake resistant house of Seismic Zone V (MSK IX or more):- Single storeyed, one brick thick walls in 1:4 cement-sand mortar, with seismic bands at plinth, window sill and lintel level, as well vertical bars at all corners is shown as constructed in Gujarat after 2001 earthquake.

Now comparing what actually exists with the guideline description provided above, you can judge the whole building as well as your unit house in the building whether during MSK VIII earthquake, it could be subjected to *destructive damage* or *heavy cracking* or *minor damage*.

If you find that the conditions in the building are of a type where destruction or heavy damage will be likely to occur, you should proceed to strengthen (retrofit) the building for earthquake safety, for which you can contact a qualified Structural Engineer or call the following for guidance:-

**Professor Anand S. Arya or Ankush Agarwal**

**G O I – U N D P , D i s a s t e r  
R i s k M a n a g e m e n t  
P r o g r a m m e**

**Ph:- 011- 65396386,**

**E-mail:- anand.s.arya@undp.org**