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# Lest we forget! Reminiscing the Bhuj earthquake

**C.M. Dordi**

It is now just over two years that a devastating earthquake struck the Indian soils. The Republic Day of India on January 26 2001, would be remembered by many, specially those several hundred thousands people whose life virtually took a somersault as their homes were destroyed. They lost their near and dear ones and lost their belongings and personal possessions. Some families were totally wiped out while some citizens lost almost everything they had and were virtually on the streets for several days till such time some temporary shelter was provided.

The losses in such an earthquake are extremely high. In Bhuj, the earthquake had measured a magnitude of 7.7 (M 7.7) on the moment scale. The epicentre was located at 23.40° north, 70.34° east, around 75 km east of the city of Bhuj.

It is estimated that over 13,800 human lives were lost and over 167,000 persons were injured due to this earthquake. About 90 percent of the deaths were in the largest district of Kutch - Gandhidham, a major city and four neighbouring large towns, Bhuj, Bhachau and Rapar were devastated. Many infrastructural set-ups were destroyed or dislocated resulting in complete chaos and confusion and the rescue workers took few days to reach the isolated, devastated areas. Nearly 230,000 one- and two-storeyed masonry structures collapsed and over 980,000 were damaged. It was also observed that several reinforced concrete framed buildings collapsed. This includes 130 multistoreyed buildings in Ahmedabad city located around 200-km from the epicentre. The net direct and indirect economic loss due to the damage and destruction is estimated to be around US$5 billion. This was a great setback in the developmental process not only for the state of Gujarat but also for the entire country.

Memory is often short lived. Those citizens, who have not suffered direct losses in this calamity may have forgotten this

**An inadequately designed hotel building collapsed during the Bhuj earthquake. The hotel was inaugurated in December 2000 and collapsed on January 26, 2001**

**Table 1: Human response to major earthquakes**

| Stage | Time | Event | Reaction | |
|---|---|---|---|---|
| | | | Positive | Negative |
| 1 | 0 – 1 min | Major earthquake | — | Panic |
| 2 | 1 min – 1 week | After shocks | Rescue and survival | Fear |
| 3 | 1 week–1 month | Diminishing | Short term repairs after shocks | Allocation of blame to builders, designers, officials, etc. |
| 4 | 1 month-1 year | — | Long term repairs. Action for higher standards | — |
| 5 | 1 year– 10 years | — | — | Diminishing interest |
| 6 | 10 years to next earthquake | — | — | Reluctance to meet costs of seismic provisions etc., Increased non-compliances with regulations |
| 7 | Next earthquake | Major earthquake | Repeat stages 1 to 7 | |

event. The seriousness of the problem due to such devastating earthquakes has still not been realised by many. The long-term human response to major earthquakes all throughout the world is quite similar. Bhuj earthquake is no such exception. *Table* 1 briefly shows the human response at different intervals of time.

## Lessons to be learnt

With every failure there are lessons to be learnt. The Bhuj earthquake too has taught us several lessons. From the common man to the political leaders, from an uneducated citizen to the experts in profession, from the poor to the rich, each and every citizen is a stake holder in such tragic disasters. Everyone needs an awakening. Where do we start? How do we reach out to all in this populous country of ours? Human beings cannot prevent earthquakes but certainly they can be prepared to face these disasters by proper mitigative measures. Many lives are lost due to collapse of structures during the earthquake. The earthquake occurred in Bhuj was in less densely populated area than many other urban areas in our country. What would have happened if the same intensity would have struck within the close vicinity of a densely populated city like Delhi, Mumbai or Kolkata? India has faced a number of major and moderate earthquakes in the past, *Table* 2. However, every time we get awakened for a short while during which we realise that something needs to be done. But, later on we tend to become complacent.

**Table 2: Past earthquakes in India**

| Year | Location | Magnitude, M | Human death toll |
|---|---|---|---|
| 1819 | Kutch | 8.0 | 1500 |
| 1887 | Assam | 8.7 | 1500 |
| 1900 | Coimbatore | 6.0 | Nil |
| 1905 | Kangra | 8.6 | 19000 |
| 1934 | Bihar – Nepal | 8.4 | 11000 |
| 1935 | Quetta | 7.6 | 30000 |
| 1950 | Assam- Tibet | 8.7 | 4000 |
| 1956 | Anjar | 7.0 | 115 |
| 1967 | Koyna | 6.5 | 200 |
| 1970 | Bharuch | 5.2 | 200 |
| 1988 | Bihar Nepal | 6.6 | 1004 |
| 1991 | Uttar Kashi | 6.6 | 768 |
| 1993 | Latur (Killari) | 6.4 | 8000 |
| 1997 | Jabalpur | 6.0 | 38 |
| 1999 | Chambli | 6.6 | 63 |

An increase in magnitude, M, by 1.0 implies, 10 times higher waveform or amplitude and about 31 times higher energy released. The energy released by the an atom bomb dropped on Hiroshima in 1945 had energy equivalent to M 6.3 scale earthquake. Most of the energy released by an earthquake goes into heat and fracturing the rocks while, fortunately, only a small quantum of this energy goes into the seismic waves that travel to large distances shaking the ground and hence causing damage to man made dwellings and infrastructure.

Generally, the attitude of the citizens is quite complacent towards earthquakes. Most feel that they occur less frequently and not in the city they stay. However, they are mistaken as several earthquakes occur each year. These earthquakes are of varying magnitude. *Table* 3 gives annual average number of earthquakes across the world of different magnitude classified in different groups.

The earthquakes generally of intensity about M5 can cause death and destruction while the minor and very minor earthquakes

**Table 3: Earthquakes across the world**

| Group | Magnitude | Annual average number |
|---|---|---|
| Great | 8 and higher | 1 |
| Major | 7 – 7.9 | 18 |
| Strong | 6 - 6.9 | 120 |
| Moderate | 5 - 5.9 | 800 |
| Light | 4 - 4.9 | 6,200 |
| Minor | 3 - 3.9 | 49,000 |
| Very minor | 2 - 2.9 | 365,000 |
| | 1 - 1.9 | 2,920,000 |

are often unnoticed. Professor Armaity S. Desai, former chairperson, University Grants Commission, New Delhi, a noted educationist and an eminent social worker expressed that in India, our major problem is not only safety in construction, but also the problem of accessibility to the people living in lakhs of villages and in many remote regions. She feels that there is a need to devise strategies that make use of the panchayati raj system in the country, training key members including the women members. She strongly feels that if we have to reach the millions in the country, we have to train grass root level workers for the job who are trained in both construction and retrofitting. These workers must also be good communicators. They could be either masons, or others trained for the purpose. The major focus, she feels, should be on retrofitting if loss of life and property has to be avoided. She suggests that citizens need to be proactive in this matter. The priority even here should be for seismic prone areas.

Prof Haresh C. Shah, chairman, World Seismic Safety Initiative (WSSI) expressed some personal views to the writer on the issue of the vulnerability and earthquake risk faced by some of the developing countries. New developments in the science and engineering of earthquakes have taken place in countries such as USA, Japan and to some degree in Europe. During the same time span, countries such as India, China, Indonesia, Turkey and few others have accumulated a large pool of experts in academic as well as governmental organisations, who are world class in terms of their knowledge and their contributions to the science and engineering of earthquakes. Sadly however, if one looks at the current state of earthquake risk in some of the developing countries, it becomes obvious that they are not much better off now than they were three decades ago. According to Prof Shah, many of the

**Collapse of a multi-storeyed building. Besides many reasons for failure, the main reason was additions and alterations done without considering earthquake forces**

fundamental problems that contribute to the lack of success in terms of risk reduction are related to economy, politics, social issues, lack of organisational set up and organisational infrastructure. One of the reasons would be that many experts in developing countries are not developing or adapting "appropriate" technologies. Mimicking technologies and risk reduction options that may not be relevant under their economic and social structure are unlikely to fetch favourable results.

## Major issues

Some of the issues which needs to be focussed upon as per Prof Shah are as follows.

- It is very difficult, if not impossible, to develop and implement strategies for earthquake risk reduction without the society's understanding of the type and level of risk. Experts in developing countries have not made sufficient efforts in raising the awareness of the citizens about the problems and possible solutions.
- In a society with many competing demands on available resources, it is not clear to many as to how one can balance the risk/reward equation. In an economically developing country, it is more difficult to justify the time and resources needed for earthquake risk reduction.
- There is a widespread perception that to do anything about mitigating earthquake risk, the immediate or short-term cost is enormous. This may be true but such scalar messages impact on the ability of a community to do simple things such as awareness drive, self-help solutions, community based retrofitting, financial risk management options, disaster management plans, non-structural mitigation, etc.
- There is relatively little communication between researches, academics and a few well known professionals.
- The few world class individuals in the country have not been able to make the citizens, engineering community, the governmental organisations and the regulators aware about the type and level of risk and what measures would buy maximum benefit at minimum cost. Without "bottom up" interest in implementing risk management strategies, it is very difficult to make any headway towards earthquake risk reduction.
- The group of professionals such as architects, structural engineers, contractors, government inspectors etc lack in sufficient professional accountability as far as the performance of structures is concerned. Even in countries where good building codes exist, there is very little effort to implement and enforce those codes. Activity to practise these professions is not based on licensing or accountability check.

Prof Haresh Shah observes that one of the most frustrating facts is that there are countries, like India, where there is knowledge, there are resources and there is awareness but still there is very little initiatives in earthquake safety. He feels that urban earthquake risk in developing countries is truly a ticking time bomb.

Strategies which have worked successfully in one country may not at all work in another country. Organisations like WSSI and GHI (Geohazards International) are working hard to develop strategies in collaboration with host countries. One such beginning was made under the joint auspices of Gujarat Ambuja Cements Ltd and WSSI at an international workshop on "Professional issues of earthquake safety of built environment" which was organised by them in association with Indian Institute of Technology, Mumbai on December 4 and 5, 2002. A report on the workshop as well as its recommendations were published in the December 2002 issue of this *Journal*. The author is hopeful that the the process of implementing the recommendations of the workshop will gather momentum.

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