Proceedings of the
World Congress on Natural Disaster Mitigation, New Delhi, 19-22 February 2004, Vol.1, pp 217-222.

Some Capacity Building Initiatives in India on Earthquake Risk Reduction

Sudhir K. Jain and **C. V. R. Murty**
Department of Civil Engineering
Indian Institute of Technology Kanpur
Kanpur 208 016

Over 60% of India is under the threat of moderate to severe seismic hazard. This paper recalls a few initiatives capacity building that were expected to (a) increase awareness amongst the engineering and general communities of the prevalent seismic threat, (b) provide primary knowledge on earthquake resistant design, and (c) develop plans to embark on large scale earthquake disaster mitigation in the country. The successes of these low-key but important initiatives will help prepare the country for the daunting task of developing earthquake resistance in its built-environment at the earliest opportunity.

Introduction

Indian earthquake problem is well known. In his book on *Elementary Seismology*, Charles Richter devoted an entire chapter entitled "Some Great Indian Earthquakes" to the large earthquakes in India. As seen in Table 1, during 1897–1950, four great earthquakes (magnitude exceeding 8.0) occurred in India. Fortunately, no earthquakes of M>8.0 have occurred in the country since 1950. Many experts argue that such an earthquake may occur anytime along the Himalayan belt.

The casualty figures in Table 1 clearly underline the fact that Indian preparedness for strong earthquake shaking is rather low, and that the country is subjected to unacceptably large seismic risk. Particularly alarming is the fact that numerous multistory buildings constructed in recent years fell like a pack of cards during the Bhuj earthquake of 2001. About 220 km from the epicenter, in the city of Ahmedabad, 130 such buildings collapsed killing about 750 persons.

Table 1: Some Significant Earthquakes in India (*This list is not complete*).

Date	Event	Time	Magnitude	Max. Intensity	Deaths
16 June 1819	Kutch	11:00	8.3	IX	1,500
12 June 1897	Assam	17:11	8.7	XII	1,500
8 February 1900	Coimbatore	03:11	6.0	VII	Not Known
4 April 1905	Kangra	06:20	8.0	X	19,000
15 January 1934	Bihar-Nepal	14:13	8.3	X	11,000
15 August 1950	Assam	19:31	8.6	XII	1,530
21 July 1956	Anjar	21:02	6.1	IX	115
10 December 1967	Koyna	04:30	6.5	VIII	200
23 March 1970	Bharuch	20:56	5.2	VII	30
21 August 1988	Bihar-Nepal	04:39	6.6	IX	1,004
20 October 1991	Uttarkashi	02:53	6.4	IX	768
30 September 1993	Killari (Latur)	03:53	6.2	VIII	7,928
22 May 1997	Jabalpur	04:22	6.0	VIII	38
29 March 1999	Chamoli	00:35	6.6	VIII	63
26 January 2001	Bhuj	08:46	7.7	X	13,805

The Geological Survey of India has done some truly outstanding work on investigation of earthquakes in the 19th century, for instance, the investigation by Thomas Oldham of the Kachar earthquake of 1869, and by R D Oldham of the Assam earthquake of 1897. Similarly, in the 1930s, some outstanding work was done in Baluchistan on earthquake resistant constructions by the Railways, Military and Civil administration, and all this well documented (Jain and Nigam, 2000; Kumar 1933). Formal teaching and research in earthquake engineering was taken up at Roorkee in the early sixties. Despite early gains in earthquake engineering, India's progress towards earthquake safety has been highly inadequate. This is mainly due to the fact that over the years (a) earthquake engineering came to be an exclusive domain of academics, and the professional engineers and other stakeholders did not get involved in issues of earthquake safety, and (b) due attention was not paid to the issues of capacity building and leadership development in the subject, and it was implicitly assumed that a single academic institution or a handful of academics can *solve* the "earthquake problem". The Bhuj earthquake has changed the scenario considerably wherein the administrators are very supportive of the agenda of seismic safety but find that there is not enough expert manpower at all levels to execute the agenda.

This paper discusses some of the capacity building projects the two authors have been involved in for some years.

Training of Professional Engineers

Training the professional engineers in earthquake resistant construction is a huge, and perhaps a never-ending project. In general, the training needs in the Civil Engineering profession do not receive the same kind of priority as in other fast-changing areas of technology, say, in telecommunications. It is generally difficult to convince civil engineers that they may benefit from investing their time and money on training. This must be seen in the context that India still does not have a competence based licensing of engineers, and hence there is no requirement of engineers undergoing a minimum number of continuing education credits annually.

An enormously successful training programme on seismic design of reinforced concrete buildings has been conducted by the authors for professionals for the last ten years in a number of locations in India, Nepal and Bhutan. Typical duration of this programme is five days, even though some programmes of different duration and on different topic have also been conducted (Jain and Murty, 2003). Most of these courses are the self-supporting type, wherein the entire costs are met by the registration fee charged to the participants.

Since 1992, about 2,000 engineers have been trained through these continuing education courses. In numerous instances, some of the participants have subsequently explained how the course has helped them improve their design and construction practices. It was heartening for the authors to see in the small town of Imphal (in north-east India, in highest seismic zone V) several buildings under construction with correct seismic detailing of reinforcement as a result of the efforts of course participants.

National Information Centre of Earthquake Engineering (NICEE)

The engineering of earthquake-resistant constructions is rather new, and rapid developments are taking place in this subject. The 1933 paper by the young railway engineer, S. L. Kumar, charged with constructing earthquake resistant railway quarters in Quetta in 1931, shows that in a short span, he was able to procure and study the most important publications from USA, New Zealand and Europe, and develop a good understanding of the state of the knowledge of the subject as prevalent at that time. Unfortunately, despite the revolution all around of communications, the same cannot be said for a typical engineer today.

There is an explosion of new knowledge on the subject internationally, and the Indian academics and professionals are finding it increasingly difficult to access this knowledge.

To address this scenario, National Information Centre of Earthquake Engineering (NICEE) was set up at IIT Kanpur to meet needs of the country in terms of "information" on Earthquake Engineering. Need for such a Centre emerged from a workshop conducted at IIT Kanpur in October 1996 (Murty et al., 1998). The original objectives of NICEE were:

(a) To keep track of availability of new publications and other materials in the area of earthquake engineering;
(b) To create and maintain a decent storehouse of publications and other materials on earthquake engineering;
(c) To disseminate information about availability of the above material at IIT Kanpur to the interested professionals, researchers and academicians; and
(d) To make available the material to interested persons in a timely manner.

Clearly, the Centre was conceived as primarily a "library oriented" project. However, with time, its objectives have been changed to include all activities connected with dissemination of information. An endowment of Rs.50 Lakhs (about US$ 110,000) was raised with the objective that its interest be used for operating expenditure of the Centre. In addition, a three-year grant was provided in 2001 by the *Board of Research in Nuclear Sciences* towards a part of the operative expenditure.

First proposal for the Centre was developed in late 1997. The first success in raising endowment contribution was achieved in 1999. While the fund raising activity for NICEE was in progress, the activities of NICEE were started in a modest way without making a formal announcement of its formation. The 2001 earthquake expedited the formal launch of the Centre. Within a few days of the earthquake, the web site of NICEE was launched (www.nicee.org), and NICEE started receiving an enormous response.

In the meanwhile, NICEE formed strong relationships with numerous organisations and individuals around the world and many have contributed significantly to the Centre by providing their publications or other materials as gift, *e.g., Multidisciplinary Centre for Earthquake Engineering Research (MCEER)* at Buffalo (USA), *Earthquake Engineering Research Institute* (EERI) in USA, *New Zealand National Society for Earthquake Engineering (NZSEE)*, *Professor George W. Housner* of California Institute of Technology, Pasadena (USA), and *Late Professor N. C. Nigam* in India.

The Center is engaged in a variety of interesting projects. Two major e-Conferences have been conducted by NICEE as discussed below. More recently, the Centre has distributed free of cost two CDs on the Bhuj earthquake, originally prepared by the EERI. The Centre has developed a Hindi translation of the IAEE manual on "*Earthquake Resistant Non-Engineered Constructions*" which is being disseminated free of charge to all interested persons.

EQ Tips

The project "IITK-BMTPC Series on Earthquake Tips" was started in early 2002. *Indian Institute of Technology Kanpur (IITK)* with sponsorship of the *Building Materials and Technology Promotion Council (BMTPC)*, New Delhi (in the Ministry of Urban Development, Government of India) took up this project to widely disseminate the basic concepts of earthquake resistant constructions through simple language. The project consists of developing twenty-four (24) Earthquake Tips on two A-4 size pages of written material with graphics. It is targeted at an educated person interested in building construction. The tips cover topics such as basic introduction to earthquakes and

terminology such as magnitude and intensity, concepts of earthquake resistant design, and aspects of aseismic design and construction of buildings. One tip is released every month for publication to all interested journals, magazines, and newspapers. The tips are also placed at the web site of NICEE (www.nicee.org).

A large number of journals of architecture, construction and structural engineering, and many prestigious newspapers are publishing these Tips. Some of these publications made an exception to their editorial policy of publishing only the exclusive materials in the interest of disseminating information about earthquake safety to the public.

National Programme on Earthquake Engineering Education (NPEEE)

A comprehensive *National Programme on Earthquake Engineering Education (NPEEE)* has been launched in India by the Ministry of Human Resource Development of the Government of India (www.nicee.org/npeee). The seven *Indian Institutes of Technology* and the *Indian Institute of Science, Bangalore,* are operating this project to provide training of teachers from colleges of engineering, architecture and polytechnics. The project includes the following activities:

(a) Conducting short-term (one- to four-week) and medium-term (one semester) training programmes for teachers of engineering colleges, polytechnics, and architecture colleges. These courses will also allow participation of a limited number of working professionals.
(b) Sponsoring a limited number of young teachers for international exposure to work for up to a year in an international environment. This training could be in the form of established courses, or as research assignments.
(c) Providing partial financial support to a large number of teachers to attend international conferences, and hence to get an exposure on the international state-of-the-art in this subject.
(d) Inviting a few international experts to the premier institutions for teaching, research, and long-term collaborations.
(e) Developing teaching aids, course materials, textbooks, manuals, and commentaries.
(f) Developing of modest teaching laboratories in about ten engineering colleges and strengthening of more advanced teaching/research laboratories in the eight premier institutions.
(g) Providing library resources in earthquake engineering to about one hundred engineering colleges.
(h) Organizing of workshops and conferences to share ideas and sensitize different stakeholders.

The programme is open to all recognized engineering colleges, polytechnics and schools of architecture having related academic degree or diploma programme, irrespective of whether these are government funded or privately funded. The programme has started in April 2003 initially for three years with a budget of about Indian Rupees 13.76 Crores (about US$ 3 million). This amount does not include institutional overheads, salaries, buildings or other infrastructure since the eight premier institutes are publicly funded. The programme has made considerable progress in the last several months. For instance, (a) about thirteen short courses of one or two week duration each have already been conducted under the programme for faculty members, (b) a group of seventeen faculty members from all over the country have completed a one-semester long certificate programme in Earthquake Resistant Design at IIT Kanpur while another set of about 23 teachers are currently undergoing a similar programme at IIT Roorkee, (c) several workshops have been conducted to develop curriculum, and (d) some successes have already been achieved towards modifying curricula to include adequate coverage of earthquake engineering.

E-Conferences

To commemorate the first anniversary of the tragic Bhuj earthquake of 2001, a two-week e-Conference was organized beginning 26 January 2002 on "Indian Seismic Codes". The e-Conference was free of cost and no registration fee was charged to the participants. About 1,200 persons participated; about 100 persons from about ten countries made about 300 postings during the two weeks. The conference proceedings have been provided on the web site of NICEE and a summary published in a leading Indian journal (Rai and Sheth, 2002). The conference helped clarify many issues of concern to the participants, and also identified many important changes needed in the current Indian seismic codes.

Encouraged with the success of the above, in August 2002, another e-Conference was organized by NICEE of one-week duration on the topic "Professional Issues in Structural Engineering in India". This conference also received an enormous response. Out of about 1,600 members on the conference, about 130 members from a dozen countries wrote messages: a very good ratio indeed. The 290 messages if printed back to back on font size 10 required about 175 pages. A great wealth of information on professional issues in structural engineering in India was generated. The e-conference is now leading to several initiatives to help improve the professional ambience in the country, *e.g.,* the Structural Engineers Forum of India.

Structural Engineers Forum of India

During the e-conference of August 2002 hosted by NICEE, a strong need was felt for a platform where structural engineers can share ideas and exchange views electronically, and there were suggestions that NICEE should take up such an activity. However, it was felt that NICEE should move on to other activities, and a web-based platform in the name of "Structural Engineers Forum of India" (SEFI) was created by a group of five individuals. These individuals also support the site through cash contribution as well as by spending considerable amount of personal time. One of the e-conferences was also sponsored by a capacity-building project in Gujarat.

For instance, in response to the need articulated in the e-conferences for a forum to electronically discuss and share ideas, a group of engineers have now established a new web site "Structrual Engineers Forum of India" through voluntary contributions (www.sefindia.org). The web site hosts articles (without a formal review process), provides excellent links, hosts e-conferences, and provides a discussion forum. Any individual can register at SEFI without having to pay any charges. Its membership has grown steadily with time and is currently 650 individuals registered on its site, and the number has been growing for the last one year.

Technical Education in Gujarat

As compared to the Latur earthquake, the devastation in the Gujarat earthquake was spread over a far larger area geographically. Also, while in the Latur earthquake only the rural area was affected, in the 2001 earthquake the devastation was caused in the rural as well as the urban areas. In that sense, the reconstruction issues are far more challenging in the Gujarat earthquake. A massive reconstruction project has been in progress in the region with support from the World Bank, the Asian Development Bank and others.

Besides a comprehensive rehabilitation project, the Gujarat project has several capacity building components that can have far reaching contributions towards seismic safety. For instance, the curricula of engineering at degree and at diploma level have been modified to include appropriate component of earthquake engineering (Jain and Sheth, 2002). This experience has been very useful to the NPEEE discussed above. The state is also working towards certification of masons, and competence based licensing of structural engineers.

Review of Building Codes

The seismic safety is deeply connected with building codes and their implementation. Of late, the process of code development in India has been a matter of serious concern. It is now taking far too much time to revise some of the important codes. For instance, the revision of the main seismic code IS:1893-1984 is still not complete: only Part 1 of this code could be published in 2002, while other parts are still to be revised. The professionals have often complained that the codes are acquiring sophistication without the supporting commentaries and explanatory handbooks. To address this issue, the Government of Gujarat has assigned a project to IIT Kanpur to study the codes related to earthquake, wind (and cyclone) and fire. The scope of work includes: (a) review of existing codes to suggest improvements, (b) develop commentaries and explanatory handbooks, and (c) wide dissemination of these documents. This work is currently underway and a set of 16 documents are already placed on the web site of NICEE (www.nicee.org) for enabling the professionals to review and comment on those.

Concluding Remarks

This article gives a flavour of some of the capacity building activities towards seismic safety currently underway in India and in which the authors have had some involvement. Many of these activities have been appreciated within and outside the country. Some elements that may have helped with these activities are:

(a) Most of these activities have started small and then grown big with time. Rather than make a grand plan and wait for resources in terms of funds and manpower, the readily available resources were used to start modest and as the activities gained credibility, more resources became available.

(b) The effort was to take up which of the important items were possible to initiate rather than making an attempt to take up all the important items at the same time. With time, it was possible to take up more issues and bigger projects.

(c) Communication is the key to the success of any capacity building project. The web site and large email listings of NICEE, SEFI and NPEEE have made important contributions to the successes of these efforts.

These experiences illustrate a larger number of small initiatives at a number of institutions or organizations are likely to be more effective.

References

Jain,S.K., and Murty,C.V.R., (2003) "Some Innovative Education and Outreach Projects in India for Earthquake Risk Reduction," **Seismological Research Letters**, Vol.74, No.5, Sep./Oct. 2003, pp 545-551.

Jain,S.K., and Nigam,N.C., (2000) "Historical Developments and Current Status of Earthquake Engineering in India," Proceedings of the **Twelfth World Conference on Earthquake Engineering**, Auckland, New Zealand, 30 January – 03 February 2000, Paper No.1792.

Jain,S.K., and Sheth,A., (2002) "Earthquake Engineering in the Civil Engineering Curricula," **The Indian Concrete Journal**, Vol.76, No.9, September 2002, pp 558-562.

Kumar,S.L., (1933), "Theory of Earthquake Resisting Design with a Note on Earthquake Resisting Construction in Baluchistan," Paper No. 165, **Punjab Engineering Congress**, pp 154-189.

Rai,D.C., and Sheth,A., (2002), "e-Conference on Indian Seismic Codes." **The Indian Concrete Journal**, Vol.75, No.7, July 2002.