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## Training of teachers for capacity building towards earthquake safety in India

**Alpa Sheth and Sudhir K Jain**

*In the 'Point of View' from the same authors, published in the September 2002 issue of this journal, the need to include earthquake engineering topics in the civil engineering curricula at diploma, degree and post-graduate levels was highlighted. It is not enough to merely update the curricula for students; qualified teachers have to be developed in this subject. The present feature discusses the training needs in earthquake engineering at the level of educational institutions. The presentation is based on the discussions in a workshop organised at Gandhinagar under the aegis of Gujarat State Disaster Management Authority wherein the need to generate a viable mechanism for implementation of the teacher's training programme was highlighted.*

The Bhuj earthquake of January 26, 2001 has been an eye-opening event for the cause

of earthquake engineering in India. This is the first Indian earthquake to have caused colossal damage in urban areas. It has clearly exposed the severe limitations of modern Indian constructions from the view point of seismic safety. The collapses and the damages sustained by modern multi-storey buildings, and the relatively inadequate and poor retrofitting of many such buildings undertaken after the earthquake, clearly point towards the current skill deficits in seismic engineering not just in the state of Gujarat but in the entire country<sup>1</sup>.

Development of earthquake engineering as a discipline occurred in India rather early, and the first Indian seismic code was published in 1962. However, an average civil engineer in the country has not yet been adequately sensitized to the issues of earthquake safety. A typical undergraduate civil engineering curriculum in the county does not include any coverage of earthquake engineering. Even at the post-graduate level, only a small fraction of structural engineering students gets a

chance to study earthquake analysis and design. This results in most civil engineers not receiving any formal training in this subject during the undergraduate or post-graduate studies. Even if we were to include earthquake engineering in the curricula, it may not be effective till we have sufficient number of qualified teachers in the subject.

The training needs in earthquake engineering are at different levels, including:

- at the level of educational institutions so that all future graduating civil engineers and architects are equipped with adequate background in earthquake engineering
- at the level of upgrading earthquake engineering skills in the community of practising engineers since at present most of the practising engineers are not trained even in the rudiments of seismic engineering.

For both the above to happen, it is imperative to build a strong resource base of teachers who are capable of catering to

the above needs. Thus, an extensive teacher-training programme is essential.

In order to assess the needs of colleges and polytechnics in Gujarat and generate a viable mechanism for implementation of the teacher training programme by consensus of the targeted beneficiaries, a workshop was organised at Gandhinagar under the aegis of Gujarat State Disaster Management Authority. The participants included senior faculty members from premier degree and polytechnic colleges as well as experts in the field of seismic engineering. This write-up includes some of the recommendations of the workshop since what is needed in Gujarat is also applicable for other parts of the country. At a later stage, two workshops were held in Ahmedabad to develop recommendations on the curricula changes at diploma, degree and post-graduate levels; these are discussed elsewhere<sup>2</sup>.

### Objectives

The objectives of the teacher training programme should consist of the following.

- (i) To create a pool of teachers who are adequately equipped with earthquake engineering skills to teach earthquake engineering to students at diploma, degree and post-graduate levels.
- (ii) To generate a faculty pool from the teachers and the practising engineering community who shall be able to address the needs of continuing education for the practising engineers on a long-term basis.
- (iii) In the long term, to develop a self-sustaining community of engineers skilled enough to lead the development of indigenous earthquake technology. This will require the fostering of key individuals benefiting from liaison with developing technology in the international sphere so that country may become not just self-sufficient, but develop expertise comparable with the best international practices.

### Methodology

The needs of teacher training in seismic engineering are extensive and cannot all be fulfilled immediately. However there are some urgent needs that need expedient re-

sponse. In view of this, the capacity building of educational institutions needs to be phased into the following programmes.

#### Short term

This will consist of short-term training modules for teachers of degree colleges and polytechnics that can be conducted on priority basis. Each module shall consist of programmes of one to two week duration on identified subjects in earthquake engineering. The objective of this short-term programme is to enable the teachers to develop enough depth and breadth in the subject to be able to do justice to their class-room teaching. It should be emphasised here that in order to teach a subject well, a teacher should know a lot more than what he/she is to teach. The short term training shall form a basis as well as motivating factor for the teachers to venture into further training in the field of earthquake engineering.

#### Medium term

This programme could be one semester long, dealing with introductory as well as advanced topics. It will consist of several post-graduate level courses in earthquake engineering to give the trainee faculty members a good specialisation in the subject. This programme could be considered as an intermediate programme towards a Master's or Doctoral programme in earthquake engineering. Moreover, many faculty members have already earned their higher degrees in other areas of civil engineering and addition of this one-semester module to their education will help them develop expertise in the subject.

#### Long term

Training programmes of one-year duration or more are being termed as long-term training. This would consist of a Master's or Doctoral programme in earthquake engineering in eminent institutions in India or abroad. Moreover, many faculty members need to be placed to work as visiting scholars (without earning a degree) in eminent institutions. Placing highly motivated teachers in an international environment for research and exposure is a very effective way to develop leadership in this subject. The one-semester programme discussed above should prepare the teachers adequately to benefit from such placements.

In addition to the above, the capacity building in technical education system in the area of earthquake engineering should include library resources, computational

hardware and software, and laboratory development for teaching and research.

### Targeted beneficiaries

The country has three kinds of technical institutions:

- government
- grants-in-aid
- self sponsored.

Even though the government does not financially support the self-sponsored institutions, the graduating engineers from all these institutions have the same impact on the quality of engineering being practised in the country. Hence, from the point of view of capacity building, it is imperative that the training of teachers programme should cover all three types of institutions. It is pertinent to mention here that the quality improvement program (QIP) of the All India Council for Technical Education (AICTE), meant to improve quality of technical education in the country, extends financial support to teachers of all three types of institutions without any differentiation.

In general, separate courses should be conducted for the degree and polytechnic college teachers for two reasons.

- (i) The polytechnic teachers may require refresher classes for the same course at a more basic level.
- (ii) The level of teaching may need to be varied keeping in view the different aptitudes of polytechnic and degree college teachers.

However, there may be some polytechnic teachers with higher level of qualifications and motivations who may fit in better in the courses meant for degree level teachers; this should be encouraged wherever necessary.

### Short-term training programmes

Courses of duration one- to two-week are being termed as short-term training. These are short-term in the sense that faculty members may be able to go away for such training during the semester or summer/winter vacations while the college does not have to find substitute teacher during their absence. Earthquake engineering has over the years acquired a lot of sophistication.

Hence, the short-term courses can be at two levels:

- (i) introductory courses wherein basic concepts of earthquake engineering are covered
- (ii) advanced courses on specialised topics (namely, seismic hazard evaluation, site response analysis, push-over analysis, performance-based design, base isolation systems, etc.

A right mix of both types of courses are needed in the country.

For training of teachers, it is better to use standard text-books as far as possible for the introductory level courses. This will enable better self-study by the teachers and it will make it easier for them to teach the topics in their own classes. However, for many courses suitable text-books are simply not available, and in such cases adequate resource materials such as notes, etc should be provided to the participants.

The teaching schedule should allow for an active participation from the teachers and should give sufficient time and scope for reflection and assimilation of the subject matter. To this end, the training should include tutorial and homework problems with discussion of solutions with the

resource faculty. Wherever relevant, experimental demonstrations should be included. At the end of each training course, the participants should be asked to fill up a course evaluation form to assess the strengths and weaknesses of the training. A review of such feedback forms is a must to ensure that the training programmes are being effective.

Table 1 lists the introductory short-term courses recommended by the Gandhinagar workshop for teachers of the Gujarat state that need to be conducted urgently.

## Medium- and long-term trainings

Despite the best possible implementation, the short-term programmes cannot meet all needs of the teachers because of inherent limitation of the duration. Hence, a one-semester training programme at the post-graduate level, with usual homework assignments, examinations and grades, can be very effective for teachers to develop expertise in earthquake engineering without having to go for another degree. For instance, many teachers already have higher degrees such as a Ph.D., and yet may want to specialise in earthquake engineering considering the importance of the subject in the current Indian context: such a course will be ideal for them.

Training of one-year and longer duration are being termed here as long-term training. Currently, the teachers of degree level engineering institutions are eligible to go for higher degree (masters and doctoral) under the Quality Improvement Programme (QIP) of the All India Council for Technical Education (AICTE). However, due to limited number of seats available therein, additional possibilities need to be created under the QIP for earthquake engineering. Similarly, a parallel QIP has recently been launched for the polytechnic college teachers and that too needs to be fine tuned to meet the manpower requirements in earthquake engineering.

To maintain quality and international standards in our system, it is important that adequate exchange of ideas takes place with top international institutions. Hence, a small number of young and bright teachers should be sent abroad to premier international institutions for training. This training could be in the form of established courses, or as research assignments of six-months or one-year duration. This is considered necessary to avoid in-breeding since very few institutions in India currently have strong earthquake engineering programmes. Additionally, teachers should be encouraged to attend international conferences and workshops in earthquake engineering by providing liberal funding for international travel.

In general, there is an acute shortage of teachers in engineering institutions, and many colleges will find it difficult to spare their faculty members for medium and long term trainings. It will therefore help very much if the colleges could be enabled to hire additional ad-hoc teachers so that the teaching does not suffer on account of regular faculty being away on trainings.

## Other issues on educational institution capacity building

### Curriculum development

The objectives of training of teachers will not be met if they in turn do not get a chance to teach the subject to their own students. Considering the earthquake risk to most parts of India, it is high time that topics of earthquake engineering are included as compulsory part of curriculum in civil engineering and architecture. Separate workshops were organised in Ahmedabad for development of curricula in colleges of Gujarat; these are discussed in a separate article<sup>2</sup>.

**Table 1: Proposed short-term courses for teachers in Gujarat**

Sr. No	Course title	Polytechnic	Degree college	Pre-requisite course	Duration
1	Basic structural dynamics	Yes	Yes	None	One week
2	Fundamentals of seismic engineering	Yes	Yes	1	One week
3	Fundamentals of reinforced concrete design	Yes	No	None	One week
4	Analysis and design of earthquake resistant buildings in reinforced concrete	Yes	Yes	2 for degree 2 and 3 for polytechnics	One week
5	Computer methods of structural analysis for high rise buildings	No	Yes	4	One week
6	Advanced structural dynamics	No	Yes	1	Two weeks
7	Damage assessment, repairs & rehabilitation of earthquake affected reinforced concrete structures	Yes	Yes	4	One week
8	Design and retrofit of masonry buildings	Yes	Yes	2	One week
9	Ductile design and detailing of steel structures	No	Yes	2	One week
10	Advanced concrete technology	Yes	Yes	-	One week
11	Earthquake engineering in geotechnology	No	Yes	-	One week

## Library

Currently, most books on earthquake engineering are published by overseas publishers and hence are quite expensive. Therefore, most libraries tend not to have such books. This needs to be corrected by ensuring that the college libraries have a decent collection of books, monographs and other publications in earthquake engineering.

## Computational software and hardware

To teach the principles of earthquake engineering, educational institutions will require adequate computational hardware and software tools. Also, some of these tools will enable these institutions to provide research and consulting services, and thus will go a long way in capacity building in the institutions.

## Laboratories

A few select degree colleges and polytechnics should also strive to develop teaching and/or research laboratories in earthquake engineering.

## Concluding remarks

The Bhuj earthquake of January 2001, even though tragic, has also provided us with an opportunity to develop better capacity for future damaging earthquakes. Development of manpower and the institution development are the first step towards any serious efforts towards seismic risk reduction. On one hand, efforts are on in the state of Gujarat to kick off a vigorous training of trainers programme. On the other hand, the Ministry of Human Resource Development, Government of India is launching a major initiative entitled National Project on Earth-

quake Engineering Education (NPEEEE). The NPEEEE will use the seven IIT's and the IISc Bangalore as resource institutions for training of teachers from colleges of engineering, architecture and the polytechnics. It will have provision for short- and medium-term trainings, provision for international exposure to teachers through trainings and participation in conferences, development of curricula and resource materials, development of laboratories, etc.

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## References

1. JAIN, S.K., LETTIS, W.R., MURTY, C.V.R., and BARDET J.P. (Ed) Bhuj, India Earthquake of January 26, 2001 Reconnaissance Report, *Earthquake Spectra*, Supplement A to Volume 18, July 2002, pp. 398.

2. JAIN, S.K. and SHETH, A.R. Earthquake engineering in the civil engineering curricula, *The Indian Concrete Journal*, September 2002, Vol. 76, No. 9, pp. 558-562.



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