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EARTHQUAKE ENGINEERING CAPACITY BUILDING IN EDUCATIONAL SECTOR IN INDIA

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SUMMARY

A comprehensive National Programme on Earthquake Engineering Education (NPEEE) has been launched by the Ministry of Human Resource Development of the Government of India with a view to develop capacity in education sector in earthquake engineering. The project includes components such as short- and medium-term training programmes for faculty members of numerous colleges in India, international exposure to faculty members, development of resource materials and teaching aids, development of library and laboratory resources, and organization of conferences and workshops. The paper discusses the genesis of the project, its methodology, and the implementation experiences, with a view that the same may be useful to other countries for capacity building in earthquake engineering.

INTRODUCTION

Formal academic activities in Earthquake Engineering were started in India in the late 1950s at the University of Roorkee (UOR). Nevertheless, the typical engineering curricula in the country does not incorporate components related to earthquake resistant constructions. This results in most civil engineers not receiving any formal training in earthquake engineering during the undergraduate or post-graduate studies. This anomaly needs to be corrected for a country such as India with an enormous earthquake problem. Even implementation of a revised curricula with adequate coverage of earthquake engineering principles may not be effective in the absence of sufficient number of qualified teachers of the subject, course materials, text books, etc. Hence, the entire issue of earthquake engineering education is fairly involved, and this had been a matter of concern well before the Bhuj earthquake (Murty [1]).

The 2001 earthquake provided the necessary impetus to initiate a comprehensive National Programme on Earthquake Engineering Education (NPEEE) through the Ministry of Human Resource Development

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(MHRD) of the Government of India. The paper discusses the genesis of the project, its methodology, and the implementation experiences, with a view that the same may be useful to other countries for capacity building in earthquake engineering.

GENESIS

In view of huge losses during the Bhuj earthquake, there was concern at all levels in the country. The Cabinet Secretariat of the Government of India wrote to the MHRD regarding training of teachers in this subject. The Minister of Urban Affairs too discussed the matter with the Minister of Human Resource Development. Therefore, to discuss the entire issue a meeting was called by the MHRD in August 2001 with representatives of premier academic institutions, All India Council for Technical Education, research institutions, and other ministries and organizations concerned with seismic safety.

Participants in the meeting recognized the need for developing capacity within the engineering and architectural institutions of the country in this subject and decided that the main vehicle of this change should be *training of teachers* and *curriculum development*. Capacity building of teaching institutions will enable them to: (a) teach the principles of earthquake engineering to their students, (b) provide training to the professional engineers in this subject since most professional engineers have not studied this subject during their college days, (c) conduct research and development, (d) provide consulting services to important civil engineering projects, and (e) from time to time, provide the government with intellectual inputs towards technical and policy issues for earthquake safety.

In the meeting, it was decided to develop a national initiative towards this, called the *National Programme on Earthquake Engineering Education (NPEEE)*. The proposal thus developed was circulated by the MHRD to other concerned Ministries and Departments for their feedback and comments. In August 2002 Standing Finance Committee of the MHRD cleared the project and first grant for NPEEE was released by the Ministry in March 2003. The project activities started immediately thereafter, with a launch workshop held at the Indian Institute of Technology Delhi on April 5, 2003.

THE PROGRAMME

It was decided in the planning stages that the project is to have a limited focus: training of trainers and on curriculum development. For instance, notwithstanding the importance of research and development for seismic risk reduction, NPEEE does not provide resources for the same by the academic institutions. It is hoped that other concerned Ministries will take similar other steps for the remaining components of seismic risk reduction.

Initial project duration has been kept as three years even though it is recognized that such a programme is needed for 10 to 20 years to be fully effective. India has more than one thousand technical institutes that teach civil engineering or architecture at diploma, undergraduate or postgraduate levels, and there is a large variation in the quality of expertise available at different institutions. The project is operated by the seven Indian Institutes of Technology (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras, and Roorkee) and the Indian Institute of Science Bangalore as resource institutes.

A budget of Rs 137 million (about US$ 3 millions) has been approved for a three-year period. This budget does not include salaries, buildings, overheads, etc since all the eight resource institutions are publicly funded. The following activities are included in the present phase of NPEEE:

Training
Short-term (1-4 weeks) and medium-term (1 semester) training of teachers of engineering colleges, polytechnics and architecture colleges will be undertaken at the eight resource institutes. Short-term training is defined as that of one-week to four-week duration for which the college administrators may not have to relieve the trainee from his semester teaching responsibilities. These courses can be particularly useful to give a first exposure to the teachers in Earthquake Engineering, as well as for higher-end specialized topics.

Some of the resource institutions depending on their own manpower are expected to develop one-semester certificate course in Earthquake Engineering for teachers. These courses, not leading to degrees or diplomas, will be treated as the continuing education programmes, and a certificate will be awarded to teachers on successful completion. Many teachers already have Masters'/Doctoral degree and they may find it very suitable to go through this one-semester programme. Moreover, it will enable colleges to develop teaching manpower in this subject in a reasonably short period.

All costs connected with training, including boarding, lodging and travel of the trainee faculty members are covered by the MHRD funds. The courses conducted through NPEEE also allow participation of a limited number of working professionals. However, the cost on training of professionals is not to be borne out of the MHRD funds.

Library Resources
The programme provides for books and publications in earthquake engineering to be provided to about 100 colleges in the country at the rate of Rs 100,000 (about US$ 2,200) per college. Selection of these colleges is to be based on open competition in view of their faculty expertise and other activities in earthquake engineering. Some library support is also provided to the eight resource institutes.

Laboratory Enhancement
The programme will support development of basic teaching laboratories at about ten colleges at the rate of Rs 1.5 million (about US$ 33,000) per college. The colleges will be selected based on open competition depending on their current infrastructure (research and otherwise), past work, and faculty resources. Different colleges may choose to enhance their equipment in different ways depending on the infrastructure currently available with them and their long-term vision. Selection of these colleges is based on open competition. Modest enhancement of the advanced teaching and research laboratories is also supported at the eight resource institutes at the rate of Rs 5 million (about US$ 110,000) per institute.

International Exposure
To maintain quality and international standards in the system, it is important that adequate exchange of ideas takes place with top international institutions. Hence, the programme also provides support for international visitors to the resource institutions for durations ranging from one month to six months, and for partial travel grants (up to Rs 50,000, that is about $ 1,100) for Indian academics to attend international conferences abroad. In addition, a small number of young teachers will 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 duration.

Development of Curricula
A concerted effort will be made to develop curricula, teaching aids, course materials, textbooks, manuals, and commentaries to codes.

Dissemination of Knowledge
Workshops and conferences will be organized to develop curricula, share ideas, and sensitize different stakeholders in earthquake disaster mitigation.

IMPLEMENTATION STRATEGY

Eight premier institutes (seven IITs and IISc) will be the lead resource institutes to provide the technical know how and training to the teachers of engineering colleges/polytechnics and schools of architecture. The programme will be open to all recognized engineering colleges/polytechnics and schools of architecture having related academic degree/diploma programme regardless of whether these are privately or publicly funded. It is recognized that the eight resource institutes do not have the same strengths in the area of Earthquake Engineering. Hence, these institutes may share different activities in different proportions. Depending on the need and the participation of different resource institutions, funds are allocated to them.

For success of the programme complete transparency and a good communication system were considered essential. A detailed Project Implementation Plan (PIP) was developed through consensus of the eight resource institutions and the Ministry officials. The PIP provides complete transparency in terms of various activities. The PIP clearly outlines detailed budget and financial norms for various activities, and the checks and the balances. Several thousand copies of the PIP have been freely distributed around the country and a soft copy is available on the NPEEE web site (www.nicee.org/npeee). The web site contains complete information about the Programme, various activities, application forms, and other relevant information. A large email listing of faculty members of civil engineering in the country has been developed which currently stands at more than 1,500 persons.

Amongst the eight resource institutions, one institute was designated as the nodal institute for effective implementation and one faculty of the nodal institute was designated as the National Coordinator for NPEEE. For effective implementation and monitoring, two standing committees were formed: *National Committee on Earthquake Engineering Education (NCEEE)* and *Program Implementation Committee (PIC)*. The NCEEE is responsible for overall monitoring of NPEEE, and coordination with other Ministries/Departments and AICTE. It also recommends allocation of funds to participating institutes depending on the need and the level of participation of the institutions. It is chaired by a senior administrator, the Joint Secretary responsible for technical education in the MHRD, and has representation from the other concerned Ministries/organizations, resource institutions, and finance division of MHRD. Table 1 gives constitution of the NCEEE.

Table 1: National Committee on Earthquake Engineering Education (NCEEE)

1.	Joint Secretary (Technical Education), Ministry of HRD, GoI, New Delhi	Chairman
2-3.	Two Institute Coordinators of Resource Institutes (7 IITs and IISc) *by rotation.*	
4.	Representative of the Ministry of Urban Development	
5.	Representative of the Ministry of Home Affairs (Disaster Management)	
6	Representative of the Department of Science and Technology	
7.	Nominee of the Chairman, All India Council for Technical Education	
8.	Finance Advisor, Ministry of HRD or his Nominee	
9.	National Coordinator, NPEEE	
10.	Director (Technical Education), Ministry of HRD, GoI, New Delhi	Convener

The Programme Implementation Committee (PIC) is responsible for (a) ensuring timely and effective implementation, (b) allocation of activities to different resource institutes and ensuring inter-institutional coordination, (c) selection of colleges and trainees for various activities, and (d) all other matters related and incidental to implementation of the programme. It is chaired by Director of one of the resource institutes, and its membership consists of representatives of the eight resource institutions, and one representative each of an engineering college, of an architecture college, and of a polytechnic. Table 2 gives constitution of the PIC.

Table 2: Programme Implementation Committee (PIC)

1.	Professor Prem Vrat, Director, I.I.T. Roorkee	Chairman
2-9.	Institute Coordinators of the eight Resource Institutions	
10-12.	Three representatives from Other Institutions (one each from engineering college, architecture college, and polytechnic)	
13.	National Coordinator	Convener

The main activity under NPEEE is the training of teachers and it was considered important to ensure the highest possible standards for the training programmes. NPEEE requires that at the end of all short courses, a test be conducted to evaluate value addition of the training and to evaluate the suitability of the trainees. To measure the quality of the training courses, a standard Course Evaluation Form is to be filled by each participant. Within a month of completion of short-term training course, the Course Coordinator is expected to send the following to the National Coordinator for the consideration of the PIC (a) A complete list of all participants in the course along with their complete address and affiliation, (b) A summary of course evaluation responses, (c) List of assessment scores in the test at the end of the course by the course participants, (d) A copy of the question paper for the test, and (e) Two sets of course materials used in the course.

PROGRESS AND CONSTRAINTS

The Programme has made considerable progress in less than one year of its existence. For instance, thirteen short courses of one or two week duration each have already been conducted by January 2004, exceeding the annual target of 350 man-weeks of training per year. In the remaining part of the financial year 2003-04, one more programme is scheduled in March 2004. A set of 20 short courses are scheduled for 2004-05, again exceeding the target. A group of seventeen faculty members from all over the country completed a one-semester long certificate programme at IIT Kanpur in December 2003, while another set of twenty one faculty members will complete a similar programme at IIT Roorkee in May 2004. For the semester starting in July-August 2004, IIT Kanpur, IIT Roorkee and IISc Bangalore have volunteered to conduct the semester programme. This is very encouraging considering that the faculty of the resource institutions undertake this teaching over and above their regular teaching responsibilities.

Numerous curriculum and other workshops have been conducted under the programme (e.g., Murty [2], Rai [3]), and some others were sponsored by NPEEE. Curricula of civil engineering diploma in the states of Uttar Pradesh and Uttaranchal have already been modified to include appropriate coverage of earthquake engineering as a result of one of the NPEEE workshops. Professor Bruce A Bolt of the University of California at Berkeley became the first international visitor under NPEEE by spending one month in India under the programme. Besides spending most of his stay at IIT Kanpur, he visited several other institutions in the country and delivered lectures. More such visitors are expected in the coming months and years. A colleague at IISc Bangalore is currently working on a resource manual on developing

teaching laboratory in earthquake engineering. This manual will help the colleges to develop and fabricate simple teaching experiments locally at low cost.

NPEEE is significant not only because of its potential towards seismic risk reduction, but has wider implications for the technical education in India. This is the first project wherein the eight premier institutions are working together for a common and focused objective of developing capacity in a subject in other technical institutions. It is providing very valuable lessons on their working together which could help evolve a viable model for more such future projects in diverse areas of science and technology.

NPEEE poses a number of challenges in its implementation. The resource institutes have limited number of faculty members in the area of Earthquake Engineering. After the Gujarat earthquake of 2001, there is a significantly higher level of activity in this subject area and hence most such academics currently have too much work at their hand. On the other hand, most engineering institutes in the country are facing a huge shortage of faculty members. Therefore, sending the faculty members for trainings is not always convenient to the college administrators for academic reasons. The semester programme is not only demanding in academic requirements, but also requires the trainees to be away from their families for about five months. Therefore, it is most important to keep the morale and enthusiasm of the participating faculty high.

CONCLUDING REMARKS

The programme even though in its first year has done well and is being appreciated in the technical education circles in India. The components that are key to its success include: (a) an effective communication system in the form of a web site, a large electronic mailing list, and a printed version of Programme Implementation Plan (PIP), (b) total transparency in terms of different activities and financial norms and budget, (c) all concerned colleges were included regardless of their source of funding, (d) programme was kept small enough that could be managed well and no attempt was made the solve the "entire" problem of HRD in a short duration of three years, and (e) it focuses on a small area (technical education) and does not attempt to achieve all components of seismic risk mitigation.

The last point above is rather important. The NPEEE was launched with a one-day workshop in April 2003 on "earthquake engineering curriculum". Participants included a wide cross section of more than 100 faculty members and professional engineers. Most speakers chose to speak on what needs to be done to ensure safety of buildings and what all should have been, and is not, included in this programme. It was clear that in an environment where everyone has been talking of the problem but not much was being done, the participants saw a new hope in the form of NPEEE and their expectations were that it should solve the entire problem. In formulating the programme, it was decided to do one component well rather than attempt everything so that the new initiative is not killed under the weight of unduly large expectations.

As the NPEEE was being developed and implemented, the Government of Gujarat had initiated a programme for capacity building of engineering colleges in Gujarat through training of teachers and curriculum changes. These activities have been discussed elsewhere (Jain [4], Sheth [5, 6]) The experiences of Gujarat too were very valuable in some of the NPEEE activities.

Finally, the implementation of programme has benefited from the fact that it is managed by a relatively younger group of persons who over the years had developed good rapport and understanding. An important bye-product of the programme has been development of excellent networking of faculty members across the country who participate in numerous activities of NPEEE. This will go a long way in enabling the academics to collaborate in the long run and work as strong teams for larger projects.

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REFERENCES

1. Murty CVR, Sinha R, Jain SK. "A Report on Earthquake Resistant Construction in Civil Engineering Curriculum." Newsletter of the Indian Society of Earthquake Technology, 1999: 1- 10.
2. Murty CVR, Rai DC, Gupta A, Jain SK. "Introducing Earthquake Engineering in Civil Engineering Curriculum." The Indian Concrete Journal 2004; 78(2): 110-116.
3. Rai DC, Jain SK. "A Report on the Workshop on Earthquake Engineering Curriculum for UP Polytechnics, 29-30 July 2003 at IIT Kanpur." 2003. http://www.nicee.org/npeee/UPPolyWS.htm
4. Jain SK, Sheth A. "Earthquake Engineering in the Civil Engineering Curricula." The Indian Concrete Journal 2002; 76(9): 558-562.
5. Sheth A, and Jain SK. "Training of Teachers for Capacity Building Towards Earthquake Safety in India." The Indian Concrete Journal 2002; 76(10): 629-632.
6. Sheth A, Jain SK, Thiruppugazh V. "Earthquake Capacity Building and Risk Reduction Measures in Gujarat post Bhuj 2001 Earthquake." Thirteenth World Conference on Earthquake Engineering, Vancouver, Canada. Paper no. 2018, 2004.