

Earthquake engineering curriculum for polytechnics in MP and Chhattisgarh

**M.C. Paliwal, V.H. Radhakrishnan
and Sudhir K. Jain**

The 2001 Gujarat earthquake has clearly illustrated the gravity of situation in India with respect to earthquake vulnerability. Numerous multistory buildings, constructed in recent years, collapsed like a pack of cards. About 13,805 persons were killed and a total economic loss of around Rs 250 billion was reported. Earthquake is a natural event, but the disaster caused is due to unsafe constructions. Hence, the solution to the earthquake problem lies in the construction of seismically-safe structures.

Unfortunately, over the years, adequate attention was not paid to the need for civil engineering and architecture curricula to include the concepts of earthquake engineering¹. As a result, most of the practising engineers and architects in India never learnt the subject as part of their course. Nevertheless, the Gujarat earthquake has made the country realise the need for capacity building in the technical institutions in this subject, for curriculum changes, and for the training of teachers². The ministry of human resource development (MHRD) of the government of India has launched the National Programme on Earthquake Engineering Education (NPEEE) for this purpose; details of the programme are available at www.nicee.org/npeee.

A one-day workshop was jointly organised by the Indian Institute of Technology Kanpur (IITK) and National Institute of Technical Teachers' Training Institute (NITTTR), Bhopal on May 31, 2004 under the aegis of NPEEE. The objective of the workshop was to discuss the entire issue of incorporating earthquake engineering in the civil engineering curriculum of polytechnics of the states of Madhya Pradesh and Chhattisgarh. This write-up summarises the workshop proceedings and its recommendations.

Polytechnic education system in MP and Chhattisgarh

The participants first reviewed the system of polytechnic education in Madhya Pradesh and Chhattisgarh. There are about 20 polytechnics in MP and about 10 in Chhattisgarh having civil engineering or construction technology discipline. The sanctioned strength of teachers in civil engineering is typically around six to eight in each polytechnic. However, there is an acute shortage of faculty because the recruitment of new teachers has not taken place for quite sometime. Most polytechnics typically have two regular, two part-time and two contract basis teachers in civil

engineering. Many polytechnics lack the advantage of having regular principals or regular heads of the department. Inadequate strength of teachers is a matter of serious concern. However, it was heartening to see that on average, the percentage of teachers with master's degree in engineering was much better in these two states than that in some of the other states in the country. Recently, the state of Madhya Pradesh has given autonomy to many of its polytechnics so that facilities like buildings and equipment may be used for revenue generation and this is expected to help improve the morale of these institutions.

In one batch of civil engineering class, around 30 students are admitted. Job prospects are not so encouraging in the government sector currently, and therefore, most of the diploma holders are absorbed in the private sector. The salaries offered in the private construction companies are very low (as low as Rs 2,000 to Rs 4,000 per month was mentioned), and hence, many diploma holders tend to pick up jobs unconnected with their training. It was also pointed out that due to a large number of new private engineering colleges, the quality of students joining polytechnics has drastically deteriorated in the recent years. It is generally seen that the students who

Table 1: Courses available in the civil engineering curriculum of the diploma Programme

Foundation courses	Physics, chemistry, mathematics and communication skills
Hard core courses	Applied mechanics, engineering drawing workshop technology
Soft core courses	Environmental engineering, marketing management, elements of mechanics and electrical engineering, computer application
Basic technology courses	Surveying, hydraulics, mechanics of structures, civil engineering drawing, material technology, soil mechanics, construction management, works organisation and management
Applied technology courses	Public health engineering, irrigation, quantity surveying, structural design and drafting, highway engineering
Diversified courses	Students have to select any two subjects: railways and tunnel engineering, advanced construction technology, advanced concrete technology, etc.

enrol in diploma programmes come from low-income groups because they cannot afford to study in private engineering colleges. Moreover, many students often pursue another course (say a degree in another subject) simultaneously with diploma and hence do not pay enough attention to their diploma studies. Extremely low salaries on one hand and deterioration in quality of students joining the programme on the other, are matters of serious alarm.

Diploma holders have traditionally played a very important role in construction supervision and many of them have done very well and risen to higher ranks. The leaders of civil engineering profession in the country need to seriously consider the role and future of diploma engineers and work out a future strategy to ensure that competent personnel continue to be available for construction supervision.

Current status of civil engineering curriculum

Until recently, Chhattisgarh was a part of MP and therefore the same curriculum is followed in both the states. It was developed in 1992 by the Board of Technical Education (BTE) Madhya Pradesh with the assistance of Technical Teachers' Training Institute (TTTI), Bhopal. The curriculum is based on the semester system. It allows for multi-point entry: students can join after high school, intermediate or B.Sc. and depending on their qualification the period of their course would differ. The students are awarded "marks" as against grades in different courses.

Presently, the curriculum of civil engineering diploma programme is divided into six groups namely, foundation, hard core, soft core, basic technology, applied technology and diversified courses, Table 1.

There are 34 courses in civil engineering diploma programme presently. However, it is envisaged that this number be reduced to 30 as per base paper developed by the Rajiv Gandhi Technological University, Bhopal.

Some recent initiatives

Concerned about the need to include earthquake engineering in the curriculum, in May 2001, NITTTR, Bhopal conducted a workshop on inclusion of earthquake-related aspects in curriculum of civil engineering and a report on the same was sent to concerned institutions³.

Through an initiative of the Gujarat State Disaster Management Authority (GSDMA), Gandhinagar, the curriculum in the state of Gujarat has been modified to include earthquake engineering and this has been discussed by Jain and Sheth⁴. Subsequently, under the National Programme for Earthquake Engineering Education (NPEEE), a workshop at IIT Kanpur developed recommendations for the polytechnics of UP and Uttaranchal which have been implemented⁵.

The curriculum revision process for both MP and Chhattisgarh states is currently on. In Madhya Pradesh, work on revision of curriculum has been entrusted to Jabalpur Polytechnic by the Rajiv Gandhi Technological University, Bhopal, under which all engineering colleges and polytechnics of the state now function. The university has prepared a base paper on revision of curriculum giving detailed guidelines and has set up Boards of Studies for different disciplines at the diploma level. After its formation, the state of Chhattisgarh has also started curriculum development activity under the Canada-India Institute Linkage Project (CIILP). Thus, the workshop at Bhopal on May 31, 2004 was very timely and it is expected

that it will be possible to incorporate its recommendations in the upcoming revisions of the curriculum in the two states.

Proposed curriculum changes

The workshop participants were unanimous about the need for curriculum changes to ensure adequate coverage of earthquake engineering. To achieve this objective, two models were discussed.

- (i) Earthquake engineering as a separate subject (followed by polytechnics of UP and Uttaranchal)
- (ii) Inclusion of topics related to earthquake engineering in existing courses/ subjects (followed in Gujarat)

A considerable discussion took place on the merits and demerits of these two models. It was felt that the Gujarat model may be suitable and better in the long run as it helps to integrate earthquake engineering aspects with civil engineering education and does not lead to an impression that earthquake engineering is a special subject different from the engineering practice. However, UP model has clear advantages over Gujarat Model in the short-run from planning, design, implementation, and training point of view. Secondly, as a separate course, its need and importance is better emphasised to students and teachers. After some thorough brain storming, most of the participants were of the view that earthquake engineering should be introduced as a separate subject in the curriculum of civil engineering diploma programme.

A draft syllabus for the new course on earthquake engineering was discussed. Participants were of the view that the basic emphasis of the course should be on conceptual aspects of earthquakes, their occurrence and effects on structures, condition of site soils, earthquake resistant construction of masonry and reinforced concrete structures including architectural planning, and retrofitting. Certain topics such as structural dynamics, which are more mathematical in nature, should be discussed only very briefly. Further, it was felt that construction aspects of structures are most important and should be emphasised. Based on these discussions and considering the primary objectives of the course, the syllabus for this new course was developed as per Table 2.

Further, it was also agreed that the students should spend at least two sessions in the computer laboratory to study, through CDs and internet, different types of damages sustained in the past earthquakes and the remedial measures undertaken. Also, in the course on civil engineering drawing, they should be asked to make one drawing of a small masonry building with earthquake resistant features, and another drawing of a small RC frame building with ductile detailing.

Road ahead

The curriculum changes should be supported through two key elements: training of teachers and resource materials⁶.

A one-week course was conducted at NITTTR Bhopal on earthquake resistant buildings from 19th July to 23rd July 2004. Colleagues from Khandwa Polytechnic pointed out that they are likely to organise a short course for teachers on this subject under the sponsorship of Indian Society of Technical Education (ISTE). Further, once the curriculum changes are implemented, it may be possible for the National Programme on Earthquake Engineering Education (NPEEE) to sponsor one or two short courses exclusively for polytechnic teachers of MP and Chhattisgarh at one or more of the resource institutions of NPEEE.

Considerable resource materials are now available on the subject. Some such publications were distributed to the

participants of the workshop. It was felt that the teachers should be encouraged to develop text book(s) on this subject. Moreover, it will be helpful if in the meanwhile, one of the polytechnics could create a folder of resource materials that could be shared with other polytechnics. It was mentioned that the Disaster Management Institute (DMI) Bhopal has published a handbook on non-engineered earthquake resistant construction recently and the same could also be useful for polytechnics.

Concluding remarks

There is an urgent need to introduce earthquake engineering in the curriculum of civil engineering diploma programme of MP and Chhattisgarh. A suggested curriculum is given in *Table 2*. However, curricula by themselves alone are not enough. It is important to review the current status of polytechnic education, with particular reference to civil engineering. The polytechnics seem to be operating with too few teachers and unless this issue is adequately addressed, any curriculum changes will be ineffective. Finally, the low salaries being offered to civil engineering diploma holders by the private construction firms, low morale of the students, and the deterioration in the quality of students joining the civil engineering diploma could have significant long-term impact on the construction scenario in India and these issues should be addressed by the civil engineering industry.

Table 2: Proposed course details for polytechnics of Madhya Pradesh and Chhattisgarh

Sl. No.	Topics	Periods
1	Causes of earthquakes and seismic waves, magnitude, intensity and energy release, basic terminology, characteristics of earthquakes, seismic hazard, vulnerability and risk, seismic zoning.	4
2	Past Indian earthquake disasters, performance of structures, response, relief and rehabilitation issues.	4/2
3	Philosophy of earthquake resistant design and concept of ductility, Short and long period structures, concept of spectrum, static force calculations.	3
4	Architectural considerations: building simplicity, symmetry, irregularities, continuity and uniformity	3
5	Effect of soils and liquefaction, remedial measures, construction of earth structures	4
6	Seismic construction of brick and stone masonry buildings, provisions of IS:4326	7
7	Seismic construction of RC buildings, detailing provisions of IS:13920	9
8	Post-earthquake handling of buildings; Retrofitting of masonry and reinforced concrete buildings	4
9	Quality control and construction issues	
	Total	36

Note: In addition to the above,

- In drawing class, one drawing sheet on a small masonry building with seismic details.
- In drawing class, one drawing sheet on a small RC frame building with seismic details.
- One visit to a construction site where good seismic detailing is being practised.

Table 3: Details of participants

Name	College
Rakesh Kumar Awasthy	Kalaniketan Polytechnic College, Jabalpur
Shrihari Agrawal	Formerly of MANIT Bhopal
Sudhir Singh Bhadauria	Rajiv Gandhi Tech University, Bhopal
Rajesh Bhargava	Polytechnic College, Nowgong
D S Chandel	Govt Polytechnic College, Satna
Ashish Dongre	Govt Polytechnic, Khandwa
Sudhir K Jain	IIT Kanpur
V K Jain	Govt Polytechnic College, Ashoknagar
B K Jaiswal	Govt Polytechnic College, Sanawad
SN Kamde	Government Polytechnic, Durg
K K Keshari	S V Polytechnic College, Bhopal
K K Mazumdar	K Govt Polytechnic, Raigarh
D K Mehta	M P Housing Board, Bhopal
M C Paliwal	NITTTR Bhopal
V H Radhakrishnan	NITTTR Bhopal
P K Sharma	SATI Polytechnic, Vidisha
L S Shongar	M P Housing Board, Bhopal
R S Sisodiya	MJP Govt Polytechnic College, Khandwa
O P Soni	S V Polytechnic College, Bhopal
Arvind Supekar	Shri Vaishnav Polytechnic, Indore

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The details of the participants of the workshop are given in *Table 3*.

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Prof M.C. Paliwal is assistant professor in the civil engineering department of National Institute of Technical Teachers' Training and Research (NITTTR) Bhopal since 1996. He has 11 years of teaching experience in engineering colleges at Pantnagar University and Bombay

University. He is working in the areas of earthquake resistant building construction, structural engineering, environment education and management system, engineering education and research, curriculum development, vocation education and training.



Prof V.H. Radhakrishnan is a technical educator and trainer and as an experienced civil engineer, and has about 27 years of proven accomplishments. His special areas of expertise with reference to civil engineering include geo-technical engineering, earthquake engineering education, construction technology and management and environmental education and management system. Currently, he is managing and coordinating World Bank assisted technical education Project III as project coordinator

and nodal officer for selected north eastern states of India, for which NITTTR Bhopal is the academic consultant.



Dr Sudhir K. Jain is currently professor in the department of civil engineering at the Indian Institute of Technology (IIT), Kanpur. His areas of interest include earthquake-resistant design, seismic design codes, and dynamics of buildings. He is national coordinator of the National Programme on Earthquake Engineering Education and is the co-ordinator of the National Information Centre of Earthquake Engineering (NICEE) hosted at IIT Kanpur. He is a director of the International Association for Earthquake Engineering, and of the World Seismic Safety Initiative.

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