

NPEEE—Looking back

National Programme on Earthquake Engineering Education
A Ministry of Human Resource Development (Government of India) Initiative
Executed by the Indian Institutes of Technology (Bombay, Delhi, Guwahati, Kanpur,
Kharapur, Madras and Roorkee) and Indian Institute of Science (Bangalore)

April 2007



www.nicee.org/npeee



Genesis...

NPEEE was a programme launched by the Ministry of Human Resource Development, Government of India, New Delhi involving eight premier institutes of technology in the country, with the agenda of building capacity amongst colleges of engineering, architecture and polytechnic institutes nationwide, in order to further earthquake education and earthquake-resistant constructions in the country. It was in operation during April 2003 through March 2007.

Key components of the project included short-term and medium-term training programmes for faculty members, international exposure to faculty members through participation in conferences and seminars as well as in training programmes, development of curricula, resource materials and teaching aids, development of library and laboratory resources, and organization of conferences and workshops.

NPEEE was administered through the National Committee on Earthquake Engineering Education (NCEEE), that was responsible for overall monitoring of NPEEE, and for coordination with other Ministries/Departments and AICTE. NPEEE was steered through a Programme Implementation Committee (PIC) and a number of its sub-committees. To ensure transparency in its activities and financial operations, a Project Implementation Plan (PIP) was initiated along with a website; both have been important tools for effective implementation of the programme.

The strength of the Programme and its widespread acceptance and goodwill lay in the transparent administrative mechanisms, non-discriminatory policies with regard to private versus government funded institutes, feasible and manageable domain of operations, and its human resources that drew upon some strongly motivated and committed individuals working as a cohesive team.

National Committee on Earthquake Engineering Education (as on 31 March 2007)

Chairman

Sri Ravi Mathur, Joint Secretary (Technical Education), Ministry of HRD, GoI, New Delhi

Convener

Ms. Seema Raj, Director, Ministry of HRD, GoI, New Delhi

Members

Two Coordinators by rotation from IITs and IISc Bangalore

Professor Ravi Sinha, IIT Bombay (for 2007)

Professor A. K. Jain, IIT Delhi (for 2007)

Representative of the Ministry of Urban Development

Representative of the Ministry of Home Affairs (NDM)

Representative of the Ministry of Science & Technology

Nominee of the Chairman, AICTE

Professor Sudhir K Jain, IIT Kanpur, as National Coordinator

FA (HRD) or his Nominee

Project Implementation Committee (as on 31 March 2007)

Chairman

Professor S. K Dube, Director, IIT Kharagpur

Convener

Professor Sudhir K Jain, National Coordinator, NPEEE Department of Civil Engineering, IIT Kanpur

Institute Coordinators from Resource Institutions

Professor Ravi Sinha

Department of Civil Engineering, IIT Bombay

Professor A. K. Jain

Department of Civil Engineering, IIT Delhi

Professor S K Deb

Department of Civil Engineering, IIT Guwahati

Professor CVR Murty

Department of Civil Engineering, IIT Kanpur

Professor S K Nath

Department of Geology and Geophysics, IIT Kharagpur

Professor A Meher Prasad

Department of Civil Engineering, IIT Madras

Professor D K Paul

Department of Earthquake Engineering, IIT Roorkee

Professor C S Manohar

Department of Civil Engineering, IISc, Bangalore

Representatives from other Institutions

Professor Madhavan Pillai

Department of Civil Engineering, NIT, Calicut

Professor Subir Saha

School of Planning and Architecture, New Delhi

Professor K K Soni

CV Shah Polytechnic, Surendranagar

Professor Persi Engineer

Sarvajanic College of Engineering & Technology, Surat

**Professor Prem Vrat, Director, IIT Roorkee, chaired the PIC until June 2006.*

Cornerstones

NPEEE adopted a holistic approach to capacity building in earthquake engineering by targeting institutions and faculty for training, exposure and resource building. Six key elements formed the cornerstones of this approach.

1 BUILDING HUMAN RESOURCE IN EARTHQUAKE ENGINEERING

NPEEE has proactively imparted training to technical teachers through numerous training programmes and has consistently exceeded the original target of 350 man-weeks of short term training per year.

2 FACILITATING KNOWLEDGE TRANSFER

NPEEE has adopted a multi-pronged approach that makes use of different tools and formats for teaching, including among others, development and dissemination of computer software and publications.

3 STRENGTHENING INSTITUTIONS

Capacity building has to begin in the classroom to ensure that the professionals of tomorrow are equipped to take up the challenge of a safer future. Thus, educational institutions in the country must be equipped to deliver cutting edge knowledge and facilities to their faculty and students. NPEEE provided support to institutions to upgrade and extend their laboratories, and enhanced their libraries by supplying a wide range of publications.

4 CURRICULUM DEVELOPMENT

To ensure that more and more of tomorrow's professionals are aware of and sensitized to earthquake safety concepts, intervention has to happen in the classroom of today.

NPEEE has spearheaded a strong movement to bring about changes in the engineering, architecture and polytechnic curricula so that the budding professionals are well equipped in this critical area involving the safety of millions of our fellow countrymen, women and children.

5 INTERNATIONAL BENCHMARKS

The international professional community in earthquake engineering has much to offer by way of expertise and exposure to our own professionals. Recognizing this, NPEEE facilitates young teachers to spend time in universities overseas. The Partial Travel Support Scheme for attending international conferences allows an exchange of ideas and provides effective mechanism for self evaluation of individuals with respect to their peer groups. The International Visitors Programme brings key earthquake engineering professionals from across the globe to the resource institutes. This fosters close working associations with the best in the profession and further presents opportunities for developing collaborations.

6 SELF-EVALUATION

Recognizing that any system can be enriched and further honed through self criticism and evaluation, NPEEE has put in place a mechanism for collecting feedback from the beneficiaries of various programmes and incorporating their suggestions after careful consideration. This has ensured a vibrant and outward looking environment, which is open to an ongoing process of renewal and improvement.

This report...

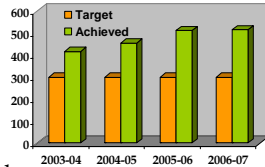
Four years into its operations, NPEEE has achieved several of the targets set at the time of its inception. It is time for taking stock and looking ahead, and for further developing the agenda of bringing earthquake safety issues to the professional communities of our country. This Report summarizes the activities undertaken in these past four years and indicates the road ahead for the future.

Building Capacity

SHORT TERM TRAINING – EXCEEDING TARGETS

A large number of short courses (one or two week duration) have been conducted at the 8 resource institutes where faculty members of colleges of engineering/architecture and polytechnics were trained. NPEEE has been consistently exceeding its original target of 350 man-weeks of training per year for the teachers:

- 418 man-weeks during 2003-04
- 456 man-weeks during 2004-05
- 513 man-weeks during 2005-06
- 516 man-weeks during 2006-07



Contribution of the different resource institutes to the short term training has varied depending on availability and interest of faculty in imparting the training:

- 192 man-weeks at IIT Bombay
- 84 man-weeks at IIT Delhi
- 161 man-weeks at IIT Guwahati
- 293 man-weeks at IIT Kanpur
- 70 man-weeks at IIT Kharagpur
- 531 man-weeks at IIT Madras
- 351 man-weeks at IIT Roorkee
- 219 man-weeks at IISc Bangalore

1360
teachers
trained

A total of 1360 teachers received training in one or more short courses in the past four years. Some of the trainings also drew participants from Nepal and Bangladesh, and the industry in India.

NPEEE put in place a monitoring system to ensure the quality of its training courses. Barring an exception or two, all the training programmes were rated extremely highly by the participants.

SEMESTER PROGRAMMES

This certificate programme of one-semester duration was conceptualized to give the teachers an opportunity to develop in-depth knowledge of the subject. A number of such programmes have been conducted for the college teachers.

Institute	Schedule	No. of Participants
IIT Kanpur	2003-2004 I Semester	17
IIT Roorkee	2003-2004 II Semester	20
IISc Bangalore	2004-2005 I Semester	9+1 from industry
IIT Roorkee	2004-2005 I Semester	7+1 from industry
IISc Bangalore	2006-2007 II Semester	6

Due to acute shortage of teachers in engineering colleges and difficulties in having the parent institutions release faculty for long duration, the number of trainees in these programmes has been somewhat low. However, those who did undergo this training have gained substantially from it and have been very responsive to the programme.

INTERNATIONAL TRAINING

NPEEE provides opportunities for a few young college teachers to undergo training in international environments. The objective of the programme is to develop young faculty to provide leadership in research activities in colleges. A number of colleagues have undergone six-month research training stints at prestigious universities abroad. The results have been spectacular as seen from the research output and the publications that are resulting from such collaborations.

New Zealand

- **G Umarani**, Institute of Road & Transport Technology, Erode
Host Institute: University of Catenbury, Christchurch, New Zealand
Research Topic: Consideration of slab effect in building seismic performance

- **Rakesh K Khare**, SGS Institute of Technology & Science, Indore
Host Institute: University of Catenbury, Christchurch, New Zealand
Research Topic: Seismic design of precast concrete structures

Japan

- **S V Dinesh**, SIT, Tumkur
Host Institute: Yamaguchi University, Tokiwadsi, Japan
Research Topic: Soil dynamics (liquefaction evaluation, cyclic shear strength, dynamic properties under large strain amplitude) on loose sand

Canada

- **Indrani Gogoi**, Assam Engineering Institute, Guwahati
Host Institute: Ecole Polytechnique, Montreal, Quebec, Canada
Research Topic: Earthquake vulnerability assessment of structures
- **A V Bhaskara Rao**, Bapatla Engineering College, Bapatla
Host Institute: University of Toronto, Canada
Research Topic: Further development of the self-centering brace concept for earthquake-resistant design

UK

- **L. Govindaraju**, R. V. College of Engineering, Bangalore
Host Institute: University of Oxford, U. K.
Research Topic: Generation of seismic input motion for studying soil-structure interaction problems and study on failure of Quay-Walls near the water fronts.

USA

- **Debashish Bandyopadhyay**, Jadavpur University, Kolkata
Host Institute: University of Arizona, Tuscon, USA
Research Topic: Post-earthquake structural health assessment technics without input excitation data and with limited noise contaminated response data and probabilistic application in earthquake engineering
- **A K Dutta**, Jorhat Engineering College, Jorhat
Host Institute: University of South Carolina, USA
Research Topic: Semiactive/hybrid control of seismic excitation of a cable-stayed bridge.
- **B. B. Soneji**, Government Polytechnic for Girls, Ahmedabad
Host Institute: University of New York, Buffalo, USA
Research Topic: Seismic Protective System.

OPPORTUNITIES IN ITALY

IIT Kanpur and University of Naples Federico II (Italy) entered into an agreement for two Italian government scholarships for young Indian researchers to work at the University of Naples Federico II (Italy) in earthquake engineering for one year at no cost to NPEEE. Two colleagues were selected for the same after a careful selection procedure. **Dr. S. Chandrasekaran Iyer**, BHU Institute of Technology, Varanasi is currently conducting research in Italy under this arrangement.

Development & Dissemination of Resource Materials

LABORATORY MANUAL DEVELOPED BY IISc BANGALORE

Professor C S Manohar and Mr S Venkatesha of Indian Institute of Science, Bangalore, have developed a package of resource materials for development of experimental setups for earthquake engineering education. This is available for free download from NPEEE site and is being provided on a CD, to the Colleges, on request. The manual is in three parts: Students manual, Teachers manual, & Fabrication manual. The latter provides all fabrication details so that a typical college can actually develop the experimental set-ups in-house at a very low cost. A number of

engineering colleges have effectively used the manual to develop a laboratory and a laboratory course.

TEACHING RESOURCE MATERIAL FOR ARCHITECTURE CURRICULA DEVELOPED BY IIT KANPUR

IIT Kanpur has developed a teaching resource material on earthquake design concepts for architecture colleges in the form of power point presentation (about 600 slides). It was tested in a short course of faculty of Architecture Colleges and revised on the basis of feedback received. One copy of notes along with a CD containing all the 600 powerpoint slides was distributed free of charge to architecture colleges. Others can procure these at nominal charge from NICEE, IIT Kanpur.

FREE DISTRIBUTION OF SAP & ETABS SOFTWARES

M/s Computers & Structures Inc, Berkeley, USA were persuaded to donate free of charge their softwares SAP and ETABS to all interested colleges of engineering, architecture and polytechnics in India. This is a major break through in terms of creating cutting-edge learning resources for colleges in India and towards capacity building in the country for earthquake resistant design. These two softwares are considered state-of-the-art in earthquake engineering and are quite expensive. In fact, ETABS recently won the *Top Seismic Product of the 20th Century Award* from the Applied Technology Council (ATC) and Engineering News Records (ENR). About 253 colleges have already received these softwares. There were no financial implications on this account, i.e., neither NPEEE nor the colleges incurred any expenditure to obtain these softwares.

RESIST SOFTWARE

Computer software, RESIST has been developed by Professor Andrew Charleson of New Zealand, as a very effective tool to help architecture students integrate structural issues into the architectural design process. Considering its utility, and far reaching implications in creating rational and earthquake resistant architectural designs, NPEEE commissioned him to create an Indian version of the same, which includes Indian codes and Indian construction typologies. NPEEE has distributed this software to all engineering and architecture colleges in the country to facilitate effective dovetailing of safety concerns in the architectural design process, in the classroom.

PRINTING AND DISSEMINATION OF EXISTING LITERATURE

NPEEE has sponsored printing of existing literature:

- IITK-BMTPC Earthquake Tips by CVR Murty
- IAEE Guidelines on Non Engineering Construction (English & Hindi)
- Annotated Images from the Bhuj, India Earthquake of January 26, 2001 (CD)
- Bhuj, India Republic Day January 26, 2001 Earthquake Reconnaissance Report (CD)
- Seismic Hazard and Risk Analysis, by Robin K. McGuire
- Earthquake Rebuilding in Gujarat, India by CVR Murty, et al.
- Seismic Conceptual Design of Buildings - Basic principles for engineers, architects, building owners, and authorities by Hugo Bachmann
- Earthquake Dynamics of Structures, A Primer by Anil K. Chopra
- Earthquake Design Criteria by G. W. Housner and P. C. Jennings
- Design of Foundations in Seismic Areas: Principles and Applications, by S. Bhattacharya (Editor)
- Fundamentals of Seismic Protection for Bridges, by M Yashinsky and MJ Karshenas

These have now been distributed in large numbers in the country and can be obtained from NICEE at IIT Kanpur either free or on a nominal charge.

International Visitors

The Programme supported visits by a number of international experts to the resource Institutes for durations ranging from 3 weeks to 7 weeks. Several collaborative activities have emerged from these visits.

IIT KANPUR



Late Prof Bruce Bolt
University of California, Berkeley,
USA Visited during Jan-Feb 2004



Prof Andrew Charleson
Victoria University of
Wellington, New Zealand
17 Oct 2004 – 5 Jan 2005 and
17 Oct – 26 Nov 2005



Prof Svetlana N Brzev
British Columbia Institute of Tech.,
Vancouver, Canada Visited during
12 Dec 2005 – 04 Jan 2006



Prof Armen Der Kiureghian
University of California,
Berkeley, USA Visited during
13-26 Dec 2005

IIT ROORKEE



Prof Miha Tomazevic
Slovenian National Building and Civil
Engineering Institute, Ljubljana
Visited during 16 March - 12 April 2004

IIT MADRAS



Prof Kyle M Rollins
Brigham Young University, USA
Visited during 30 March – 28
April 2006

IIT DELHI



Prof Pol D. Spanos
Rice University, Houston,
USA Visited during 12-26
January 2007

International Travel Support

Under this programme, teachers are provided partial travel grants up to Rs 50,000/- to attend international conferences; they must raise balance funds from other sources. Through this grant, a good number of faculty members, from all over the country, are getting an opportunity to present research papers at international conferences. This effort is showcasing India and Indian research activities in an international arena, besides giving colleagues a much needed opportunity to benchmark themselves with peers worldwide.

RECIPIENTS OF NPEEE TRAVEL SUPPORT

A Boominathan, Indian Institute of Technology Madras
A Meher Prasad, Indian Institute of Technology Madras
A V Bhaskara Rao, Bapatla Engg. College, Bapatla
Alok Goyal, Indian Institute of Technology Bombay,
Alok Madan, Indian Institute of Technology Delhi
Ami Shah, S V Patel Institute of Technology, Vasad
Amita Sinhal, Indian Institute of Technology Roorkee,
Amlan K Sengupta, Indian Institute of Technology Madras
Anjan Dutta, Indian Institute of Technology Guwahati
Ashok Kumar, Indian Institute of Technology Roorkee
Ashwani Kumar, Indian Institute of Technology Roorkee
B G Birajdar, Pune Institute of Engineering and Tech., Pune
B K Maheshwari, Birla Institute of Tech. and Science, Pilani
B K Raghu Prasad, Indian Institute of Science Bangalore
B R Srinivasa Murthy, Indian Institute of Science Bangalore
B K Maheshwari, Indian Institute of Technology Roorkee
B Nageswara Rao, Indian Institute of Technology Madras
Balkrishna B Soneji, Indian Institute of Technology Bombay
Bimal A Shah, MS University, Baroda
Biswajit Sharma, Jorhat Engineering College, Jorhat
C V R Murty, Indian Institute of Technology Kanpur
D K Paul, Indian Institute of Technology Roorkee
Daya Shanker, Indian Institute of Technology Roorkee
Debasis Roy, Indian Institute of Technology Kharagpur
Durgesh C Rai, Indian Institute of Technology Kanpur
Ganesh Hegde, Indian Institute of Technology Bombay
Gautam Bhattacharya, Bengal Engineering College, Howrah
H R Wason, Indian Institute of Technology Roorkee
Hemang Parikh, MS University, Baroda
Indrani Gogoi, Assam Engineering Institute, Guwahati
J Kalyan Kumar, Hindustan College of Engineering, Chennai
J P Narayan, Indian Institute of Technology Roorkee
Jagdish G Kori, Dr. J J Magdum College of Engg., Jaysingpur
Javed N Malik, Indian Institute of Technology Kanpur
Jaya K P, Anna University, Chennai
Jayanta Pathak, Jorhat Engineering College, Jorhat
Joanna P S, Hindustan college of Engineering, Chennai
K S Nanjunda Rao, Indian Institute of Science Bangalore
Keya Mitra, Bengal Engineering & Science University, Shibpur
Khalid Moin, Jamia Millia Islamia, New Delhi
M K Shrimali, Malaviya National Institute of Tech., Jaipur
M L Sharma, Indian Institute of Technology Roorkee
M M Rao, Indian Institute of Technology Delhi
M T Pratap Kumar, Ghousia College of Engg., Ramanagaram
Maganti Janardhana, JNTU College of Engineering, Hyderabad
Mahua Mukherjee, Indian Institute of Technology Roorkee
N S Kumar, Ghousia College of Engineering, Bangalore

O R Jaiswal, Visvesvaraya National Institute of Tech., Nagpur
Panchal Vijaykumar Ramanlal, Indian Institute of Tech. Bombay
Papori Rani Barooah, Girls Polytechnic, Guwahati
Pradipta Banerji, Indian Institute of Technology Bombay
Pranesh Murnal, Govt. College of Engineering, Karad
Purshottam Sankhla, Govt. Polytechnic College, Jodhpur
R S Jangid, Indian Institute of Technology Bombay
R. Angeline Prabhavathy, Hindustan College of Engineering, Kancheepuram
Raju Sarkar, G B Pant Polytechnic, New Delhi
Rajul K. Gajjar, L.D. College of Engineering, Ahmedabad
Ramancharla Pradeep Kumar, IIIT Hyderabad
Ravi Sinha, Indian Institute of Technology Bombay
Ravindra Deshmukh, Manipal Institute of Technology, Manipal
S K Prasad, S J College of Engineering, Mysore
S R Satish Kumar, Indian Institute of Technology Madras
S Rajasekaran, PSG College of Technology, Coimbatore
S K Deb, Indian Institute of Technology Guwahati
S R K Reddy, Gudlavalleru Engg. College, Gudlavalleru
S V Bakre, VNIT, Nagpur
Sarvesh K Jain, Madhav Institute of Tech. & Science, Gwalior
Sivakumar Babu, Indian Institute of Science Bangalore
Subrata Chakraborty, Bengal Engineering College, Howrah
Sudhir K Jain, Indian Institute of Technology Kanpur
Tande Shrirang Nivrutti, Walchand College of Engg., Sangli
Tushar Kant Datta, Indian Institute of Technology Delhi
U K Sharma, Indian Institute of Technology Roorkee
Umesh Kumar Sharma, National Institute of Tech., Hamirpur
Vasudha A Gokhale, Dr B N College of Architecture, Pune
Vinay S Purani, Government Engg. College, Gandhinagar

Institutional Capacity Building

LABORATORY ENHANCEMENT

Ten colleges have been provided with a laboratory grant of Rs 15 Lakhs each. This has enabled them to make a modest but important beginning in terms of developing an earthquake engineering laboratory.

- SGS Institute of Technology & Science, Indore
- Govt. Engineering College, Pune
- MNIT, Jaipur
- NIT, Kurukshetra
- NIT, Calicut
- NIT, Silchar
- NIT, Suratkal
- NIT, Warangal
- PSG College of Technology, Coimbatore
- Thapar Institute of Engineering and Technology, Patiala

Additionally, a laboratory grant of Rs. 51 lakhs each to the resource institutes has helped in further strengthening research facilities at these institutes. For instance a six-axes earthquake simulator (1m by 1m table, 500 kg payload capacity, accelerations up to 2g over a frequency range up to 15 Hz) has been developed indigenously at IISc Bangalore using the NPEEE grant.

LIBRARY ENHANCEMENT

Books and publications in earthquake engineering were provided to 100 colleges all over the country. All colleges, nationwide, were invited to apply for this support and the 100 colleges were selected based on credentials. IIT Delhi has centrally procured these books to avail large discounts in prices. The list of 100 colleges is given elsewhere. The following books and publications were procured and provided to the colleges:

Books Distributed to 100 Colleges

- Bridge Engineering Seismic Design: Principles and Applications in Engineering Series, *Wai-Fah Chen and Lian Duan*
- Design for Earthquakes, *James Ambrose & Dimitry Vergun*
- Design of Seismic Isolated Structures: From Theory to Practice, *Farzad Naeim and James M Kelly*
- Dynamic Analysis & Earthquake Resistant Design Vol. 1, (Strong Motion and Dynamic Properties), *Japanese Society of Civil Engineers*
- Earthquake Protection, *Andrew Coburn and Robin Spence*
- Earthquake Rebuilding in Gujarat, India; An EERI Recovery Reconnaissance Report, *CVR Murty, et. al.*
- Earthquake Resistant Concrete Structures, *G G Penelis and Andreas J Kappos*
- Earthquake Risk Reduction, *David J Dowrick*
- Earthquake-Resistant Design of Masonry Buildings Vol.1, *Miha Tomazevic*
- Earthquakes, *AKR Hemmady*
- Earthquakes, *Bruce A Bolt*
- Earthquakes: An Architect Guides to Non Structural Seismic Hazards, *Henry J Lagorio*
- EERI Special Report "The Great Sumatra Earthquake and Indian Ocean Tsunami of December 26, 2004: The Effects in Mainland India and in the Andaman-Nicobar Islands", *Sudhir K Jain, et. al.*
- Dynamic Analysis & Earthquake Resistant Design Vol. 2, (Methods of Dynamic Analysis), *Japanese Society of Civil Engineers*
- Dynamic Analysis & Earthquake Resistant Design Vol. 3, *Japanese Society of Civil Engineers*
- Dynamics of Structures: Theory & Applications, *A K Chopra*
- Earthquake Design Practice for Buildings, *David Key*
- Earthquake Engineering Handbook, *Wai-Fah Chen and C Scawthorn*
- Elements of Earthquake Engineering, *Jai Krishna, A R Chandrasekaran and Brijesh Chandra*
- Fundamentals of Earthquake-Resistant Construction, *Ellis L Krinitzsky, James P Gould and Peter H Edinger*
- Geodynamics of Northeastern India and the Adjoining Region, *D R Nandy*
- Geotechnical Earthquake Engineering Handbook, *Robert W Day*
- Geotechnical Earthquake Engineering, *Steven L Kramer*
- Guidelines for Earthquake Resistant Non-Engineered Construction (English and Hindi)
- Fundamentals of Seismic Protection for Bridges, *M Yashinsky and M J Karshenas*
- IITK-BMTPC Earthquake Tip, *C V R Murty*
- International Handbook of Earthquake & Engineering Seismology Part - A, (Eds.) *W H K Lee, H Kanamori, P C Jennings and C Kisslinger*
- International Handbook of Earthquake & Engineering Seismology Part - B, (Eds.) *W H K Lee, H Kanamori, P C Jennings and C Kisslinger*

- Keeping Schools Safe in Earthquakes, *OECD, Paris, France*
- Manual of Seismic Design, *James L Stratta*
- Masonry & Timber Structures Including Earthquake Resistant Design, *A S Arya*
- Protection Against Earthquakes, *Dharam V Mallick*
- Seismic Design and Retrofit of Bridges, *M J N Priestley, F Seible and G M Calvi*
- Seismic Design of Reinforced and Precast Concrete Buildings, *Robert E Englekirk*
- Seismic Design of Reinforced Concrete and Masonry Buildings, *T Paulay and M J N Priestley*
- Seismic Hazard and Risk Analysis, *Robin K McGuire*
- Steel Structures : Controlling behavior through Design, *Robert Englekirk*
- The Seismic Design Handbook, *Farzad Naeim*
- Earthquake Design Criteria, *G. W. Housner and P. C. Jennings*
- Earthquake Dynamics of Structures: A Prime, *Anil K. Chopra*
- Seismic Conceptual Design of Buildings, *Hugo Bachmann*
- Structural Dynamics Vibrations & Systems, *M. Mukhopadhyay*
- Earthquakes, *H. N. Srivastava*
- Ductility of Seismic Resistant Steel Structures, *Gioncu V. and Mazzolani F. M.*
- Earthquake Engineering: From Engineering Seismology to Performance based Engineering, *Bozorgria Y. C. and V. V. Bertero*
- Dynamic of Structures, *Humar J. L.*
- Simplified Building Design for Wind and Earthquake Forces, *Ambrose, J. and Vergun D.*
- Fundamentals of Structural Dynamics, *Craig R. R and Andrew J. Kurdila*
- Instrumentation in Earthquake Seismology, *Havskov Jens & Alguacil Gerardo*
- Seismic Resistant Steel Structures, *Mazzolani F. M.: Gioncu V.*

Indian Standards

- IS:1893 (PART 1) - 2002, *Indian Standards Criteria for Earthquake Resistant Design of Structures: Part 1 - General Provisions & Buildings*
- IS:4326-1993, *Indian Standard Code of Practice for Earthquake Resistant Design & Construction of Buildings*
- IS:13827-1993, *Indian Standard Guidelines for Improving Earthquake Resistance of Earthen Buildings*
- IS:13828-1993, *Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings*
- IS:13920-1993, *Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces*
- IS:13935-1993, *Indian Standard Guidelines for Repair & Seismic Strengthening of Buildings*

CD Resources

- Annotated Images from the Bhuj, India Earthquake of January 26, 2001, CD, EERI (USA)
- Bhuj, India Republic Day January 26, 2001 Earthquake Reconnaissance Report, CD version of the 400 page volume, EERI (USA)

100 Colleges that received Library Support

- Ajaya Binaya Institute of Technology, Piloo Mody College of Architecture, Cuttack, Orissa
- Arasan Ganesan Polytechnic College, Shivakasi, Tamil Nadu
- Assam Engineering College, Guwahati, Assam
- Bengal Engineering and Science University, Howrah, WB
- Birla Institute of Technology & Science, Pilani, Rajasthan
- Birla Institute of Technology, Dhanbad, Jharkhand
- Birla Vishvakarma Mahavidyalaya, Anand, Gujarat
- BLDEA's VP Dr. P G Halakatti College of Engineering & Technology, Bijapur, Karnataka
- Coimbatore Institute of Technology, Coimbatore, TN
- College of Engineering, Thiruvananthapuram, Kerala
- College of Engineering and Tech., Bhubaneswar, Orissa
- College of Engineering, Amravati, Maharashtra
- College of Engineering, Visakhapatnam, AP
- College of Technology, Pantnagar, Uttaranchal
- DD Institute of Technology, Nadiad, Gujarat
- Faculty of Technology and Engineering; MS University of Baroda, Vadodara, Gujarat
- Dibrugarh Polytechnic, Dibrugarh, Assam
- Dr. B R Ambedkar National Institute of Technology, Jalandhar, Punjab
- Dr. D Y Patil College of Engineering and Technology, Kohlapur, Maharashtra
- Engineering College Kota, Kota, Rajasthan
- Faculty of Architecture, Integral University, Lucknow, UP
- Faculty of Engg. & Tech., Jamia Milia Islamia, New Delhi
- Faculty of Engineering & Technology, Annamalai Nagar, TN
- GZS College of Engineering and Tech., Bhatinda, Punjab
- Girls' Polytechnic, Guwahati, Assam
- Government College of Engineering, Karad, Maharashtra
- Government Engineering College, Ponda, Goa
- National Institute of Technology, Raipur, Chattisgarh
- Government Polytechnic for Girls, Ahmedabad, Gujarat
- Government Polytechnic, Aurangabad, Maharashtra
- Government Polytechnic, Bijnore, UP
- Government Polytechnic, Muzaffarpur, Bihar
- Government Polytechnic, Palanpur, Gujarat
- Government Polytechnic, Panaji, Goa
- Government Polytechnic, Porbandar, Gujarat
- Government Polytechnic, Rajkot, Gujarat
- Government Polytechnic, Srinagar (Garhwal), Uttaranchal
- Government Polytechnic, Tumkur, Karnataka
- Government Polytechnic, Vadnagar, Gujarat
- Institute of Engineering & Rural Technology, Allahabad, UP
- Institute of Technology, Varanasi, UP
- International Institute of Information Tech., Hyderabad, AP
- IPS Academy, Indore, MP
- Jawaharlal Nehru Engg. College, Aurangabad, Maharashtra
- JJ College of Architecture, Mumbai, Maharashtra
- JNTU College of Engineering, Anantapur, AP
- JNTU College of Engineering, Hyderabad, AP
- Jorhat Engineering College, Jorhat, Assam
- Kerala Government Polytechnic College, Kozhikode, Kerala
- LS Raheja School of Architecture, Mumbai, Maharashtra
- LD College of Engineering, Ahmedabad, Gujarat
- Lukhdirji College of Engineering, Morbi, Gujarat
- MBM Engineering College, Jodhpur, Rajasthan
- MJP Polytechnic College, Khandwa, MP
- MMM Engineering College, Gorakhpur, UP
- M Patel Institute of Engineering & Technology, Gondia, MP
- Madhav Institute of Technology & Science, Gwalior, MP
- Malaviya National Institute of Technology, Jaipur, Rajasthan
- Manipal Institute of Technology, Udupi, Karnataka
- Maulana Azad National Institute of Technology, Bhopal, MP
- MEASI Academy of Architecture, Chennai, TN
- Moderator Gnanason Polytechnic College, Kanyakumari, TN
- Motilal Nehru National Institute of Tech., Allahabad, UP
- Muzzzfarpur Institute of Technology, Muzzzfarpur, Bihar
- National Institute of Technology, Silchar, Assam
- National Institute of Technology, Hamirpur, HP
- National Institute of Technology, Warangal, AP
- National Institute of Technology and Science, J&K
- National Institute of Technology Calicut, Calicut, Kerala
- National Institute of Technology, Jamshedpur, Jharkhand
- National Institute of Technology, Kurukshetra, Haryana
- National Institute of Technology, Rourkela, Orissa
- National Institute of Technology, Surathkal, Karnataka
- National Institute of Technology, Tiruchirappalli, TN
- Institute of Science & Tech., NIRMA University, Ahmedabad, Gujarat
- North Eastern Regional Institute of Science & Technology, Itanagar, Arunachal Pradesh
- PSG College of Technology, Coimbatore, TN
- Periyar Maniammai College of Technology for Women, Thanjavur, TN
- Pondicherry Engineering College, Pondicherry
- Poojya Doddappa Appa College of Engineering, Gulbarga
- Purulia Polytechnic, Purulia, WB
- RVR & JC College of Engineering, Guntur, AP
- SGGGS College of Engineering & Tech., Nanded, Maharashtra
- SGS Institute of Technology & Science, Indore, MP
- SS Government Polytechnic, Zaheerabad, AP
- SRKR Engineering College, Bhimavaram, AP
- Sardar Vallabhbhai National Inst. of Tech., Surat, Gujarat
- Sarvajanic College of Engineering & Tech., Surat, Gujarat
- Faculty of Technology; School of Building Science and Technology; CEPT University, Ahmedabad, Gujarat
- School of Planning & Architecture, Jawaharlal Nehru Technological University, Hyderabad, AP
- Siddaganga Institute of Technology, Tumkur, Karnataka
- SJ College of Engineering, Mysore, Karnataka
- SRM Engineering College, Kattankulathur, TN
- TKM College of Engineering, Kollam, Kerala
- Thapar Institute of Engineering & Tech. Patiala, Punjab
- Thiagarajar College of Engineering, Madurai, TN
- University BDT College of Engg., Davangere, Karnataka
- University Vishvesvaraya College of Engineering, Bangalore, Karnataka
- Vaish Technical Institute, Rohtak, Harayana
- Visvesvaraya National Institute of Technology, Nagpur

Workshops & Conferences by Resource Institutes

To share ideas, sensitize stakeholders in earthquake disaster mitigation, and to impart knowledge in earthquake engineering, numerous conferences and workshops were organized at the resource institutes.

Also, several workshops were conducted to brainstorm the curriculum issues and to develop curricula. Some of these are listed here.

IIT BOMBAY

- 3rd Indo-German Workshop on "Seismic Safety of Structure, Risk Assessment and Disaster Mitigation, 12-14 March, 2007(121 participants)

IIT DELHI

- National Workshop on *Earthquake Engineering Curricula: Challenges and Road Ahead*, 05 April 2003 (100 participants)
- National Workshop on *Earthquake Engineering Education in India: Looking Ahead*, 5 January, 2007 (90 participants)

IIT KANPUR

- *Earthquake Engineering Literature Survey Workshop for Masters' Students*, 25-31 March 2003 (60 participants), 23-28 August 2004 (73 participants), 29 August-3 September 2005 (74 participants), 21-26 August, 2006 (62 participants)
- *Earthquake Engineering Curriculum Workshop for UP Polytechnics*, 29-30 July 2003 (20 participants)
- National Workshop on *Introducing Earthquake Engineering in Civil Engineering Curriculum*, 22-23 August 2003 (57 participants)
- Review Workshop for *Resource Material in Earthquake Engineering Education* (for faculty members), 25-29 August 2003 (19 participants), 26-30 April 2004 (42 participants), 1-5 August 2005 (30 participants)
- Curriculum Workshop for *Architecture Programme in Colleges of Gujarat*, 21 October 2003 (22 participants)
- Review Workshop of the *NPEEE One-Semester Training Programme*, 19-23 April 2004 (17 participants)
- Brainstorming Workshop on *Tectonic Geomorphology*, 3-7 May 2004 (26 participants)
- *Inclusion of Earthquake Related Aspects in the Curricula of Civil Engineering Diploma Program (MP and Chhatisgarh)*, 31 May 2004 (20 participants)

- Third International Symposium on *New Technologies for Urban Safety of Mega Cities in Asia*, 18 -19 October 2004 (142 participants)
- Workshop for *Inclusion of Earthquake Engineering in Architecture Assistantship Course in Polytechnics in UP*, 11 October 2004 (11 participants)
- National Workshop on *Introducing Concepts of Earthquake Engineering in the Curricula of Architecture Courses*, 28-29 November 2004 (29 participants)
- *National Seminar on Engineering Response to Hazard of Terrorism*, 25-26 September, 2006 (73 Participants)

IIT ROORKEE

- Workshop on *Retrofitting of Structures*, 10-11 October 2003 (29 participants)
- Curriculum Workshop for Polytechnics of Haryana, 17-18 April 2004 (19 participants)
- Curriculum Workshop for Polytechnics of Himachal Pradesh, 17-18 April 2004 (23 participants)
- Curriculum Workshop for Polytechnics of Punjab, 17-18 April 2004 (14 participants)
- Summer Training Course on *Earthquake Engineering* for 3rd year UG, 7 June - 2 July 2004 (17 participants), 6 June - 1 July 2005 (15 participants)
- Curriculum Development Workshop on *Diploma Courses in Civil Engineering and Architecture for Rajasthan*, 24 September 2004 (23 participants)
- National Symposium on *Seismic Hazard Analysis and Microzonation*, 23- 24 September 2005
- Symposium on *Earthquake Engineering for Teachers*, 18-19 August, 2006 (14 participants)
- 13th Symposium on *Earthquake Engineering*, 18-20 December 2006 (250 participants)

IIT MADRAS

- 2nd Indo-German Workshop on *Seismic Safety of Structures, Risk Assessment and Disaster Mitigation*, 15-16 February 2004 (86 participants)
- Indian Geotechnical Conference 2006 on *Geotechnical Engineering - Indian Experience GEOINDEX*, 14-16 December, 2006 (450 participants)

IISC BANGALORE

- Workshop on *Experimental Methods in Earthquake Engineering Research*, 10-11 February 2005 (34 participants)
- National Workshop on *Tsunami Hazard along the Indian Coast*, July 2005 (47 participants)

- National Symposium on *Structural Dynamics, Random Vibrations and Earthquake Engineering*, 21 – 22 July 2005 (47 participants)
- *The Structural Engineering Convention*, 14– 16 December 2005

Outreach Activities by Colleges

A number of outreach activities by the colleges in the form of trainings, workshops and conferences have been sponsored by the NPEEE:

- **PSG College, Coimbatore**
National Conference on Earthquake Analysis and Design of Structures EQUADS-06, 2 – 3 February, 2006
- **SIT, Tumkur**
National Conference: HYDRO – 2005 with Special Reference to Tsunami, 8-9 July, 2005
- **Bengal Engineering & Science University, Shibpur**
National workshop on Earthquake Resistant Design for Built Environment, 6 – 7 January, 2006
- **Gandhi Institute of Technology and Management, Vishakhapatnam**
International Conference on Advances in Structural Dynamics and its Applications (ICASA – 2005), 7 – 9 December, 2005
- **Shanmuga Arts, Science, Technology and Research Academy, Sastra**
International Conference on Earthquake Engineering (ICEE – 2006), 25 – 26 February, 2006
- **School of Planning and Architecture, Anna University**
Earthquake Resistance of Buildings for Architects, 2 – 4 March, 2006
- **NIT, Hamirpur**
National Conference on Technology for Disaster Mitigation (TDM 2006), 29 - 30 September 2006
- **S. S. Engineering College, Bhavnagar, Gujarat**
Geotechnical Earthquake Engineering, 9-14 October, 2006
- **Bengal Engineering & Science University, Shibpur**
International Conference on Civil Engineering in the New Millennium: Opportunities and Challenges, 11-14 Jan., 2007
- **Vidyabharti Trust Polytechnic, Umrakh**
One-day Sensitization Programme for Masons and Barbenders, 18 Jan., 2007
- **Visvesvaraya National Institute of Technology, Nagpur**
One-day Sensitization Programme for Masons and Barbenders, 27 Feb., 2007

- **Sardar Vallabhbhai Patel Institute of Technology, Vasad**
One-day Sensitization Programme for Masons and Barbenders, 19 Mar., 2007
- **Periyar Maniammai College of Technology for Women, Thanjavur**
One-day Sensitization Programme for Masons and Barbenders, 20-21 Mar., 2007
- **N.B.K.R. Institute of Science & Technology, Vidyanagar**
One-day Sensitization Programme for Masons and Barbenders, 25 Mar., 2007
- **Government Polytechnic, Durg**
One-day Sensitization Programme for Masons and Barbenders, 25 Mar., 2007
- **Shanmugha Arts, Science, Technology and Research Academy University, Thanjavur**
One-day Sensitization Programme for Masons and Barbenders, 30 Mar., 2007

Curriculum Changes

NPEEE has proactively worked towards changes in curricula of civil engineering and architecture so as to incorporate concepts of earthquake engineering. Numerous workshops were conducted with the concerned faculty members of the colleges to brainstorm and to develop a consensus on not only the curricula but also the implementation issues.

Two major national workshops were conducted, one for engineering and one for architecture curricula:

- National Workshop on Introducing Earthquake Engineering in Civil Engineering Curriculum, 22-23 August 2003 (57 participants), IIT Kanpur
http://nicee.org/eqw/EQEWS_CW01.pdf
- National Workshop for Introducing Concepts of Earthquake Engineering in the Curricula of Architecture Courses, 28-29 November 2004 (29 participants), IIT Kanpur

The developed curricula were widely disseminated. A survey conducted in December 2005 indicated that out of 94 colleges that responded, 69 colleges now teach earthquake engineering.

Similarly, out of the 177 teachers that responded to the questionnaire, 117 indicated that their respective colleges now teach earthquake engineering. Considering that the curriculum issues are dealt with by the numerous universities through their boards of study, etc, this is considered a very encouraging trend. However, a great deal still remains to be done for sensitization of the universities and the colleges

towards the need for teaching earthquake engineering concepts.

The polytechnics follow common curricula across the states. Hence, several state-specific workshops were conducted to develop curricula for the polytechnics:

- Earthquake Engineering Curriculum Workshop for UP Polytechnics, 29-30 July 2003 (20 participants), IIT Kanpur
- Inclusion of Earthquake Related Aspects in the Curricula of Civil Engineering Diploma Program (MP and Chhatisgarh), 31 May 2004 (20 participants), IIT Kanpur
- Workshop for Inclusion of Earthquake Engineering in Architecture Assistantship Course in Polytechnics in UP, 11 October 2004 (11 participants), IIT Kanpur
- Curriculum Workshops for Polytechnics of Haryana, 17-18 April 2004 (19 participants), IIT Roorkee
- Curriculum Workshops for Polytechnics of Himachal Pradesh, 17-18 April 2004 (23 participants), IIT Roorkee
- Curriculum Workshops for Polytechnics of Punjab, 17-18 April 2004 (14 participants), IIT Roorkee
- Curriculum Development Workshop for Diploma Courses in Civil Engineering and Architecture for Rajasthan, 24 September 2004 (23 participants), IIT Roorkee

POLYTECHNIC TEXT BOOKS

After attending curriculum workshop & training programme of the NPEEE, Sri Sone Lal, Head of Civil Engineering, Government Polytechnic, Lucknow, published a text book in Hindi on "Earthquake Engineering". This text book is in line with curriculum that was implemented in the States of Uttar Pradesh and Uttaranchal on the basis of NPEEE workshop.

The polytechnic systems in UP, Uttaranchal and Gujarat have already incorporated the recommendations in the curricula for civil engineering diploma and the architectural assistant diploma programmes. Information from other states is still awaited.

Feedback

In December 2005, a general survey was conducted to evaluate performance of the NPEEE. A questionnaire was sent to the colleges and the teachers that had participated in the NPEEE one way or the other. About 94 colleges and 177 teachers responded, which is a very high rate of participation for such a survey. They were asked to rate on a scale of 1 to 5 three issues and the results were very positive:

NPEEE has been useful in capacity building of colleges and teachers:

Average response was 4.62 (out of maximum of 5.0) from the colleges, and 4.76 from the teachers.

The Programme has operated well:

Average response was 4.40 (out of maximum of 5.0) from the colleges, and 4.65 from the teachers.

The Programme should continue:

Average response was 4.84 (out of maximum of 5.0) from the colleges, and 4.91 from the teachers.

The Road Ahead...

The NPEEE has been a singular success storey in capacity building considering the short time period of its existence, and the limited amount of funds spent on the same. The response of the general body of teachers in the country and the college administrations has been extremely positive and encouraging.

Besides capacity building, the Programme has enabled the eight resource institutions to gain experience in working together on a mission to help develop a discipline in other institutions. It therefore provides a role model for developing many areas of technology critically needed by the country.

NPEEE is being acclaimed not just in India but also outside. There has been substantial interest from the neighbouring countries in the same.

Capacity building is a long process and the programme must continue for some years in order to make the full impact. Moreover, there is a need to upgrade the programme to also include:

- a) Development of a vibrant research environment in the country to address many problems related to earthquake safety that are unique to India, for example, Indian construction typologies, and construction environment.
- b) Some research opportunities for teachers in their respective colleges, so that they remain engaged in the area of earthquake engineering, generate new knowledge, and provide leadership to the communities and local governments.
- c) Training opportunities to the engineers working in the government departments and the private sector.
- d) Training opportunities for colleagues from other developing countries. India is now in a position to demonstrate its leadership worldwide with respect to capacity building in earthquake engineering education.

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