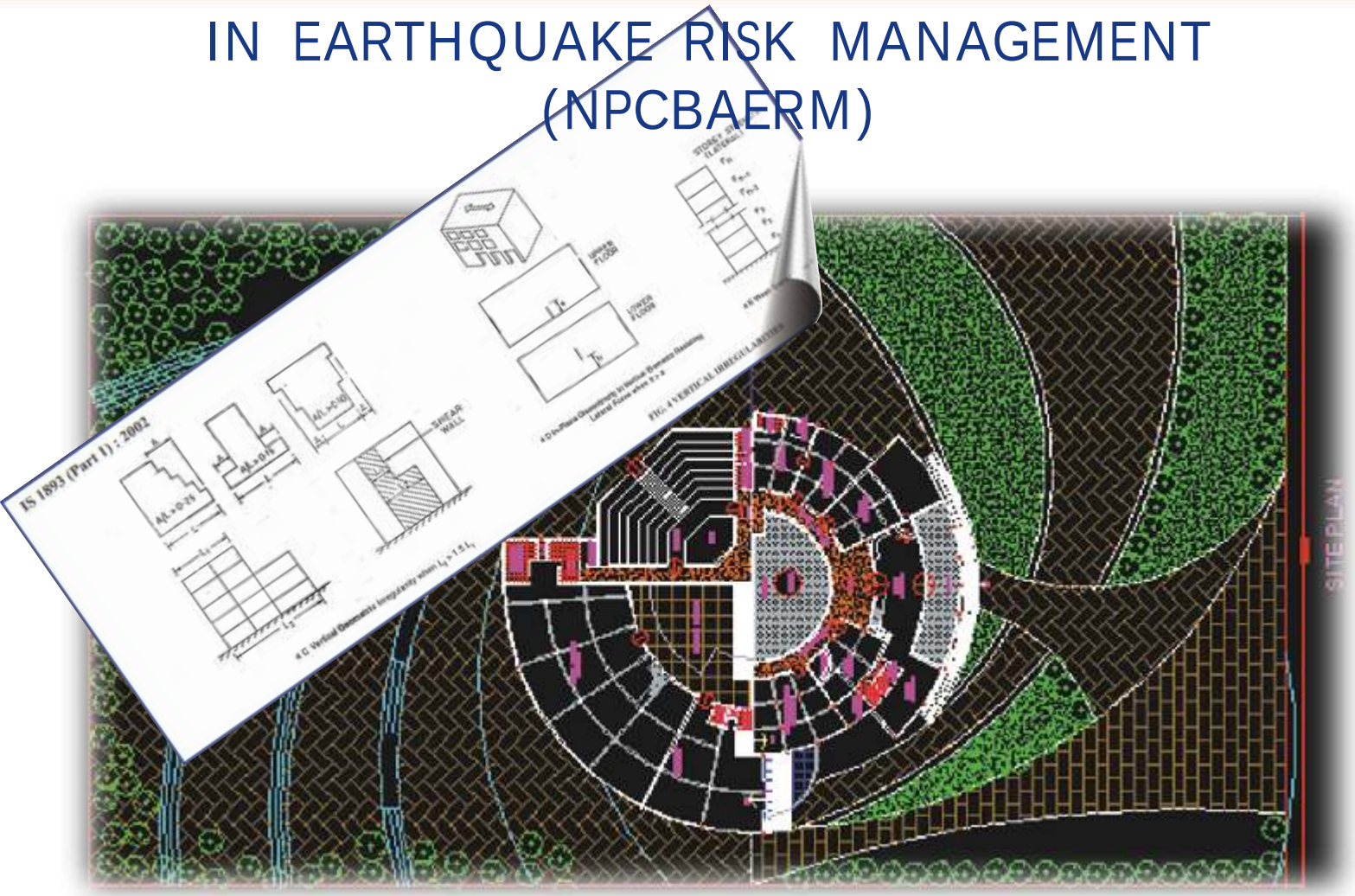
NATIONAL PROGRAMME FOR CAPACITY BUILDING OF ARCHITECTS IN EARTHQUAKE RISK MANAGEMENT (NPCBAERM)



GOVERNMENT OF INDIA
MINISTRY OF HOME AFFAIRS
NATIONAL DISASTER MANAGEMENT DIVISION

NATIONAL PROGRAMME FOR CAPACITY BUILDING OF ARCHITECTS FOR EARTHQUAKE RISK MANAGEMENT (NPCBAERM)

1. Background:

1.1 Traditionally, India has been vulnerable to various natural hazards on account of its unique geo-climatic conditions especially earthquakes, which is considered to be among the most destructive-with the potential of inflicting huge losses to life and property. Around 60% of the country's landmass is prone to moderate, high or severe earthquake risks. Almost the entire northeast region, northern Bihar, Himachal Pradesh, Jammu & Kashmir and some parts of Gujarat are in seismic zone V, while the entire Gangetic plain and some parts of Rajasthan including the capital of the country are in seismic zone IV. Rapid urbanization and unplanned development has led to the situation that millions of people in various parts of the country are at risk from earthquake.

1.2 In the last decade India has experienced several destructive earthquakes, which resulted in the death of large number of people and caused huge losses to property including the Lattur earthquake of 1993 and the Bhuj earthquake of 2001, which caused extensive damage to lives and property. In the span of last 15 years, India has experienced six earthquakes of moderate magnitude. Although moderate, these earthquakes did cause disproportionately high degree of losses to human life and property, which highlights the vulnerability of the population and infrastructure to earthquakes. These earthquakes that turned into national disasters exposed the gross inadequacy of our preparedness measures and the urgent need for putting in place comprehensive earthquake risk management measures.

2. Initiatives taken by the Ministry of Home Affairs (MHA) for disaster risk reduction:

2.1 Over the past couple of years, the Government of India has brought about a paradigm shift in the approach to disaster management. The new approach proceeds from the conviction that development cannot be sustainable unless disaster mitigation is built into the development process. Another corner stone of the approach is that mitigation has to be multi-disciplinary spanning across all sectors of development. The new policy also emanates from the belief that investments in mitigation are much more cost effective than expenditure on relief and rehabilitation.

2.2 The steps being taken by the Government emanate from the approach outlined above. The approach has been translated into a National Disaster Framework [a roadmap] covering institutional mechanisms, disaster prevention strategy, early warning system, disaster mitigation, preparedness and response and human resource development. The expected outputs, areas of intervention and agencies to be involved at the National, State and district levels have been identified and listed in the roadmap.

3. Earthquake Mitigation Measures by MHA:

3.1 Considering the earthquake vulnerability of the country, MHA have advised the States and UTs to ensure that the following measures are put in place:

(a) (a) Review and, if necessary, amend building byelaws to incorporate the BIS seismic codes for construction in the concerned zone. Similarly, it should be ensured that the plans/designs of the Government construction departments are in accordance with the BIS codes for these zones.

(b) In the municipal areas, make it mandatory for the builders/buyers to submit building plans prepared by an architect and certified by a structural engineer to get building construction permission and make the architect and structural engineers who have prepared the building plan and structural design accountable for adherence to the BIS codes/building bye-laws.

(c) Evaluate the seismic safety of the existing life-line buildings such as hospitals, water supply towers, fire stations, schools with a capacity of 1000 or more students, main administrative buildings transportation and communication infrastructure etc. and take effective steps for retrofitting.

(d) Lay down mandates for private builders/developers to carry out retrofitting of all private hospitals, cinema halls, shopping malls and multi-storied residential and office complexes.

(e) Carry out awareness generation campaigns through mass media, rallies, meetings, audio-visual shows, distribution of pamphlets, posters covering various aspects of earthquakes, their effects, Do's and Don'ts to create awareness among the people about vulnerability to earthquakes.

3.2 Recently the Government has approved a National Programme for Capacity building of Engineers for earthquake Risk Management. Under the project, 2-5 State Resource Institutes (leading engineering colleges) in each State/UT will be identified to assist the urban local bodies in the review and revision of the byelaws to incorporate the BIS codes and also train the municipal engineers in Earthquake resistant constructions and retrofitting techniques. . These institutions will conduct training programmes for engineers in the State PWD as well as Engineers working in the private sector in seismically safe construction, as also provide consultancies/advise to the State on retrofitting of lifeline buildings. In order to equip the identified State Resource Institutions/Partner Institutions to discharge their roles, faculty members from the Civil Engineering Departments of these institutions will be trained in a 6-week capsule course in earthquake engineering in 11 identified National Resource Institutions.

3.3 A National Core Group for Earthquake Mitigation has been constituted to review and validate the plans for earthquake mitigation; provide advice to States and other State agencies on various mitigation aspects and review the progress of action plans. At present the Core Group is working on the following issues;

- Review and revision of building byelaws of all the States/UTs in order to incorporate relevant BIS codes for seismically safe construction.
- Preparation of programmes/projects related to Earthquake Mitigation

- Inclusion of earthquake mitigation/engineering elements in the undergraduate course for engineering/architecture/ polytechnics
- Drawing up training programme for municipal engineers and architects for ensuring implementation of byelaws.
- Drafting of model-building bye-laws (for Seismic zones III, IV, and V) covering all the major features of the BIS codes and non-structural aspects for earthquake safety.
- Preparation of model amendments for State Town and Country Planning Act as well as zoning regulations
- Preparation of guidelines and manuals for earthquake vulnerability reduction.

3.4. Government of India are of the view however, that training of Engineers will not be sufficient to by itself, as Architects have a major role to play in construction. It will be necessary, therefore, that Architects are trained in aspects of seismically safe construction.

4. Rationale of the Project:

4.1 *Building collapse the major issue in earthquake vulnerability:* Earthquakes are natural hazards, but the disasters are man-made. As has often been quoted, "Earthquakes don't kill, unsafe buildings do". It is the high vulnerability of our building stock that turns these hazards into disasters. The collapse of engineered and non-engineered building during earthquakes is the main contributor to the loss of lives and injuries to the people. The Latur earthquake of 1993, caused large-scale collapse of non-engineered houses while the destruction caused in Ahmedabad following the Bhuj earthquake showed reinforced concrete framed ('engineered') buildings in poor light. While, in the older and non-engineered houses, the damage was owing to faulty design, weak construction material and poor maintenance, non-compliance to seismic safety regulations in engineered buildings lead to extensive collapses.

4.2 *Issues in seismic safety of construction:* For ensuring adequate earthquake resistance features in construction three steps need to be followed. First, there must be appropriate codes and byelaws to guide architects, and engineering designers. Secondly, the provisions of the codes need to translate to seismically safe designs and techno-legal regimes are to be put in place for enforcement of these codes and byelaws. Thirdly, there must be some means of inspection to ensure that the constructions actually follow the prescribed designs and specifications.

4.3 *Importance of architects in ensuring seismic safety in construction:* While structural safety is the main focus of Engineers, the structural configurations chosen by Architects control the overall behaviour of structures during earthquakes. Ensuring structural and operational safety of the buildings would require adequate attention to not only the structural design, but also the form and configuration of the building for lateral loads. According to the great earthquake engineer Late Henry Degenkolb,- "If we have a poor configuration to start with, all the structural expert can do is to provide a band-aid –to improve a poor solution as best as s/he can. Conversely if we start off with a good configuration and framing system, even a poor engineer cannot harm its

ultimate performance too much". In this context the role of the architects is crucial in the entire cycle of building construction—concept, form and configuration, structural design and detailing, construction and provision of services and non-structural elements.

4.4 In the urban areas, aspiring house-builders usually take the help of architects. The architect prepares a building plan to suit the site, requirements and budget of the client. The next step would involve preparation and submission of drawings as per the statutory requirements of the local urban authority. The architect then prepares working drawings (including detailed structural designs and drawings by the architects' appointed structural engineer) specifications and prepare estimate of cost and tender documents. The responsibility of the structural engineer/representative is to ensure that the construction of the building (that is actually executed by various building contractors (masonry, carpentry, electrical, plumbing etc)) is as per the specifications. Usually a construction manager/site supervisor who works under the guidance and direction of the Architect carries out the day-to-day supervision. And finally the Architect submits completion reports and drawings and assists the client in obtaining the completion/ occupancy certificate after due inspections by the statutory authority. Thus the architectural aspects of the earthquake performance of buildings are those features that are decided by the architect, before the engineer makes his contribution. The overall form and configuration of buildings is an architectural issue and the architect may select or design non-structural elements without reference to the engineer.

4.5 Thus it can be seen that in most parts of our country, in general, the Architect leads a team of professionals in the creation of a structure. Most decisions related to functional as well as structural aspects are taken by the Architect her/himself. Thus, even though the responsibility of ensuring safety is of the structural engineer, it is the Architect who certifies the structural stability of the building to the concerned authorities. So it is crucial that the architects be aware of the building behaviour in earthquakes and of the forces that act on various parts of a building during an earthquake.

4.6 *Present Constraints:* Knowledge about Earthquake Resistant Design and Construction in the form of Codes of Practice and Guidelines is available in the country. The Bureau of Indian Standards (BIS) has laid down the national standards for construction in seismically vulnerable areas. However in many States/Cities, these codes have not yet been made a part of the building byelaws. In many States, building byelaws are non-existent, and even in states where the byelaws incorporate these codes, due to lack of awareness, education and poor enforcement, these codes are not being followed. As a result seismically unsafe constructions are still coming up thus increasing our urban vulnerabilities thus increasing our urban vulnerabilities at an alarming rate. One of the most important factors contributing to this situation is the lack of education and training of architects in earthquake engineering principles and designs. In most of the architectural institutions, seismic design is not taught at the undergraduate level as a compulsory subject. Rarely a course on earthquake design is taught at the undergraduate level even as an elective. Although action is being taken for the revision in the curriculum to include seismic design in the undergraduate curriculum for architects, the large numbers of practicing architects currently practicing in the country need to be trained in principle of seismically safe construction.

4.7 *Need for the project:* The government is now emphasizing the inclusion of earthquake engineering elements in the undergraduate engineering and architectural courses. However, this will only address the new entrants to the college of architecture. Training of currently practising architects in seismically safe design and construction is necessary, since seismically safe construction can be ensured by both engineers and architects working together.

4.8 Practising architects need to be trained to ensure that all new constructions are earthquake-resistant to keep from increasing the vulnerability and thus the risk associated with the built environment. Such training would interalia, educate the architects on the architectural aspects that determine the earthquake resistance of buildings and also the problems and nature of earthquake effect on buildings, earthquake resistant designs and construction of buildings, as also in the vulnerability assessment of existing buildings and retrofitting etc. Ultimately, there is a need to move towards a certification system whereby architects can practise only after they have undergone a course in seismically safe construction. Necessary arrangements for this purpose are required to be made.

4.9 Any programme for earthquake mitigation will have to take care of these aspects and it is envisaged that improvement in architectural designs; changes of configuration and methods employed in construction, would go a long way towards effectively reducing our vulnerability to earthquakes.

5. Goal:

1.1 The overall goal of the programme is sustainable earthquake risk reduction in the country.

6. Coverage:

6.1 All the States and Union Territories of the country of the country will be covered under the programme.

7. Time duration:

7.1 The duration of the project will be of three years - from June 2004 to May 2007.

8. Objectives of the programme:

(i) Ensure seismically safer habitats by training of practicing architects.

(ii) Capacity building of the Colleges of Architecture at the National and State levels for ensuring effective training of practicing architects in earthquake safety.

(iii) Development of Resource Materials/ training modules for sensitization/ training of architects

(iv) Putting in place a system of training and subsequently of certification for practicing architects.

9. Present regulatory System for architects in the country:

9.1 Indian Institute of Architects (IIA): The Indian Institute of Architects (IIA) is the national body of Architects in the country. Having started in the year 1917, the institute today has more than 15000 members. The Institute has a major role to play in promoting the profession of architecture by organizing and uniting in fellowship the Architects of India to promote aesthetic, scientific and practical efficiency of the profession both in Practice and in Education. IIA is represented on various national and international committees connected with architecture, art and the building industry. The Indian Institute of Architects is registered under the Societies Registration Act XXI of 1860 as a voluntary organization of Architects. The only other organization at the national level is the Council of Architecture established under the Architects Act 1972 with the statutory duty of Registration. Thus, the registration with IIA is not mandatory for practising as an Architect, since it is a voluntary organization. However the united efforts of members of IIA help to regularly provide valuable suggestions for improving the education of Architecture with the help of prominent and experienced Architects develop capacities and provide training to the students and professionals through workshops, training programmes, seminars, competitions, exhibitions, etc.

9.2 Council of Architecture (COA): The Council of Architecture (COA) has been constituted by the Government of India under the provisions of the Architects Act, 1972**.** The Act provides for registration of Architects, standards of education, recognized qualifications and standards of practice to be complied with by the practicing architects. The Council of Architecture is charged with the responsibility to regulate the education and practice of profession throughout India besides maintaining the register of architects. For this purpose, the Government of India has framed Rules and Council of Architecture has framed Regulations as provided for in the Architects Act, with the approval of Government of India. Any person desirous of carrying on the profession of 'Architect' must register himself /herself with Council of Architecture**.** For the purpose of registration, one must possess the requisite qualification as appended to the Architects Act, after having undergone the education in accordance with the Council of Architecture (Minimum Standards of Architectural Education) Regulations, 1983. The registration with Council of Architecture entitles a person to practice the profession of architecture, provided he holds a Certificate of Registration with up-to-date renewals. The Council of Architecture, plays a major role in maintaining the standards and ethical practices of the profession of architecture, and hence is important. At present there are 33,000 registered architects out of which 26,000 hold valid registration.

10. Proposed framework of the project:

In respect of architects who have passed out from the schools before the inclusion of earthquake resistant components in the course curriculum but not yet started independent practice, it is proposed that there will be one-week training modules. In consultation with CoA, a system will be evolved for permitting them to function as independent practicing architects after completion of the course.

In case of existing practising architects, they will be required to complete the above mentioned one week module in a staggered system within a time frame of one month and submit the certificate to CoA. A system will be devised in consultation with CoA to make it mandatory.

11. Project support activities:

1.1 The above objectives are proposed to be achieved as follows: -

1.2 There are 110 Schools of Architects across the country inclusing Schools or Architecture situated in the campuses where Engineering Courses are also offered. It is proposed that all above 110 Colleges offering courses in architectures will be designated for training practising architects.

1.3 The first step would be to train the faculties of State Resource Institutes in seismically safe designs. Faculties from these State Resource Institutes will be trained in 10 identified National Resource Institutes. The list of the National Resource Institutes will be finalized in consultation with IIA/ CoA and with approval of National Core Group for Earthquake Mitigation.

1.4 For training of architects in the States/UTs, a two-fold approach will be adopted. Two faculty members from each institute will be trained in a two-week course at the designated National Resource Institute. The services of these Institutes will then be utilized for training of practicing architects in States/UTs.

1.5 MHA will provide financial support for sensitization of architects. IIA will take up sensitization of architects in earthquake resistant feature in different chapters as and when the meeting of these chapters is held. The Ministry will assist in organizing resource persons for sensitizing the architects of these chapters, as well as ensure the participation of the State Government in such training programmes.

12. Project Framework:

(i) Networking and capacity building of all the colleges of architecture and engineering colleges offering courses in architecture so as to develop them into focal points for providing training to architects. A total of 110 Institutes will be networked for this purpose.

(ii) Development and preparation of one-week special training module/materials for training of trainers (ToT) from these Institutes.

(iii) Training of faculty from 110 Institutes in two-week special training module at National Resource Institutes- (about 10 in number) which will be selected in consultation with IIA/ CoA and with the approval of the National Core Group for Earthquake Mitigation. The programme envisages training of 250 faculty members from these 110 institutes at Nationa Resource Institutes.

(iv) Development and printing of training modules by National Resource Institutes for training of architects.

(v) These Institutions will undertake one-week training programme for 10,000 architects.

(vi) Support will be given to National Resource Institutes for library and laboratory development

(vii) 110 Institutions involved in the programme will be supported for development of library facilities.

(viii) Creation of a framework/system in consultation with CoA/IIA for mandating that practising architects will need to undergo the capsule course within a specified time frame.

(ix) Necessary arrangement with IIA an other Associations of Architects will be tied up in consultation with Council of Architects for undertaking sensitization of architects through out the country

13. Terms of Reference (TOR) For the Institutions at different levels

The Institutions at different levels will have the following responsibilities;

13.1 National Resource Institutes/ IIA /CoA

- Conduct of training programmes for 250 faculty members from State Resource Institutes in two weeks special module in seismically safe construction in a time span of one year.
- Development and printing of course curriculum and training materials/ module for architects.
- Putting in place a framework/system for mandatory registration/ compulsory competency assessment of the practicing architects.

13.2 State Resource Institutes

- Conduct of training programme for 10,000 architects in a period of three years.
- Development of library facilities.

14. Programme Management:

14.1 National level arrangements: At the national level the Ministry of Home Affairs will be the Nodal agency for execution of the project. The project implementation will be overseen by a Steering Committee (SC) consisting of the members of the Core Group on Earthquake Mitigation and representatives of CoA and IIA, and representatives of various resource institutes across the country, under the chairmanship of the Joint Secretary, NDM. The SC will meet quarterly to review the progress of the programme.

14.2 State level arrangements: In each State/UT, a Steering Committee will be formed out of nominees of Council of Architecture, selected members of resource institutes in the State and specialists in the subject matter under the chairmanship of the State Relief Commissioner/ Secretary Disaster Management to review the progress of the programme at the State level. The Steering Committee at the State level will meet quarterly to review the progress of the programme.

15. Execution arrangements

15.1 Ministry of Home Affairs, Government of India will execute the programme in collaboration with States/ UT Administrations. The national nodal agency, MHA will provide support to strengthen

the institutional, administrative, techno-legal system for earthquake vulnerability reduction. The State Government would provide support for the successful implementation of the programme.

16. Financial Management and Accounting:

16.1 The total cost of the project works out to Rs.4.51 crores as indicated in the Annexure. The expenditure will be incurred by way of grants-in-aid to be given to National Resource Institutes and each State/UT. The States/UTs will then release funds to the State Resource Institutes where the faculty will be trained for carrying out project activities. The State Resource Institutes in each State will be leading colleges of Architecture /Engineering Colleges offering course in Architecture to be designated by the concerned State Governments and Council of Architects.

16.2 It is proposed to provide funds to the National Resource Institutes and the State Governments for carrying out activities under the programme as grant-in-aid from the non-plan budget. At present, grants-in-aid to ATIs are given for faculty support from the plan scheme. Since should appropriately be funded from non-plan funds because it will result in capacity building and not creation of assets, it is proposed that the expenditure may be borne from non-plan funds allocated to this Ministry. Necessary funds may be provided at RE stage from the overall non-plan budget of the Ministry.

17. Approval

17.1 Approval of the Home Secretary is solicited for taking up the National Programme for Capacity Building for of Architects for Earthquake Risk Reduction (NPCBAERM) over a period of three years at the cost of Rs. 4.51 crore.

Activity	Remarks	Numbers	Modules in which they will be trained	Duration	Unit Cost	Cost Implications
National level consultations/ workshops to launch and publicize the programme/ finalize the modalities of programme implementation/ and holding consultations for finalization of the training module	Participants will be faculty members from National and State level colleges of Architecture and engineering colleges offering courses in architecture, relief commissioners, directors of Technical Education from various States/ UTs etc.	Four workshops will be held with in the project period	N.A	1-2 days per workshop	2.5 lakhs	**10.00 lakhs** 2004-05: 5 lakhs 2005-06: 2.5 lakhs 2006-07: 2.5 lakhs
Support to Indian Institute of Architects, Council of Architects and other associaiations for sensitization of architects through Continuing Education Programme[CEP]	Support will be given to IIA for the sensitization of architects under their continuing education programme of the Indian Institute [IIA] on the role of architects towards seismically safe-built environment	A total of 4000 architects will be sensitized through 40 orientation programme	One day	One-day orientation programme	Rs 55,000/- per orientation programme X 40 programmes= 22.00 lakhs[cost of hiring of resource persons including their travel Rs 40,000/-, cost of printing packages-technical materials including CDs, reference materials, etc Rs 15,000/-]	**22.00 lakhs** 2004-05: 5 lakhs 2005-06: 17 lakhs 2006-07: nil

Activity	Remarks	Numbers	Modules in which they will be trained	Duration	Unit Cost	Cost Implications
National Level TOT at the National Resource Institutes for faculty members of selected Colleges of Architecture and Engineering Colleges offering Architecture course from all States/UTs	A total of 250 faculty members from 110 institutes offering courses in architecture will be trained at the National Resource Institute as Training of Trainers	250 (will be trained in 10 batches over a period of one year)	One-weeks' special module	One week	#Training cost @ Rs 6 Lakhs for each module (6X10)=60.00 lakhs) (including training materials, resource persons, field visit, hiring lecture hall, office expenses etc) # misc. expenses 10% overhead of Rs.60.00 lakhs =Rs. 6.00 lakhs #lodging and boarding @ Rs 350 per day. (Rs.250 for boarding and lodging including tea and breakfast and dinner and Rs.100 for two coffee/ tea breaks and lunch to be provided during training by the Resource Institutes (350X14X250)=12.25 lakhs# Travel expenses @Rs. 10,000 per participant (10,000X250)=25 lakhs	**103.25 lakhs** 2004-05: 103.25 lakhs 2005-06: nil 2006-07: nil

Activity	Remarks	Numbers	Modules in which they will be trained	Duration	Unit Cost	Cost Implications
Development and printing of model Special Training Curricula, training materials and training guide book by the National Resource Institutes to be used for the TOTs and to be sent to 110 State Resource Institutes	Development course material for 1 week module for ToT and practising architects by a team of experts nominated by the National Resource Institutes in consultation with COA and IIA	N.A	N.A	N.A	Training materials for State Resource Institutes for training of 10,000 architects) @ 200 x 12000 copies = Rs 24.00 lakhs	2004-05: 24 lakhs 2005-06: nil 2006-07: nil
Library and Equipment support to National Resource Institutes	Equipment for the purpose of demonstration to be provided to National Resource Institutes, besides library support	10	N.A	N.A	Rs.5 lakhs to each Institute	**50.00 lakhs** 2004-05: 50 lakhs 2005-06: nil 2006-07: nil
Training of practising architects by the faculty members of State Resource Institutes who have received training at National Resource Institutes	Training will be imparted to practicing architects in a one-week module	10,000	One-week module	To be conducted in one week or undertaken over a period of one month	(Rs.100 for two coffee/ tea breaks and lunch to be provided during training by the Resource Institutes (100X7X10,000) Lodging / Boarding cost will have be picked up by the participants thus not budgeted under the programme	**70.00 lakhs** 2004-05: 15 lakhs 2005-06: 27.5 lakhs 2006-07: 27.5lakhs

Activity	Remarks	Numbers	Modules in which they will be trained	Duration	Unit Cost	Cost Implications
Support to 110 Institutes for conducting 1 week module	Support will be given to the 110 Institutes for conducting training modules	A total of 250 batches will be held across all States/ UTs to train 10,000 practicing architects (40 architects per batch)	One week module	One week module	Rs 25,000/- per module (25,000X250)=Rs 62.50 lakhs Misc. expenses overheads @10% of 100.00 lakhs= 6.25 lakhs	**68.75 lakhs** 2004-0: 18.75 lakhs 2005-06: 25 lakhs 2006-07: 25 lakhs
Library and equipment support to State Resource Institutes	Elementary equipments for the purpose of demonstration, besides library support	A total of 110 institutions will be supported	N.A	N.A	Rs.0.75 lakhs	**82.50 lakhs** 2004-05: 12.5 lakhs 2005-06: 35 lakhs 2006-07: 35 lakhs
Support to COA system for mandatory registration of Practicing architects	Support will be provided to COA for creation of a country-wide system for compulsory certification whereby practicing architects can practice only after they have passed the certification examination.	N.A	N.A	N.A	A lump sum amount of Rs. 10.00 lakhs will be provided to CoA/IIA	**10.00 Lakhs** 2004-05: 2 lakhs 2005-06: 8 lakhs 2006-07: nil
Evaluation of the Programme	Evaluation to be carried out during the last quarter of two years period to assess the impact of the programme	N.A.	N.A.	N.A.	N.A.	**10.00 lakhs** 2004-05: nil 2005-06: nil 2006-07: 10 lakhs
		Total Cost				**Rs. 450.5 lakhs (Approximately Rs 4.51 crores)**

Year wise phasing of expenditure

Year	Amount (Rs. in lakhs)
2004-2005	235.5
2005-2006	115.00
2006-2007	100.00
Total	450. 5

EARTHQUAKE RESISTANT DESIGN AND CONSTRUCTION

One-week Training Course for Teaching in Architects

S. No.	TOPICS	L	S
1	**Building Safety from Natural Hazards: an Introduction** Earthquake. Fire safety in buildings. Cyclone effects: High winds, storm surge, and cyclone safety aspects in buildings. Floods. Landslides	1	
2	**Elementary Seismology**: Earthquake occurrence in the world, plate tectonics, faults, earthquake hazard maps of India & and the States. Causes of earthquake, seismic waves; magnitude, intensity, epicenter and energy release, characteristics of strong earthquake ground motions. Seismological Instruments: Seismograph, Accelerograph, Seismoscope/Multi SAR.	1	
3	**Introduction to Theory of Vibrations:** Single degree undamped & damped systems, resonance, response to earthquakes, elastic response, concepts of response spectrum. Flexibility of long & short period structures; concepts of response spectrum.	2	
4	***Site Planning*, Building Forms and Architectural Design Concepts for Earthquake Resistance:** Historical experiences Site Selection Site Development Building forms:- Horizontal & vertical eccentricities, mass and stiffness distribution, soft storey etc. Seismic effects related to building configuration. Plan & vertical irregularities, redundancy & setbacks. Special Aspects:- Torsion, appendages, staircases, adjacency, pounding Contemporary international approaches	3	6

S. No.	TOPICS	L	S
5	**Performance of Ground & Buildings in Past Earthquakes:** Earthquake Effects:- On ground, soil rupture, liquefaction, landslides. Behaviors of various types of buildings, structures, power plants, switch yards, equipments, lifelines and collapse patterns Behaviour of Non Structural Elements like services, fixtures, mountings Social & Economic Consequences of earthquakes Lab simulation of models.	1	2
6	**Seismic Design Principles:** Concept of seismic design, stiffness, strength, period, ductility, damping, hysteric energy dissipation, center of mass, center of rigidity, torsion, design eccentricities. Ductility based design: Design of energy absorbing devices. Seismic base isolation and seismic active control.	2	
7(a)	**Structural Detailing:** Innovations & Selection of appropriate materials IS Code provisions for the buildings:- IS:1893-2002, IS:4326-1993 Horiz. & vert.seismic co-efficients, valuation of base shear, distribution ofshear forces in multistorey bldg. Seismic Detailing Provisions: Masonry & Wood Buildings (IS: 4326, IS: 13828), Adobe houses (IS: 13827) Seismic Designs & Detailing of RC & Steel Buildings: IS: 1893 – 2002; IS: 13920 – 1993; IS: 456 – 2000; IS: 800 – 2004. Special reinforcing and connection details in structural drawings.	4	
7(b)	**Earthquake Resistant Construction Details:** Various Types and construction details of: Foundations, soil stabilization,retaining walls, plinth fill, flooring, walls, openings, roofs, terraces, parapets, boundary walls, under ground and overhead tanks, staircases, and isolation of structures. □ Local practices: traditional regional responses.	2	5

S. No.	TOPICS	L	S
8	**Construction Quality Control:** □ Sequence of Construction: Good supervision practices, Critical check points and certification at certain stages, reporting, maintenance of records, testing.	1	
9	**Vulnerability Assessment & Seismic Strengthening of Buildings:** Seismic vulnerability evaluation of existing buildings. Weakness in existing buildings, aging, weathering development of cracks Concepts in repair, restoration & seismic strengthening, materials & equipments for restoration of masonry & concrete structures. Methodologies for seismic retrofitting.	4	
10	**Techno-legal & Techno-financial Aspects in Building Projects.** Building Bye-laws. Cost Benefit Studies	1	
11	**Architectural Design Projects:** Design development by the participants in consultation with Structural Engineer Load Bearing 2 storey school/hospital in seismic Zone V. 5 Storied R.C. framed building with *soft* ground storey at Delhi, founded on soft non-liquefiable soil.	To be integrated with 4, 7 (a) & 7(b)	
12	**Teaching Methodology:** Preparation of design brief for earthquake resistant construction in architectural design studios. Preparation of lecture materials Teaching aids: different approaches. Conduct of lab experiments Sourcing information, availability of reference material and institutional network. Evaluation of Architectural design	7	
	TOTAL	**29**	**13**

EARTHQUAKE RESISTANT DESIGN AND CONSTRUCTION

One-Week Training Course for Practicing Architects

S. No.	TOPICS	L	S
1	**Building Safety from Natural Hazards: an Introduction** Earthquake. Fire safety in buildings. Cyclone effects: High winds, storm surge, and cyclone safety aspects in buildings. Floods. Landslides	1	
2	**Elementary Seismology**: Earthquake occurrence in the world, plate tectonics, faults, earthquake hazard maps of India & and the States. Causes of earthquake, seismic waves; magnitude, intensity, epicenter and energy release, characteristics of strong earthquake ground motions. Seismological Instruments: Seismograph, Accelerograph, Seismoscope/Multi SAR.	1	
3	**Introduction to Theory of Vibrations:** Single degree undamped & damped systems, resonance, response to earthquakes, elastic response, concepts of response spectrum. Flexibility of long & short period structures; concepts of response spectrum.	2	
4	**Site Planning, Building Forms and Architectural Design Concepts for Earthquake Resistance:** Historical experiences Site Selection Site Development Building forms:- Horizontal & vertical eccentricities, mass and stiffness distribution, soft storey etc. Seismic effects related to building configuration. Plan & vertical irregularities, redundancy & setbacks. Special Aspects:- Torsion, appendages, staircases, adjacency, pounding Contemporary international approaches	3	6

S. No.	TOPICS	L	S
5	**Performance of Ground & Buildings in Past Earthquakes:** Earthquake Effects:- On ground, soil rupture, liquefaction, landslides. Behaviors of various types of buildings, structures, power plants, switch yards, equipments, lifelines and collapse patterns Behaviour of Non Structural Elements like services, fixtures, mountings Social & Economic Consequences of earthquakes Lab simulation of models.	1	2
6	**Seismic Design Principles:** Concept of seismic design, stiffness, strength, period, ductility, damping, hysteric energy dissipation, center of mass, center of rigidity, torsion, design eccentricities. Ductility based design: Design of energy absorbing devices. Seismic base isolation and seismic active control.	2	
7(a)	**Structural Detailing:** Innovations & Selection of appropriate materials IS Code provisions for the bldgs:- IS:1893-2002, IS:4326-1993 Horiz. & vert.seismic co-efficients, valuation of base shear, distribution ofshear forces in multistorey bldg. Seismic Detailing Provisions: Masonry & Wood Buildings (IS: 4326, IS: 13828), Adobe houses (IS: 13827) Seismic Designs & Detailing of RC & Steel Buildings: IS: 1893 – 2002; IS: 13920 – 1993; IS: 456 – 2000; IS: 800 – 2004. Special reinforcing and connection details in structural drawings.	4	
7(b)	**Earthquake Resistant Construction Details:** Various Types and construction details of: Foundations, soil stabilization,retaining walls, plinth fill, flooring, walls, openings, roofs, terraces, parapets, boundary walls, under ground and overhead tanks, staircases, and isolation of structures. □ Local practices: traditional regional responses.	2	5

S. No.	TOPICS	L	S
8	**Construction Quality Control:** □ Sequence of Construction: Good supervision practices, Critical check points and certification at certain stages, reporting, maintenance of records, testing.	1	
9	**Vulnerability Assessment & Seismic Strengthening of Buildings:** Seismic vulnerability evaluation of existing buildings. Weakness in existing buildings, aging, weathering development of cracks Concepts in repair, restoration & seismic strengthening, materials & equipments for restoration of masonry & concrete structures. Methodologies for seismic retrofitting.	4	
10	**Techno-legal & Techno-financial Aspects in Building Projects.** Building Bye-laws. Cost Benefit Studies	3	
11	**Architectural Design Projects:** Design development by the participants in consultation with Structural Engineer Load Bearing 2 storey school/hospital in seismic Zone V. 5 Storied R.C. framed building with soft ground storey at Delhi, founded on soft non-liquefiable soil.		
	TOTAL	**24**	**13**

* Note: The studio hours to be used as practical sessions either with the help of sketch books or computers depending upon the availability.