ICUS REPORT 2004-01

An Undertaking of
The International Association for Earthquake Engineering (IAEE)
in support of
The International Decade for Natural Disaster Reduction (IDNDR)

WORLD SEISMIC SAFETY INITIATIVE (WSSI)

ICUS/INCEDE
INSTITUTE OF INDUSTRIAL SCIENCE THE UNIVERSITY OF TOKYO

INTERNATIONAL CENTER FOR
URBAN SAFETY ENGINEERING

INSTITUTE OF INDUSTRIAL SCIENCE
THE UNIVERSITY OF TOKYO

SEISMIC RISK MANAGEMENT FOR COUNTRIES OF THE ASIA PACIFIC REGION

- Proceedings of the 3rd WSSI International Workshop -

Edited by

Kimiro Meguro, Dushmanta Dutta
ICUS, The University of Tokyo, Japan
and
Tsuneo Katayama
NIED, Tsukuba, Japan

ISBN 4-9902067-0-3

Serial Number 5

Seismic Risk Management for Countries of the Asia Pacific Region
- Proceedings of the 3rd WSSI International Workshop -

ICUS REPORT 2004-01

INTERNATIONAL CENTER
FOR URBAN SAFETY ENGINEERING
Institute of Industrial Science, The University of Tokyo
4-6-1 Komaba, Meguro-ku,
Tokyo 153-8505, Japan
Tel: (+81-3)5452-6472
Fax: (+81-3)5452-6476
http://icus.iis.u-tokyo.ac.jp/
E-mail: icus@iis.u-tokyo.ac.jp

Prof. T. C. Pan, Secretary, WSSI
Director, Protective Technology Research Centre
Nanyang Technological University
50 Nanyang Avenue, Singapore 639798
Tel: (+65) 6790-5285
Fax: (+65) 6791-0046
E-mail: cpan@ntu.edu.sg
http://www.ntu.edu.sg/ptrc/

CONTENTS

JICA REPORTS ON INTERNATIONAL COOPERATION TOWARDS EARTHQUAKE DISASTER REDUCTION

REPORTS FROM INTERNATIONAL ORGANIZATIONS

APPENDICES

At the Opening Ceremony…

INTRODUCTION

K. MEGURO[1], D. DUTTA[1] and T. KATAYAMA[2]
[1]ICUS, IIS, University of Tokyo, Japan
[2]National Research Institute for Earth Science and Disaster Prevention, Tsukuba, Japan

This report contains the proceedings of the third International Workshop on Seismic Risk Management for Countries of the Asia Pacific Region organized by the World Seismic Safety Initiative (WSSI) during December 7-8, 2003.

This was the third international workshop organized by WSSI in Bangkok, Thailand. The main objectives of WSSI to organize this workshop were to stock in its own programs and to learn from its past experience and that of the countries WSSI has worked with.

The workshop was successful in creating a platform to look in depth to the past activities of WSSI in different countries and their impacts in seismic risk management.

1. BACKGROUND

The first Bangkok workshop was held in February 1993 with a theme of assessing the status of earthquake mitigation policies and plans in place in the countries of the Asia Pacific Region. This region historically had many earthquakes and extensive economic and human losses. The region during the decade of the 80s and early 90s was going through major urbanization and economic development. With the declaration of the IDNDR program in the early 90s, it was most appropriate that WSSI would compile a status of earthquake mitigation policies within the countries of the Asia Pacific Region. With that goal in mind, a workshop was organized during February 8-11, 1993 in Bangkok. This was the first major effort of WSSI after its formation in 1992. Thirty participants from nineteen countries were invited and attended the workshop and provided a written record of their countries' mitigation policies and plans. The work was published as proceedings of the workshop by WSSI and the International Center for Disaster-mitigation Engineering (INCEDE), with assistance provided by the Asian Institute of Technology (AIT) and the Asian Disaster Preparedness Center (ADPC) in Bangkok (Meguro and Katayama, 1993).

After the first Bangkok workshop, various programs and efforts were initiated by International Decade for Natural Disaster Reduction (IDNDR) and by other international organizations in many of the countries that had attended the first Bangkok workshop. So it was decided to reconvene and re-enact the 1993 Bangkok workshop five years later during January 18-20, 1999. The purpose of the second workshop was to once again compile and record the achievements made by the countries, which were present in the 1993 study. The second workshop in 1999 provided a wonderful and most crucial data on the achievements (or lack of) of IDNDR during the five years since the 1993 workshop. Almost all the countries that had been present at the 1993 workshop were once again invited to the second workshop. WSSI, INCEDE, and the United Nations University (UNU) published proceedings of the second workshop (Meguro and Shah, 1999).

Once again, it is almost five years since the second Bangkok workshop. Also, it has been almost ten years since the founding of WSSI. During those ten years, WSSI has worked with many countries around the world in general and in Asia Pacific Region in particular. WSSI and its programs during those ten+ years had some remarkable successes in some countries and in others; they have not been able to make an impact in terms of implementation of risk mitigation strategies. Also during those ten+ years, WSSI has learned a lot in terms of its goals, objectives, and methods of operations. WSSI in 2003 has more experience of what works and what does not work. WSSI understands the limits of what it can achieve with the resources it has.

2. OBJECTIVES

To take stock in its own programs and to learn from its past experience and those of the countries WSSI has worked with, it was decided to hold the third Bangkok workshop in December 7-8, 2003. The purposes of this workshop were to:

1. Learn from the countries where WSSI programs have made some positive difference in terms of earthquake risk mitigation and management.
2. Learn from the countries where WSSI programs have not made any major impact in terms of earthquake risk mitigation efforts.
3. Develop a plan in consultation with all the attending countries about what WSSI should do for the next five years and where they should focus their human and financial resources.

It has been anticipated that such an effort would help the Board of WSSI to develop a robust five-year plan which could be a “Road Map” for WSSI and which could be consistent with the needs and resources of WSSI for the coming years.

3. THE WORKSHOP

The workshop was attended by 52 participants from 19 countries. The participants included the representatives from most of the countries that participated in the last two Bangkok workshops of WSSI in 1993 and 1999. The workshop was also attended by the representatives from a few other Asian countries for the first time, representatives from six international organizations, Japan International Cooperation Agency (JICA) and three private sector organizations involved in JICA projects. Appendix 2 of this report includes the complete list of the participants in the workshop.

The two-day program of the workshop started with the Opening Session, where the objectives and agenda of the workshop and past activities of WSSI were presented by the WSSI Board of Directors (BoD) Chairman and three members of BoD. It was followed by five technical sessions and a discussion session. The detailed program of the workshop is included in Appendix 1 of this report. The five technical sessions included presentations of country reports from 14 countries and four JICA reports on international cooperation projects towards earthquake disaster reduction in Asia. The country reports emphasized on the earthquake risk mitigation efforts, strategies, responses and assessment measures initiated in their respective countries. Important roles played by WSSI as a catalyst in initiating several activities for earthquake disaster reduction in different countries are highlighted in the country reports. The four presentations on JICA related activities introduced major projects and programs of JICA on international cooperation, which have been implemented in an attempt to reduce seismic risk in different countries of Asia.

In the discussion session, the representatives of the six international organizations including Asian Disaster Reduction Center (ADRC), ADPC, Disaster Reduction Institution (DRI), United Nations Center for Regional Development (UNCRD) and UNU, presented their views on WSSI activities and past, present and future collaborations with WSSI in seismic risk management in the region. It was followed by a general discussion held to analyze the success and failure of past activities of WSSI and to formulate the guidelines for future activities based on the needs of the region.

4. OUTCOMES

The participants in their reports acknowledged WSSI's role in being a catalyst to many countries in the Asia Pacific Region in improving their earthquake risk awareness. They have also suggested scope of activities where WSSI can contribute and make an impact. The participants unanimously agreed that the mission of WSSI should be to reduce earthquake risk (and vulnerability) in vulnerable communities in developing countries with a view to assist sustainability of these communities, and that this should be pursued through developing and promoting an integrated approach adapted to the specific conditions of the communities.

It was noted and decided that WSSI should provide mechanisms through which a multi-sectoral and multi-disciplinary approach is insured in addressing the earthquake problems in the region. In understanding that WSSI should divert its focus from paying more attention from engineering/ technical part to the social dimensions of the disaster reduction with a view to paving the last mile in materializing the fruits of research. The recommendation of the discussion session, summarized by the WSSI BoD Chairperson, Dr. T. Katayama of National Research Institute for Earth Science and Disaster Prevention (NIED), Tsukuba, Japan, is included in the Appendix 3.

5. ACKNOWLEDGEMENT

WSSI greatly appreciates the following three Japanese organizations for their generous donations to hold the 3rd International Workshop on Seismic Risk Management for Countries of the Asia Pacific Region, December 7-8, 2003, Bangkok, Thailand.

- Nippon Koei Co., Ltd.
- OYO Corporation
- Pacific Consultants International

We sincerely thank Ms. Roopa Rakshit, the Editorial Associate of the Regional Network Office for Urban Safety (RNUS) of ICUS at AIT, for her tremendous help in various editorial activities in making this report. Without her sincere efforts, it would not have been possible to bring this report to you in such a short time. We also appreciate very much Mr. Booker M. Ajuoga from Uganda for allowing us to use his photographs in this report.

REFERENCES

1. Meguro, K. and T. Katayama (1993) (ed.). "Seismic Risk Management for Countries of the Asia Pacific Region", Proceedings of the WSSI International Workshop, INCEDE Report No. 5, University of Tokyo, Japan, 192 pages.
2. Meguro, K. and H. C. Shah (1999) (ed.). "Seismic Risk Management for Countries of the Asia Pacific Region", Proceedings of the WSSI Second International Workshop, INCEDE Report No. 14, University of Tokyo, Japan, 216 pages.

REPORT OF WSSI FUTURES COMMITTEE

W. IWAN, K. MEGURO and B. TUCKER
Members, Board of Directors
WSSI

Committee Recommendation

The Futures Committee recommends that:

> *Either WSSI should revise its Mission and Goals along with its operational structure, or WSSI should be dissolved.*

1. HISTORY OF WSSI

The World Seismic Safety Initiative (WSSI) was established in 1992 as an undertaking of the International Association of Earthquake Engineering (IAEE) to promote the spirit and goals of the International Decade of Natural Disaster Reduction (IDNDR). The IDNDR has been concluded, but the vision that motivated these world-wide efforts has lived on. At present, WSSI is an independent not-for-profit organization incorporated in Singapore and governed by a Board of Directors. The President of the IAEE is an Ex-Officio member of the Board of WSSI, but there is no formal (legal) connection between the two organizations.

2. REVISED MISSION STATEMENT

The Committee recommends that the Mission Statement of WSSI be revised as follows:

> *The Mission of WSSI is to reduce the level of earthquake risk in the most vulnerable communities in developing countries to an acceptable level consistent with sustainability of these communities.*

3. RECOMMENDED GUIDING PRINCIPLES

Rather than a set of specific goals, the Committee recommends that WSSI adopt the following Guiding Principles of operation. These principles should provide the underlying framework for all activities of WSSI.

The Guiding Principles of WSSI are to:

1. *Act as a catalyst and facilitator rather than implementer of large projects.*
2. *Focus on development of regional and local awareness, capacity, and leadership.*
3. *Emphasize low cost high benefit strategies to address its Mission.*

4. *Emphasize strategies that span the "last mile" to affected communities.*
5. *Cooperate with organizations having similar goals on a non-competitive basis.*

4. ACTIVITIES CONSISTENT WITH PROPOSED MISSION AND GUIDING PRINCIPLES

The Committee believes the following types of activities are consistent with the proposed Mission and Guiding Principles. This list is not intended to be exhaustive.

1. *High Level Meetings*
2. *Safer Cities Program*
3. *Leadership development and recognition programs*
4. *Education and training programs including workshops*
5. *Development of disaster prevention infrastructure*
6. *Earthquake reconnaissance programs*
7. *Regional, national, and international conferences*

5. RECOMMENDED STRUCTURAL REORGANIZATION

The Committee believes that structural reorganization of WSSI is imperative. The proposed reorganization is designed to not alter the basics character of WSSI but significantly improve its operational capabilities. The fundamental change made in the reorganization is to:

Establish a new operations and management element within WSSI (the "Management Team") to support the present Administrative Structure (the Board of Directors and Officers).

The Management Team would serve a similar function to the "staff" of an operational organization while still being responsible to the Administrative Structure of WSSI (The Board of Directors). The basic concept of the proposed new structure is shown in Figure 1.

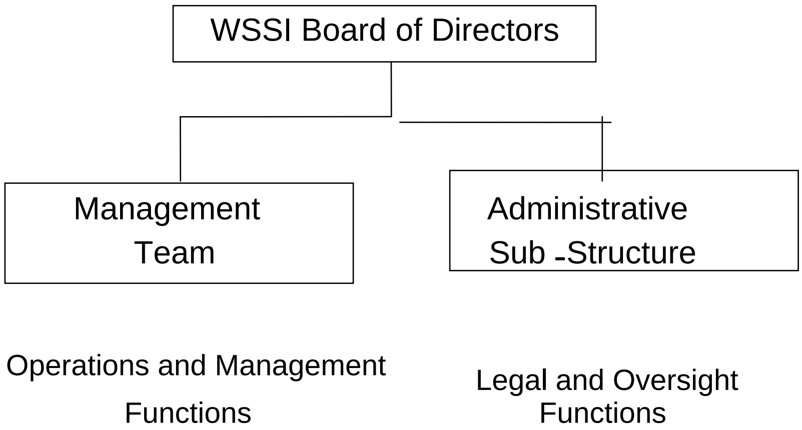


Figure 1: Proposed Organizational Structure

6. EXPECTED BENEFITS OF THE REORGANIZATION

1. *Allows the Administrative Structure (The Board of Directors and Officers) to function in a vision setting and oversight role without worrying about day-to-day operations.*
2. *Places day-to-day operational management in the hands of a team of individuals who are selected for their experience, availability and other attributes needed to undertake this function.*

7. ADMINISTRATIVE STRUCTURE

The Administrative structure would remain essentially as it is presently. This structure consists of a Board of Directors who are individuals with international stature and demonstrated administrative skills and the Officers of the Corporation. In the future, it is envisioned that the organization may possibly be expanded to include such entities as:

National and/or Regional Sub-Committees, and
Project Advisory Committees involving a mix of local, international, junior, and senior individuals

The Administrative structure is shown in figure 2:

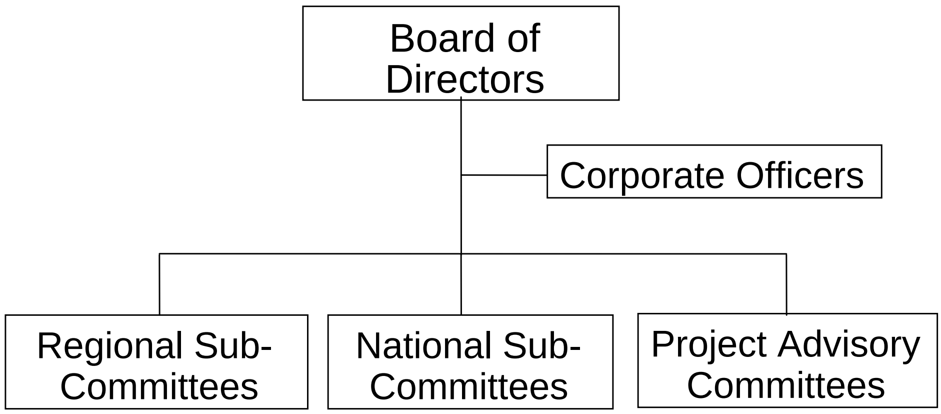


Figure 2: Administrative Structure

8. MANAGEMENT TEAM STRUCTURE

The Management Team should consist of an Executive Management Committee consisting initially of 3-4 individuals. These individuals should be selected by the Board of Directors based on their ability to contribute to the operational management of WSSI. The Chair of the Executive Management Committee should be an Ex-Officio member of the Board. Other members of the Executive Management Committee may serve on the Board if elected.

It is anticipated that the Management Team will also have a number of Project Implementation Teams whose members represent a mixture of senior and more junior individuals. In addition, Leadership Training Fellows and/or Interns may become members of the Management Team. There may also be volunteer and paid support staff as the opportunity and need arises.

The Management Team may be allowed to maintain bank accounts separate from the corporate accounts in Singapore at the discretion of the Board. Additionally, subsidiary not-for-profit organizations may be established in other countries to facilitate the raising of funds in those countries.

The Management Team structure is shown in Figure 3.

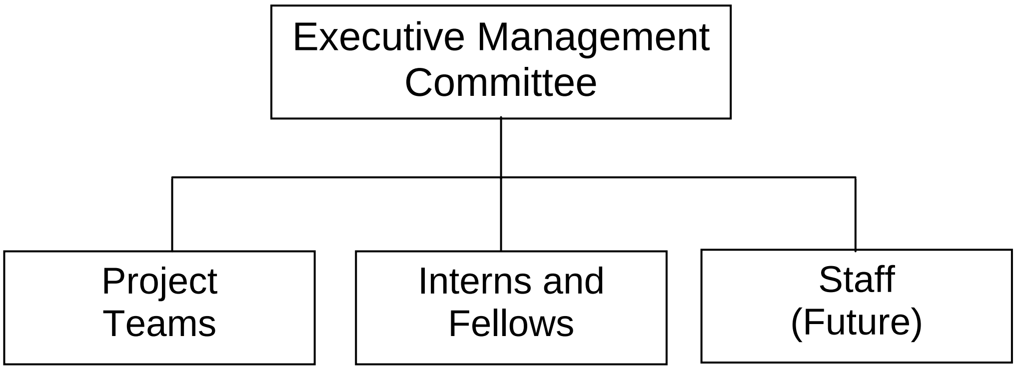


Figure 3: Management Team Structure

9. RELATIONSHIP OF WSSI TO RELATED ORGANIZATIONS AND ACTIVITIES

The Committee examined the relationship between WSSI and a number of other organizations. It was concluded that there were some similarities between these organizations but that there was insufficient overlap to justify any talk of mergers at this time. WSSI desires to fulfill a role that is complementary and non-competing with that of other organizations. A brief summary of some of the relevant organizations and activities follows.

GHI: GHI has a similar Mission Statement, but has a somewhat different focus and style of operation. It is believed that a synergistic relationship currently exists between GHI and WSSI.

EMI: EMI has a focus on large urban cities which is quite different from that of WSSI. EMI also has a different methodology for achieving its Mission. Continued cooperation between EMI and WSSI would me mutually beneficial

EERI World Housing Project: The World Housing Project has a similar geographic reach to that of WSSI, but rather different focus of activity. The interactive web site developed by the World Housing

Project is a potentially useful tool to accomplish the mission of WSSI. Future collaboration between WSSI and the housing project is a distinct possibility.

10. POSSIBLE SOURCES OF REVENUE

The Committee discussed possible sources of revenue that might be considered by the Board and the Management Team. These include but are not limited to:

Philanthropy
Grants
Workshops that draw upon the expertise of affiliates
Special Courses
International Journal for Earthquake Risk Reduction in Developing Countries
Revenue Sources (Continued)
International Conferences
Monograms or similar marketable documents
Sale of Seismic Safety Logo "gear" (tee shirts and other wearing apparel) at important events such as the WCEE. Example logo: "Earthquakes are inevitable but disasters can be avoided"

It is hoped these and other possible sources of revenue will be discussed further by the entire Board.

Prof. W. Iwan and Prof. K. Meguro

Glimpses from the Workshop…

Dr. R. Shaw from Japan and Mr. A. M. Dixit from Nepal

Mr. S. Ohya from Japan, Member, WSSI Board of Directors with Dr. P. Warnitchai from AIT, Thailand

Dr. S. Herath with Mr. M. Watanabe from Japan

TEN YEARS WITH THE WORLD SEISMIC SAFETY INITIATIVE

T. KATAYAMA
Director General
National Research Institute for Earth Science and Disaster Prevention
Tsukuba, Japan

1. INTRODUCTION

In December 2002, I attended the International Workshop on Community-Based Disaster Management which was held in Manesar, near New Delhi, India, and then I participated in the International workshop on Professional Issues for Earthquake Safety of the Built Environment, held in Mumbai. Following these workshops in India, we held the sixteenth Board of Directors Meeting of the World Seismic Safety Initiative (WSSI) which was held in Singapore and attended by thirteen directors from seven countries. Attendance was extremely good considering that the total number of directors is fifteen.

If I had not been involved in the establishment of WSSI ten years ago, I would not have participated in any of these meetings. WSSI has changed my interest in the field of earthquake engineering, and my attitude to earthquake disaster mitigation throughout the world, especially in developing countries. It goes back to the summer of 1984, to the eighth World Conference on Earthquake Engineering (WCEE) held in San Francisco.

2. THE INTERNATIONAL ASSOCIATION FOR EARTHQUAKE ENGINEERING AND THE UNITED NATIONS INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION

The International Association for Earthquake Engineering (IAEE) is a nonaffiliated academic organization active in the field of earthquake engineering. The objective of the association is to promote international cooperation among scientists, engineers, and other professionals in the broad field of earthquake engineering through the interchange of knowledge, ideas, results of research, and practical experience.

The IAEE holds it’s WCEE every four years. It was during the eighth WCEE in San Francisco in 1984 that Frank Press addressed the participants of the conference and proposed the establishment of an international decade of hazard reduction in which all countries would join forces to reduce the consequences of natural disasters. He emphasized that there would be no better way to start the new millennium than with a world which was better organized to reduce suffering from natural disasters.

The IAEE and the conference participants enthusiastically endorsed the idea and recommended prompt action for implementation. I never expected at that time that I would be personally involved in this "wonderful but penniless" project. The proposal gained the attention of academic institutions and associations worldwide. In December 1987, only three years after Press's original proposal, a United Nations General Assembly (UNGA) Resolution declared the 1990s as the "International Decade for Natural Disaster Reduction (IDNDR)" to promote internationally-coordinated efforts to reduce material losses and social and economic disruption caused by natural disasters, especially in developing countries.

When the ninth WCEE was held in Japan in 1988, we knew that we had to do something to support the IDNDR. But we did not know what that "something" was, and the IAEE did not show any definite strategy towards the IDNDR. During this conference, I was appointed secretary-general of the IAEE. In October 1991, I organized a small meeting in Tokyo to discuss what we could and should do as earthquake engineers to contribute to the IDNDR. However, the meeting turned out to be an occasion for a harsh self-examination for the IAEE. The meeting recommended that IAEE should make structural changes that would facilitate its ability to promote the earthquake engineering programme for IDNDR, and that IAEE should prepare a working paper on its role in the decade.

The tenth WCEE was held in Madrid in July 1992. During the Madrid conference, everybody knew that unless a special initiative was established with the capacity to gather people and funds, the possibility for IAEE to have a significant impact on the IDNDR was remote. The IAEE decided to launch the "World Seismic Safety Initiative" as a new undertaking in support of the IDNDR with the goals of disseminating state-of-the-art earthquake engineering information throughout the world, to incorporate experience and research findings into recommended practices and codes in earthquake-prone countries, and to advance engineering knowledge through problem-focused research.

The IAEE executive committee approved the establishment of the WSSI, and with T. Paulay as IAEE President, officially appointed an eleven-member Board of Directors shortly thereafter.

I thought this was the last chance for IAEE to contribute to the IDNDR. The WSSI needed to take action because disasters respect actions, not words.

3. THE 1993 BANGKOK WORKSHOP

In January 1993, a meeting of the Scientific and Technical Committee (STC) of the IDNDR was held in New Delhi, India. Haresh Shah and I attended this meeting and proposed the WSSI as a new IDNDR project. I vividly remember that one of the committee members commented that they should postpone the approval of our proposal until we could show more concrete activities together with a solid financial base. Eventually, the WSSI was approved as an international and regional IDNDR project, but we have to admit that even today lack of funds is the most serious problem facing WSSI activities.

Immediately following the STC meeting in India., the WSSI held a workshop entitled, "Seismic Risk Management for Countries of the Asia-Pacific Region" in early February 1993 in Bangkok, as the first initiative of the WSSI.

The Asia-Pacific Region, historically, has sustained extensive economic and human losses from earthquakes. The region, in recent decades, has been undergoing major urbanization and economic development. It was thought most appropriate that the WSSI should compile a list of earthquake mitigation policies and plans in place in the countries of the region.

The beginning is always the most important part of the work. This first modest but definitive step by the WSSI turned out to be a great success beyond all our expectations. We felt strongly that the WSSI was not going to be just another paper organization, and that we could make a dent in managing earthquake risks in developing countries.

We invited about thirty participants from nineteen countries to a golf club in a suburb of Bangkok. There were participants from such nations as Bangladesh, Brunei, Malaysia, Myanmar, Nepal, Pakistan, Thailand, and Viet Nam, whose names had rarely been heard in the international earthquake engineering community. They were waiting to be addressed to do something, although they had not participated in any international meetings of earthquake disaster mitigation before. Undisturbed by the noise from Bangkok, all of us freely and sincerely discussed the dilemma we faced. The challenge was to find the right combination of actions that would mitigate the earthquake risks through an integrated strategy, consistent with the available resources of these countries and aspirations of their citizens.

Participants commented on how the available knowledge was used or not used in developing earthquake disaster mitigation strategies in their home countries. They requested the WSSI to help raise public and government awareness of earthquake risks in the decision-making sector, in particular. Towards this objective, the WSSK recognized the importance of holding high level meetings to be attended by government officials, business leaders, people from social and cultural institutions, as well as the mass media.

The greatest gain from the Bangkok Workshop was the feeling of partnership cultivated among all the participants from developed and developing countries in the field of earthquake disaster science. Whenever we face hardship in managing the WSSI, we remember the Bangkok Workshop and the colleagues who had the common goal to mitigate the impacts of earthquake disasters.

4. HIGH-LEVEL MEETINGS

We have so far held more than ten high-level meetings (HLMs) in eight cities, mostly, but not all, in Asia: Colombo, Dhaka, Hanoi, Kampala (Uganda), Kathmandu, Kuala Lumpur, Singapore, and Yangon. Convening HLMs is one of the most important programmes of the WSSI. HLMs are long-range educational projects, which do not expect short-term outcomes.

The President of Uganda attended the HLM held in Kampala, Uganda's capital, in December 1997, and delivered a keynote speech. More than 300 participants attended the plenary session. He thanked the WSSI for choosing Uganda as a venue for the eighth HLM and showed great interest in making Uganda a geographic focus for spreading the message of awareness and preparedness in Sub-Saharan Africa. He promised the central government's commitment to provide increased resources.

In spite of all the efforts made during the IDNDR, very little attention had been paid to the needs and aspirations of Sub-Saharan Africa countries. No one had attended any regional or international conferences on earthquake engineering or seismology from this part of the world. The countries located along the Great African Rift Valley had been left out of the world earthquake community.

The HLM was managed by local people. The local host organizations in Uganda were a university, the Ministry of Natural Resources, and the Ministry of Labour and Social Welfare. The local hosts prepared the venue and invited local participants which included the media, the diplomatic corps, the Red Cross of Uganda, leading civic and business leaders, representative from the academic and scientific communities, and local practicing engineers. Three WSSI directors and one resource person represented the WSSI who, as usual, traveled and attended the HLM at their own expense.

It clearly indicated once more that HLMs are always a success when there is efficient preparation by the local people. It is also critical to have strong personal ties between the local host and the WSSI.

I remember the Myanmar HLM, planned in 1996 which was not a success. A participant from Myanmar to the Bangkok Workshop asked us to hold a HLM in Yangon while we were in Bangkok in 1993. Myanmar was not an easy country to visit in those days. We could not reach the person concerned on the phone. Answers to our faxes were hard to access and it was impossible to adequately prepare the meeting. But we were optimistic, because we had successfully held six HLMs by then. We thought that things would go well once we were in the country. We adopted a courageous approach. A timid person is frightened before a danger, a coward during the danger, but a courageous person afterwards.

We arrived in the country, however, to find nothing had been prepared for the HLM and there were no individuals with whom to talk. We visited, one by one, a university, the national railway company, and several other disaster-related organizations. Nobody knew about the WSSI or showed any interest in earthquake-disaster mitigation in Myanmar. I realized that we were confusing action with haste. But when we left the country, we were still feeling optimistic, because our friend from the Bangkok workshop came to see us in the hotel on the morning of our departure to tell us that the next time would be different.

And the "next" time came soon. During our first visit in 1996 to Myanmar, we found that there were only a few seismologists and earthquake engineers in the country, and that there was no strong-motion seismometer. The OYO Corporation, a geotechnical consulting company in Japan, whose president happened to be a WSSI director, decided to donate several strong-motion seismometers to Myanmar to establish a modest seismometer network. The company invited two scientists to Japan to teach them how to handle the instruments. As a result of our continued efforts, in 1999, we received an official invitation to hold an HLM and a special lecture meeting there. Now, there are ten strong-motion seismometers in Myanmar, and WSSI is preparing a follow-up meeting in Yangon, the capital, in February 2003.

5. THE WSSL'S HLM POLICY

When we held the twelfth WSSI Board of Director's Meeting in Singapore in December 1999, the IDNDR was reaching its finale. We decided however to continue the activities within the WSSI beyond 2000, and therefore adopted an official policy of holding HLMs based on past experience. It was thought necessary for the WSSI to define more objectively the roles of the HLMs for future reference. This was especially important because our resources are extremely limited.

The objectives to be achieved by HLM's were therefore summarized as follows:

- To trigger local high-level efforts;
- To build on, and encourage, local resource mobilization;

- To sensitize people - professionals, administrators, and politicians;
- To help identify and prioritize local actions;
- To assist in developing local sustainability through local efforts;
- To assist in adding credibility to local efforts;
- To assist in local efforts for fund-raising activities; and
- To assist in national networking.

Priority should be given to those countries where situations are dominated by a combination of high seismic risk and low preparedness. More emphasis should be placed on the latter, and attention should also be given to countries with medium/low seismic risk but low preparedness. In order that precious time, energy and money not be wasted, it may be necessary to seek dialogues between local people and the WSSI before an HLM is planned.

HLMs have been held on a voluntary basis in the past. However, this kind of activity cannot be continued without stable funding. Discussions are always made on possible practical solutions such as: (a) development aid offered by developed countries - in this case, holding an HLM can be included as part of a larger project supported by such aid organizations; (b) funds generated by holding a money-generating workshop in a place close to where the HLM is held; and (c) sales of a book or a monograph on introductory seismology and earthquake engineering written or compiled by WSSI directors or resource persons.

We have held several fee-paying lectures but without much success. The money generated was generally too little for the efforts needed to prepare such meetings. Although the WSSI was incorporated in Singapore in May 1995 as a nonprofit public benefit company for reasons of liability, fund-raising, and tax status, we are enjoying little benefit, at the moment. We estimate that we need a minimum of US$20,000 a year to run the organization in even the most modest manner. For the time being, this amount is shared between Japan and the US by the personal efforts of directors. After all, we have to at least partially approve the judgment of the IDNDR STC member who commented on the need for a solid financial base for the WSSI during its meeting in India, in 1993.

Given the nature of a typical HLM, it should not be repeated in the same country. It should be understood that it usually takes time to achieve the goals set by the WSSI, and it would be inappropriate to expect instant improvement following an HLM. It may be necessary for us to maintain a dialogue in order to encourage further development, locally. The WSSI may help developing countries establish courses in earthquake engineering and disaster management, and to further increase the local awareness in earthquake disaster mitigation.

6. INTERDISCIPLINARY OBSERVATIONS ON THE 2001 BHUJ EARTHQUAKE IN GUJARAT, INDIA

Soon after the Bhuj Earthquake hit the Kuch region of Gujarat State in India, at 8:46 am on 26 January 2001, Haresh Shah, Chairman of the WSSI Board of Directors, contacted four of the board members including myself who happened to be attending a workshop in Japan. Shah asked us what the WSSI could possibly do to best provide the international community with an additional opportunity to learn from this disaster. All of us knew that, like many earthquakes in recent times, numerous academic, professional, and humanitarian organizations would send teams of experts to study and learn from this unfortunate event. As a result, many reports would be published which would focus individually on scientific, technical, economic, and social issues.

We, the four board members, deliberated intensely on the matter, and came up with the idea of assembling a unique reconnaissance team from developed and developing countries around the world with different interests and different professional backgrounds. We conveyed this plan to Shah, who in turn recruited the participation and support of the Earthquakes in Megacities Initiative (EMI) through its Chairman, Fouad Bendimerad.

This was, to our knowledge, the first experiment to look at the earthquake consequences as a learning process for many individuals from developing countries. Without such an experiment, many of the team members might not get the opportunity to be on site, and to see the technical, economic, scientific, social, and political forces that contributed to the widespread death and destruction. However, implementing the idea was not an easy task. It required huge efforts by Shah before a team of twenty-one members from thirteen countries was sent on 25 February 2001 to the site to conduct an eight-day reconnaissance trip visiting eleven cities, towns, and villages in the region.

The mission, jointly supported by the WSSI and the EMI, culminated in a unique report beginning with the following sentences:
It is the dawn of the 5lst Republic Day of India, January 26, 2001. Some 400 students with their teachers are marching toward the town hall of Anjar to participate in the flag hoisting ceremony in observance of the India, Republic Day. There is slight chill in the air on a clear and sunny morning, quite usual during the winter days. The students, future leaders of republic India, are marching through very narrow streets-perhaps less than 10-ft wide-of downtown Anjar, singing popular patriotic songs. The narrow streets are surrounded by 2-story stone/masonry buildings. Suddenly, the earth beneath them snaps, first making a loud noise as if a bomb went off, followed by violent ground shaking that lasts for over a minute. A cloud of dust arises making it difficult to see what has happened. When dust clears, the surrounding buildings are no more standing. The violent shaking of the earth has leveled them burying under its rubble the marching students and teachers, and some inhabitants of the buildings that have collapsed. Joyful

singing turns into painful screams for help. Very few students and teachers escape injury or death; most of them perished, leaving their parents and loved ones behind. It is a sight that Anjar would not forget (for) a very, very long time to come.[2]

The cover of the report shows a photograph of writing on a wall in Anjar which says, “400 rallying children gone. God Bless.[3]

We believe that the experiment provided a dynamic and ’’live” learning experience for many of the members of the team. Only through such an effort can we increase the awareness of countries about what are the main engines of death and destruction due to earthquake events. The WSSI hopes that this awareness-raising experience will provide some countries represented in the team motivation to address the problem of earthquake risk reduction, and will give them the perspective and value of pre-disaster planning for mitigating the effects of future earthquakes.

We also believe that the make-up of the team, the purpose of the trip, and the unique and refreshing way of learning from a disaster should become the standard for future efforts to be formulated. Although the experiment was a resounding success, I would like to add that it required a huge amount of time and energy on a voluntary basis by some of the WSSI directors and WSSI-related resource persons.

7. BEYOND HLMS AND WORKSHOPS -THE WSSI IN ITS SECOND DECADE

According to the review made by the IAEE’s Ad Hoc Committee on the WSSI:

> A wide gap exists between the recommendations of experts expressed at the high-level meetings and the actual implementation of needed political and economic measures aimed at reducing seismic risk.
> The existence of this gap must be recognized when trying to assess the expected benefits of the WSSI program both in the immediate future and under a long-term perspective.[4]
> We have always considered what the WSSI can do beyond HLMs and workshops.
>
> The problem is indeed difficult. We have so far concentrated on establishing small, realistic, and well-focused projects.

We are very pleased that our efforts are registering concrete achievements in many parts of the world. Countries such as Malaysia, Myanmar, Nepal, Pakistan, Singapore, Thailand, and Uganda have established national organizations of earthquake engineering, and they have been approved as IAEE member countries.

The impact of the WSSl activities on Nepal is something of which we are proud. To evaluate the effectiveness and impact of IDNDR-related WSSI programmes towards earthquake disaster mitigation, we held the second Bangkok Workshop in 1999. We asked participants to self-evaluate the achievements in their countries between 1993 and 1999 by identifying their earthquake disaster preparedness capacity from 0 (no capacity) to 10 (perfection). The answer from a Nepalese representative was 1 in 1993 and 3 in 1999, giving a threefold improvement within six years. Awareness for earthquake preparedness has been enhanced greatly, and an international project to strengthen school buildings has been carried out successfully. Efforts by the local people attracted the attention of donor countries and international organizations, and they supported several projects for earthquake disaster mitigation in Nepal.

Several years ago, the Consortium of Organizations for Strong-Motion ObservationSystems (COSMOS) in the US started to replace its old instruments with newer ones. The seismometers being replaced are often in good working order, but no longer meet the requirements of the COSMOS. Towards extending the useful life of these instruments, the WSSI and COSMOS have initiated a programme to facilitate their redistribution.

The current board of fifteen international directors[5] has ultimate responsibility for all WSSI activities. Although we do not feel the simple parent-child relationship between IAEE and the WSSI, we maintain the original close relationship by having Luis Esteva, IAEE President, as a WSSI director. In addition to this, two of the current directors are a past president and a past secretary-general of IAEE.

As a senior member of the WSSI board of directors, I often think that we might have been a little too complacent about what we have done in WSSI. However, an undertaking like the WSSI will never be maintained without some complacency and selfishness of the people involved.

The activities of the WSSI have now entered their second decade. The leadership of Haresh Shah during the first ten years has contributed tremendously to what WSSI has become. There is no doubt that WSSI owes much to his personal visibility in the international community of earthquake engineering. He has, however, stepped down from the Chair of the WSSI Board of Directors, and I succeeded him as of January 2003. The continued support of interested parties in our future activities is greatly appreciated.

NOTES

1. The eleven original board members were: Hiroyuki Aoyamn, Teddy Boen, Wilfred D. Iwan, Tsuneo Katayama (Cochair), Roman Kintanar, Gunter Klein, Roberto Meli, Rudolfo Saragoni, Haresh C. Shah (Cochair), Charles Thiel, Jr., and Kenro Toki.
2. World Seismic Safety Initiative (WSSI)/Earthquake and Megacities Initiative

(EMI). "Mission Report" (2001).

3. Ibid.

4. International Association for Earthquake Engineering (IAEE) Ad Hoc Committee on the WSSI, "Review" (1997).

5. Directors of WSSI as 1 January 2003 are: Teddy Boen, Roger D. Borcherdt, Sheldon Cherry, Weimin Dong, Luis Esteva, Tore Haalvaldsen, Wilfred D. Iwan, Sudhir K. Jain, Tsuneo Katayama (chair), Mark Klyachko, Kimiro Meguro, Satoru Ohya, Tso-Chien Pan, Haresh C. Shah and Brian E. Tucker.

6. The words of the American poet, Henry Wadsworth Longfellow come to mind, "Most people would succeed in small things if they were not troubled with great ambitions."

Footnote:

This article is taken from "Regional Development Dialogues" (Vol 24, No. 1 Spring 2003, pp.107-114) with an official permission of the United Nations Center for Regional Development (UNCRD).

THE LAST MILE-EARTHQUAKE RISK MITIGATION ASSISTANCE IN DEVELOPING COUNTRIES

HARESH C. SHAH
Obayashi Professor of Engineering Emeritus
Stanford University
USA

1. PREFACE

Over the past three to four decades, we have seen many joint programs between developed countries and developing countries to help the latter in managing their earthquake risks. These programs span the whole spectrum of disciplines from seismology and geology to engineering, social science and economy. Many of these programs have been effective in raising awareness, in urging governments to work towards risk reduction, and in spawning an "industry" of disaster management in many of the developing countries. These industries include non-profit organizations, NGOs, for profit organizations, and in general a sleuth of opportunities for entrepreneurial individuals from urban regions of developing countries.

As these evolving opportunities unfold, we have seen death and destruction due to earthquake after earthquake in developing countries, strongly suggesting that the problems for which those assistance programs were developed are not very effective, at least in the short run. We have seen deaths, injuries, social trauma, economic disruptions, and general interruption of life continue unabated. So it is natural to ask why is this happening. Are the assistance programs reaching the right people? May be we are reaching the right people and doing the right type of things in these countries but we have not allowed enough time for our good actions to take effect. May be we are reaching the right people and doing the right actions for all the miles we need to cover in helping communities mitigate their earthquake risks. The question may be whether we are reaching people who represent the last mile. So in this brief paper, I am not saying that the work many organizations have done over the past few decades in mitigating earthquake risk in developing countries is not appropriate. What I am questioning is whether we have covered that last mile, whether we have reached all the right people, whether we have used the available resources in doing all that we can and should do.

In telecommunication industry, they define the most crucial link between available technology of narrow and broadband communication and the use of that technology by a typical homeowner as the problem of "**Last Mile".** The reasoning being that unless the last connection between the homeowner and the most sophisticated available technology is not there, all the available technology cannot be effective for the vast market of consumers. The problem of last mile has been a challenge in that industry for many years and still continues to be the crucial link. Giants of telecommunication industries are still battling for the control of the last mile.

Coming back to our focus of risk mitigation in developing countries, it seems to me that we have not done all that we could do in making the connection between those who are trying to help and those who need help, the problem of Last Mile. In this short paper, I will try to articulate what I think is a problem at hand. Why do we keep seeing the catastrophes of Chi Chi, Bhuj, Turkey, Algeria, and on and on. This paper is written to generate discussions, self analysis of our approaches, what we are doing right and what we are not doing right, and hopefully, try to make a proper connection between the last mile and all the programs we (community of organizations around the world working towards earthquake risk mitigation) have been working on so diligently and hopefully for the past few decades.

2. SOME OBSERVATIONS

In the context of earthquake risk mitigation in a developing country and the “Last Mile”, I would say that the following actions affect and impact the citizens who will experience the next catastrophic earthquake.

1. Earthquake codes and **their strict implementation** in urban and rural communities for engineered structures.
2. “How to” type of instructions to build non-engineered and rural structures.
3. Helping the village or community build safer homes, safer schools, safer hospitals, and safer community infrastructures.
4. Awareness at the individual, family, and community level of earthquakes and what to do before, during, and immediately after an earthquake.
5. Social and political preparedness for the next catastrophic event at all levels of private and public enterprises.

I am sure there are many such actions that could impact a community or region due to future events that I have not included. That could be a difficult task and for the purpose of this paper, it is not crucial to be all-inclusive. **The point at this time is to understand the context of the Last Mile. In that context, it is that action or actions, which will actually help a community, reduce (or mitigate) its earthquake risk.**

Now, let us look at our own personal experiences over the past few decades. Personally, I have been involved in many professional, non-governmental, philanthropic, academic and similar organizations. Many of these organizations have worked internationally with great passion and dedication to help reduce the problem of earthquake risk in many developing countries around the globe. Many of these efforts have resulted in visible improvements in earthquake risk profiles of communities in developing nations. These efforts have involved meetings, conferences, workshops, seminars, courses, public lectures, and just networking. All these efforts and means to our end are fine and laudable. However, how many of these efforts pass the test of linking with the last mile. Many of these efforts are between people like us the academics, senior governmental officials, and usually the most educated and "aware" people. How many times have we seen that the connection between "us" and the last mile is not complete? It often discontinues after a meeting or a workshop or a conference is conducted. How often a $100,000 (as an example) grant to help reduce earthquake risk in a specific developing region of the world ends up in spending 90% of that in conducting a workshop or a conference and hardly anything remaining for the last mile? In many developed countries, I have often seen hundreds of thousands of dollars are spent in developing a program, in travel, in discussion meetings, in workshops, etc. and very little left for the final beneficiary who is supposed to be helped by us. How will the risk profile and the risk culture ever change in developing countries unless we are connected all the way up to and including the last mile?

As Koffie Annan, Secretary General of United Nations said in 1999, ***"Building a culture of prevention is not easy. While the costs of prevention have to be paid in the present, its benefits lie in a distant future. Moreover, the benefits are not tangible; they are the disasters that did not happen".***

With the current mode of operation of many organizations around the world who are "assisting" developing nations deal with their earthquake risk mitigation efforts, the score card of how well they are doing will not come until a future date (could be decades). It is quite possible that this future score card will look good. In the interim, individuals and organizations will feel (or will claim) a sense of success at their programs and ways of spending resources. As they say, only time will tell. Unfortunately, this delay in getting their score card will result in time and resources spent, may be making the right connections for the first hundreds of miles and not reaching the last mile, and most important, in lost opportunities.

3. ISSUES RELATED TO THE LAST MILE

It is generally accepted by many who have worked towards earthquake risk reduction in developing countries that non-scientific and non-technical issues play a major role in implementing known risk reduction strategies. Let us look at some of these issues.

- ❖ Perception of risk is an important part. Without the society's understanding of the type and level of risk, it is very difficult if not impossible to develop and implement strategies for earthquake risk reduction. Many developing societies live their daily lives under varieties of risk. Unless it is clear to them as to how earthquake risk fits into their hierarchy of risk, it is very hard for them to either "get excited" or do something about that risk. So the first and foremost requirement for a developing society to implement needed risk reduction strategies is to understand the earthquake risk and how it relates to other man made or natural risks. In my experience, many developing societies have not properly understood earthquake risk. The experts in these countries have done relatively poor job in raising the awareness of the citizenry about the problem and possible solutions. Most experts in those countries have not taken special care in traveling the last mile.

- In a society with many competing demands on available resources, it is not clear to many as to how one can balance the risk/reward equation. What level of resources need to be spent to achieve an acceptable level of safety is a complex problem. Even in industrialized countries, the answer to such a complex question is not obvious. So in an economically developing country, it is even more difficult to justify the time and resources needed for earthquake risk reduction.
- There is a wide spread perception that to do anything about mitigating earthquake risk, the immediate or short-term cost is enormous. The technical community has mainly propagated this perception. The message has been that earthquake resistant structures require specialized knowledge and that to build earthquake resistant structures or to upgrade existing structures to some acceptable level of performance, the cost is not trivial. This may be true but such scaler messages impact on the ability of a community to do non-capital intensive actions such as awareness drive, self-help solutions, community based retrofitting, financial risk management options, disaster management plans, non-structural mitigation, etc.
- There is relatively little communication between researchers, academics, and few well-known professionals and the rest of the country, which is at risk. The few "world class" individuals in the country have not been able to make the citizens, the engineering community, the governmental organizations, and the regulators aware about the type and level of risk and what measures would buy maximum benefit at minimum cost. This has created an awareness vacuum. Without "bottoms up" interest in implementing risk management strategies, it is very difficult to make any headway towards earthquake risk reduction.
- The group of professionals such as architects, structural engineers, contractors, government inspectors, etc. have very little professional accountability for poor performance of structures. Even in countries where good building codes exist, there is very little effort to implement and enforce those codes. As a result, we have seen great death and destruction in many recent earthquakes. Ability to practice these professions is not based on licensing or accountability checks.
- In developing countries, usually an organizational infrastructure that allows a good working partnership between academics, engineering practitioners, government

regulators, financial institutions, and social activists does not exist. Thus, the time between the generation of knowledge and its implementation on the ground is excruciatingly long.

These and many such reasons can be cited for a lack of progress in many countries. One of the most frustrating observations that I have made is that there are groups of countries where there is knowledge, there are resources, and there is awareness. Still, there is very little hope in terms of how a major urban center in India or China or Turkey will perform in a future earthquake. What can we do in those countries to make a difference? Is the problem of connecting the last mile making it difficult to achieve desired outcomes? For too long, individuals in some of those countries have been "preaching" to their own kind. And, perhaps, it could be said that foreign "experts" have been preaching to local experts and the resulting information exchange terminates at that level. It is time to change the way risk mitigation and risk management has been approached in these countries. It is important to understand the last mile that will make all the worthwhile efforts connect all the way from articulation of problems to possible solutions and actions.

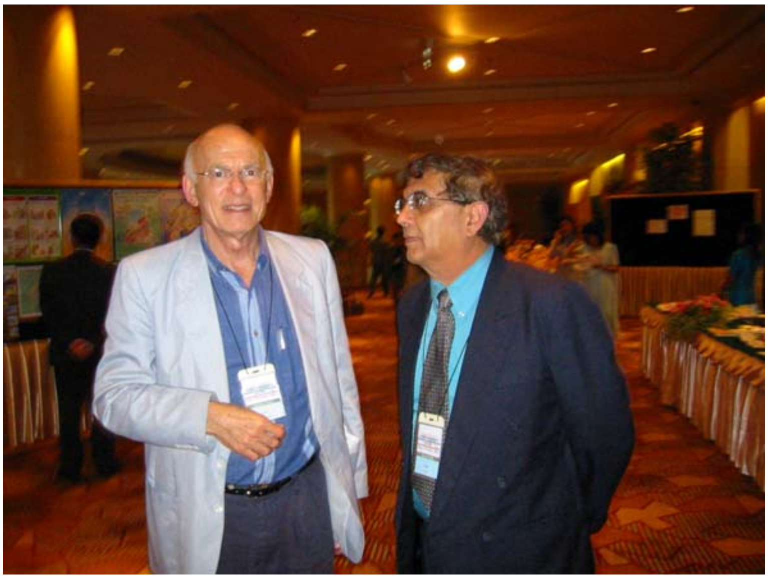
4. CONCLUDING REMARKS

The main theme of this paper is whether we are reaching **all** the right people and are developing **all** the right strategies for reducing earthquake risk in developing societies. This simple question is put in the context of the **"Last Mile".** The general concern that is expressed is in terms of the relative expenditure of resources between the last mile and all the previous miles. By their very nature, it seems that considerable resources are spent in articulating the problems, in studying the nature of the problems, and in communicating between the like-minded solution providers. As a result relatively very little is left over or available to connect between all the miles that are traveled and the last mile. If in fact there is some merit in the central theme of this paper, it may be time for all of us to question our assumptions and our actions and make needed modifications so that there is a robust connection to the last mile.

Prof. H. C. Shah from USA, Member, WSSI Board of Directors

Moments from the Workshop …

Prof. W. Iwan from USA and Prof. T. Haavaldsen from Norway, Members, WSSI Board of Directors



Prof. S. Cherry from Canada, Ex-President, IAEE and Prof. H.C. Shah from USA, Member, WSSI Board of Directors

Mr. Y. Egawa, Ms. Tsunozaki and Mr. T. Tanaka from Japan

STATUS OF EARTHQUAKE RISK MITIGATION IN BANGLADESH

M. A. ANSARY
Department of Civil Engineering, BUET
Bangladesh

ABSTRACT

This paper presents a brief summary of the activities and research work undertaken in the field of earthquake engineering for the last five years. Highlights of completed and current BUET research activities are also briefly discussed. Currently, BUET, Bangladesh Earthquake Society, government and some non-government organizations, a few other public universities of Bangladesh and media are playing a major role in earthquake risk mitigation efforts. Bangladesh still has a long way to go to achieve a satisfactory level of earthquake disaster mitigation. Some general recommendations are provided to meet these objectives. A summary of actions undertaken as per the recommendations of previous WSSI workshops and some future actions to be carried out are also proposed.

For the last few years, different organizations in Bangladesh organized several small and large workshops and made numerous recommendations without making any considerable impact on the society. With the help of several field surveys carried out in different communities of Dhaka and other four major cities of Bangladesh the author found out that although community leaders have some knowledge of earthquake, they are still unaware about the catastrophic effect of an earthquake on their communities. Almost all those densely populated communities have grown haphazardly with narrow alleyways, fraught with old and new non-engineered vulnerable structures, unplanned road networks. The communities have very little earthquake and fire preparedness. So to walk 'the last mile', the author requests WSSI to provide assistance to BES and NCEE-BUET to undertake community-based awareness and preparedness programs.

1. INTRODUCTION

Bangladesh is susceptible to frequent damaging earthquakes. Although in the recent past no major earthquake has occurred, but in the past few hundred years, several large catastrophic earthquakes struck this area. So far, all the major recent earthquakes have occurred away from major cities, and have affected relatively sparsely populated areas. This has limited the human casualty and the economic losses. However, the 1993 Killari and 2001 Gujarat earthquakes in India has amply demonstrated that inappropriate construction technology may lead to high casualty levels even for moderate earthquakes (Sinha and Goyal, 1994).

In 1897, an earthquake of magnitude 8.7 (recently modified by Ambraseys (2000) to be 8.0) caused serious damages to buildings in the northeastern part of India (including Bangladesh) and 1542 people were killed. Recently, Bilham et al. (2001) pointed out that there is high possibility that a huge earthquake will occur around the Himalayan region based on the difference between energy accumulation in this region and historical earthquake occurrence. The population increase around this region is at least 50 times than the population of 1897 and cities like Dhaka, Kathmandu, Guwahati have population exceeding several millions. It is a cause for great concern that the next great earthquake may occur in this region at any time.

A strong earthquake affecting major urban centers like Dhaka, Chittagong, Sylhet may result in damage and destruction of massive proportions and may have very severe long-term consequences for the entire country. After the 1971 independence, most major urban centers of Bangladesh have grown tremendously due to unabated migration from the smaller towns and rural areas. As a result, the cities have developed in haphazard fashion with little consideration for proper town-planning norms. There is, consequently, a need to be prepared against all possible natural and man-made disasters that are likely to occur in Bangladesh. For this purpose, it is essential to have realistic understanding of the consequences of likely damage in major cities due to different disasters. This will permit rational planning of mitigation efforts in order to minimise effects of these disasters.

The extent of damage to structures and casualty level due to an earthquake in the future can be reduced by the introduction of suitable mitigation measures. These mitigation measures can be categorized as structural and/or non-structural. The structural measures are those that directly influence the performance of building stock through strengthening of code provisions and the prevalent construction practice. Incorporating the appropriate structural mitigation measures can reduce the vulnerability of any building type. The non-structural mitigation measures include improvement in the state of awareness and preparedness before a disaster, land-use control and other government policies, and the infrastructure related to response following a disaster. The non-structural measures help to reduce the severity of casualty levels following an earthquake. In order to reduce the consequences of a major earthquake in the cities of Bangladesh, it is necessary that appropriate structural as well as non-structural measures be undertaken.

2. ACTIVITIES FOR THE LAST FIVE YEAR

The first and second WSSI workshops were held in Bangkok in 1993 and 1999, respectively. Besides the workshops, WSSI held ten high-level meetings (HLMs) in eight cities (Katayama, 2003). The only HLM by WSSI was held at Bangladesh in 1994. But after that HLM, there were no WSSI activities in Bangladesh. In 2001, WSSI sponsored the author to participate in an interdisciplinary reconnaissance team from developed and developing countries around the world to visit the earthquake affected Gujarat state. It was an unique experience for the author to visit and to get "real life" learning experience from an earthquake devastated region in the presence of experienced people of different interests and professional background. This exposure motivated the author to work in the field of earthquake risk reduction.

The author was also lucky to be trained in earthquake engineering under the guidance of Prof. Katayama, University of Tokyo. After returning to Bangladesh in 1996, the author together with a BUET team comprising of Prof. Choudhury and Dr. Al-Hussaini submitted a project proposal to the Jamuna Multi-purpose Bridge Authority to install seismic devices on the bridge (a 4.8 km long RCC deck girder bridge) and the surrounding area. The Panel of Expert at the 9th Milestone Meeting approved the project on March 1997. But it took another six years to get approval from GoB and install the instruments on the bridge. The author also developed a course on Earthquake Engineering for postgraduate level at BUET and for the last seven years the course has been offered at the postgraduate level. In the following paragraphs a brief summary of activities undertaken by different organizations of Bangladesh to mitigate earthquake disaster are presented.

2.1 Bangladesh University of Engineering & Technology (BUET)

Department of Civil Engineering, BUET offers postgraduate courses on Earthquake Engineering, Soil Dynamics, Structural Dynamics and Vibration Analysis. Until 1996, only two postgraduate thesies linked with Earthquake Engineering. But after 1996, six more postgraduate theses related to this field were completed. Currently two students are pursuing their Ph.D and four more students are pursuing their Master's thesis in Earthquake Engineering field.

Department of Civil Engineering, BUET is working as a consultant to the 4.8 km long Jamuna Multi-purpose bridge to monitor the seismic instruments that the faculty members of the Department under the leadership of the author, helped to install in July 2003. In addition to the seismic instrumentation of the bridge, there is a borehole accelerograph at 57 m depth and seven free-field seismic instruments at Bogra, Natore, east and west end of the bridge, Mymensingh, Gazipur and Dhaka. **Figures 1** and **2** show location of the bridge, free field and bridge instrumentation.

In April 2002, BUET put forward a proposal for the establishment of a National Center for Earthquake Engineering (NCEE) and included it in BUET's next five-year plan for implementation. In March 2003, an MOU was signed between NCEE and ICUS, University of Tokyo. Recently, a linkage is established between Virginia Polytechnic Institute, USA and

NCEE with USAID funding. The author is working as the NCEE project director for this linkage program.

Under the leadership of the author, several BUET team performed field surveys after the recent Bangladeshi earthquakes (Ansary et al., 2001, Ansary et al., 2003). The author also visited earthquake-affected parts of Gujarat state of India as mentioned earlier with GERIT (Mistry et al., 2001) under the joint sponsorship of EMI-WSSI. The author has also contributed to two reports on unreinforced masonry and on mud houses to the EERI's World Housing Encyclopedia Project.

2.2 Government Agencies

Disaster Management Bureau (DMB) was established with the help of UNDP and UNICEF in 1993. Although initially it was established to manage flood and cyclone, after the 1997 earthquakes in Chittagong and Sylhet region, Bureau started to train different government officials and volunteers about pre and post-earthquake preparedness and management techniques. For the last couple of years, Bureau conducted fifty or more earthquake training workshops in different regions of Bangladesh. In 2002, it also published a Disaster Management Training Manual. The second part of the manual has a complete chapter on Earthquake Training Module and Public Awareness Guidelines.

The Ministry of Disaster Management & Relief (MDMR) is currently working as the government coordinator for all activities regarding earthquake. Recently, they asked all the concerned ministries, departments and armed forces division to submit Contingency Plan regarding earthquake. The Ministry also compiled a list of available rescue and recovery equipment available in the country. MDMR is currently taking preparation to hold a mock drill in the mid week of December 2003. It will be held in the Dhupkhola field at the old part of Dhaka city, where the current population density exceeds 70,000 per sq. km.

The second phase (2003-2008) of Program for Enhancement of Emergency Response (PEER), a USAID funded international project includes Bangladesh with the existing four other PEER affiliated countries – India, Indonesia, Nepal and Philippines. The program aims to strengthen and institutionalize capacities in emergency and disaster response of the member countries. An MOU in this regard will soon be signed between PEER and Ministry of Disaster Management & Relief (MDMR).

In 2001, Bangladesh Meteorological Department (BMD) initiated a project to establish four broadband seismic stations at Rangpur, Sylhet, Dhaka and Chittagong cities. The author is a member of the technical committee providing support to purchase and install the seismic stations.

Public Works Department (PWD) is responsible for constructing all the government buildings of the country. For the last two years, the Department arranged several in-house workshops to train their engineers about earthquake resistant design. Also the engineers of this organization have started to use seismic codes in designing buildings.

Bangladesh Armed Forces Division (AFD) played a significant role in all past disaster management in the light of the tasks assigned in the "Standing Order on Disaster, 1999" circulated by MDMR. Recently, Bangladesh Armed Forces, in consonance with the national initiative, chalked out a contingency plan for Dhaka city (Rasul, 2003). According to the AFD's contingency plan, the city is divided into eight sectors with predefined tasks after an earthquake. AFD will also activate "Disaster Management and Relief Monitoring Cell" at Prime Minister's Office after an earthquake.

Geological Survey of Bangladesh (GSB) is the oldest organization in the country involved with the development of seismic zonation maps. The organization was instrumental in developing the 1972 and 1979 seismic zonation maps (Choudhury, 1993). But unlike its predecessor the Geological Survey of India (GSI) under the British rule, it did not initiate any research in earthquake field. Currently it depends on USGS and GSI for earthquake source information.

2.3 Bangladesh Earthquake Society

Bangladesh Earthquake Society (BES), a non-government voluntary organization was established on April 2002 and was registered on January 2003. The first election of the society was held on August 2003 and a 12 member executive committee (EC) was elected. The EC members consisted of engineers, geologists, NGO activists and government administrators. The author was elected as the Secretary-General of the Society for 2003-2005 terms.

After the July 2003 Rangamati Earthquake, the author and other members of the Society visited the affected earthquake sites and provided the government with their technical advice. BES also organized two national level workshops and four monthly seminars. The first workshop was jointly organized with RAJUK [Capital Development Authority] on August 21, 2003 to train the engineers of Bangladesh about the earthquake resistant design. The second workshop was organized together with Disaster Management Bureau (DMB), Ministry of Disaster Management and Relief on September 4, 2003 to sum up the findings of 2003 Rangamati Earthquake. Both the workshops put forward a set of recommendations to be implemented either by the government or by the NGOs with the help of donor agencies. The second workshop was the first of its kind where architects, armed forces personnel, engineers, geologists, NGO activists and government officials presented their papers.

In March 2003, an MOU was signed between BES and ICUS, University of Tokyo.

2.4 Non-government Organization

CARE-Bangladesh is involved in the disaster related field of Bangladesh for the last thirty years. But only after the 2001 Gujarat Earthquake, it focused its attention in earthquake disaster. Some recent activities of CARE are: Circulation of pamphlets among the general masses on communities' role before, during and after an earthquake; development of seismic risk scenarios for different cities of Bangladesh; planning to circulate IAEE's manual for the seismic design of non-engineered construction in Bengali; arranging different earthquake sensitization seminars and workshops in different parts of Bangladesh. The author collaborated with CARE in these projects.

Bangladesh Red Crescent Society (BDRCS) also arranged a seminar to discuss their role before, during and after an earthquake in line with MDMR's policy in September 2003.

Similarly some NGOs and societies such as ActionAID, CARITAS, EPRC, FBAST, GJKS, JUUAB, SAFE and SDF organized seminars and workshops on earthquake risk mitigation in different cities of Bangladesh.

2.5 Other organizations

Bangladesh Insurance Academy (BIA) conducted the first workshop on catastrophic risk management in 1998. The second workshop on similar topic was held on November 2003. The author acted as a resource person in both the workshops.

Recently BRAC University together with ADPC, Bangkok organized a two-weeks long workshop on Earthquake Vulnerability Reduction in Cities (EVRC3). The author worked as a resource person at that workshop.

Conscience for Existence, a student organization of BUET under the direct patronization of the author worked at the community level of one of the wards of Dhaka city (Ratan et al., 2003). Recently, the group organized an exhibition to share their experience of the survey carried out in the community level of the old Dhaka.

Department of Civil Engineering, Chittagong University of Engineering & Technology (CUET) established an Earthquake Research Centre in 2001. It started a joint research together with the University of Macedonia, Skopje. Under the agreement faculty members of CUET are regularly trained in Skopje.

Geohazards Research Group (GRG) of the Department of Geology of Dhaka University in cooperation with Lamont-Doherty Earth Laboratory of the University of Columbia, USA installed a broadband seismometer in Dhaka (Khan, 2003) and several GPS devices at some places of Bangladesh recently. The Department also got funding from Ministry of Science & Technology (MOST) to carry out research in the field of earthquake hazard assessment for 2003-2004. Recently, Dhaka University administration has started to assess the vulnerability of their existing buildings and halls to prioritize their retrofitting measures.

Institute of Engineers Bangladesh (IEB) organized several seminars on earthquakes. Currently it is offering some courses on earthquake resistant design together with Engineering Staff College, Bangladesh.

Institute of Diploma Engineers Bangladesh (IDEB) also offered several courses on earthquake vulnerability and seismic design of structures. The author also acted as one of the resource persons at those workshops. Real Estate and Housing Association of Bangladesh (REHAB) also conducted one seminar after the 2001 Bhuj Earthquake.

Department of Civil Engineering, Shahjalal University of Science & Technology (SUST) and the author is currently working to develop seismic microzonation map of Sylhet. In addition, building data survey for particular wards of Sylhet were carried out.

In 2002 UNDP submitted a Comprehensive Disaster Management Program (CDMP) proposal to the forum of donor agencies. It got donor communities approval in early 2003. The sub-program 4 (a)-ii of the PCP contains an urban risk research component on urban earthquakes. The objective is to facilitate an expansion of mitigating programs through initiating studies to obtain an in-depth knowledge about the earthquake threat and related risks in the urban areas recommending mitigation measures for selected cities of Bangladesh.

Some buildings were also retrofitted by private and government organizations. But no systematic process to retrofit vulnerable structures was undertaken by any government organizations.

2.6 Mass media

Mass media such as newspapers and television networks played a vital role during the recent 2003 Rangamati Earthquake. They covered and broadcasted as much information as they could collect from the affected areas of Barkal, a remote hilly town. The journalists followed the different expert teams who visited the earthquake-hit areas and published their findings in the National Dailies and showed live footage in the Television News. Currently, newspapers have taken initiative to regularly publish news of earthquakes and interviews of local earthquake experts and their research activities, which will certainly enhance public awareness level.

3. SUMMARY OF BUET RESEARCH

A brief summary of completed and current research works at the Department of Civil Engineering, BUET are presented.

3.1 Completed research activities

3.1.1 *Development of design spectra*

In this study an effort was made to develop response spectra from simulated earthquakes using different soil parameters (Noor, 1997; Ansary et al., 2000) as Bangladesh lacks strong ground motion data. **Figure 3** presents the developed design spectra for different soil types.

3.1.2 *Seismic hazard assessment*

Recently Sharfuddin (2001) developed a new earthquake catalogue for Bangladesh and the surrounding region. Based on this catalogue and using existing attenuation law, seismic hazard were assessed. Finally an updated seismic zonation map of Bangladesh was proposed as shown in **Figure 4**. This zoning map is based on consistent peak ground acceleration levels with a return period of 200 years.

3.1.3 *Soil-structure interaction*

Iqbal (1999) studied soil-structure interaction effects of tall buildings with mat foundation. Ahmad (1998) studied seismic response analysis of isolated and non-isolated bridges.

Hoque (2002) investigated a soil-structure interaction problem of a simple deck-girder bridge. He studied behavior of an abutment as well as of the total system of a bridge under dynamic loading.

3.1.4 *Magnitude-intensity relationships*

Sabri (2001) investigated magnitude-intensity and intensity-attenuation relationships for earthquakes in Bangladesh using macroseismic data. A selected sample of isoseismal maps from 18 events were revised and used for this study. The regression analysis for the whole data set, which consists of 74 (I_i, D_i) pairs corresponding to 18 events, gives the following mean attenuation expression:

$$I = 8.378 + 1.283(M_S) - 0.0007483(R) - 4.9(\log R) \pm 0.93P \qquad (1)$$

where M_s is the recalculated surface wave magnitude, R is the hypocentral distance that corresponds to the mean epicentral radius $D_i = (R_i^2 - h_o^2)^{1/2}$ of isoseismal I_i in km, and h_o is mean focal depth and P has different values for different probabilities.

3.2 Current research activities

3.2.1 *Community-based activities*

The author with the help of final year undergraduates and graduate students of the Department of Civil Engineering of BUET and SUST undertook field survey in different cities of Bangladesh. The survey data collected different existing building and infrastructure information of different wards of the cities (Ansary and Meguro, 2003). Additionally, students also communicated with the local ward commissioners and inhabitants to find out their earthquake related knowledge and preparedness level. **Figure 5** presents some field-level activities of the students in Ward 64, Dhaka City.

3.2.2 ***Seismic microzonation***

A crucial step towards preparedness for future seismic events and mitigation of seismic risk involves a microzonation study of a city. Also local site conditions and local site effects are the most important factors when an earthquake strikes a human settlement. Keeping this in mind, seismic microzonation maps for Dhaka (Ansary, 2003) and other major cities of Bangladesh are being prepared. For this purpose microtremor observation as well as one-dimensional numerical simulation (SHAKE) has been performed to complement the experimental results. **Figure 6** presents site amplification and liquefaction potential maps of Dhaka. The site amplification map has three zones with the following characteristics: zone 1 with resonant frequency of less than 3 Hz and mean ground motion amplification of 2.5; zone 2 corresponds to resonance frequencies in a band of 3 to 5 Hz having a ground motion amplification of 1.8; zone 3 corresponds to resonance frequency greater than 5 Hz and mean ground motion amplification of 1.8 Hz. The liquefaction map has two zones: a zone with liquefaction possibility and the other with no liquefaction possibility. Similar maps for Chittagong, Mymensingh, Rangpur and Sylhet are under preparation.

3.2.3 ***Seismic risk***

As mentioned earlier that a building inventory was carried out and based on the collected information, seismic risk for scenario earthquakes were estimated for Dhaka (Ansary and Meguro, 2003). **Figure 7** presents thana wise average building damage and cost of damages for an intensity VIII earthquake. Currently building inventory survey of Chittagong, Mymensingh, Rangpur and Sylhet cities are being conducted.

3.2.4 ***Vulnerability assessment of existing structures***

Vulnerability assessment of existing structures using NDT technique is important. So far all the damage scenarios developed for Bangladesh were based on fragility curves proposed by Arya (2000). The researcher of BUET has recently got some fund from University Grant Commission (UGC) to carry out research in this direction.

4. DISASTER MITIGATION IN BANGLADESH

Bangladesh achieved remarkable success in managing frequently occurring hazards such as cyclones and floods. The country has a well-organized Cyclone Preparedness Plan (CPP), which boasts a volunteer list of around 36000. Even country like India and Sri-Lanka try to emulate CPP. To cope with the earthquake disaster a similar Earthquake Preparedness Plan (EPP) need to be implemented.

For earthquake disaster mitigation, professional as well as government solution is required. Architects, engineers, geologists, planners etc. will provide technical aspects and NGOs, mass media and social scientists will provide social aspects of professional solution. Builders, financial institutions, land developer would be required to support professional solution. Government agencies can help to implement professional solution through policymaking and policy enforcement. Government solution should clearly point out regulatory jurisdiction of each organization. For earthquake disaster mitigation following pre and post measures should be undertaken on an urgent basis.

4.1 Awareness and capacity building

- Increase public awareness through education (school children), earthquake drills, interactive website, mass-media, publication, training etc.
- Training of building inspectors, community leaders, construction workers and masons.
- Updating earthquake engineering course curriculum.

4.2 Earthquake engineering research

- Installation of free field accelerographs and seismographs for engineering and seismology studies.
- Seismic hazard assessment based on free field data and source models.
- Vulnerability assessments of structures using structural analysis and nondestructive testing.
- Develop laboratory and testing facilities.
- Development of indigenous and cheap retrofitting measures. Microzonation of urban areas based on different soil effects.
- Updating building code.

4.3 Earthquake resistant construction

- Legal enforcement of building code.
- Proper use of ductile steel and lateral force resisting systems.
- Building insurance to promote earthquake resistant construction.
- Retrofitting critical structures such as schools, hospitals and fire offices.
- Urban and regional planning to mitigate earthquake effects.

4.4 Post-earthquake response

- Develop automatic safety shutdown system for electricity, gas, telephone and water supply system whenever the ground shaking exceeds a certain limit.
- Develop facilities for post earthquake search and rescue operation.
- Local people and organizations most effectively do rescue of victims because they are able to carry this out more quickly than outside agencies. Community based voluntary group should be trained who

can actively participate in rescue operation just after an earthquake disaster.

- Prepare contingency plans.
- Coordination among different interest groups involved in the post earthquake rescue effort.
- Arrangement of emergency medical treatment facilities for injured people.

5. ACTIONS TAKEN AS PER PREVIOUS WSSI WORSHOP RECOMMENDATIONS

The first WSSI Workshop held at Bangkok, Choudhury (1993) proposed a set of recommendations for future. They are:

- Currently at BUET, a PhD research involving seismic risk analysis for some major cities of Bangladesh is undertaken. The research will also develop attenuation law for Bangladesh based on data provided by the strong motion network recently deployed by BUET.
- Estimation of seismic hazard analysis of Bangladesh and surrounding area (Sharfuddin, 2000) based on recently developed earthquake catalogue between 1865-2000. Data completeness was also carried out.
- Magnitude-intensity and intensity attenuation law were developed for Bangladesh and surrounding area (Sabri, 2001).
- Liquefaction potential and site amplification maps for Dhaka (Rashid, 1999) were developed. The author and co-researchers are currently developing similar maps for other cities.
- Reassessment of code reappraisal was carried out (Noor, 1997).
- Disaster Management Bureau, MDMR (2002) already developed and published a training manual for different categories of people of the country. DMB also circulated pamphlets and calendars with simple instructions on do’s and don’ts of earthquake.
- A mock earthquake drill arranged by MDMR, which will be held in early December 2003.
- IAEE published guidelines for non-engineered constructions were translated in to Bengali by the author, which will be soon distributed among engineers by BES under CARE-Bangladesh sponsorship.
- Already seven free-field strong motion stations were deployed by BUET. Dhaka University under a joint collaboration with University of Columbia, USA (Khan, 2003) deployed a broadband seismograph at the Geology Department of Dhaka University. BMD submitted another proposal to the Planning Ministry, which comprises installation of four broadband seismic stations at four cities.

6. GENERAL ACTIONS RECOMMENDED UNDER WSSI

The author for further execution recommends the following actions:

- Community-based volunteer groups for different wards should be formed. These groups should also be trained so that during and after a disaster they function efficiently in search and rescue work, and distribute relief material among the distressed.
- Developing a method for the interaction between BES and WSSI. WSSI should also help BES to get approval from IAEE.
- Organizing national and international workshops in Bangladesh.
- Review and update the existing National Building Code (BNBC, 1993). Circulate a simplified version of the code for the easy understanding for the general mass.
- Earthquake Preparedness Plan (EPP) similar to CPP should be promulgated by MDMR on an urgent basis.

7. SPECIAL FOCUS FOR FUTURE WSSI ACTIVITIES

For Bangladesh, urban earthquake risk is high due to high population density, low awareness, haphazard development, least emergency response and recovery capability of the cities. According to a report published by United Nations IDNDR-RADIUS Initiative, Dhaka and Tehran are the cities with the highest relative earthquake disaster risk (Cardona et al., 1999).

The author would like WSSI to help either NCEE or BES to walk the 'last mile' as suggested by Shah (2003). The author is currently trying to reach the ward people of Dhaka City through his students. Already some community level meeting with local Panchayat Committee was held and some important feedbacks were obtained (Ratan et al. 2003). It was found that the community would like to have expert's advice in awareness drive, self-help solutions, community based retrofitting, disaster management plans, non-structural mitigation etc. Each community/Panchayat meeting with 50 to 60 people would require only USD 300 to hold. If several such meeting (Dhaka has 90 wards, the existing situation of around 30 wards are critical from earthquake point of view) can be held in the old part of Dhaka city with the help of multimedia presentation, the awareness level of the local people would increase tremendously. WSSI can help in this regard. The author is proposing to hold 10-15 such meetings per year in different wards with the assistance of two research assistants (one architect and one civil engineer) who will be involved as full time staff to contact the ward commissioners, investigate local communities' problems related with earthquake vulnerability and preparedness and motivate the ward people to participate in such meetings. A budget of around USD 8000 per year will be required, which includes salary of the research assistants for one year. To start this program an initial investment will be required to buy a laptop computer and a multimedia system.

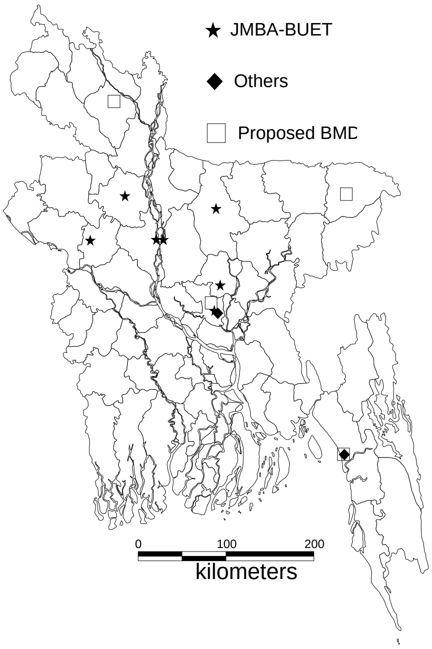


Figure 1: Location of accelerographs in Bangladesh

Figure 2: Jamuna Bridge together with some installed accelerographs and field ETNA

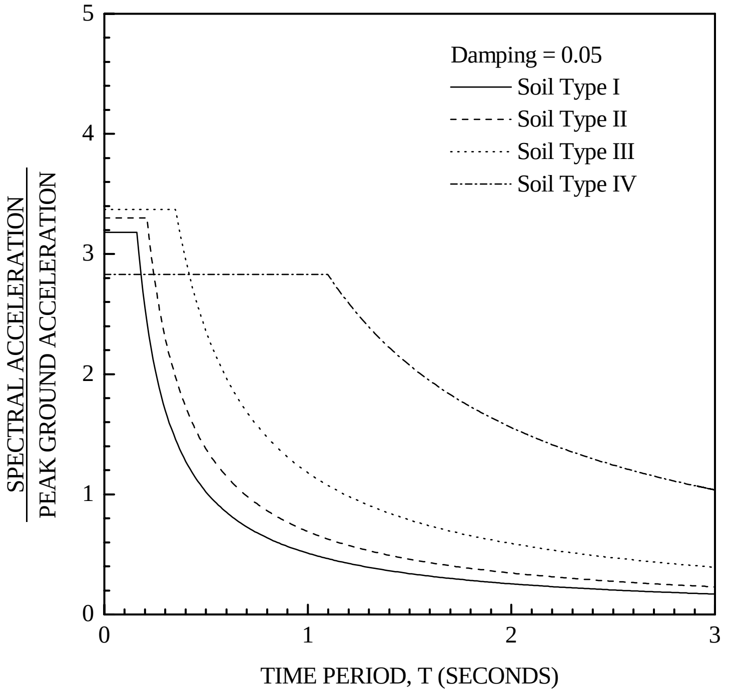


Figure 3: Proposed design response spectra

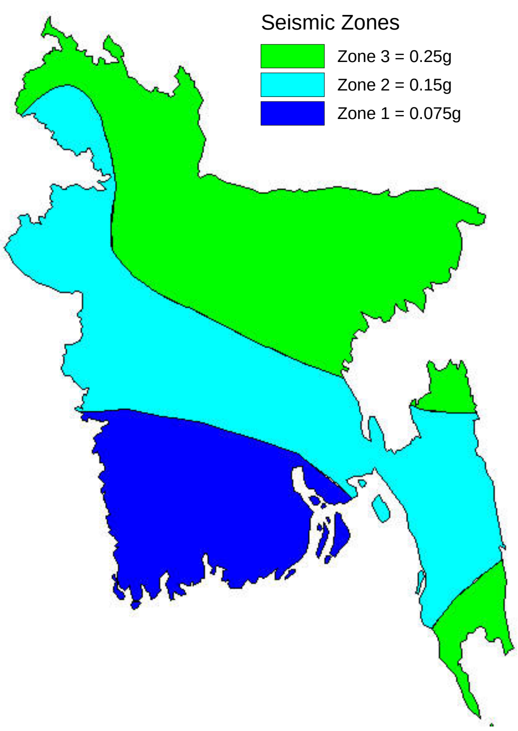


Figure 4: Updated seismic zonation map of Bangladesh

Figure 5: Panchayat level community based meeting at Ward 64, Dhaka

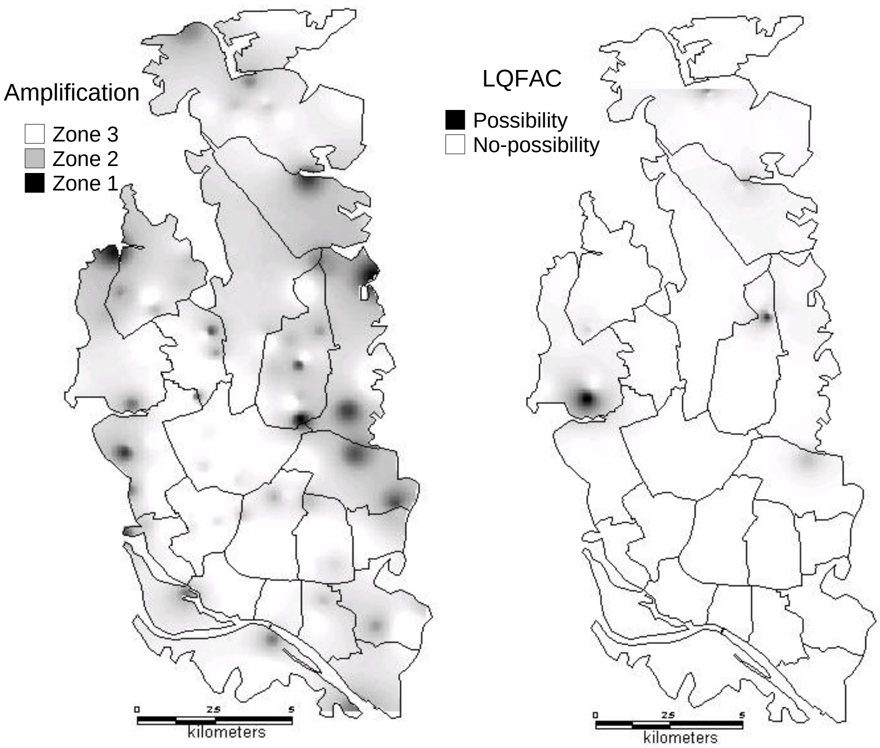


Figure 6: Seismic microzonation maps for Dhaka

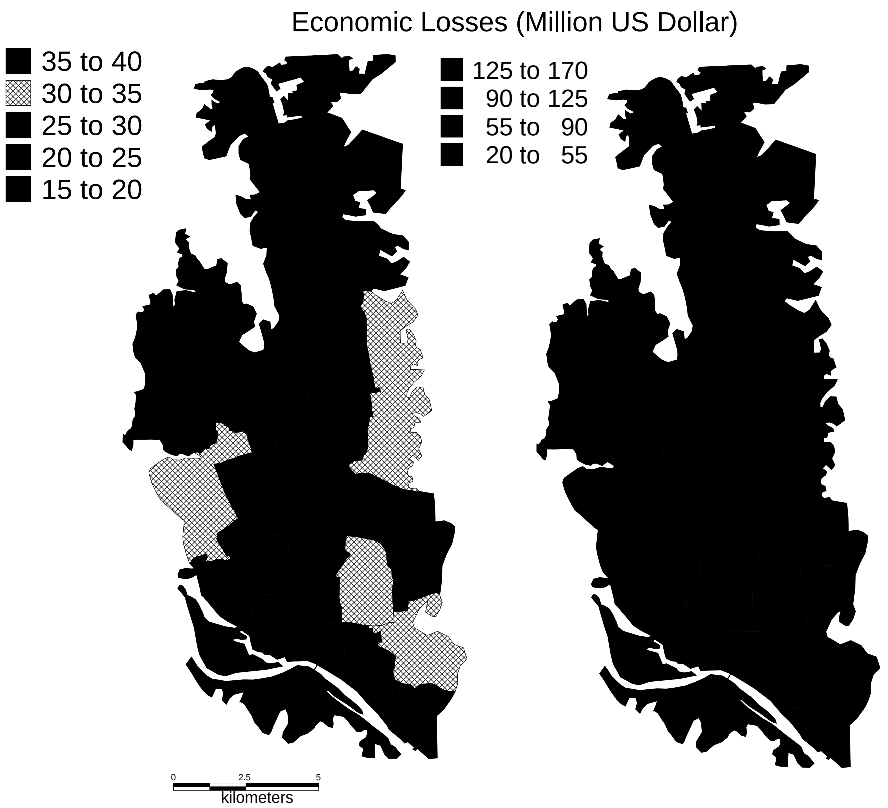


Figure 7: Thanawise average damage and economic losses for intensity VIII earthquake for Dhaka

8. ACKNOWLEDGMENT

The author would like to acknowledge MOST, GoB grant in 1998-1999 and CARE-Bangladesh fund in 2001-2002 through which building inventory data of Dhaka and other cities were collected.

REFERENCES

1. Ahmad, S.I., 1998. Seismic response analysis of isolated and non-isolated bridges, *M.Sc. Engineering Thesis*, Department of Civil Engg., BUET, Dhaka.
2. Ambraseys N.N., 2000. Reappraisal of North-Indian Earthquakes at the Turn of the 20^{th} Century, *Current Science*, 79 (9-10): 1237-1250.
3. Ansary, M.A., Noor, M.A. and Seraj, S.M., 2000. Response spectra based on simulated earthquakes: its application and assessment. *Journal of Civil Engineering*, 28 (1), 1-20.
4. Ansary, M.A., T.M. Al-Hussaini, M. Sharfuddin and J.R. Choudhury, 2001. 1999 Moheskhali Earthquake: A Damage Study, *Journal of Asiatic Society of Bangladesh*, 27 (2), 139-149.

5. Ansary, M.A., 2003. Site amplification study of Dhaka city by using microtremor observation, *CASR Research Project Report*, Department of Civil Engg., BUET, Dhaka.
6. Ansary, M. A., A. Sadek and T.M. Al-Hussaini, 2003. 2003 Rangmati earthquake and engineering assessment. *Proceedings of the seminar on 2003 Rangamati Earthquake*, September, Dhaka.
7. Ansary, M.A. and Meguro, K., 2003. A study on damage scenarios for buildings in Dhaka, Bangladesh, *Natural Hazards* (accepted for publication).
8. Arya, A., 2000. Non-Engineered Construction in Developing countries - An Approach toward earthquake Risk Prediction, *Proc. of 12th World Conference on Earthquake Engineering*, New Zealand No. 2824 (published in CDROM).
9. Bilham, R., V.K. Gaur and P. Molnar, 2001. Himalayan Seismic Hazard, *SCIENCE*, 293.
10. BNBC, 1993. Bangladesh National Building Code, HBRI-BSTI.
11. Cardona, C., R. Davidson and C. Villacis, 1999. Understanding Urban Seismic risk Around the World, *Summary Report on the Comparative Study of the United Nations International Decade for Natural Disaster Reduction*, RADIUS Initiative.
12. Choudhury, J. R., 1993. In Meguro, K and Katayama, T. (editors), Seismicity in Bangladesh, *Proceedings of the WSSI Workshop*, February, Bangkok.
13. DMB 2002. Disaster management training manual, published by Disaster Management Bureau, MDMR.
14. Hoque, M.M., 2002. Analysis of bridge-soil interaction under dynamic loading, *M.Sc. Engineering Thesis*, Department of Civil Engg., BUET, Dhaka.
15. Iqbal, M.A., 1999. Soil-structure interaction effects on tall buildings with mat foundation, *M.Sc. Engineering Thesis*, Department of Civil Engg., BUET, Dhaka.
16. Katayama, T., 2003. Ten years with the world seismic safety initiative, *Regional Development Dialogue*, 24 (1), 107-114.
17. Khan, A.A., 2003. Earthquake scenario of Bangladesh in reference to Kolabunia earthquake of July 27, 2003-vulnerable assessment of megacities, *Proceedings of the seminar on 2003 Rangamati Earthquake*, September, Dhaka.
18. Mistry, R, Dong, W. and Shah, H., 2001. Interdisciplinary observations on the January 2001 Bhuj, Gujarat earthquake, *WSSI-EMI* publication.
19. Noor, M.A., 1997. Reappraisal of code provisions for structures subjected to seismic loading, *M.Sc. Engineering Thesis*, Department of Civil Engg., BUET, Dhaka.
20. Rashid 1999. Seismic microzonation of Dhaka city based on site amplification and liquefaction, *M.Engineering Thesis*, Department of Civil Engg., BUET, Dhaka.
21. Rasul, I. I., 2003. Contingency plan of Bangladesh armed forces for earthquake disaster management in Dhaka city, *Proceedings of the seminar on 2003 Rangamati Earthquake*, September, Dhaka.

22. Ratan, M. A. A., Kashem, M. S. B., Hoque, M. M. and Ansary, M. M., 2003. Participatory community based disaster management: experinces from old Dhaka. *Proceedings of the seminar on 2003 Rangamati Earthquake*, September, Dhaka.
23. Sabri, S. A., 2001. Earthquake-intensity attenuation relationship for Bangladesh and surrounding region, *M. Engg. Thesis*, BUET, Dhaka.
24. Shah, H., 2003. The last mile: earthquake risk mitigation assistance in developing countries, unpublished report.
25. Sharfuddin, M., 2001. Earthquake Hazard Analysis for Bangladesh, *M.Sc. Engg. Thesis*, BUET, Dhaka.
26. Sinha, R. and Goyal, A., 1994. Damage to buildings in Latur earthquake, *Current Science* 67, 380-385.

Dr. Mehedi Ahmed Ansary from Bangladesh

EARTHQUAKE RISK REDUCTION: STATUS REPORT FOR INDIA

S. K. JAIN
Department of Civil Engineering, IIT Kanpur
India

ABSTRACT

India has a huge earthquake problem and has experienced several M>8 earthquakes. Some notable activities towards seismic safety took place in India in the early part of twentieth century. Yet, the country remains highly vulnerable to earthquake disasters. The 2001 Bhuj (Gujarat) earthquake has clearly outlined the vulnerability of modern Indian constructions to strong shaking and this has had a deep impact on the seismic safety agenda of the country. The paper describes some recent developments, both pre- and post-Bhuj earthquake. It also discusses a range of concerns that need to be addressed if the country is make a real progress towards seismic safety. Finally, some suggestions are made for collaborations between India and other developing countries that can be facilitated by the World Seismic Safety Initiative (WSSI).

1. INTRODUCTION

Indian earthquake problem is well known. In his book on Elementary Seismology, Charles Richter devoted an entire chapter entitled “Some Great Indian Earthquakes”. During 1897-1950, four great earthquakes (magnitude exceeding 8.0) occurred in India (Table 1). Fortunately, no earthquakes of M>8.0 have occurred in the country since 1950. Many experts argue that such an earthquake may occur anytime along the Himalayan belt (e.g., Bilham et al. 2001).

Several of the moderate earthquakes (magnitude ~ 6.5) in recent years (Table 1) have occurred in areas of low population density, for instance, the Uttarkashi and the Chamoli earthquakes. The Koyna earthquake of 1967 took place in an area considered aseismic at that time (in zone I of seismic zone map at that time). Similarly, the deadly Latur earthquake of 1993 occurred in area considered stable and placed in the lowest seismic zone.

The casualty figures in Table 1 clearly underline the fact that Indian earthquake preparedness is rather low, and that the country is subjected to unacceptably large seismic risk. Particularly alarming is the fact that numerous multistory buildings constructed in recent years fell like a pack of cards during the Bhuj earthquake of 2001. About 220 km from the epicenter, in the city of Ahmedabad 130 such buildings collapsed killing about 752 persons.

Table 1: Some Notable Earthquakes in India

Date	Event	Time	Magnitude	Max. Intensity	Deaths
16 June 1819	Kutch	11:00	8.3	IX	1,500
12 June 1897	Assam	17:11	8.7	XII	1,500
8 February 1900	Coimbatore	03:11	6.0	VII	Not Known
4 April 1905	Kangra	06:20	8.0	X	19,000
15 January 1934	Bihar-Nepal	14:13	8.3	X	11,000
15 August 1950	Assam	19:31	8.6	XII	1,530
21 July 1956	Anjar	21:02	6.1	IX	115
10 December 1967	Koyna	04:30	6.5	VIII	200
23 March 1970	Bharuch	20:56	5.2	VII	30
21 August 1988	Bihar-Nepal	04:39	6.6	IX	1,004
20 October 1991	Uttarkashi	02:53	6.4	IX	768
30 September 1993	Killari (Latur)	03:53	6.2	VIII	7,928
22 May 1997	Jabalpur	04:22	6.0	VIII	38
29 March 1999	Chamoli	00:35	6.6	VIII	63
26 January 2001	Bhuj	08:46	7.7	X	13,805

2. HISTORICAL DEVELOPMENTS

There have been some remarkable developments in India for more than about one hundred years in the field of earthquake engineering (Jain and Nigam, 2000).

In September 1931, Sardari Lal Kumar, a young railway engineer in his twenties was given a rather challenging assignment by his Chief Engineer. The magnitude 7.4 Mach earthquake of August 27, 1931 near Quetta (Baluchistan: now in Pakistan) caused a shaking intensity of VIII on Rossi-Forrel (RF) Scale and killed about 100 persons. Kumar was instructed to design earthquake resistant quarters for the railway staff in Baluchistan.

Kumar completed his assignment and later presented a very interesting paper in the Punjab Engineering Congress (Kumar, 1933). This paper outlined the concepts of earthquake resistant constructions, provided details of the buildings that he designed and the cost implications thereof. He also suggested the first ever seismic zone map for India, and recommended the seismic factors for different zones and for two different types of buildings. During the 1935 Quetta earthquake (M7.6; intensity upto X on RF scale; about 20,000 dead) in that area, the earthquake-resistant railway quarters located in the area of maximum damage were the only houses that remained undamaged.

The 1935 Quetta earthquake led to massive reconstruction programmes that incorporated design for seismic forces. These programmes were widely acclaimed at that time.

Even before these interesting events in Baluchistan in the thirties, the M8.7 Assam earthquake led to the development of earthquake resistant *Assam Type Houses* in the north-eastern part of India. These houses have stood the test of time, and have proved to be excellent for earthquake performance.

A formal teaching and research programme was initiated at Roorkee in India about forty five years back. The first formal seismic code was developed in 1962 (IS:1893-1962).

3. THE PROBLEM

Despite early gains in earthquake engineering, why has India's progress towards earthquake safety been so dismal? There are several reasons for such a situation including those associated with a typical developing economy: a relatively poor governance at all levels, priority to provide basic amenities such as food, shelter and medical care to a huge population, etc. The issues related to governance are beyond the scope of this paper.

A developing country like India has a very wide range of constructions: dwellings done without any engineering inputs using traditional materials to most modern buildings and nuclear plants. Since the maximum deaths occur in non-engineered dwellings, the issue of non-engineered buildings diverts the attention of the decision makers, administrators, and even science and engineering leaders. This leads to trivialization of the subject wherein the earthquake engineering is reduced to a "non-engineering problem". In fact, the 2001 earthquake was the first instance of an Indian earthquake causing collapses of modern multi-storey buildings since the earlier earthquakes in the past decade had occurred in the rural or semi-urban settings. Prior to the Bhuj earthquake, it was most difficult to argue to the non-specialist decision makers that the country needs to take special steps to ensure compliance of seismic codes.

On one hand, some of the Indian construction and consulting organizations are competing worldwide, on the other hand at local level there has been a general decline of construction quality in the country. With decline of the caste system (wherein son of a mason inherited masonry as his vocation) and lack of proper vocational training, it is now increasingly difficult to find a competent mason to carry out an ordinary job. One must recall that only about a century ago, Indian masonry was world renowned. There is no system for certification of construction trades in India. The country has no system for competence based licensing of engineers.

The efforts and initiatives after the Baluchistan earthquakes in 1930's were led by the professional engineers and not by academics. However, with starting of research and training at Roorkee, the professional engineers in the country started looking at earthquake engineering as a super specialty to be tackled by academics and experts. This is clear from the minimal involvement of professional engineers in the affairs of the Indian Society of Earthquake Technology. Failure to integrate the professional engineers into the earthquake safety agenda has been a major detriment for seismic safety.

For about a quarter century, earthquake engineering was associated only with the Roorkee University in India. Only in the mid-eighties, a few other academic and research institutions started taking serious interest in earthquake engineering. Even now, there are very few *experts* in India in earthquake engineering considering the needs of a large country and the sophistication of earthquake engineering. Lack of adequate number of experts in the country has meant that the opportunity created by the 2001 earthquake could not be fully exploited towards earthquake safety.

Until very recently, no serious efforts were made to include earthquake-resistant constructions into the curricula of civil engineering education (e.g., Murty et al., 1998). In addition, there were inadequate continuing education opportunities in the country for engineers to learn seismic engineering. This has caused a very wide gap in the knowledge of an average civil or structural engineer in India with the state-of-the-practice in earthquake-resistant constructions in the developed countries. For instance, the Indian seismic codes are found wanting in many respects (e.g., Jain, 2002)

4. SCENARIO AFTER 2001 BHUJ EARTHQUAKE

The Latur earthquake of 1993 was the most deadly earthquake in India since independence; but it too had a limited impact on the mindset of the country towards earthquake safety since only rural areas were affected. The large casualties were caused by collapses of rubble stone masonry houses with very heavy roofs, and the earthquake did not carry the message of vulnerability of modern building stock in our urban areas. The earthquake of 2001 has changed the perception of the country. For the first time, TV screens around the country showed in graphic details the vulnerability of typical Indian urban constructions. As a result, impact of this earthquake on the mindset of public as well as policy makers has been enormous.

The experts of earthquake engineering have an inherent handicap in championing the cause of earthquake safety. They stand to gain professional advantages from seismic safety programmes, and hence, their pleadings for safer constructions are not always effective. It is best if the agenda of seismic safety is owned by the policy makers and the experts are simply to provide intellectual inputs. The Bhuj earthquake has made the policy makers concerned about seismic safety and the country is now open to new ideas and initiatives to achieve the same.

Clearly, there are no quick fixes to a problem ignored for half a century, and one has to be patient in implementing changes. And yet, the opportunity created by the Bhuj earthquake cannot be allowed to whither away. This is the time to make quick gains towards earthquake safety before the administrators loose interest with emergence of some other urgent agenda, or get demoralized due to lack of response from the technical community. The technical community must now respond by providing needed inputs in a timely manner. Unfortunately, we have too few experts and too few institutions with expertise in the subject. Despite these handicaps, some remarkable progress has been made in India in the recent years (both pre- and post-Bhuj earthquake) towards seismic safety. These are outlined in the subsequent sections of this paper.

5. SOME RECENT DEVELOPMENTS:

5.1 Latur Project

The Latur earthquake of 1993 was the most deadly earthquake since India's independence. It led to a massive reconstruction programme in the area. The programme is documented elsewhere (EERI, 1999). The earthquake did lead to increase in the awareness levels around the country. As a result of this earthquake, an upgradation of the seismic network was undertaken.

5.2 Gujarat Project

As compared to the Latur earthquake, the devastation in the Gujarat earthquake was spread over a far larger area geographically. Also, while in the Latur earthquake only the rural area was affected, in the 2001 earthquake the devastation was caused in the rural as well as the urban areas. In that sense, the reconstruction issues are far more complex in Gujarat. A massive reconstruction project has been in progress with support from the World Bank, the Asian Development Bank and others. While in the Latur project, the affected persons were provided houses constructed by the government or the NGO's, the Gujarat rehabilitation project is an "owner-driven" project wherein the government only provides financial and technical support.

Besides a comprehensive rehabilitation project, the Gujarat project has several capacity building components. For instance, the curricula of engineering at diploma, degree, and post-graduate programmes in Civil Engineering in the colleges of Gujarat have been modified to include appropriate component of earthquake engineering (Jain and Sheth, 2002), and a large number of faculty members have received training in the subject (Sheth and Jain, 2002). This experience has been very useful to the National Programme on Earthquake Engineering Education (NPEEE) discussed elsewhere in this paper. The state is also working towards voluntary certification of masons, and a compulsory competence-based licensing of structural engineers.

As a part of the capacity building exercise, the Government of Gujarat has commissioned a number of studies: on review of codes and development of commentaries/ handbooks (discussed subsequently in the paper), feasibility study of seismic microzonation, risk and vulnerability assessment, early warning systems, etc. These studies and the other resource materials being developed in Gujarat will be of significant value to other vulnerable regions also.

5.3 Activities of Ministry of Home Affairs (MHA)

Prior to the Bhuj earthquake, the Ministry of Agriculture of the Government of India was responsible for issues connected with natural disasters. After the Bhuj earthquake the portfolio of natural disaster mitigation has been shifted to the Ministry of Home Affairs. Several pro-active steps are being initiated by the Ministry towards earthquake safety which will be visible in the times to come. A National Core Group for Earthquake Disaster Mitigation has been formed by the MHA to advise on various tasks associated with earthquake risk reduction. A National Earthquake Vulnerability Reduction Programme has been launched by MHA together with United Nations Development Programme (UNDP) in 37 cities of the country: these cities have been chosen on the basis of seismic zone (zone III and above) and population (more than 500,000).

5.4 National Programme on Earthquake Engineering Education (NPEEE)

A comprehensive National Programme on Earthquake Engineering Education (NPEEE) has been launched by the Ministry of Human Resource Development of the Government of India. The project envisages eight premier institutes of technology (the seven Indian Institutes of Technology and the Indian Institute of Science Bangalore) to act as resource institutes. The project includes components such as short-term (one- to four-week) and medium-term (one semester) training programmes for faculty members within the country, international exposure to faculty members, development of resource materials and teaching aids, development of library and laboratory resources, and organisation of conferences and workshops. Complete details of the programme are available at the NPEEE web site (www.nicee.org/npeee).

The programme started in April 2003 initially for three years with a budget of about Indian Rupees 137.6 million (about US$ 3 million). The Programme has made considerable progress in less than one year. For instance, (a) About thirteen short courses of one or two week duration each have already been conducted under the programme for faculty members, (b) A group of seventeen faculty members from all over the country have completed a one-semester certificate programme in Earthquake Resistant Design at IIT Kanpur and another group of twenty-two faculty members are currently undergoing a similar training at IIT Roorkee, (c) several workshops have been conducted to develop curriculum, (d) civil engineering curricula at diploma levels in the states of Uttar Pradesh and Uttaranchal have already been modified to incorporate earthquake engineering coverage as a consequence of one of these workshops (Rai and Jain, 2003), and (e)

Professor Bruce Bolt of the University of California at Berkeley (USA) recently visited IIT Kanpur for one month under NPEEE.

5.5 National Information Centre of Earthquake Engineering (NICEE)

The engineering of earthquake-resistant constructions is rather new, and rapid developments are taking place in this subject. The professionals and the academics were finding it difficult to keep up with the latest books, journals, reports, and other materials emanating from other countries considering the high costs. The National Information Centre of Earthquake Engineering (NICEE) was set up at IIT Kanpur to meet needs of the country in terms of "information" on Earthquake Engineering.

Originally, the Centre was conceived as primarily a "library oriented" project. However, with time, its objectives included all activities connected with dissemination of information. An endowment of Rs 5 million (about US$ 110,000) has been raised with the objective that its interest be used for operating expenditure of the Centre.

First proposal for the Centre was developed in late 1997 and first endowment contribution was received in 1999. While the fund raising activity for NICEE was in progress, the activities of NICEE were started in a modest way without making a formal announcement of its formation. Within a few days of the 2001 Bhuj earthquake, the web site of NICEE was launched (www.nicee.org), and NICEE started receiving an enormous response.

The Center is engaged in a variety of interesting projects. For instance,

a) Two major e-conferences have been conducted by NICEE as discussed later in the paper.

b) The Centre has distributed free of cost about one thousand sets of two CDs each on the Bhuj earthquake, originally prepared by the EERI.

c) It has published Hindi translation of the manual on non-engineered construction (IAEE, 1986), which is being distributed free of charge.

d) The Centre has been organizing an annual one-week workshop to help Masters' students in civil engineering from across the country with literature survey for their thesis work. This is aimed at helping the colleges develop a strong research base through students.

5.6 Seismic Codes

Bureau of Indian Standards (BIS) in India is responsible for developing various standards related to wide ranging products and services, including all sectors of civil engineering. The country has a number of seismic codes:

IS:1893-1984 Indian Standard Criteria for Earthquake Resistant Design of Structures

IS:4326-1993 Indian Standard Code of Practice for Earthquake Resistant Design and 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 and Seismic Strengthening of Buildings

Of these, the code IS:1893 is the main code. It was taken up for revision in the early nineties and the revision has not yet been completed. After the Bhuj earthquake, Part I of this code pertaining to buildings has been released [IS1893 (Part 1)-2002]. The other parts related to water tanks, stacks, bridges, dams etc are yet to be revised. Long intervals between code revisions are a matter of serious concern.

As the sophistication in the seismic codes has grown around the world, these have been supported by commentaries and handbooks for effective implementation. Unfortunately, the system of developing explanatory handbooks and commentaries of BIS codes has not been effective for some time now. In view of this, the Government of Gujarat has sponsored a study on review of codes and development of commentaries and explanatory handbooks for the codes on earthquake, wind and fire. The project is being implemented by the Indian Institute of Technology, Kanpur alongwith several other academic institutions. All reports of the project are to be widely disseminated and in fact even the draft reports are being placed on an open web site (www.nicee.org) to enable the interested professionals to give feedback while the documents are being developed.

5.7 Microzonation Projects

The Department of Science and Technology of the Government of India has initiated efforts towards seismic microzonation of a number of cities in the country, including Delhi, Jabalpur, and Guwahati. These are being executed through a number of academic and research institutions. A project on feasibility study for seismic microzonation for cities of Gujarat has been sponsored by the government of Gujarat and is being executed by the Oyo Corporation, Japan.

5.8 Licensing of Engineers

India does not have a system for competence based licensing of structural and other engineers. In recent years, it has been realized that in the WTO regime, country stands to loose significant opportunities without a proper licensing system. Engineering Council of India (ECI) has been formed after the Gujarat earthquake as an umbrella organization of a number of professional bodies. ECI is aiming to develop a comprehensive licensing system for different disciplines of engineering. Some feel that the ECI efforts are being spread too thin since they are taking up all disciplines of engineering (civil, electrical, aerospace, …) simulataneously. Clearly, needs for licensing are much more severe in a discipline like civil or structural engineering as compared to that in say aerospace engineering. More recently, the All India Council for Technical Education (AICTE) has made its intentions known to initiate licensing of engineers. AICTE is primarily charged with regulating the technical education sector and it is not clear if they are the right body for licensing of engineers.

5.9 WSSI Workshop in Mumbai

In December 2002, the World Seismic Safety Initiative (WSSI) organized a two-day International Workshop in Mumbai on theme “Professional Issues for Earthquake Safety of Built Environment”. More than seventy engineers and others interested on the topic debated the issues connected with earthquake safety. It was felt that there is an urgent need for regulation of the profession of structural engineering through competence based licensing. A Blue Ribbon Group was formed to pursue the agenda of licensing of engineers. However, more than just formation of this group, the workshop created an excellent opportunity for structural engineers and other stake-holders in construction industry to sit across the table and discuss issues of common concern.

5.10 E-Conferences and Structural Engineers Forum of India (SEFI)

To commemorate the first anniversary of the Bhuj earthquake, a two-week e-conference was organized in January 2002 on “Indian Seismic Codes”. About 1,200 persons participated; about 100 persons from about ten countries made about 300 postings during the two weeks. The conference proceedings were provided on the web site of NICEE and a summary published in a leading Indian journal (Rai and Sheth, 2002). The conference helped clarify many issues of concern to the participants, and also identified many important changes needed in the current Indian seismic codes.

Encouraged with the success of the above, in August 2002 another e-conference was organized by NICEE of one-week duration on the topic “Professional Issues in Structural Engineering in India”. This conference also received an enormous response. Out of about 1,600 members on the conference, about 130 members from a dozen countries wrote messages. A great wealth of information on professional issues in structural engineering in India was generated (Jain and Sheth, 2003).

With the above two e-conferences, a need became clear for a platform wherein the structural engineers (and others) can communicate and share ideas. To help develop leadership in the country, NICEE decided to not undertake this activity directly, but helped put together a group of engineers who established an electronic forum “Structrual Engineers Forum of India” (SEFI) through voluntary contributions (www.sefindia.org). The web site is receiving enormous response; it now has more than 650 subscribers and there is a continuous exchange of ideas through the discussion forum. The SEFI has also hosted a number of e-conferences since it formation in January 2003.

5.11 Training of Professional Engineers

An enormously successful training programme on seismic design of reinforced concrete buildings has been conducted by the author alongwith Professor C V R Murty of IIT Kanpur for professionals for more than ten years in a number of locations in India and in Nepal and Bhutan. Typical duration of this programme is five days, even though some programmes of different duration and on different topic have also been conducted. Most of these courses are the self-supporting type, wherein the entire costs are met by the registration fee charged to the participants.

Since 1992, about 2,000 engineers have been trained through these continuing education courses. In numerous instances, some of the participants have subsequently explained how the course has helped them improve their design and construction practices. It was heartening for the authors to see in the small town of Imphal (near border with Myanmar; in highest seismic zone V) several buildings under construction with correct seismic detailing of reinforcement as a result of the efforts of course participants.

5.12 Low-Cost Books

The author believes that the most cost effective means to achieve seismic safety in the developing countries is to make the latest literature, books and other information available at reasonable cost. In view of the unfavourable exchange rates, the students and professionals find the standard text books published in the developed countries as too expensive. In recent times, Indian editions have been published for several books on earthquake engineering, and are available at a fraction of the cost of what these books will cost if imported.

5.13 School Curriculum

Recently, the Central Board of Secondary Education (CBSE) has introduced the subject of disasters in class VIII, and a text book has been published.

5.14 Uttaranchal Capacity Building Project

A capacity building project has been completed by the Asian Disaster Preparedness Centre (ADPC), Bangkok for the state of Uttaranchal for seismic risk reduction with funds from the Asian Development Bank (ADB). Dissemination of reports and other resource materials of the project may be useful for other vulnerable regions.

5.15 Project of GeoHazards International

The GeoHazards International (GHI) have been engaged in a project in India with funding from the USAID. The project aims at risk reduction in urban centres.

5.16 Earthquake Tips

The project "IITK-BMTPC Series on Earthquake Tips" was started in early 2002. Indian Institute of Technology Kanpur (IITK) with sponsorship of the Building Materials and Technology Promotion Council (BMTPC), New Delhi (in the Ministry of Urban Development, Government of India) took up this project to widely disseminate the basic concepts of earthquake resistant constructions through simple language. The project consists of developing twenty-four (24) Earthquake Tips on two A-4 size pages of written material with graphics. The Tips cover topics such as basic introduction to earthquakes and terminology such as magnitude and intensity, concepts of earthquake resistant design, and aspects of aseismic design and construction of buildings.

A large number of journals of architecture, construction and structural engineering, and many prestigious newspapers are publishing these Tips. The Tips are also serving as resource materials in colleges and for professional engineers.

6. ROAD AHEAD AND CONCERNS

Clearly, a lot is happening in India, but a discussion of this kind will be incomplete without a mention of a few areas of concern.

a) After the Bhuj earthquake, many states and cities have made the compliance of seismic codes mandatory. However, there are no mechanisms in place to enforce this compliance. It is not enough to depend on the "written undertaking" by the structural engineers that the codes have been complied with. This is similar to the issue of seat belts in the automobiles; just making the seat belts mandatory does not work until it is backed up with enforcement through fines for those not wearing the seat belts.

b) The Bhuj earthquake very graphically showed that all is not well with the state of structural engineering practice in India, and a system of competence-based licensing is the first pre-requisite to set this situation right. Unfortunately, not much progress is being made in this direction.

c) There is a lack of depth in the system with respect to issues on seismic safety and many rather simplistic solutions are often suggested for this complex problem. It also leads to unrealistic expectations and goals, for example, “I will like to see all the hospitals retrofitted in the next five years”. There is a need for the public policy experts to learn from the experiences of other countries towards seismic risk reduction and then adapt those to Indian conditions.

d) When discussing seismic safety, there is too much emphasis on “retrofitting” as compared to ensuring code compliance of new constructions. A huge stock of unsafe buildings is being added every day which will be candidates for retrofitting tomorrow. Clearly, the first focus should be on putting in place a system for code compliance of new constructions. Thereafter, a systematic and well-debated approach to retrofitting should be adopted.

e) While significant expenditure is being incurred in seismic instrumentation and seismic microzonation, not enough attention is being paid to research in earthquake engineering. For instance, the country needs to develop expertise on seismic retrofitting considering local construction types and local materials, a lot of work is needed on seismic hazard analysis, and a probabilistic seismic zone map is yet to be developed.

f) The lack of progress on revision of Indian seismic codes is a matter of serious concern. It not only means that the country does not have updated codes, but also indicates that there are no pressures whatsoever on the system for good codes.

g) While significant activity towards faculty development in earthquake engineering has been initiated under the NPEEE, it is important to engage the faculty thus trained in the area of earthquake engineering through research or outreach projects. Else, after extensive training the faculty will return back to their old routine in their respective colleges and the opportunity created by their training will not be fully utilized by the country. A programme on research and outreach in earthquake engineering is therefore urgently needed.

h) Before the Bhuj earthquake, the issue of seismic safety was being championed by a few academics. After the earthquake, many administrators too are concerned and are championing the cause which is most encouraging. However, the engineering profession as a whole is still not involved in this crucial task; this refers both to government engineering departments as well as to the engineering societies and associations. Since earthquake is primarily an “engineering” problem, unless the professionals take the leadership role and own the problem, the issue cannot be adequately addressed.

7. CONCLUDING REMARKS

The above discussion may have a lot of commonality with other developing countries, and intent of a frank discussion on various issues has been that these experiences may be of value elsewhere. It will be mutually beneficial for other developing countries to collaborate with India and WSSI can play an important role in this. Some possibilities are:

a) It should be possible for the NPEEE training programmes for engineering faculty to include some faculty from other developing countries.

b) The NICEE can be a good model for other developing countries to follow for setting up an information dissemination system. Moreover, significant cost savings may be achieved by collaborating with NICEE.

c) The resource materials being developed can be adapted in other countries.

d) There is scope for exchange programmes for academics and professionals can be very effective.

REFERENCES

1. Bilham, R., Gaur, V.K., and Molnar, P., 2001. "Himalayan Seismic Hazard. *Science*, 293, 1442-1444.
2. EERI, 1999. *Innovative Earthquake Recovery in India.* Lessons Learned Over Time, Learning From Earthquake Series, Vol. II, Earthquake Engineering Research Institute, USA, 95p.
3. IAEE, 1986, *Guidelines for Earthquake Resistant Non-Engineered Construction*. International Association for Earthquake Engineering, Tokyo, Japan, 158p.
4. Jain, S. K., 2002. Codes, Licensing and Education. *2001 Bhuj, India Earthquake Reconnaissance Report*, (eds. S K Jain, W R Lettis, C V R Murty, and J P Bardet), *Earthquake Spectra*, supplement A to volume 18. Oakland, CA: Earthquake Engineering Research Institute, 319 – 339.
5. Jain, S. K. and Nigam, N. C., 2000. Historical Developments and Current Status of Earthquake Engineering in India. *Proceedings of the Twelfth World Conference on Earthquake Engineering*, Auckland, New Zealand, Paper No. 1792.
6. Jain, S. K. and Sheth, A., 2002. Earthquake Engineering in the Civil Engineering Curricula. *The Indian Concrete Journal*, 76, 558-562.

7. Jain S K and Sheth A, 2003. e-Conference on Professional Issues in Structural Engineering in India. *The Indian Concrete Journal,* 77, 893-896.
8. Kumar, S.L., 1933. Theory of Earthquake Resisting Design With a Note on Earthquake Resisting Construction in Baluchistan. Paper No. 165*, Punjab Engineering Congress,* pp154-189.
9. Murty, C. V. R., Sinha, R., and Jain, S. K., 1998. A Report on Earthquake Resistant Construction in Civil Engineering Curriculum. *Newsletter of the Indian Society of Earthquake Technology,* 1 - 10.
10. Rai, D.C. and Jain, S. K., 2003. *A Report on the Workshop on Earthquake Engineering Curriculum for UP Polytechnics*, 29-30 July 2003 at IIT Kanpur. *(Available at http://www.nicee.org/npeee/UPPolyWS.htm)*
11. Rai, D.C., and Sheth, A.R., 2002. e-Conference on Indian Seismic Codes, *The Indian Concrete Journal,* 76, 376-378.
12. Sheth, A., and Jain, S. K. 2002. Training of Teachers for Capacity Building Towards Earthquake Safety in India. *The Indian Concrete Journal,* 76, 629-632.

Prof. S. K. Jain from India

THE CONSEQUENCES OF EARTHQUAKE "LUGOVAYA" IN ZHAMBYL REGION OF THE REPUBLIC OF KAZAKHSTAN

M. NURAHMET
Kazakh State Research and Experimental Design Institute on Earthquake Engineering and Architecture (KazNIISSA)
Kazakhstan

ABSTRACT

This report includes a brief description of the last earthquake struck on May 23, 2003 in the southern part of Kazakhstan. Detailed information on the consequences of the earthquake: size of destruction, procedure of works on elimination of the earthquake consequence, methods of retrofiting of structures are mentioned in the report. The article talks about the work and activities of KazNIISSA in the area of elimination of earthquake consequences in respect to the current site development.

1. INTRODUCTION

The south and south-east territory of Kazakhstan is one of the most active seismic zones of the Central Asian seismic region. The last strong earthquake occured on May 23, 2003, in the southern part of the Republic of Kazakhstan, 400 km from Almaty City and 100 km from Taraz City, with the epicenter at the station Lugovaya. According to information from the engineering seismic station "Almaty" the magnitude of "Lugovskoye" earthquake was 5,4 by the Richter scale, the depth of source (according to different appraisals) was 4-8 km. The earthquake intensity at the epicenter was 7-8 points by the scale MSK-64. The aftershocks with an intensity of 3 points repeated every day for the next 3 months.

2. THE CONSEQUENCE OF EARTHQUAKE ON 23.05.2003 AT THE STATION LUGOVAYA IN ZHAMBYL REGION OF THE REPUBLIC OF KAZAKHSTAN

The earthquake caused considerable damages within the territory of more than 500 km² destroying about 8600 buildings. The area that suffered from earthquake to a great extent there were seven settlements where around 30 thousand people lived. As a result of earthquake 3 men died, 26 – were wounded and 20820 people were left homeless. The dead children were of the school and preschool age. The economic damage caused by the earthquake exceeded USD 120 million.

The instrumental data on ground oscillations at the epicenter was not received, that is why the intensity of earthquake was estimated on the basis of the seismic scale MSK-64 descriptive part. Main results of the macro-seismic research are given in the table below.

№	Settlement name	Earthquake intensity (magnitude)
1	station Lugovaya	7-8
2	village Abai	7
3	village Kyzyl-Sharua	7
4	village Kulan	6-7
5	village Kara-Kystak	6-7
6	village Zhalpaksaz	6-7
7	village Ak-Bulak	6
Note. *The table includes the information on the settlements where the earthquake magnitude was not less than 6 points of the Richter scale.*		

The special commissions which included specialists from the Republic were called for reconstruction of the buildings that had been damaged due to the earthquake. The commission's tasks were to take final decisions on determination of recovery work, volume and methods of damaged building's reconstruction, to give recommendations to the developers on the projects being developed by them and approval of such projects, as well as approval of decisions on pulling down of buildings and structures.

To take decisions upon operative inspection development of the district site that were damaged was carried out beforehand.

The general management of survey and project works was provided by the Head Kazakh State Research and Experimental Design Institute on Earthquake Engineering and Architecture (KazNIISSA).

The appropriate card (conclusion) containing the main data on the building constructive solutions, information on existing damages and recommendations on reconstruction and pulling down was prepared for each examined building. In addition, the cards with the reports on buildings examination/inspection were prepared. In addition to constructive solutions and damages, these reports contained the justification for necessity of pulling down, reconstruction with retrofiting of buildings and major overhaul of buildings.

As a rule, hospitals and schools, some office buildings and also boiler-houses that had to start their operation at the beginning of the heating season were included in the list of especially important establishments to be immediately reconstructed and retrofitted.

The examination of the site development showed that in spite of the fact that there were appropriate normative directory documents the overwhelming majority of buildings within the earthquake zone, except large-panel and brick buildings, had been built without any antiseismic measures. Most of office buildings and schools that had been built 20-30 years ago had some antiseismic measures. The plans of those buildings had been developed for areas with seismicity of 8 and 9 points with due consideration for the requirements of the normative documents effective at the design time (Seismic Code II-A 12-69 and Seismic Code II-7-81 «Building in seismic regions»). But construction itself was carried out with poor quality building materials and with deviations from design project.

As a result of the earthquake almost all individual residential buildings with walls of adobe brick, breeze block and brick that were in zones of seismic load with intensity of 7 and 8 points had damages of the second and third degrees and some buildings (those of adobe brick) had damages of the fourth degree.

The earthquake which occured on May 23, 2003 occurred to a large extent at the territory of the station Lugovaya where 9594 people lived and where its intensity varied from 7 to 8 points by the Richter scale.

Adverse (in seismic respect) engineering-geological conditions influenced the intensity of the earthquake at the station Lugovaya to a large extent. The clay loams with evident slump properties and high level of subterranean waters (up to 0,5 m from ground surface) predominate in the subfoundations. Some parts are waterlogged.

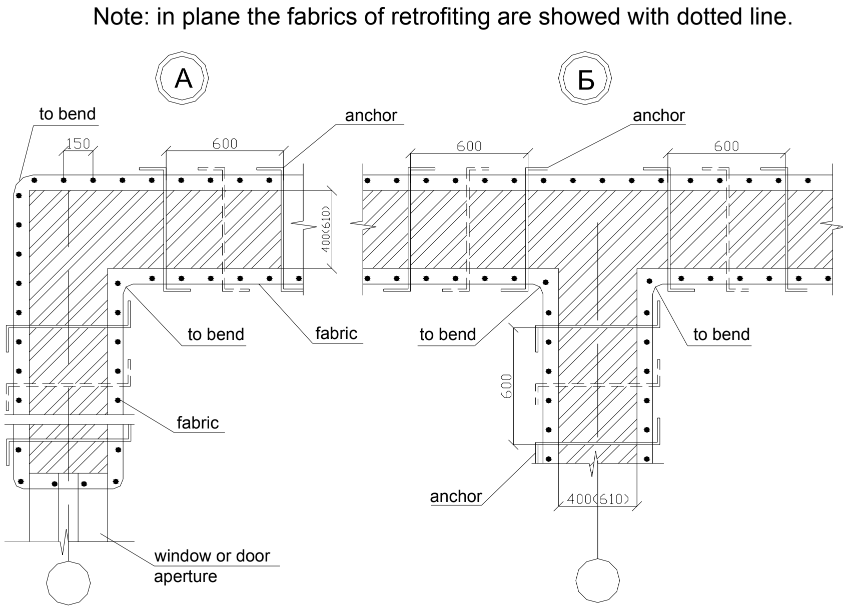
One-storey buildings with load-bearing walls of adobe-brickwork (1486 houses) and of brickwork (820 houses) out of 2450 constructions predominate in the site development of the station Lugovaya. The small group consists of two- and three-storey buildings with load-bearing walls of brickwork and also with the walls of wooden sleeper.

After the earthquake almost all the houses with adobe-brickwork had damages of second degree. About 50% of those houses had damages of the second and third degrees and some houses had damages of the fourth and fifth degrees (utter breaking-down). Caving of walls and their parts, rupture of wall matings with formation of through-wall vertical and inclined cracks, deformations in the load-bearing wooden constructions of the coatings are typical for the houses of adobe brick.

One-storey houses with the load-bearing walls of brickwork were damaged to a lesser degree but damages mainly of the second and third degrees (75% out of their total quantity) are also predominate in this group. There are cracks in the junctures between reinforced concrete slabs of coatings, vertical and inclined through-wall cracks in the load-bearing brick walls in those houses.

In the process of elimination of the earthquake consequences by the building organizations of the Republic of Kazakhstan, it was necessary to construct and retrofit about 8600 residential buildings all over again. Within the period of two weeks the Institute KazNIISSA developed the methods of retrofiting. The mass retrofiting of the buildings of adobe brick (more than 2000) was carried out in our practice for the first time. The experimental estimate of the parameters of free vibrations of the damaged buildings before and after retrofiting was carried out which showed sufficiently high effectiveness of the retrofiting methods. Thus the period of the examined buildings were 0.15 seconds before retrofiting, and 0.04 seconds after retrofiting. This implies that the stiffness of house constructions after retrofiting increases about 16 times more.

The retrofitting of houses of adobe brick was carried out with the help of the vertical reinforcing fabrics that were placed on each side of the walls in the layer of high-strength mortar of thickness not less than 4 cm from each side (see picture 1). The foundations of the houses were built of rubble stone which was also put to retrofitting (see picture 2).



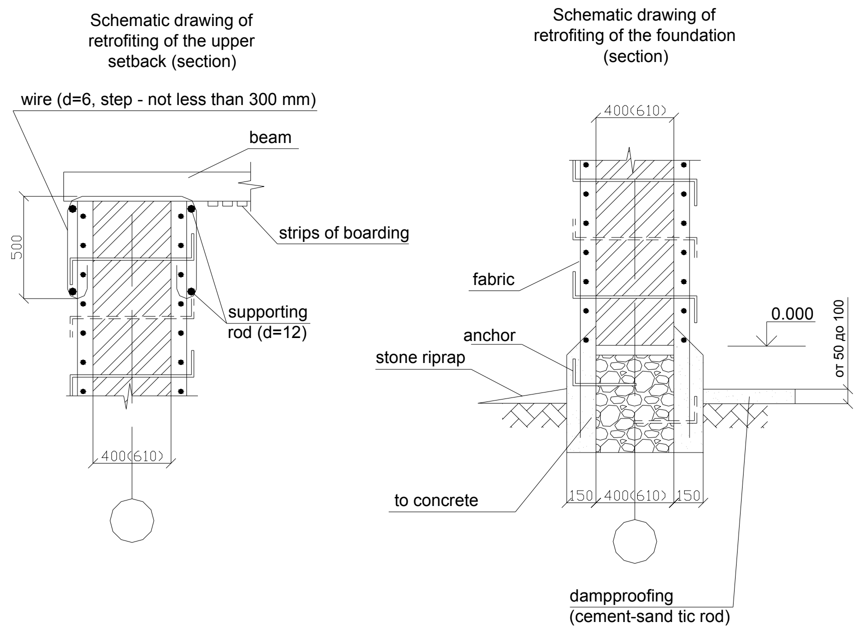
Picture 1: Retrofiting of walls of adobe brick house by the reinforcing fabrics in layer of high-strength mortar.

Construction retrofitting of living houses were conducted under supervision by the Institute KazNIISSA in cooperation with local administration. In the process of construction the bond resistance of laying on unbound junctures that stood not less than seven days was examined selectively in the houses being rebuilt with the load-bearing walls of brickwork. The houses where the bond resistance of laying was lower than the normative one were additionally retrofitted by two-sided fabric in the layer of high-strength mortar.

The schoolhouses that were exposed to seismic loads with intensity of 6-8 points also were seriously damaged. Out of fifteen buildings of secondary schools:

- three schools where the antiseismic measures were not carried out were pulled down; by the first of September four new schools were built in their place;

- twelve schools had to be retrofiting in spite of some antiseismic measures. All those schools were commissioned by the beginning of the school year.



Picture 2: Retrofiting of walls and foundation of adobe brick house.

The main reasons for schoolhouse's damages were not intensity of seismic loads but the bad quality of their construction and deviations from plan.

Due to the fact that the earthquake at the station Lugovaya occurred at night there were no dead or wounded children in the schoolhouses, but general estimate of seismic resistance of buildings of rural schools which is a cause for concern.

Magnitude of the earthquake at the station Lugovaya was comparatively moderate but negative social and material consequences are highly evident. Similar consequence of the earthquake with moderate magnitude in the countryside are also well known from experience of the CIS countries (Uzbekistan, Tajikistan and others) and far foreign countries.

Buildings of countryside in the Central Asia are mainly represented by the houses built from local ground materials (loam, adobe brick and others) the site development. Cheapness and quickness of building of houses from such materials predetermine their mass character. It is evident that houses with the load-bearing walls of adobe brick must not be built in seismic regions and the earthquake at the station Lugovaya proved this again.

The earthquake of 7 and more points can result in more tragic consequences. The houses with walls of adobe brick are especially dangerous. Pulling down of such houses and building of the earthquake-proof ones will involve great costs. It is reasonable to retrofite the houses of this construction what we can see by the example of the earthquake at the station Lugovaya. Economic analysis shows that building of a new house meeting the standards requirements will cost about $20 000 and the retrofiting of the damaged houses will cost $5000. Moreover the retrofiting of houses considerably reduces the time of building commissioning.

It seems the normative documents regulating the construction in seismic regions are required to differentiate the approaches to designing of objects of urban and rural site development. Moreover it is reasonable to raise the requirements of the buildings where maintenance is connected with a long-time presence such as schools, kindergartens, child institutions of public health service. In particular the height of the said buildings is recommended to be not more than of 2 stories, and the calculated seismic load should have the increasing coefficient of not less than 1.3-1.5.

Currently the KazNIISSA experience in retrofiting and reconstruction of buildings damaged by severe earthquakes is being improved and widely used in the process of development of projects on retrofiting of the present site development buildings. In particular the KazRIEBA has recently developed a number of projects on retrofiting the standard schoolhouses and kindergartens where framework do not have any crossbars. The projects are developed with due consideration for the necessity of constructing the hard disks in ceilings and retrofiting of supporting construction units of ribbed reinforced concrete slabs of ceilings. Reaction to the seismic load by the connecting diaphragms of different structures and configurations is provided by the projects. Some projects of this series have been implemented in practice.

When developing the projects on retrofiting of skeleton-type buildings the diaphragms of monolithic reinforced concrete (sometimes connecting diaphragms of steel rolling sections) are usually used for reaction to the seismic loads. Methods of analysis of such buildings are improved simultaneously with development of the projects on retrofiting.

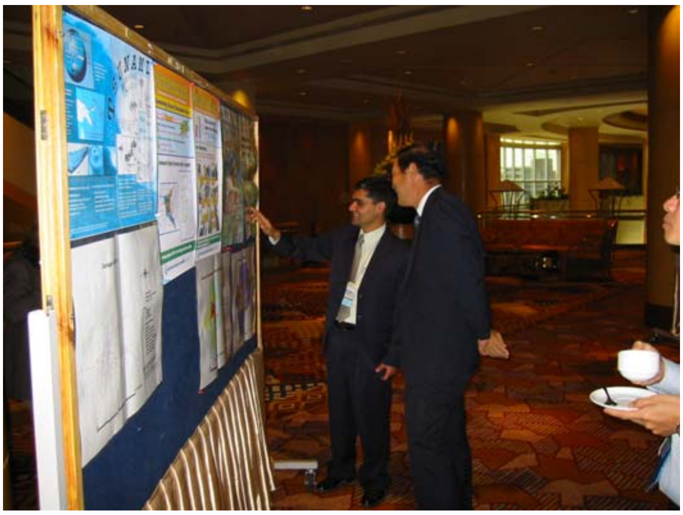
During reconstruction with retrofiting of buildings with brick load-bearing walls special attention is focused on retrofiting of ceilings, especially in the cases when the latter are made of wooden beams. As a rule the brick walls are retrofitted with reinforced fabrics in the layer of high-strength gunned mortar. Sometimes the new ceilings of monolithic reinforced concrete are made in buildings with ceilings of wooden beams.

The global experience shows that the task of ensuring absolute seismic security of population residing at seismic territories are still far from final solution. However, the system of main building regulations allowing to substantially alleviate the earthquake consequence and to increase security of the most vulnerable part of the society (children) has developed in full. These rules and regulations, based on experience of earthquakes in the past and results of special researches, are generalized in appropriate normative documents which are the main instruments of practice carrying out of the State policy aimed at reducing of buildings and constructions vulnerability to earthquakes. Analysis of earthquake consequence indicates that observance of requirements of the normative documents during designing and construction of buildings, irrespective of intensity of seismic loads and their specific properties allows to reduce considerably the destruction size.

Mr. Makish Nurahmet from Kazakhastan

Glimpses from the Workshop…

Posters from participants on display…



THE SEISMIC RISK REDUCTION ACTIVITIES IN MONGOLIA

S. DEMBEREL
The Research Center of Astronomy and Geophysics of the Mongolian
Mongolia

ABSTRACT

The paper begins with brief information of Mongolia and a history of seismic observations at Mongolia. The organizational chart of the Research Center of Astronomy and Geophysics of the Mongolian Academy of Sciences, with it's the research directions, national and international research involvement, the project of Seismology are presented. The national network for seismic observations of the territory is described. The tectonic background, seismicity, important earthquakes in the past and the micro zonation of capital city Ulaanbaatar are discussed. Organizations and activities relevant to earthquake disaster mitigation are presented.

1. INTRODUCTION

1.1 Brief country information

Mongolia, with a vast but sparsely populated territory, is land-locked country of 1,564,100 km^2 located in central Asia (Figure 1). It stretches about 2,400 km from west to east and about 1,260 km from north to south and bounded on the north by Russia and on the southeast and west by China. The total length of the country's boundary line is 8,158 km. Mongolian territory is three times bigger than Thailand's. Mongolia is mountainous country with an average altitude of 1,580 meters above the sea level. The lowest point Khokh-nuur in the east is 552 meters above sea level and the highest point is the mountain Nairamdal in the Mongolian Altai (in the west) which stands at 4,374 meters. The geography of the country is characterized by great diversity. From north to south it can be divided into 4 areas, mountain-forest steppe, mountain steppe, semi-desert and the desert. In the west- north the mountain ranges and ridges are overgrown with wild forests, big lakes and tempestuous rivers. The vast grasslands of the Asian steppe stretch across the eastern part of the country. The Gobi Desert lies in the south occupying somewhat less than one-third of the Gobi Region, the rest being semi-desert grassland. The typical landscape, a nature-lover's paradise, is an undulating steppe land providing fine pastures. The population of Mongolia is at present 2,475,400 people. It is almost 26 time less than Thailand citizens. The present yearly rate of population growth is estimated as 2.8 per cent. Much of the population growth of Mongolia has been absorbed in urban areas. The present urban population is above one million, Ulaanbaatar having 846,500 inhabitants-one third of the total population of Mongolia. However, a significant part of the urban

Figure 1: The map of Mongolia

population still live in ger habitations on the town peripheries. While the average population density of Mongolia is just over 1,6 person per sq. km, the population density of South Gobi Province is only 0.3 per sq. km.

1.2 The Research Center of Astronomy and Geophysics (RCAG) of the Mongolian Academy of Sciences (MAS)

The Center of Astronomy and Geophysics has determined its mission and objectives and are carrying out its activities within the present framework of organizational structure since 1997. The foundation for research work in astronomy and geophysics was established in 1957 –the International Year of Geophysics. The Center is conducting basic research activities in the basic four fields (sectors) of astrophysics, astrometry, seismology and geomagnetic investigation, within the directions of astronomy and geophysics. Each sector has its own development history, main directions of research work, results, future trends based on their own specifics, research equipments, working experience and database, it has been continuously carrying out its activities since 1960s. The center has contributed to basic world science, and has comparative advantages in terms of professional staff resources and locality.

Internal Organizational Structure:

Mission of the Center is: "Contribute to the world scientific information fund by the results from theoretical and practical work of research based on ancient fundamental science; strengthen the priority position in specific directions of the astronomic and geophysical academic research in Mongolia; become a resource for new knowledge and information of astronomic and geophysical research in Mongolian society; create an enabling environment for continuous development of the institution and its staff".

A flexible organizational structure was chosen based on this mission and daily activities are undertaken. Organizational structure of the institution is shown in Figure 2.

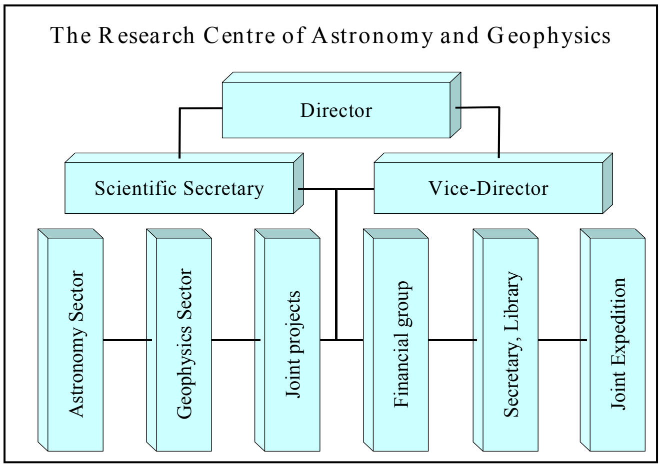


Figure 2: Scheme of Organizational Structure of the Center

<u>The main directions of seismic investigation:</u>

- Installing and operating the seismic networks for investigation of the earthquake characteristics.
- Investigation to seismic wave propagation in earth deep and surface by a seismological survey.
- The investigation to determined mainshock fault size, source strength and time to exceed with geodynamics process by the seismological survey.
- Earthquake engineering research for the seismic hazard mapping
- Verification of the nuclear experiment and operating seismic array networks
- NDC (National Data Center) of CTBTO.

<u>The main results:</u>

- The determined dynamic and kinematics parameters that are arrival time (To), epicenter distance (Δ, km), depth hypocenter (φ,λ), magnitude (M), energy class (K) interpreted the seismic network data. From these results are produced yearly a catalogue of seismic data and a bulletin to exchange the seismic data with International Seismological Organizations.
- We have taken the above materials and made "Mongolian seismic microzoning map" (M1: 2500000) with the investigation results of strong earthquake mechanism, activity, regional seismic regime and seismicity of Mongolia by the seismic propagation strength, time and space. We have also evaluated 75% of Mongolian territory with intensity 7 and more than 7 scale (MSK-64) probability.

- The century's strong earthquakes and the reasons for tectonic activities are a collision of India and Asian plates, so has exceed with tectonic force feature and deep structure of results of a big fault. We have been a hypothesis that it was young in case geodynamics processing. We have determined a mantle thickness and a crust by seismic wave velocity and reduced quantitative change. From the above, conclusion are drawn that a crust thickness is over than lithosphere thickness of under mountain region.
- We have resolved that the seismic specter is distributed through different kind of soil conditions to give a seismic force with disparity intensity 1-2 scale by the complete engineer-seismological investigation, which have determined the evaluation of strong mainshock hazard (risk) on the urban city, that is located on the seismic activity region.

Future feature:
- We are planning to transform the seismic stations from analogical on paper to digital format in the near future, to expand seismic data base, to develop the methods of accurate seismic event detection and determination of earthquake parameters, to precise a seismicity and to study the deep structure model by the seismic wave propagation, to exceed the seismological, geological and engineer-seismological investigations with Baikal and Central Asian geodynamics process.

2. THE SEISMOLOGICAL OBSERVATION IN MONGOLIA

Within the frame of the International Geophysical year the first seismic station "Ulaanbaatar" was installed (set up) and thus the study of seismological began in 1957. On the 04 Dec 1957 occurred the Gobi-Altai earthquakes with M=8.1 by the scale XI-XII, producing 270 km surface break. It was notified that a new seismological study is to be developed in Mongolia. The first step of the study, was to make a catalogue of the problems to mark the historical earthquakes in Mongolia, to increase seismic stations and to prepare national researchers.

The first basic scientific seismological investigation was set up by experienced research workers Mr. I.Baljinnyam, D.Munkhuu, Dr.B.Tsembel and assistant research worker Mrs. L.Selenge. Since middle of 1960, first national research workers, Mrs. M.Adiya, Mr. G.Bayar and Dr. T.Dugarmaa graduated from University of Irkutsk and are still working in the same field. Currently, there are 25 research workers, including 2 Doctors of Philosophy, seismologist, theoretical physics, geophysics, engineer-geologists, engineer-geodesist, electronic engineers, construction engineer and the young research worker candidates, that are Mr. M.Ulziibat, Ch.Odonbaatar and Mrs. D.Ankhtsetseg.

We are conducting important research activities with the scientists from the Institute of Earth Crust, Irkutsk of Russian Academy of Sciences, the "Department Analyse et Surveillance de l'Environnement" of the "Commissariat a l'Energie Atomique" and the U.S. Geological Survey and studying a new technology, conducting the field work in the seismic activity region, carrying out engineer-seismological investigation and publishing the scientific results. At present, Mongolia territory has 9 analog seismic stations working (figure 3) with photorecords, around Ulaanbaatar (UB) there are 5 real time telemetred digital stations working and one mini-array of CTBTO (figure 4).

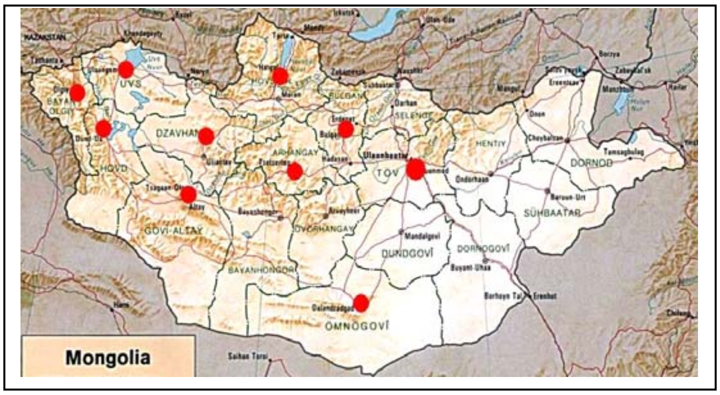


Figure 3: Location seismic analogical stations

We have studied seismology, engineering seismology and seismogeology and learning to provide normal work of seismic stations, to interpret a new modern technology, to make data base of seismological researching (investigating) and also to study seismicity, regional seismic regime, strong earthquakes source mechanism, seismic wave distribution by the geology, tectonic and geodynamic process. We have published the scientific papers, reports and books, which included all research results for scientists.

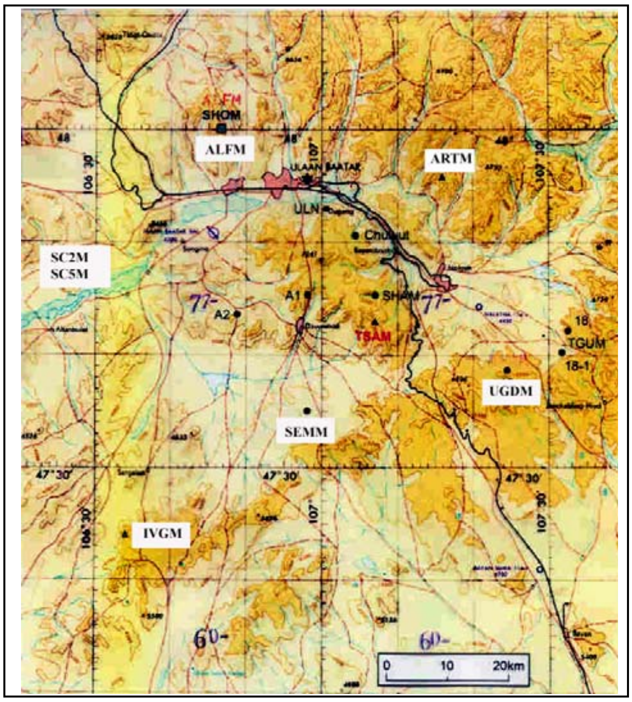


Figure 4: Seismic stations around UB

In the past centuries, earthquakes catalogues of Mongolia have shown that large earthquakes occurred with magnitude more than 5 (Table 1). From these earthquakes, 4 major (catastrophic) strong earthquakes occurred in Mongolian territory with many thousand kilometers of surface break.

Table 1: Strong Earthquakes in territory of Mongolia in XX century

N	Name	Date	Lat.	Lon.	Mag	Intens	Fault
			φ	λ	M	I_0	Km
1	Unegtei	1903.II.01	43.4	104.5	7.5	X	
2	Zezerleg	1905.YII.09	49.5	97.3	7.6	X-XI	130
3	Bulnai	1905.YII.23	49.3	96.2	8.2	XI-XII	370
4	Mongol-Altai	1931.YIII.10	46.8	89.9	8	XI	180
5	Gobi-Altai	1957.XII.04	45.1	99.4	8.1	XI-XII	270
6	Bayanzagaan	1958.IY.07	45.11	98.42	6.9	IX	7
7	Saihan	1958.YI.23	48.7	102.9	6.1	VIII-IX	
8	Buuriin hyar	1960.XII.03	43.2	104.4	6.7	IX	18
9	Mogod	1967.I.05	48.1	102.9	7.8	X-XI	45
10	Uureg nuur	1970.Y.15	50.18	91.27	7	IX	6
11	Tahiin shar	1974.YII.04	45	94.18	6.9	IX	17
12	Munhhairhan	1975.III.31	46.8	91.6	5.7		
13	Zambagarav	1988.YII.23	48.62	90.64	6	IX	
14	Buteeliin nuruu	1989.Y.13	50.18	105.49	5.8		
15	Busiin gol	1992.XII.27	50.95	98.17	6.2		
16	Alag erdene	1992.II.05	50.19	100.03	5.3		
17	Manlai	1992.YIII.31	44.1	106.5	5.5		
18	Menengiin tal	1993.XI.19	47.75	116.49	5.1		
19	Erdene	1994.II.10	44.46	111.88	5		
20	Han Hohii	1994.YIII.31	49.08	94.35	5.1		
21	Mongol Altai	1995.YI.22	50.27	89.85	5.4		
22	Deren	1998.IX.24	46.3	106.2	5.4	VI-VII	No fault
23	Sagsai	1998.XI.21	49.03	89.27	5.7		
24	Mongol Altain ovor	1998.XI.25	47.61	89.74	5.6		
25	Sagsai	2003.V.07	48.46	89.38	5.7		
26	Altain hyazgaar	2003.IX.27	49.98	87.9	7.3		

The Tsetserleg (Mw=8.0) earthquakes occurred in July 9,1905. It produced over 130 km of surface breaks along a left-lateral strike-slip fault with reverse component. The 23 July 1905 Bolnay (Mw=8.1) earthquakes occurred two weeks later and produced 375 km of surface breaks. During these earthquakes, the motion on the fault was of the order of 12m on average. The Fu Yun earthquakes on 10 august 1931, Mw=8 occurred on a right-lateral strike-slip fault of the western border of the Altai range. The Gobi-Altai earthquakes on 04 December 1957 Mw=8.1 ruptured a major left-lateral strike-slip fault over 270 km.

We have drawn up the official seismic zoning map for Mongolia with scale M1: 250000 in 1998 and the microzoning map of the region (aimags and others) then were sent to the Institution of Building Construction and Urban Planning. We have exchanging seismic data with International Data Center and seismological organization.

In 1994, a digital telemetred seismic network was set up around Ulaanbaatar within the frame of a Mongolian French collaboration in geophysics. It was the beginning of a very fruitful technical and scientific cooperation between our Center and the Laboratoire de détection et de Géophysique of the Département Analyse Surveillance, Environnement in French. This network consists of 6 components (3 short period and 3 broad band) and 5 vertical short period stations whose data are sent permanently to the Research Center of Astronomy and Geophysics in Ulaanbaatar. Detection, interactive processing, event location and data storage are achieved at the Center. The aperture of this network (60 km x 70 km) allows consistent regional monitoring in real time once calibration of the stations has been performed.

The 6 component stations (ALFM), one broad band 3 components and one short period 3 components, will be included to the 50 primary stations network of the International Monitoring System to verify the future Comprehensive Test Ban Treaty. The data will be sent continuously to the future International Data Center through the French National Data Center by VSAT facilities.

The seismic data are continuously transmitted in real time to the Observatory where they are digitized, using a personal computer (PC) based on Seismic Event Detector associated with a GPS synchronized timing unit, and permanent recordings on a graphical recorder as well as on a movable magnetic disks. For routine processing and analysis, other PC with Integrated Software in Seismology are used. Offline playback and data analysis lead to a seismological weekly seismic bulletin reporting arrival times of events, epicenter determinations and magnitude evaluations. This weekly bulletin should be mixed with the National Bulletin and distributed to different countries of Asia and to the International Data Center.

This Mongolian – French collaboration in geophysics has allowed the development of new facilities for seismic studies in Mongolia. The seismic network around Ulaanbaatar is providing valuable data in complement to those of the existing National Seismic Network. This network is also in accordance to the standard of the global monitoring system designed for verification of the CTBT. These new data are providing the basis for a technical and scientific collaboration between Mongolian and French geophysicists.

Our Center is the official agency for a maintaining Comprehensive Nuclear Test Ban Treaty Organization's (CTBTO) geophysics network

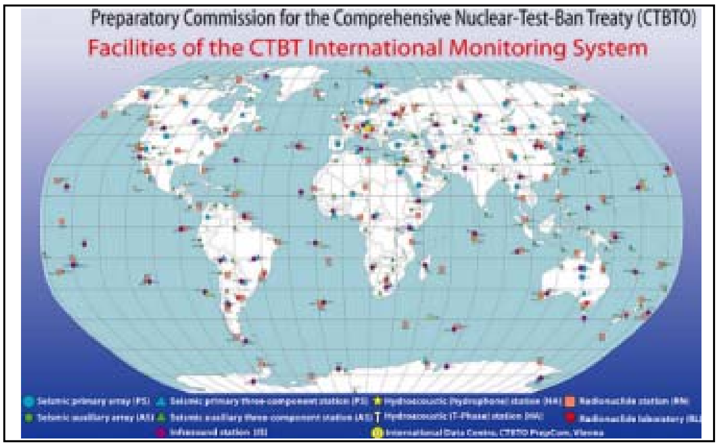


Figure 5: Facilities of the CTBTO

stations. A CTBTO International Monitoring System of 321 stations will collect data worldwide and transmit them in near real-time to the International Data Center in Vienna. The 170 seismic, 60 infrasound and 11 hydro acoustic monitoring stations will be capable of detecting the seismic and acoustic waves caused by a nuclear explosion. The 80 radio nuclide monitoring stations, supported by 16 laboratories, will measure air samples for the presence of radioactive material. At Mongolia located PS 25 mini area seismic, IS 34 infrasound, RN 45 radio nuclide stations network.(Figure 5)

In 5 years (1997-2002) scientific program was carried out in GPS-geodesy undertaken in the framework of a collaboration between the Research Center for Astronomy and Geodesy of the Mongolian Academy of Science (Ulaanbaatar, Mongolia), the Institute of the Earth's Crust, Siberian Branch of the Russian Academy of Science (Irkutsk, Russia), and Géosciences Azur, National Center for Scientific Research (Sophia Antipolis, France). In the framework of scientific projects "Global Positioning System measurements of active crustal deformation in Western Mongolia" we achieved good results which were published in scientific publications. (Eric Calais., 2002.)

Scientific projects "Seismic Hazard at Capital Ulaanbaatar, it's vicinity" with scientists from LDG DASE France (project leader Dr. Antoine Schlupp) and "Mongolian-Baikal Lithosphere Seismological Transect" (project leader Dr. Anne Deschamps) with researchers from Institute of the Earth Crust, Irkutsk, Siberia and Géosciences Azur, CNRS, Nice, France are underway.

3. ONE CENTURY SEISMICITY MAP OF MONGOLIA

As one of the important scientific results of Mongolian and French cooperation on geophysics we built a homogeneous catalogue of the seismicity of Mongolia using the high level of detection of modern seismic station installed since 1994 combined with 40 years of SKM-3 recording data and event known mainly by macroseismic data for the period 1900 to 1964. (Figure 6)

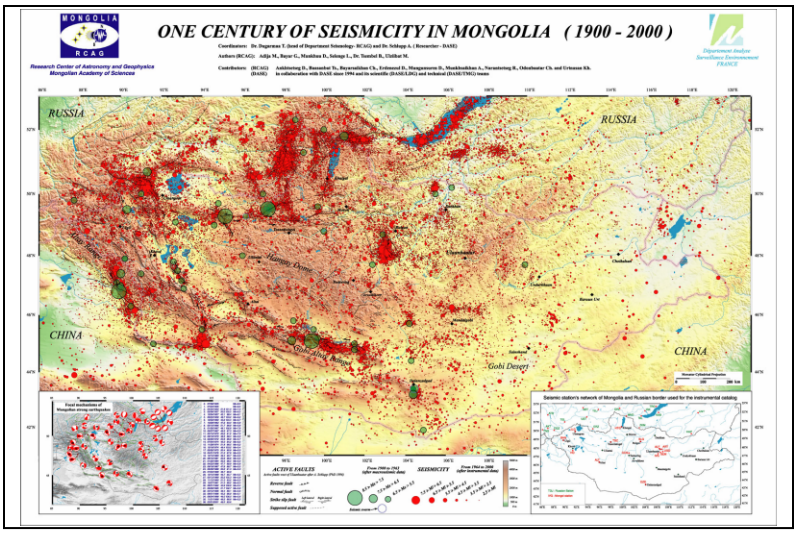


Figure 6: The map "One century of seismicity of Mongolia"

We collected three kinds of seismic data: international published data (before 1964), seismic data recorded by the Mongol seismic network consisting in 10 analogical seismic stations (1964-2000) and completed since 1994 by several digital telemetred stations widespread around Ulaanbaatar city and in western Mongolia. (Figure 7)

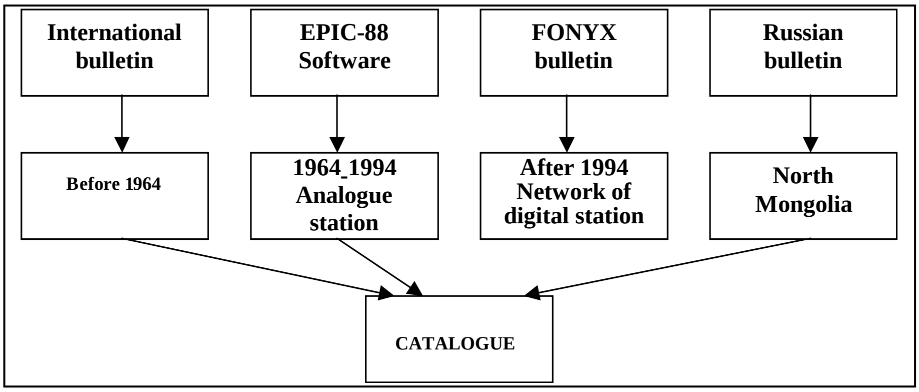


Figure 7: Catalogue procedure scheme

We relocated about 3200 events in the explosion areas and detected about 2700 quarry blast moved from the seismic data base to a quarry blast data base. The explosion areas are as follows:

- Baga-nuur 971 qb

- Shariin gol 850 qb
- Erdenet 203 qb
-3 south expl. 595 qb
-Baga-Khangai 62 qb

We have defined a new seismic attenuation law for Mongolia. We use this new law to correct all previous data and it is now included in our daily seismic analysis process.

Our magnitude law is as follows:

ML=LogA/T+0.816xLog(D)+0.00045xD-1.22 (1)

We compared the seismic event's location of our reviewed data base with those published by international seismological organizations (USGS - ISC - EMSC)

The result consist of a map showing one century of known seismicity, first published map of seismicity of Mongolia. The seismic catalogue has been completely reviewed and contain more then 250.000 events. This map is available worldwide and is the base for research in seismology in the territory of Mongolia.(Dugarmaa T., and al. 2002)

4. THE SEISMICITY OF ULAANBAATAR

Ulaanbaatar is the capital city of Mongolia and it is the country’s main political, economic, industrial, scientific and cultural center. It is situated between four mountains /Bogda Khan Uul, Chingeltei Uul, Bayanzurh Uul and Songino Khairhan/ of the Khentii mountain chains at the Altan Tevsh valley of the Tuul basin at the altitude of 1500 m above sea level /latitude 47° 57` north and longitude 106° 55`. (Figure 8)

Figure 8: Capital city Ulaanbaatar

Most of the Ulaanbaatar territory has had difficult engineering and geological conditions and located in a seismically active zone /or 7-8 points along the Richter scale/. The city total territory is 470,400 square hectares, and its residential area covers 22,400 hectares, out of which 12.3 thousands are under apartment buildings, 4.1 thousands – under the ger districts, 6.1 thousands – common land, 33.6 hectares are green zones. As of the end of 2002, over 30 per cent of the entire population of Mongolia or 824.7 thousand people are city residents. The density of population in Ulaanbaatar is the highest with 175 persons per 1 km^2. With carrying capacity of 400,000 people, the overcrowded city faces currently an ecological imbalance, decreasing living standards and growing poverty.

Before 1999, a partial plan for developing residential ger districts was formulated, which again became un-realistic due to the social development trends and economic crises. The latest Constitution of Mongolia provides that "every citizen is entitled to chose his/her place of residence" and in accordance with it the migration to the city became very strong, thus entailing the city to be over populated, unplanned expansion of the city territory and the ger districts, with relatively cheap housing or gers. Only in 1989-2002, the city population went up by 41 per cent or 250,000 citizens, the population growth was high and intensive construction works were under way. In this context, multiple problems needed to be resolved in city construction and planning domains. (Tselmeg M., 2003.)

In Mongolia, as well as in all high seismic countries of the world, study of seismicity and estimation of probability of future destructive earthquakes are important for economic stability and human protection. Seismological condition of Ulaanbaatar region are directly connected with seismic conditions of the territory of Mongolia. Mongolia characterizes the transition between compressive structures associated with India-Asian collision and extensive structures localized in north of the country as Hovsgol area and Baykal rift. Since 1905, Mongolia suffered four earthquakes with magnitude larger than 8 (Tsetserleg 1905, Bolnai 1905, Fu-Yun 1931 and Gobi-Altai 1957). (Table 1) These events associated with displacement along the faults up to 12 meters (Baljinnyam and al 1993, Schlupp A.,1997). The cumulative deformation along the Gobi-Altai fault shows that the return period of such great earthquakes on this fault are of the order of 5000 years with a strain rate about 1 mm/year. Active faults are numerous and large but the occurrence of these four large earthquakes in less than one century is unusually high (Schlupp A.,1997).Ulaanbaatar is situated at the east of these main active faults. Therefore, we have to understand better the seismotectonic model of the region by collecting new data about deformation near Ulaanbaatar. At the present, Today, we are collecting the seismic data from 9 analog seismic stations with records on photo paper, 5 high dynamic digital seismic stations, one CTBTO mini-array (10 stations) telemetred in real time to our NDC and one IRIS station. We are presented a seismicity of the Ulaanbaatar region by about 10602 events from the seismic catalogue with after marcoseismic data 1913 to 1963 and after instrumental data 1964-2002 by depending on technological and detection characteristics. We have taken a study's region about 350 km radius around Ulaanbaatar city, and divided the region in six subregion, which is characterized by the epicenter's density, geological structure and active fault. The range of magnitude are from 3 to 7. It shows high activity near the Mogod Earthquake, 5 January 1967, Mw= 7,2 and some dense activity as 180 km south of the capital in Deren region where a recent event was largely felt at Ulaanbaatar(Anhktsetseg D., and al. 2003.). The other seismicity is more widespread. Despite of magnitude are low in that region, they are recognized active faults with no particular seismicity associated where event up to magnitude 7 can occurred. This work is associated with paleoseismological survey on particular active faults. From the seismicity map, the region near Ulaanbaatar is seismically active and some earthquakes, which can have destructive effect on the city Ulaanbaatar, can take place. (Figure 9)

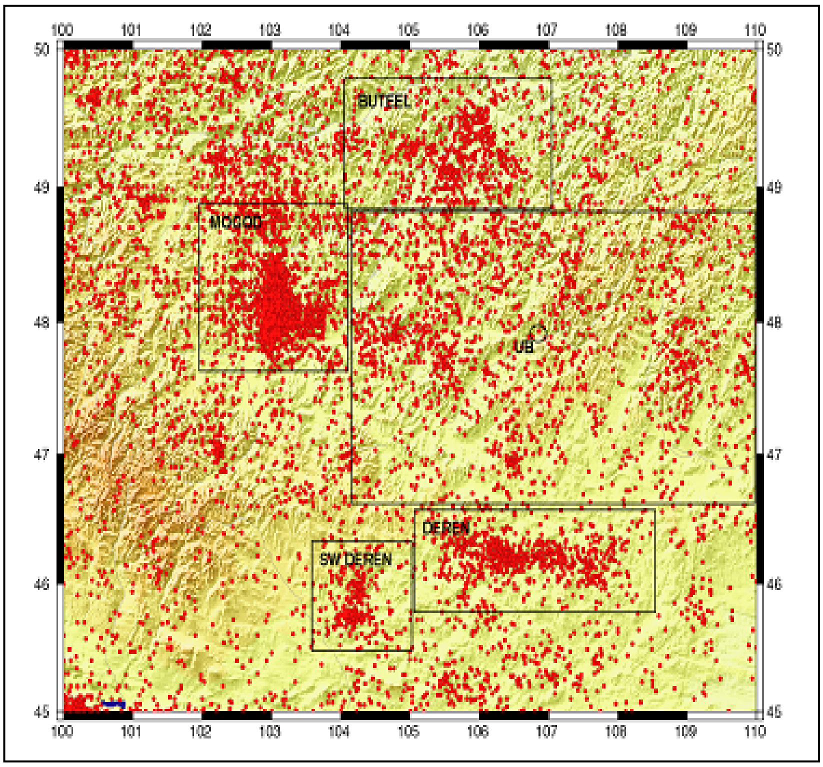


Figure 9: The Seismicity map of the Ulaanbaatar area (M ≥ 1.8)

Concerning seismic hazard, one key question is whether high seismicity rate is representative of what we may expect in the future and what is the hazard assessment with smaller, but more frequent, events. In that context, the knowledge of the seismic hazard at Ulaanbaatar, capital of Mongolia where 35 to 40 % of the population live, is of first importance. Some quaternary fault scarps were recognized at a distance of 40 to 200 km from Ulaanbaatar. We estimate that they could produce magnitude 6.5 to 7 earthquakes and may cause damage in the city. Our objective is to assess seismic hazard at Ulaanbaatar taking account of the dense seismicity recorded since 1994, revised regional attenuation law and estimated recurrence time on the faults near Ulaanbaatar obtained from paleoseismic survey. We have also undertaken a microzoning to estimate site effects from seismic measurements and noise recording within the Ulaanbaatar sedimentary basin. The regular seismicity allows us to compare several techniques (site/reference and H/V either on recorded noise or event). We will estimate the ground accelerations at Ulaanbaatar, and their recurrence time, produced by events localized either on large faults detected or anywhere for the low seismicity. The final result (the end 2003) will be the zonation of seismic hazard with its characteristics for Ulaanbaatar.

5. THE LAST STRONG EARTHQUAKE IN ALTAI (M=7.3) ON SEPTEMBER 27, 2003

On September 27, 2003 at 11:33 (GMT) the strong earthquake with magnitude M=7.3 has happened in Altai. Location of epicenter is 49.99N 87.90E and depth 18.4 kilometers and ruptured a big fault along many kilometers. It is just near of Mongolian west border and at Ulgii city we had some damage of buildings. Our Center with LDG DASE France organized a expedition to study this earthquake and aftershocks directly near to the epicenter. Our seismologists worked in Mongol Altai region during 40 days. Using 5 mobile stations (Airoi, MoBal) we recorded aftershocks and conducted first investigation of this earthquake.(Figure 10)

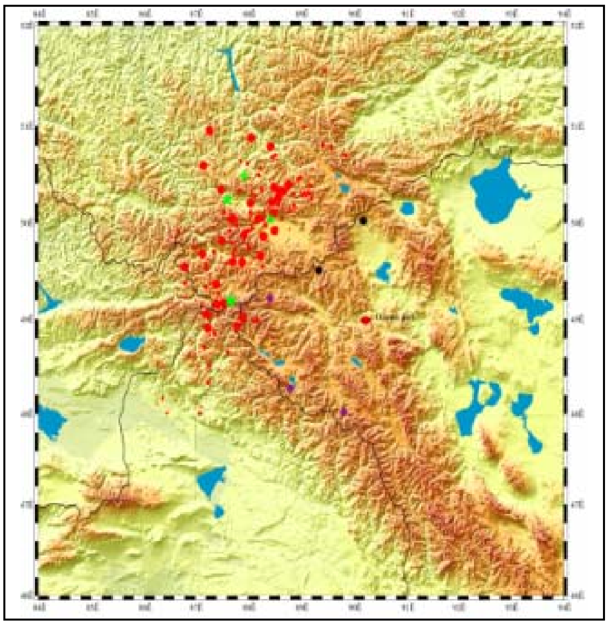


Figure 10: Aftershocks in Altai. ★ *– Aftershocks* ● *- M=1.5-4.5*

To study this strong earthquake in details we are planning to organize and send in June or July 2004 to Mongol Altai region a international team of seismologists from the Institute of the Earth's Crust, Siberian Branch of the Russian Academy of Science (Irkutsk, Russia), and LDG DASE France.

6. WSSI AND MONGOLIA

After receiving the official invitation to the Third International Workshop on "Seismic Risk Management for Countries of the Asia Pacific

Region" from Dr. Tsuneo Katayama, Chairman, WSSI Board of Directors, I have read three reports kindly sent me. I was impressed by people who worked during these 10 years in WSSI, who made many useful things on earthquake disaster mitigation throughout the world, especially in developing countries. It was really heroism from these people, who spent huge energy and efforts practically on a voluntary basis.

Main organization on the natural disaster reduction at Mongolia is State board for Civil Defense. Our center has close cooperation with this organization providing them all strong earthquake data. During last month when I prepared my presentation to WSSI workshop I had a fruitful discussion with deputy chief and secretary of State Permanent Emergency Commission Mr. Togoo CH. I introduced Mr. Togoo Ch. to WSSI activity. We decided to continue our discussion more constructively after WSSI workshop.

At Ulaanbaatar I had a meeting with Dr. Tomohiko Hatori from Asian Disaster Reduction Center(ADRC). ADRC is planning to support the Urban Seismic Risk Management Seminar in UB organized by three Mongolian governmental organizations, Strategic Planning and Management Department of Ministry of Nature and Environment, International Cooperation Department of Ministry of Nature and Environment, and State Board for Civil Defence. The seminar will be held in March, 2004. The title of seminar is "Vulnerability and Risk Assessment of the Possible Earthquake and Measure to Prevent Earthquake Disaster in Urban City". Our center is invited to this seminar and we are preparing two presentations “The seismological observation at Mongolia” and “Seismic hazard map of Ulaanbaatar”. I met the coordinator of this seminar Ms. Bolormaa Borkhuu, Officer of Strategic Planning and Management Department and discussed about a participation to this seminar some people from WSSI. It would be better to participate in this seminar in order to have more information about Mongolia. It is like Mongolian proverb “Better to see once than to hear thousands”.

I have read "The Last Mile" by Prof. Haresh C. Shah with a great interest. Here are many critic about results of some projects from a international organizations which was useless. It is a first time when I read officially distributed and so strongly discussed, a self-examination material for some international organization. It means the WSSI has a future. I am sure that many people from developing countries will be agree with me about importance of international efforts to reduce the level of earthquake risk in the most vulnerable communities in developing countries to an acceptable level consistent with sustainability of these communities. In that context we should develop and increase The World Seismic Safety Initiative activity in the new format, revising its Mission and Goals along with its operational structure which was proposed by W. Iwan, K. Meguro, and B. Tucker.

It is not so easy to have positive effects on seismic risk reduction activity in developing countries when result of our efforts will depend from many factors.

After my attendance to WSSI workshop I am planning to participate in the TV project about seismic hazard and seismicity of Mongolian territory. After a strong earthquake in the west Mongolia –Altai region we received a proposal to participate in this TV project. I requested TV project manager to move date of this project to late day after my arrival from WSSI workshop in order to include some useful materials about WSSI activity on the seismic hazard reduction field throughout the world in my presentation. It would be useful if WSSI will provide local coordinators by serial materials about earthquake hazard, activity and experience from developed countries.

There are a few government organizations as Government executive agency-State Board for Civil Defense, Urbanization and Investment Department of Ulaanbaatar city administration, the Strategic Planning and Management Department of Ministry of Nature and Environment and etc. Each of these organization is "expert" in one aspect of earthquake hazard reduction problem. But it is only with the association of all the knowledge that we can promote reduction of seismic risk, in Mongolia as all over the world. I am optimist and sure that in future we with WSSI will carry out useful joint project on the seismic risk mitigation in Mongolia.

REFERENCES

1. Anhktsetseg D.[1], Dugarmaa T.[1], Schlupp A.[2], Ulziibat M.[1], Odonbaatar CH.[1], Bayarsaihan Ch.[1], Munkhsaihan A.[1], 2003. ([1] Research Center of Astronomy and Geophysics of Mongolian Academy of Sciences, [2] Departement Analyse, Surveillance, Environnement, BP12, Bruyeres le Chatel, 91680, France) Seismicity around capital Ulaanbaatar, Mongolia. IUGG 2003 Abstract. S04b-Posters.
2. Baljinnyam, I., Bayasgalan, A., Borisov, B.A., Cisternas, A., Dem'yanovich, M.G., Ganbaatar, L., Kochetkov, V.M., Kurushin, R.A., Molnar, P., Philip, H. and Vashchilov, Y.Y., 1993. Ruptures of Major Earthquakes and Active Deformation in Mongolia and its Surroundings. Geol. Soc. Am., Mem. 181, 62pp.
3. Dugarmaa T., Schlupp A., Adiya M., Ankhtsetseg D., Bayar G., Munkhuu., Selenge L., Tsembel B., Ulziibat M., Odonbaatar Ch., Mungunsuren D., Munkhsaihan A., Narantsetseg R., Urtnasan Kh., Bayarsaihan Ch., Baasanbat T., 2002. Seismic map of Mongolia and Site Effect Microzoning at the capital, Ulaanbaatar. Eos, Transactions, American Geophysical Union,Vol. 83, №47, AGU Fall Meeting, San Francisco, California.
4. Eric Calais., 2002. Global Positioning System measurements of active crustal deformation in Western Mongolia. 1997-2002 report. http://www.eas.purdue.edu/~calais/projects/central_asia.html

Schlupp A.,1997. Néotectonique de la Mongolie Occidentale analysée à partir de données de terrain, sismologiques et satellitaires, *PhD Thesis*, Univ. Louis Pasteur Strasbourg.

5. Tselmeg M., 2003. City planning and land management. Workshop "Municipality of Ulaanbaatar City and The World Bank" http://www.ub2003.com/presentation_06.html

Mr. S. Demberel from Mongolia

EARTHQUAKE DISASTER MITIGATION ACTIVITIES IN INDONESIA JAN 1999 – NOV 2003

K. PRIBADI, D. HOEDAJANTO and T. BOEN
Indonesia

ABSTRACT

This paper highlights the various activities related to earthquake disaster mitigation in Indonesia since WSSI second workshop in Bangkok in January 1999 up to November 2003. The paper also explains in brief the Indonesian political and economic situations and the uncertainty related to the decision in setting the priority for disaster mitigation activities in Indonesia in part due to the still unsettled decentralization process.

1. INTRODUCTION

During the WSSI Second Bangkok Workshop in January 18-20, 1999, the Indonesian representative mentioned four most urgent needs in improving the earthquake safety in Indonesia, namely:

1. Finalize the Indonesian Seismic Zoning map
2. Finalize the Revision of the Seismic Code
3. Establish a Structured Organization for Disaster Management
4. Duplicate Projects such as IUDMP and RADIUS in other cities

The following is a summary on the progress achieved related to the above needs.

2. INDONESIAN SEISMIC ZONING MAP

The progress in developing the Indonesia Seismic Hazard map may be summarized as follows:

2.1 Shah and Boen Seismic Hazard Map

In 1996, with the assistance of WSSI, a Seismic Hazard model was produced by Shah and Boen and presented during the Indonesian Society for Structural Engineers annual conference in Jakarta, August 1997. A probabilistic hazard model for estimation of the seismic hazard in Indonesia has been developed on the basis of available data, studies, and literature. Seismic source zones have been delineated on the basis of regional plate tectonics and seismicity. The occurrence of earthquakes in the seismic source zones has been modeled as a Poison process in combination with the Gutenberg-Richter relationship. Source zone seismicity parameters have been estimated from historical earthquake data. The Great Sumatra fault zone was included into the model, and slip rate data used to estimate its seismicity parameters. A seismic map showing peak ground acceleration (PGA) with 10 % probability of exceedance in 50 years on average soil conditions has been developed using this model and attenuation equations by Crouse (1991) and Fukushima & Tanaka (1990) for the whole country, except the islands of Kalimantan and Sulawesi. The map was developed using standard probabilistic hazard methodology and took into account uncertainties associated with the attenuation models.

2.2 J. Firmansyah & M. Irsyam Seismic Hazard Map

In 1999, J. Firmansyah & M. Irsyam of the Department of Civil Engineering, Institute of Technology Bandung developed a seismic hazard map for Indonesia based on probabilistic modeling. The assessment takes advantage of recent higher quality regional seismological data, re-appraised older instrumental catalogues and current tectonic interpretations. Peak ground accelerations on base rock are estimated based on seismic sources in the Indonesian archipelago that is located in the convergence zone of three major lithospheric plates; the Indian-Australian plate, the Pacific plate and the Eurasian plate.

The seismic source modeled the earthquake potential to a depth of 200 km beneath ground surface. They include the Great Sumatra, Sukabumi, Palu Koro and Sorong faults, all subduction zones and shallow crustal of Indonesia. Two attenuation functions were used, one proposed by Young (1997) was selected for subduction environments and another one, attenuation function of Joyner & Boore, was used for other seismic sources. A seismic hazard map for Indonesia showing peak ground accelerations (PGA) on base rock with 10 % probability of exceedance in 50 years was developed based on the Gutenberg-Richter magnitude vs. frequency relationship in combination with a Poison process mode.

2.3 GSHAP Seismic Hazard Map

In 1999, Global Seismic Hazard Assessment Program (GSHAP) published a map based on the work of Shah & Boen. In the model, two sources were used to characterize the region: Sumatra subduction zone and the Sumatra fault. The Preliminary Determination of Epicenters (PDE) catalog was used to determine rates on the subduction zone, slip rates were used to determine the frequency of earthquakes along the fault. Two ground motion prediction equations were used to estimate the ground shaking hazard. In these models peak horizontal ground acceleration is calculated for hazard level of 10 % probability of exceedance in 50 years.

2.4 USGS Seismic Hazard Map of Sumatra

In 2000, Mark Petersen et al from USGS produced a seismic hazard map for Sumatra and the Malaysian peninsula based on probabilistic analysis using the procedures for the US National Seismic Hazard maps. Regional earthquake source models were constructed and standard published and modified attenuation functions were used to calculate the peak ground acceleration at 2% and 10 % probability of exceedence in 50 years for rock site conditions. A modified and declustered catalog was developed to provide independent earthquake information. Four source zones that characterize earthquake in four tectonic environments: subduction zone interface earthquakes, subduction zone deep intraslab earthquakes, strike slip transform earthquakes, and intraplate earthquakes. The recurrence rates and sizes of historical earthquakes on known faults and across zones were determined from this modified catalog. In addition to source zones, two source models consider two major faults that are known historically to generate large earthquakes: the Sumatra subduction zone and the Sumatra transform fault. Ground motions were calculated using ground motion prediction relations that were developed from seismic data obtained from the crustal interpolate environment, crustal intraplate environment, along subduction zone interface and from deep intraslab earthquakes. For interpolate and intraplate crustal earthquakes ground motion prediction that are consistent with California (interplate) and India (intraplate) string motion data for distances beyond 200 km are used. In the analysis, alternative source and attenuation models are used and weighted them to account for uncertainties in which model is most appropriate for Sumatra and Malaysian peninsula.

The seismic map used in the current Seismic Code was developed mainly by combining and modifying the maps as mentioned in 2.1 and 2.2. Modifications were mainly based on inputs from the Geologic Research and Development Center (GRDC), Bandung. In this near future, all parties involved in developing the existing Indonesian Seismic Hazard maps plan to produce a new map taking into considerations new developments in the field as indicated in 2.3 and also additional data available.

3. SEISMIC CODE (SNI 03-1726-2002)

The move to renew the old Indonesian Earthquake Code got its first unofficial kick-off around 1995 upon reviewing the UBC 1994. It was concluded that the existing code which was based on the state of the arts of the early 80’s were not good enough to answer the actual need of better earthquake resistance building for our country. An informal gathering was started at the office of Indonesian Society of Civil and Structural Engineers (HAKI)[1].

In the past HAKI has been instrumental in all process of drafting our national code for civil works, in which the official prime mover has always been the Office of the Public Works Department (PWD). This time around however while the same operating procedure was followed, there was a new small twist introduced by our PWD Office. Instead of picking the chairperson of the working group through the usual election process

[1] HAKI is the abbreviation of the Indonesian name of the Indonesian Society of Civil and Structural Engineers. HAKI stands for Himpunan Ahli Konstruksi Indonesia.

established in a national workshop, the PWD Office decided to directly appoint the chairperson and give full authority to proceed with the works. While the working team were indeed formed by selecting representative of almost all parties interested and involved in civil works, the fact remain that the process did not lend it self to a more democratic approach in important discussions and decisions. In the course of the works many conceptual differences emerges, especially after the publication of the UBC 97. HAKI presented their view and proposed to adopt the UBC 97 as the main resource of the new code.

Right from the onset, there was a big conceptual difference among members of the working group. One party strongly adopted a soft and conciliatory approach by introducing moderate changes to bridge the gap between our then existing code and the new state of the arts portrayed in UBC recommendation, while the other party (consisting most of the working group members), including those from HAKI who were not directly involved in the process, prefer to a more realistic and easier approach by fully adopting the UBC 97.

It was believed that the main reason for the first party who choose to adopt their approach was to prevent sudden and drastic changes in the new Earthquake Code. This in a way is to guard against possible legal problems that may arise against the local government especially for new buildings built based on the old code. In the old Earthquake Code, the return period for the design earthquake was 200 years. There were strong wishes among the leading Indonesian researchers and practicing engineers to completely revise it and started to build a new Earthquake Zoning Map based on 500 years return period. The drive to change the map was finally accepted, however the impact of some important and drastic changes which were the introduction of much higher performances demand to the structure were “soften” by adopting some formulas derived specifically for the purposes. Trial and error approach combined with some mathematical exercise were carried out to lend a hand for the establishment of formulas which may still give close end result to those obtained using the old code. The idea was probably to prevent possible negative social impact if the public learned that their building, which were designed and constructed based on the old code, were actually become under designed under the new code.

Some of the main concerns were:

1. The use of the minimum value as the established design ground acceleration for region within two contours of maximum ground accelerations. This concept do not agree with the practice used in other world codes,
2. Derivation of R value for certain type of structural system which were not backed by appropriate and credible research and field investigation/observation,
3. The formulae used to establish the R value for structure with different structural subsystem. Averaging the R value of each system seems to be inappropriate.
4. Some clauses such as for accidental torsion are not in accordance to the current prevailing standard practice etc.

It was due to those reasons the Office of MHSI (Ministry of Human Settlement and Infrastructure), replacing the former PWD Office, could not bring an official consensus on the new code SNI-03-1726-2002. The parties involved came to its positions and do not want to let go their opposing differences. Those who disagree and understand the basic choose to adopt the use of either UBC 97 or 2000 IBC in their practice. However there are many more engineers who do not understand, and hence have to take the chance of adopting probably in some cases an unsafe code for their practice.

The introduction of Performance Based Earthquake Engineering in the latest world Codes should raised another concern. To master the technique of this PBEE, there is strong requirement to understand the basic knowledge of nonlinear structural response. Certainly the case raised above on the use of improperly substantiated R coefficients needs to be addressed and better explanation should be given to general public. This is very important to guard against misuse which may then leads to unexpected failure.

It may easily be summarized that the new SNI 03-1726-2002 code for Earthquake Resistance Building needs to be revised as soon as possible. To keep it officially floating as a legal document is not healthy for the profession as well as for the academic circle.

Considering the advancement shown in 2000 IBC, many felt that it is better and more practical to adopt 2000 IBC as our main reference. Unfortunately this may not be easily accomplished. The role of the current MHSI Office is still too dominating, and indirectly their wish will get its way. If history repeat it self, then maybe we have to wait for at least another ten years before we have a new code to replace the current one.

4. STRUCTURE OF DISASTER MANAGEMENT IN INDONESIA

During the Second WSSI workshop, the Indonesian representative stated the importance of establishing a structured organization for disaster management in Indonesia. Five years later, the situation is not much changed. As is known, disaster management activities in Indonesia are coordinated by BAKORNAS PBP (National Coordinating Board for Disaster and IDP Management), chaired by the Vice President, while the Coordinating Minister for People's Welfare and Poverty Alleviation acts as its Vice Chairman as well as the Daily Executive in Chief, established under the Presidential Decree No. 3/2001 and its revision Presidential Decree No.111/2001.

The Secretary of the Vice President is assigned as the Secretary for BAKORNAS PBP. BAKORNAS PBP is a **non-structural coordination body** for disaster management in Indonesia under and is responsible directly to the President. It has operational instruments at all levels, from the central down to district and city levels. BAKORNAS PBP involves various government institutions; NGOs and community organizations.

Mission of BAKORNAS PB:

- Formulating and establish policy of disaster management and IDPs' handling in a quick, efficient and effective manner
- Coordinating the implementation of disaster management and IDPs' handling activities in an integrated manner.
- Providing guidance and supervision on disaster management and IDPs' handling efforts which include prevention, rescue and relief, rehabilitation and reconstruction.

4.1 Problems on the Policy Level

On the practical side, BAKORNAS PBP until now still puts heavy emphasize on emergency response and much, much less on the prevention and mitigation side of disasters. Despite its stated missions, much less efforts and resources were put for coordinating prevention, mitigation and preparedness activities.

Currently, the organization is much preoccupied by the social conflicts occurring in many parts of the country, and its attendant problems, such as handling of IDP and refugees. Also some efforts were focused on forest fire and haze problem, as it already created political implications at the regional and global level.

For other types of disasters (earthquake, flood/flash flood, landslide, volcanic, etc.) coordination efforts seem to be intensified during disaster period only for emergency response purposes.

Starting from rehabilitation/reconstruction stage, coordination is turned over to the technical ministries, such as the Ministry of Settlement, Ministry of Health etc. In this case the opportunity to include integrated mitigation efforts (from reconstruction/rehabilitation stage) starts to diminish, and people tend to construct/reconstruct/develop as before the disaster, therefore creating the "disaster-reconstruct-develop-disaster" vicious circle.

In the past regime, policies on disaster management and mitigation had been developed summarily, but at the implementation level, its effectiveness is questionable and many of the policies have low acceptability.

4.2 Problems at the Local Level

The local community and the local authorities operate in the same pattern as the national institutions. No priority is given to pre-disaster preparedness and mitigation.

Awareness is in general very low at the community level, as there are only very few awareness raising programs conducted in a coordinated and sustainable manner.

In most cases, local authorities put disaster preparedness and disaster mitigation efforts on the lowest priority in their annual budget setting.

4.3 Possible Causes for the Situation

First of all, it might be suggested that the non existence of a legal basis for disaster management in Indonesia contribute to this situation. There is currently no law/act on disaster and disaster management which could enhance the initiatives in mitigation and prevention of disasters. Other legal provisions related to disaster and disaster prevention can be found spreading in other acts, such as the act on Regional Spatial Plan etc.

The second cause could be found in the fact that BAKORNAS PBP is a non structured institution with no vertical authority at all. The only permanent part of BAKORNAS PBP is the Secretariat of BAKORNAS PBP, which is currently chaired by the Secretary of the Vice President, assisted by Vice Secretary and 4 deputies (Deputy for Disaster Management, Deputy for IDPs' Handling, Deputy for Cooperation and Community Participation and Deputy for Administration). National policy formulation at this institution is not a straight forward job, because it requires the deliberation of all the members of BAKORNAS PBP, which seldom put enough resources to this kind of activity. BAKORNAS PBP resources, in term of funds, personnel and equipment is very limited, because as a non structured institution, it does not have an operational or development budget, except for secretarial purposes only, which uses the Secretary of Vice President's office resources.

Coordination of disaster mitigation and prevention activities is very limited, because of the above constraint, and those activities are supposed to be carried out by the relevant line ministries and technical departments, which on the other side, except for certain case, usually do not have specialized divisions in charge of conducting mitigation efforts. In general, the effectiveness of BAKORNAS PBP in disaster prevention and mitigation can not be fully developed because of the inherent constraints adhered to the organization, and at the lower level (local government level) the pattern recurs similarly. Strengthening/improving of the disaster management institution is a must to achieve a saver environment and saver community.

5. DUPLICATION OF IUDMP / RADIUS PROJECTS RESULTS

For phase III implementation of Indonesian Urban Disaster Mitigation Project (IUDMP 1999-2002), it was agreed that IUDMP should not repeat a city's demonstration activities elsewhere and instead the following activities were prepared for IUDMP phase III.

5.1 Implementation of IUDMP – Phase III

- Replication in Bengkulu City
- Development of user friendly document for information dissemination

- National Training of Trainers for School Earthquake Safety Program
- National Lessons Learned Workshop for Indonesian City and District Managers (collaborate with Association of City Government/APEKSI)
- Develop and implement rapid risk assessment procedure for cities in Indonesia, to follow-up demand raised during the workshop
- Development of national strategy on urban disaster mitigation (collaborate with BAKORNAS PBP)
- Preparation of a strategic organizational business plan for an ITB Center on Disaster Mitigation and Prevention

5.2 IUDMP Replication in Bengkulu City

- Workshop on Seismic Risk and Earthquake Resistant Building in Bengkulu City (Local Government Officials, Professional Groups, Academia)
- Workshop on School Safety for School Community
- Training Program on "Repair, Retrofitting and Strengthening of the Earthquake Damaged Building" (City Engineers, Contractors and Consultant, Academia)
- Training for Craftsmen on "Construction of Earthquake Resistant Building"
- Workshop on Preparedness Planning: "Disaster Management and Earthquake Hazard in the City of Bengkulu" (Local Community Groups)

5.3 Development of User Friendly Document for Information Dissemination

- Bilingual earthquake picture dictionary.
- Booklet of earthquake, its phenomena, disaster and alternative mitigation efforts for the general public.
- Guideline for implementing Disaster Mitigation Initiative for City Managers.
- Guideline for Earthquake Safe construction/building for simple house.

5.4 National Training of Trainers (TOT) for School Earthquake Safety Program

The program objective is to increase the awareness and preparedness of the elementary school community toward earthquake risk. The specific objectives are:

- To raise awareness of the school society in nation wide.
- To produce Earthquake School Preparedness manuals/modules that are endorsed by The Directorate General of Primary and Secondary Education -Ministry of National Education

- To prepare adequate personnel for the dissemination of the manuals through the training program.
- To train teachers and representative of Teacher Training Center so they could convey earthquake school preparedness material to students and community related.
- To give guidance for teachers in the learning and implementation process of earthquake school preparedness program.

The first TOT program was held in Bandung and has successfully trained 61 potential trainers from 35 Indonesian cities, the second was held in Lembang (Bandung) and attended by 60 participants, the third in Bengkulu also attended by 60 participants, the fourth in Kuningan (West Java) also attended by 60 participant, the fifth in Lembang was attended by 120 and the sixth also in Lembang with approximately 120 participants. The total amount of teachers trained so far is far from sufficient since there are still 200 cities that are very prone to earthquake hazards (from Zone 4, 5 and 6). The Director General himself has supported this program and stated that it should be adopted in the school program as extra curricular activities in teaching “life skills” to students and the TOT program itself should be continued until it reaches the substantial numbers of municipalities. This activity is being handled by the ITB “Research Group on Disaster Mitigation.”

5.5 National Lessons Learned Workshop for Indonesian City and District Managers (Collaborate with Association of City Government/APEKSI)

The Workshop objective is:

- To introduce and share the experience on disaster mitigation activities, especially activities conducted by the City Government of Bandung in collaboration with IUDMP ITB.
- To introduce the concept of urban disaster mitigation, especially earthquake disaster, and the concept of disaster risk assessment in urban areas.

The Workshop was attended by 90 participants, including speakers and invitees, from 29 Cities and District member of APEKSI and APKASI (District Government Association of Indonesia), including some City Mayors and Head of District Governments.

5.6 Develop and Implement Rapid Risk Assessment (RRA) Procedure for Cities in Indonesia, to Follow-Up the Demand Raised during the Workshop

The objective of the RRA is to rapidly evaluate potential seismic hazard and vulnerability of the cities as a risk measure of the city to seismic disaster. More specifically, the objective of the RRA is to provide the followings:

- Preliminary microzonation and seismic hazard maps of the cities based on preliminary estimate of peak ground acceleration (PGA)

at baserock considering effect of local ground conditions and identification of collateral hazards.
- Qualitative vulnerability conditions of the city that may consist of buildings, lifelines, and population.
- Description of seismic risk of the city to seismic disaster.
- Recommendations of action plans required for seismic disaster mitigation.

RRA is implemented in City of Bengkulu, Denpasar, Manado and Palu.

5.7 Development of National Strategy on Urban Disaster Mitigation (Collaborate with BAKORNAS PBP)

The objective of the activity is to formulate a draft of a national policy in Urban Disaster Mitigation leading to the institutionalization of the policy into a legal product through a series of BAKORNAS PBP Working Group meetings, facilitated by the IUDMP team.

The national policy follow up has successfully gained a collective support at the national level. BAKORNAS PBP has accepted The Draft of National Policy on Urban Disaster Mitigation, and as a follow-up, an inter-ministerial meeting has been held by BAKORNAS PBP for seeking a collective approval and adoption of the policies at the national level. In fact, the policy draft was modified with the valuable inputs from almost all participants of National Workshop, which was interdepartmentally represented.

5.8 Preparation of a Strategic Organizational Business Plan for an ITB Center on Disaster Mitigation and Prevention

The activity produced a document containing the needs and the strategic plan for new research activities, i.e. the Strategic Plan for Institutionalizing the Research Activities on Disaster Mitigation and Prevention at the Institute Technology Bandung Indonesia. In January 2003, a center called “Research Group on Disaster Mitigation” was officially formed.

5.9 The Extension Phase of IUDMP (January – December 2004)

There is a plan to extend the IUDMP implementation in Indonesia through a support from USAID-OFDA, in the framework of AUDMP Extension. The focus of this phase (Phase IV) is on consolidating the result of the preceding IUDMP phases, in particular on ensuring the sustainability of the processes and products, while taking into account the changes occurring induced by the devolution and decentralization processes in the country. The effort will be directed at working with the local government institutions as well as various NGOs interested in the advocacy for disaster mitigation, in particular those working with the communities in reconstructing their damaged houses and public buildings in the war-conflict area in some parts of Indonesia.

6. UNCRD POST EARTHQUAKE SCHOOL SAFETY PROGRAM

As part of its replication program, using the window of opportunity provided by the event of the June 2000 Bengkulu earthquake, the IUDMP-ITB collaborated with United Nations Center for Regional Development (UNCRD) has proposed a post earthquake school safety program in Bengkulu City. The UNCRD at that time was promoting the school earthquake safety project in the Asia-Pacific and the active role of the local community in constructing school buildings that are safe from earthquake hazards.

The program was initially planned to emphasize on full community based for school safety, however, at that time, sweeping moves were underway to rapidly devolve political and fiscal power to lower levels of government. Law 22/199 deals with political autonomy and Law 25/1999 deals with fiscal balance power between central government and the regions. This autonomy policy strongly emphasizes on the community participatory in most aspect of the development of the region. However, due to many internal and external factors, such as the political, financial, social, culture and economic condition, the transition process will be much longer than it is expected.

Because of that, the UNCRD-ITB school safety program in Bengkulu City were adjusted to suit the existing conditions, such as the current practice of top down approach in providing the school buildings and facilities in Indonesia. Thus, the program implementation was then directed toward the twofold aim. First was to raise the school community awareness. Second was to have a post earthquake school reconstruction program which covered evaluation on damaged schools, analysis of construction design, training for increasing technical skill of selected group of people and the field inspection.

The overall aim of the efforts on post earthquake school reconstruction program were to introduce the techniques for constructing earthquake resistant school buildings and repair, retrofitting, and strengthening of earthquake damaged school buildings to technical personnel involved directly in reconstruction and rehabilitation phase of earthquake damage in Bengkulu through such activities: field inspection, evaluation on damaged schools, analysis of construction design, training and inspection.

The evaluation of damaged school buildings was done through the reconnaissance field inspection. As the typical problem of school buildings in Indonesia, most damage were mainly due to some classical matter, i.e. poor detailing shown in shop drawing, poor quality of construction material, poor workmanship, lack of supervision during the construction and lack of maintenance during the operation of the building.

Based on the above assessment, analysis of construction design was conducted on one of the public elementary school, i.e. SDN 62. A set of redesign drawings was produced, which can be used for the purpose of retrofitting and/or strengthening the damaged school building or for the reconstruction of the whole building. These multi purpose redesign drawings were expected to be able to accommodate the existing city program on relief and rehabilitation, since there were many significant donors who were willing to fund the reconstruction damaged school buildings. The success story of implementing the design was that at this moment the drawings were replicated for many school rehabilitations in Bengkulu city and province.

The initiatives in increasing the knowledge and technical skills of school safety were conducted through two series of training. First training program emphasized on the raising of knowledge and know-how of the strengthening and reconstructing the damaged school buildings, meanwhile the second training emphasized specifically to increase the technical skills of the selected group of community who were involved in the Bengkulu city the post earthquake school rehabilitation program.

After the UNCRD sponsored project finished, the drawings provided by the team were adopted for the repair of damaged and construction of new school buildings throughout Bengkulu. The team in collaboration with the University of Bengkulu was assigned to repair, reconstruct ten school buildings and mosque funded by a private Indonesian TV station Indosiar and one by Gulf Oil. Apart from that, many other school buildings were repaired and reconstructed based on the drawings provided by the team, but funded by private institutions.

7. INDONESIAN POLITICAL AND ECONOMIC SITUATION

The economic and political situation remains very unsettled. Indonesia has gone through a period of much turmoil. The financial and economic crises persist. The new democracy is also undergoing growing pains and there remains much tension between different segments of the political body. To this has been added the unrest in various parts of the country that has further exacerbated the economic situation and has made disaster management very difficult.

In many ways, nevertheless, it is remarkable how much is going on in the face of this turmoil. This is a testament to the basic strength of the Indonesian people. It is also a portent, we believe, for better times in the future if the unrest can be overcome.

For the present, the turmoil has had an impact on the focus of disaster management activities in general. In addition, since 1999, there has been an ongoing movement toward fundamental changes in the relationships between central and local government levels. In May, 1999, the Parliament (DPR) passed two laws. The two laws created a legal framework for devolution of political and fiscal power.

Law 22/1999, on regional autonomy, deals with "political autonomy." Law 25/1999, on fiscal balance between the central government and regions. Both Laws 22/1999 and 25/1999 were drafted with relatively open language to be refined through corresponding implementing regulations.

Two ministerial decrees have also been issued under the umbrella of the reform process in support of the decentralization process. Along with Law 22/1999, President decree (Keppres) No. 49/2000 sets guidelines for the establishment of the Board for Development of Regional Autonomy (DPOD) which includes local government representation through their associations and local parliaments.

The Ministry of Home Affairs (MOHA) issued KepMen No. 16/2000 which provides support for the development of independent local government associations and sets the procedures for selecting the association representatives who will sit on the DPOD.

In summary, decentralization in Indonesia is an on-going and dynamic process. It can be expected that many changes will yet occur in the extent to which political and fiscal power is devolved. At present, it can be presumed that local governments will emerge with considerably greater autonomy than in the past, particularly for those functions typically associated with urban management, such as delivery of urban services and infrastructure development. Local governments also appear highly likely to gain far greater authority of expenditure of block-type transfers from the central government; but this reliance on central government transfers does create some limitations for local governments. Lastly, the development of new local government associations will help support and sustain the decentralization process by advocating for improved local governance and by improving the professionalism of local officials.

This is a period of transition and it is likely that it will be some time before the shape of responsibilities and relationships are clear. In any process of decentralization this is normal. In the meantime, resources remain very limited at both the local and national levels, due to the economic crisis. There is also considerable uncertainty concerning the division of responsibilities and the capacity of local government to undertake its new responsibilities, both financially and in human resource terms. Until this decentralization process is fully settled, disaster mitigation activities in Indonesia most probably will not be a priority.

REFERENCES

1. Anonym, November 1999. *Report of UNESCO Project on Education Material Development*.
2. Anonym, December 2000. *Report of Indonesian Ministry of Research and Technology in Bengkulu for the Reconstruction and Rehabilitation Program*.

3. Anonym, November 2000. *Report of the UNCRD & IUDMP-ITB Training Program on Earthquake Resistant Building in the City of Bengkulu*.
4. Anonym, September 2000. *Project Completion Report of the Indonesian Urban Disaster Mitigation Project,* ITB-ADPC
5. Anonym, December 2002. *Project Completion Report of the Indonesian Urban Disaster Mitigation Project: Replication of Urban Disaster Mitigation Initiative,* ITB-ADPC
6. Boen, T., *Impact of Earthquake on School Building in Indonesia*.
7. Boen, T. *Report on the Damage and Repair of the Bengkulu Earthquake of June 4, 2000*, Teddy Boen Konsultan (in Indonesian).
8. Boen,T., T.C. Pan, K. Megawati, J.M.W. Brownjhon, and C.L. Lee. *Report on the Bengkulu Earthwuake on the Bengkulu (Southeran Sumatra) Earthquake of June 2000 (Mw 7.7)*, School of Structure Civil Engineering, Nanyang Technology University.
9. Department of Civil Engineering ITB, *Bengkulu Earthquake Survey Report June 2000*.
10. Firmansyah, J. and M. Irsyam, 1999. *Development of Seismic Hazard Map for Indonesia*, Department of Civil Engineering ITB.
11. GSHAP, 1999. *The Global Seismic Hazard Assessment Program (GHSAP) 1992-1999, Annuali di Geofisica*. Summary Volume, edited by D. Giardini, 957-1230.
12. Mayor of Bengkulu City and Pribadi, 29-31 January 2001. *The Earthquake Disaster in Bengkulu*. UNCRD International Workshop on Earthquake Safer World in the 21st Century, Kobe.
13. Mujiman, November 2000. *Report of Technical Training for Craftmen on the Earthquake Resistant Building in Bengkulu city*.
14. Petersen, M.D., et al (USGS), 2000. *Probabilistic Seismic Hazard Analysis for Sumatra, Indonesia and Across the Malaysian Peninsula*.
15. Pribadi, K.S. and H.P. Rahayu, June 1999. *Raising Public Awareness in Urban Disaster Mitigation: Case Study of Bandung City, Indonesia*. IDNDR Paris Conference, Paris-France.
16. Rahayu, H.P., et al., November 1999. *Development of Earthquake Education Material*. UNESCO Project, Report.
17. Rahayu, H.P., et al, May 2000. *Implementation of Education Campaign Program in Bandung*. IUDMP Project Report.
18. Shah, H.C., and T. Boen, April 1996. *Seismic Hazard Model for Indonesia*. Proceeding HAKI Conference 1997.

SEISMOLOGICAL ACTIVITIES IN MYANMAR

M. SOE and H. H. MYO
Department of Meteorology and Hydrology
Myanmar

1. INTRODUCTION

Myanmar is situated on the boundary of Alpide-Himalayan Earthquake Belt where devastating earthquakes had occurred from time to time and there is obviously the seismic risk in and near the country. The earthquakes in this Alpine-Himalayan region have resulted in massive loss of life and untold suffering. The Alpine-Himalayan earthquake zone, extending from the Mediterranean Sea to the Andaman Sea, is characterized by a widely diffused continental region encompassing young mountain ranges. These mountains owe their existence to large compressive forces resulting from collision of Indian plate and Eurasia Plate and are mostly associated with shallow earthquakes.

A geological collision between Indian subcontinental plate and the rest of Eurasia Continental plate on which Myanmar stands and the collision is still in progress. The world highest mountains, Himalayas rise abruptly from the flat, densely populated Ganges Plain in the northern India and shield the Tibatan plateau from the seasonally shifting monsoon winds of southern Asia.

As an example of its current effects of collision, we believed the great earthquake that occurred in the region was the result of forces originated in the collision area. Even in Myanmar, the moderate seismically active country, the Bago earthquake of 5 May 1930 caused the loss of about 500 lives at Bago and 50 lives at Yangon with major destruction at Bago and some destruction at Yangon. The Sagaing earthquake of 16 July 1956 caused damages to religious edifices and buildings at Sagaing and about 40 lives were lost. The Pagan earthquake of 8 July 1975 caused destruction to many historical monuments at Pagan and 2 lives were lost. It was really the untold religious heritage losses to its people. The Tagaung earthquake of 5 January 1991 caused moderate destruction to the surrounding area. The Taungdwingyi earthquake of 21 September 2003 caused landslide, liquefaction, sand Eurption. Some horistorical pagodas, schools and houses destroyed at Taungdwingyi and neighbouring areas. 7 lives were lost. A list of some of the strong earthquakes that occurred in Myanmar is given in table 1.

The population of Myanmar is over 50 millions and most of the people live along and near the Central Belt's area. This main active fault runs north to south passing near by Yangon, Bago, Pyay, Naung U, Mandalay and Monywa. The establishment of a strong motion network in Myanmar aim towards understanding the level and type of seismic hazard, reducing the impact of future earthquakes and encourage the on-going activity for earthquake disaster prevention in Myanmar.

2. BACKGROUND INFORMATION

The department of Meteorology and Hydrology, D.M.H is responsible for all tasks related to the works for Mitigation and prevention of natural disasters including Earthquake monitoring. The seismological works performed by D.M.H are routine observation and analysis of seismological record and providing information for the general public and related department for mitigation and prevention of earthquake disasters as well as providing earthquake events, strength and frequently experience area within Myanmar, to related project such as construction. Those tasks and services are performed as near real time and continuous for 24 hours every day. Whenever earthquake may occur within Myanmar as well as worldwide area detected at D.M.H stations, D.M.H provides those information to government organization and mass media.

3. PAST AND PRESENT SEISMOLOGICAL INSTRUMENTS

The Department of Meteorology and Hydrology (D.M.H) has introduced seismological monitoring activities since 1963.

The first seismograph instrument was established in Myanmar since Pre Second World War. This is a pendulum type of earthquake recorder (seismoscope) installed at the university of Yangon. It was ceased during the war.

The D.M.H introduced it's first seismograph was a WILLMORE and SPENGNETHER (U.S.A) in 1963 at Yangon and 1966 at Mandalay. Since the instrument uses photo-paper, as a hard copy, it was very hard to obtain real time event.

The next generation seismograph, was visual recording seismograph (Katsujima-Japan) installed in D.M.H Yangon as well as Mandalay in 1977.

Katsnjima Long period seismograph was installed at Yangon in 1984. Also Katsnjima solar powered seismograph installed at Sittwe in 1984 and at Dawei in 1985 as well.

The next one is a digital strong motion seismograph (K_2) in 1995.

Ten sets of Modern Strong motion Accelerohraphs, ETNA SI, kindly donated by OYO Coporation, Japan through WSSI was installed at ten stations in Myanmar during the year 2001-2002.

Two sets of digital seismographs have been installed in DMH Headquarter (Yangon) and Mandalay in April 2003, which were donated by Yunnan Seismological Bureau, People Republic of China. Out of these two, the one from Mandalay station is directly connected to Beijing (China Seismological Bureau – CSB) through VSAT communication.

4. WSSI ACTIVITIES IN MYANMAR

The first High Level Meeting was held in the Department of Meteorology and Hydrology (DMH), Myanmar, jointly sponsored by WSSI and DMH on 7th to 8th December, 1999. At this meeting, OYO corporation kindly donated 10 sets of Strong Motion Accelerographs through WSSI to establish a Strong Motion Network in Myanmar. For the installation of accelerographs, the Workshop and Seminar on Strong Motion Network was held in Department of Meteorology and Hydrology (DMH) again which was jointly sponsored by WSSI and DMH on 29th to 30th September, 2000. After that Workshop and Seminar, 10 sets of strong motion accelerographs were installed by guidance of DR.MASUDA and two personals from DMH who were trained at Japan for two weeks on the training course on Installation of the Bore Hole Type Accelerometer and Operation of the Strong Motion Recorder. Another Introductory course on the effects of earthquakes was held in Department of Meteorology and Hydrology (DMH), Myanmar in 18th May, 2001. Earthquake course was held in DMH on 24th-28th February 2003 again.

All these above mentioned workshop, seminar and meeting, there were many participants from many departments, like Department of Meteorology and Hydrology (DMH), Myanmar Earthquake Society (MES), Yangon and Mandalay City Development Committee(YCDC and MCDC), Public Works Department, Human Settlement and Housing Department etc, and participants from Universities attended and discussed about the public awareness and preparedness for earthquake disaster prevention.

Ten sets of strong motion accelerographs were completely installed at ten stations, Yangon, Paethin, Sittwe, Pyay, Mandalay, Bago, Monywa, Nyaung U, Myitkyina and Meiktila.The locations of ten sets of strong motion accelerographs are shown in table 2 and the seismological stations in Myanmar are shown in Fig. (1).

5. RECENT STATUS OF 10 SETS OF STRONG MOTION ACCELERLOGRAPHS

5.1 Yangon Station

The strong motion accelerograph (ETNA-SI-879) has been installed at Yangon station on 16.12.2002. From the installation time to now, the adjustment of threshold values have been made many times. Strong motion accelerograph never recorded the events. The noise level of Yangon station is too high. And then, all three components (North-South component(L), Vertical component(V) and East-West component(T))are off set. Now Yangon station is under repairing with guidance of Dr. Masuda.

5.2 Pathein Station

The installation of the strong motion accelerograph (ETNA-SI-877) has been finished at Pathein Station on 20.12.2000. Till now, the threshold value was setting by (0.08) for three channels. Auto Voltage Power Supply was out of order on 30th May 2001. Now it has been already repaired During the operational period, there were no recorded events.

5.3 Sittwe Station

The strong motion accelerograph was completely installed at Sittwe station on 3.2.2001. The threshold value for three channels was (0.04) each. There were two recorded event on19.10.2001 and 13.9.2002. Strong motion accelerograph from Meiktila also detected the first event and the strong motion accelerograph from Bago also recorded the second event. These events (TV001.evt & WT001.evt) are shown in Fig. (2) and (3).

Sr. No.	Date	Maximum Acceleration	Phase	S-P
1	2001/10/19	8.3Gal	P,S	18sec
2	2002/09/13	0.9Gal	S	

5.4 Pyay Station

The installation of strong motion accelerograph had been completed at Pyay station on 16.4.2001. The threshold value for three channels was (0.06) each. During three years, there were four recorded events from this station. These events (DX007.evt, Vg001.evt, Eb001.evt & Eb002.evt) are shown in Fig.(4), (5) ,(6) and (7).

Sr. No.	Date	Maximum Acceleration	Phase	S-P
1	2001/10/07	6.2Gal	S	
2	2003/01/17	1.9Gal	P,S	12sec
3	2003/09/21	14.3Gal	P,S	16sec
4	2003/09/21	1.5Gal	S	

5.5 Mandalay Station

Strong motion accelerograph was completely installed at Mandalay station on 6.11.2000. The threshold value for each channel was (0.04). During the operational period of three years, there were 3 recorded events on 31.5.2001 (DI001.evt), 8.7.2001 (EJ001.evt) and 21.8.2001 (EM001.evt). All these events are shown in Fig. (8), (9)& (10).

Sr. No.	Date	Maximum Acceleration	Phase	S-P
1	2001/05/31	2.0Gal	P,S	2sec
2	2001/07/08	6.2Gal	P,S	2sec
3	2001/08/21	1.4Gal	P,S	13sec

5.6 Bago Station

Strong motion accelerograph was completely installed at Bago station on 14.8.2001. At first, the threshold value for three channels had been set with (0.08) each. Later, we adjusted the threshold value again for 3 channels (0.08, 0.04, 0.08). Finally, the threshold value for three channels was (0.04) each. There were 6 events from Bago station. These events (JK006.evt, NS005.evt, XH002.evt, Ap001.evt, At001.evt & At002.evt) are shown in Fig. (11), (12), (13), (14), (15) & (16).

Sr. No.	**Date**	**Maximum Acceleration**	**Phase**	**S-P**
1	2002/08/18	1.6Gal	P,S	14sec
2	2002/09/13	1.0Gal	S	
3	2002/11/16	1.0Gal	P,S	10sec
4	2003/03/26	2.3Gal	S	
5	2003/09/21	5.2Gal	P,S	27sec
6	2003/09/21	1.0Gal	S	

5.7 Monywa Station

The 2nd time installation of strong motion accelerograph was finished at Monywa station on 6.6.2001. The threshold value was (0.06). There were no recorded events during the operational period.

5.8 Nyaung U Station

The installation of strong motion accelerograph at Nyaung U station was finished on 30.7.2001. The threshold value was (0.08) each. There were seven recorded events. One of these events (DJ017.evt) was recorded from SMA and three analog seismograph stations (Yangon, Mandalay & Sittwe). These events (Dj015.evt, Dj016.evt, Dj017.evt, Di014.evt, Di015.evt, Dn003.evt & Dn004.evt) are shown in Fig. (17), (18), (19), (20), (21), (22) & (23).

Sr. No.	**Date**	**Maximum Acceleration**	**Phase**	**S-P**
1	2001/09/29	4.0Gal	P,S	6sec
2	2001/10/07	1.9Gal	P,S	11sec
3	2002/04/06	2.6Gal	P,S	10sec
4	2002/11/18	4.8Gal	P,S	6sec
5	2002/12/09	5.6Gal	P,S	5sec
6	2003/09/21	11.1Gal	P,S	22sec
7	2003/09/21	1.8Gal	S	

5.9 Myitkyina Station

Strong motion accelerograph at Myitkyina station was completely installed on 1.6.2001. The threshold value for each channel was (0.08). There was an earthquake on 3.9.2002 (JB001.evt) which Mandalay analog seismograph also detected. This recorded event is shown in Fig (24).

Sr. No.	**Date**	**Maximum Acceleration**	**Phase**	**S-P**
1	2002/09/03	14.7Gal	P,S	5sec

5.10 Meiktila Station

The strong motion acceleragraph had been installed at Meiktila station on 7.8.2001. The threshold value was (0.08). The Auto Voltage Power Supply (APS) was out of order on 9.5.2002 to 25.7.2003. From the installation time to now, there were recorded two events. These recorded events (Gy009.evt&Hm001.evt) are shown in Fig (25) & (26).

Sr. No.	**Date**	**Maximum Acceleration**	**Phase**	**S-P**
1	2001/10/19	1.7Gal	S	
2	2003/09/21	22.4Gal	P,S	13sec

In 21 September 2003, (4) stations out of (10) stations were recorded the strong earthquake of Taung Dwin Gyi in Myanmar. It is indicating that those not functioning (6) stations have to repair or calibrate. In order to resume the defected stations we would like to request from respective company or agency's advise. Since we had already carried out the threshold setting with our best knowledge, the defected equipments are still not satisfaction.

6. REMOTE READING NETWORK

Although Myanmar PSTN (Public Switch telephone Network) are reliable for facsimile, Internet modem and dial-up PC modem Network, the SMA network is still not function. We guess that the AT command string, we already tried is not fit for those used between modem-PSTN line and seismo configuration. In this regards particular setting for the equipment is also requested.

7. TRAINING, AWARENESS AND PREPAREDNESS PROGRAM

DMH was collaborated with UNDP under UNDP/Integrated Community Development project for the Hazard Reduction Training Workshop on 21st to 23rd August, 2003 in the Deltaic area and landslide and

Erosion Training workshop on 15th November, 2003 in the southern Shan State.

In 2004, DMH will implement the Human Resources Development course on Natural Disaster (Level 1, Level 2, Level 3) jointly sponsored with Dagon University.

8. FUTURE PLANS FOR NEXT 5 YEARS

DMH of Myanmar and its relationships with WSSI has gradually progressed of Meeting, Workshop, Seminar and Valuable lectures by WSSI.

Myanmar has also been very fortunate in the progress of the seismological division of DMH, from the assistance and guidance of the WSSI.

For the future progress of the DMH of Myanmar with accelerograph stations, it is essential that we promote our communication system to implement a Strong Motion Network.

The future plan is intended to remedy the prevailing weakness in communication system and generating advanced technicians in the years ahead as per priority given below:

(1) Training for advance data analysis for Strong Motion Accelerographs.
(2) Training for maintenance of accelerographs.
(3) The guidance of an expertise.
(4) To provide spare parts and accessories for Strong Motion Acceleragraphs.
(5) Trainings for short term and long term in Seismology and Earthquake Engineering.
(6) To draw the microzonation map and building code for Myanmar with the guidance of WSSI.

9. CONCLUSION

The Taungdwingyi Strong Earthquake magnitude 6.7 had occurred on 21.09.2003. For this event, Bago, Pyay, Meiktila and Nyaung U stations recorded. The maximum acceleration of these four stations are 5.2 gal, 14.3 gal, 22.4 gal and 11.1gal respectively. During the operational period of three years, there were 25 recorded events from seven stations (Bago, Pyay, Mandalay, Meiktila, Myitkyina, Nyaung U and Sittwe). There were no recorded events from three stations (Yangon, Pathein and Monywa). Recently, civil engineering students from Yangon Institute of Technology are applying some of these recorded events to draw the earthquake resistant design by computing the base shear. The recorded events will be useful for further study in seismology field and earthquake engineering field. The Strong Motion Network now consists of only ten stations in a wide area.

Therefore, there are more chance to apply in research works than the earthquake information issue by using the recorded events.

The Department of Meteorology and Hydrology is now trying to promote our communication system to link the stations as a network. DMH is the national agency responsible for seismological to meet the requirements of the nation and its people. It also takes responsible to implement a strong motion network project.

This project provides us a great opportunity to study and learn the modernized strong motion accelerographs and the advanced technical knowledge. The future guidance of World Seismic Safety Initiative (WSSI) will always be a great assistance to the progress of our department. DMH is trying the best to successfully complete the establishment of the strong motion network in Myanmar.

Table 1: List of strong earthquakes in Myanmar

Sr. No.	Date	Epicenter		Magnitude (Richter Scale)	Remarks
		Latitude (ºN)	Longitude (ºE)		
1	23-05-1912	21.00	97.00	8.0	North of Taunggyi, serious landslide
2	06-03-1913	17.00	96.50	7.0	"Hti" of Shwe-maw-daw Pagoda grounded
3	05-07-1917	17.00	96.50	7.0	"Hti" of Shwe-maw-daw Pagoda grounded
4	19-01-1929	25.90	98.50	7.0	Brick buildings destroyed at Htaw-Gaw
5	08-08-1929	19.25	96.25	7.0	Railway lines destroyed at Swa
6	16-12-1929	25.90.	98.50	7.0	Landslide at Htaw-Gaw
7	05-05-1930	17.00	96.50	7.3	Many houses destroyed, 500 killed in Bago. Some houses destroyed, 50 killed in Yangon
8	03-12-1930	18.00	96.50	7.3	Some houses destroyed, about 30 killed in Phyu.
9	27-01-1931	25.60	96.80	7.3	Brick buildings collapse, landslide at Kar-mine
10	12-09-1946	23.50	96.00	7.5	Pagoda collapse at Ta-gaung
11	15-08-1950	28.50	96.50	8.6	Under the influence of Assam earthquake, Chindwin river at Mawlaik and Kalewa, Ayeyarwady river at Aunglan flow upstream
12	16-07-1956	22.00	96.00	7.0	Pagoda & buildings at Sagaing destroyed, about 40 killed. Sagaing bridge moved slightly.
13	08-07-1975	21.50	94.70	6.8	Many historical pagodas destroyed 2 killed near Bagan.
14	05-01-1991	23.48	95.98	7.1	Landslide & some buildings destroyed at Tagaung, Hti-gaint, Kawlin and Thabeikyin and surrounding area . 2 killed
15	22-09-2003	19.94	95.72	6.7	Landslide, liquefaction and sand Eruption. Pagodas, some bridges, houses and schools destroyed at Taungdwingyi and surrounding areas. 7 killed.

Table2: Information about strong motion network stations

Sr. No	Station	Lat. °N	Log. °E	Height Meters	Feet	Telephone	S.S.B	Date	Foundation	Borehole Depth
1	Mandalay	21°59'	96°06'	78	257	02/39120	√	6-11-2000	Lime Stone	2' 5"
2	Yangon	16°54'	96°10'	20	61.25	663514	√	16-12-2000	Alluvial	10' 6"
3	Pathein	16°46'	94°46'	4	13	042/24377	X	20-12-2000	Alluvial	13' 10"
4	Sittwe	20°08'	92°53'	5	16	043/21168	√	3-2-2001	Sandy Soil	10'
5	Pyay	18°48'	95°13'	38	124	053/21116	√	16-4-2001	Hard Soil	10'
6	Myitkyina	25°22'	97°24'	145	475	074/22346	√	1-6-2001	Hard Soil	10'
7	Monywa	22°06'	95°08'	81	245	071/21031	√	6-6-2001	Sandy Soil	11' 6"
8	NyaungU	21°12'	94°55'	61	200	062/70254	√	30-7-2001	Sand Stone	7'
9	Meiktila	20°20'	95°50'	214	703	064/21120	√	7-8-2001	Hard Soil	10'
10	Bago	17°20'	96°30'	9	31	052/21095	X	24-8-2001	Alluvial	10'

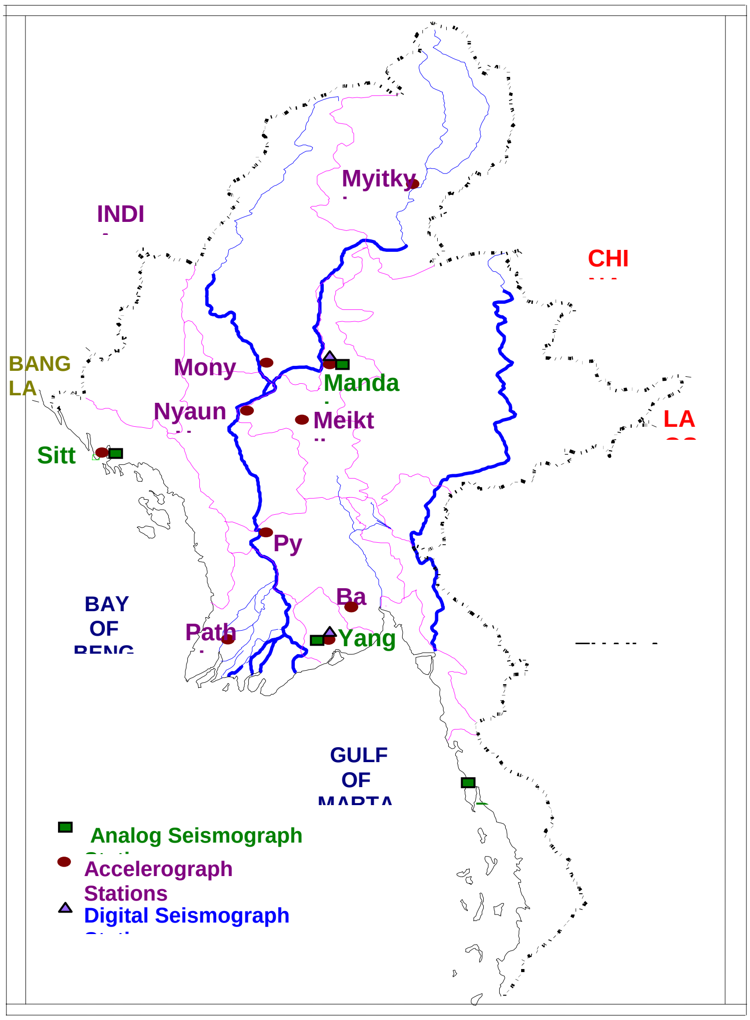


Figure 1: Seismological stations in Myanmar

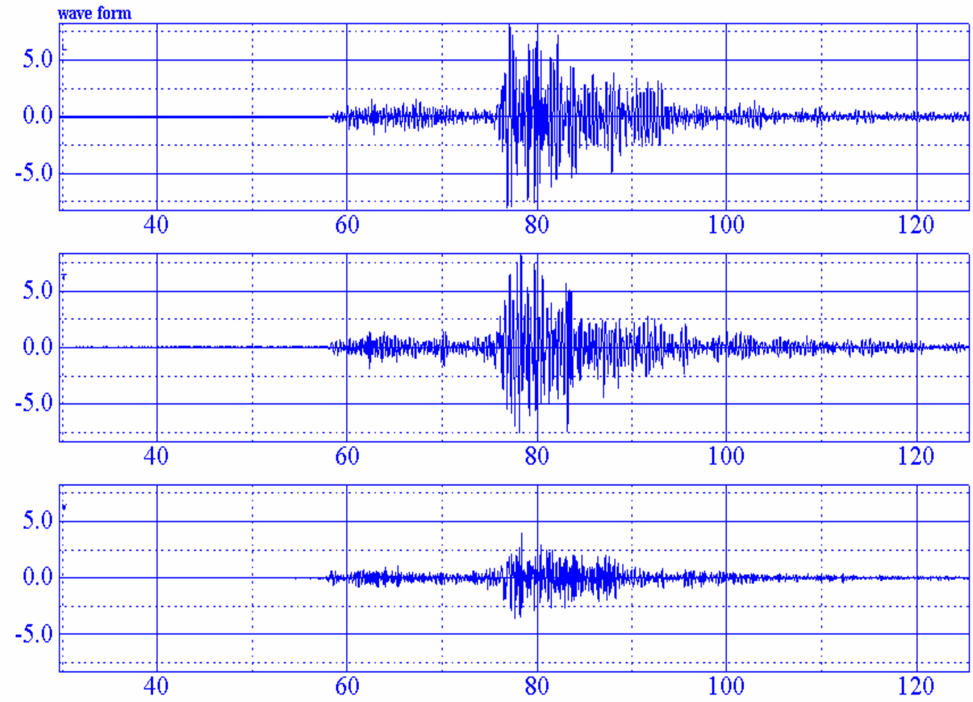


Figure 2: 2001/10/19 07:04:30 UTC at Sittwe

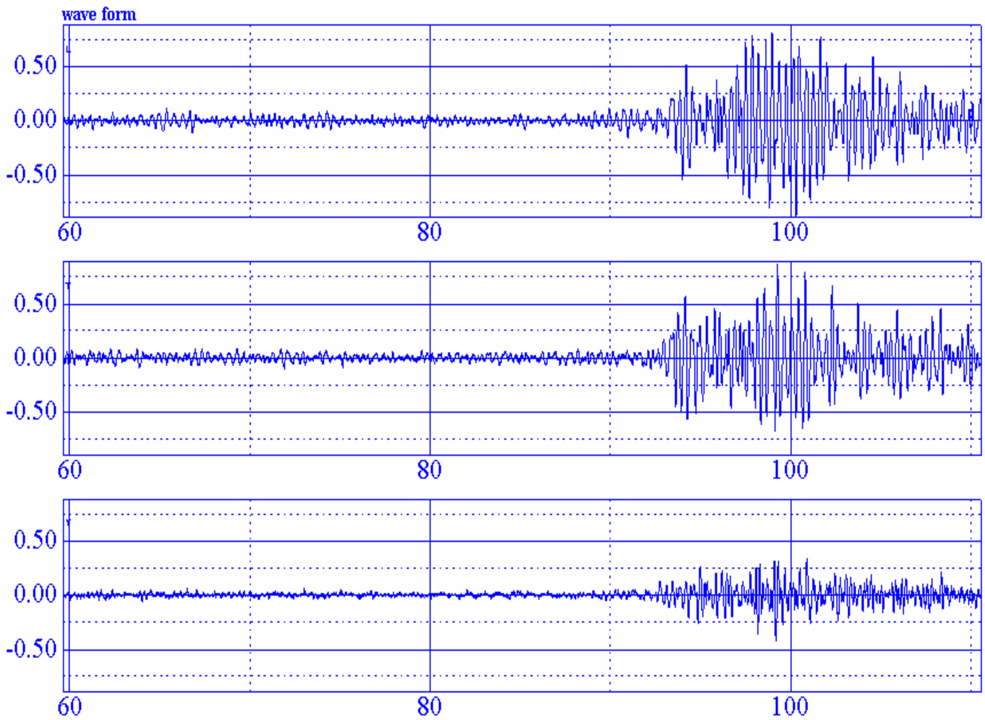


Figure 3: 2002/09/13 22:31:00 UTC at Sittwe

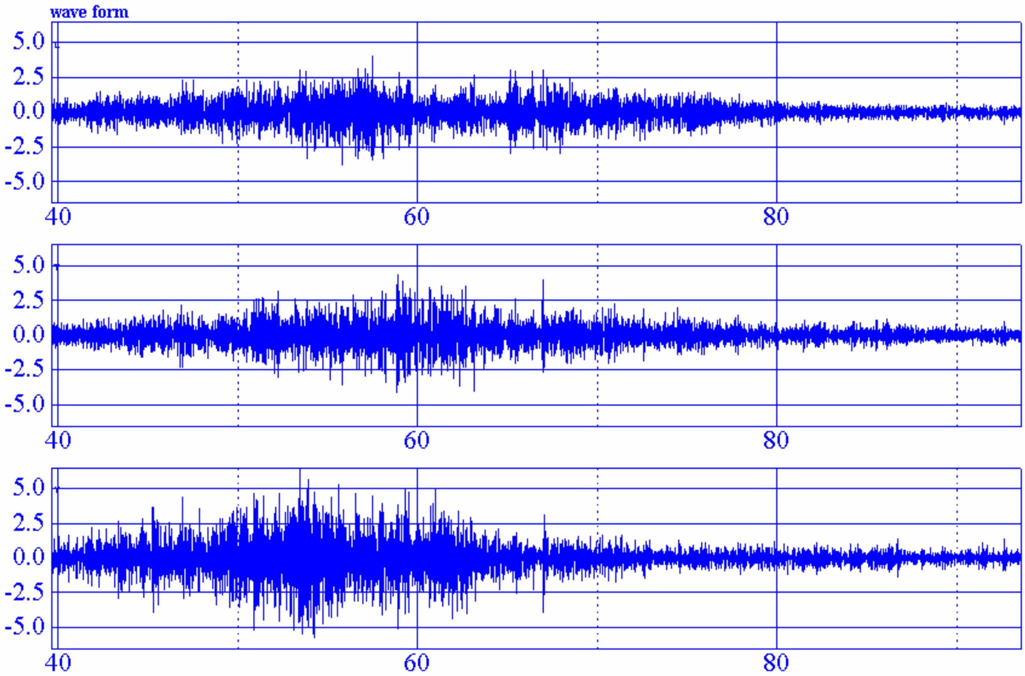


Figure 4: 2001/10/07 14:43:40 UTC at Pyay

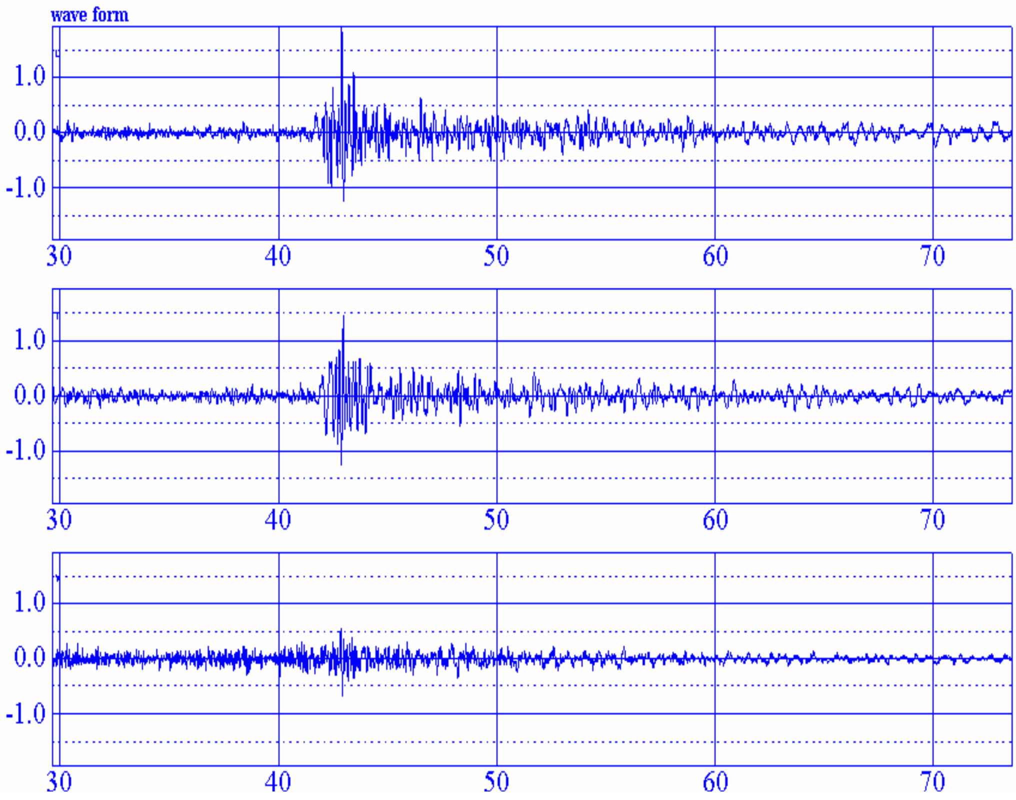


Figure 5: 2003/01/17 02:53:43 UTC at Pyay

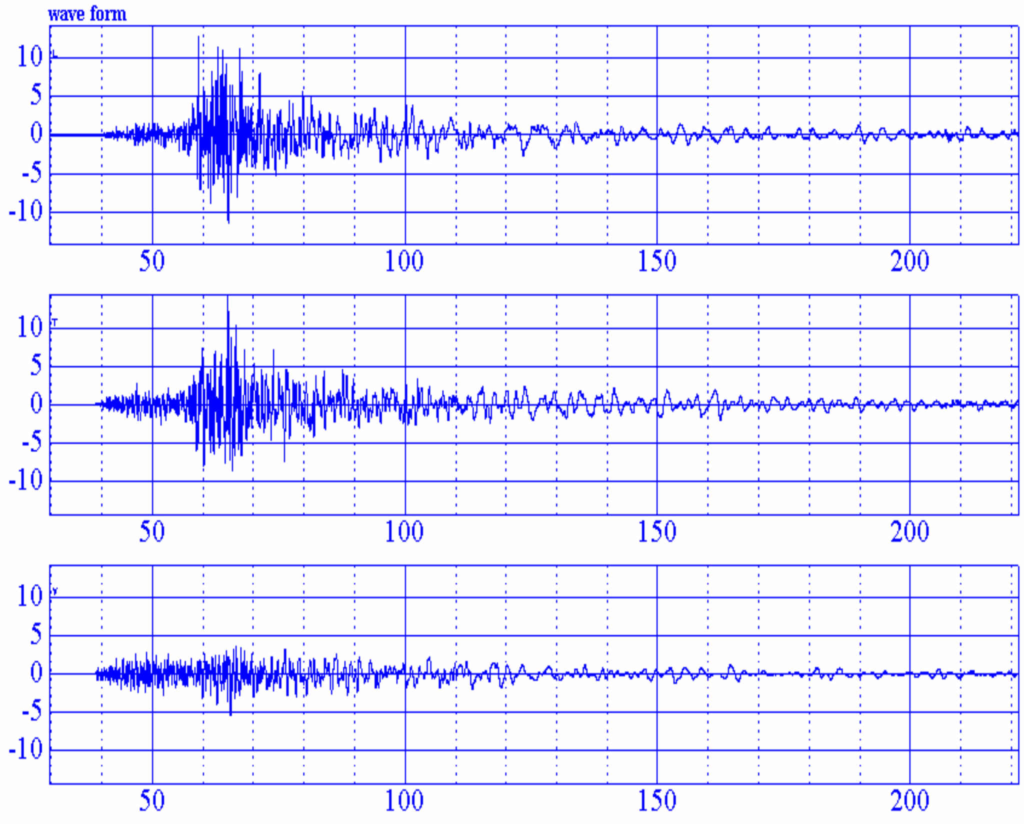


Figure 6: 2003/09/21 18:16:30 UTC at Pyay

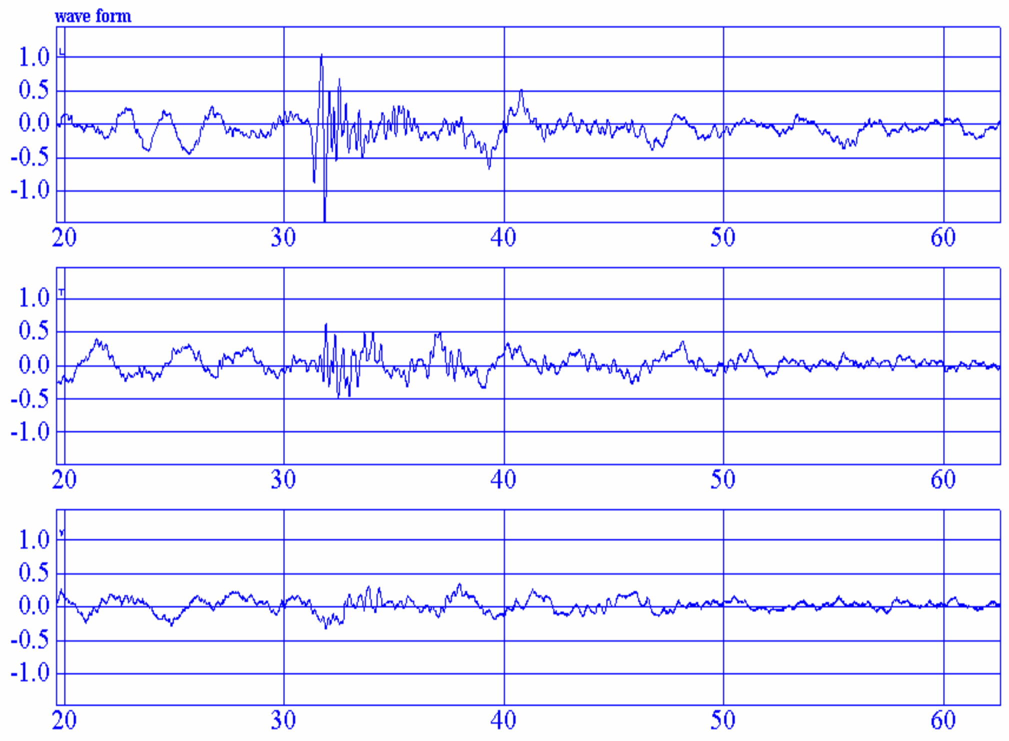


Figure 7: 2003/09/21 18:20:20 UTC at Pyay

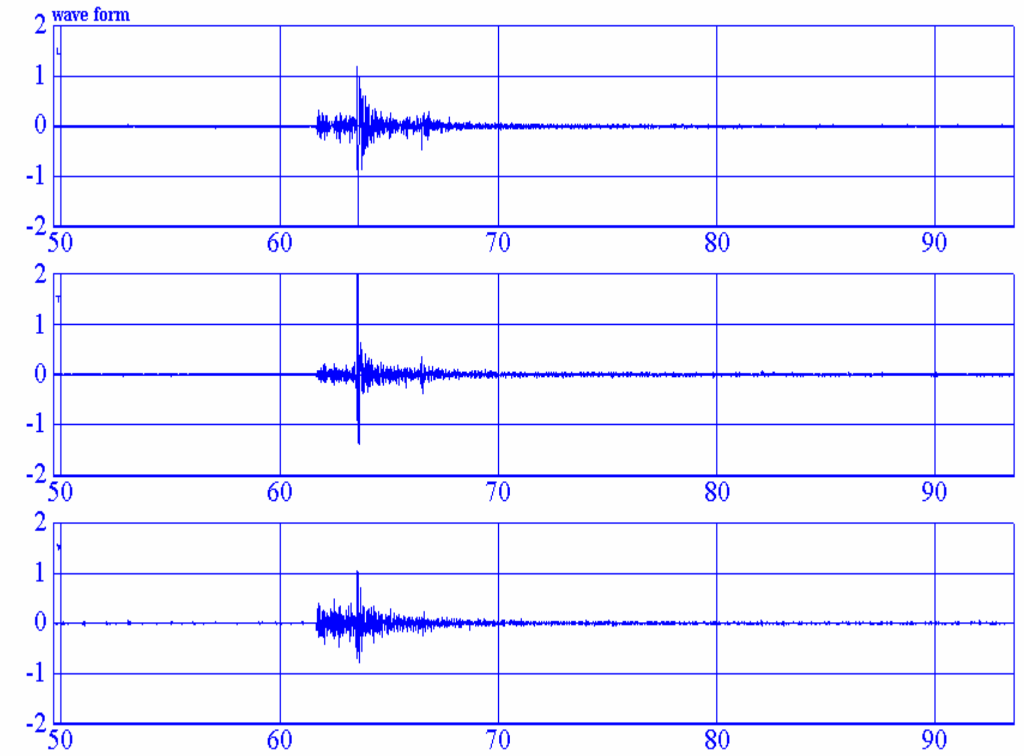


Figure 8: 2001/05/31 21:46:50UTC at Mandalay

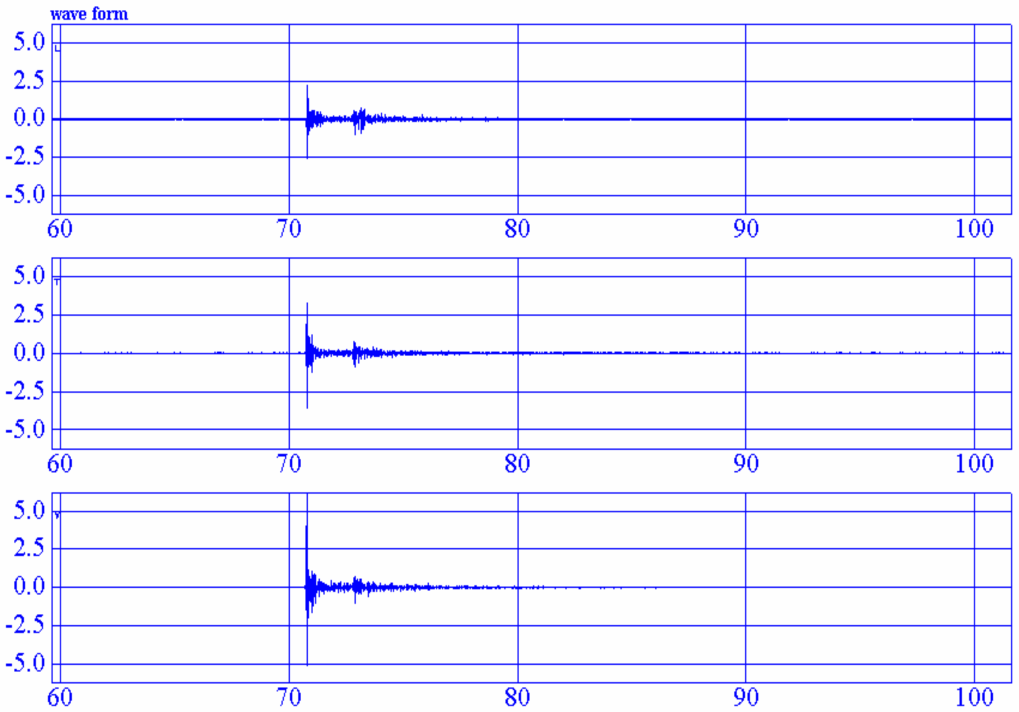


Figure 9: 2001/07/08 20:05:00UTC at Mandalay

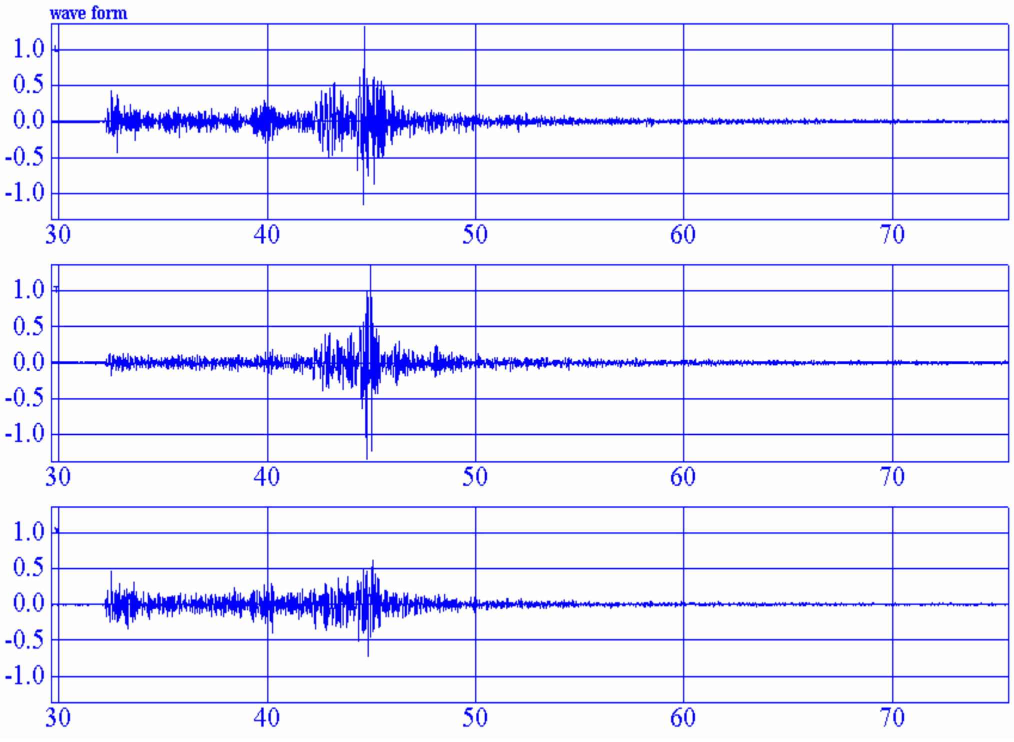


Figure 10: 2001/08/21 20:17:30UTC at Mandalay

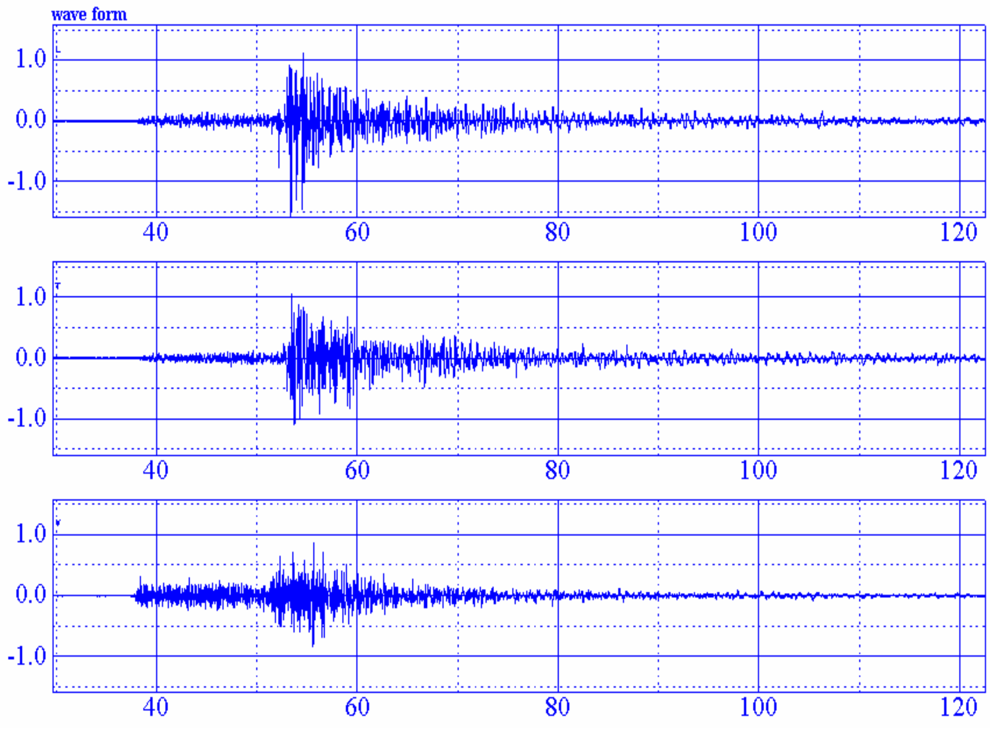


Figure 11: 2002/08/18 21:07:30UTC at Bago

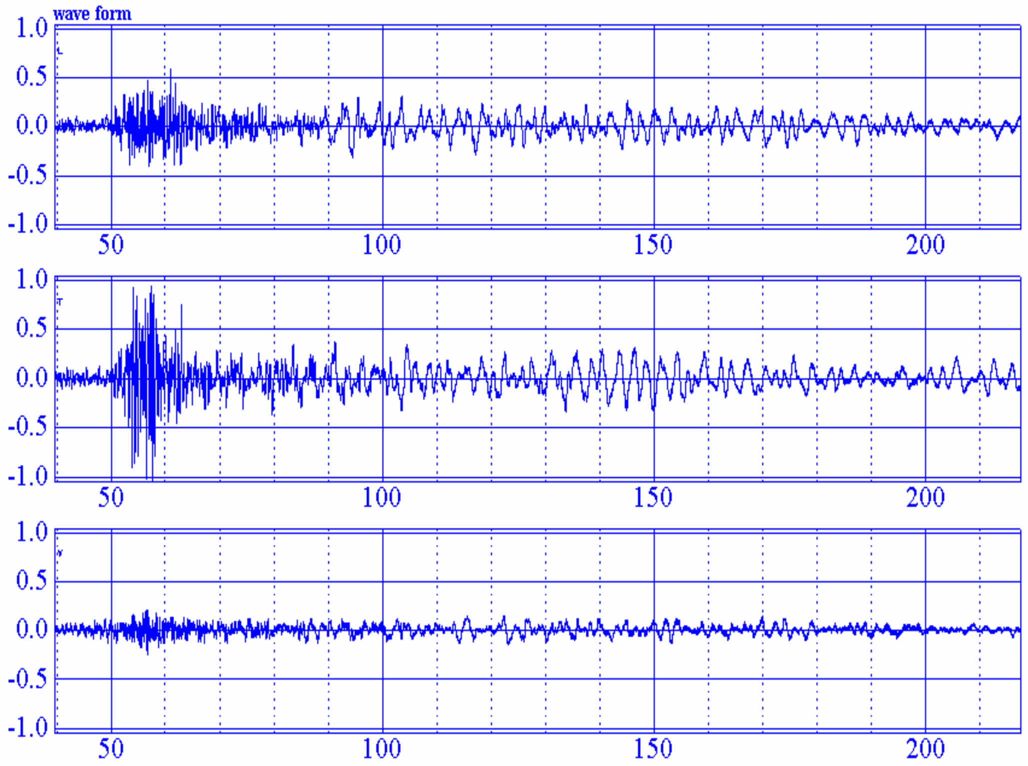


Figure 12: 2002/09/13 22:30:40UTC at Bago

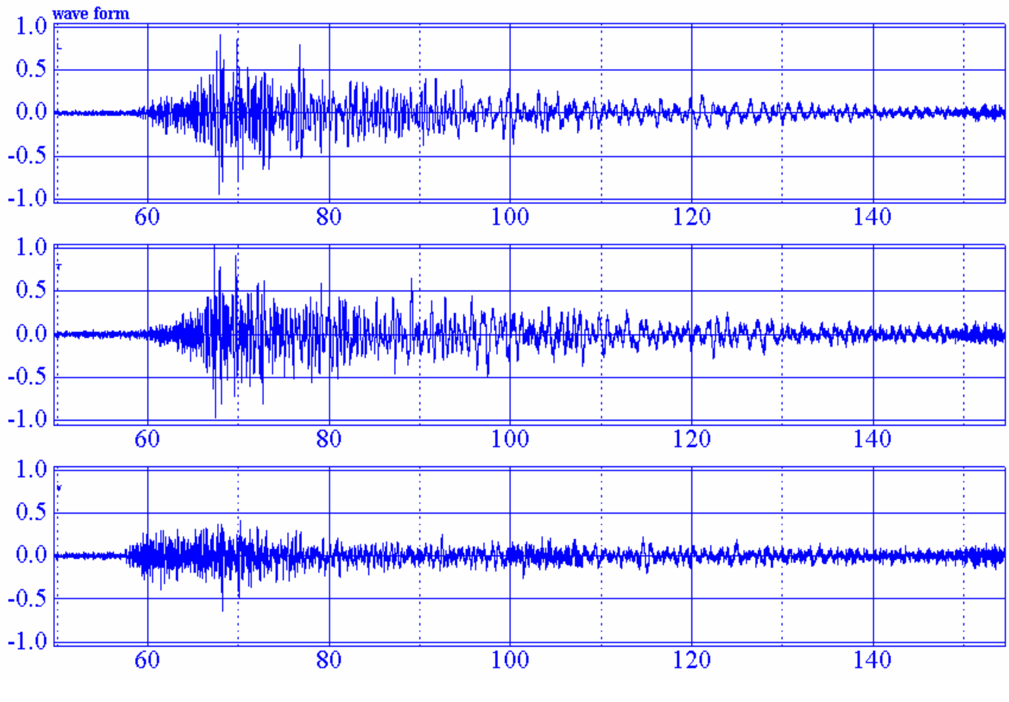


Figure 13: 2002/11/16 16:55:50UTC at Bago

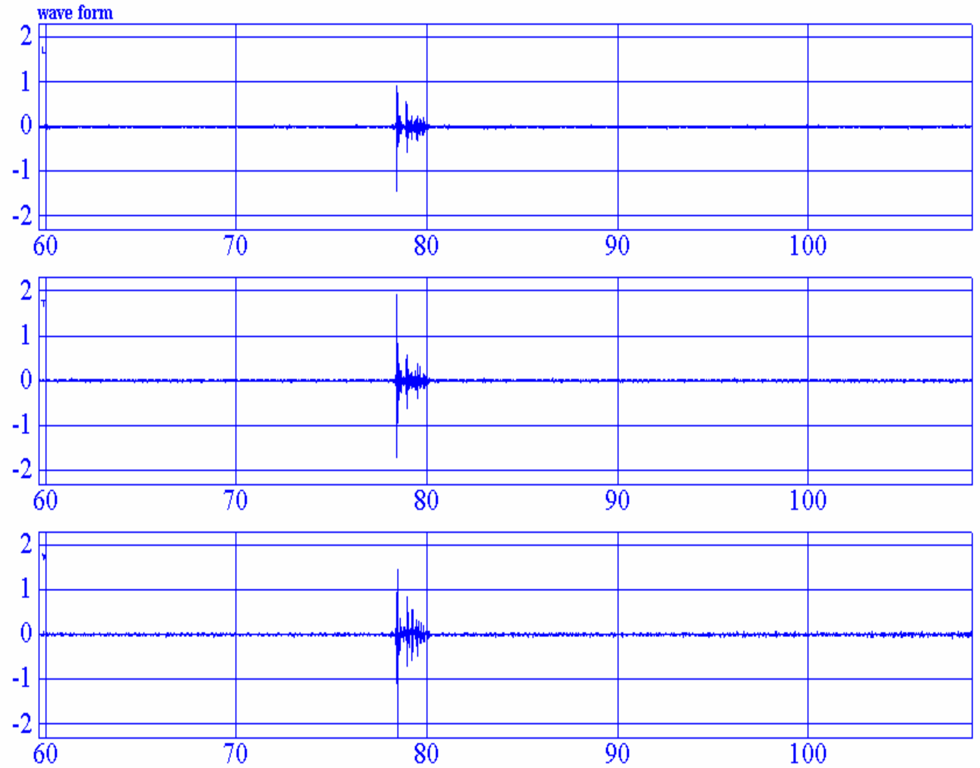


Figure 14: 2003/03/26 02:58:00UTC at Bago

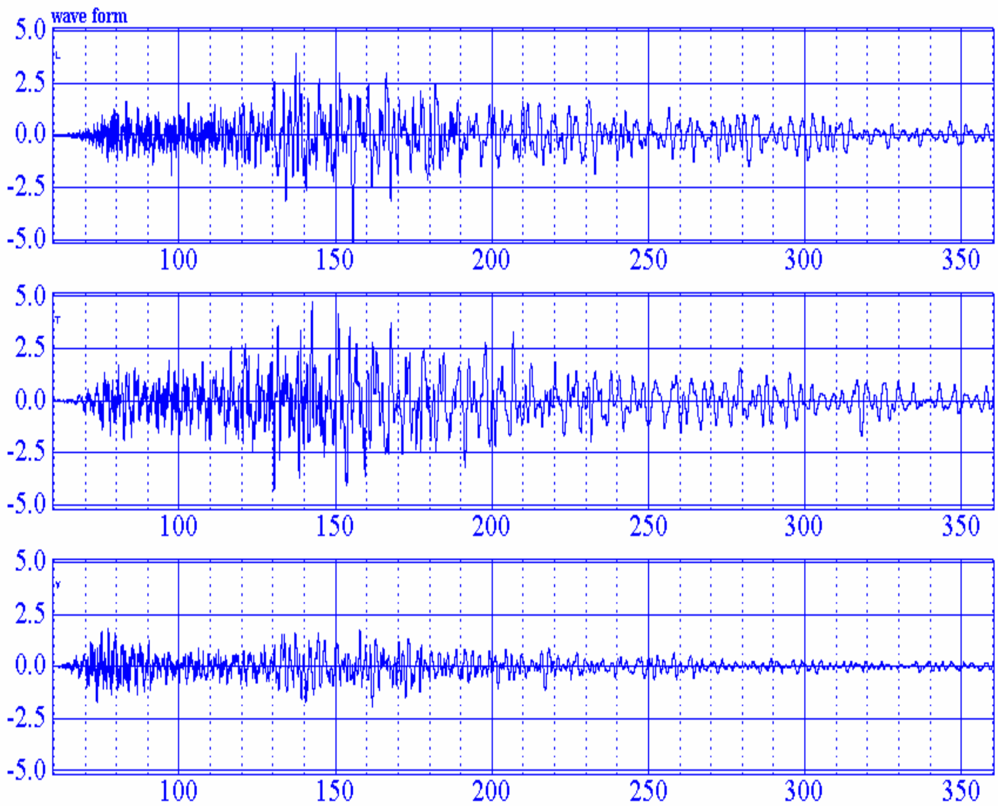


Figure 15: 2003/09/21 18:17:00UTC at Bago

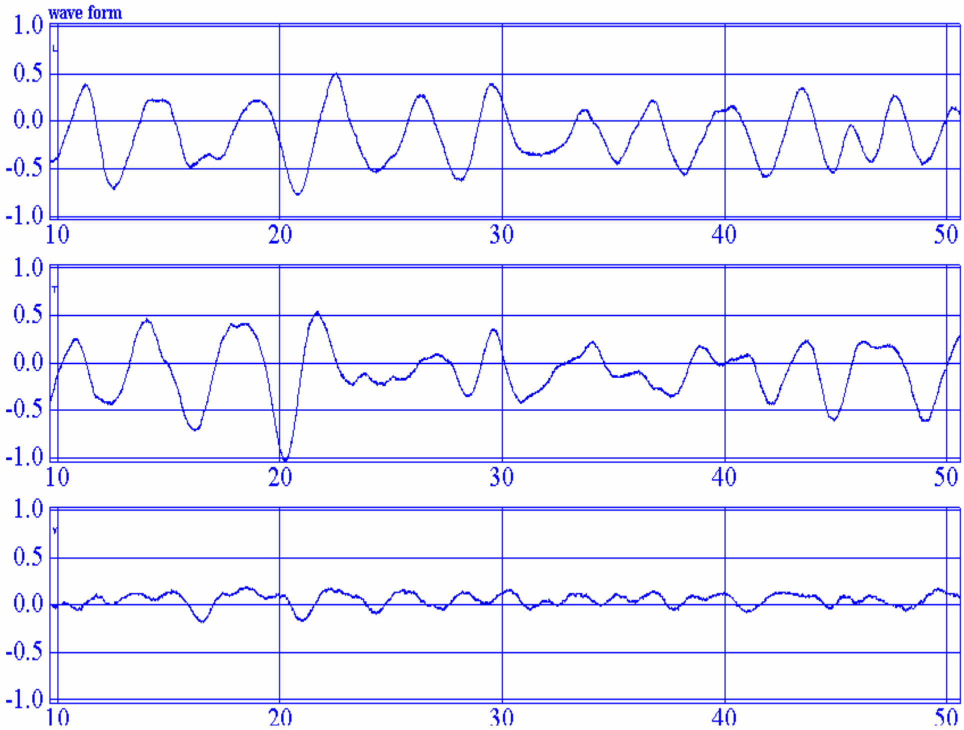


Figure 16: 2003/09/21 18:17:00UTC at Bago

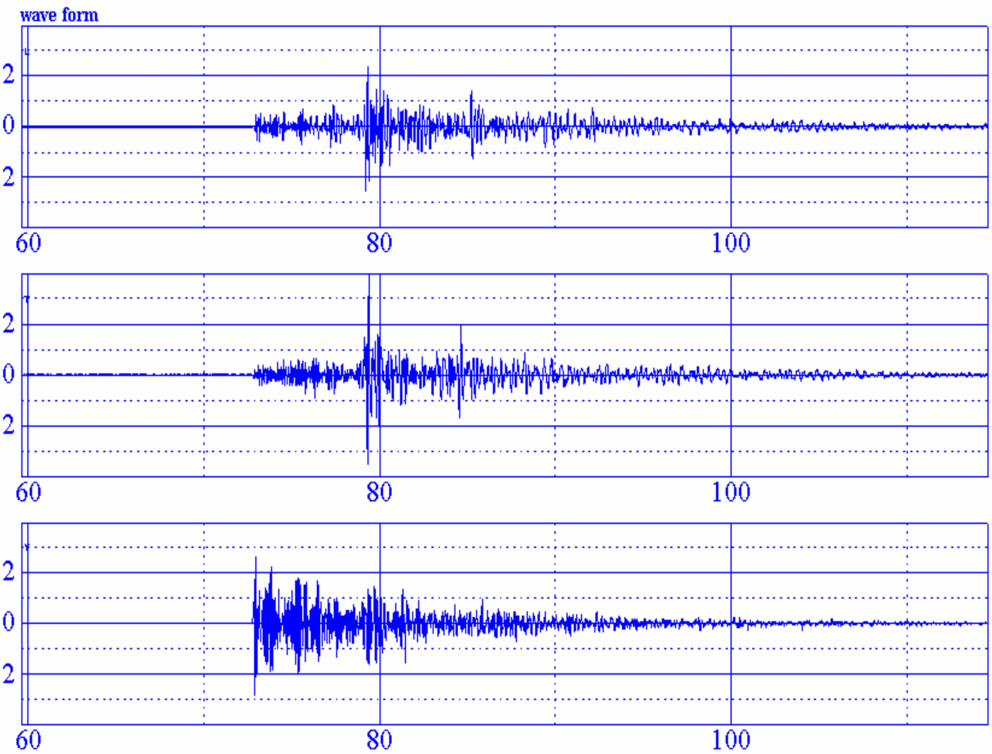


Figure 17: 2001/09/29 17:44:00UTC at Nyaung U

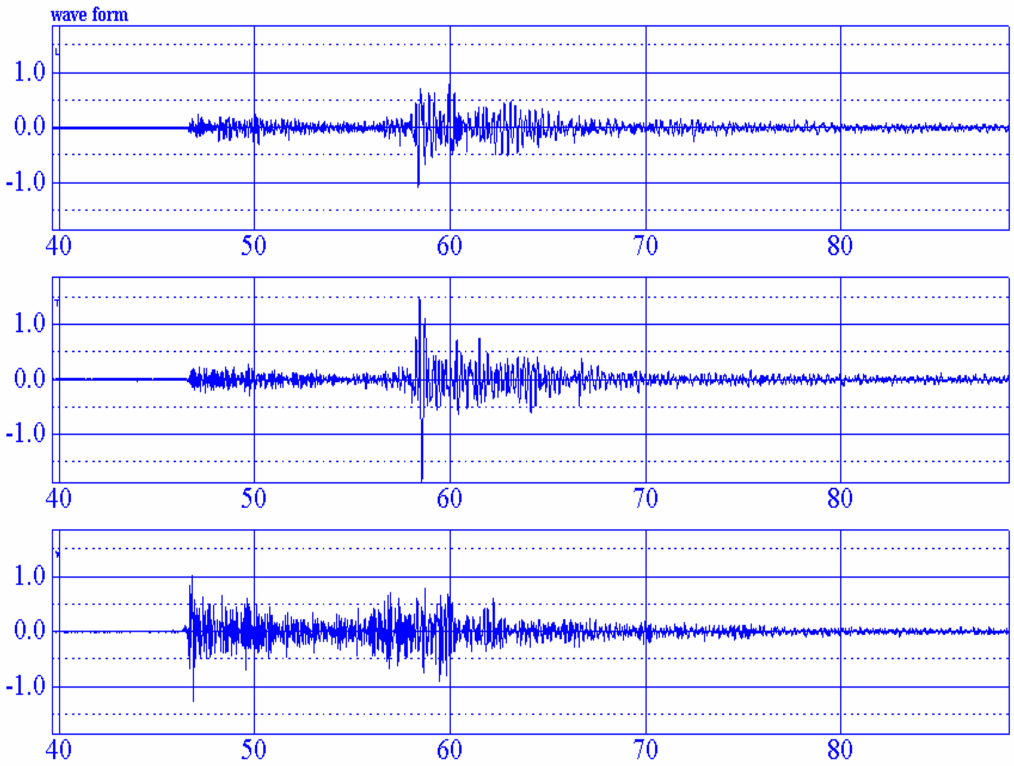


Figure 18: 2001/10/07 10:01:40UTC at Nyaung U

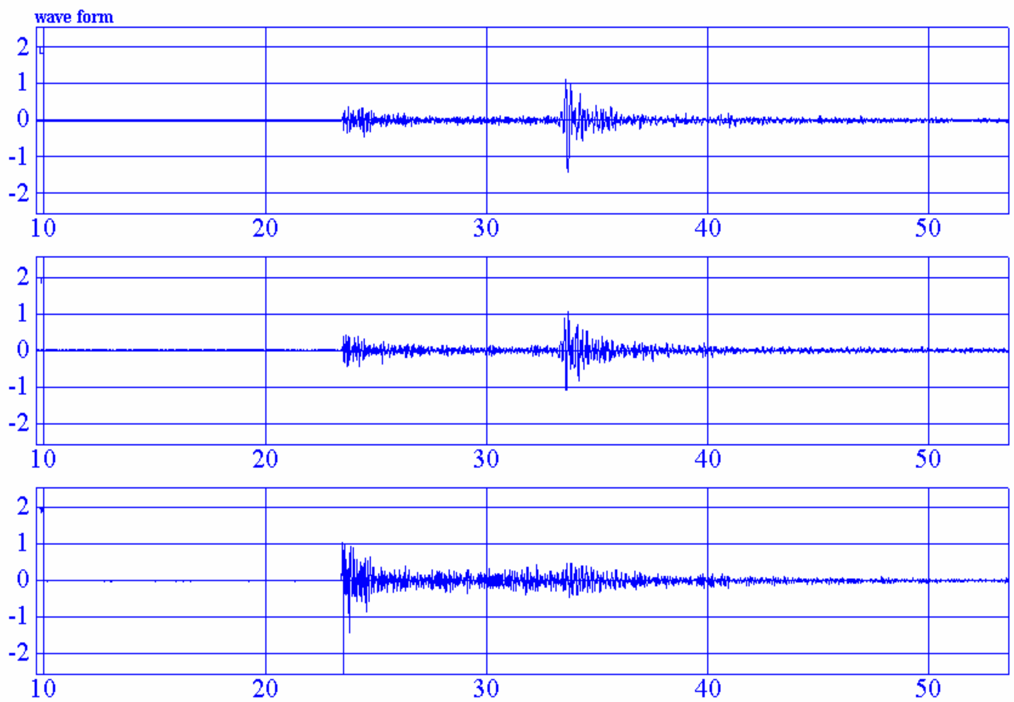


Figure 19: 2002/04/06 07:41:10UTC at Nyaung U

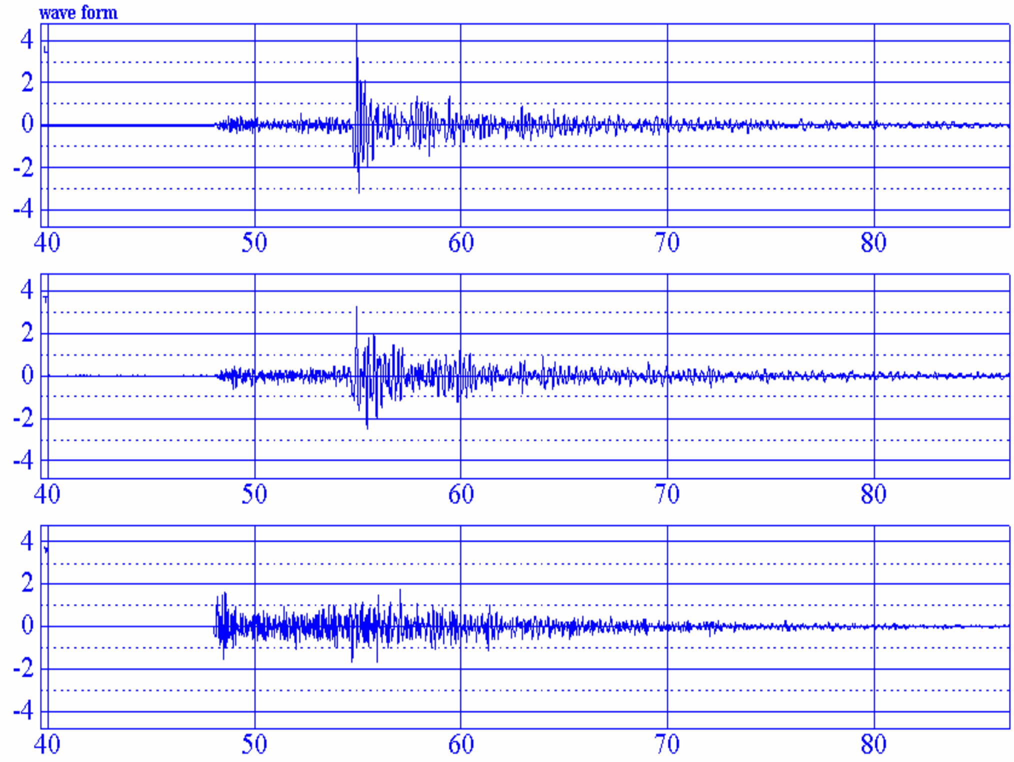


Figure 20: 2002/11/18 21:59:40UTC at Nyaung U

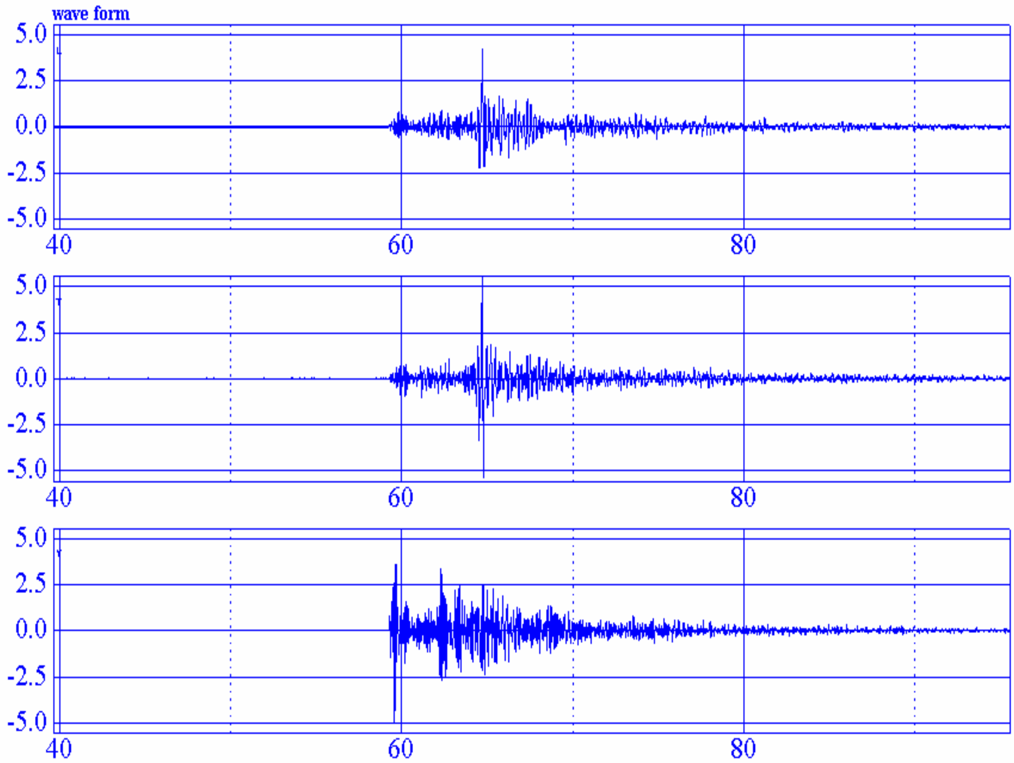


Figure 21: 2002/12/09 08:05:40UTC at Nyaung U

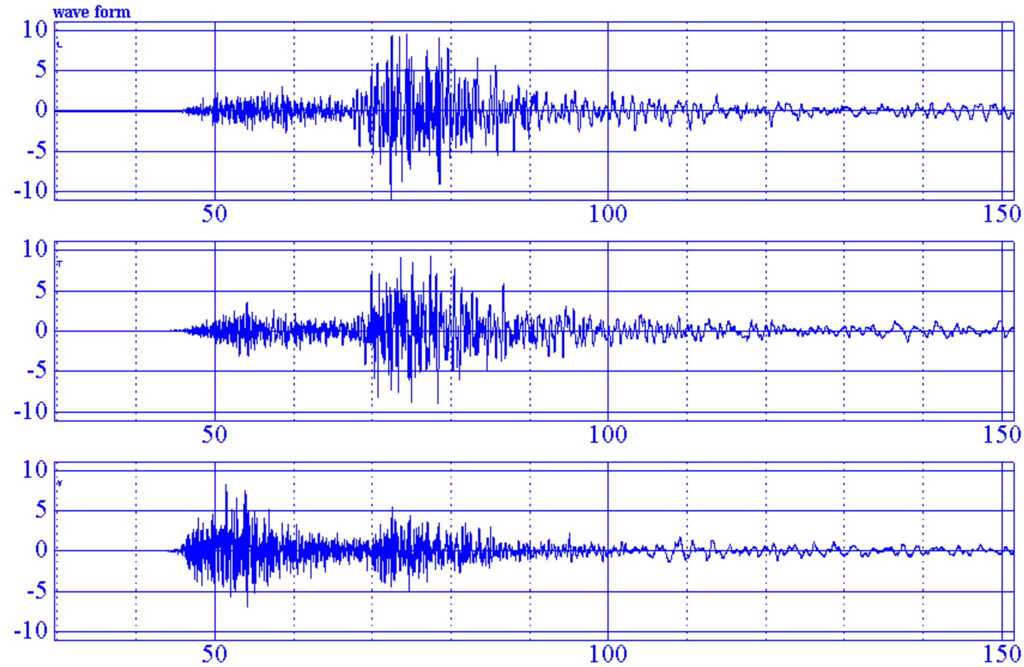


Figure 22: 2003/09/21 18:16:30 UTC at Nyaung U

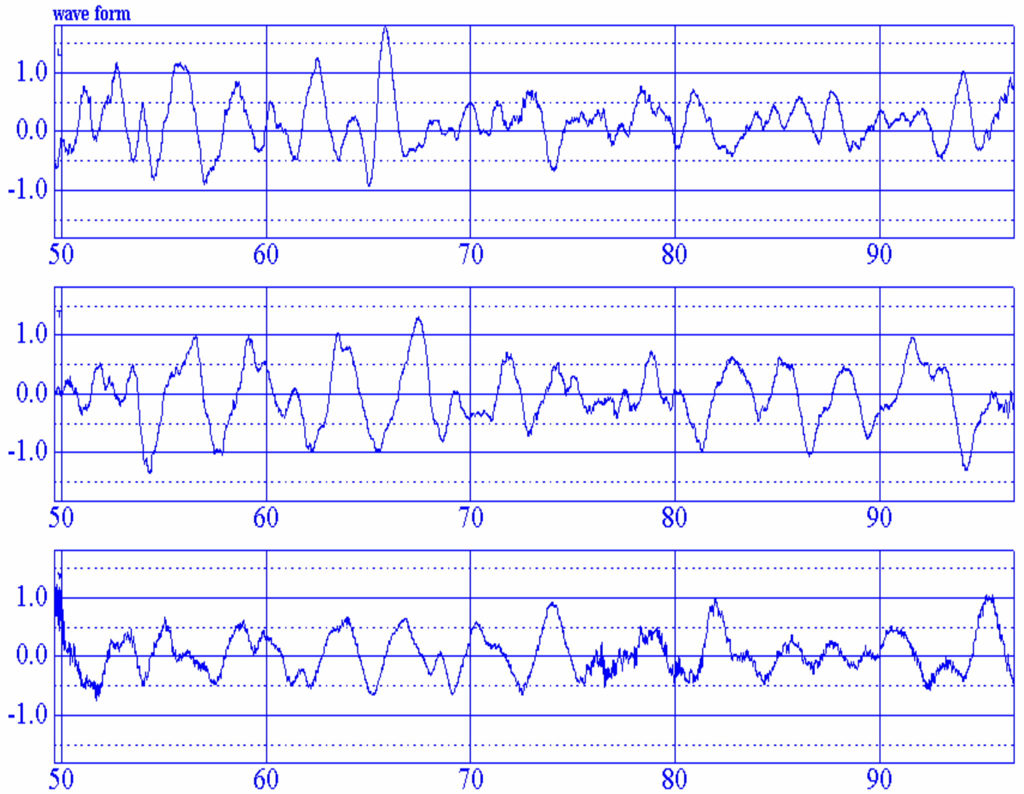


Figure 23: 2003/09/21 18:18:50 UTC at Nyaung U

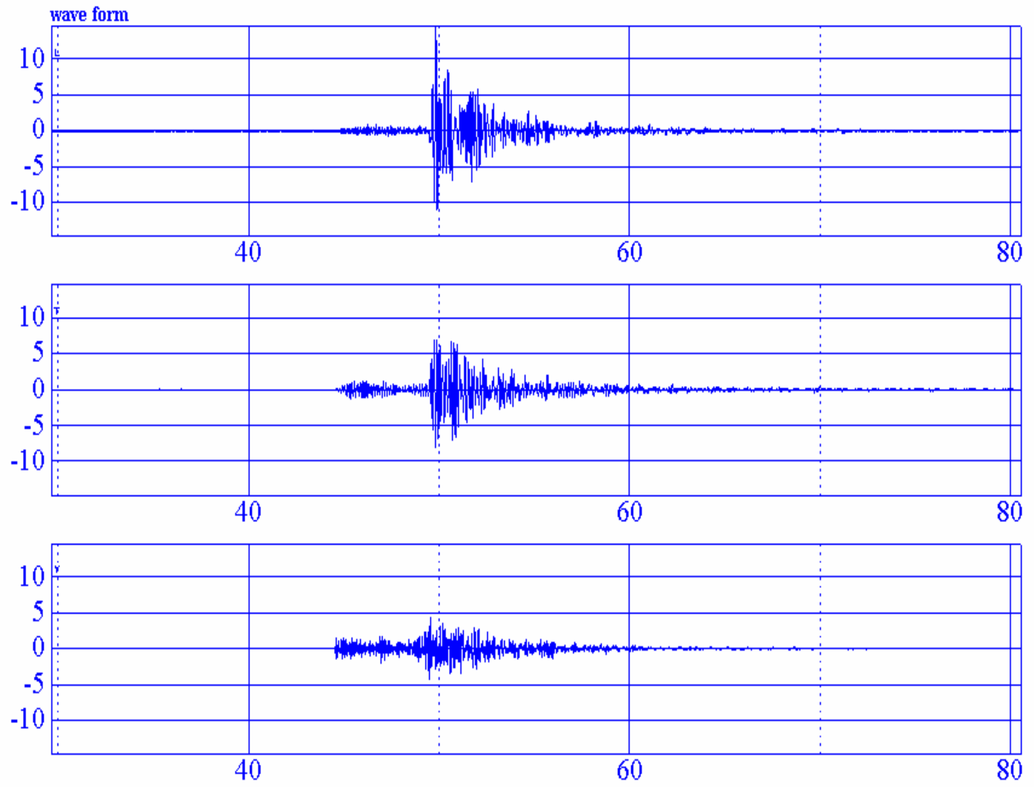


Figure 24: 2002/09/03 21:37:30UTC at Myitkyina

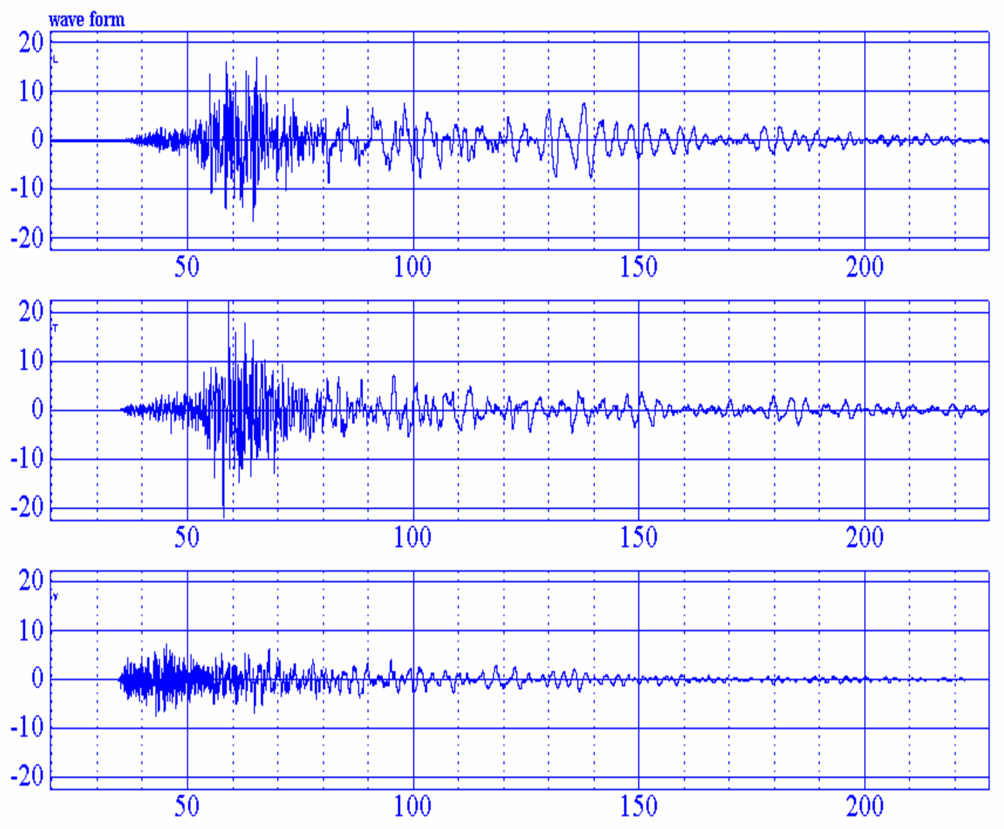


Figure 25: 2001/10/19 07:05:20UTC at Meiktila

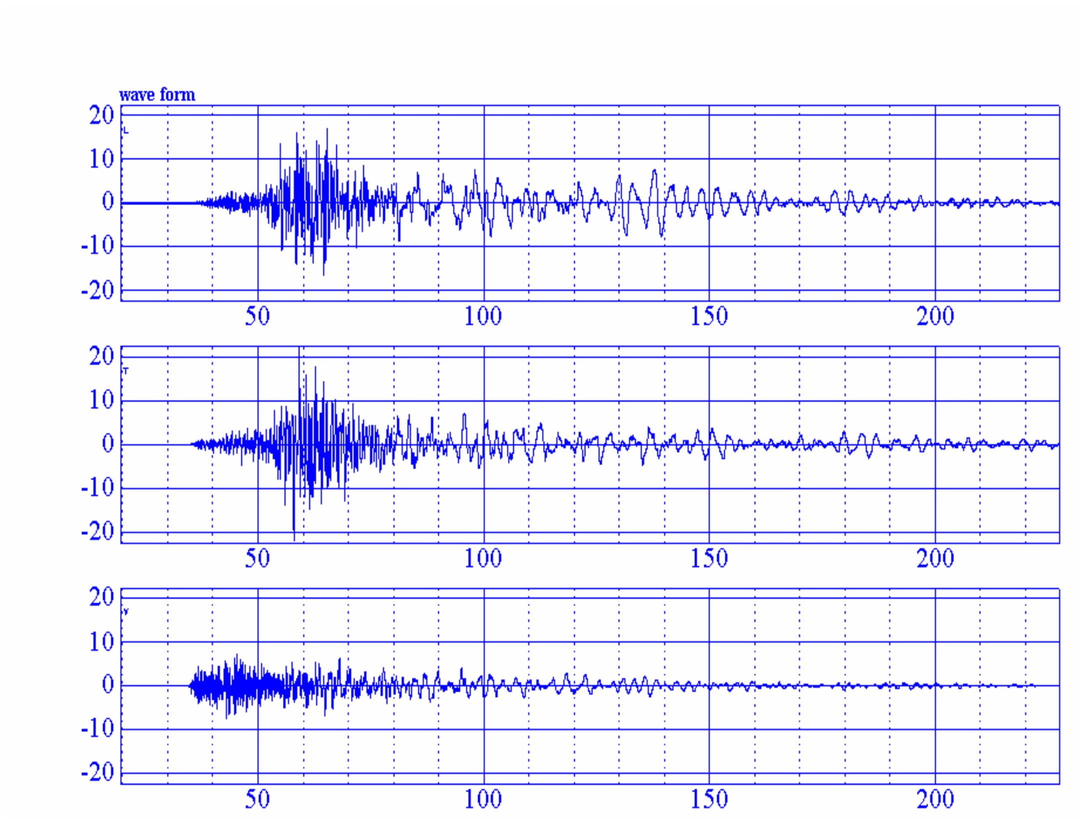


Figure 26: 2003/09/21 18:16:20UTC at Meiktila

Mr. S. Han, Ms. H. H. Myo and Mr. M. Soe from Myanmar presenting the Seisomological Activities in Myanmar

EXPERIENCES OF EARTHQUAKE RISK MANAGEMENT IN NEPAL

A. M. DIXIT and B. H. PANDEY
National Society for Earthquake Technology (NSET)
Nepal

ABSTRACT

The World Seismic Safety Initiative (WSSI) was one of the first movements that provided significant influence and encouragement to the local efforts for achieving earthquake safety that were started in Nepal after the Udayapur Earthquake of 1988, which caused significant damage in eastern Nepal. One of such positive influences was the creation of the National Society for Earthquake Technology Nepal (NSET) that has successfully implemented, in cooperation with national, regional, and international organizations, several successful programs of earthquake risk management including risk assessment, action planning, and implementation of risk reduction measures. Success of NSET programs lies in appropriate adaptation of methodologies available worldwide to suit local conditions and implementation of the risk management programs with maximum participation of the local communities. As a result of the collective efforts, remarkable achievements have been made in terms of a) enhanced earthquake awareness at all levels, b)visible improvement in seismic safety in new construction in Kathmandu, c) incorporation by the national and local governments seismic safety consideration in policy and legal framework, d) increased number of institutions implementing seismic safety program leading to participation in such initiatives by ever-increasing mass of population at risk, and e)enhanced image of NSET as a credible non-government organization.

The paper describes in more details the methods and replicable results of the successful earthquake risk reduction initiatives, and points out the new challenges that need to be tackled for sustaining the achievements and widening the outreach in the country and the region.

1. INTRODUCTION

Efforts towards earthquake risk management started being implemented in Nepal rather late. Despite the fact that systematic geological studies started being conducted in Nepal as early as the 1930s, Nepal was rather late in realizing the earthquake threat that the country is exposed to. While the 1988 Udayapur Earthquake awakened the Nepalese professionals to the need to develop organized approaches to mitigate the risk, the creating of the World Seismic Safety Initiative was instrumental in helping

Nepal to start a series of initiatives towards earthquake risk management at the government, academic and non-governmental sectors.

This paper presents an account of the significant progress made in Nepal towards improving earthquake safety in the last decade giving details of the methodologies and the results obtained. The accomplishments pertain to institutional capacity enhancement, development of practical methodologies in hazard and risk assessment, and also in developing appropriate approaches and mechanisms for the implementation of seismic risk reduction strategies and programs. The following positive changes could be emphasized:

- There has been a remarkable change in terms of policies, especially in the are of building code development and implementation
- The level of earthquake awareness in the population is remarkably enhanced in areas where people and agencies were active in the past decade. It indicates towards a very high potential of bringing in change in other parts of the country also.
- The demand for earthquake-resistant construction is growing – house-owners are influencing the municipal authorities to include seismic safety in the building permit process. The importance of such change in peoples' attitude towards earthquake safety becomes obvious when one considers that it is taking place at a time when there was no significant devastating earthquake in Kathmandu in the past several decades.
- More and more institutions are implementing earthquake risk management actions as their regular agenda

With these successes, the challenge now is to continue the momentum so that the lessons learned could be utilized on a larger scale so as to improve earthquake performance in many more number of urban and urbanizing settlements in Nepal and the adjacent areas. The problem is enormous given the rapid growth of the urbanizing settlements in the country. In the existing settlements, such as the core areas of Kathmandu, the problem appears to be almost hopeless. However, successful cases of effective awareness raising, and achieved positive changes in the mindset of people, provides certain level of optimism on the possibility of vulnerability reduction even in old cities such as Kathmandu.

While these changes are very positive, they are just the start. There is still much to be done. There are several challenges to be met. A decade ago, the concerned professionals and agencies were at their wit's end especially after the 1988 Udayapur Earthquake. Now, the same people and agencies know how things can be improved and are implementing programs that include disaster mitigation. They know and are better convinced on the truth of what WSSI propagated – the time to act is NOW!

2. UNDERSTANDING THE SEISMIC HAZARD

The National Building Code Development Project implemented during 1992-1994 carried out an assessment and mapping of primary seismic hazard at the national scale so as to derive the design seismic forces required for seismic analysis of structures (BCDP, 1994). The project also carried out a qualitative liquefaction hazard mapping of Kathmandu Valley. The National Society for Earthquake Technology – Nepal (NSET) implemented, in association with GeoHazards International and the Asian Disaster Preparedness Center (ADPC) the next significant project, the Kathmandu Valley Earthquake Risk Management Project (KVERMP), during 1997-2001 (NSET, 1999[1], NSET, 1999[2]). KVERMP used the isoseismal map of 1934 Great Bihar-Nepal Earthquake for Kathmandu Valley and a preliminary liquefaction susceptibility map developed by BCDP, 1994 to make a simple loss estimate for a scenario earthquake that could result in shaking intensities of IX MMI, similar to the 1934 event. Later, during the implementation of the Study on Earthquake Disaster Mitigation in the Kathmandu Valley (SEDM), implemented by the Japan International Cooperation Agency (JICA), surface ground motions for scenario earthquakes were estimated by analyzing the soil characteristics based on drilling data and on-site survey of P and S wave velocity logging (JICA, 2002). Besides these, there are some isolated seismic hazard assessments for hydropower development projects in the country.

While efforts were made so far by the earthquake risk reduction programs to use the existing information on the hazard as much as possible, there has been a clearer understanding on the need to put efforts to analyze the details of such seismic problems as derivation of appropriate attenuation relationship, better understanding of the phenomena of earthquake-induced landsliding in the Himalayan environment, soil-structure interaction, basin effect, etc. NSET has initiated preliminary dialogue with academic institutions of Nepal and other developed countries to undertake such studies and researches jointly.

The Department of Mines and Geology (DMG) continues seismic monitoring in the country using the national network of 21 short-period seismograph stations. However, there are only 2 strong ground motion instruments active in the country so far.

The current level of our knowledge on earthquake hazard is adequate for developing preliminary estimates of earthquake risk for the purpose of planning risk reduction initiatives and improving the policy and legal environments. More detailed researches, for example detailed mapping for microseismic zoning, are, however, necessary in order to provide a sound scientific basis for the implementation of risk reduction measures.

3. UNDERSTANDING SEISMIC VULNERABILITY AND RISK

3.1 Urban Risk Assessment of Kathmandu Valley

KVERMP carried out a simple loss estimation study for a repeat of the 1934 earthquake in modern day Kathmandu Valley. The location and vulnerability of Kathmandu Valley's infrastructure including the critical facilities was determined through interviews with about thirty institutions. The information collected in these interviews was combined with previously conducted studies, and then a loss estimation study was conducted using earthquake loss models designed for use in Japan and the US such as ATC-13. Although construction and maintenance of structures in Nepal vary considerably from those in Japan and the US, it was agreed that these readily available models produced useful, conservative results at a sensible cost, considering that the main aim of the project was to promote mitigation action rather than conduct detailed scientific or technical research. Loss estimates were conducted for the road system, the water system, the electricity system, the telephone system, and typical structures. In addition, possible death and injury figures were determined by looking at statistics from previous comparable earthquakes from around the world.

A scenario document that explains the results of the earthquake loss estimation study in layman's terms has been written and published in English and Nepali languages (NSET, 1999[1]). This document includes a description of possible damages to various vital systems in Kathmandu, and an explanation of the repercussions of this damage on life in Kathmandu Valley.

A more detailed assessment of seismic vulnerability was done by the Japan International Cooperation Agency (JICA) in cooperation with the Ministry of Home and several Nepalese institutions under the project "**The Study on Earthquake Disaster Mitigation in the Kathmandu Valley, Kingdom of Nepal**" (MOHA/HMGN-JICA, 2002). It included damage analysis of existing building stock, public facilities, and lifeline networks Human casualty figure were also estimated for different scenario earthquakes. The purpose of this earthquake disaster analysis was to create a disaster mitigation plan recognizing all phenomena and conditions that could emerge following a major earthquake occurring near Kathmandu Valley in future. Naturally, the hazard mapping was done in more detailed and it included field surveys including subsurface exploration, social structure surveys, limited building inventory and analyses. As a result, risk assessment was done at the level of municipal wards.

NSET recently implemented another earthquake disaster risk reduction initiative in close collaboration with the Kathmandu Metropolitan City (KMC) under a UNESCO program called **Cross-Cutting Transversal (CCT) Initiative of UNESCO: Earthquake Risk Reduction in Asia, Latin America and the Pacific**. It included developing several scenarios for future earthquakes affecting the Kathmandu Valley using the simple loss estimation RADIUS tool. The scenarios for future conditions considered the population and urban growth tendencies of Kathmandu Metropolitan City (KMC). Current urban growth and policies were tested against such scenarios to understand their implications in the growing levels of urban earthquake risk. Municipal staffs themselves carried out the seismic risk assessment with necessary support from NSET. Naturally the ownership of the results thus obtained lies with the municipality, which fact itself became a great motivating factor.

3.2 Urban Earthquake Risk Assessment for Other Municipal Areas

Based on the experience of KVERMP and considering the context of smaller cities of the country, NSET successfully piloted the "Municipal Earthquake Risk Management Program (MERMP)" in close collaboration with ADPC under the final phase of the Asian Urban Disaster Mitigation Program (AUDMP). MERMP was implemented in three municipalities, namely, Banepa (central Nepal); Dharan (eastern Nepal), and Vyas (Mid-western Nepal). MERMP included a full package of a) earthquake hazard assessment based on secondary information, b) seismic vulnerability assessment using current knowledge on the building construction practices, c) risk assessment by the municipal engineers and urban planners using RADIUS tool, d) earthquake risk management action planning based on the understanding of the earthquake, e) implementation of the School Earthquake Safety program in one of the schools inclusive of mason training and earthquake preparedness planning, f) community level awareness raising program including those focusing to use folklores, and g) organizing Earthquake Safety Days and other awareness raising activities such as free consultation on earthquake-resistance construction, orientation lectures on earthquake safety, exhibition of real size models of construction elements such as reinforcement steel for columns and beams, etc.

MERMP for the cities resulted in collection of all available information regarding earthquake risk of the cities in one place, analysis of the information and presentation of the analysis results to those presumed responsible for aspects of earthquake disaster management. Risk maps were prepared using RADIUS tool for scenario earthquake. Interviews were conducted with operators of urban facilities with risk map of the city, where they were asked on the possible impact of the shaking to their facilities. Workshops in each city were held after interviews to produce earthquake scenario for the city that were supported and owned by the workshop participants, the stakeholders. An action plan was then developed with commitments of implementation expressed by the city leaders.

3.3 Detail Vulnerability Assessment of Urban Building Stock of Kathmandu Valley

While implementing KVERMP, NSET prepared the building damage scenario empirically based on expert opinion. It was estimated that 60% of the building in the valley would collapse in the event of a scenario earthquake with the level of shaking similar to that of the 1934 Nepal-Bihar Earthquake in Kathmandu. The prevalence of large stock of old masonry buildings and practice of unsafe building construction without consideration of seismic requirement is the reason behind such result.

The high level of seismic vulnerability of the Kathmandu Valley building stock was confirmed by SEDM, which concluded 54% of the buildings will be heavily damaged in case of the repeat of the 1934 earthquake level of shaking in Kathmandu. This was done on the basis of a building inventory and detailed analysis of about 1200 buildings from 69 sample sites. The buildings were inventoried with details collected for over 100 characteristics including information on the owner, location, age, usage, repair and extension history, past experiences of cracks, construction materials and type of structure, number of stories, shape, layout, soil, and topography. Damage analysis was made against fragility curves developed for Nepali buildings.

3.4 Detail Vulnerability Assessment of Urban Building Stock of Other Municipalities

Building inventories have been prepared for the municipal areas of Dharan, Banepa, and Vyas municipalities as a component part of MERMP. The building inventory has collected information on structural type, material, age, number of stories, configuration, provision of lateral load resisting systems, and construction method. Visible damage to the buildings has been recorded in terms of its spatial distribution, and potential level of damage estimated by using fragility curves adapted for the locality. The buildings have been mapped in Geographic Information System (GIS).

3.5 Structural Vulnerability Assessment of Public School Buildings

One of the components of the KVERMP was the School Earthquake Safety Program (SESP), which included a vulnerability assessment of Kathmandu Valley's public schools as an example of how to conduct earthquake risk mitigation projects in Nepal. The purpose of this assessment was not to identify individual schools as vulnerable, but to quantify the risk faced by the entire system. For the assessment, at first, the project team created a questionnaire that could be filled out by school headmasters. This questionnaire included topics such as size of buildings, density of students, year(s) of construction, whether or not an engineer was involved in the building design or construction, etc. Additionally, simple questions were asked about structural characteristics, presented through illustrations and descriptions. The project conducted 17 seminars with school headmasters from 65% of the total 643 public schools in the Valley to teach them about earthquake risk, about the necessity of planning for earthquakes in their school, and how to fill out the project questionnaire. Subsequently, the headmasters conducted the survey and data on 430 schools were returned to the project. The conclusions were extrapolated to the entire building stock of the existing public schools of Kathmandu Valley. The result of vulnerability analysis is shown in Table 1.

3.6 Vulnerability Assessment of Health Facilities

Considering the high seismic risk of Kathmandu Valley as shown by the earthquake damage scenario (over 100,000 injuries to the extent of requiring hospitalization in case of scenario earthquake with a shaking intensity of IX MMI!), NSET was asked by the advisors to include risk assessment for the hospital system of Kathmandu. It was natural because earthquake-resistant construction standards have not been effectively applied and special guidelines have not been considered for hospital facilities in general in Nepal. For this reason, there is a high possibility of the hospital buildings not being functional during a large seismic event.

At this, NSET implemented two different studies to evaluate the seismic performance of the Bir Hospital. One was done in cooperation with US Army in 1999 and the other was implemented in 2000 in collaboration with a group of expert-volunteers from New Zealand. Both the studies indicated towards a high level of earthquake risk for the hospital. Obviously, it was necessary to assess the vulnerability of the entire health system of the country. Obviously, it was necessary to develop a system of such assessment, as the existing methodologies would not fit in the condition of Kathmandu where data on building construction (design and as-built drawings, reinforcement details, quality of construction materials etc.) were totally lacking.

Later, in 2002, NSET implemented the project “Structural Assessment of Hospitals and Health Institutions of Kathmandu Valley” jointly with the World Health Organization and Ministry of the Health, HMGN. The purpose of this study was to develop/apply appropriate methodology for the evaluation of earthquake vulnerability of the medical facilities in general, and to understand the actual situation of the reliability of the medical facilities in Kathmandu Valley, in particular. A structural engineer from South America was recruited to learn from the rich experiences of the Pan American Health Organization (PAHO).

The study included qualitative assessment of 14 hospitals of Kathmandu Valley, and a quantitative assessment of the Bir Hospital in case of a scenario earthquake. It yielded alarming data: only 10% of hospitals will be functional after an MMI IX intensity earthquake! The overall performance of hospitals in different earthquakes is presented in Figure 1.The study made a strong recommendation on the urgent need of improving earthquake resiliency of existing medical facilities in Kathmandu Valley.

From the study, it was found that non-structural mitigation measures are less costly but highly effective for risk reduction, and could be implemented with resources available locally, whereas structural interventions would require significant external support – technically as well as financially.

Table 1: Vulnerability of Public School Buildings in Kathmandu Valley

Particulars	**Details**	**%**
Total number of Public Schools/buildings	643/1100	
Typology of traditional school buildings	Adobe (sun-dried bricks) or Earthen Buildings (mud cake buildings)	5
	Stone/brick masonry in mud mortar	56
	Rectangular block (Brick or hollow concrete block or semi-dressed stone in cement mortar)	28
	Reinforced Concrete Frame (RC Frame)	11
Existing Condition (with extrapolation for 643 schools)	Hazardous for use at present (Pull down and reconstruct ASAP!)	10 - 15
	Can be saved (with structural intervention, Retrofit, Repair and Maintain ASAP)	25
	Good for vertical load (but not for lateral shaking), need retrofitting	65
Vulnerability Assessment (for intensities IX MSK shaking)	Collapsed Grade	66
	Severe Damage or partial collapse (not repairable/not usable after shaking)	11
	Repairable Damage	23

In view of this, NSET started implementing, in agreement with the Ministry of Health and with financial support from the World Health Organization (WHO) a detailed non-structural assessment of 10 major hospitals of the country: 5 located inside the Kathmandu Valley, and the other 5 hospitals located outside the Valley. The study has identified priority action for non-structural vulnerability mitigation, many virtually cost-free or at minimal costs. It is expected that implementation of the recommended non-structural mitigation measures, which are expected to be at minimal costs, would be started immediately.

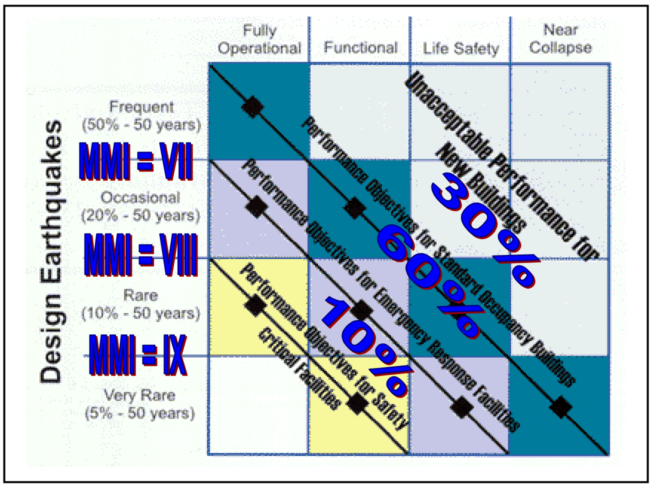


Figure 1: Performance of Hospitals in Kathmandu

3.7 Vulnerability Assessment of Lifeline Facilities

NSET undertook a study for the assessment of seismic vulnerability of the drinking water supply system of Kathmandu city with financial assistance from UNICEF. The work was done as a consensus project in view of high level of earthquake risk identified for the water supply stem for Kathmandu by the KVERMP studies. Once again, NSET was confronted with having to use methodologies applicable only for developed countries. Therefore, significant efforts were made to develop a practical methodology for assessing the seismic vulnerability of water supply network system, its components, and the minimal requirement of institutional capacity was developed by adapting the Applied Technology Council ATC-25-1 (ATC, 1992) tool with appropriate adjustment for Kathmandu context. Assessment results in the form of network system damage for scenario earthquake are presented using Geographic Information System (GIS).

Based on possible maximum enhancement of the present intuitional capacity and spatial distribution of the possible damage extent, optimum routes for speedy restoration of water supply services to meet a minimum level are identified under two different scenarios i.e. 1) as it is condition, and 2) conditions of improved system. The study also presented the spatial distribution of emergency water demand in case of earthquake event. It was found that a large number of breakages will be in the pipeline system mainly due to ground shaking. Very old stock of pipeline without maintenance, and non-recognition of earthquake risk in design and construction of water system are identified as the main causes for such pathetic situation.

4. RESEARCH AND DEVELOPMENT

4.1 The SLARIM Project

A multidisciplinary research project “Strengthening Local Authorities in Risk Management (SLARIM)”, aiming at the development of a methodology for spatial decision support systems for urban risk management is being carried out in Lalitpur Sub-Metropolitan City, one of the five municipalities in Kathmandu Valley. NSET joined hands with the International Institute for Geo-information Science and Earth Observation (ITC), Netherlands, and the International Centre for Integrated Mountain Development (ICIMOD) to develop the methodology based on the ground realities of earthquake vulnerability reduction needs and their integration into the municipal decision-making process. Graduate students of ITC are involved in the research work that spans hazard assessment, vulnerabilities conditions, social structure, and the possible use of space technology for reducing vulnerabilities and improving the structural resistance by implementing a sound building permit system. NSET’s experts provide technical supervision to the research; ICIMOD provides institutional and logistic support.

4.2. Joint work with Academic Institutions

NSET is in the process of entering into an understanding with the Kathmandu University and Pokhara University for the development of appropriate academic curricula on aspects disaster risk reduction and management and earthquake engineering to be delivered at undergraduate as well as graduate levels.

Similar projects are being explored jointly with the University of North Umbria (UNU), UK to support research on social aspects of disaster risk reduction in Nepal. Kathmandu University is also a partner. NSET will play the role as the institution with knowledge on earthquake risk mitigation.

NSET is also working closely with the Department of Civil Engineering of the Institute of Engineering, Tribhuwan University, for the development and initial delivery of the courses on behavior of structures to dynamic loading and earthquake geotechnical engineering. Process is undergoing to develop course-curriculum on earthquake-resistant construction and disaster management. NSET is providing assistance in these initiatives as resource institution.

In order to facilitate and coordinate the efforts on seismic risk reduction in reseach, development and professional practice, NSET has started preparing a roster of Nepalese professionals and students in the field of earthquake engineering and disaster management.

In all these efforts, NSET maintains close contact with Indian academic institutions such as the IIT Powai, IIT Roorkee, and the IIT Kanpur.

5. PLANNING FOR EARTHQUAKE RISK REDUCTION

Action plans for earthquake risk management have been developed for different cities in order to address the earthquake risk estimated from the earthquake scenario development exercise under the different programs. The following sections provide brief description of the current levels of action plan development and implementation in different urban areas of the country.

5.1 Kathmandu Valley Earthquake Risk Management Action Plan

An Action Plan was created by NSET, with active participation of about 82 concerned institutions of Kathmandu, including the main emergency response institutions and the emergency response agencies (NSET, 1999[2]), to start the process of systematically reduce the risk over time. The Action Planning process was a logical continuation of the earthquake hazard evaluation and risk assessment component (earthquake damage scenario development). The Prime Minister of Nepal officially released and endorsed this plan in January of 1999, in a National Meeting devoted to the Earthquake Safety Day. The purpose of the plan is to assist His Majesty's Government of Nepal, concerned agencies, and the municipalities in Kathmandu Valley to reduce Kathmandu Valley's earthquake risk over time by coordinating and focusing risk management activities. Ten specific initiatives were defined as high priority. As assigned during the planning process, NSET is now tasked with the implementation of three of the initiatives of the plan, notably, a) Implementing School earthquake Safety Program, b). Improving the safety of existing buildings by propagating non-structural vulnerability measures, and c) awareness raising and assisting the municipalities to implement seismic code for new buildings. NSET is also active in aiding and promoting other initiatives of the action Plan. A separate project, titled the Kathmandu Valley Earthquake Risk Management Action Plan Implementation Project (APIP) is being implemented for this with financial support fro the US Office of Foreign Disaster Assistance (US OFDA)

5.2 Earthquake Disaster Management Plan suggested by SEDM

The SEDM proposed generation and implementation of earthquake disaster reduction plans at different levels of the government. It was suggested that the individual disaster management plans should be prepared at each level of government and institutions by the method of full participatory planning by all stakeholders. A framework of the disaster management plan was recommended by SEDM as shown in Figure 2.

NSET is assisting the Ministry of Local Development (MOLD) in the development of necessary framework for the implementation of the recommendations of SEDM as much as they concern the municipalities.

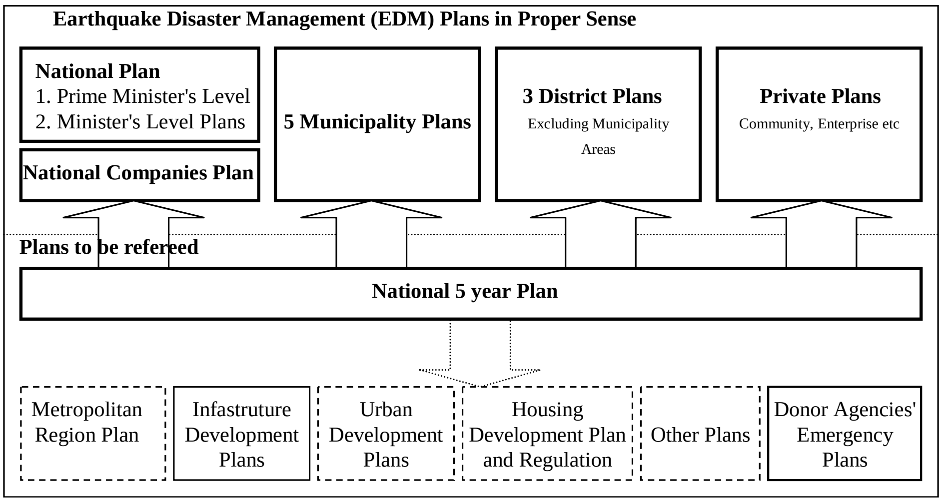


Figure 2: Structure of Disaster Management Plans suggested by SEDM

5.3 Municipal Level Action Planning in MERMP

One of the components of the MERMP in each city was the preparation of an action plan for reducing earthquake risk identified during the earthquake scenario development process. The action planning processes in the cities- Banepa, Dharan and Vyas were very much participatory and served as great awareness tool among stakeholders of the city and local champions. As the risk reduction efforts are to be started from a scratch, there is usually a long list of actions deemed important by the participants of the plan development exercise. However, it is very encouraging to note that earthquake vulnerability reduction (EVR) measures such as building code implementation, School Earthquake Safety Program, trainings for mason and petty-contractors for earthquake resistant construction, and awareness raising are the common priority items in the action plans of all the three municipalities. The most effective outcome of the plans is that municipalities already started the doable actions like certifications of trained masons and contractors for earthquake-resistant construction, and have adopted policy of incentives for earthquake-resistant building construction.

5.4 Kathmandu Metropolitan City Level Risk Reduction Plan

Kathmandu Metropolitan City (KMC) prepared the earthquake risk reduction plan under UNESCO initiative using RADIUS tool with the help of NSET. The plan summary is presented in Table 2.

Table 2: Planning for priority Actions by KMC for Disaster Risk Reduction

Urgent Measures	Medium-term Measures	Long- term measures
▪Seismic Building Code Implementation ▪Establishment of Emergency Response System ▪Develop and put into effect Land-use-plan considering earthquake risk	◈ Formulate policy and program for identifying open spaces and preserving them ◈ Designate evacuation routes and sites ◈ Develop mechanism of incentives for new construction in designated land and dis-incentives to control construction in dense area ◈ Control construction in high hazard area	◈ Develop integrated plan of greater city so that disaster free development could be achieved with resource balance, density distribution and proper infrastructure planning ◈ Support surrounding village areas with infrastructure and services so that population will be dispersed. ◈ Establish linkage of city risk reduction plan with national development plan(5-year plan) ◈ Prepare disaster recovery plan

6. IMPLEMENTATION OF EVR MEASURES

6.1 School Earthquake Safety Program

The School Earthquake Safety Program (SESP) stared being implemented in Kathmandu Valley as one of the components of the

KVERMP. Subsequently, it has become one of the most successful programs of NSET.

Originally, SESP had the objectives of (i) Vulnerability assessment of about 1100 buildings belonging to 644 public schools, and (ii) implementation of retrofitting works in one of the schools as a pilot project. Following the completion of the pilot project successfully, NSET continued the program with national and international support and assisted other schools inside and outside Kathmandu Valley to retrofit existing building seismically or to construct a new earthquake-resistant building for the school.

To date, the SESP has covered 15 communities. The program is being implemented as one of the components of NSET's Action Plan Implementation Project (APIP) in Kathmandu, and under the Municipal Earthquake Risk Management Program (MERMP) outside the valley. The components of SESP, now, are: (a) Training of masons, (b) Training of teachers, parents and students on earthquake preparedness and preparedness planning, and (c) seismic retrofit or earthquake-resistant reconstruction of public school buildings.

The following paragraphs provide a brief description of the most important achievements of SESP.

Affordability of Seismic Improvement of School Buildings Established:

SESP has demonstrated technical and also financial feasibility: the only requirement is the voluntary participation by the community including the members of the school advisory and construction management committees, donation of a fourth of the labor by the masons as in-kind contribution, and strict adherence to the NSET's mechanism of SESP implementation, which ensures work as well as financial transparency. The strict requirement usually pays off – a recent school building at Dhapakhel of Kathmandu was completed with better quality control and reliable seismic resistance at 75% of the estimated cost for similar construction as per the prevalent practice for public construction. This fact demonstrates that seismic safety is not only achievable, but achievable at cost level less than commonly believed; provide there is participation by the community. Raised awareness, and the increase in the confidence level of the population in the influence areas, and the seismic resistance of new construction which usually replicate the demonstrated elements of safety employed in the school are added benefits.

NSET has learned a great deal in terms of the prevalent building typologies, the inherent problems, and the likely solutions for enhancing their structural safety. The experience gained is being consolidated in the form of a Hand Book for Seismic – Resistant Construction and Retrofitting of School Buildings in Nepal.

Establishment of a System of Mason Training and Curriculum Development:

About 5-10 masons from each school communities have been trained in the skills of seismic retrofitting, earthquake-resistant construction and quality control. One of the masons in each school site has been trained as Trainers. These trainer masons are given the responsibilities of supervising the construction works at other schools in future under the program. Based on the experiences gained from the mason training, a curriculum/guideline for Mason Training has been prepared.

Awareness Raising, Training of Teachers, Parents, and Children:

SESP is being implemented with maximum participation of the government institutions (Central Region Education Directorate, District Education offices of related Districts), District Development Committees and Village Development Committees, the school management systems, and the parents and the students. The government agencies provide funds and policy guidance, while the actual implementation of construction works is handled by the school management committees with technical inputs and supervision from NSET. Such implementation mechanism, together with the formation of Central -, District -, and school level advisory committees, considerably widened the outreach of the program and its ownership.

Several meetings are held with the local communities and the school officials. NSET will continue its efforts in implementing such training program in the schools. All this has resulted in greater awareness in the communities on earthquake disaster risk and risk reduction. It is seen that new constructions in the settlements surrounding the schools are incorporating seismic-resistant elements, mostly by consulting the SESP masons. A strong replication potential of the program concept, and hence sustainability of efforts, is thus evident.

Replication:

In all the villages under the direct influence of SESP (usually the adjacent village development committees), the house owners have been replicating the construction methods employed in school building to construct their private houses without intervention from NSET. Except some minor features, newly constructed houses adopt all basic earthquake-resistant construction technologies such as the seismic bands, wall stitching, vertical tensile rods etc. This fact demonstrates that the training of masons on earthquake-resistance construction is the key for achieving earthquake safety in conditions of developing countries where more than 85% of the buildings are non-engineered, constructed by informal mechanism with the trust between the house-owner and the mason playing the most important role in making decisions related to the construction.

A rough calculation suggests that a well-trained mason who is convinced on the methods of earthquake safety by being involved in SESP helps create 15 new residential construction earthquake safer every year by convincing the house-owner of the benefits.

Schools are also particularly tractable for earthquake safety programs. Schools structures are typically very simple and relatively small, unlike other critical facilities. Therefore it is inexpensive to build new schools in an earthquake resistant fashion and it can be affordable to retrofit existing schools. Also, by raising awareness in schools, the entire community is reached because the lessons trickle down to parents, relatives, and friends

6.2 Awareness Raising Programs

Raising earthquake awareness is a strong component of every major initiative undertaken by NSET in Nepal. Every activity undertaken is shaped to raise the awareness of different groups - government officials, media, international agencies, etc., i.e. all sections of the society: from officials and decision-makers at the central government through the municipal and ward-level authorities and elected representatives, to the communities in the villages. The objectives of awareness raising are different for the different target groups: for politicians and high officials, it to convince them of the necessity to look at disaster risk reduction as a development issue, for the general public it is enabling them to understand the risk and to identify possible measures that could reduce the vulnerability on an incremental basis. The awareness raising programs are designed in such a way that it means not only transferring of knowledge and information but also internalization of the knowledge, and ultimately its ownership and use, as much as possible, in day to day life of the common man. Some of the major awareness raising activities is described below.

6.2.1 Earthquake Safety Day Program

At NSET’s request, His Majesty’s Government of Nepal declared January 15 (or 16) as the Earthquake Safety Day of Nepal, and established an Earthquake Safety Day National Committee (ESD Nat COM) for observing the Day annually throughout Nepal. ESD Nat COM draws representatives from all emergency response organizations and critical facilities management. NSET, in coordination with the ESD Nat COM, organizes a variety of activities that extend for many days. The main events are the Earthquake Safety Exhibition and Symposium. Other events include public broadcast of earthquake safety message by the Prime Minister; awareness rally through the streets; national meeting with the government ministers; shake-table demonstration of traditional building models with and without seismic safety elements; children essay/painting competition; street drama on earthquake safety, etc. Numerous publications such as information leaflets, calendars, earthquake-resistant construction posters were distributed to the public. At NSET's initiation, the ESD program, last year, was observed in 10 municipalities including MERMP cities. Earlier, only Kathmandu used to observe the main national program.

6.2.2 Radio/TV Programs

Several local radio and TV programs aired earthquake safety and preparedness messages on a regular basis using NSET’s publications as the basic guide for mass education. NSET also has collaboration agreements with two local FM Radios in Kathmandu and Pokhara for airing weekly 30-minutes programs on earthquake safety. These are non-profit radio stations.

The Kathmandu Municipality has provided adequate time slot per week on the national Nepal Television to broadcast a program series on earthquake safety. The program targets the homeowners and convinces them on the possibility and affordability of making their homes earthquake-resistant, and making their family safe by learning earthquake preparedness. NSET provides expert knowledge to the program. Increasingly, NSET management and professionals are invited by national radio/TV channels to deliberate on aspects of earthquake risk in Kathmandu and outside.

6.2.3 Public Talks and Orientation programs

A number of public talks in earthquake safety have been organized in different community gatherings such as the regular meetings of Rotary Clubs, the Scout Jamborees, trade associations etc... The number and regularity of such talk programs has increased significantly after participation of Nepalese professionals in the study and reconstruction activities the Gujarat Earthquake of 2001. We made it a point that the experiences of Gujarat was brought to Nepal as much as possible. Such talks that used lots of illustrations on the damage not only informed the public about the Kathmandu Valley's earthquake risk, but it also gave us feedback on the concerns and perceptions of the public, which have helped us tailor our public awareness campaign subsequently. In meetings of professional organizations such as the Nepal Engineers Associations, Society of Nepalese Architects, Nepal geological Society etc, lecture sessions on earthquake are incorporated. Besides these, NSET give special orientation classes to international communities working in Nepal upon request. The number of such requests is increasing unprecedented. Government organizations also have started to do so for technical assistance on policy and program formulation.

NSET holds orientation program for house-owners who want to retrofit or construct their houses to be earthquake-resistant on weekly basis (every Friday afternoon) it its office. The participation is free-of-charge on first-registered-first-chance basis because of the limited capacity of the hall.

6.3 Building Capacity of Municipalities in Seismic Code Implementation

Through a partnering approach with other organizations and stakeholders, NSET is supporting programs for integration of seismic resistance into the process of new construction, improving seismic performance of existing buildings, and in increasing the experts' knowledge of the earthquake phenomenon, vulnerability, consequences and mitigation techniques. In collaboration with the National Forum for Earthquake Safety (NFES), NSET is supporting the Lalitpur Sub-Metropolitan City (LSMC) by providing regular orientation programs to house-owners, and by providing technical assistance to municipality for preparing guidelines for streamlining the building permit process. This was done following LSMC's decision to implement provisions of the Nepal National Building Code since January 2003. This was declared open during the celebrations of the Earthquake Safety Day 2003. The following Figure 3 shows the framework of building code implementation in LSMC. Following suit, the Kathmandu Metropolitan City as well as other municipal organization are determined to implement the building code on mandatory basis, and are doing preparatory works of implementing the code as their bye-laws. NSET is providing technical assistance in this process.

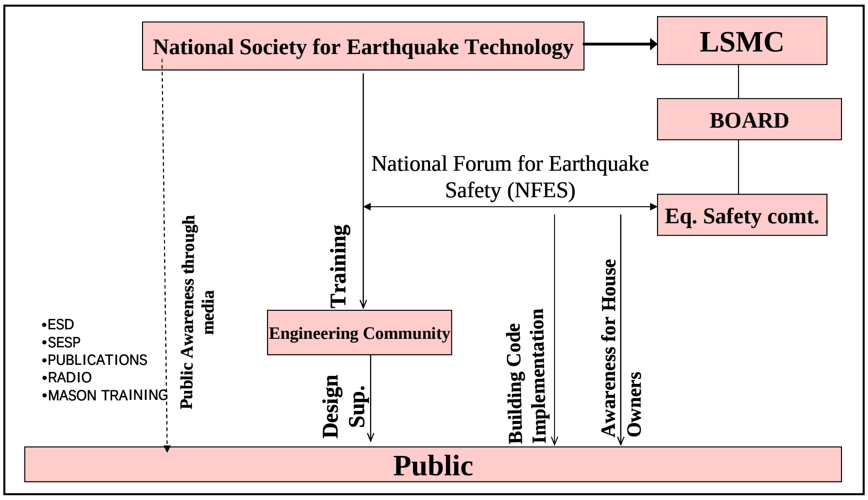


Figure 3: Building code implementation framework in LSMC

6.4 Grass-roots level training programs

Apart from the mason training programs conducted by NSET as a part of the School Earthquake Safety Program, The government department of Housing and Urban Development (DHUD) implements mason training programs in different parts of the country periodically. Although the number of trainees is relatively small, the curricula developed for the training is useful for any other agency that could be interested in such program implementation.

NSET also provides specialized training programs for the petty contractors and builders on aspects of earthquake-resistant construction. It has been found that a walk-over along the municipal area with the builders who were involved in the major constructions and analyzing the structural details together with the builders is a strong method to convince the builders on the commonly repeated mistakes in construction. Such training programs are very effective, some of the municipalities, such as Dharan and Vyas municipalities, two of the MERMP cities, started certification system that permits only those contractors trained in earthquake-resistant construction to bid for construction awards.

There are several training programs conducted by NSET and others on aspects of individual and collective safety from earthquakes before, during, and after an earthquake.

6.5 Pre-Positioned Emergency Rescue Stores (PPERS)

PPERS is a collection of different items of light search and rescue stored in one place (a room or metallic container) in pre-disaster phase and kept in disaster safe location at various places in Kathmandu.

In October 2002, British Army Civil Affairs (CA) Group conducted an exercise on “Emergency Planning Assessment for a Major Earthquake in the Kathmandu Valley”. One of the recommendations of the exercise was to enhance the capability of community by establishing PPERS. A project concept was developed; NSET provided required technical assistance to the CA Group on PPERS Project.

The purpose of PPERS is to provide a reserve of essential tools and equipment to assist in the immediate response to a major disaster, such as an earthquake, in the Kathmandu Valley.

PPERS is intended to help those responders on the ground at the local level who is going to be the first responder and enable to rescue as quick as possible.

The PPERS project is designed to enhance the local capacity by providing the tools and equipment, so that the emergency response could be mobilize to full effect by:

- neighbor helping neighbor
- street helping street
- community helping community

6.6 Establishment of Ward level Disaster Management Committees

Several municipal Wards in Kathmandu Metropolitan City (KMC) and Lalitpur Sub-Metropolitan City (LSMC) have constituted ward-level Disaster Management Committees (WDMC) that includes representatives from community-based organizations, NGOs, businesses, clubs and the intelligentsia. The WDMCs are modeled after similar committee in the KMC ward 34 that was created five years ago with assistance from NSET. Subsequently, proceeds from the WSSI fellowship were used for assisting the WDMC34 in formulating and implementing ward level planning and implementation actions. The experimentation paid off- very interesting experiences with rich lessons learned have been accumulated by some of the WDMCs which have even found places in international publications.

7. IMPROVEMENTS IN POLICY ENVIRONMENT

High Level Meeting (HLM) of WSSI in Kathmandu in 1994 was the first milestone towards influencing the policy-makers on earthquake risk management in Nepal. Subsequently, several policy improvement initiatives have been formulated and implemented in the country. These policies help create conducive environment for achieving disaster risk reduction and emergency response. Some of the efforts and achievements in these areas are described below.

7.1 Creation of the Nepal Forum for Earthquake Safety (NFES)

NFES has been established as one of the technical committees of the Nepal Bureau of Standards and Metrology, a government department. NFES draws membership from a wide sector: government, private consultants, contractors, builders, their associations as well as the representatives from engineering institutes, professional societies, material producers and traders, municipal authorities etc. It is a forum dedicated to the task of improving seismic performance of new construction by encouraging compliance of Nepal standards in terms of quality control of materials and construction processes including observing all stipulations of the earthquake codes.

7.2 Mandatory implementation of national building code

The Bureau of Standards and Metrology has initiated a process for defining the draft Building Code as Nepal Standard. Several of the 22 documents that was prepared as the National Building Code, which is focused on seismic safety, has been accepted as Nepal Standards.

Recently, the Council of Ministers has decreed that the stipulations of the National Building Code should be made obligatory for all government building constructions. It also urged the municipal authorities to strengthen the current building permit process so that code compliance becomes mandatory for all new constructions in the urban areas

7.3 Incorporation of disaster mitigation policy in tenth 5-year national plan

For the first time in Nepal, the document on the 5-year development plan incorporates natural disaster management as one of the objectives of the government in order to contribute towards "making the (infrastructural?) Construction and development projects of the country durable, sustainable and capable of providing the intended service". Thus the development plan of the country now encourages prevention and mitigation as important efforts for disaster prevention (Tenth 5-year Development Plan, HMG/N, 2002). The policy statement in the plan includes preparation of long term disaster management action plan, incorporation of disaster risk in infrastructure construction projects, conduction of public awareness programs on disaster, establishment of central disaster management department and earthquake hazard mapping.

In the same spirit, the government has allocated a nominal amount for building code implementation under a separate heading in the budget for the current fiscal year.

7.4 Local Self Governance Act and Kathmandu Metropolitan City Act

The recently promulgated Local Self Governance Act 1999 (LSGA, 1999) gives a fresh momentum to the process of decentralization and devolution of authority. It empowers the local governments to undertake disaster management activities. Techno-legal aspects of mitigation actions are now considered within the jurisdiction of local governments.

A separate act, notably, Kathmandu Metropolitan City Act, is being formulated in order to provide a comprehensive legal and policy framework for an effective governance of the capital

8. IDENTIFIED CHALLENGES

The preceding sections provide accounts of remarkable achievements made in terms of raising public awareness and creating demand for earthquake safety. Several case studies have been generated, replicable methodologies have been formulated and tested, and training curricula have been generated and propagated. That gives tremendous satisfaction to disaster management professional of Nepal.

However, despite these successes, one has to agree that the earthquake risk of communities in Nepal is very high, and a lot more vulnerabilities are being generated every day than contained.

Stopping the ever-increasing earthquake risk is a daunting task! Furthermore, given the existing constraints in terms of limited material as well as man power resources, and also because of the lack of suitable policy and legal environment, the task of disaster risk reduction and emergency response planning and capability development appears to be very difficult if not insurmountable.

Under these circumstances, we have listed the following as the major challenges faced by Nepal and also by those who want to assist Nepal to become earthquake-resilient.

8.1 Develop Methodologies for Assessment and Mitigation Suitable For Local Problems

Many times, the available methodologies of assessment as well as mitigation are not suitable to the local environment largely because of the difference in the typologies of the construction resulting from the preference of certain construction materials by the community. Appropriate methodologies need to be developed and tested so that the local problems could be addressed properly. Example could be assessing the available seismic resistance of typical Nepali buildings built in brick in mud mortar. There are several historical building, monuments and temples that are built of these materials and technologies. Many of these buildings in Kathmandu Valley are standing for the past several centuries and are being used now also. Obviously they are strong-enough to have resisted several of the devastating earthquakes in Kathmandu and parts of Nepal.

A careful understanding of the seismic resistance of the traditional architectural styles needs to be developed so that there is unison of approach while trying to improve the seismic performance of existing traditional Nepali building.

8.2 Improve Formal and Informal Communication

People tend to shy away from earthquake risk reduction concepts because of the general unfamiliarity with the phenomena. Not everybody would have been in an earthquake theatre. This results generally in the lack of proper interest, and low level of buy-in.

Communication with the stakeholders could be effective under such situation only if the communication is frequent, repeated, persistent, and accompanied with successful demonstration projects. Focusing on implementing the earthquake risk reduction activities, howsoever small, is therefore necessary. It pays to communicate success of demonstration actions, howsoever small.

8.3 Need drastic improvement in Capacities

Nepalese institutions tasked with disaster risk reduction and emergency response do not generally have the required capacity to implement these activities. Such capability lacking is felt at every level- from the masons to the builders and up to the technical professionals. Even qualified civil engineers many times happened not to have exposed to elements of earthquake engineering because they studied in countries without significant earthquake problems. On the other hand, many municipal agencies do not have adequate number of engineers and architects who could decide in favor of improved seismic safety of buildings and institutions. A chronic problem is the lack of adequate number of trained building inspectors with the municipal corporation.

9. RECOMMENDATIONS FOR FURTHER IMPROVEMENTS

The achievements made by Nepal in the past 10-12 years in terms of successful implementation of earthquake risk reduction actions could be considered as a matter of pride and satisfaction by those who are involved in the process directly or indirectly. The success made is surprising, especially if one considers the fact that Nepal is one of the weakest economies and the nation has not made / does not have capability to make/ any significant investment in disaster risk reduction, and that the seismic risk of the country is one of the highest in the world if one considers earthquake lethality as an indicator.

Such situation puts forward two main challenges to the concerned professionals and agencies a) continue the support provided so far to ensure that the efforts and investments made so far are insured, and b) assist the local institutions, central and local governments, and non-governmental organizations, to take up new and ever-widening responsibilities. One has to understand that raising earthquake awareness of the community reduces the risk significantly, but it also tremendously increases the demand for more and better knowledge, technologies, management tools, institutional capabilities, and improved policy and legal environment. Coping with such natural, expected and desired outcome may become a maddening trance for the activist especially if he/she or the institution fails to receive the support, mainly a moral support!

The following are seen as the major tasks that need to be addressed in coming times.

A) Scale up Activities: there could be a serious blow to all the efforts and successes achieved so far, and people would stop believing in mitigation if the earthquake occurs now. Therefore, it is necessary to accomplish and consolidate as much as possible before the next big one. The scale of implementing the methodologies that are proven to be replicable, e.g. hazard/risk assessment, action planning of earthquake risk management, implementation of SESP, mason training, earthquake awareness etc.), need to be implemented in as wide geographical area as possible. There should be a significant increase in the number of masons trained in earthquake-resistant construction, or the number of engineers trained in earthquake vulnerability reduction for Cities (EVRC).

So far NSET worked in Kathmandu Valley and some cities. It is necessary to implement projects in all the 58 municipalities of Nepal. Perhaps it is necessary to implement similar initiative also in the adjoining districts/municipalities in India.

B) Make the Approach comprehensive: Success in earthquake risk management can not be achieved in piecemeal. The efforts should be comprehensive: it should tell the common man how to construct safer abode, how to maintain it, how to convince his neighbor on the benefits of EVR, what to do before, during, and after an earthquake, how to demand earthquake safety from the state etc.

C) Emphasize on Action Implementation: It is clear at this stage that the School Earthquake Safety Program (SESP) works wonderfully in developing countries. Then why to waste time by not implementing similar initiatives.

D) Emphasize on Grass-roots level works: The most vulnerable are at the grass-roots level, and the ones most willing to implement EVR are also at the grass-roots level.

E) Publicize Success Stories (anyway they are few and far in- between!) Given the low level of awareness and the complexity of earthquake risk reduction measures, it is recommended to emphasize on successful cases.

BIBILOGRAPHY

1. ATC, 1992. A model methodology for Assessment of Seismic Vulnerability and Impact of Disruption of Water Supply System, Project report ATC 25-1, ATC, USA.
2. HMG/N, 2002. Tenth *5-year National Plan*. Kingdom of Nepal, National Planning Commission, HMG/N, Kathmandu, Nepal
3. LSGA, 1999. *Local Self Governance Act 1999*. His majesty's Government of Nepal, Kathmandu. Nepal
4. MOHA/HMGN-JICA, 2002. The study on earthquake disaster mitigation of Kathmandu valley, Kingdom of Nepal, Project Report, Ministry of Home Affairs, HMG/N, Kathmandu, Nepal.
5. MPPH/HMGN, 1994. Seismic Hazard Mapping and Risk Assessment for Nepal, Project document, National Building Code Development Project, Ministry of Physical Planning and Housing, HMG/N, Kathmandu, Nepal.
6. NSET, 1999[1]. *Kathmandu Valley's Earthquake Scenario*. National Society for Earthquake Technology (NSET), Kathmandu, Nepal
7. NSET, 1999[2]. The *Kathmandu Valley Earthquake Risk Management Plan*. National Society for Earthquake Technology (NSET), Kathmandu, Nepal

Mr. A. M. Dixit and
Mr. B. Pandey from Nepal

Presenters at the Workshop…

Dr. M. Klyachko
from Russia

Mr. T. Boen
from Indonesia, Member,
WSSI Board of Directors

Dr. N. H. Phuong
from Vietnam

RECENT ACCOMPLISHMENTS ON SEISMIC HAZARD MITIGATION IN TAIWAN

C. H. YEH, H. Y. HO and K. C. TSAI
National Center for Research on Earthquake Engineering
Taiwan

ABSTRACT

Recent accomplishments on reconstructions of damaged regions after the Chi-Chi Taiwan earthquake in 1999 are described. The promotion and dissemination of seismic hazard mitigation technologies and strategies are briefly introduced in this paper.

1. INTRODUCTION

Taiwan is located at the circum-pacific earthquake belt and has suffered from devastating earthquakes in almost every decade. In 21 September 1999, Chi-Chi earthquake occurred due to the rupture of Chelongpu fault. Its magnitude was 7.3 with a focal depth of 7 kilometers, attacked central Taiwan. This earthquake has resulted in 2,488 deaths, 11,000 injuries, and caused more than 100 thousand households severely wounded due to various degrees of building damages. The total economic losses were about US$11.5 billions. Since then, the central government of Taiwan has devoted efforts on reconstructing the disastrous regions and implementing the seismic disaster reduction systems against future earthquakes. Several coordinated projects are undertaken in Taiwan to identify the hazard sources, reinforce the civil infrastructures, integrate information and scenario simulation systems, improve communication capabilities, and to educate, as well as disseminate these information to, the general public.

2. BASIC FRAMEWORK FOR DISASTER REDUCTION PLAN

In this paper, the basic framework of disaster reduction plan implemented in the Taiwan government is briefly introduced. The framework comprises the laws, organizations and plans that are designed to allow the government, public services and private sectors to become aware of various kinds of natural hazards and to be well-prepared for the occurrence of these hazards. It is believed that through the regular exercises based on scenario simulations are essential in improving emergency responses.

2.1 Hazard Mitigation and Response Acts

The Executive Yuan promulgated the “Disaster Prevention and Mitigation Scheme” on August 4, 1994. Its purpose is to set up a disaster prevention and response system and to upgrade its disaster mitigation capabilities. Due to the 1999 Chi-Chi Taiwan earthquake which resulted in more than 2,400 casualties and enormous economic losses, Taiwan government has decided to establish a comprehensive and efficient administrative system for disaster prevention. The "Disaster Prevention and Mitigation Act" was passed by the Legislative Yuan and approved by the President on July 19, 2000. The act consists of several parts, including general statements, organization of the hazards mitigation system, and plans for hazard mitigation, countermeasures for hazard preparedness, emergency responses and recovery, penalties, and appendix. A brief description of the act is given below.

- General Statements: describing the purpose of this act, definitions of terms, and agencies in charge of different kinds of hazards.
- Organization of the hazard mitigation system: in order to execute hazard mitigation tasks, it stipulates that agencies in the central and the local governments have to convene necessary committees. It also requires that in order to facilitate these tasks, they are allowed to set up units to execute, consult, or research.
- Mitigation plans: it stipulates the initiation of basic plans concerning hazard mitigation, the procedures for approval, and the contents of the plans.
- Preparedness: it stipulates the obligations of government and relevant agencies, and items of preparedness for hazard mitigation.
- Emergency response: it stipulates the emergency response measures and the scope of duties when a disaster has occurred.
- Recovery: it stipulates that the government agencies as well as the public organizations should jointly participate in the coordination of post-disaster recovery.
- Penalties: it stipulates the penalties associated with the violation of this law.
- Appendix: it stipulates the budget planning, emergency loans, donations, standards setting, etc.

2.2 Organizations

The organizations and the framework of the disaster reduction management system in Taiwan are shown in Figure 1. Based upon the "Disaster Prevention and Mitigation Act", the Hazard Mitigation Committee of the Execute Yuan is formed to take in charge of implementation and coordination of the national policies for hazard mitigation. The Committee Chairman is the Premier of the Executive Yuan. The secretaries of the central ministries and scholars are members responsible for formulating and promoting the Basic Plans for Disaster Prevention and Response. The administrative organs are mandated to prepare and fulfill their operation plans or local plans for disaster prevention and response.

In order to achieve the goals for hazard mitigation and emergency response, temporary mission task forces are formed by various levels of government. The Central Disaster Prevention and Mitigation Briefing set up by the Executive Yuan is the highest unit of special mission for disaster prevention and response. The municipal city government and regional governments will also set up the disaster prevention and response task forces which are overseen by the Hazard Mitigation Committee of the Executive Yuan. In the level of regional government, governors serve as chairpersons of the regional disaster prevention councils. Thus, the designated units or staffs shall be responsible for all the obligations and responsibilities on disaster prevention and response.

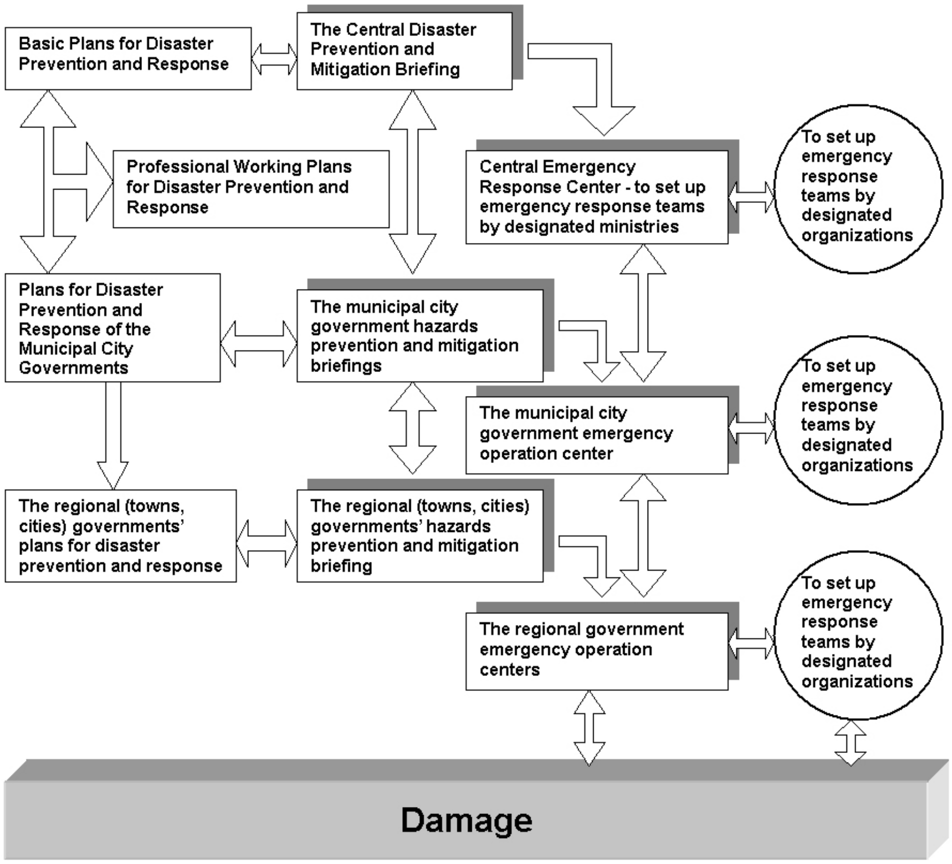


Figure 1: Framework of Disaster Reduction Management System in Taiwan

2.3 Hazard Mitigation and Response Plans

Basic Plan for Disaster Prevention and Response. This is the national plan for disaster prevention and response. Its first version has been approved by the Central Disaster Prevention Committee on June 20, 2001. The Basic Plan includes key features of the overall and the long-term disaster mitigation and response planning and strategies. The plan also provides the guidelines on the operation plans and local plans for disaster prevention and response.

Operation Plans for Disaster Prevention and Response. The plans shall be formulated by various administrative ministries and public services according to the Disaster Prevention and Response Act and the Basic Plan for Disaster Prevention and Response.

Local Plans for Disaster Prevention and Response. The plans shall be formulated by municipal or regional (counties or cities) Disaster Prevention and Response Committees according to the local conditions.

3. EARTHQUAKE ENGINEERING RESEARCHES AND DISASTER MITIGATION TECHNOLOGIES

During the past years, several coordinated research programs on earth science, earthquake engineering and disaster mitigation technologies have been conducted through the supports of various government agencies, including the Central Weather Bureau, Ministry of Education and National Science Council. Some of these projects are described in the following.

3.1 Strong Motion Monitoring Networks

There are more than 650 strong-motion stations installed around Taiwan by the Central Weather Bureau (CWB). This is part of the "Taiwan Strong Motion Instrumentation Program (TSMIP)" launched in 1991. In the same program, the CWB has also installed more than 50 sets of strong-motion arrays in buildings and bridges to monitor the seismic responses. It has provided valuable data for research on system identification and health diagnosis of structures. Thousands of strong-motion records have been collected and used in studying various attenuation laws of strong-motion parameters, site effects due to topographic and geologic conditions, and so on. In particular, the strong-motion records of the 1999 Chi-Chi Taiwan earthquake provide valuable data to investigate the near-fault responses of structures subjected to long-period velocity pulses, or to study the seismic source rupture model, etc.

The CWB also develops "Taiwan Rapid Earthquake Information Release System (TREIRS)", allowing the detection of an earthquake, including its magnitude, epicenter and focal depth all within a total of 90 seconds immediately following its occurrence. Through an integrated application of the TREIRS and TELES (to be explained later), the central and local emergency response centers can obtain the intensity maps of the ground motion parameters, or the hazard maps of the predicted damages and casualties, etc. in 15 minutes after occurrence of strong earthquakes.

The current distribution of strong-motion stations in Taiwan is likely the densest in the world. However, the applications of these strong-motion records would be limited if a complete geologic database of each site is not available. Therefore, started in 2000, the National Center for Research on Earthquake Engineering (NCREE) and CWB launched a joint effort to investigate the site conditions of the strong-motion stations. It includes collecting the basic soil properties and the wave velocity of the stratum. At the time of writing this paper, a total of 175 stations has been investigated. In addition, all the research results are systematically stored in the database and accessible through Internet. This database is extremely useful in further research on the site effect analysis and earthquake-resistant design.

3.2 Seismic Evaluation and Retrofit of School Buildings

There were many school buildings severely damaged or collapsed during 1999 Chi-Chi Taiwan earthquake; especially those buildings in primary and secondary schools. According to statistics, 786 school buildings were subjected to various degrees of damage. Among them, 656 were severely damaged and 43 were collapse. In Nantou County only, twenty percents of the school buildings were severely damaged or collapsed. Most school buildings were constructed according to a common plan. Typically, these classrooms were allocated side by side in a row and the corridor is cantilevered without outer columns. Therefore, due to a lack of redundancy and the effects of short-column, there has been a strong tendency that school buildings collapsed along the corridor. The Ministry of Education has decided to allocate funds on seismic evaluation and retrofit of vulnerable school buildings.

The preliminary seismic resistance assessment of a school building can be made by filling out a simple table during the visual inspection. The original version of the table was developed during the post-earthquake reconnaissance following the 1999 Chi-Chi earthquake. From the statistics of the school building damages, the maximum unit load for columns and minimum ratio of wall cross-sectional area to total floor area were estimated. After the preliminary assessment, the detailed seismic evaluation method can be further applied considering the demand and capacity of the school buildings. Detailed example assessments were carried out for school buildings based on the possible strength and ductility. In addition, the feasibility of various retrofit technologies for school buildings has been studied experimentally. In order to disseminate the methodology of seismic evaluation and retrofit for school buildings, tutorial courses and workshops have also been held. At least twenty-one collapsed school buildings have been reconstructed and most damaged school buildings have been repaired and strengthened using various approaches including enlarging the columns, adding shear walls, adding wing-walls, reinforced concrete jacketing and steel jacketing.

3.3 Seismic Evaluation and Retrofit of Highway Bridges

In order to determine whether it has been damaged or not, more than one thousand highway bridges were inspected immediately after the Chi-Chi earthquake. Almost all the collapsed bridges were on the Chelongpu fault due to the large deformation occurred on two sides of the fault. Strong ground shaking near the fault zone has caused either the shear-type or the flexure-type failure modes on the columns, or severe damages on the bearing or anti-falling systems. It appears very difficult to prevent damages caused by extremely large ground deformation. Nevertheless, several projects have been launched in order to study effective disaster mitigation strategies for highway bridges that may run across active fault zones.

In 2001, the Taiwan Area National Freeway Bureau (TANFB) of Ministry of Transportation issued a planning project to evaluate the seismic capacities and seismic hazards of freeway bridges, surveying retrofit technologies for existing bridges. It has allowed the prioritization according to available budgets to retrofit existing bridges. The recommendations have been accepted by the Council for Economic Planning and Development of Taiwan. According to the schedule, all the bridges in Sun Yat-Sen freeway, the first and the most important freeway in Taiwan, will complete the retrofit work by 2009.

3.4 Construction and Upgrade of Electrical Power Systems

The Chi-Chi earthquake had paralyzed Taipower's ability to transmit and distribute electric power to many of its customers. Damages of hundreds of 345 KV, 161 KV and 69 KV transmission towers in the affected area caused the immediate blackout in the middle and north of Taiwan. Some substations and switchyards were also damaged, although the impact of their damage on the entire power system was usually much less direct than the failure of transmission system. A notable exception was the switchyard at Chung-liaw located about 7 kilometers away from the epicenter. Being pivotal to the power transmission, the functional loss of this switchyard was one of the key factors responsible for the post-earthquake electrical power interruption.

Taking the advantage of the government emergency decree announced following this earthquake, the construction of the third 345 KV transmission line was immediately accelerated. The northern segment of the third transmission line was completed in 2000 spring. After its completion, the network reliability and redundancy has been significantly enhanced. In the long term perspective, the "Sixth Transmission and Substation Project" has been launched to further improve the power system in Taiwan. The project was started in July 2001 and will be completed by December 2006. It will build or upgrade 272 substations and add additional 3,660 ckt-km of transmission lines.

3.5 Update of Seismic Design Codes

During the past years, NCREE has led the efforts in updating the seismic force requirements for building and bridge designs in Taiwan. Based on the uniform hazard analysis for a return period of 475 years, the design response spectral accelerations with 5% damping ratio at short and 1 second periods are calculated for each administrative unit, either in a village, town or city level. Furthermore, by considering the local site effects, the site-dependent modification coefficients have been defined.

In order to check the performance of structures under the maximum considered earthquakes, the maximum considered response spectral accelerations corresponding to a return period of 2500 years, are also developed at short and 1 second periods. In addition, in order to consider the basin effects, microzonation of Taipei basin has been incorporated in the updated version of the seismic design codes. The near-fault effects are also taken into consideration through applying the near-fault coefficients to amplify the seismic demands at the near-fault regions. In the meantime, in order to fully implement the performance-based design in the future, the procedures for the performance evaluation were also studied during the past years. Most of these researches focused on the topics of design ground motions, mathematical model and analysis procedures.

3.6 Networked Experimental Simulation Technology

Information technology has a great potential to gain wide applications on earthquake engineering experiments or simulations, such as the NEES and the ED-Net projects launched in the United States and Japan, respectively. It can effectively satisfy the needs on large-scale structural experiments. An Internet-based environment, named ISEE (Internet-based Simulation for Earthquake Engineering) has been developed in NCREE for collaborative networked pseudo-dynamic tests among different laboratories. ISEE employs a database for experimental data exchange and repository, a web service for experiment setup and data sharing, and facility controllers with tele-operation capability. It also possesses an OpenSees-based analysis engine to perform pseudo-dynamic analyses, the video and data broadcasting systems share the real-time video images and experimental response digital data with interested viewers through Internet.

A series of networked pseudo-dynamic tests using the database approach show that the network and data processing cost about 0.2 seconds and 2 seconds per time step, about 20% and 70% of the total elapsed time in the domestic and transnational experiments, respectively. It appears rather feasible for most of the low-speed pseudo-dynamic tests.

With real-time videos and experimental data sharing internationally, the ISEE has been applied to the Taiwan-US-Japan collaborative large-scale RCS and CFT-BRB composite frame experiments in 2002 and 2003, respectively. Further researches are continued to enhance the robustness and functionalities of the ISEE environment. The objectives include the promotion of the ISEE to other research laboratories in Taiwan, and to integrate with ED-Net, NEES and the other earthquake engineering networks in the world.

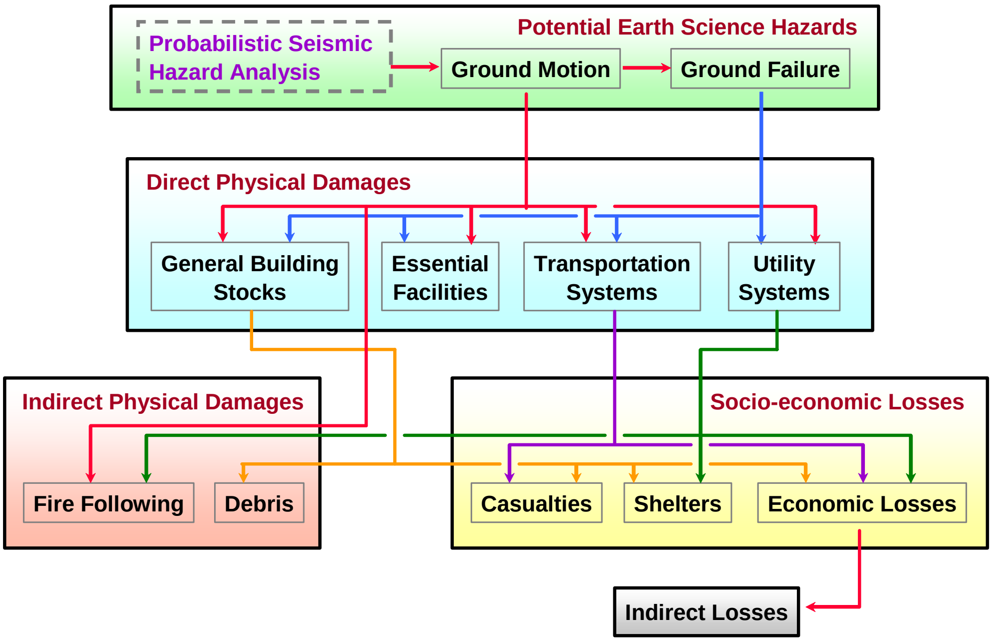


Figure 2: Framework of analysis modules in HAZ-Taiwan project.

3.7 Seismic Disaster Simulation and Loss Estimation

Based on the framework of HAZUS, the National Science Council launched the HAZ-Taiwan project in 1998. In the scope of that project, various kinds of seismology, geology and inventory database have been collected. In addition, a number of analysis modules including potential earth science hazard analysis, damage assessment of engineered structures, and socio-economic loss estimation have been developed and further calibrated. Although the Risk Management Solutions, Inc., a well known consultant company in the United States, developed the first version of the application software, forms the basic methodology of HAZ-Taiwan. National Center for Research on Earthquake Engineering has further developed the second version of the application software.

The latest application software developed in the HAZ-Taiwan project is called "Taiwan Earthquake Loss Estimation System (TELES)". The framework of analysis modules in TELES is shown in Figure 1. To complement the functionality of HAZUS, the TELES software is designed to fulfill three objectives. The first objective is to act as a decision-making support system in emergency responses and to estimate the induced damages, casualties and losses in very short time after occurrence of strong earthquakes. The second objective is to comprehensively estimate the possible consequences of strong earthquakes and to assist in proposing the disaster mitigation plans for local governments. The third objective is to estimate the maximum probable loss and annual average loss due to strong earthquakes and to help governments and private sectors in proposing the catastrophic risk management policies.

4. INFORMATION AND COMMUNICATION SYSTEMS

4.1 Existing information system

A number of organizations have developed their own information systems to meet the needs in various phases, such as the mitigation, preparedness, emergency response, and recovery phases in disaster management. Users are the relevant operation staffs in the ministries or institutes. The existing information systems of several organizations are described briefly as follows:

(a) **National Fire Administration (NFA), Ministry of the Interior**: When a disaster is recognized, information is collected accordingly and transmitted through the internet. The location of the disaster will be marked on the GIS-based maps. Furthermore, resources for rescue forces and medical services can be inquired according to the scale, classification, the phase of the natural hazard.

(b) **Water Resources Agency (WRA), Ministry of Economic Affairs**: When a natural hazard is forming, the information comes from the River Management Office, such as water levels in rivers and dams, and operation status of hydrological equipments and facilities, are integrated into the disaster information system. The information is also provided to other government agencies through intranet system.

(c) **Central Weather Bureau (CWB), Ministry of Transportation and Communications**: Information provided by the CWB includes typhoon tracks, precipitation observations, satellite images, radar echoes, numerical weather forecast model predictions, and earthquake monitoring information. All the information can be accessed from the web site of CWB for extended application.

(d) **The Soil and Water Conservation Bureau (SWCB), Council of Agriculture**: Information provided by the web-based disaster information system of SWCB includes the state of landslide alert, announcement of debris flow, heavy rainfall and typhoon related information in mountain area.

(e) **National Science and Technology Center for Disaster Reduction Center (NCDR), National Science Council**: When a typhoon attacks Taiwan area, NCDR provides decision-making support information to the Central Emergency Response Center. It includes the hourly rainfall forecast for each river basin, inundation potential maps for each county and city, and potential maps of debris flow creeks in Taiwan area.

(f) **National Center for Research on Earthquake Engineering (NCREE), National Science Council**: Soon after the occurrence of a strong earthquake, the information of the ground motion intensity, ground failure extent, building damage counts and casualty estimates are calculated by the Taiwan Earthquake Loss Estimation System. This is one of primary accomplishments of HAZ-Taiwan project explained in section 3.7.

4.2 e-Taiwan project for disaster management

The existing information and decision-making support systems for disaster management were designed independently by various government agencies and research institutes. It is crucial to integrate all the information systems into a unified multi-purpose disaster management system. The e-Taiwan project is an important part of the "Challenge of 2008 - National Development Plan". One of the objectives of the e-Taiwan project is to establish an integrated information and communication system for disaster management. The total budget of the e-Taiwan project is around NT$700 millions for the upcoming five years. The tasks of this project are briefly described as follows:

(a) Developing a national decision-making support system for disaster management

- Integrating the existing decision-making support systems from various government agencies.
- Developing a standard decision-making support system for central and local governments.
- Setting up an information management system for disaster prevention and response.

(b) Integrating and replenishing the data bank for disaster management

- Integrating and replenishing the existing data bank from each government agency and institute.
- Developing a platform for data sharing, maintenance and management of disaster data bank.
- Establishing a standard operation system for disaster data bank for central and local governments.

(c) Developing the disaster information system for training and education

- Developing an information system of disaster education for professional and decision maker..

(d) Developing an e-learning system for disaster management

4.3 Communication system

Based on the lessons learned after the catastrophic earthquakes and typhoons, Taiwan government has given more efforts on the communication systems for disaster reduction and emergency response. However, there are still many issues need to be further resolved. Firstly, the information for hazard analysis and disaster prediction in early warning phase appears insufficient. Secondly, the transmission system could be out of function when a hazard occurs, and the local disaster information might not be sent back to report. As a result, the commander in emergency response center would be unable to know what could have happened, and consequently he could not effectively dispatch rescue forces and medical resources.

Currently, the major communication systems for disaster information in Taiwan are the wired or radio devices such as telephone, fax, internet, walky-talky, mobile phone, satellite communication, and so on. However, the wired system may be damaged by strong wind of typhoon or by ground failure due to earthquakes. The communication systems might also be shutdown due to the power failure. The mobile phone could be one of the solutions for disaster information transmission. However, the communication devices or the transmission equipments may be damaged due to inundation, strong ground shaking or power failure. Besides, the development of information system requires transmission and procession of huge amount of digital data including voice, image, video, and so on. The information content is multiplexed and requires large bandwidth for data transmission. Consequently, one of the goals in developing communication systems for disaster information in Taiwan is to increase the transmission capacity through multiple channels.

The communication systems for disaster information in the "Challenge 2008 - National Development Plan" include two projects that are to plan, design, and establish microwave and satellite communication systems. The microwave communication project plans to set up a communication network with 167 microwave stations, which are distributed over the Taiwan area. The government agencies can communicate with the on-site experts and rescue teams when a disaster occurs. The satellite communication project plans to set up a communication network by satellite technology. The major tasks in establishing the communication systems include the construction of immovable stations and mobile systems to receive the microwave signals. When immovable stations are damaged in the disastrous area, a mobile network can be readily set up to maintain connectivity and the efficiency of rescue actions.

5. EDUCATION OF HAZARD MITIGATION

Recently, both the government and public services have given more efforts on education of hazard mitigation and disaster reduction. The promotion and dissemination works are conducted one after another. It focuses on designing the operational rules, editing the class materials, extending the courses, promoting related educational activities, strengthening educational facilities, setting up computer networks, etc. For example, the consultant office of Ministry of Education has launched a 4-year project on the "Improvement of Natural Hazard Mitigation Education in Civil Engineering" since 1998. This project has strengthened the contents and deepened the foundation of natural hazard mitigation education of civil engineering in colleges. In the mean time, Central Weather Bureau has edited "One hundred questions on typhoon", "One hundred questions on earthquake", "Natural hazard mitigation manual", and "An outlook on weather world" brochures for public disaster reduction education. These handbooks are free for the public in order to increase their knowledge and awareness of natural hazards.

Due to the rapid economic development and society changes, there are further needs on hazard mitigation education, especially about the policies, responsibilities, curriculum, course materials, and resources integration. For example, there are only 2% of colleges that teach disaster prevention education for common courses. Most of the courses focus on individual disaster, only a few courses touch on the multiple disasters. Textbooks mention disaster prevention and hazard-related knowledge. However, its contents often focus on disaster prevention attitude and skills. Only a few textbooks touch upon psychological adjustment and recovery, which is a long-term potential post-disaster problem. The audiences for hazard mitigation education are mainly students. There have been very few interactions between government agencies and professional organizations. After reviewing the current status of hazard mitigation and emergency response policies, problems, and demands, the consultant office of Ministry of Education has proposed the "Improvement of Hazard Mitigation Education Project in Taiwan".

5.1 Goal

After reviewing contents on hazard mitigation education implemented in other countries, it is found that the key points on hazard mitigation education in schools are as follows: the awareness and attitude of hazard mitigation and preparedness, appropriate emergency response measures, periodic exercises, building up of hazard mitigation system in communities, participation of students' parents, hazard mitigation training programs for administration staffs and teachers in schools, safety information on buildings, related researches on hazard mitigation education, and international cooperation on hazards mitigation.

The hazard mitigation education in the other countries focuses on actions. Although the knowledge-based learning is important, how to secure lives and properties through the establishment of hazard mitigation system is the key point for hazard mitigation education. It is therefore suggested that integrating resources for hazard mitigation education, setting up qualified learning curriculum, and enhancing public hazards resistance capacity be the ultimate goals of hazard mitigation education for Taiwan.

5.2 Implementation strategies

The goals of education program are to increase the public awareness on the importance of preparedness and emergency response. Through this education program, it is expected to foster hazard mitigation awareness of the public, to strengthen disaster resistance capacity of the society and to reduce risks. After reviewing the awareness and capability in each education level, the following implementation strategies are suggested:

- Strengthening public awareness on hazard mitigation.
- Developing appropriate courses and materials.
- Expanding learning approaches and education resources.
- Improving education facilities.

- Training the instructors for hazard mitigation education.
- Gaining instructional experiences and knowledge.
- Establishing hazard education exemplification and an evaluating system.
- Integrating resources with activities from schools, societies and hazard-related sectors of government.

5.3 Expected outcomes

When this project is completed, expected outcomes will be as follows:

- For each learning level (including elementary schools, junior middle schools, senior high schools, colleges, universities, adult education centers, etc.) and for each kind of disaster (including earthquakes, hurricanes, debris flows, man-made disasters, etc.), it is expected that the project managers complete the investigation of the demands in various stages. Other completed tasks will include the design of appropriate course material, training teachers and instructors, performing demonstration and evaluating performance.
- To complete the design and promotion of emergency responses of schools in different stages for hurricanes, floods, debris flows and earthquakes. That is to complete the design of plans for both natural hazards and man-made disasters for elementary schools, junior middle schools, senior high schools, colleges and universities.
- To complete the improvement of social and adult education, and to evaluate the performance, promotion abilities, and teaching facilities (e.g. software and hardware) of the hazard mitigation education agencies.
- To set up the web-sites and knowledge banks for various learning stages (including elementary school, junior middle schools, senior high schools, colleges, universities, adult education centers, etc.), so that the user can assess the course materials through the Internet.
- To plan and to set up resource centers for hazard mitigation education. To integrate the outcomes of hazard mitigation education projects during 2003-2006, including course materials, teacher training program, performance evaluation measures, and emergency response plans for various learning stages.

6. COLLABORATION WITH LOCAL GOVERNMENTS

The National Science Council of Taiwan has supported many hazard mitigation and disaster reduction projects and obtained fruitful results in the areas of potential earth science hazard analysis, damage and risk assessment, scenario simulation, early warning and estimation system, seismic capacity evaluation and retrofit technology, hazard-mitigation database, strategy and performance evaluation, etc. Many of these results have been implemented in practice. One of the examples is briefly described as follows.

The NSC had a collaboration agreement with the Municipal Government of Taipei (MGT) from 1999 to 2002 to assist in technology transfer from NSC to MGT for applications. Figure 3 shows the flow chart for the main tasks in this collaboration project. This project has completed the following tasks:

- Unification of rainfall stations into a system, development of high resolution inundation maps, development of inundation display and flood mitigation decision-support systems.
- Rating and mapping landslide potential hazard, and development of landslide warning system.
- Development of decision-making support system for earthquake disaster and loss estimation, earthquake scenario simulation, and proposing evacuation routes in case of damaging earthquakes.
- Development of Taipei City Hazards Mitigation Plan.

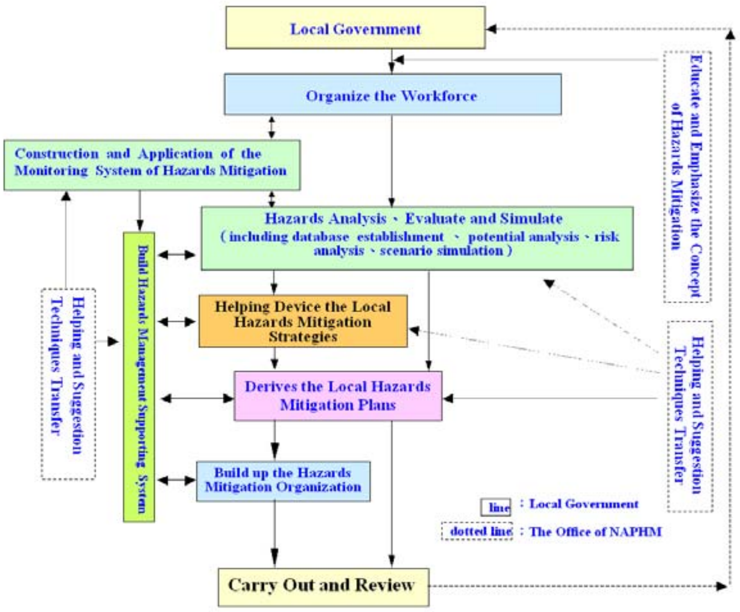


Figure 3: The Process flow of the Cooperation Project

With the assistance of the NCDR and NCREE, the MGT's working group has gained the technology and laid a solid foundation for improving hazard mitigation. For instance, during the typhoon events of Nakri and Sinlaku in the year of 2002, the emergency responses of Taipei City government had demonstrated the enhanced capability by utilizing technologies acquired during the period of collaboration. Similar collaboration agreements have been signed with several local governments. As more progresses are made in dissemination of mitigation technologies, the mitigation capability will be further enhanced in Taiwan.

7. INTERNATIONAL COOPERATIONS

In order to plan, integrate and coordinate earthquake-engineering researches in Taiwan, the National Science Council founded the National Center for Research on Earthquake Engineering (NCREE) in 1991. The main objectives of NCREE are to promote earthquake-resistant design, to stimulate innovative technologies, and to provide experimental facilities and services to government, academia and practice professionals in Taiwan. It also commits collaborations with many other research institutes, including MCEER, PEER and University of Texas, A&M in the United States, Kyoto University and Kobe University in Japan, PWGS in Canada, and so on.

In complying with the International Cooperation on Research and Training Programs of the National Science Council of Taiwan, NCREE has organized two short-term training course programs on seismic design of structures in the past two years. These training courses meet the suggestions given by the World Seismic Safety Initiative (WSSI). The participants came from many countries across the continents, including Costa Rica, Dominica, El Salvador, Guatemala, India, Indonesia, Malaysia, Mexico, Nepal, Philippines, Singapore, Thailand, Turkey and Vietnam. NCREE not just provided lectures, but also technical tours, round-trip airplane tickets and six-day accommodations. In October 2003, the program has been arranged to allow sharing the knowledge and experiences among different countries through presentations made by all participants.

8. CONCLUDING REMARKS

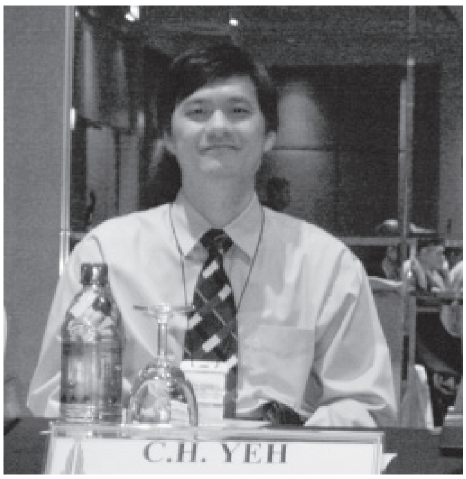
Damaging earthquakes are likely to happen again in the future. Disasters resulted from strong earthquakes could be more devastating than the 1999 Chi-Chi earthquake if the seismic sources are close to metropolitan areas. Since Taiwan is a developed country and locates in a seismic active region, it is essential for the governments, public services, private sectors, and individuals be well-prepared, knowing what to do and how to response when a strong earthquake occurs unpredictably. As a member of the earth village, Taiwan would like to learn lessons and exchange information, experiences and technologies with other developed countries as well as sharing our knowledge with developing countries.

REFERENCES

1. Ban-jwu Shih, 2002. First International Conference on Debris-Flow Disaster Mitigation Strategy, pp. 197-207.
2. Chen, C.H., Lai, W.C. Cordova, P., Deierlein, G. G. and Tsai, K.C., 2003, “Pseudo-Dynamic Test of a Full-Scale RCS Frame: Part 1 – Design, Construction and Testing”, Proceedings, International workshop on Steel and Concrete Composite Constructions, Taipei, Taiwan.
3. Lass, W., Reusswig, F., and Kuhn, K. D., 1998. *Disaster Vulnerability and Sustainable Development*, German IDNDR Series No. 14e, German IDNDR Committee for Natural Disaster Reduction.

4. Mileti, D. S., 1999. *Disasters by Design*, Joseph Henry Press, Washington, D. C.
5. Tsai, K.C., Hsiao, P.C., Lai, J.W., Chen, C.H., Lin, M.L. and Weng, Y.T., 2003, "Pseudo Dynamic Experimental Responses of a Full Scale CFT/BRB Composite Frame", Proceedings, Joint NCREE/JRC Workshop International Collaboration on Earthquake Disaster Mitigation Research Methodologies, Facilities, Projects and Networking, Taipei, Taiwan.
6. Yen, C. L., 1998. *Planning of National Science and Technology Program for Hazards Mitigation*, National Science Council Monthly, Vol. 26, No. 7 (in Chinese).
7. Yen, C. L., 1997. *Research on Disaster Reduction Technology in Taiwan*, Paper presented at 3rd Cross-Strait Symposium on Hydrotechnology Exchange, Beijing, China (in Chinese).
8. Yen, C. L., Tsai, Y. B., Chen, L. C., Lee, C. S., Hsu, M. H., Lin, M. L. and Loh, C. H., 1997. *Planning Study on Science and Technology Research for Hazards Mitigation*, Report, National Science Council, Taipei, Taiwan (in Chinese).

Dr. K. C. Tsai and
Dr. C. H. Yeh from Taiwan



EARTHQUAKE RISK MITIGATION EFFORTS: THE PHILIPPINE EXPERIENCE

B. C. BAUTISTA
Philippine Institute of Volcanology and Seismology (PHIVOLCS)
Philippines

ABSTRACT

This paper discusses the earthquake risk mitigation efforts in the Philippines spearheaded by the Philippine Institute of Volcanology and Seismology (PHIVOLCS). The approach being taken deals with balancing the conduct of seismological studies and the implementation of innovative activities that can raise the levels of awareness and preparedness of local communities to earthquake disasters.

The Philippine experience involves the upgrading of the institutes capability to monitor and document earthquake occurrences in the country and the conduct of seismic hazard studies in both regional and microlevels. These generated various hazard maps which are distributed to the public. The elements-at-risk such as schools, hospitals and lifelines are also plotted on these hazard maps and can be used for planning how appropriate socio-economic and engineering responses could be designed. These maps can now be used for educating various communities in order to guider them in preparing appropriate disaster action plans. Only through an understanding of these hazards and their associated risks can vulnerabilities be reduced by convincing these communities to act now and prepare themselves against future earthquake disasters. The other step actively pursued by PHIVOLCS is finding innovative and creative ways on how to raise public awareness through seminars, workshops, town watching exercises, earthquake drills and disaster action planning. For the next few years, our target for our information dissemination campaigns would be the tsunami prone communities in the country through the setting up of tsunami markers, memorials, designing evacuation route and teaching them nature possible precursors for tsunami occurrence.

1. INTRODUCTION

This paper discusses the experience of the Philippine Institute of Volcanology and Seismology (PHIVOLCS) in implementing programs related to earthquake risk mitigation from the time that the Institute took over the Seismology mandate in 1986. Like other developing countries, the Institute's programs for earthquake risk mitigation is dependent on available funds. Inspite the lack of funds, the institute continued to address the needs of its vulnerable communities for proper earthquake information and the need to develop a culture of earthquake-prepared communities.

2. EARTHQUAKE MITIGATION STRATEGIES SINCE THE 1990 LUZON EARTHQUAKE

The mandate of conducting earthquake-related studies in the Philippines is under the Philippine Institute of Volcanology and Seismology (PHIVOLCS). This responsibility was transferred to the Institute after government reorganizations in 1984 and 1986. Prior to this, from 1901 to 1986, the seismological mandates rested with the Philippine meteorological agency, which is similar to setups in other Asian countries.

When PHIVOLCS assumed the responsibilities of being the earthquake monitoring agency in the country, it took over the operation of nine manned, analog seismic stations. These stations were responsible for monitoring the seismicity of the entire archipelago. The instruments were carry-over from a previous United Nations Development Programme (UNDP) grant which upgraded the seismic network of the country to WWSSN standards. Computers were still hard-to-acquire then especially for developing countries. Hence, plotting of earthquake epicenters was done manually using the graphical method. Communication with the nine stations was done through single side band radios. Only one station had its own telephone unit. There were photographic strong motion instruments but films for recording had been out of the market by the time the photographic accelerographs were transferred to PHIVOLCS. The transfer also included warm bodies mainly trained in seismic observations and basic repair and maintenance of these equipment. Meanwhile, as in other developing countries then, earthquake awareness efforts were still not so widely done and supported at that time. Hence, the level of awareness of the public was limited.

From 1986 to 1989, earthquake data processing and database management started to be computerized. Attempts to raise public awareness were initiated through seminar-workshops with audience coming from local government units. Two of these workshops were held in the Cordillera Administrative Region (CAR) and in Baguio City in June 1990. The interest then was not so high and encouraging probably since the last earthquake in that region happened long time ago. A month later, a Ms 7.8 struck northern Luzon including CAR and Baguio City. The quake killed more than 1,200 people mainly due to building collapsed. Nineteen buildings collapsed in Baguio and Cabanatuan Cities while several others in these cities were severely damaged. Severe liquefaction caused other buildings and bridges to tilt and sink in Dagupan City, another city in Northern Luzon. With the deaths and severe economic impact (about 99 million pesos) caused by this quake, it served as an eye opener to the authorities about the need to have a strong earthquake risk mitigation program in the country. After this and until now, PHIVOLCS continued on with activities leading to increasing the earthquake awareness and preparedness. It targeted specialized audience, especially those who could replicate the knowledge, such as teachers, media, engineers and local government officials. PHIVOLCS also gave attention to tapping local knowledge of indigenous communities about disaster preparedness. At present, the same kind of earthquake seminar workshop is being done by PHIVOLCS in different earthquake risk areas including Metro Manila and the level of acceptance is very high.

2.1 Preparedness Efforts for Earthquakes in the Philippines

2.1.1 Development of capability for warning and Generation of Sufficient Database for Conducting Seismic Hazard Maps

Knowing that a truly upgraded and state-of-the art seismic network comparable to developed countries costs money which a developing country like the Philippines can ill-afford, PHIVOLCS drafted and endorsed a proposal on a project entitled “Improvement of the Earthquake and Volcano Monitoring Network of the Philippines” to the Japan International Cooperation Agency (JICA) right after the 1990 earthquake. Since only a short list of projects are endorsed by the government each year to JICA, the PHIVOLCS project took years to be approved, given funding and implemented. In anticipation of the eventual approval and to show that PHIVOLCS has the setups in place to host and implement a high-level project such as the development of a state-of-the art seismic network, PHIVOLCS constructed several seismic stations from 1991 to 1999. The Institute also upgraded its manpower pool in its field stations by recruiting graduates with engineering degrees. At the same time, from a two-floor rented office space that it used to occupy, PHIVOLCS managed to obtain government funds to build its own four-storey building that now houses its four technical divisions, one administrative division, a Data Receiving Center, one S & T library, 1 geochemical laboratory, a GIS laboratory, a thin sectioning room, a radio-communication room, auditorium, two mini-conference rooms, a visiting scientist room and a canteen. At the fourth floor are 18 individual rooms targeted for use of its visiting scientists who have collaborative projects with PHIVOLCS.

In 1999, the proposed JICA project was finally implemented. The project consists of two phases. Phase 1 consists of upgrading the seismic stations of PHIVOLCS, which numbered 34 in 1999, from an analog to a digital setup. This phase also installed a digital strong motion instrument, intensity meter and two PCs in each of the 34 stations in the country. Phase II is divided into both Phase IIa and Phase IIb. Phase IIa consists of installing radio-telemetered networks in the five most active volcanoes of the Philippines. Phase IIb is the establishment of 30 new remote seismic stations linked through satellite communications technology. When operational, the new seismic network will consists of 34 manned stations and 30 remote stations to bring the total number of stations to 64. At the same time, the JICA grant also provided GPS instruments for studying ground deformation of volcanoes and faults, electronic tiltmeters and portable strong motion instruments for emergency seismic monitoring.

Meanwhile, for Metro Manila, a seven-station radio-telemetered network has been established and being operated by PHIVOLCS. The aim is to detect possible foreshocks that could indicate possible future movement of the valley Fault System, the active fault that transects the metropolis.

The high quality seismic data being generated by the upgraded network can now be used in conducting seismic hazard assessment studies. For the last few years, seismic hazard studies in the Philippines involved the estimation of strong ground motion using both probabilistic and deterministic approaches, seismic microzonation studies of key cities using microtremor observations, paleoseismology and active faults mapping, identification of liquefaction-, landslide-prone and tsunami-affected areas. While studies of seismic hazards were primarily concentrated on a regional level, PHIVOLCS has started to focus on doing these seismic hazard studies on a microlevel. For Metro Manila, first generation hazard maps showing ground rupture, ground shaking and liquefaction hazards had recently been completed. Other large cities that are also at risk from large earthquakes are the next targets. The elements at risk such as population, lifelines, vertical and horizontal structures for each of these urban centers are also being incorporated in the hazard maps for immediate use of planners, civil defense officials, policy-makers and engineers. The maps can also now be used to describe possible scenarios during times of strong events and how appropriate socio-economic and engineering responses could be designed.

2.1.2 Earthquake Awareness and Preparedness

Meanwhile, PHIVOLCS has been very active in conducting activities that can raise public awareness and finding ways how scientific studies can influence building code implementation and land use. This is done through public education. Formal attempts by PHIVOLCS in cooperation with the Department of Education to incorporate the knowledge about geologic hazards into the elementary school curriculum has been successful. At present, concepts about earthquakes and volcanoes are now being taught to primary school children. Meanwhile, a graduate degree course in Earthquake Engineering was also initiated and is now being done together with the Polytechnic University of the Philippines (PUP), one the largest state universities in the country. This is to produce graduates that can take the lead on conducting earthquake engineering studies and practice in the country. Faculties harnessed to teach in this special graduate studies program include PHIVOLCS scientists as well as faculties from other engineering departments of other universities and engineers from the Association of Structural Engineers of the Philippines. The Memorandum of Agreement (MOA) between PHIVOLCS and PUP also states that PHIVOLCS facilities and equipment may be used by the graduate students.

2.1.3 Other Raising Earthquake Awareness Activities

Publication and dissemination of reading materials audiovisual packages that explain earthquake hazards:

To reach a wider audience, PHIVOLCS embarked into the publication of pamphlets, posters and annual reports that can be easily understood by ordinary person. This was done by translating these materials into different local dialects aside from the English language. These materials include comics liquefaction, tsunami and landslides. Another example is the PHIVOLCS Earthquake Intensity Scale (PEIS) poster that has both English and Filipino translations. To illustrate possible impacts at each intensity levels, commonly found in Filipino households and local settings & structures were used in the poster. Meanwhile, audio-visual packages such as videos have also been prepared and have been disseminated all over the Philippines. Meanwhile, to also address the scientific needs of both local and international communities, PHIVOLCS published several monographs and proceedings as well as professional papers in addition to research papers of PHIVOLCS employees published in international refereed journals.

Holding of seminars, workshops, caravans, etc. to reach out to a wider audience:

For the last decade, PHIVOLCS held seminars and workshops that addressed earthquake disaster preparedness. Lecturers usually include PHIVOLCS scientists, local officials, local civil defense officials and the media. Another approach employed by PHIVOLCS is the conduct of a Science and Technology (S & T) caravan. This is to ensure that the target audience which in this case are the students and teachers are given first hand exposure to faults and other geologic phenomena they will encounter within the caravan itinerary. Aside from this for the last couple of years, walk-in lectures had been conducted by PHIVOLCS usually catering to more than 60,000 students and teachers. The 34 field stations/observatories of the Institute also serve as venues for educational field trips for local students, teachers and residents. Visiting them provide the local people first-hand observation on how seismic monitoring is done and perhaps convince some students to take up earth science courses in the future.

Successful use of Tri-media Support in Information Dissemination:

PHIVOLCS had also developed a special relationship with the local and international media through frequent interactions, seminars and good relationships that had paid off when PHIVOLCS used the tri-media in disseminating scientific information during volcanic and seismic crisis. PHIVOLCS scientists had maintained an accessible and open attitude to the media people resulting in a good exchange of information. This camaraderie had also helped PHIVOLCS deliver its message to the public in an accurate manner as the communication lines between the scientists and the media had remained open and free-wheeling through the years.

Reaching out to other sectors of Philippine society in terms of disaster mitigation efforts:

PHIVOLCS also implements projects that study how the women sector can be used during earthquake disasters. As mentioned earlier, another project is the study of how the unique cultures of tribal communities or ethnic groups can be used for disaster mitigation.

Establishment of linkages with the academe for seismic observations:

During the development of the National Seismic Network, PHIVOLCS has chosen to locate three seismic stations inside school campuses so that the school's science classes could utilize PHIVOLCS setups in explaining how seismic observation is being carried out. Recently, PHIVOLCS has conducted a pioneering effort to include the academe and students where these stations are located in the day-to-day monitoring of earthquakes in the Philippines. The institute had started to initiate collaborative works with at least one university in Southern Luzon, the Polytechnic University of the Philippines – Lopez campus where a seismic observation set-up, consisting of a seismograph and its accessories, will be installed in the future and will be operated by the faculty members and students of the university's civil engineering department. Operators underwent training in the PHIVOLCS Main Office covering topics in basic seismology, station operation & maintenance and seismogram dissection & reporting. Eventually, with the success of this initial program, PHIVOLCS foresee its expansion to include other universities as well, giving the academe an active participation in the monitoring and study of earthquakes in the Philippines.

Meanwhile, several recently-implemented collaborative projects address the need to have both top-bottom and bottom-up approach as possible solutions to earthquake disaster mitigation.

The Metro Manila Case Study (MMCS):

The Metro Manila Case Study (MMCS) under the Development of Earthquake and Tsunami Technologies for the Asia Pacific Region (EqTAP) implemented together with the Earthquake Disaster Mitigation (EdM) of the National Research Institute for Earth Science and Disaster Prevention (NIED) of Japan

The Development of Earthquake and Tsunami Technologies for the Asia Pacific Region (EqTAP) project aims to adopt earthquake and tsunami technologies applicable to the Asia Pacific region. For the Philippines, the project selected Metro Manila and the Metro Manila Case Study was conceptualized and implemented starting 2000. Since Metro Manila consists of 17 cities and municipalities, the MMCS decided to focus on three cities (Manila, Muntinlupa and Marikina) to apply EqTAP technologies. Since the guiding principle of EqTAP is to adopt the collaborative and consult scheme of the risk management framework, several consultative meetings as the project was being implemented were held among the stakeholders of the local government units, school officials and representatives from other institutions who might be affected during a large-magnitude earthquake.

The Earthquake Impact Reduction Study of Metro Manila (MMEIRS):

This project aims to develop a master plan for Metro Manila in the event that a large-magitude earthquake hit the metropolis. The project has produced seismic hazard and risk maps including calculations of loss and casualties for a scenario earthquake. An interesting component is the holding of a community-based disaster management (CBDM) activity for three communities in Metro Manila. In these communities, town watching activity and digital imagination game (DIG) were conducted. Basically, these activities let the participants identify the hazards and risks in their community while the DIG activity let them prepare scenarios based on the hazard maps. This project is being supported by JICA.

Collective Strengthening of Community Awareness for Natural Disasters (CSCAND):

This project is a collaborative project between PHIVOLCS, selected local government units and the United Nations Development Programme (UNDP). It aims to harness community participation and raise awareness of the hazards and risks in their community and offer solutions on how losses can be minmized or prevented. It is an offshoot of the original project called Crustal Stress and Community Awareness Network (CSCAN), which was organized in 2000 in 10 selected sites in Luzon island. In 2000, several crustal stress measuring devices were installed in different places in Luzon to detect possible changes that could be related to earthquake activity. The unique feature is that local volunteers are the ones doing the daily readings from this equipment. Data are sent to PHIVOLCS and Chinese scientists for processing and analysis. Aside for their participation in data gathering, the volunteers and other local people are being trained to look for possible environmental precursors in their area that could be related to an impending large earthquake.

For the past year, the project has held workshops that combine traditional lectures and town watching activities. For Metro Manila, the group has embarked into the training of school officials on how to do an earthquake drill properly. Aside from this, the project have also initiated plans to initiate the production and use of earthquake placemats on fast food chains and for development of effective signages and directional signs in shopping malls. Parents and teachers eating at these fast food chains are the targets of these earthquake placemat project. We want to get their attention at the time that they are waiting for their food orders. The placemat design offers simple and interesting easy-to-answer quizzes, picture games and puzzles that inform rather than frighten users. Meanwhile, at any one time, malls might host half a million people and any sudden panic caused by earthquake, power outage or any emergency might trigger stampede. This project aims to urge mall owners and concerned officials into putting up clear signages that could guide people on the exit signs during emergencies in these crowded places. Another recent accomplishment under this project is the production of a 60-sec TV/movie plug early this year that tells audience what to do should a strong intensity shaking occurs. The movie plug shows various frequently visited sites within a mall and it teaches the audience what to do when shaking happens. The plug was shown in 220 cinemas and TV channels all over the Philippines.

Development of a Rapid Earthquake Damage Assessment System (REDAS):

This program develops a computer software that can compute and simulate the seismic hazards (ground shaking, liquefaction, landslide and tsunami) in a given area immediately after an earthquake. At the same time, the vulnerability can also be assessed since the elements at risks are also being included in the database. This software will guide civil defense officials and disaster managers in deciding where to deploy relief and rescue operations after a damaging earthquake. The software can also be useful to planners and engineers in making earthquake safe designs, land use plans and policies.

Earthquake Risk, Vulnerability and Earthquake Awareness and Preparedness of Residents in Multi-Storey Mass Housing Communities in Metro Manila:

This is a recently-agreed collaborative project between the Philippine Institute of Volcanology and Seismology (**PHIVOLCS**) and the National Housing Authority (**NHA**). The main objective of the project is to contribute towards the minimization of earthquake disasters in Metro Manila, Philippines through the promotion of disaster awareness and preparedness among mass housing project residents. The project will specifically focus on multi-storey, high occupancy mass housing projects of the government. One provision of this collaborative project is for PHIVOLCS to help NHA assess the vulnerability of several government multi-storey mass housing projects which are located in areas close to the Valley Fault System and in other areas of the metropolis expected to experience high intensity ground shaking due to site amplification. The vulnerabilities of each mass-housing project will be assessed by determining the level of seismic hazards each project site is exposed to, by evaluating the structural soundness of mass housing project buildings using ambient vibration measurement and by evaluating the level of awareness and preparedness of residents thru questionnaire surveys. PHIVOLCS and NHA will then choose and prioritize four most vulnerable mass housing project sites for intensive earthquake awareness and preparedness campaign. The chosen sites will serve as a pilot study sites wherein specific earthquake drill plans will be designed, implemented and evaluated.

Retrofitting of Structures and Implementation of Building Codes:

As a result of PHIVOLCS continuous efforts, it was able to convince other agencies to implement retrofitting measures to important critical infrastructures. The mandate to do retrofitting is under another government agency, the Department of Public Works and Highways (DPWH). Recently, DPWH has started the retrofitting of some flyovers in the metropolis. PHIVOLCS also sit in as one of the bodies in charge of revising the existing building codes. Last year, the active faults maps by PHIVOLCS were incorporated in the latest version of the Structural Code of the Philippines, a referral code of the building code.

3. WHAT EFFECTIVE TECHNIQUES HAVE WE LEARNED?

Musson, a scientist said that “Earthquakes are a serious threat to communities exposed to them, and the main aim of seismology, ultimately, is to reduce that threat”. For the past years, what we have learned precisely through the years of finding solution to the earthquake disaster problem is that to gain success is to strike a balance between the pursuit of scientific knowledge and letting the public use this knowledge. When scientists make sure that their results are shared and taught to the end users themselves, it becomes the most effective way of making science work for them. This can be done through simple, understandable language when presenting these to them. The use of eye-catching designs and colors for exhibits and posters had been very effective especially when dealing with students and teachers. For teachers, we have learned how to teach them how to use teaching aids such as gelatin and sand and water to illustrate liquefaction, wooden sticks of varying sizes to illustrate building response and popsicle sticks glued together to illustrate building design. Building a local version of shaking table has been another effective tool to show children how earthquake feels and what they should do when it happens.

For higher level users like local government officials, providing them hazard maps with plotted elements at risks for their own city or town is an effective way for them appreciate their vulnerabilities and prepare action plan accordingly. Town watching or community watching exercises are also effective means for them to look at the hazards in their communities with “new eyes”. Living in one’s community for years make one get used to the hazards. Looking at it through this activity had helped community leaders and dwellers look at their community more objectively and think of possible solutions that can be done from their own capabilities or from their local governments. In the CSCAND workshops and in various community-based disaster management training course, the institute through its collaborators in JICA and UNDP, has already went down to the community level to impart earthquake awareness. The next step now is for them to make their own disaster action plan based on the knowledge given them. They have vowed that they will aim for this while we have also affirm that the Institute will continue to contribute its technical expertise for the making of these disaster action plans.

The tri-media is another stakeholder who must also be taught about earthquakes and how they can help at various stages of the disaster phase. A refreshing approach is by letting them visit active fault areas and seeing for themselves their location and the fault’s geomorphological expressions.

4. THE ROAD AHEAD

The road ahead challenges us to develop the updated and detailed seismic hazard maps to address the needs of urban planners, engineers and disaster managers. During the last decade, most of the outputs were regional in scale. It is only during the last two years that hazard maps on a microlevel has been done. The target is to do this mapping scale on other seismically vulnerable cities in the country where risks and vulnerabilities keep on increasing.

At the same time, the road ahead challenges us to think and devise of new ways and techniques to reach more communities. The task is urgent since next damaging earthquake can happen anytime. For rapid onset events especially tsunamis, tsunami inundation maps, markers, memorials, as well as designation of evacuation routes are possible good activities that can be initiated within the next five years. We will continue to find ways to complete the next mile to complete our mandates and to seal the efforts accomplished during the last decades on raising earthquake awareness and preparedness.

Dr. B. Bautista from Philippines

HAZARD REDUCTION THROUGH COMMUNITY-BASED INITIATIVES

A. HASHAM and M. BAIDULLOEVA
City Coordinators for Central Asian Earthquake Safety Initiative, Dushanbe
Tajikstan

ABSTRACT

The Republic of Tajikistan is the smallest and southernmost republic of the former Soviet Union. The country gained its independence on September 9, 1991. Since then, Tajikistan has had to deal with the dual challenges of a collapsed state-centric political and economic system along with a brutal civil war which lasted approximately five years.

Tajikistan is also prone to a number of natural hazards and in the span of two years, 1992-1993 experienced three out of the ten most severe disasters between 1975 and 2000, according to the ratio of amount of damage to GDP. In addition to these hazards, Tajikistan is located in one of the most seismically active zones in the world. In the 20th century alone, Tajikistan experienced a number of major earthquakes which resulted in substantial loss of life and damage to social and economic infrastructure.

Similar to other sectors, the collapse of the Soviet Union had a considerable impact on the government and local population's general awareness and preparedness for seismic hazards. Recognizing the potential devastating impact of seismic hazards on major cities in Central Asia an innovative project was initiated in April 2003 covering three major cities in the region. One of the marked differences of this project is that while it recognizes the role of information gathering and analysis, it has sought to move away from seismology simply being important to scientists and making it a concern of the general public including practitioners and decision-makers. While the latter are important in establishing an effective enabling environment and one which promotes seismic safety, the Earthquake Safety Initiative is based on the principle that the emphasis must be on prevention and preparedness and not on response. Moreover, this preparedness must be undertaken at the household level whereby individual families must assume ownership for their own safety and security and not on a remote state authority. In order to achieve this, the project's approach encourages community-based disaster mitigation, awareness of risk and knowledge of risk reduction measures amongst a broad group of stakeholders, broad community involvement, and capacity-building of existing local organizations and institutions to engage in mitigation activities on a long-term basis.

1. INTRODUCTION

The Republic of Tajikistan is the smallest and southernmost republic of the former Soviet Union. A landlocked country, with a total land area of 143, 000 square kilometers, it shares borders with Uzbekistan to the west and north, the Kyrgyz Republic to the northeast, China to the east, and Afghanistan to the south. More than 93% of the territory of Tajikistan is mountainous and only 7% of the land is arable. Over 72% of the population lives in rural areas.

Tajikistan, one of the countries with the fastest-growing population rate in the former Soviet Union, presently has a population of just over 6 million, with a little more than 10% of the total population residing in its capital, Dushanbe. The country gained its independence on September 9, 1991. Since then, Tajikistan has had to deal with the dual challenges of a collapsed state-centric political and economic system along with a brutal civil war which lasted approximately five years. This has been a challenging period of transition which has included the abrupt discontinuation of universal social benefits provided by the Soviet Union, a high level of unemployment with approximately 80% of the population living below the poverty level, and national and regional tensions. It is only since the signing of the Peace Accords in 1997 and with the ensuing relative political, economic, and social stability that the country has been able to fully concentrate on addressing issues regarding its long-term development.

2. TAJIKISTAN: HIGHLY VULNERABLE TO NATURAL HAZARDS

The designation of the International Decade for Natural Disaster Reduction in 1989 was critical in highlighting the significant increase in disaster-related losses of life and livelihoods in recent years. It is estimated that the number of people affected by natural disasters was three times higher in the 1990s than in the 1970s and economic losses were five times higher. Moreover, it is expected that this trend will increase during the 21st century with issues such as population expansion, displacement, and environmental degradation all contributing to increase vulnerability of populations and infrastructure.[1] Natural disasters affect all regions and countries. However, it is clear that when such disasters occur in developing or transition countries, they serve to undo development gains and add further burdens on weak systems which do not have adequate capacity to respond effectively. The end result is further economic and often social and political instability.

Tajikistan, due to its geography and climate, is prone to a number of natural hazards. According to an Asian Disaster Reduction Centre report, Tajikistan has experienced three out of the ten most severe disasters between 1975 and 2000, according to the ratio of amount of damage to GDP.[2] In fact, in the span of two years, 1992-1993, Tajikistan experienced two floods and one landslide which combined resulted in almost 1,600 deaths and more than 100,000 people affected.

In addition to these hazards, Tajikistan is located in one of the most seismically active zones of Central Asia and the world in general.[3] In the 20th century alone, Tajikistan experienced a number of major earthquakes which resulted in substantial loss of life and damage to social and economic infrastructure. The combined intensity and location of an earthquake in the Western Pamir mountains in 1911, resulted in a massive landslide covering the village of Usoi, backing up the Murghab river, creating Lake Sarez and the world's highest natural dam. Similarly, the Khait earthquake, in 1949 created a landslide which moved at a catastrophic speed and buried under it several villages including 28,000 lives. Most recently, in 1989, an earthquake 30 kms from Dushanbe, although measuring only 5.3 on the Richter scale, caused a massive landslide which resulted in 274 deaths and left more than 30,000 homeless. In addition to these high magnitude earthquakes Tajikistan experiences a number of earthquakes of a lesser magnitude, which may be more isolated in their impact but still serve to disrupt the lives and livelihoods of thousands.

In recent years, the cultivation of more marginal lands and the increased migration to urban areas, due to the economic pressures in the post-independence era, have created conditions which multiply the likelihood and impact of natural hazards increasing the overall percentage of population at risk.

3. ATTEMPTS TO MITIGATE SEISMIC HAZARDS DURING THE SOVIET ERA

The catastrophic earthquakes of Ashkhabad (1948) and Khait (1949) resulted in considerable resources being provided by Moscow to further research and determine the nature of earthquake occurrence and its forecasting in the Soviet Union.

From the early 1950s, the Soviet Union provided considerable attention and resources to finding out more about seismic hazards including: identifying epicenters and their occurrence; determining the energy of earthquake; learning more about the spectral composition of vibration; determining the mechanism of an earthquake's epicenter; learning about seismic regime in time and duration. Much of the information collected from this effort is now being used as base line information for conducting further research not only in former Soviet Union countries but throughout the world.

As part of this increased attention on seismology, an Institute of Seismology and Seismic Resistant Construction, which was made part of the Academy of Sciences, was established in Dushanbe in 1951. Moreover, a world class research centre was erected some 70 kms from where the Khait earthquake occurred in order to conduct further research and testing of seismic activity.

Following its inception, this research centre and the one Dushanbe became one of the largest and most prominent seismological centers in Central Asia. Here, a variety of investigations were undertaken, including a substantial number of which were conducted as part of joint projects with other scientific research institutions throughout the world.

Overall, the Soviet era was important in that the awareness of and support provided by the central government ensured that significant resources were prioritized and provided for the identification, monitoring, and mitigation of natural hazards. To this end, the state played an active role in regulating and safeguarding economic and social infrastructure.

4. SEISMIC SAFETY AND AWARENESS IN THE POST-INDEPENDENCE ERA

Similar to other sectors, the collapse of the Soviet Union had a considerable impact on the government and local population's general awareness and preparedness for seismic hazards. The collapse of the state-centered political system and the ensuing civil war in Tajikistan resulted in i) a significant lack of financial and material resources for disaster preparedness, mitigation, and prevention measures; ii) a general shift in attention and resources away from disaster preparedness to more pressing needs, such as food security; and iii) loss of highly competent, professional staff who left their posts due to security reasons or meager pay in state institutions.

Between 1992 and 2001, of the 33 seismological stations in Tajikistan, 4 stations were totally destroyed and 15 stations located in the Garm region were damaged and/or destroyed during the country's brutal civil war. The rest of the stations have lacked resources in order to maintain and operate basic equipment. The result is that the once vibrant monitoring and analysis which was being conducted within Tajikistan is now of a very low level. This is of considerable concern given the country's exposure and general vulnerability to seismic activity.

More than the effects on seismological research, the collapse of the Soviet Union and the relatively few resources available to the newly independent state has resulted in many more structures at risk than before. Most buildings in Dushanbe have received very little attention in terms of maintenance. In fact, the strains of the civil war and related socio-economic challenges have placed greater burdens on them. The end result is that most existing structures are in a very poor condition with many of them being beyond repair and unsuitable for use.

Moreover, new buildings are being constructed without adequate monitoring from the state which lacks resources to ensure that building codes and standards are adhered to. Compounding this situation is that in an effort to cut time and building costs, many contractors are using poor quality materials – often because proper materials are simply not available – or techniques which are sub-standard resulting in buildings which do not meet seismic safety requirements.

This is all exacerbated by poor planning and chaotic building practices within the city, a lack of access to basic information about earthquakes and their awareness amongst a population of which a considerable percentage has only recently migrated from rural to urban areas, and a lack of coordination amongst key government agencies and relevant research institutions as to how this risk can be mitigated.

5. EARTHQUAKE SAFETY INITIATIVE IMPLEMENTED IN THE CENTRAL ASIAN REPUBLICS

Recognizing the seismic hazards in Central Asia, in particular, the increased exposure of major cities in the region to this threat and the need for increased technical assistance and coordination amongst specialists and decision-makers, a workshop was held in Almaty in 1996.[4] One of the major conclusions reached was that an earthquake of MSK IX intensity would result in 120,000 serious injuries and 40,000 deaths in Dushanbe alone. Moreover, more than one-half of all residential buildings in the Central Asian capitals would likely collapse or be damaged beyond repair if exposed to an MSK IX level of shaking.[5] In addition to the deaths and injuries, the city would experience tremendous physical destruction, with ensuing economic disruption, which would place even greater strains on fragile political and economic systems.

One of the immediate impacts of the workshop was an increased awareness and recognition that a broad group of stakeholders including scientists, practitioners, decision-makers, and local community members were required to work at different levels and through different channels in order to improve the city's overall seismic safety.

While such developments were being recognized in the field of seismology and among key stakeholders, Tajikistan was undergoing a significant transformation which would enable risk reduction initiatives to be implemented with a relatively high level of success. The signing of the Peace Accords in 1997 provided an initial foundation since which time Tajikistan has experienced considerable political, economic, and social stability. This has allowed the country to move away from a significant reliance on humanitarian assistance and begin to focus on and undertake measures to foster and safeguard its long-term development. This shift has been critical in providing an overall environment in which risk reduction programs are recognized as being essential and therefore accepted by all involved. One initiative which has benefited from and served to contribute to this stability has been the Central Asian Earthquake Safety Initiative (ESI).[6] The goal of this project has been to reduce the vulnerability to earthquakes of three major cities of Central Asia: Almaty, Kazakhstan; Dushanbe, Tajikistan; and Tashkent, Uzbekistan.

One of the marked differences of this project from previous projects implemented in Tajikistan is that while it recognizes the role of information gathering and analysis, it has sought to move away from seismology simply being important to scientists and making it a concern of the entire general public including practitioners and decision-makers. While the latter are important in establishing an effective enabling environment and one which promotes seismic safety, the ESI is based on the principle that the emphasis must be on prevention and preparedness and not solely on response. Moreover, this preparedness must be undertaken at the household level whereby individual families must assume ownership for their own safety and security and not on a remote state authority. In order to achieve this, the project's approach encourages community-based disaster mitigation, awareness of risk and knowledge of risk reduction measures amongst a broad group of stakeholders, broad community involvement, and capacity-building of existing local organizations and institutions to engage in mitigation activities on a long-term basis.

The goal of the ESI has been to convey to the general public that mitigation is not a task reserved for specialists, but rather, everyone's responsibility. For this reason, it is imperative that knowledge acquired by specialists not simply remain in computers or specialized, scientific publications but that such knowledge be disseminated to as wide an audience as possible and in a manner and format which can be accessible to all. Through this interaction, one objective is to increase the awareness of citizens who are, in turn, able to demand policy changes from public officials.

6. ACHIEVEMENTS TO DATE

During its first year, the ESI focused on four key activities. The first has been to identify and involve all key stakeholders in meetings in order to inform them of the project, its objectives, and opportunities as to how each stakeholder can get involved and make a noticeable contribution to the project. Thus, through a number of meetings, individuals from the government, including the Ministry of Emergency Situations and Civil Defense, research institutes such as the Institute of Seismology and Tajik Technical University, and international and local organizations actively involved in disaster reduction initiatives came together in order to discuss challenges and opportunities related to the project. This gathering was important in order to establish and foster bonds amongst a number of individuals from different spheres and specializations to come around a common concern with a common objective. This was something quite innovative given that disaster preparedness and general crisis management was something that was previously the exclusive responsibility of the state. By bringing together this diverse group of individuals, the project was able to meet one of its key objectives: namely creating a working group which would come together and work effectively with a high level of cooperation.

In order to coordinate the activities of the stakeholders, a City Coordinating Unit was identified: Focus Humanitarian Assistance (FOCUS). FOCUS was chosen given that it has considerable experience in working with local communities and authorities in the area of risk reduction in rural areas of Tajikistan. Overall project management and technical assistance would be provided by GeoHazards International (GHI) which has considerable experience in implementing seismic safety initiatives and is considered as a lead agency in the field.

A second key output of the first year was the development of an Urban Risk Reduction Framework. The Framework provided a quick overview as to what was being done at various levels (namely at the community, provincial, national and regional levels) by different stakeholders in order to reduce the potential impact of natural hazards. In addition to providing an outline of what is being done, the Risk Reduction Framework highlights what is not being done in order to increase seismic safety. Moreover, the Risk Reduction Framework also serves as a baseline survey in order to identify not only what is done directly through the ESI but also other initiatives which may be direct or indirect offshoots of the project through the awareness and capacity that it generates.

The third impact of the project is that it has served to identify and further develop the skills of local practitioners involved in disaster risk reduction initiatives, either working for the government or implementing agencies. In order to provide the stakeholders an understanding of what the project could achieve, a number of them traveled to Turkey in order to visit activities which have been implemented there by GHI and its local partners. What was unique about this study tour is that it involved participants from all three Central Asian republics involved in the project. Thus, the project has been successful in not only fostering relationships amongst various stakeholders within individual countries but has also created strong working relationships throughout the region.

The fourth major output of the project in its first year has been the development and adaptation of key training materials which were initially developed and piloted in Turkey. This includes a training seminar for Basic Disaster Awareness and a 20 page handbook. The seminar targets master trainers who through a cascade model will be able to reach a broad number of other trainers. These trainers will, in turn, disseminate the materials and information directly to the beneficiaries – namely local community members.

During the development of these materials, close attention was paid to ensure that the text and images selected for the documentation would be suitable for the local context. In order to reach the maximum number of individuals and ensure that the materials are accessible to local communities, it has been agreed that the materials will be developed first into Russian and then into the local languages of the three Central Asian republics.

Figure 1: An example of materials developed and modified for the local context

One unique feature of this project is that the materials have been developed with key involvement from a number of stakeholders. This has created a strong working relationship amongst the partners as well as an individual sense of ownership amongst each contributing agency. Thus, when the materials will be finalized it will not be simply the product of an individual or one agency but a collective committed to reducing the impact of seismic hazards.

7. FUTURE ACTIVITIES

As part of its activities for the second year, GHI and FOCUS will provide training to master trainers from agencies interested in using the materials developed as part of this project. This will ensure that the message and the method in which it is delivered are common and trainers are appropriately familiar with all of the material and its content. By ensuring the quality of the materials and the training of trainers, the project is able to work with a large number of disseminating partners and reach as broad of an audience as possible.

Moreover, in order to reach other sectors of the population, the project will develop more specialized materials in the second year. The first will target schoolchildren and an exciting exercise book outlining key basic disaster awareness principles will be developed along with a corresponding activity guide for teachers. In addition to targeting schoolchildren, through the Risk Reduction Framework, it became clear that institutes of higher learning could also benefit from the project. Thus, in the second year of the project, FOCUS will lead a workgroup in collaboration with faculty at Tajik Technical University to localize the curriculum developed in Turkey. The curriculum will include: basic disaster awareness, non-structural mitigation, structural awareness, community emergency response team skills and community outreach and planning. This partnership with a major Tajik university is critical in ensuring that future professionals trained in the engineering faculty will receive exposure to concepts such as community-based mobilization and non-structural mitigation – concepts which traditionally have not been part of the curriculum previously.

In the third year, the project will focus on ensuring that the materials developed continue to be disseminated to as broad an audience as possible covering all diverse sectors of society. Thus, there will continue to be training of trainers to ensure the quality of the training workshops. This is part of the overall objective of strengthening local institutions and their capacity to identify and implement risk reduction initiatives.

8. CHALLENGES TO AND LESSONS LEARNED FOR EFFECTIVE RISK REDUCTION

Overall, to date, the project has been very well received and there is great enthusiasm from all the partners and stakeholders. In many ways, it has served as a model for broader risk reduction initiatives and not simply those focusing specifically on seismic hazards.

However, through the implementation of this project, the agencies involved have also identified one major challenge. The most striking challenge is that there are a large number of buildings that are highly vulnerable to significant seismic activity. Given the high costs of retrofitting or demolishing and reconstruction, it is unlikely that this is something that will be resolved in the short- to medium term. This is of considerable concern given the high level of seismic activity in the region and the recurrence of major earthquakes which serve to increase the overall vulnerability of these cities. Recognizing this limitation, the project has sought to encourage people to undertake those measures, such as non-structural mitigation efforts, which are possible for the majority of the population to complete in the short-term and are highly effective. For example, based on evidence following the earthquake at Izmit, Turkey in 1999, it was clear that many injuries occur due to a lack of adequate planning and simple measures such as fastening large furniture in homes could prevent certain injuries sustained during and after an earthquake.

9. CONCLUSION

The Central Asian Earthquake Safety Initiative is a very exciting and ambitious project in that it has sought to gather individuals from the scientific community, diverse government agencies, local communities, and international and local implementing agencies to work on a common concern through “collective solutions”. Although managing these relationships has been challenging at times, given the social, economic and political context of Tajikistan and the transition which it is undergoing, the project and the manner in which it has sought to be participatory and emphasize consensus-building have been quite successful. Consequently, the Risk Reduction Framework and the emphasis on preparedness rather than response offer many lessons which can be adopted in other risk reduction initiatives and not simply those which focus on seismic hazards.

ENDNOTES

[1] "Natural Disaster Risk Reduction: The Policy and Practice of Selected Institutional Donors," A Tearfund Research Project, July 2003.

[2] Asian Disaster Reduction Centre Biweekly News, February 18, 2003.

[3] Please see Appendix B below for a list of all major earthquakes which have occurred in Tajikistan between 1888 and 1991.

[4] The proceedings of this workshop are published in "Seismic Hazard and Building Vulnerability in Post-Soviet Central Asian Republics," edited by King, Stephen; Khalturin, Vitaly; and Tucker, Brian; NATO Science Partnership Sub-series, February 1999.

[5] Please see Appendix C below for a list of Structural Types, their Occupancy Total in Dushanbe, and the Expected Damage Levels

[6] The project is funded through a cooperative agreement between the United States Agency for International Development, Office of Foreign Disaster Assistance (USAID/OFDA) and GeoHazards International (GHI). The project will last three years (October 2002-September 2005).

APPENDIX A:
THE IMPLEMENTING AGENCIES

GeoHazards International (GHI) was established in 1991 as a nonprofit organization dedicated to reducing death and injury caused by natural hazards in the world's most vulnerable communities. Thus, the organization has developed considerable capacity in his area targeting the cities of developing countries which are the least prepared to cope with the earthquake risk that increases exponentially with population density. Recognizing that the needs of the people who live in such vulnerable communities have been virtually ignored, GHI developed and is implementing a four-step plan to reduce future death and injury from earthquakes in the developing world. The steps are i) raise awareness, ii) reduce the identified risk, starting with the community's most critical services, iii) assure that new construction is earthquake resistant and iv) encourage involvement of local experts engineers, scientists and government officials with their counterparts abroad.

Focus Humanitarian Assistance (FOCUS) is an international group of agencies established in Europe, North America, and South and Central Asia that have developed a specialization in disaster preparedness, mitigation, prevention and disaster response. FOCUS is an affiliate of the Aga Khan Development Network (AKDN). The AKDN is a federation of institutions whose collective mandate embraces health care, education, rural development, micro-finance, promotion of private sector commercial enterprises, research and learning, and applied art, culture and architecture. All member agencies of the AKDN share a common objective: to empower people to take charge of their own lives and environments in order to expand their opportunities and choice. The programs emphasize community participation, local expertise, rigorous management of resources, use of appropriate technology and ultimate self-sufficiency. Active in Tajikistan since 1997, FOCUS has implemented a variety of initiatives including training for local communities, strengthening government capacities to respond to emergencies (targeting the Ministry of Emergency Situations and Civil Defense), and implementation of various projects designed to mitigate natural hazards and increase local preparedness.

APPENDIX B:
SIGNIFICANT EARTHQUAKE IN TAJIKISTAN 1888-1991

Date	District	Intensity	Mag.	Impact
1888	Kairakum	8	6.3	
1895	Karategin	8-9	5.4	
21.10.1907	Karatag	9	7.4	
21.10.1907	Karatag	9-10	7.3	
21.10.1907	Karatag	7-8	6.2	
18.02.1911	Sarez	9	7.4	Lake Sarez formed.
28.12.1923	Shahristan	8	6.4	
16.09.1924	Karategin	-	6.4	
22.09.1930	Faizabad	8	5.7	
31.08.1934	Argankul	8-9	6.5	
8.10.1935	Argankul	8-9	6.1	
14.10.1935	Argankul	7-8	4.9	
30.05.1939	Karategin	8-9	5.8	
20.04.1941	Dashti Khirson	9	6.5	
26.04.1941	Dashti Khirson	7-8	5.5	
6.05.1941	Dashti Khirson	7-8	5.6	
19.05.1941	Jirgatal	7-8	-	
11.01.1943	Faizabad	8-9	6.0	
12.01.1943	Faizabad	8-9	5.5	
12.01.1943	Faizabad	8-9	4.7	
10.07.1949	Khait	9-10	7.4	28,000 people died.
23.01.1954	Roshtkala	8	5.8	
22.09.1956	Range of Peter I	7-8	4.5	
4.01.1958	Range of Peter I	8	5.5	
16.10.1963	Center of Pamir	8	6.5	
2.02.1965	Southeast of Pamir	7-8	6.0	
31.01.1977	Isfarinsk	7-8	6.1	
3.03.1981	Northeast of Pamir	-	5.4	
29.09.1982	Southeast of Pamir	-	5.4	
26.02.1983	Range of Peter I	7-8	5.3	
26.10.1984	Jirgital	7-8	6.2	
13.10.1985	Kairakum	7-8	6.0	
22.01.1989	Gissar	7-8	5.3	274 people died
5.03.1990	Southern Pamir		6.0	
29.03.1990	Northern Pamir		5.6	
25.03.1990	Range of Peter I		5.9	
26.04.1991	Miyonadu		5.9	

APPENDIX C:
Structural Types, Their Occupancy Total, and the Expected Damage Levels

<table>
<tr><th rowspan="2">STRUCTURAL TYPE</th><th colspan="2">OCCUPANCY</th><th colspan="3">DAMAGE LEVEL</th></tr>
<tr><th>Thousands</th><th>% Urban Population</th><th>MSK VII</th><th>MSK VIII</th><th>MSK IX</th></tr>
<tr><td>1. Unengineered structures, including small adobe and unreinforced masonry buildings</td><td>1,200</td><td>20%</td><td>Heavy damage</td><td>Partial to total collapse</td><td>Total collapse</td></tr>
<tr><td>2. Brick bearing-wall systems with wooden floors, one to two stories, pre- 1955</td><td rowspan="3">1,400</td><td rowspan="3">23%</td><td>Moderate to heavy damage</td><td>Partial collapse</td><td>Total collapse</td></tr>
<tr><td>3. Brick bearing-wall systems with precast reinforced concrete (RC) floors, three to five stories, pre- 1957</td><td>Slight to moderate damage</td><td>Heavy damage to partial collapse</td><td>Partial collapse</td></tr>
<tr><td>4. Brick bearing-wall systems with precast RC floors, some seismic detailing, post- 1957</td><td>No damage to slight damage</td><td>Moderate heavy damage</td><td>Heavy damage to partial collapse</td></tr>
<tr><td>5. Precast RC frames with welded joints and brick infill walls, four to nine stories</td><td>400</td><td>7%</td><td>Slight damage</td><td>Moderate heavy damage</td><td>Heavy damage to partial collapse</td></tr>
<tr><td>6. Precast RC large-panel systems with dry or wet joints</td><td>1,800</td><td>30%</td><td>No damage to slight damage</td><td>Slight to moderate damage</td><td>Moderate damage</td></tr>
<tr><td>7. Other</td><td>1,300</td><td>20%</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>6,100</td><td>100%</td><td></td><td></td><td></td></tr>
</table>

Presenters at the Workshop…

Ms. M. Baidulloeva from Tajikstan

Prof. S. Cherry from Canada

Mr. M. Matovu and Mr. B. M. Ajuoga from Uganda

SEISMIC RISK AWARENESS ACTIVITIES IN UGANDA

B. M. KIGGUNDU and E. M. TWESIGOMWE
Uganda Seismic Safety Association
Uganda

ABSTRACT

Uganda Seismic Safety Association (USSA) owes its origin to the WSSI Board Meeting of 25th April 1997. At this meeting a decision was taken to hold the 8th WSSI High Level Meeting in Kampala, Uganda. The Kampala Meeting was held 1-2 December 1997. Among the resolutions made was the declaration that Uganda was to become the Focal Point for Earthquake Disaster Information in the African Continent. It was then realized that an organization was required to fulfill this resolution. Hence, USSA was formed in April 1998, with the major objective of networking, through sharing information related to earthquakes, and increasing public awareness.

USSA is a non-governmental organization recognized by Uganda Government and is the 50th member of the International Association for Earthquake Engineering (IAEE).

USSA organizes annual seminars/ conferences and has so far held two national seminars and two International Conferences. The first seminar was held in 1998 on the theme "Earthquake Disaster Reduction" and the second one was held in 2000 on the theme "Earthquake Resistant Low-cost Housing. Both seminars were held in Kabarole District, which is one the most earthquake affected Districts in Uganda. The first international conference was held in Kampala, December 2000, on the theme "Reducing Earthquake Effects in Developing Countries". The second conference was held in Entebbe, December 2002, on the theme "Earthquake Hazards in a Developing Country".

USSA publishes a Newsletter with two issues per year. Other activities of USSA includes: Development of guidelines for earthquake resistant (low-cost) construction in Uganda, under Ministry of Works, Housing and Communications; Drafting of the National Disaster Policy under the Ministry of Disaster Preparedness and Refugees, in the office of Prime Minister; Development of building codes that take into account seismic forces, under Uganda National Bureau of Standards.

Members of USSA involved in research have participated in development of a design code, assessment of seismic hazard (development of seismic zone map for Uganda) and material selection for construction in earthquake areas of Uganda. In training, one member has completed M.Sc program and two are now doing their Ph. D programs.

1. INTRODUCTION

The African continent is dominated by one major geological feature, the East African Rift System (EARS), stretching from the Red Sea and Gulf of Aden in the north to the Mozambique Channel in the south. Uganda lies between the two branches of EARS, the Western Rift and the Eastern Rift. It is mainly the Western Rift that is associated with seismic activity in Uganda.

The most earthquake- prone districts in Uganda are located in the West, as can be seen in Figure 1. These districts have experienced moderate earthquakes some of which have caused damage or destruction to some of the buildings and death to humans.

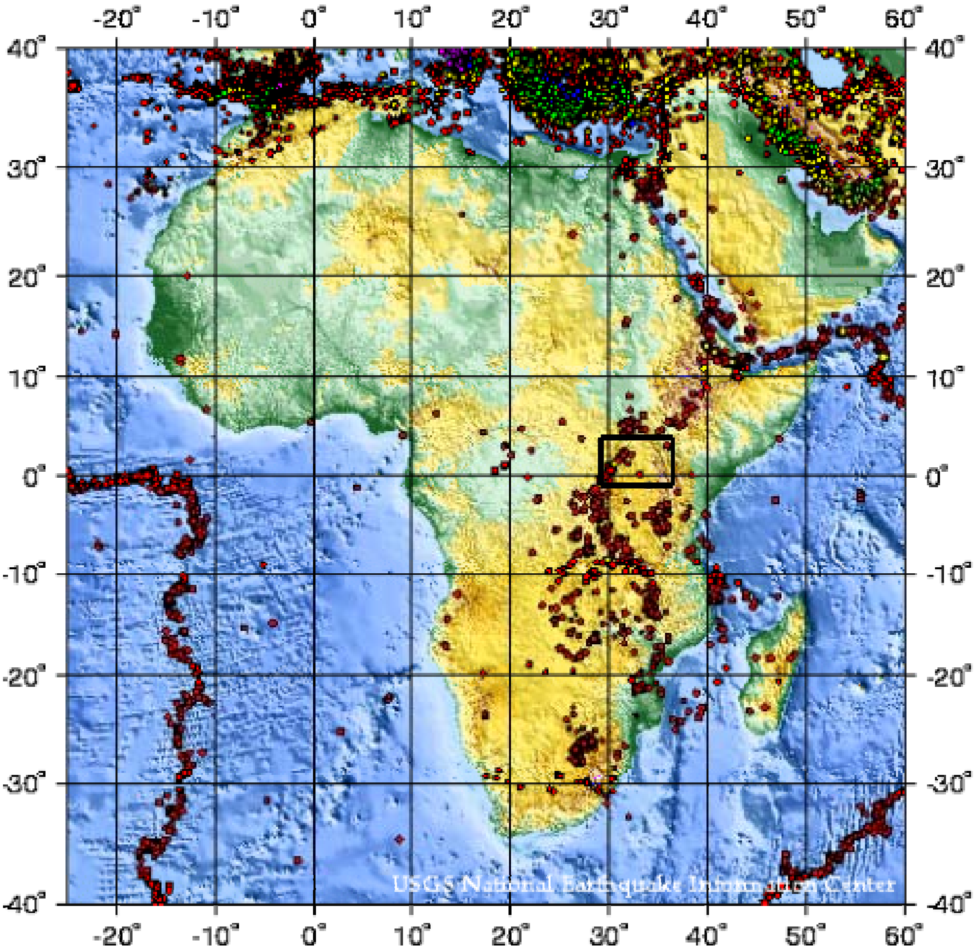


Figure 1: Seismicity of Africa: 1977-1997. The square shows position of Uganda.

There are a number of government departments and non-governmental organizations (NGOs) that are involved in the awareness-promotion programs in order to address the mitigation, the preparedness, the response, and recovery aspects in the event of an earthquake disaster. One such organization is the Uganda Seismic Safety Association (USSA), which is spearheading the dissemination of earthquake related information in the country.

2. 8th WSSI HIGH LEVEL MEETING, KAMPALA

At the World Seismic Safety Initiative (WSSI) Board Meeting on 25th April 1997, a decision was made to hold the 8th WSSI High Level Meeting in Kampala, Uganda. This High Level Meeting was to be the first of its kind on the African continent and was held on 1 – 2 December, 1997 at the Uganda International Conference Center, Kampala – Uganda.

This 8th WSSI High Level Meeting was graced by His Excellency the President of the Republic of Uganda, Yoweri Kaguta Museveni. The High Level Meeting which was locally termed Kampala International 8th WSSI High Level Meeting was attended by four members of the WSSI Board of Directors namely; Prof. Haresh Shah, Prof. T. Haavaldsen, Assoc. Profs, Ken Sudo and Kimiro Meguro. Local participants included Cabinet Ministers, senior government policy makers, researchers, consulting engineers, insurance agents, community leaders, media agents, business leaders and university students.

Some of the highlights in the opening address by the President were (Proceedings, 1997):

- Uganda was honored to host the 8th WSSI High Level Meeting.
- Uganda has had its share of earthquakes citing 2-earthquake events in Uganda namely the 1966 Toro earthquake (M= 6.7) causing death of 130 people, injuring 1300 people and destroyed 7000 houses. The total damage was estimated at U.S $1.7million; the second being 5th February 1994 – Kisomoro earthquake (M=6.0) leading to 8 people dead and damage to property worth U.S $60million. The President stated that the country was still grappling with the consequences of this earthquake.
- The President stated that following the 1994 earthquake, he took interest being in charge of the country to educate himself about the physics of earthquakes.
- The country is to expect new infrastructural developments like high rise buildings, which would house large populations increasing the vulnerability index.
- Uganda was a participating member of the UN Disaster Management Training Program. In 1994 following the occurrence of the earthquake, it was recommended to formulate disaster Management Policies.
- The President showed great interest in making Uganda a geographic focus for spreading the message of awareness and preparedness in sub-Saharan Africa.

A significant resolution from this 8th WSSI High Level Meeting was to make Uganda a **Focal Point** for earthquake disaster related information in sub-Saharan Africa. In addition, it was recommended that a seismic risk reduction program involving safeguards for mitigation of earthquake disasters should be set up in Uganda.

3. IMPACT OF WSSI ON UGANDA'S AWARENESS

3.1 Political Impact

The President of Uganda has since 1997 made pronouncements regarding inclusion of earthquake effects in design and construction of building infrastructure and most recently (2nd February 2003) when he was laying a foundation stone for a 16-storey Church House along Kampala Road. The President said "I hope that this building has plans to insulate it against earthquakes". He also recently requested for formulation of a **Cabinet Paper**, which is to be tabled before the Executive following which a bill will be formulated for Parliamentary debate. Once it passes Parliament, it will become an Act of Parliament which will be endorsed by the President. Once it's endorsed, then it will be mandatory for any developer to inculcate earthquake effects in the designs and hence construction.

3.2 Inauguration of Uganda Seismic Safety Association (USSA)

Following the conclusion of the 8th WSSI HLM High Level Meeting in Kampala and in particular the **Focal Point** resolution, the Uganda Seismic Safety Association (USSA) was born in early 1998. The executive committee consisted of Kiggundu, B. M. (Chairman); E. M. Twesigomwe, Vice Chairman/Treasurer; Okoka Obomba, Public Relations Officer; John S. Kintu, Secretary and Members: Booker Ajwoga and U. Bagampadde.

Some of the major USSA objectives are: promotion of research on issues related to reduction of earthquake effects, to raise public awareness; disseminate knowledge through seminars, conferences, etc. and contribute to Policy Development on disaster preparedness and management including enforcement of building regulations and guidelines.

3.3 Activities of USSA

3.3.1 First National Seminar

In December 1998, the USSA carried out its first national seminar which was held in the most seismically active district of Uganda, Kabarole in Fort Portal town. The theme of the seminar was: ***Earthquake Disaster Reduction*** and was attended by Policy makers (both central and local governments), engineers, architects, scientists, contractors, religious leaders, school administrators, community leaders and general public.

The main resolution from this seminar was the need to establish earthquake resistant building guidelines for the region. It was also resolved to hold this seminar at least once every two years. The local government promised to make budgetary allocations hence forth towards enhanced awareness.

3.3.2 Commencement of Research Efforts

In 1998, humble research efforts commenced in the Department of Civil Engineering, Makerere University towards development of a design code. This effort was undertaken by Musoke, A. whose result has been taken over by the Uganda National Bureau of Standards to formulate the code in the appropriate format.

3.3.3 Holding 1st International Conference, Kampala, Uganda

Preparation for the first International Conference on the theme **Reducing Earthquake Effects in Developing Countries** followed the completion of the first national seminar and took place on 4th –5th December 2000. This conference brought in delegates from Norway, Italy, Japan, Africa and locally Uganda.

This conference was graced by Prof. Edward Rugumayo, Minister of Trade, Industry and Tourism and closed by Major Tom Butime, Minister of Disaster Preparedness and Refugees in Prime Minister's Office.

Resolutions at the end of this conference included: Holding this series of conferences bi-annually or 2-year intervals, completion of the design code, enhanced awareness creation, development of training materials, etc.

3.3.4 Development of a National Code

Numerous members of the USSA were invited to participate in formulation of the design code along with consultants, members of the Uganda National Bureau of Standards and Uganda Institution of Professional Engineers. A member of USSA chairs this Technical Committee on Building Codes.

The code is soon ready but only pending the agreed upon seismic zoned map of the country and approval by the Uganda National Bureau of Standards governing council.

3.3.5 2nd National Seminar

The second seminar was organized on the theme **Earthquake resistant low cost housing** and was successfully held in Fort Portal in December 1999.

The seminar was attended by both Central Government and Local Government officials, members of District Disaster Committees of Kasese, Kabarole and Bundibugyo Districts, school administrators, researchers, builders and general public.

3.3.6 Holding 2nd International Conference Entebbe, Uganda

The second International Conference was held in Entebbe at Windsor Lake Victoria Hotel on the theme: **Earthquake Hazards in a Developing Country.** The conference was held in December 2002.

This conference was well attended with foreign delegations from Norway, Libya, (World Islamic Call Society), local Ugandans who consisted of policy makers, researchers, scientists and many University undergraduate students.

The conference was opened by 1st Deputy Prime Minister and Minister for Disaster Preparedness and Refugees who said on behalf of Government that *"efforts of USSA were commendable and should be supported by Government in order to develop sound knowledge packages towards protecting the development efforts of Ugandans"*. In fact following this conference and his brief to His Excellency the President, the Minister was requested to prepare a **Cabinet Paper** for subsequent discussion in cabinet. The paper is before the Cabinet for consideration.

This conference was closed by Mr. John Nasasira, Hon. Minister of Works, Housing and Communications.

3.3.7 3rd National Seminar

A 3rd National Seminar has been planned for 5 – 7th December, 2003 on the theme "**Earthquake Disaster Preparedness: Which Way Forward Uganda"**. The venue is Fort Portal and expected Guest of Honor is 1st Deputy Prime Minister and Minister for Disaster Preparedness and Refugees.

3.3.8 Partaking Research Studies in Japan

In the year 2001-2002, two members of USSA were sponsored for studies in earthquake engineering and seismology under the sponsorship of the JICA Program of Japan.

The two members benefited greatly and were attached to the International Institute of Seismology and Earthquake Engineering (IISE) of Japan. The courses were specifically taken at the Building Research Institute, Tsukuba Science City, Japan.

3.3.9 Training Program at Makerere University

One member (Adolf Kahuma, 2002) completed a Master of Engineering Degree Program in the area of Material Selection for Construction in an Earthquake Area of Uganda (various sand materials studied).

Two members of USSA are pursuing PhD studies in earthquake engineering in a sandwich program between Makerere University and Norwegian University of Science and Technology. The two proposed PhD areas are:

- Mujugumbya, Paul:

Prediction of Kampala's building stock's response on earthquakes.

- Moses Matovu Jr.:
  Development of computer based model for seismic response and capacity evaluation of existing buildings in Uganda.

4. PARTICIPATION IN INTERNATIONAL EVENTS

4.1 East Africa 99 Disaster Conference

USSA was asked by government to forward 2 names of members to be part of a government delegation to the Conference in Nairobi, Kenya in January 1999.

Kiggundu, B. M. and E. M. Twesigomwe formed part of about 20-member delegation and upon reaching the venue, a USSA member was voted to lead the delegation. Leadership meant preparing a statement about the state of Disaster Preparedness in Uganda.

Major developments included need for sound disaster policies in participating countries as well as concerted efforts to provide definite resources and implementable plans to combat disasters.

4.2 RADIUS project

Kampala City was one of the cities that participated in RADIUS "Understanding Urban Seismic Risk around the World" project. Mujugumbya Paul, a member of USSA, was the Kampala City representative. He also participated in the RADIUS symposium that took place in October 1999 in Tijuana, Mexico.

4.3 Seismic Risk Assessment for Kampala

Following the completion of RADIUS project, it was released that more data on Kampala was required. The parameters on which more information was required include the likelihood of experiencing an earthquake, the quality of city's buildings, and the readiness of emergency preparedness teams in the city. Therefore Earthquake Risk Assessment for Kampala was undertaken by four students from of Norwegian University of Science and Technology assisted by Mujugumbya. The major conclusions from this study were that (1) low death toll under GeoHazard International scenario will result if the City experiences a moderate earthquake, (2) most of the public buildings would suffer damage that will require extensive repairs or replacement.

The analysis was based on the city experiencing peak ground acceleration of 0.1 (%g) in 50 years.

The following recommendations were made (Aarseth et al, 2002):

- Improve earthquake preparedness for Kampala;

- New buildings be designed to withstand earthquakes; and
- Microzonation studies be undertaken.

4.4 International Interdisciplinary Observer Team on the Bhuj Earthquake

USSA was afforded the rare opportunity to be part of the unique reconnaissance team which was sent to witness and document lessons for future generations on the aftermath of the Bhuj earthquake in Gujarat, India.

This was a unique and unforgettable exposure to awesome aftermath destruction by Mother Nature through earthquakes of man-made infrastructure! USSA through the Chairman applauded the unique opportunity.

4.5 Participate in the 2nd Bangkok Workshop on Asia-Pacific Region

B. M. Kiggundu, the Chairman of USSA was invited to participate in the workshop. During the participation, a status report was presented about the activities of the USSA in Uganda. This workshop was a good learning opportunity about the extent of earthquake disasters the world over especially in the Asia-Pacific Region.

4.6 Participation in Japan

One member (Kusemererwa, P. R, 2003) independently wrote a paper entitled “Urban Disaster Mitigation and Environmental Impact Assessment of Urbanization in Uganda, Proceedings of the Second International Symposium on New Technologies for Urban Safety of Mega Cities in Asia, University of Tokyo, Japan, October 30-31, 2003” and was presented to the conference in Tokyo, Japan.

This member solicited independent funding to cover and present the above paper.

He has intimated an interest to pursue a Masters degree in Urban Earthquake Mitigation Engineering at the University of Tokyo, but has no funding to meet the anticipated cost or the study.

5. OTHER ACTIVITIES OF USSA

5.1 Participation in Development of Building Guidelines for Earthquake resistant (low-cost) Construction in Uganda

The Ministry of Works Housing and Communications of Uganda established a National Task Force to which USSA has members.

The first report of the Task Force was presented at the 2nd International Conference in Entebbe. The guideline is ready and its inauguration together with model housing plans is anticipated this December 2003 in Fort Portal.

5.2 Publication of USSA Newsletter

USSA introduced a newsletter in 2001 with 2 issues per year. Problem of keeping pace with the regularity is the voluntary nature of compiling articles continues to front the USSA.

5.3 Participation in Drafting the National Disaster Policy

A couple of members of USSA were co-opted to numerous workshops to discuss development efforts of a national disaster policy.

The Draft Policy is already drafted to cabinet level.

6. RECOGNITION BY GOVERNMENT

USSA was recently informed that government was about to formalize our relationship to government. The relationship once established shall be housed in the Prime Minister's office and be subject to receive funding for our recurrent operations.

This development will also lead to a Secretariat which will require capacity support from good friends.

7. AREAS OF SUPPORT FOR USSA

The following areas are arranged in order of priority to benefit the USSA and hence the country:

7.1 Training

Training needs are in the following areas at postgraduate level:

- Earthquake engineering - 1 to 2 Masters degrees
- Seismology - 1 to 2 Masters degree
- Social Seismology - 1 to 2 Masters degree
- Support to International Conferences - especially WCEE, etc.
- Research support – local research efforts to address local research needs.

7.2 Equipment

Equipment is required for field and the secretariat.

Field equipment include ground motion sensors. Currently Uganda National Seismic Network consists of five stations, three of which are equipped with short period seismometers and two with broadband seismometers. The plan is to increase the density of the network. Thus more seismometers and accelerometers are required.

Secretariat equipment needs include computers with accessories, GIS software, digitizing table and printers.

8. ACKNOWLEDGEMENT

USSA wishes to thank the organizations and departments that have stimulated and supported it in carrying out its activities. They include: WSSI, WHO, UNESCO, NUFU, Italian Co-operation Program, World Islamic Call Society, Ministry of Works, Housing and Communications, Ministry of Disaster Preparedness and Refugees in Office of Prime Minister and Makerere University.

REFERENCES

1. Aarseth, Lars Cristian, Kleppe, O. J., Storvik, V. and Thomassen, R. M., 2002. Earthquake Risk Assessment of Kampala, Uganda. *M.Sc. Thesis, Noryegian University of Science and Technology*.
2. USSA, 1997. Earthquake Disaster Preparedness, *Proceedings 8th WSSI High Level Meeting, Makerere University, Kampala, Uganda.*
3. Kahuma, A., 2002. An investigation of Relative Suitability of Sand Deposits for Construction of Earthquake Resistant Systems in Kabarole, Kyenjojo and Kamwenge Districts. *M.Sc. thesis, Makerere University*.
4. Kusemererwa, P.R, 2003. Urban Disaster Mitigation and Environmental Impact Assessment of Urbanization in Uganda, *Proceedings of the Second International Symposium on New Technologies for Urban Safety of Mega Cities in Asia, University of Tokyo,*

Dr. B. M. Kiggundu from Uganda

EARTHQUAKE HAZARD AND EARTHQUAKE RISK ASSESSMENT IN VIETNAM

N. H. PHUONG
Hanoi Institute of Oceanography
National Centre for Natural Science and Technology
Vietnam

ABSTRACT

This report gives an overview of what have been done in Vietnam in the field of seismic hazard and seismic risk assessment. It also points out the actions required in the near future.

1. INTRODUCTION

Seismic risk assessment, mitigation and management in earthquake research are are still way behind in Vietnam. While the methodology and technique for seismic hazard assessment in the country has reached a high level, the study on such a level of high practical value as earthquake risk is still in its infancy.

It is the time for Vietnam, a country prone to large earthquakes and a country which has more than four decade of history on earthquake research, to take action on a earthquake disaster preparedness plan.

This report gives an overview of what have been done in Vietnam in the field of seismic hazard and seismic risk assessment, so far. It also highlights the actions required in the near future.

2. EARTHQUAKE RESEARCH IN VIETNAM: STATE OF THE ART

2.1 Seismicity

Vietnam is known as a country with rather high seismic hazard level. Two earthquakes of magnitude 6.7 have occurred during the 20^{th} Century in the northwestern part of the country, while offshore Vietnam, a volcanic earthquake of magnitude 6.1 was recorded in 1923. As well, there is a growing understanding of the active faults in some places in North Vietnam and on continental shelf of the country, which indicates that they may generate as large earthquakes as any that occurred during 20^{th} Century. A comprehensive catalog compiled for 1900 onwards shows a high seismic activity in the northern part (inland) and in the central part (offshore) of the country (Fig.1). However, since all the largest earthquakes have occurred in remote areas, far from the urban and development centers, they were not recognized as the devastating ones.

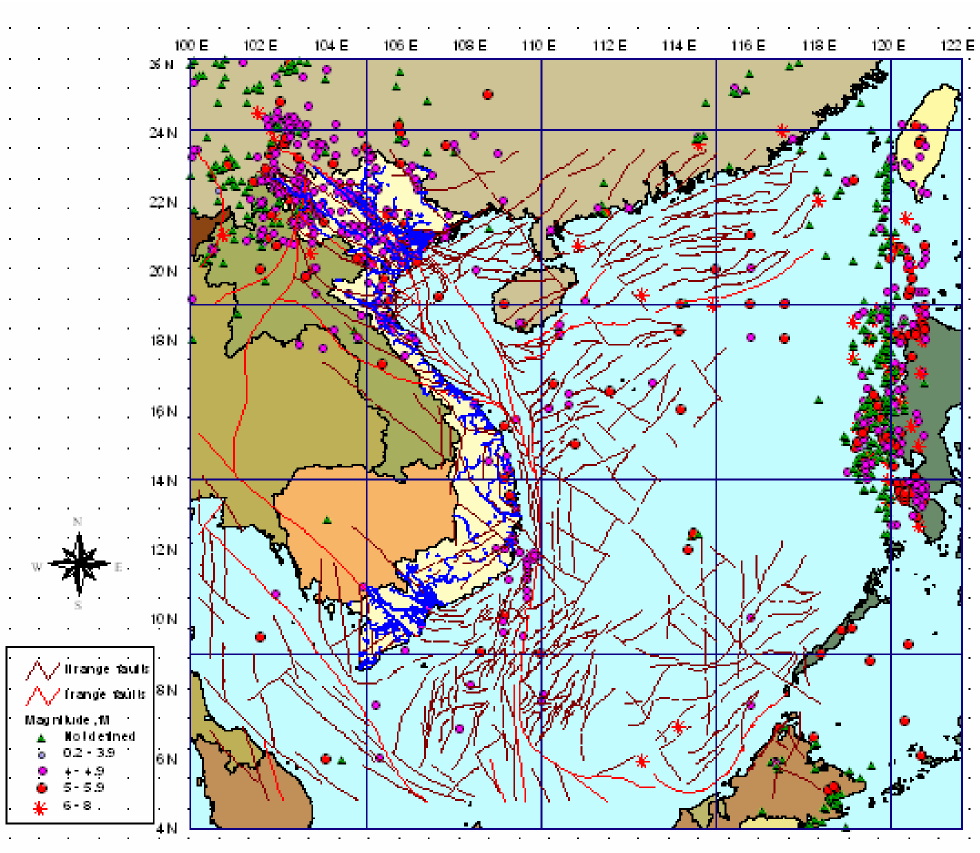


Figure 1: Seismicity of Vietnam and adjacent areas

2.2 Seismograph stations

Although the first event was recorded within Vietnam in 1903, the first seismograph station in Vietnam was established in Phulien in 1924. However, only after 1975, with synchronic operation of 5 seismograph stations, the seismic events occurred in North Vietnam have been determined by equipment. At present, Vietnam has a network of 15 seismograph stations, which consists of a telemetry array of 6 stations and other 9 of 3-comp. stations. All stations are short-period PC-based digital recording ones. As majority of earthquakes have been observed in North Vietnam, the telemetry array and six 3-comp stations are installed in the northern part, while three other 3-comp stations are in the southern part of country. Some main parameters of the station network are shown in table 1. The seismograph network of Vietnam monitors the seismic events of magnitude exceeding 3.0 in North Vietnam and exceeding 4.0 in the whole country.

Table 1: Site information of the Seismograph Network of Vietnam

N	Station name	Latitude Deg min	Longitude deg min	Elevation, m	Seismometer
1	Phu Lien *	20 48.36	106 37.81	90	L-4C-1D
2	Bac Giang*	21 17.41	106 13.65	15	L-4C-1D
3	Tam Dao*	21 27.88	105 38.74	1200	L-4C-1D
4	Chua Tram*	20 56.29	105 41.33	50	L-4C-1D
5	DoanHung*	21 37.61	105 11.03	70	L-4C-1D
6	Ba Vi *	21 06.13	105 22.12	182	L-4C-1D
7	Sa Pa	22 20.30	103 50.11	1150	L-4C-3D
8	Lai Chau	22 02.32	103 09.26	1100	LE-3D
9	Dien Bien	21 23.38	103 01.10	480	LE-3D
10	Son La	21 20.03	103 54.30	700	L-4C-3D
11	Hoa Binh	20 47.77	105 20.32	80	L-4C-3D
12	Vinh	18 32.88	105 42.00	5	LE-3D
13	Hue	16 25.01	107 35.13	8	LE-3D
14	Nha Trang	12 16.00	109 11.66	5	LE-3D
15	Da Lat	11 56.69	108 28.91	1550	LE-3D

Note:
Tam Dao* - Station of the telemetry array
L-4C Short-period Seismometer (Mark Product)
LE-3D Short-period Seismometer (Lennartz Electronic)

2.3 Strong motions records

Although strong earthquakes have been recorded, ground motion data was not available in Vietnam for a long time. The first accelograms within Vietnam were obtained only since the year 2000, among which the most valuable is the ground acceleration data recorded from the Dien Bien earthquake of February 19th, 2001 (Ms=5.3) and five other events (Ms=4.0-4.9).

The lack of ground acceleration data makes the development of local attenuation function impossible. Up to now, the seismic hazard assessment for Vietnam has to be based on the functions developed by foreign investigators, for different regions outside Vietnam.

2.4 Earthquake Hazard Assessment

A reliable, up-to-date earthquake hazard assessment is an essential tool in national disaster mitigation in the sense that it sets out the appropriate design levels that can ensure safe, cost-effective construction. In the long term, a national building stock that is appropriately designed will prove a sound investment, in the mitigation of future disaster.

Earthquake has been studied in Vietnam since the last 60's of the 20th Century. The four-decade history of earthquake hazard assessment in Vietnam can be divided into two periods, which reflect two different approaches on methodology used: the deterministic and the probabilistic ones.

During the first period (1968-1985), deterministic methods were used for quantitative assessment of seismic hazard, with a widely recognized at that time assumption that, for a certain region, there exists an "average" seismic regime, which is constant during a long, geologic period of time. Results were presented in the form of various maps, showing spatial distribution of parameters of the seismic regime such as seismic activity, seismic shakeability, etc. The most typical maps of this period were seismic zoning maps.

The weaknesses of deterministic approach are well understood, and it has become accepted that a probabilistic one should be preferred for seismic hazard assessment in Vietnam. The second period (1985 up to now) characterized by a remarkable change, with the use of probabilistic methods in all stages of seismic hazard assessment process. Such statistical methods as Gumbel's extreme-value distributions, maximum likelihood method have been used for estimation of the hazard parameters of source zones. The Cornell-McGuire method has been used for compute probabilistic seismic hazard maps for Vietnam in terms of peak ground acceleration for a given probability level.

Some research works, typical for the two periods of seismic hazard assessment process in Vietnam, are described below.

2.4.1 Seismic zoning map

Seismic zoning map of Vietnam, which was compiled in 1985 (Pham Van Thuc and Nguyen Dinh Xuyen (editors), 1985), is a inheritance and update from existing seismic zoning schemes of North Vietnam (Rezanov I.A. and Nguyen Khac Mao, 1968) and South Vietnam (Le Minh Triet et al., 1980). Both seismic shaking zones and seismogenic zones are depicted on this map. For each seismic zone, a set of parameters such as expected maximum magnitude M_{max} and average focal depth h are indicated. Coupled with large-scale seismic microzoning maps, compiled for specific sites or urban areas, the seismic zoning map of Vietnam has been used for a long time as references for planning and construction design purpose.

2.4.2 Probabilistic seismic hazard map of Vietnam

Pham Van Thuc and Kijko A. (1985) first applied the "truncated" Gumbel's type I distribution to predict recurrence period and maximum expected magnitude for the whole territory of Vietnam within the framework of the Southeast Asia. Nguyen Hong Phuong (1991) applied the Gumbel's type I and III distributions for estimation of hazard parameters for seven earthquake source zones of Vietnam, then predicted the occurrence probabilities of maximum earthquakes for North and South Vietnam during various periods of time.

The first probabilistic seismic hazard map of Vietnam was compiled in 1993 (Nguyen Hong Phuong, 1993). Based on a seismotectonic regionalization of Vietnam, Cornell's probabilistic method and McGuire's *EQRISK* program were used for compiling the map in terms of peak ground acceleration. In developing this map, probabilistic models were used in many stages, including earthquake data processing, hazard parameter estimation and computation of hazard. In addition to extreme-value distributions, the maximum likelihood method was applied to estimation of the source zones parameters as well. The PGA maps have been updated afterwards by adding the source zones to take into account the shakings generated from the countries adjacent to Vietnam, and from the South China sea (Nguyen Hong Phuong, 1997; Nguyen Hong Phuong, 2003b).

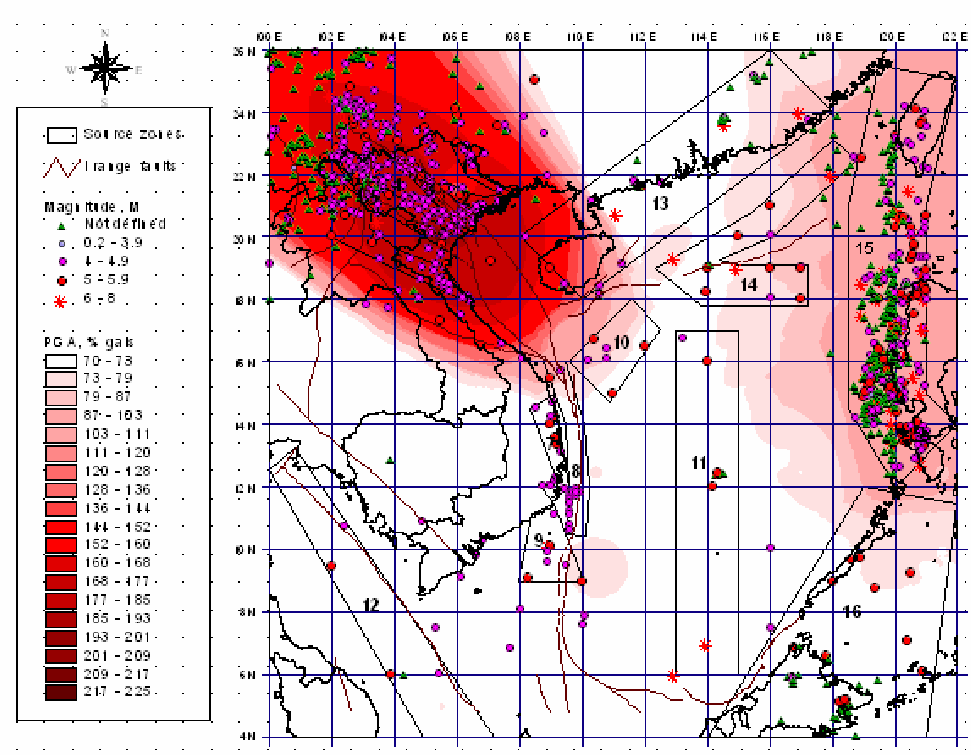


Figure 2: Probabilistic Hazard Map of Vietnam and adjacent areas, in terms of Peak Ground Acceleration (% gals), with 10% probability of exceedance in 50 years

3. EARTHQUAKE RISK MANAGEMENT IN VIETNAM

3.1 Earthquakes: not a highest priority disaster in Vietnam

Even with the events of magnitude 6.7 or higher observed in Vietnam, earthquakes are not consider as a disaster with highest priority in the country. As mentioned above, all earthquakes occurred in Vietnam are not devastating since their epicenters are located far from the urban or industrial areas. Meanwhile, typhoons, landslides and floods are very frequent disasters in Vietnam, and they cause a great deal of losses. In 1996 across all provinces about 1000 people were killed while damages totaled 655 million dollars. Many thousands of people in the Eastern provinces of Vietnam were affected in 1997 with damages of 600 million dollars.

3.2 Organizations, responsible for disaster management in Vietnam

At present, two organizations responsible for disaster management in Vietnam are the National Committee for Search and Rescue and the Flood and Storm Standing Commission. The National Committee for Search and Rescue (establish in October, 1996) is part of the Ministry of Defense and is led by the Vice Minister of Defense. The Committee consists of 25 members who are primarily expert officials. Working with the Committee is the Ministry of Food and Agriculture, Ministry of Defense, Civil Air Transport, Information Center, Ministry of Fisheries, Ministry for Fuel, Power and Energy, Agency for Water Canals, and Administrations in 61 cities. The main duties and tasks of this Committee are to arrange and bring standardize the activities of all Ministries, agencies and local administrations during any disaster where search and rescue is required.

The responsibility of the Flood and Storm Standing Commission is to provide all necessary information to assist the preparedness and response of the Search and Rescue Committee and to implement measures to mitigate any flood-and-storm related disasters including the implementation of donor funded projects that support mitigation measures.

So far, the Search and Rescue Committee and the Flood and Storm National Emergency Commission are the backbone of the disaster management institutions at national level in Vietnam. The National Committee for Search and Rescue conduct their operations under a state policy to mitigate/prevent natural disasters and decrease damage and losses by strengthening the national ability for the mitigation of disaster damages.

Recently, the government of Vietnam decided to implement a project to strengthen disaster management in Vietnam, with the assistance of 1.3 million dollars from UNDP, and 2.4 million dollars from the USAID Office of Foreign Disaster Assistance. However, as described above, most project activities are focusing on flood-and-storm related disasters.

3.3 Earthquake Hazard Related Organizations

Organizations having the same interests in earthquake hazard assessment and earthquake risk management in Vietnam can be divided into three groups: The research institutions, the organizations with constructional functions and the universities.

3.3.1 National Centre for Natural Science and Technology (NCNST)

This is a national research centre, which consists of more than twenty research institutions specialized in many fields of science and technology. Leading seismologists of Vietnam are working in Institute of Geophysics and Hanoi Institute of Oceanography, which belong to the NCNST.

Institute of Geophysics controls the network of seismograph stations, is responsible for earthquake observation, earthquake data processing and exchange, earthquake catalog compilation. It is also responsible for seismic hazard assessment and training young scientists, mostly seismologists. Hanoi Institute of Oceanography has some departments, which are dealing with seismic hazard and seismic risk assessment, and also study of earthquake-related phenomena, such as volcanoes and tsunamis.

3.3.2 Ministry of Construction

Institute of Construction Design and Technology and Institute of Construction Standards, Ministry of Construction are organizations, which study the safety of building stocks under seismic load and contribute considerably in proposing building regulations, standards and codes.

3.3.3 Universities

University of Mining and Geology, University of Construction have contributed to training and education in the earthquake- related fields.

3.4 Building Codes

In 1997, the Ministry of Construction of Vietnam has issued a Building Regulations of Vietnam. This document provides no more than just some information on natural conditions, which can affect the construction sites in the territory of Vietnam. Presented information includes building climatology, wind pressure, typhoons-flooding, meteorology and hydrology, thunders-storms, earthquakes, engineering and hydrological geology, saltiness of sphere, etc.

Considerable contribution to development of a building code for Vietnam comes from scientists from Institute of Construction Design and Technology. In 2002, a project has been implemented on Development of a Anti-seismic building standards for constructions in earthquake-prone regions. However, it will take time for the standards to come to life.

Until now, a comprehensive building code is not available for Vietnam. Anti-seismic designs for constructions is, therefore, arbitrarily applied and based on foreign building codes.

3.5 Earthquake Risk Assessment and Loss Estimation: A Breakthrough

The year 1999 has marked a start for a new direction in earthquake research in Vietnam. The earthquake risk at the regions, vulnerable to seismic shakings, have been studied. World experiences have been learned to develop an appropriate methodology for earthquake risk assessment procedure for various regions of Vietnam. In addition, GIS technology has been used for development of a decision support system, a GIS based tool for earthquake hazard assessment and loss estimation (Nguyen Hong Phuong, 2003a).

The seismic risk assessment methodology has been applied to a downtown district of Hanoi, and results are presented in the form of maps predicting building damage and casualties in the study area caused by scenario earthquakes. Results of risk assessment and loss estimation have made a strong impression on the Hanoi community and Press, as they draw quite a close-to-reality portrayal of how the urban community might suffer from the future earthquake.

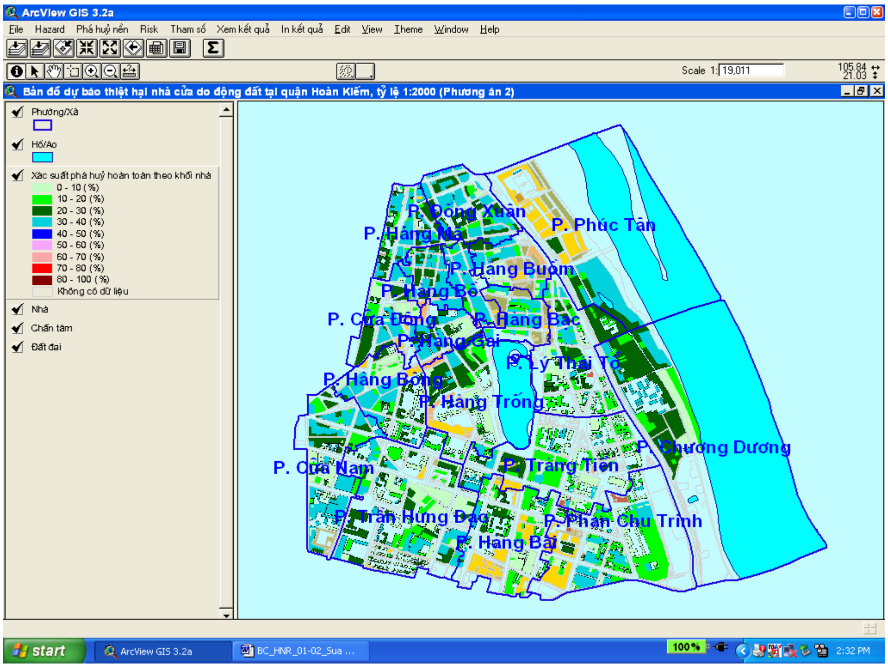


Figure 3: Mapping the probability of damage states of building stocks in Hoan Kiem District, Hanoi: extensive damage

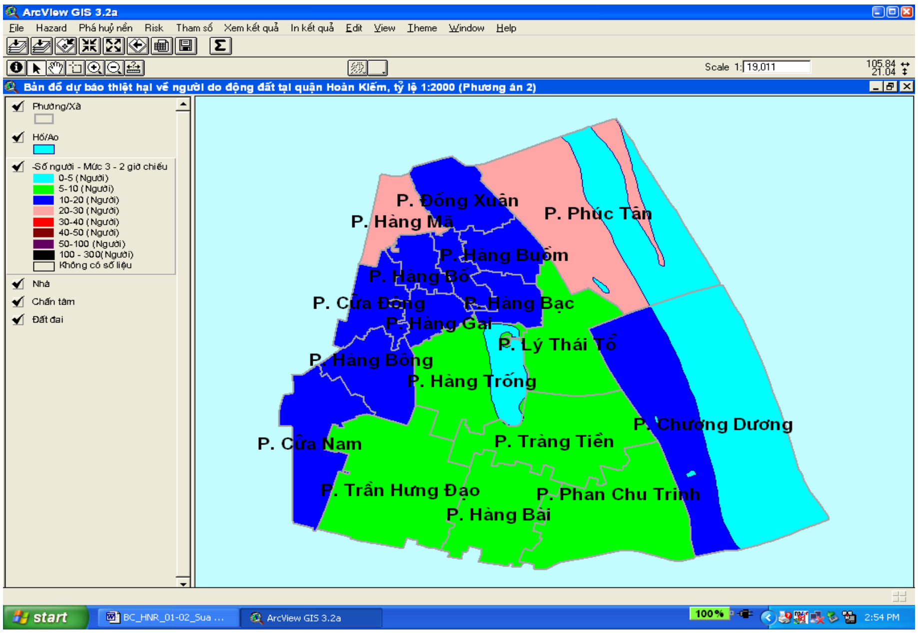


Figure 4: Estimation of Casualties for Hoan Kiem District, Hanoi

4. LESSONS LEARNED

The following actions are required for Vietnam in the near future:

- *Raising public awareness:* Earthquake hazard and earthquake risk are still not awarded not only among the community, but also among many governmental officials and decision makers. In order to have readiness both spiritually and materially against the risk, education and training should be carried out at many levels, in different forms. In addition to the community education, convincement of the governmental authorities of earthquake risks and hazards is as well crucial, given the fact that earthquake hazard is currently considered the third as priority only, after storm and flood hazards, among the natural disasters.

- *Enhancement of collaboration among the institutional bodies and organizations who have interests in and/or functional responsibilities for earthquake risks & hazards management:* Currently the related organizations are almost operating within their respective specialized fields and in isolation from each another. There seems to be an incomplete communication and interaction among the geophysicists, civil engineers and specialists, and the community. It is obvious that the development and implementation of any action plan for risk mitigation and management could not be efficient without close collaboration among the respective organizations. This shortcoming should be overcome as soon as possible in the near time.

- *Strengthening of the related organizations' capabilities:* This work would include investment to upgrade the facilities, infrastructure, training of specialists, encouragement of the research projects in earthquake hazard assessment and loss estimation, earthquake risk management etc. Efforts and works in strengthening the organizations' capabilities will also aim to continue and complete all the works that have not yet been achieved during the past few years, such as the development of an Anti-seismic building code for construction in Vietnam.

5. VIETNAM AND THE WORLD SEISMIC SAFETY INITIATIVE

In order to help Vietnam to build up readiness in responding to any potential earthquake hazards, and given the necessities as addressed above, it is hoped that Vietnam will obtain effective support from WSSI in the following areas:

- Establishment of a coordinating body who's function will be to coordinate all the activities related to seismic safety, seismic hazard mitigation and management for Vietnam. This body would be located at a research institution such as the National Centre for Natural Science and Technology, and would be equipped with necessary facilities so as to be able to manage, update, process and provide access to all the information, data and results of earthhquake hazards assessments, and earthquake risk management plan for the users. In the long run, this body would be developed to assume a broader function including site monitoring and survey, as well as technolofy transfering in the area of earthquake hazard and risk assessment. The ADPC model is a typical example to illustrate.

- Development and implementation of a joint programme/project to assess earthquake risk and develop a response plan for the community between Vietnam and a foreign counterpart, ideally with a partner from a developed country who has experiences in earquake hazard assessment and mitigation, and earthquake risk management. Initially this programme would be focusing on earquake hazards assessment for the urban communities.
- Support Vietnam to accelerate the process to join IAEE.

REFERENCES

1. Pham Van Thuc, and Nguyen Dinh Xuyen, 1985. *Seismic zoning map of the territory of Vietnam*. Unpublished report, Institute of Geophysics.
2. Rezanov, I.A., and Nguyen Khac Mao, 1968. Seismic zoning of North Vietnam. *Contributions of Meteorological Department*, Hanoi.
   Le Minh Triet, Vo Dinh Ngo, Dang Nam Trung and Dang Mau Phong, 1980. Seismic zoning of South Vietnam. *Contributions in Geophysics*, Hanoi.
3. Pham Van Thuc and Kijko A., 1985. Estimation of maximum magnitude and seismic hazard in southeast Asia and Vietnam, *Acta Geophysica Polonica*, Vol XXXIII, No4, 377-387.
4. Nguyen Hong Phuong, 1991. Probabilistic assessment of earthquake hazard in Vietnam based on seismotectonic regionalisation, *Tectonophysics, 198 (1991),* 81-93.
5. Nguyen Hong Phuong, 1993. Probabilistic Seismic hazard map of Vietnam, *Technical Report, Smith Institute of Physics of the Earth,* Moscow (in Russian).
6. Nguyen Hong Phuong, 1997. Probabilistic earthquake hazard assessment for the territory of Vietnam and adjacent regions, *Proceedings of the NCST of Vietnam, Vol.9, No1 (1997)* 115-130.
7. Nguyen Hong Phuong, 2003a. Spatial Analysis Models as Applied to Seismic Hazard Evaluation, *Advances in natural sciences, Vol.4, No3.*
8. Nguyen Hong Phuong, 2003b. Earthquake hazard maps of Vietnam and the East Vietnam sea, *Journal of the Earth's Sciences (submitted).*

JICA'S DEVELOPMENT COOPERATION FOR EARTHQUAKE DISASTER REDUCTION

M. WATANABE
Japan International Cooperation Agency (JICA)

ABSTRACT

The paper introduces major projects and programs which have been implemented in an attempt to reduce vulnerabilities to seismic impacts to societies region-wide, nation-wide and for communities at risk.

The projects address technology transfer for planning, institution building, implementation and equipment provision while programs focus on human resources development and their networking.

JICA's initiatives have been welcomed and made considerable success, but it seems disasters due to seismic impacts have been increasing in terms of number of events and magnitude of damage. Furthermore, vulnerabilities to seismic impacts are still growing world-wide due to, chiefly, quick urbanization and poor preparedness.

Major reasons of the above unfavorable circumstances can be identified as follows;

1) too much emphasis has been put on engineering aspects of initiatives for disaster reduction,
2) poor understanding on applicability of the results of initiatives for development cooperation,
3) inappropriate composition of proposed projects,
4) inadequate skills for project management,
5) shortage in funds due to lower priority setting

In order to make the projects and programs more persuasive, applicable, effective and so that successful the projects and programs must be worked out and implemented in the following manner;

1) put much more emphasis on socio-anthropological and socio-political aspects of disasters,
2) promote sound understanding of a target community and a society for which technology and skills are transferred,
3) for the above purposes, analysis on the resources and capacity must be conducted,
4) the composition of a project must be comprehensive
5) the size of a target community of a project must, as the first step, be small in order to keep an eye on all the changes in the course of project implementation,
6) set a project term long enough to make it sustainable,

1. INTRODUCTION

It must be clearly recognized that the initiatives for hazardless environments, no matter what a hazard is, require funds. In another word, hazardless environments, especially in terms of seismic risks, cannot be achieved without investing considerable amount of funds no matter how effective low-cost measures would be applied. It is therefore the most serious contradiction that those who need the initiatives for hazardless environment the most are always suffering from funds shortage.

On the other hand, people specialized in disaster mitigation and preparedness likely to transfer system or technology available in a developed country to a target society in developing countries without considering its resources and capacity. Initiatives aiming at larger disaster coping capacity are not always the same as the ones to fill the gaps and a void and not same as a market operation to meet the demand. The author tries to evaluate, based on the above views, some of the projects and programs so far conducted and implemented.

2. SOCIAL DEVELOPMENT STUDY

2.1 The Study on Disaster Prevention in Bogota, Columbia

The Study on Disaster Prevention in Bogota, Columbia was conducted in response to the request from the Columbian government in the period from 1998 to 1999. The objectives of the study were to assess the vulnerabilities of the capital city of Columbia and to work out a plan for disaster prevention and preparedness in the area of Bogota and surrounding areas. The area has been rapidly urbanized because of mainly massive migration from rural areas associated with the long-lasting conflicts among the Government force and the unti-government guerilla forces.

An estimated increase in population in a year in average is more than 100,000. Expansion of the urban areas has been so quick that the city and prefecture authorities couldn’t afford to cope with it by building proper infrastructure and exercising proper regulations for urban planning.

The major hazards are estimated to be earthquake and flood. It is pointed out that, because large fuel tanks and petrol refinery had been surrounded by residential houses, a strong seismic impact might trigger fire disasters.

The core of the disaster prevention and preparedness plan are three fold; infrastructure building, institution building and promotion of awareness to hazards among inhabitants in the areas at risk.

Although disaster mitigation and preparedness administration are directed by civilian officers, all the officers except the Director, are employed on a fixed term (one year) basis because of funds shortage.

Capacity to cope with growing vulnerabilities be therefore hardly built no matter how intensively a training seminar is organized. Institutions proposed and newly built hardly be in operational because of unstable personnel management.

2.2 The Study on Earthquake Disaster Mitigation in the Kathmandu valley, Kingdom of Nepal

The Study was conducted in the period from January 2001 to March 2002. The Study is characterized by clearly specified objectives as follows;

(1) to protect life and property in Kathmandu Valley,
(2) to strengthen the society and economy,
(3) to secure governance in case of an emergency due to earthquake.

In order to achieve the above objectives, the following three project components were set up;

(1) an earthquake disaster mitigation plan,
(2) technology transfer to Nepalese counterparts,
(3) building a database on related issues and damage assessment

As a result, the damage was assessed as follows;
totally damaged houses 53,000. (21% of the houses and buildings)
casualties 18,000 (1.3% of the population in the valley)
wounded 53,000 (3.8% of the population in the valley)

In order to make proposed coping mechanisms operational and sustainable the following supporting schemes are proposed;

(1) to build a jurisprudence for risk and emergency management,
(2) to build a coordination mechanisms by establishing a permanent structure such as the state disaster coordination copuncil,
(3) to put higher priority on the disaster mitigation and preparedness policies and confirm it in the 10^{th} 5 years State Developing Program,
(4) to empower local autonomous bodies for emergency management,
(5) to promote public awareness to earthquake disasters, and to give support to target groups for resilient capacity on a self-help basis.

In order to satisfy the above targets and based on the experiences and findings in the course of the study, the following 4 projects, among as many as 90, are proposed with special emphasis;

(1) an information system for quick and efficient collection, transmission and distribution of seismic data and emergency management information,
(2) a disaster management system for Kathmandu City,
(3) increase in seismic-resistant performance of buildings
(4) comprehensive database for earthquake disaster mitigation and prepared-ness practices.

Each of the projects and programs proposed is however hard, rather difficult, for either Government, a community or individuals to practice and implement because of, among many others, chiefly, extreme fund shortage and poor incentive.

Initiatives for disaster mitigation and preparedness must be taken, in such a least developed country, must be taken on not a demands-wise approach but a capacity-wise approach. A demand-wise approach starts with chiefly needs and demands assessment disregarding availability of resources and capacity, while a capacity-wise approach starts assessing capacity and resources available, mobilized and expected.

In the case of a demand-wise approach, in most cases, the conclusion and proposals are therefore likely to be a picture of pie in the sky or, if worst comes to worst, a copy of the system working in developed countries.

3. GRANT AID ASSISTANCE

3.1 The Seismic and Volcanological Monitoring Network Project in the Philippines

In view of tectonic active and high vulnerable nature of the Philippines, in terms of natural and social settings, and high skills in research works performed by Philippine Institute of Volcanology and Seismology (PHIVOLCS), it was concluded, after the preliminary study and subsequent discussions with the officers concerned of the Philippines Government, that over-aged monitoring equipment must be replaced and the existing monitoring networks must be expanded and strengthened.

The first phase of the program was implemented in 1999 and the second phase was implemented in 2003. The program consists of seismic sensors, systems for data transmission, logging, analysis and backup, and power supply. The systems covers the entire territory and have been providing all stakeholders with data and information on an earthquake, tsunami and volcanic activities.The systems will serve the state and societies for not only emergency management but also preparedness by making the most use of data acquired by strong motion meters.

3.2 Equipment Supply for the Center Projects

The Center Projects have been implemented aiming at promoting earthquake engineering research and strengthening the capacity for disaster mitigation in Peru (1986-1991), Mexico (1990-1996), Turkey (1993-2000), and Roumania (2002-2007). Along with the Center projects, similar projects aiming at joint research works have been implemented in Indonesia (1980-1986), Chile (1988-1991, 1995-1998), Egypt (1993-1996), and Kazakstan (200-2003) in cooperation with the staff of universities, state research institutes and consulting engineers.

The equipment provided cover broad area of research and practices ranging from image processor, audio-visual machines, grand survey machines, heavy duty machines, actuator, stress and strain meters, tension and compression units, vibrator, seismometer (strong motion and microtrometer), boring machine and computers with soft wears.

4. CENTER PROJECT FOR ENGINEERING RESEARCH AND DISASTER MITIGATION

The Center Projects have been launched aiming at promoting engineering research and disaster mitigation practices covering not only the counterparting country but also neighboring countries with similar hazardous settings. Each of the Centers is expected to be in operational after expiration of the project term.

Evaluation missions dispatched by JICA confirmed that, all the centers so far completed have been in operational fairly well and sustainability in terms of financial management and organizational build-up are fairly satisfactory, but , in some cases, sustainability in terms of research competence and engineering expertise got downgraded to some extent because of brain-drain due to transfer and migration.

5. INTERNATIONAL INSTITUTE OF SEISMOLOGY AND EARTHQUAKE ENGINEERING (IISEE)

International Institute of Seismology and Earthquake Engineering (IISEE) had been founded in September 1963 based on the resolution of the Economic and Social Committee of the United Nations and ran jointly by the Government of Japan and UNESCO. Since then, the Building Research Institute of Ministry of Construction, recently restructured as Ministry of Land and Transportation, has been playing, in cooperation with JICA, major and successful roles in organizing courses in the Institute in Japan, counterparting countries for the Center and third countries such as Indonesia and Egypt, and running the website, IISEE-net.

The number of trainees who had completed the courses comes to 1,186 from 89 countries and working as leading specialists in universities and research institute in their respective countries and international organization such as the Comprehensive Nuclear-Test-Ban Treasty Organization (CTBTO).

6. DISCUSSIONS

Successful risk management, disaster mitigation and preparedness can be achieved by the following initiatives;
1) elimination of root causes of vulnerabilities to hazards,
2) reduction in vulnerabilities to hazards,
3) proper monitoring practices on hazards,
4) human resources development,

5) public awareness promotion and
6) raising living standard.

The above initiatives, if taken on a comprehensive and timely manner, result in higher disaster coping capacity of a society and community, but if some of them would be taken inconsistently, a project will be in vain and must finish in complacency.of the officers in charge. Furthermore the result of a project must be a picture of pie in the sky. Considering the above thought, every initiative must be taken in conformity with the development stage of a target society or community.

Initiatives for capacity building of either individuals or organizations must be taken considering the posts, roles, incentives and rewards. A project and program for capacity building must have ripple effects among the people concerned because jobs for risk management, disaster mitigation and preparedness should be done on a "ONE FOR ALL AND ALL FOR ONE" basis.

Mr. M. Watanabe from JICA

SEISMIC RISK ASSESSMENT OF ISTANBUL IN THE REPUBLIC OF TURKEY

M. TAKAHASHI and T. TANAKA
Oyo International Corporation
Japan

ABSTRACT

An example of JICA's projects for earthquake disaster risk reduction is presented. Urgency of establishing strategies and measures to reduce the risk for Istanbul is highlighted. Processes of risk assessment of Istanbul, which included 1) data collection and preparation of database and maps, 2) hazard assessment, 3) risk analysis, 4) vulnerability analysis, and 5) assessment of disaster management capacity of Istanbul, were demonstrated by using the GIS maps. Recommendations to improve capacities of preparedness and to advance measures for risk reduction for Istanbul is briefly described.

Keywords: Earthquakes, Hazards, Vulnerability, Coping Capacity, Risk Assessment, Disaster Risk Reduction

1. INTRODUCTION

The recent earthquakes have claimed many thousands of lives and caused material losses in the tens of billion dollars. Urban seismic risk is rapidly increasing, particularly in developing countries, where a number of mega-cities are located. Once an earthquake strikes a large city, the damage can be tremendous, and furthermore, a terrible toll will be inflicted as divert attention and resources needed for the greatest challenges of the developing countries, i.e. poverty eradication and sustainable development.

Since 1999, under the technical assistance program JICA has implemented the earthquake disaster management projects for several earthquake prone cities, namely Teheran of Iran (Ref. [1]), Kathmandu Valley of Nepal (Ref. [2]), Bogotá of Colombia (Ref. [3]) and Istanbul of Turkey (Ref. [4]), and is now carrying out the studies for Manila of Philippines, Caracas of Venezuela and the second phase of Teheran.

Traditionally, in the disaster management the focus has been placed on preparedness for response. However, in the JICA projects efforts is shifting to developing disaster reduction strategies and measures with an aim to enable societies to be resilient to earthquake disasters and to minimizing a threat to both poverty eradication and sustainable development.

In the projects, first and foremost, the risk assessment, consisting of hazard, vulnerability, and risk analyses and evaluation were carried out.

Based on the risk assessment the disaster reduction strategies and measures was developed by the holistic approach, namely multi-sectoral, multi-disciplinary and inter-agency approach. Local participation during the process of development was crucial as the previous experiences clearly demonstrated that local government was the most effective player of in-front activities as well as citizen's capacity was effectiveness.

In this paper the study for Istanbul (Ref. [4]) is briefly described as an example of JICA's projects for earthquake disaster risk reduction.

2. BACKGROUND OF ISTANBUL EARTHQUAKE DISASTER RISK REDUCTION PROJECT

In 1999, two large earthquakes occurred around Izmit and Adapazari, and caused tremendous damage to human lives and properties in the area. These earthquakes occurred along the North Anatolian Fault (NAF) which is large scale fault line formed more than 1,000 km long from east to west in the northern territory of Turkey. Historically, many strong earthquakes occurred along this fault line. There are obvious phenomena that the epicentres of these strong earthquakes are migrating from east to west along the NAF and it is pointed out that another big earthquake may hit Istanbul, which is located at the western edge of the NAF.

Istanbul is one of the biggest cities in the Middle East, representing a centre of economic, industrial and tourist destination of the modern Turkey. Therefore, once a big earthquake hits Istanbul, it will be a catastrophic national emergency of Turkey. In order to manage the potential earthquake disaster in Istanbul, it is necessary to prepare a seismic disaster prevention/mitigation plan, emergency rescue plan and restoration plan of the earthquake stricken area from middle to long-term points of view.

The objectives of the study are 1) to integrate and develop seismic microzonation studies in Istanbul as scientific and technical basis for disaster risk reduction planning, 2) to recommend a citywide risk reduction program against damage of buildings and infrastructures, 3) to recommend risk reduction considerations in urban planning of Istanbul City and 4) to pursue technology transfer of planning techniques to Turkish counterpart personnel.

The study area and an epicentral distribution of earthquakes during 1905 and 2001 are shown in Figure 1.

3. RISK ASSESSMENT OF ISTANBUL

3.1 Data collection and preparation of database and maps

Basic data required for the risk assessment were collected and processed. A database was constructed and maps were prepared using GIS.

Data on natural conditions included topography, geology (Figure 2), soils, and earthquakes, such as tectonic setting, seismic setting, damaged earthquakes, earthquake catalogues (Figure 1), strong motion records and earthquake damages. Demography (Figure 3) is the main information of social conditions. Data on buildings (Figure 4), infrastructures, major urban facilities, and hazardous facilities were processed and mapped for the risk assessment.

Besides collecting and compiling the existing data, geological investigation and building survey were carried out.

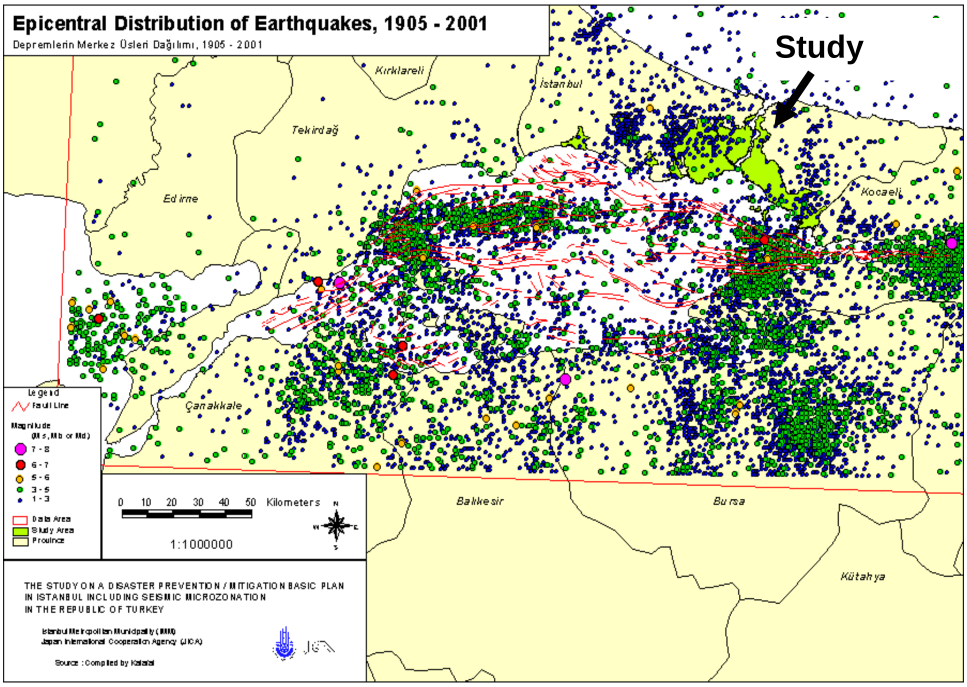


Figure 1: Study area and epicentral distribution of earthquakes,1905– 2001

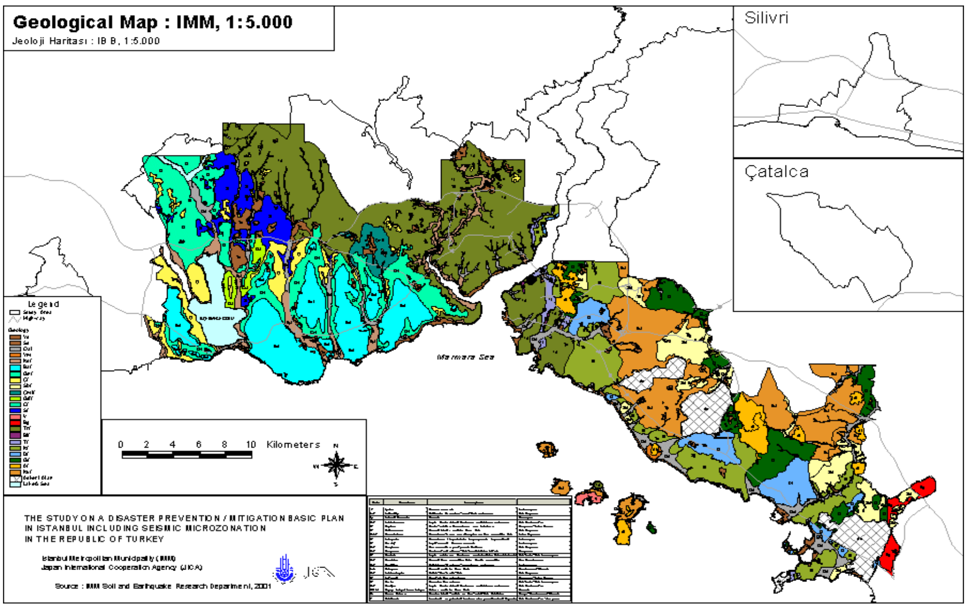


Figure 2: Geology of the study area

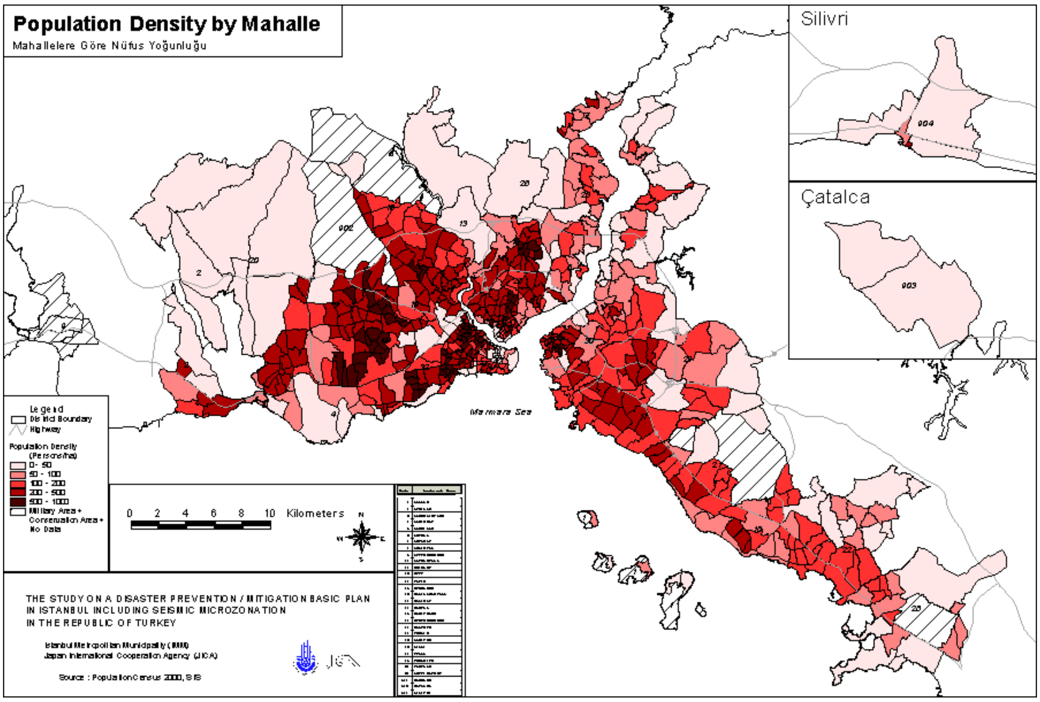


Figure 3: Population density by mahalle, 2000

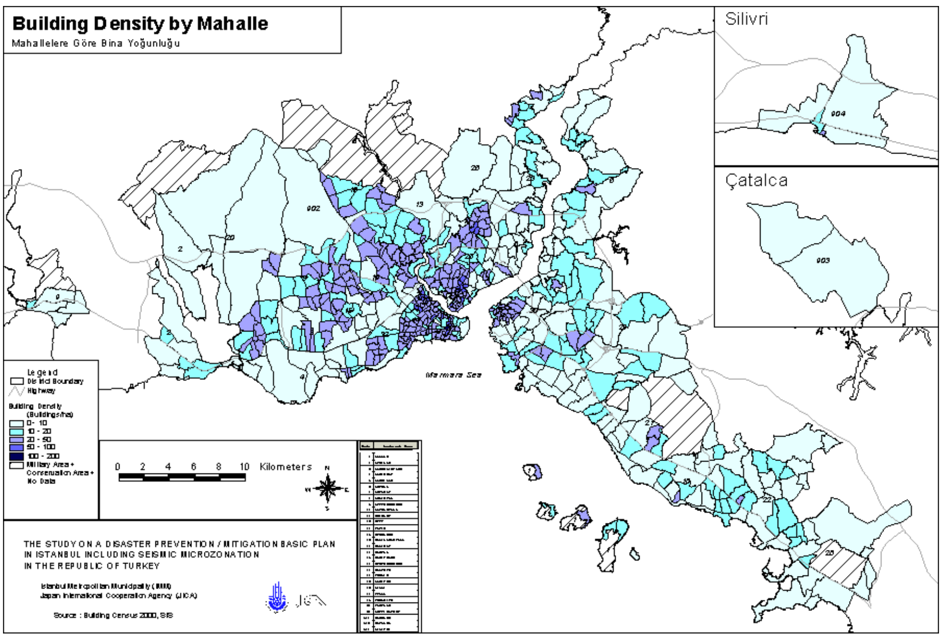


Figure 4: Building density by mahalle, 2000

3.2 Hazard assessment

For selected scenario earthquakes ground motion, liquefaction potential and stability of slopes were assessed and their distribution maps were prepared.

3.2.1 Scenario earthquakes

As summarized in Table 1, four (4) scenario earthquakes were selected to supply sufficient variation of damages for disaster risk reduction planning. The selection of the earthquakes was based on the discussions with relevant institutes / researchers and on recent huge amount of research works on North Anatolian Fault (NAF). These scenario earthquakes are located along NAF in the Marmara Sea and their difference was the length of fault segment.

Table 1: Scenario earthquakes

Scenario earthquake	Model A	Model B	Model C	Model D
Length (km)	119	108	174	37
Moment magnitude (Mw)	7.5	7.4	7.7	6.9
Dip angle (degree)	90	90	90	90
Depth of upper edge (km)	0	0	0	0
Type	strike-slip	strike-slip	strike-slip	normal fault

3.2.2 Ground motion

Based on the fault models, peak acceleration, peak velocity and acceleration response spectrum at bed rock level were estimated with selected empirical attenuation formulae that could reproduce well the observed data during 1999 Izmit earthquake. Subsurface amplification was calculated by amplification factors, which were given by an average S wave velocity over the upper 30 m of surface soil. The amplification factors were multiplied to get the peak ground acceleration (Figure 5), peak ground velocity and acceleration response spectrum at the ground surface.

3.2.3 Liquefaction potential and stability of slopes

Liquefaction potential (Figure 6) and stability of slopes were evaluated and presented by a unit of 500 meter square grid, which was used for ground motion calculation.

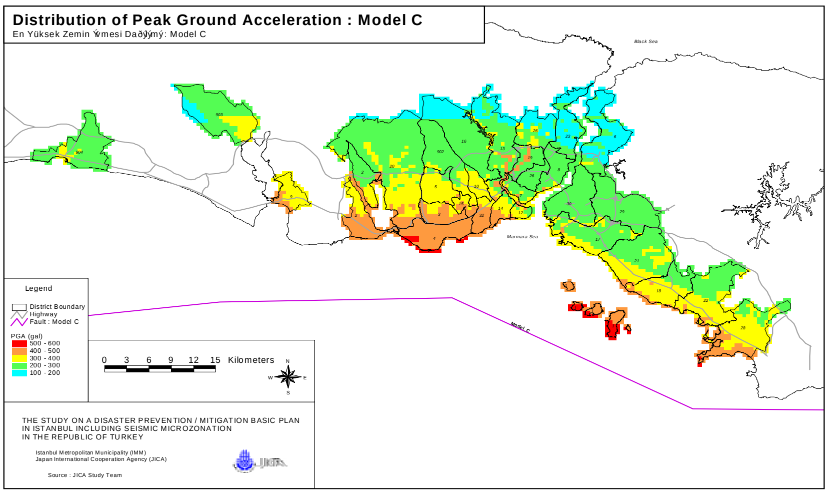


Figure 5: Distribution of peak ground acceleration, scenario earthquake Model C

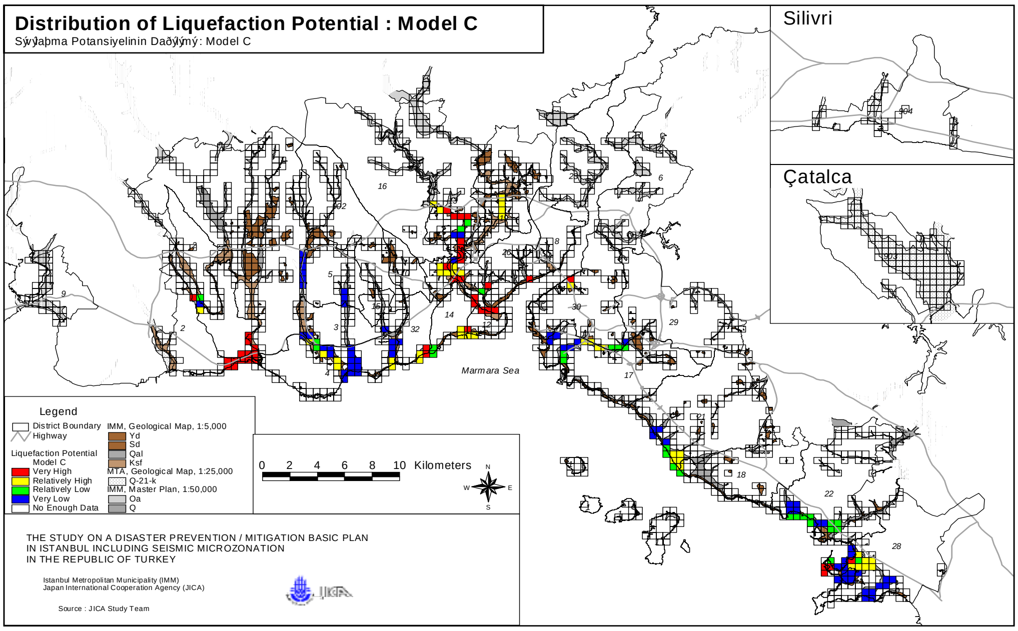


Figure 6: Distribution of liquefaction potential, scenario earthquake Model C

3.3 Risk analysis

Damages of buildings, human casualties, and damages of major public facilities, lifelines and bridges were estimated for the scenario earthquakes.

3.3.1 Buildings

The buildings, registered by the building census 2000, were classified by structure, floor number and construction year, and then damages were estimated for each classification of the buildings. Damages were ranked as "heavily-", "moderately-" and "partly-damaged" and presented by the smallest administrative unit, mahalle (Figure 7).

3.3.2 Human casualties

Assuming the major cause of human casualties was from building collapse, firstly, number of deaths was estimated by an empirical relationship between building damage and death toll, and then number of severe injuries was estimated by using an empirical relationship between death toll and number of injuries. The estimated results were presented by district (Figure 8).

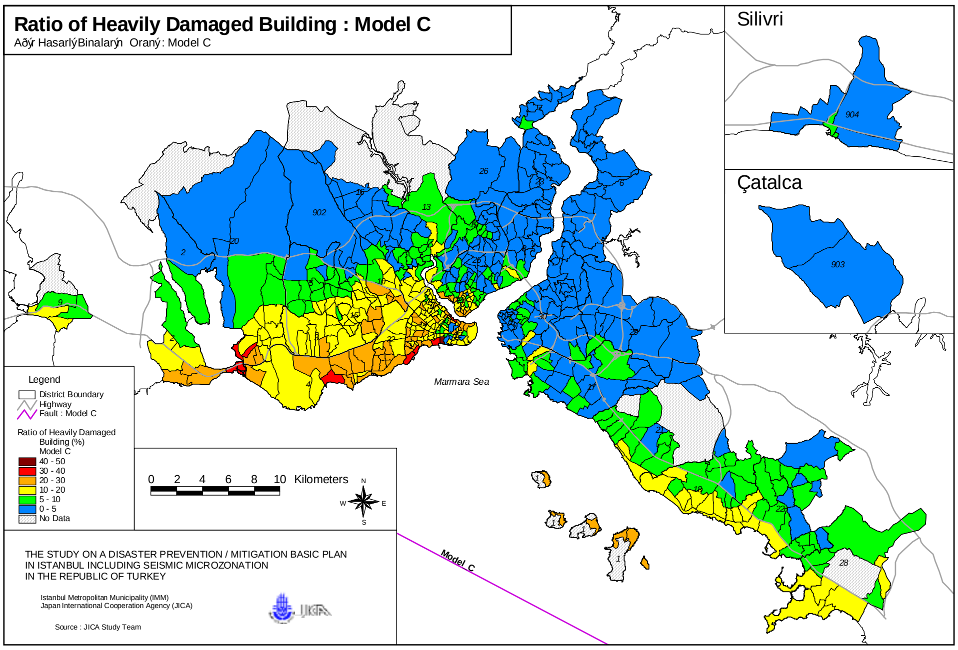


Figure 7: Ratio of heavily damaged building by mahalle, scenario earthquake Model C

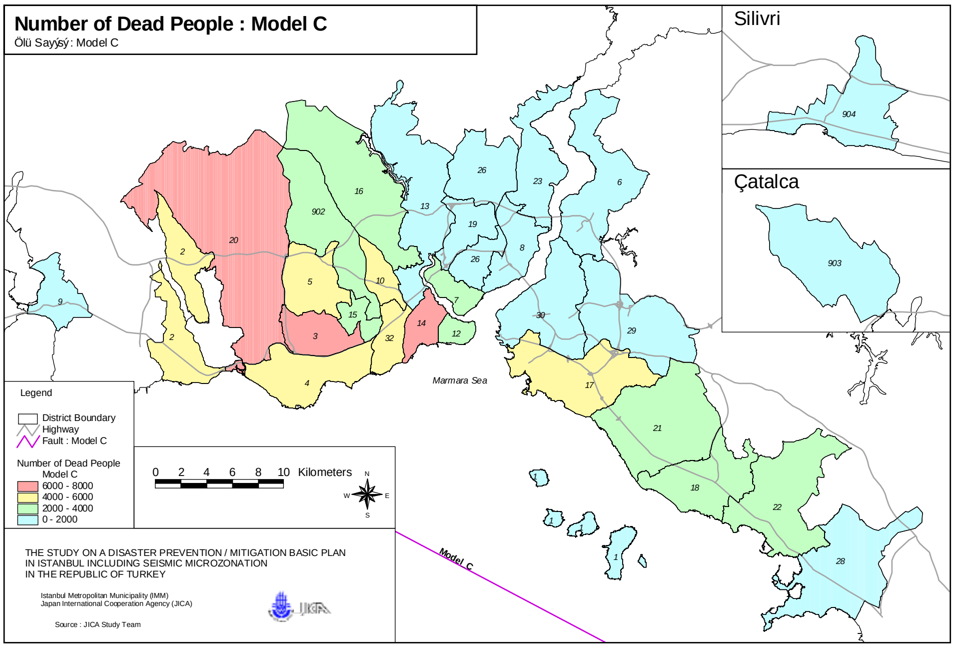


Figure 8: Number of dead people by district, scenario earthquake Model C

3.3.3 Major public facilities

Damages of the major public facilities were estimated. Those were buildings of 1) educational facilities: primary and high schools, 2) medical facilities: hospitals and policlinics, 3) fire fighting facilities: fire fighting station, 4) security facilities: district police (İlçe emniyet), police and gendarme (Jandarma) and 5) governmental facilities: ministry, provincial and municipality. Damage ratios are presented in Figure 9. The ratios of major public facilities were found similar to those of the other buildings with an exception of lower value of the fire fighting facilities. However, it does not mean the fire fighting facilities are stronger than other buildings.

3.3.4 Fires

Fire outbreaks from the hazardous facilities would cause catastrophic effects to the neighbouring area. Possibility of fire outbreaks from the facilities, such as fuel filling station, LPG filling station, warehouse of chemical products and factory of paint and polish products, was estimated, rated and mapped by mahalle (Figure 10). Fires also occur after the earthquake from cooking stove, heating system, electric leakage and short circuits, etc. of private housings and public buildings. Since most of the buildings of Istanbul were constructed by brick and concrete and the covering area by wooden buildings was less than 10 % in all of the mahalles, a possibility of catastrophic fire by flame propagation was assessed not very high (Ref. [6]).

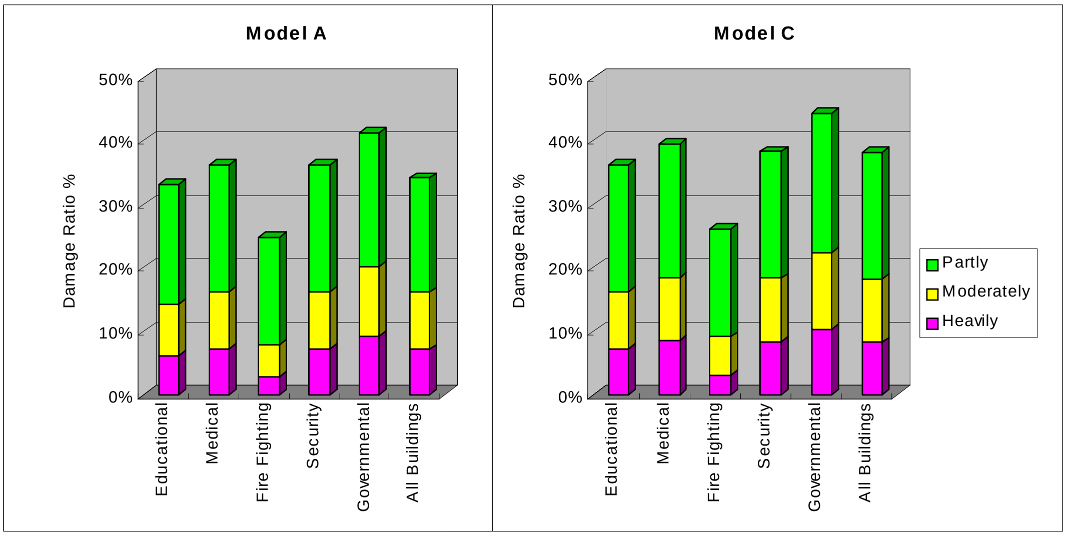


Figure 9: Damage ratio of manor public facilities

3.3.5 Infrastructures

Damages of water pipeline, sewage pipeline, gas pipeline, gas service box, electricity cable (Figure 11), and telecommunication cable were estimated and presented as either number of damaged points or total length within a 500 meters grid. The estimations were made by the statistical approach using empirical damage functions obtained from the previous earthquakes.

3.3.6 Bridges

Damage of bridges, defined as falling-off of the girder, was evaluated by Katayama's method (Ref. [5]), in which the bridges were scored by inspection of the bridges, drawings and specifications. Total of 480 bridges were evaluated and ranked as shown in Table 2.

Table 2: Estimated number of damaged bridges, falling-off of the girder

Scenario Earthquake	High probability	Moderate probability	Low probability
Model A	18	3	459
Model B	20	4	456

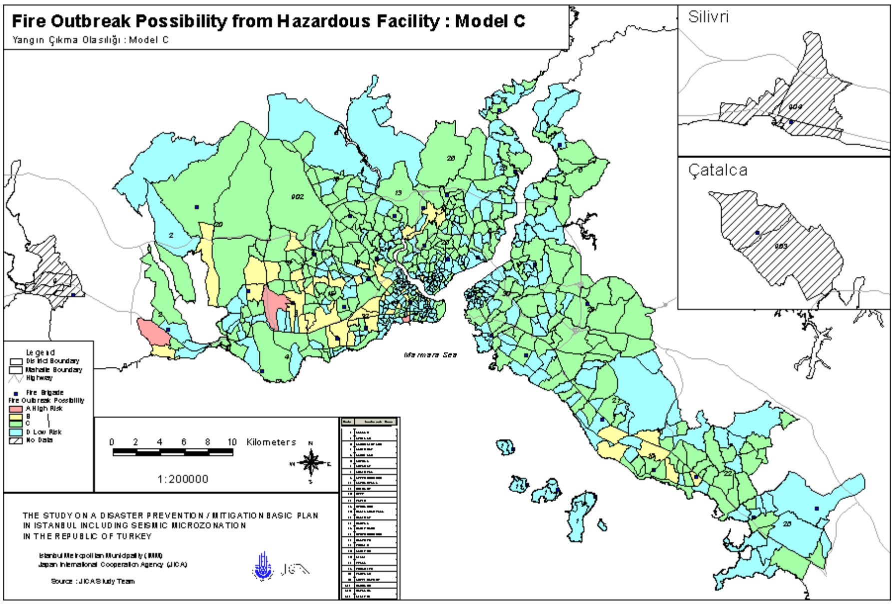


Figure 10: Fire outbreak from hazardous facilities by mahalle, scenario earthquake Model C

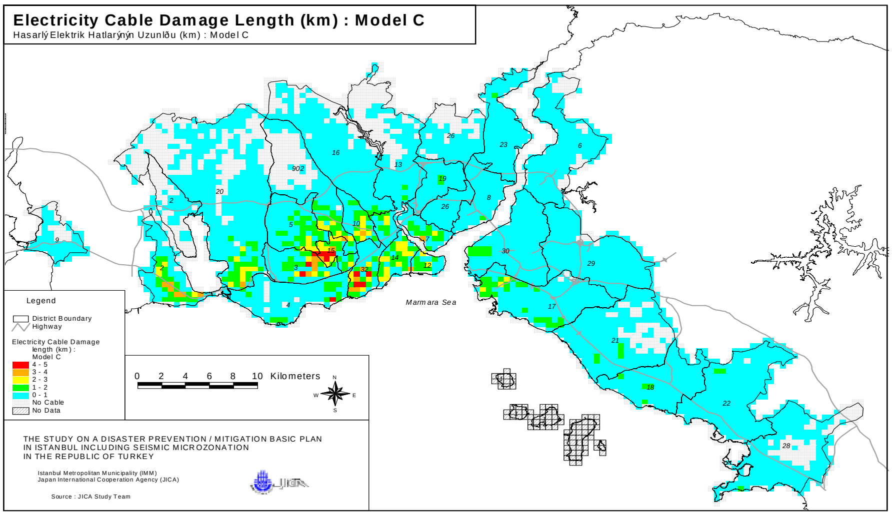


Figure 11: Length of damaged electricity cable, scenario earthquake Model C

3.4 Vulnerability analysis

Vulnerabilities of the city and the road and traffic system were evaluated. Human causalities are heavily depended on the vulnerability of the city, namely buildings and urban structure. The road and traffic system of the city is critical during response and relief, and recovery stages of the disaster management.

3.4.1 Vulnerability of the city

The vulnerability of the city was evaluated by using the following factors; 1) estimated building damages, 2) history of building and urban renewal, 3) excessive land use and building concentration, 4) road density, 5) ratio of narrow road, 6) availability of parks and open spaces, and 7) protection of historical areas. Recommendations to reduce the risks were proposed and strategic improvement areas were selected as presented in Figure 12.

3.4.2 Vulnerability of road and traffic system

The vulnerability of the road and traffic system was assessed by 1) connections to the neighbouring area, 2) road direction relative to the traffic axes, 3) road width, 4) land use, 5) building collapse or road blockage (Figure 13), and 7) bridge collapse. Importance of port and harbour facilities was stresses as strategic points during response and relief, recovery, and reconstruction stages after the earthquake disaster.

3.5 Assessment of disaster management capacity of Istanbul

3.5.1 Administrative conditions

The current disaster management systems of the national and local governments were studied and recommendations were prepared for legal and institutional systems related to disaster management, and disaster management plans and activities.

3.5.2 Civil society organizations

Disaster management capacity of civil society, such as voluntary associations, private companies, families, and professional associations in Istanbul, were studied. Proposed recommendations included flexible legal systems for the civil society, allocation of resources to the civil society, appropriate distribution of responsibility among public authorities and civil society organizations, and utilization of civil society to motivate people for the strengthening of building.

3.5.3 Public awareness and education

Public awareness of earthquake disaster and status of education for earthquake disaster were studies and evaluated.

3.5.4 Resources for response and relief

Location and capacities of medical facilities (Figure 14), fire fighting facilities, security facilities and governmental facilities in Istanbul were evaluated and mapped.

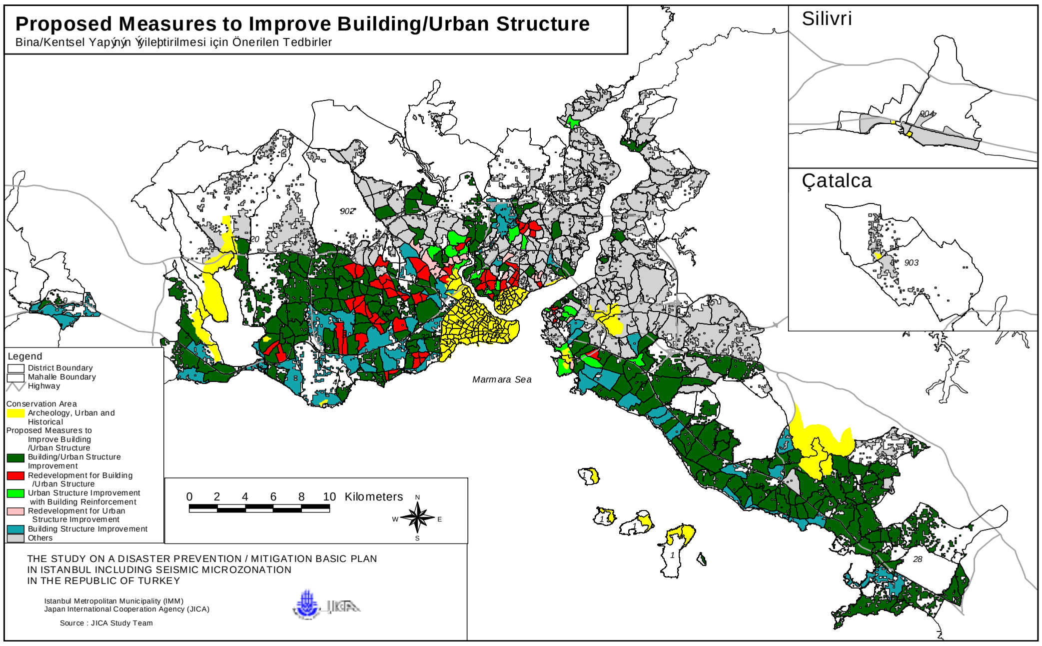


Figure 12: Proposed measures to improve buildings and urban structures

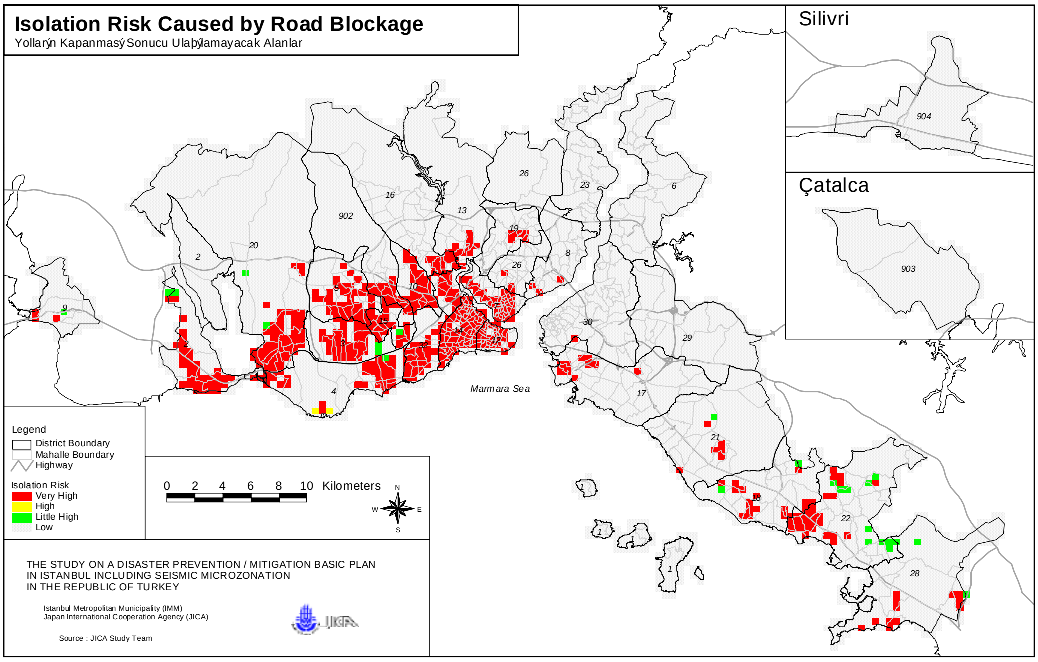


Figure 13: Isolation risk caused by road blockage

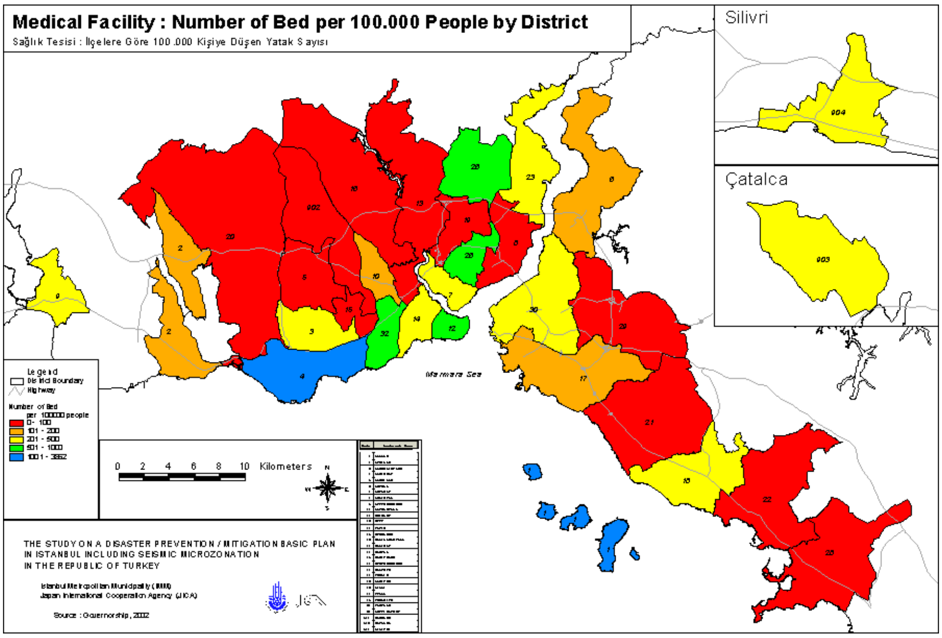


Figure 14: Number of beds per 100,000 people by district

4. RISK REDUCTION MEASURES

Based on the risk assessment recommendations were proposed to improve capacities of preparedness and to advance measures for risk reduction. The recommendations, which were structural and non-structural, or had short-, medium-, or long-term approaches, included:

- Improvement of evacuation system,
- Improvement of response, relief and recovery plans,
- Improvement of laws, organizations and disaster management plans,
- Involvement of civil society for risk reduction,
- Promotion of public awareness of earthquake hazards and education for understanding of risk reduction,
- Improvement of buildings and urban structure,
- Strengthening of public facilities and infrastructures, and
- Improvement of road, and port and harbour network for response, relief and recovery.

5. SUMMARY AND CONCLUSIONS

An example of JICA's projects for earthquake disaster risk reduction was described. Processes of risk assessment of Istanbul, which included 1) data collection and preparation of database and maps, 2) hazard assessment, 3) risk analysis, 4) vulnerability analysis, and 5) assessment of disaster management capacity of Istanbul, were demonstrated by using the GIS maps. The results of the risk assessment were used to lead recommendations to improve capacities of preparedness and to advance measures for risk reduction for Istanbul.

A systematic and a holistic approach, namely multi-sectoral, multi-disciplinal and inter-agency approach was found effective to carry out the project. Local participation was crucial to introduce local scientific knowledge and technology, as well as various political, economical, cultural, and social distinctions, into the risk assessment and the identification of disaster risk reduction measures.

Turkish experts, especially earthquake researchers, have predicted that the danger of another earthquake striking the Istanbul area is likely to occur 15 years after the Izmit Earthquake in 1999. The risk assessment in the study predicted that large-scale building damages and resulting high human casualties would occur once the earthquake strike Istanbul. The study also demonstrated the damages to infrastructures and the vulnerability of the city itself. Implementation of the risk reduction measures is urgently required.

6. ACKNOWLEDGEMENTS

The paper is based on the results of the Study on a Disaster Prevention/ Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey under the funding of Japan International Cooperation Agency (JICA). The author gratefully acknowledge the works of the JICA study team and the Turkish counterpart team, and the supervisions of the administrative consulting committee, the scientific consulting committee, the JICA advisory committee and the administrative body of JICA during the course of the Study.

REFERENCES

1. Japan International Cooperation Agency, and Centre for Earthquake and Environmental Studies of Tehran, Tehran Municipality, *Final Report : The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran*, November 2000.
2. Japan International Cooperation Agency and Ministry of Home Affairs, His Majesty's Government of Nepal, *Final Report : The Study on Earthquake Disaster Mitigation in the Kathmandu Valley, Kingdom of Nepal,* March 2002.
3. Japan International Cooperation Agency and The City of Bogota, *Final Report : The Study on Disaster Prevention in the Bogota Metropolitan Area in the Republic of Colombia,* March 2002.
4. Japan International Cooperation Agency and Directorate of Soil and Earthquake Research, The Istanbul Metropolitan Municipality, *Final Report : The Study on a Disaster Prevention / Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey,* December 2002.
5. Kubo, K. and Katayama, T., *Study Report of Earthquake Disaster Prevention of Kawasaki City : Earthquake Resistance of Civil*

Structures, Disaster Management Council, Kawasaki City, Japan, 1974 (in Japanese).
Ministry of Construction, Japan, Report on the Development of Fire Prevention Measures in the City, 1982 (in Japanese).

Mr. T. Tanaka from Japan

"MULTI-SECTORAL APPROACH" ON THE STUDY OF SEISMIC DISASTER MANAGEMENT IN THE KATHMANDU VALLEY

Y. EGAWA
Nippon Koei Co., Ltd
Japan

ABSTRACT

The Study has been carried out aiming at establishing a milestone to the following three goals of the Earthquake Disaster Mitigation.

- *Protecting the life and property of the people*
- *Strengthening socio-economic systems*
- *Securing the stability of governance*

Earthquake disaster management should be conducted under an integrating concept and set of principles that provide unity and continuity among the plans of governmental and societal entities. These principles include recognition of the need for leadership, risk reduction, dissemination of public information, and rapid response and recovery actions by all levels of government and society. In order to establish the principles and plans at each level, the study team has shown a grand vision and a master plan, emphasizing the following points.

- *Multi-sectoral approach to holistic earthquake disaster management*
- *Elaboration of disaster management policy/plans in the new national five-year plan*
- *Development of social and economical fundamentals as a presupposition of earthquake disaster mitigation*

1. INTRODUCTION

1.1 Background

The Great Gujarat Earthquake in India in January 2001 revealed the vulnerability of "non-earthquake-proof" cities and villages. In 1934, an earthquake of magnitude 8.4 caused serious damages to 60% of the buildings in the Kathmandu Valley.

It is a cause for great concern that the next great earthquake may strike Nepal at any time, after almost 70 years of silence.

The Kathmandu Valley is the exclusive centre of Nepal for politics, the economy, and society, with a large population of more or less 1.5

million. Once a great earthquake occurs, Kathmandu will suffer immense losses of life and property and will be unlikely to be able to function as the capital of Nepal.

Figure 1: Damage by 1934 Earthquake (provided by Ministry of Home Affairs)

His Majesty's Government of Nepal (HMG) has been concerned about earthquake disaster management and requested the Government of Japan to implement a study on earthquake disaster mitigation in the Kathmandu Valley. The Government of Japan, through the Japan International Cooperation Agency (JICA), the official implementing agency for Official Technical Cooperation, dispatched a preliminary survey team to Kathmandu in August 2000 and exchanged a Scope of Work and Minutes of Meeting with HMG. Nippon koei Co.Ltd. and OYO Corporation were contracted by JICA to conduct this study from January 2001 to March 2002.

1.2 Seismicity

Nepal lies on an earthquake zone formed with the subduction of Indian plate under the Himalayas, and the area has suffered with large-scale earthquakes. In 1934, an earthquake of Magnitude 8.3 caused serious damage to 60% of the buildings in Kathmandu valley. According to earthquake records and recent study, it is foreseeable that the next large-scale earthquake might occur shortly.

1.3 Goals, Concept and Objectives

The goals set in this study are focused on;

1. Protecting life and property in the Kathmandu Valley,
2. Strengthening socio-economic systems, and
3. Protecting the stability of governance even in the event of major earthquakes.

Approaching the goals as closely as possible, this study forms one milestone in a long process.

The objectives of the Study set by the Team, following the goals, are;

1) to formulate a plan for earthquake disaster mitigation in the Kathmandu Valley,
2) to carry out technology transfer to Nepalese counterpart personnel,
3) to create a database on earthquakes and for earthquake disaster estimation.

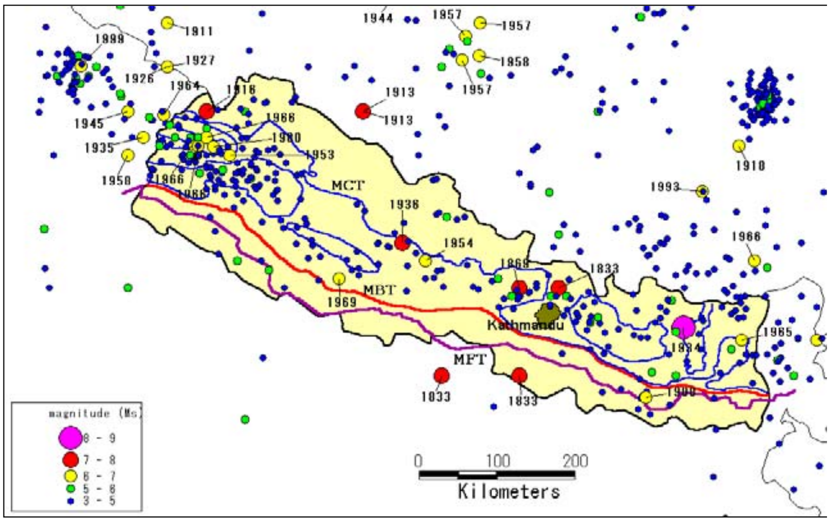


Figure 2: Epicentral Distribution in Nepal from 1255 to 2001
(Source: Department of Mines and Geology)

2. EARTHQUAKE DISASTER ASSESSMENT

2.1 Scenario Earthquakes

In this study, three new fault models were selected, and the destructive force of each was calculated as follows, based on the natural and social conditions:

1) Mid Nepal Earthquake (Richter magnitude = 8.0); MMI VIII (Modified Mercalli Intensity)
2) North Bagamati Earthquake (Magnitude = 6.0); MMI VI or VII
3) KV Local Earthquake (Magnitude=5.7); Most parts MMI VII or VIII, as high as IX along the fault line.

In addition, a fourth model, the reoccurrence of the 1934 Bihar-Nepal Earthquake (Magnitude = 8.4) was modeled for comparison. For the most part in had an MMI of VIII, in the eastern part, MMI IX.

Table 1: Three fault models and the fault model of Bihal-Nepal Earthquake

Item		Mid Nepal Earthquake	North Bagmati Earthquake	KV Local Earthquake	1934 Earthquake
Fault plane	Length (km)	135	10	8	222
	Width (km)	95	9	(4)	150
	Dip angle (degree)	5	37	90	5
Surface Wave Magnitude		8.0	6.0	5.7	8.4
Location of epicentre	N (degree)	27.25	27.65	27.65	26.42
	E (degree)	84.62	85.27	85.27	87.80

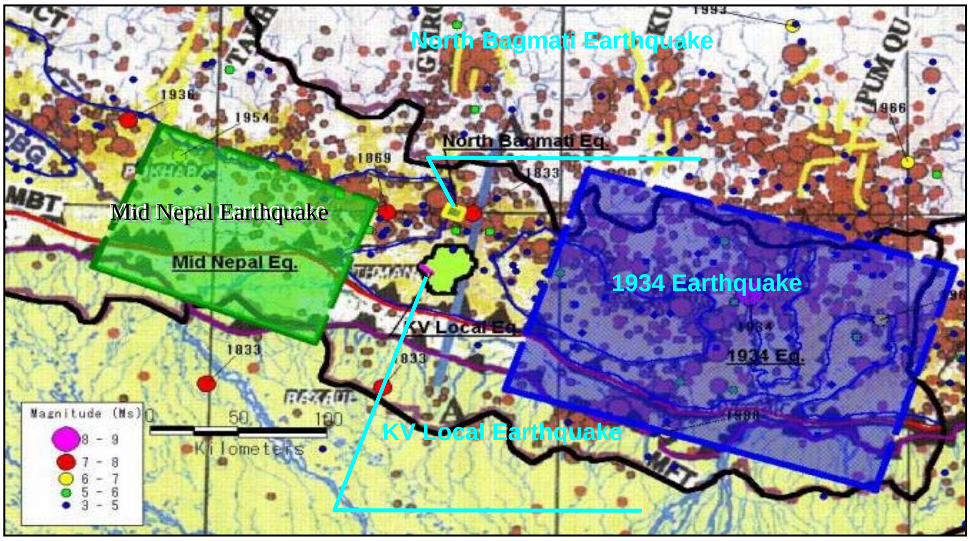


Figure 3: Scenario Earthquake Fault Model

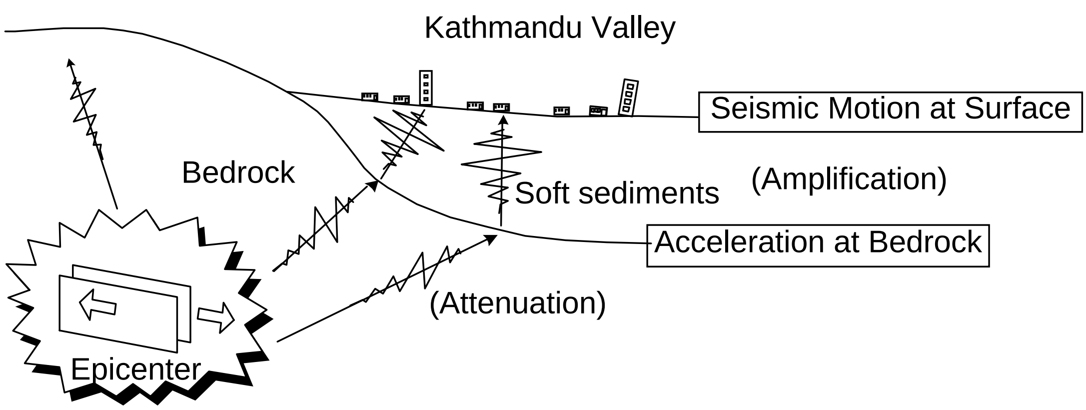
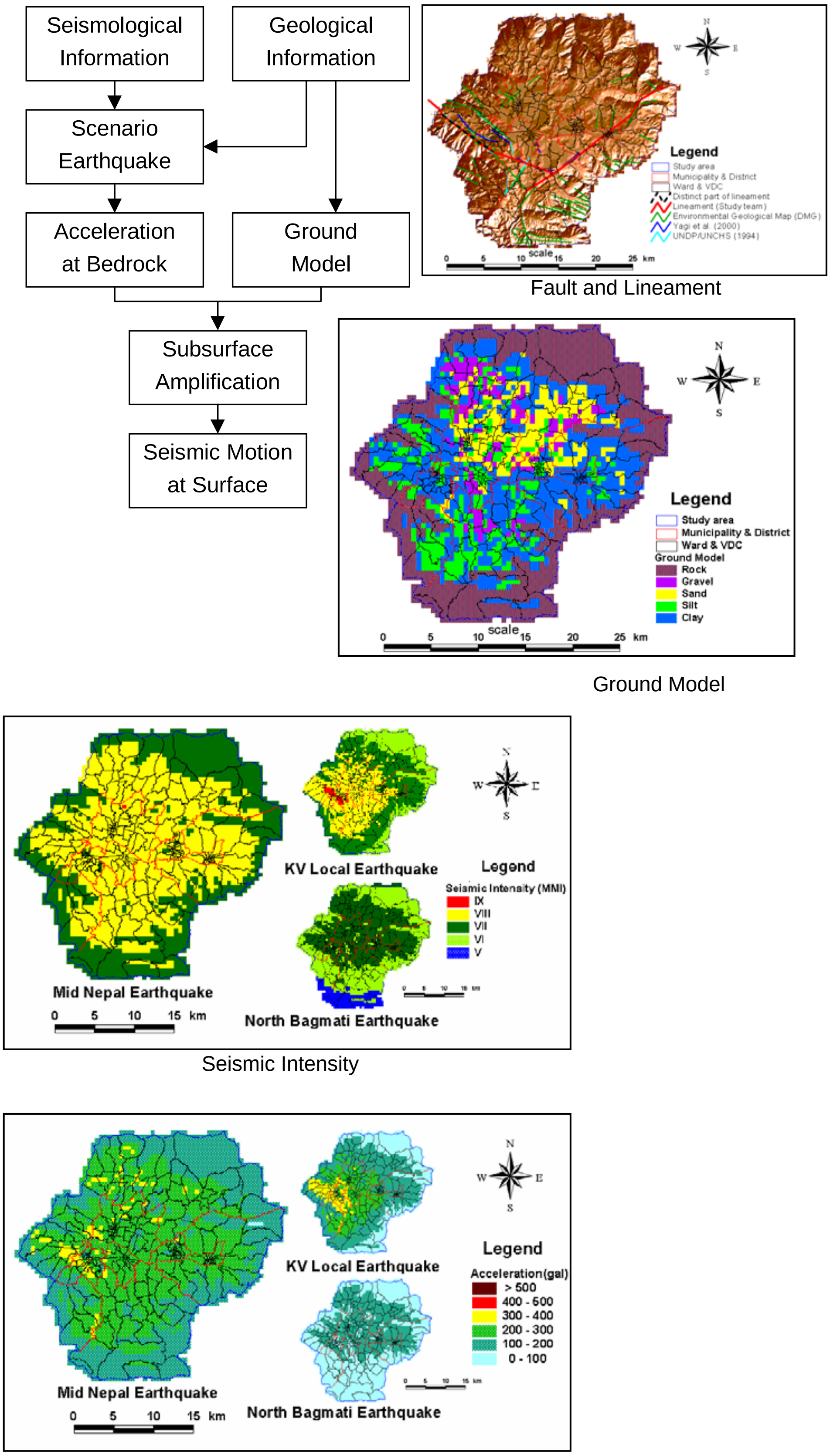


Figure 4: The image section of the earthquake in Kathmandu Valley



Peak Ground Acceleration

Figure 5: Calculation of Seismic Motion at Surface

2.2 Earthquakes Disaster Scenario

The liquefaction potential for all models was evaluated as relatively low compared with previous estimate.

The anticipated disaster, in the Kathmandu Valley that would be caused by the "Mid Nepal Earthquake" is as follows:

1) The number of heavily damaged buildings, 53,000, i.e., 21% of all buildings.
2) The death toll, 18,000, i.e., 1.3% of the total population in the Valley.
3) The seriously injured people: 53,000, i.e., 3.8% of the total population in the Valley.

Table 2: Estimated Damage of Building and casualty

Item	1934 Earthquake (Actual)	Mid Nepal Earthquake (Estimated)
Magnitude	8.4	8.0
Location of Epicentre	100 km East	150 km West
Population	300,000 (1920)	1,500,000 (2001)
Seismic Intensity	VIII – XI	VIII
Building Damage	38,055 (60 %)	128,952 (50 %)
Casualty (Death)	4,296 (1.4 %)	17,695 (1.3 %)

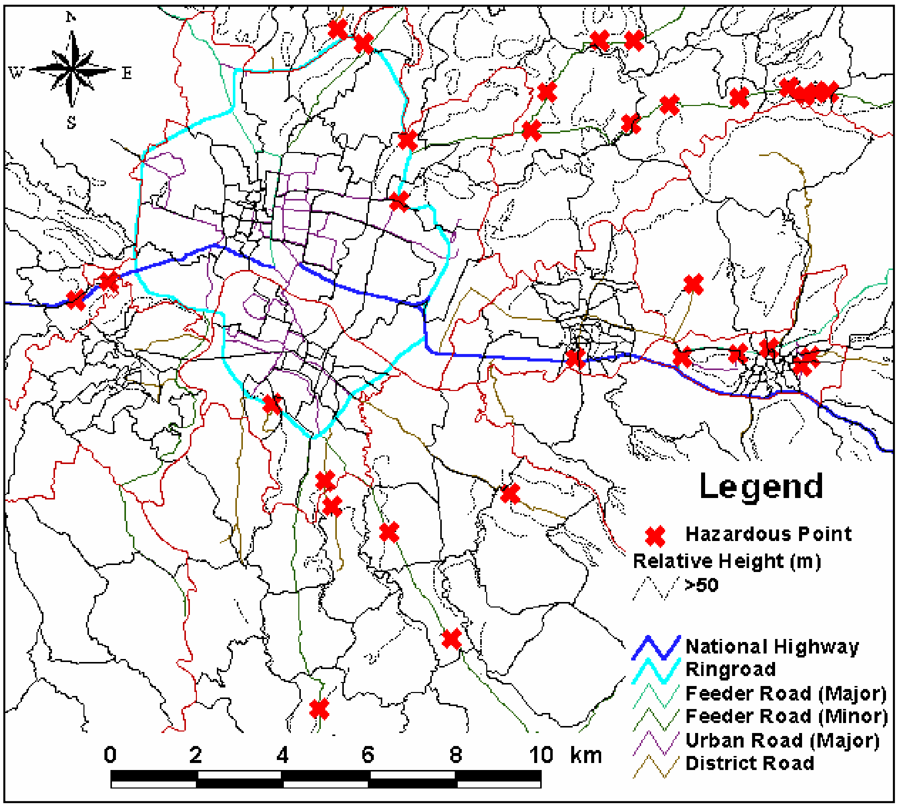


Figure 6: Estimated Damage of Road

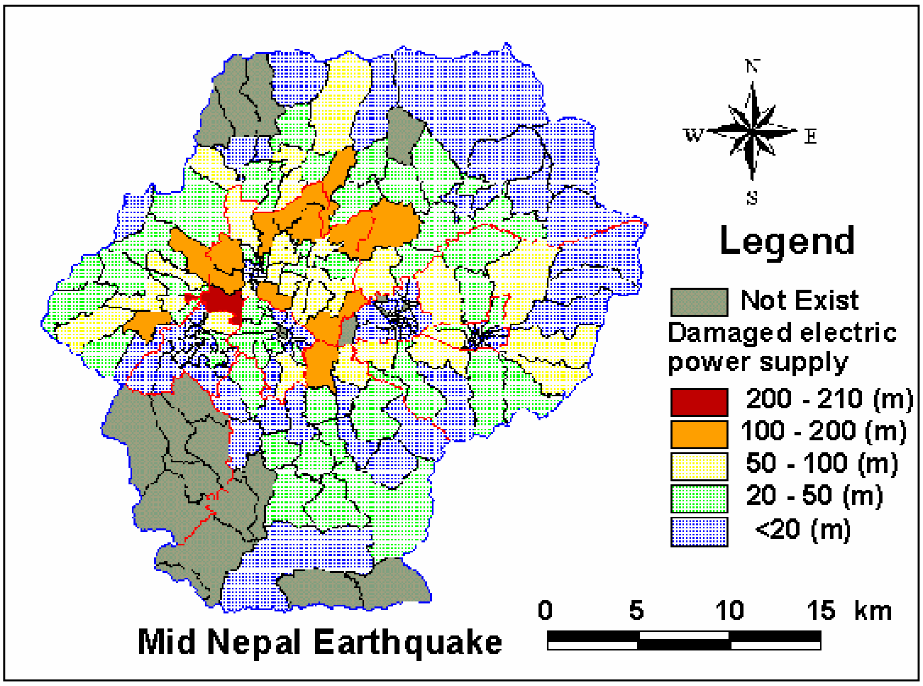


Figure 7: Estimated Damage of Power Line

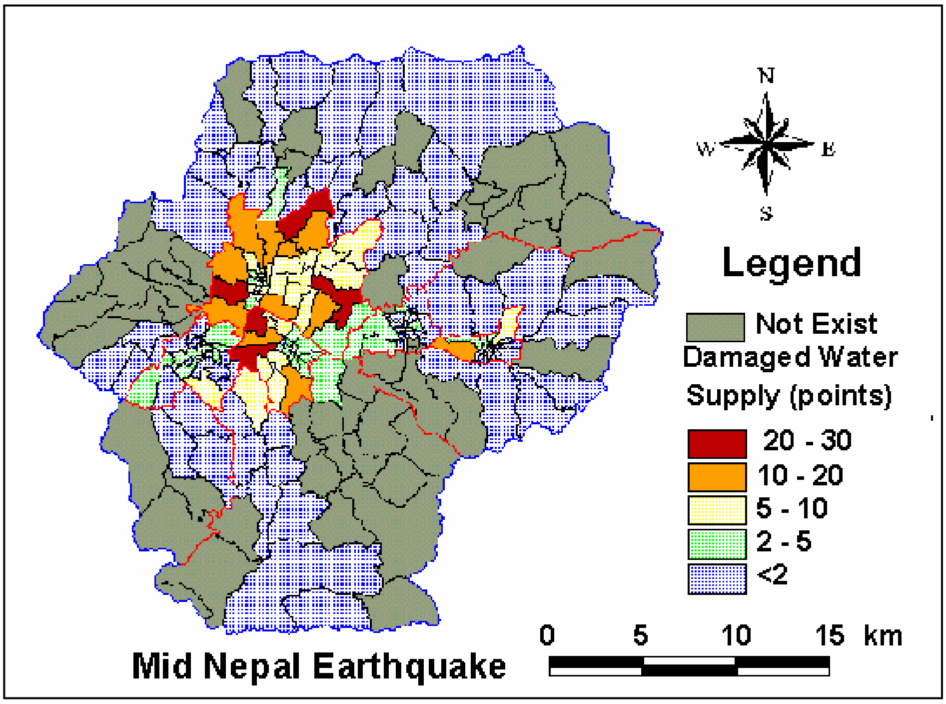


Figure 8: Estimated Damage of Water Supply Pipes

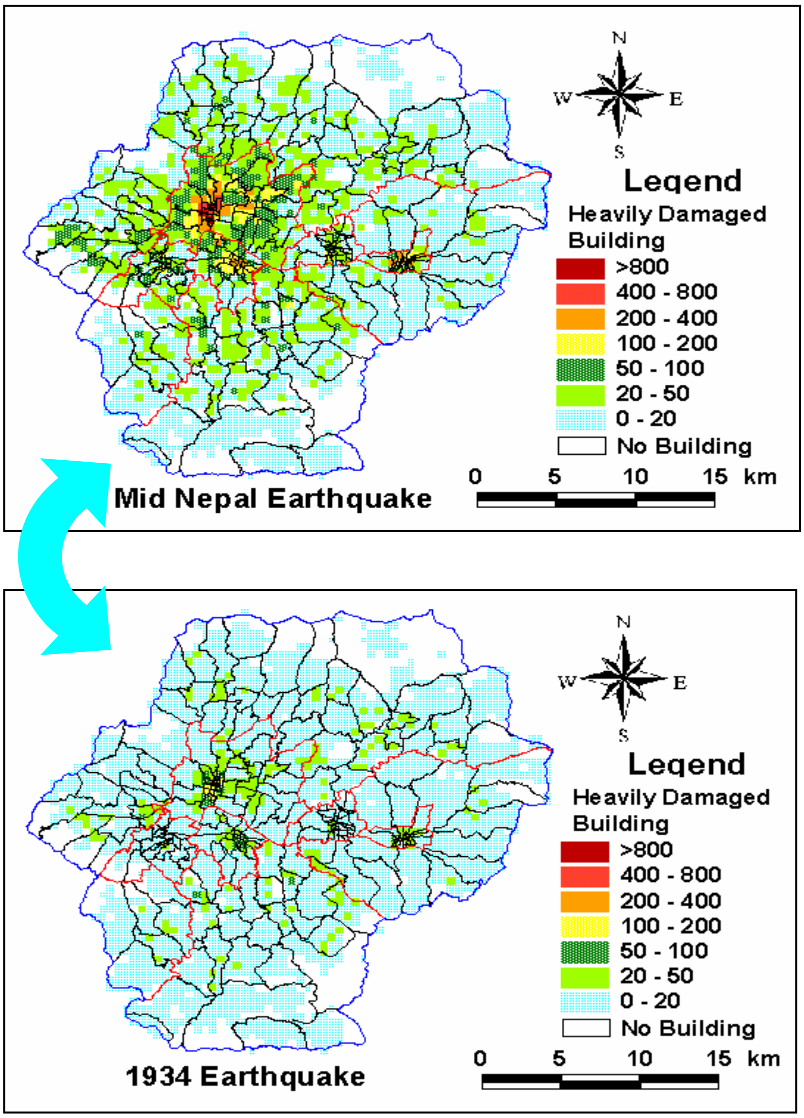


Figure 9: Estimated Damage of Building

Figure10: A Typical Building in Nepal under Construction

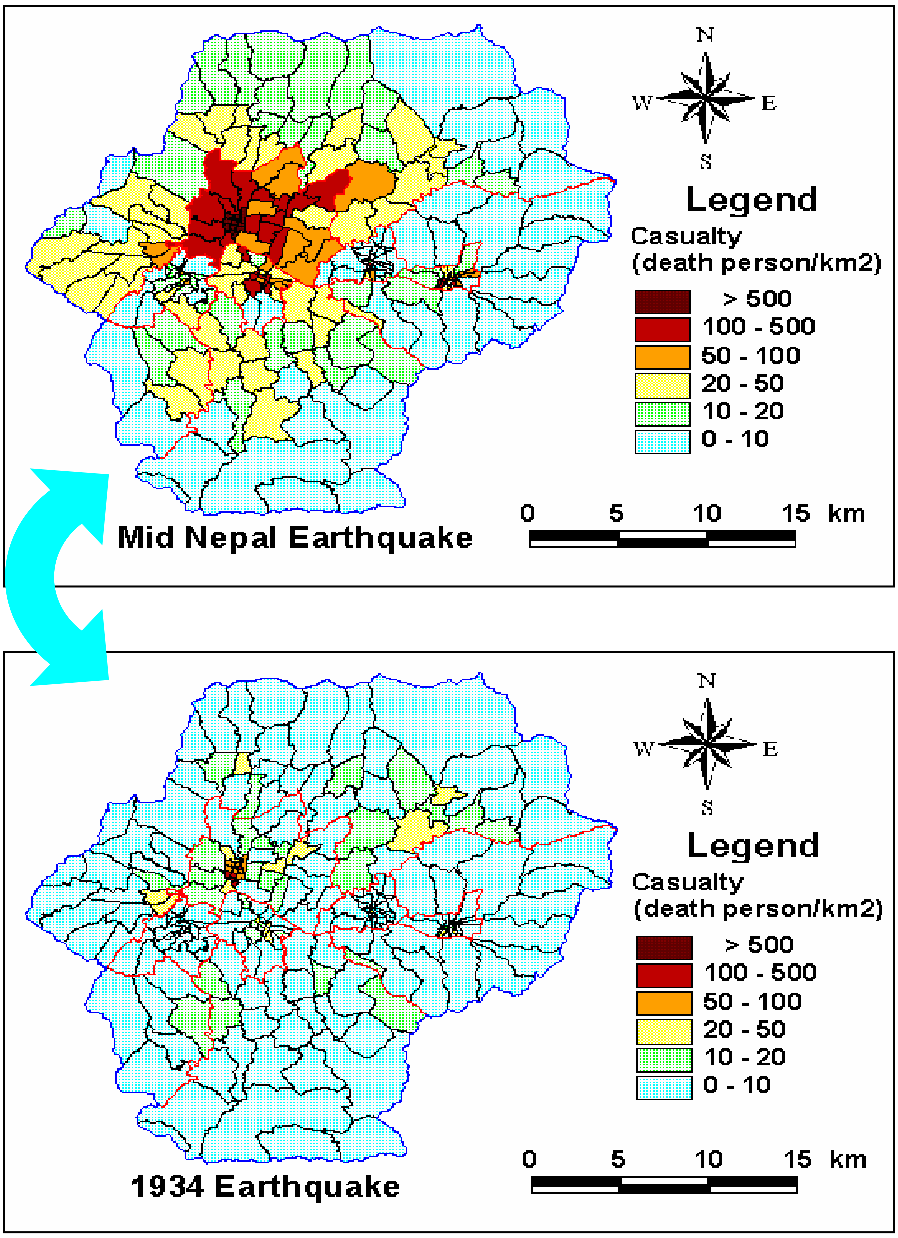


Figure 11: Estimated Damage of Casualty

3. MECHANISMS FOR DISASTER MANAGEMENT

Currently Nepal lacks the necessary mechanisms for sustainable disaster management. It is clear that the following steps must be taken to improve the capacity for disaster management in Nepal:

1) Establish a strong legal base for a comprehensive risk management system.
2) Create sustainable mechanisms for inter-governmental and inter-institutional coordination.
3) Ensure that the Tenth Five-Year Plan, currently in preparation, includes plans and funding for firm disaster mitigation measures.

4) Promote and strengthen self-governance of local bodies for risk management.
5) Promote public awareness on self-protection against earthquake disasters and outreach to targeted groups.

.

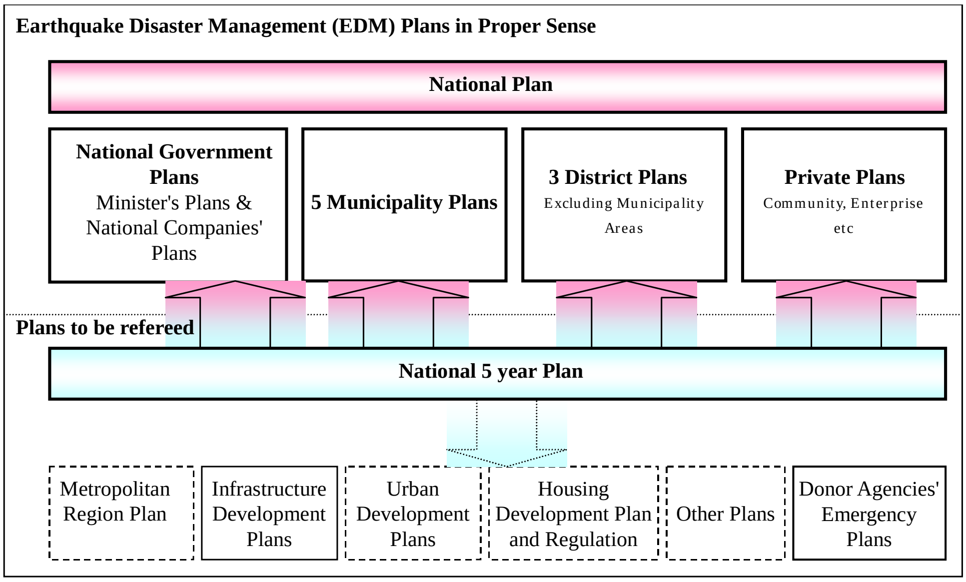


Figure 12: Structure of Disaster Management Plans and Other National Plans to be Referred

4. NEED TO MAINTAIN GOVERNANCE

The government, at all levels, is responsible for providing continuity of effective leadership, direction of emergency operations, and management of recovery operations. For this reason, it is essential that governmental entities continue to function during and following a disaster. This requires that they take actions on preparedness such as: preparing plans/manuals to guide initial response; establishing systems for communications/ coordination, including an Emergency Operations Center; and advising employees of their responsibilities in case of disaster.

Key elements of emergency plans and manuals include the assignment of responsibilities/ authority, the establishment of systems for command/ control/ communications/ coordination, and the collection/dissemination of information. Emergency response/recovery planning should be prepared for prompt/proper decision-making and smooth execution of the decided measures before, during, and after disaster.

The importance of communication for the initial response should be recognized, as well as the importance of the role of the media in communication .

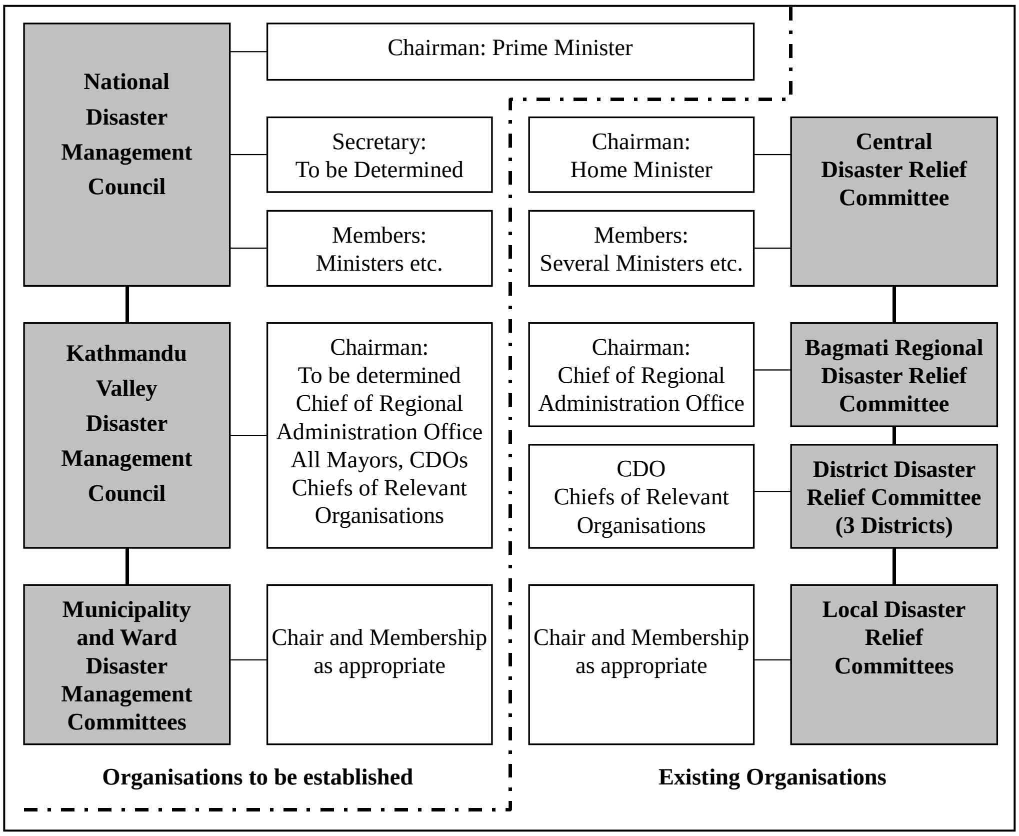


Figure 13: Disaster Management Organizations in the Kathmandu Valley

5. PROTECTION OF LIFE AND PROPERTY

Many difficulties are anticipated in the initial stages of the disaster, including search and rescue operations, medical services, cremation, drinking water and food, public health care, security, fire-fighting, management of volunteers, safety inspections of structures and infrastructure, debris removal and disposal, shelter and temporary housing, etc. Due to inadequate response planning and systems for inter-institutional coordination, public onsite services in an emergency are likely to be deficient for the time being. Community involvement and the sense of self-protection by the people are accordingly indispensable.

The logistics to support on-site activities after the occurrence of a disaster is a critical issue. The transportation system must continue to function during and after the occurrence of the earthquake disaster so that the on-site activities of search and rescue and other socio-economic activities can continue to function. Similarly, prompt restoration of electrical service and water supplies to affected areas would play an important role during the initial stage of the disaster. The existing conditions of these and other critical elements of the infrastructure are discussed, identifying the underlying problems. Priority projects to improve the current situation are also presented.

6. THE REINFORCEMANT OF THE SOCIO-ECONOMIC SYSTEM

6.1 General

Working towards sustainable development is a natural and necessary companion to working towards effective earthquake disaster management itself, because the ability to deal with earthquake disasters is highly dependent upon the fundamentals of society, economic growth and social stability, all of which are the fruits of sustainable development. Urban society is highly dependent on the socio-economic infrastructure, and any weakness makes it vulnerable to disasters can be reduced by reinforcing the infrastructure through sustainable development practices. The fundamental elements of the infrastructure are discussed.

6.2 Transportation Facilities

The existing master plan studies were reviewed. Proposals for roads, bridges and the airport to improve the access to and mobility inside the Valley are presented.

6.3 Building Structures

Most of the existing buildings have severe deficiencies regarding earthquake resistance. The report presents, discusses and makes recommendations on the current building construction system, the Draft National Building Code of Nepal, and the defects of individual types of buildings: hospitals, schools and public buildings, and historical buildings.

6.4 Electric Power Supply Facilities

An evaluation of the master plan studies on the transmission and distribution network in the Valley was performed. Provision of a stable transmission system is proposed in the city core areas of Kathmandu Metropolis. Other recommendations, including preparation and implementation of design manuals for earthquake resistance and training of personnel for an effective technical support system, are presented.

6.5 Water Supply and Sewerage Facilities

The ongoing water supply project is expected to significantly improve the extremely poor water supply and sewerage conditions. Urgent tasks include preparing design manuals for earthquake resistance (including for the ongoing water supply project), securing a water supply distribution system by water tankers, and preservation of existing wells and spouts at the local level.

6.6 Telecommunications Facilities

The current vulnerability of telecommunications facilities is carefully examined. To create a reliable network against disaster, it is recommended to complete the multiple diversity routing composition as well as to establish emergency communication and broadcasting systems.

6.7 Urban Structure

Several separate areas within the city center of Kathmandu should be designated as intensive development areas for disaster prevention by maximizing the disaster mitigation characteristics of the urban structure. Securing emergency evacuation routes and preserving evacuation areas in some areas of the city are effective measures that can be applied to Kathmandu. Each of these measures should be implemented to reinforce the city against disasters. Disaster mitigation measures in central city areas into eight strategic zones based on the characteristics of the urban structure.

7. RECOMMENDATIONS AND PROPOSALS

As a result of the study, about one hundred potential programmes in five categories were identified for the improvement of earthquake disaster management in Kathmandu Valley (Table3-Table7). The study team evaluated the programmes form the viewpoints of term, priority and reality.

Fulfillment of all the programmes would require a tremendous amount of time and money. The team consequently selected four projects, which each include several programmers, for urgent implementation. The implementation of the projects will hopefully bring visible results and thus further promote endeavors to achieve the three goals for earthquake disaster reduction.

The four projects are:

1) Establishment of an Early Earthquake Information System,
2) Establishment of a Municipality Disaster Management Institution and Exercise,
3) Building Improvement, and
4) Establishment of a Comprehensive Database for Earthquake Disaster Mitigation.

When selecting four projects, as the approach to the three goals, ninety one (91) proposals were listed in five categories, and reviewed the priority. The list shows below the next page.

Besides the selected projects, it should be noted that there are important and long-term projects with high priority/reality. i.e., the Sinduri road project aiming at improving access to the Valley, road widening projects for smoother mobility in the Valley, and the Melamchi water supply projects.

Table 3: Proposals for Sustainable Mechanism for Development of Disaster Management

No.	Item	Rating			Implementation Plan (Year)				
		Term A/B/C	Priority A/B/C	Reality A/B/C	5	10	30	50	100
Sustainable Mechanism for Development of Disaster Management									
SM-1	Establishment of Legal Foundation	B	A	C					
SM-2	Establishment of Disaster Management Council								
SM-21	National Disaster Management Council	B	A	C					
SM-22	Kathmandu Valley Disaster Management Council	B	A	B					
SM-23	Municipality/Ward Disaster Management Council	A	A	A					
SM-3	Cooperation between Government and Private Sector	B	B	B					
SM-4	Preparation of Disaster Management Plan								
SM-41	National Plan	A	A	B					
SM-42	Central Government Plans	B	A	B					
SM-43	Kathmandu Valley Plan	B	A	B					
SM-44	Municipality Plans	A	A	B					
SM-45	District Plans	B	B	C					
SM-46	Private Plans	B	B	B					
SM-5	Emphasis of Earthquake Management in National 5 Year Plan	A	A	A					
SM-6	Community Resilience and Self-Reliance								
SM-61	Citizens	A	A	A					
SM-62	School Children	A	A	A					
SM-63	Civil Servants	A	A	A					
SM-64	Masons	A	A	A					

Table 4: Proposals for Maintain Governance

No.	Items	Rating			Implementation Plan (Year)				
		Term A/B/C	Priority A/B/C	Reality A/B/C	5	10	30	50	100
Maintain Governance									
MG-1	Establishment of Real Time Earthquake Information System								
MG-11	Earthquake Information System	A	A	A					
MG-12	Seismic Intensity Information System	A	A	A					
MG-13	Earthquake Information Reporting System	A	A	A					
MG-2	Assessment of Damage Information System								
MG-21	Establishment of Lines of Communications	A	A	B					
MG-22	Improvement of Daily Business Style	C	A	C					
MG-23	Preparation of Taking Aerial Photos	A	B	A					
MG-3	Empowerment of Media								
MG-31	Seminars and Training	A	A	A					
MG-32	Amendment of National Broadcasting Act	B	B	C					
MG-33	Publicising	A	A	A					
MG-4	Establishment of Emergency Communications								
MG-41	Identifying the Defects of Radio Wave Propagation	A	B	A					
MG-42	Digital Mobil Multi Channel Access System	A	B	B					
MG-43	Simultaneous Reporting System	A	B	B					
MG-44	Portable Handset	A	B	C					
MG-45	Initiate Amateur Radio Network	A	B	A					
MG-5	Preparation for Emergency Response								
MG-51	Control System	A	A	B					
MG-52	Central Government EOC	A	A	B					
MG-53	Municipality/Ward EOC	A	A	A					
MG-54	Emergency Plans/Manuals	A	A	A					
MG-55	Facility for EOC	A	A	B					
MG-6	Discipline Public Sector								
MG-61	Discipline Public Sector	B	A	C					
MG-62	Line of Succession	A	A	B					
MG-63	Preservation of Vital Record	B	B	C					
MG-7	Preparation for Recovery								
MG-71	Capacity Building	C	B	C					
MG-72	Review/Evaluation of Existing Priorities and Projects	C	B	B					
MG-73	Preparedness	C	B	C					

Criteria for rating

Term (Required duration to complete the programme)
A: less than 5 years, B: 5 to 10 years, C: more than 10 years

Priority (Contribution to accomplishment of the goals, Significance of the problem and effectiveness of the solution, Value/impact for dollar/yen spent, Sustainability/ability to attract or generate further investments)
A: high, B: moderate, C: Low

Reality Feasibility (technical, financial, political, etc.;)
Acceptability (likelihood of receiving the support of the responsible institutions and other stakeholders)
A: high, B: moderate, C: Low

Others Cost, Role, and Responsibility

The proposal with the rating of the criteria which is high about any evaluation item

Table 5: Proposals for Strengthen Socio-Economic System

No.	Items	Rating			Implementation Plan (Year)				
		Term A/B/C	Priority A/B/C	Reality A/B/C	5	10	30	50	100
Protect Life and Property of the People									
PL-1	Search and Rescue								
PL-11	Plan for Improvement of Research and Rescue	B	A	B					
PL-12	Acceptance of International Support	B	A	C					
PL-13	Improvement of Disaster Medicine	C	B	C					
PL-14	Food and Water Supply	B	A	C					
PL-2	Shelter and Evacuation								
PL-21	Plan for Shelter, Evacuation and Removal	C	B	B					
PL-3	Medical Problem								
PL-31	Public Health Care	A	A	A					
PL-32	Remains	C	B	C					
PL-4	Other Functions								
PL-41	Security	B	B	A					
PL-42	Firefighting	B	B	B					
PL-43	Management of Volunteers	B	B	C					
PL-44	Safety Inspections	B	B	B					
PL-45	Debris Removal	B	B	C					
PL-5	Transportation System (Roads and Bridges)								
PL-51	Database	A	A	A					
PL-52	Temporary Bridges	B	B	C					
PL-6	Electricity Supply								
PL-61	Database	A	A	A					
PL-62	Solar Power	B	C	C					
PL-63	Wind Power	C	C	C					
PL-64	Diesel Generators	B	B	C					
PL-7	Staging Area	A	B	B					

Table 6: Proposals for Protect Life and Property of the People

No.	Items	Rating			Implementation Plan (Year)				
		Term A/B/C	Priority A/B/C	Reality A/B/C	5	10	30	50	100
Strengthen Socio-Economic System									
SE-1	Urban Planning								
SE-11	Urban Space Allocation Detail Planning	A	A	A					
SE-12	Assignment Planning of Intensive Development Areas	C	A	B					
SE-13	Assignment Planning of Mitigation Bypass Routes	C	B	C					
SE-14	Urban Zoning for Disaster Mitigation measures	C	A	B					
SE-2	Transportation Facilities								
SE-21	Roads to Improve Access to the Valley	C	A	A					
SE-22	Roads to Improve Mobility Inside the Valley	C	A	B					
SE-23	Improvement of Bridges	C	A	B					
SE-3	Building								
SE-31	Improving Building construction	A	A	A					
SE-32	National Building Code	A	A	A					
SE-32	Training	A	A	A					
SE-34	Inspection of Key Buildings	A	A	A					
SE-4	Electricity								
SE-41	Network Improvement	B	A	B					
SE-5	Water Supply & Sewerage Facilities								
SE-51	Database System	A	A	A					
SE-52	Distribution System by Water Tankers	B	B	C					
SE-53	Preservation of Existing Wells and Spouts	A	A	B					
SE-54	Preparation of Earthquake Resistant Design Manual	B	A	B					
SE-6	Telecommunication Facilities	A	B	B					
SE-7	Socio-Economic Influence	B	A	B					

Table 7: Proposals for Earthquake Disaster Assessment

No.	Items	Rating			Implementation Plan (Year)				
		Term A/B/C	Priority A/B/C	Reality A/B/C	5	10	30	50	100
Earthquake Disaster Assessment									
ED-1	Seismological Measurements								
ED-11	Seismological Observation	B	B	B					
ED-12	GPS Observation	C	B	C					
ED-2	Basic Data								
ED-21	Regulation of Map Data	A	A	A					
ED-3	Geological Data								
ED-31	Basement Structure Measurement of Kathmandu Valley	B	B	C					
ED-32	Geological Database	B	A	B					
ED-4	Infrastructure Database								
ED-41	Building Inventory/Census	A	A	A					
ED-42	Lifeline GIS Database	A	A	A					
ED-43	Bridge Ledger	A	A	A					
ED-5	Data Clearing House	B	A	C					
ED-6	Improvement of Damage Estimation								
ED-61	Historical Data Gathering and Analysis	A	A	A					
ED-62	Strong Motion Observation Network	B	A	B					
ED-7	Education and Research								
ED-71	Earthquake Engineering Laboratory	B	B	B					
ED-72	Training Earthquake Engineers	A	B	B					

REFERENCES

1. National Society for Earthquake Technology-Nepal(NSET-Nepal) and GeoHazards International (GHI), 1999. Earthquake Scenario. Product of the Kathmandu Valley Earthquake Risk Management Project.
2. UNDP, UN Disaster Management Secretariat, 1997. Comprehensive Database (Basic Information) on Natural Disaster Management Capabilities in Nepal. Kathmandu, Nepal, Geological Society.
3. Task Force for Revision of the Preliminary Draft of National Action Plan on Disaster Management,1995. Draft of National Action Plan on Disaster Management.
4. HMG,1994. *National Action Plan on Disaster Management and presenting the Plan,* IDNDR World Conference in Yokohama,
   Chhetri, M B. Poudyal, 2000. Disaster Management policies, Operational aspects, Problems and measures.
5. Nicholas Russell, Madhu Rarman Acharya, and Shree Ram Pant: Nepal Country Study.
6. Nepal's National Committee for the International Decade of Natural Disaster Reduction (IDNDR) 1996. National Action Plan on Disaster Management in Nepal.
7. Pandey, M. R. and P. Molnar 1988. The distribution of intensity of the Bihar-Nepal earthquake 15 January 1934 and bounds on the extent of the rupture zone, J. Nepal Geol. Soc., 5.
8. UNDP/UNCHS, 1994. Seismic Hazard Mapping and Risk Assessment.
9. Arya, A, 2000, Non-Engineerd Construction in Developing countries - An Approach toward earthquake Risk Prediction, Proceedings of the 12WCEE2000, No. 2824,pp.1-22, 2000.

Mr. Y. Egawa from Japan

URBAN DISASTER PREVENTION AND MANAGEMENT FOR THE TEHRAN AREA

I. KOBAYASHI
Pacific Consultants International
Japan

ABSTRACT

This paper intends to introduce the master plan study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area (hereinafter called "the Study"). This Study is carried out under technical cooperation scheme in Japan International Cooperation Agency (JICA). After completion of the microzoning study in November 2000, this Study was initiated on August 2002 and it will continue until September next year.

The objectives of the Study are to formulate a master plan and its implementation plan for urban seismic disaster prevention and management for Tehran City and to transfer skills and technical knowledge to counterpart personnel. The Study will formulate three types of plans according to management stages: disaster prevention and mitigation, emergency response and recovery and rehabilitation plans. Implementation plan on the master plan is prepared based on these three disaster management plans.

The plans cover the following items:

1) *Formulation of comprehensive disaster management plan*
   Earthquake disaster management plan is composed of disaster prevention and mitigation plan, emergency operation plan, and rehabilitation and reconstruction plan.
2) *Seismic structure measures for the existing building*
   The Study Team carried out seismic resistance survey on building investigation for 350 buildings in Tehran in cooperation with local consultants. Based on the field survey, the existing buildings were evaluated against seismic resistance.
3) *Preparation of disaster management map and diagnosis sheet for each district*

The comprehensive disaster management map was prepared on the basis of damage estimation results from previous microzoning study and the collected data from responsible organization. A diagnosis sheet is also prepared for each one of 22 districts.

4) *Community level activity for the disaster management*
   Several workshops were held by the Study Team to involve residents in Tehran to disaster management plan. Those workshops are the disaster management map-making at community level and community level

disaster management plan formulation by the residents. The Study Team will monitor their activity to guide them to the appropriate direction.

1. INTRODUCTION

This paper intends to introduce the master plan study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area (hereinafter called “the Study”). This Study is carried out under technical cooperation scheme in Japan International Cooperation Agency (JICA). After completion of the microzoning study in November 2000, this Study was initiated on August 2002 and it will continue until September next year. According to historical data, Tehran has suffered from several strong earthquakes with return periods of 150 years. Seismologists believe a strong earthquake will strike Tehran in near future because the city has not experienced a disastrous earthquake since 1830.

The objectives of the Study are to formulate a master plan and its implementation plan for urban seismic disaster prevention and management for Tehran City and to transfer skills and technical knowledge to counterpart personnel. The Study will formulate three types of plans according to management stages: disaster prevention and mitigation, emergency response and recovery and rehabilitation plans. Implementation plan on the master plan is prepared based on these three disaster management plans.

2. INTRODUCTION OF COMPREHENSIVE DISASTER MANAGEMENT PLAN

2.1 Formulation of Comprehensive Disaster Management Plan

A Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran was conducted with the cooperation of JICA and Tehran Municipality between 1999 and 2000. As results of the Study, it is pointed out that a strong earthquake caused by fault activity of the Ray Fault will largely affect Teheran Municipality. Huge seismic damages to both buildings and people were estimated. Teheran Municipality does not have a proper urban seismic disaster management master plan. This Study will formulate a comprehensive disaster management plan based on the previous microzoning study.

Earthquake disaster management plan is composed of disaster prevention plan, emergency operation plan and rehabilitation and reconstruction plan.

Moreover, the implementation plan will be formulated on the basis of the master plan program and project. The Study will review the implementation capacity and resources and formulate the implementation plan.

2.2 A Seismic Structure Measures for Building and Infrastructure

In order to reduce the earthquake damage, reinforcement of the existing buildings should be recommended for immediate action. The Study Team carried out seismic resistance survey on building investigation for 350 buildings in Tehran.

The framework of the disaster management plan is shown as follows:

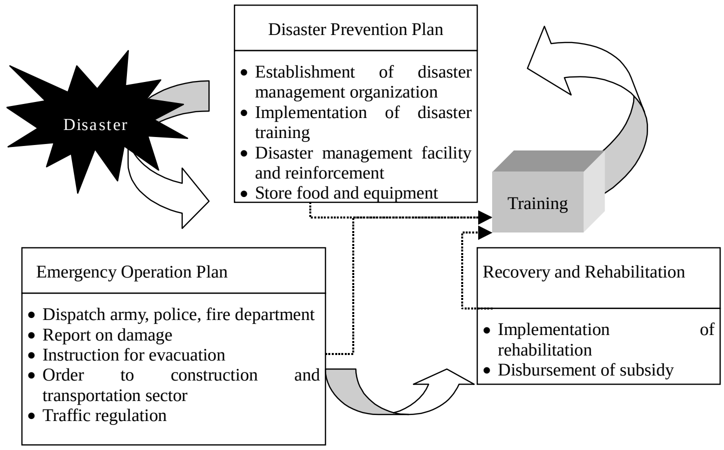


Figure 1: Concept of Disaster Management Plan

The Japanese seismic resistance methods are applied in the analysis on the seismic resistance capacity of the existing buildings. A concept of Japanese building diagnosis system " Specification on Earthquake Resistance Diagnosis and Strengthening for Governmental Buildings" is adopted and the design earthquake is given based on "Iranian Code of Practice for Seismic Resistance Design of Buildings Standard #2800". Japanese Specification provides the seismic index of structure, ***GIs***, in order to evaluate the seismic resistant capacity of building structure.

The results of the analysis show that most of the building should be strengthened or rebuilt because of insufficient earthquake resistant capacity. In order to reduce the earthquake damage, huge investment on the existing buildings is required in the next few decades. The government should provide incentive to the individual building owners to encourage strengthening of the building. The Study will formulate programs and projects of not only structural measures but also non-structural measures of the assistance.

2.3 Vulnerability Analysis in Tehran Municipality

In order to assess the seismic vulnerability of each district, district diagnosis analysis is carried out. The diagnosis analysis should identify the disaster resources and hazard. As for earthquake hazard, the results of the microzoning study were applied and the additional data collection on disaster management resources was carried out in this Study. The results of analysis are compiled in forms of district disaster management map and district diagnosis sheet for each district. Those analysis results will be utilized for each district government to formulate disaster management plan at district level. Examples of the map and sheet are shown below:

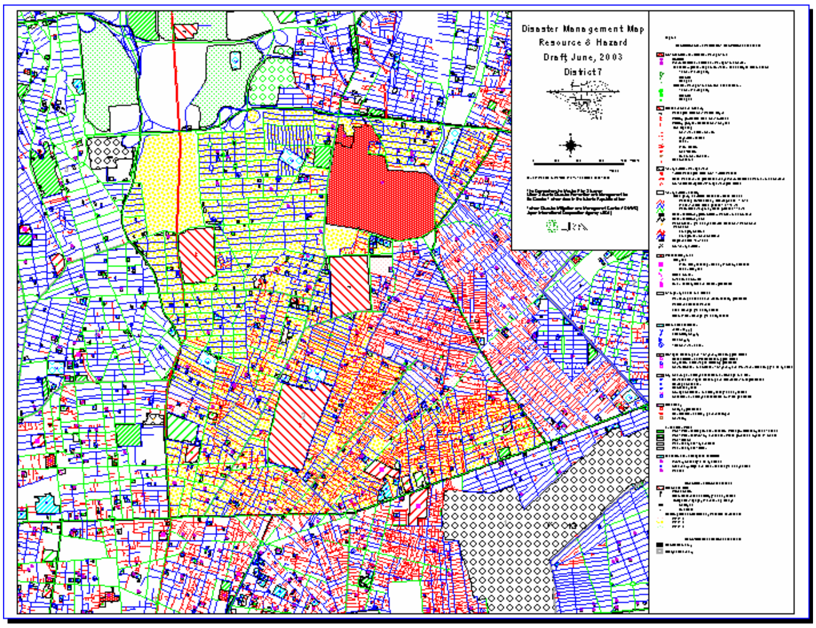


Figure 2: Example of Disaster Management Map

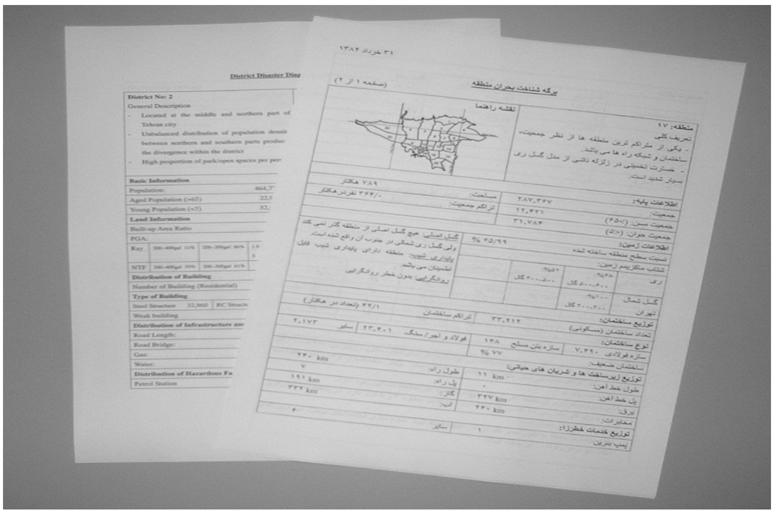


Figure 3: Example of Disaster Diagnosis Sheet

In order to evaluate the seismic vulnerability of Tehran Municipality as a whole, a comprehensive vulnerability analysis on Tehran Municipality has been prepared. The previous study quantified the damage caused by the earthquake in terms of building, human casualty, bridge and lifeline by microzone. In this Study, the area's vulnerability to the earthquake should be clarified to understand the vulnerability level within Tehran Municipality.

The analysis takes the following steps:

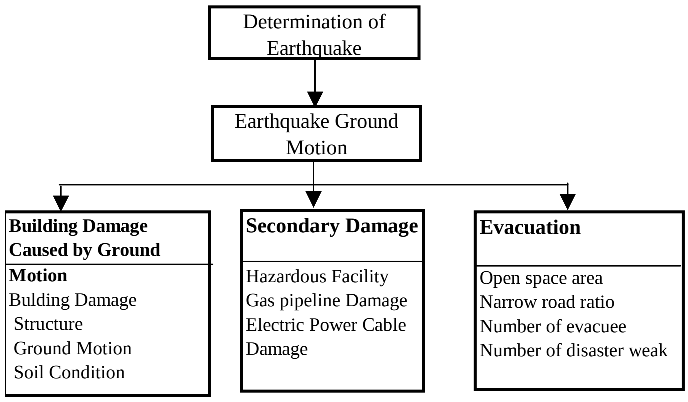


Figure 4: Procedure of Vulnerability Analysis

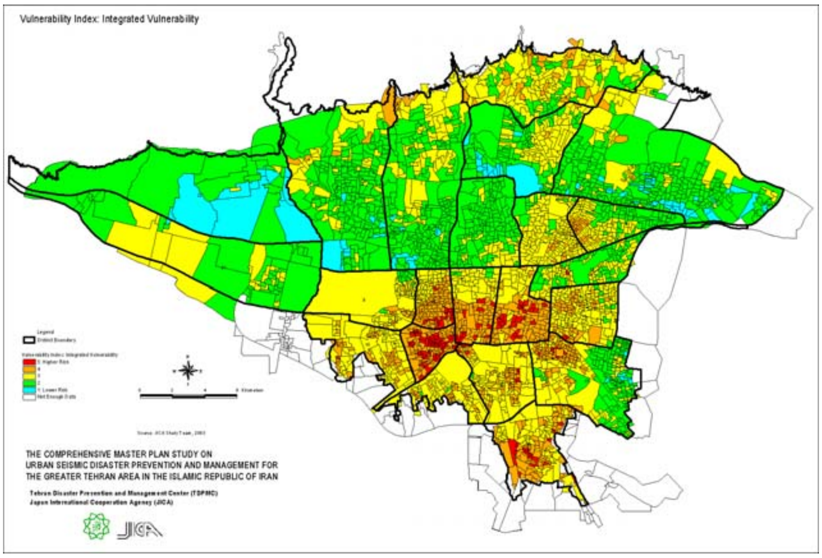
Each variable is independent of each other and is analyzed separately. After ranking each variable, all the ranks are integrated to identify the vulnerability of Tehran.

To analyze an area's vulnerability, three variables, building damage, secondary damage and evacuation and index, are used to represent each variable. The variables and indexes are summarized as shown below:

Table 1: Variables used for Vulnerability Analysis

Items	Index	Items included in the index
Building	Building damage ratio	Soil condition Earthquake ground motion Building structure
Secondary Damage	Hazardous Facility Gas Pipeline damage Electric power damage	Fuel tank, petrol station and chemical facility Gas Pipeline damage Network damage
Evacuation	Availability of evacuation area Area ratio of road blockage Evacuee density on evacuation Share of disaster weak	Collapsed building and road width Victims Share of disabled persons Open space Population

The integrated vulnerability of Tehran Municipality is shown as follows:



Source: JICA Study Team

Figure 5: Integrated Vulnerability Map

Based on the integrated vulnerability, the vulnerability level and characteristics are identified. In order to mitigate the vulnerability of existing urban structure in Tehran, the following measures could be applied:

1. Urban redevelopment
2. Road and urban infrastructure improvement
3. Area-based building construction and retrofitting
4. Individual building retrofitting and reconstruction

2.4 Community Level Activities

In order to protect life and property of the local people from earthquake damages, it is important for all disaster-related organizations–from national to community levels–to take measures in full. At the same time, individual local resident has to get a concept of self-protection, have enough knowledge of earthquake, accumulate training, learn countermeasures of disaster by experience and implement these activities at home, in the community and workplaces, etc. Furthermore, these measures for disaster preparedness can be effective if the local community cooperate, collaborate with existing community organizations such as youth association and women's groups and establish community-based groups of disaster preparedness.

For this purpose, local government will indicate the standard and regulations for appropriate and effective activities for disaster preparedness. In order to achieve those objectives, the Study Team and counterpart agency organize several workshops. such as community disaster management map making, formulation of community level disaster management plan.

The workshop plan is shown as follows:

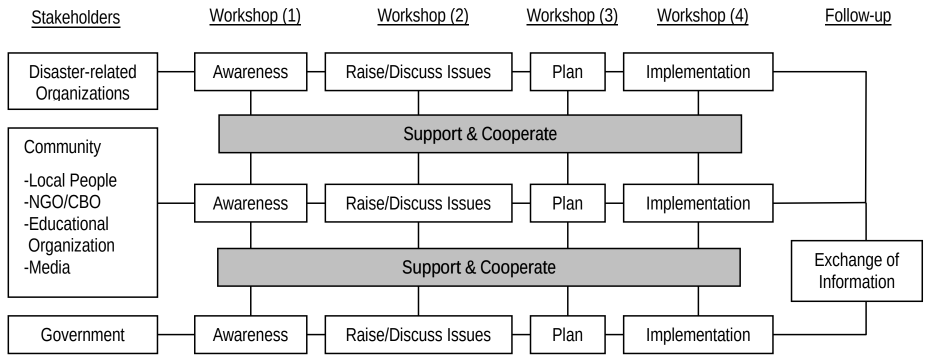


Figure 6: Workshop Schedule

2.5 Emergency Response Plan

The emergency response plan for Tehran Municipality should be established to cope with the after event. Within this Study, the following steps have been taken to formulate the plan:

- Review of existing laws and regulations;
- Identification of disaster management organization;
- Identification of responsibility for each disaster management organization;
- Review of emergency management plan for each organization; and
- Recommendation on the emergency response organization.

2.6 Formulation of Implementation Plan

Based on the master plan on seismic disaster management, a long list of project is recommended. The implementation plan is formulated. Implementation plan would include the governmental capacity for human resource and investment resources.

3. PROJECT SCHEDULE

The Study was divided into three phases: basic study and analysis, formulation of master plan on disaster prevention and management and formulation of action plan. The draft master plan will be presented in December this year and Phase 3, formulation of action plan, will be started in January 2004 and it will continue until September 2004.

4. IMPLEMENTATION ORGANIZATION

The Study has been carried out by the joint efforts of the JICA Study Team and Iranian counterpart personnel, which together form a study implementation body. The Study Team is composed of the members from Pacific Consultants International (PCI) and OYO International. The Iranian counterparts were delegated from the Tehran Disaster Prevention and Mitigation Center (TDPMC) and relevant organization from Tehran Municipality. To implement this Study, Iranian side established three committees: steering committee, technical committee and implementation committee. The figure below shows the study organization.

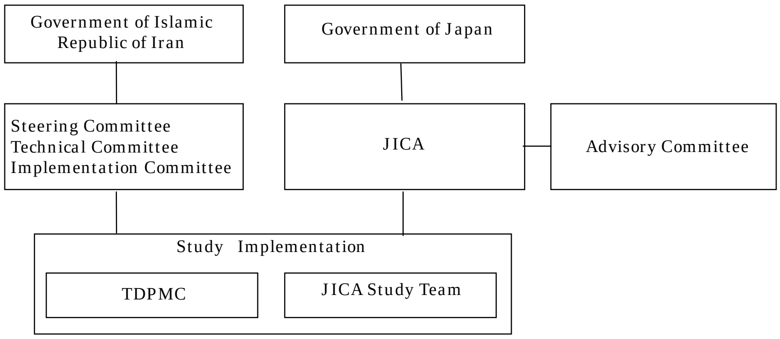


Figure 7: Study Organization

REFERENCES

1. Pacific Consultants International and OYO Corporation, 2000. *The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran*, Unpublished Report, Japan International Cooperation Agency, Japan.
2. Pacific Consultants International and OYO Corporation, 2002. *The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area Inception Report.* Unpublished Report, Japan International Cooperation Agency, Japan.
3. Building Maintenance and Management Center, ed. 1996. *Specification on Earthquake Resistance Diagnosis and Strengthening for Governmental Buildings*. Building Maintenance and Management Center, Japan.

PARTNERSHIPS TOWARDS EARTHQUAKE RISK REDUCTION: AN OVERVIEW OF ADPC ENDEAVORS

N.M.S.I. ARAMBEPOLA
Asian Disaster Preparedness Center
Thailand

"Show me the person you honor, for I know better by that the kind of person you are. For you show me what your idea of humanity is." ***Thomas Carlyle***

1. PREAMBLE

Partnerships and collaborations are shaped in mutual trust, respect and honor to embark on a journey of achievement. Partners must agree on the path to take and where it would lead them, especially when the journey itself is arduous. The quotation from Thomas Carlyle above, appears apt to describe the growing collaboration between the Asian Disaster Preparedness Center (**ADPC**), Bangkok www.adpc.net, the World Seismic Safety Initiative (**WSSI**) www.wssi.org, Earthquake Megacities Initiative (**EMI**) http://www-megacities.physik.uni-karlsruhe.de/, Risk Assessment Tools for Diagnosis of Urban Areas Against Seismic Disasters (**RADIUS**), and National Society for Earthquake Technology-Nepal (**NSET-Nepal**) www.nset.org.np towards earthquake risk reduction in the Asia-Pacific. These collaborations are amongst a series of several bi-lateral and multi-lateral partnerships that ADPC has strived to enrich towards making communities safer from natural disasters. All such collaborations have been forged with the assistance of international donor agencies (visit www.adpc.net)

All these organizations have empathy in "*reducing risk*"; "*Safer cities*", "*Education and Training*", "*Exchanging information*" "IDNDR", and "ISDR" among many other actions and strategies that lead to the reduction of the impact of earthquake (and other disasters on the part of ADPC) on communities and countries in Asia and the Pacific. A humanitarian quest of mammoth proportions to say the least!
This paper attempts to give an overview of the liaison between these institutions.

2. THE FIRST CONTACT WITH WSSI

The first contact between the two organizations ADPC and WSSI occurred at a workshop held by WSSI entitled, "Seismic Risk Management for Countries of the Asia-Pacific Region" in early February 1993 in

Bangkok. The very first initiative of the WSSI as a newly born institution. It was a beginning.

"There were participants from such nations as Bangladesh, Brunei, Malaysia, Myanmar, Nepal, Pakistan, Thailand, and Viet Nam, whose names had rarely been heard in, the international earthquake engineering community. They were waiting to be addressed to do something, although they had not participated in any international meetings of earthquake disaster mitigation before…… The greatest gain from the Bangkok Workshop was the feeling of partnership cultivated among all the participants from developed and developing countries in the field of earthquake disaster science."[1]

3. ADPC INITIATIVES IN EARTHQUAKE RISK REDUCTION

ADPC has established a Regional Consultative Committee (RCC), which brings together all national focal points for disaster management in the region. This is an appropriate forum to foster new partnerships and nourish existing ones.

Initiatives described below have come into being from partnerships established since the WSSI workshop in Bangkok referred to earlier.

The Asian Urban Disaster Mitigation Program (AUDMP) under ADPC is an eight-year program designed to respond to the need for safer cities. The ultimate goal of the program is to reduce the natural disaster vulnerability of urban populations, infrastructure, critical facilities and shelter in targeted cities throughout Asia. The purpose of the program is to:

- Establish sustainable public and private sector mechanisms for disaster mitigation that will measurably lessen loss of life, reduce the amount of physical and economic damage, and shorten the post-disaster recovery time; and

- Promote replication and adaptation of successful mitigation measures within target countries and throughout the region.

Working in conjunction with collaborating institutions in each target country, the program strategy takes a three-tiered approach viz:

National Demonstration Projects
The Information and Networking
Training, Resource Materials, and Continuing Education

4. AUDMP NATIONAL DEMONSTRATION PROJECTS FOR EARTHQUAKE RISK REDUCTION

Two projects were initiated in 1977 in Bandung, Indonesia and Kathmandu, Nepal. During the project implementation there were many indirect inputs from organizations all over the world including WSSI and EMI.

Bandung initiative (1997-2002)[2]

The implementing university, Institute of Technology, Bandung, (ITB) iudmpitb@melsa..net.id worked with the city of Bandung to prepare earthquake hazard maps and undertook a series of training and awareness raising events in the city. The project was called Indonesian Urban Disaster Mitigation Project (**IUDMP**). Four replication cities were chosen and rapid risk assessments (a new tool), were carried out by the ITB with city officials. ITB also developed an excellent training package for schoolteachers, which has been adopted by the ministry of education.
Because of generally unsettled conditions in Indonesia, it has been difficult to carry through with many of the components of the project.

Kathmandu initiative (1997-2003)[2]

The implementing NGO, **NSET-Nepal** is a dedicated professional organization whose sole objective is to study and work with earthquakes. Hazard mapping was carried out with an American partner organization, Geo Hazards International (**GHI**) www.geohaz.org, Earthquake scenarios and hazard maps were produced that demonstrated what would happen in Kathmandu if an earthquake of the magnitude of the devastating 1934 earthquake were to hit Kathmandu today. The study called the Kathmandu Valley Earthquake Risk Management Project (KVERMP) used RADIUS and has become an excellent case study for its use.

A public awareness campaign targeted on the schools and the government and local governments was carried out reaping substantial benefits.

4.1 AUDMP - The Information and Networking component

This component helped build public and private networks as a forum for exchanging information and experience on urban disaster mitigation, with the goal of replicating successful hazard mitigation practices from the demonstration projects throughout the region.

4.2 AUDMP - The Training, Resource Materials, and Continuing Education (TRMCE) component

This component provided an opportunity to further institutionalize hazard mitigation practices through seminars for national level decision makers, as well as by using an in-country and regional "train the trainers" approach for passing on technical skills via a core curriculum in hazard assessment and mitigation. The component supported the development of five new disaster mitigation courses.

The five courses are as follows:

1. Urban Disaster Mitigation Course (UDM)
2. Technological Risk Mitigation for Cities (TRMC)
3. Flood Risk Management (FRM)
4. Earthquake Vulnerability Reduction for Cities (EVRC)
5. Disaster Risk Communication (DRC)

4.3 ADPC-NSET-WSSI-EMI Collaboration for EVRC

The course development for the Earthquake Vulnerability Reduction for Cities (EVRC) saw ADPC reaching out for partnerships across the region and beyond. It was a regional course for earthquake vulnerability reduction – a first of its kind! The course builds on past and enduring endeavors such as EMI, UN, IDNDR, ISDR initiatives for RADIUS and Global Earthquake Safety Initiative (GESI) launched by UNCRD and GeoHazard International. It aspires to provide:

- Training on earthquake vulnerability reduction (EVR) strategies
- Know-how for the development of organized approaches for EVR
- Knowledge and skills for implementation of mitigation strategies
- Analysis of the need for multi-sectoral partnerships for successful implementation of EVR
- Field exposure to ongoing activities

Pak Teddy Boen of Indonesia and Prof Anand .Arya of India were the first architects of the course. At the beginning, the course name was "Seismic Vulnerability Mitigation”. Pak Teddy suggested the change to EVRC.

Focus was to draw experience from AUDMP projects in the region and hence the responsibility of content development was given to Amod Dixit of NSET-Nepal and Dr. Krishna Pribadi of IUDMP. A panel of experts (which included Dr. Fouad Bendimerad, Professor Jaminul Choudhury, Professor. Mustapha Erdik, Ms. Shirley Mattingly, Dr. P.K. Paul and other partners) were involved in the course content moderation.

The first run of the course was in Kathmandu in May 2002. It was collaboration between ADPC, NSET-Nepal, WSSI and EMI. Professor Haresh Shah of WSSI and Dr. Fouad Bedimerad of EMI, Amod Dixit of NSET-Nepal, Dr. Krishna Pribadi of IUDMP, participated as resource people with several other eminent experts and ADPC colleagues.

EVRC was conducted for the second time in November 2002 as a collaboration of ADPC, NSET-Nepal, WSSI, EMI and **ITC, Netherlands** www.itc.nl in Kathmandu. The third course was conducted in June 2003 in Dhaka, Bangladesh with **BRAC University** www.bracuniversity.net joining in the collaboration. ADPC, NSET, WSSI EMI, BRAC University and Bangladesh University of Technology, were represented in the resource panel.

The experiences and knowledge of the partners has lifted the course into recognition, winning the rapport of participants and peers.

4.4 ADB - TA

Uttaranchal initiative (November 2000 – October 2002)

This was ADPC collaboration with ADB for Technical Assistance for strengthening disaster mitigation and management in Uttar Pradesh and Uttaranchal, India

Program Components in Uttaranchal were

1: Institutional arrangements, Planning and Policy Aspects

2: Earthquake Risk Mitigation in Uttaranchal

Component on institutional arrangements focused on the following.

- Support for Establishment of Disaster Mitigation and Management Center
- Support for 6 publications (guidelines for Disaster Management Plans, Manuals for Emergencies, Warning and Evacuation, etc) by DMMC
- Study tour to Nepal, Thailand, New Zealand and Australia for 5 senior bureaucrats
- 2 District level workshops for drafting Disaster Management Plans
- 13 workshops (one per district) for public awareness and demonstration on seismic retrofitting of traditional structures
- Support for preparation of 80 Village disaster Management Action Plans and workshop for 10 village level Disaster Intervention Teams
- Production of 2 Videos (one on retrofitting for safer living and another on 'shake table' tests) produced
- Public Awareness materials and Calendars in the earthquake context produced
- Review of Building Systems in Uttaranchal, generation of Earthquake Scenario

Regional Workshop on Best Practices in Disaster Mitigation[3]

This workshop held from 24-26 September 2002 in Bali, Indonesia was collaboration between ADPC, CITYNET, UNDP, ITB, BAKORNAS PBP, ISDR and USAID. The workshop aimed to share knowledge, experiences and lessons learned on the AUDMP and showcase other disaster mitigation initiatives of city governments, non-governmental organizations and United Nation Agencies. Set in the context of Total Disaster Risk Management, the workshop focused on eight themes fundamental to urban disaster mitigation. They were

- Policy, Legal and Institutional Arrangements
- Hazard Mapping and Risk Assessment
- Capacity Building
- Mitigation Planning and Implementation
- Promoting Safer Building Construction
- Community Based Approaches
- Climate Applications and Preparedness
- Public Awareness and Social Marketing

The global community of disaster management represented the event.

4.5 Primer on Natural Disaster Risk Management for Asia

Two decades of ADPC experience has shown that a comprehensive guide on disaster management targeted for stakeholders in Asia is a crying need. AUDMP has recently embarked on the challenging task of compiling such a guide called “the Primer on Natural Disaster Risk reduction for Asia”.

The Primer would serve as a comprehensive, practical and updated resource on disaster risk management. The overall goal is to assure an appreciation for and common understanding of disaster risk management applied across all sectors and among all levels of current and potential participants in the disaster risk reduction process. The objectives of the Primer are to:

- Provide policy- and decision-makers with convincing arguments on the importance of total disaster risk management and the steps to be taken
- Serve practitioners and development workers as a state-of-the-art “how-to” guide and reference on good practices in disaster risk management in Asia
- Present professionals in related subject areas such as development planning, environmental management, integrated water resources management, geology and earthquake engineering with tested and sustainable approaches and methodologies for incorporating disaster risk management in their work.
- Contribute to the mainstreaming of a holistic approach to disaster risk management in overall development planning

Following extensive consultation with stakeholders of disaster management in a range of forums, it was agreed that the Primer would comprise of different volumes. There was consensus to start with the development of three volumes.
Volume I provide the rationale and theoretical context of a holistic approach to disaster risk management. Development is funded by USAID/OFDA.
The other volumes are hazard-specific and include “how to” guides, effective strategies, policy options, proven tools, good practices and lessons learned.
Volume II focuses on the management of slow onset flood funded by UNDP.
Volume III focuses on seismic hazards. Funding is yet uncertain.
Volumes on other hazards have been conceived but their development is dependent on funding availability.

Each volume has a consultative Advisory Group composed of regional and global experts on the specific subject area who have volunteered to serve. Hence the task has become an excellent showcase of partnership towards disaster reduction.

5. INTEGRATING DISASTER RISK REDUCTION IN ACADEMIC CURRICULA OF ASIAN UNIVERSITIES

ADPC is working with ITC-Netherlands and Institut Gegraphique National (IGN)-France in developing teaching material and case studies for the benefit of universities in the region. There are fourteen (14) universities involved in the network as at present .In this activity ADPC, ITC and IGN are in partnership with Urban planning schools to integrate risk based, mitigation planning concepts in existing teaching modules. The project is called "Capacity Building for Asia Using Information Technology Applications" (CASITA).

Hopefully further endeavors may forge a similar network for civil engineering schools to integrate safer construction in disaster prone areas.

6. A FUTURE PERSPECTIVE ON PARTNERSHIPS FOR SEISMIC RISK REDUCTION

- It is the view of ADPC that partnerships between organizations Involved in seismic risk reduction should be consolidated and nurtured. Much can happen through renewed synergism. A first step could be the participation and collaboration of all concerned in regional and global high-level meetings (HLMs).

- Such partnerships should look towards encouraging the application of risk transfer instruments in Asia such as insurance, which could bring in spillover promotion of safer construction.

- Bear influence of all organizations with a renewed focus to increase capacity building of Asian cities for earthquake response through training programs on public health emergencies, search and rescue and other relevant skills.

- Bear partnership influence to materialize an "Asia-Pacific Earthquake Safety Month Campaign" to create awareness and motivation in governments to implement earthquake risk reduction measures in their cities.

REFERENCES

1. [1]1.Katayama, T. (2003) Ten Years with the World Seismic Safety Initiative, *Regional Development Dialogue, Vol. 24, No. 1, Spring, pp. 107-114*
2. Asian Urban Disaster Mitigation Project Final Monitoring Report Submitted to USAID/OFDA, RUDO/South Asia and the Asian Disaster Preparedness Center by: Rebecca Scheurer, USAID/OFDA, Michael Lippe, Consultant, Jeanne Moulton, Consultant**,** December 2002

3. Proceedings – Regional Workshop on Best Practices in Disaster Mitigation, 24-26 September, Bali, Indonesia, ADPC 2002.

Mr. N. M. S. I Arambepola, and
Mr. A. J. Rego from ADPC, Thailand

ADRC'S ROLE IN NATURAL DISASTER REDUCTION IN ASIA

E. TSUNOZAKI and T. ISHII
Asian Disaster Reduction Center (ADRC)
Japan

ABSTRACT

The Asian Disaster Reduction Center (ADRC), established in 1998 in Kobe, is a regional center striving to a) facilitate the exchange of disaster reduction experts in Asia, b) accumulate and provide disaster reduction information, and c) carry out research into multinational disaster reduction cooperation. At the time of establishment, ADRC comprised 22 countries from Asia as member countries, 4 countries outside of Asia as advisory countries, and ADPC as an observer. In August 2000 Armenia joined as a member country, and Kyrgyz in July 2002. ADRC currently consists of 24 member countries.

ADRC's priority is to establish cooperative relationships with concerned nations and organizations in order to gather extensive and accurate information on disaster reduction, especially in the Asian region. The database on disaster reduction and other relevant information on disasters provided by member countries are available on the ADRC website (http://www.adrc.or.jp).

Capacity building of member countries as well as promotion of cooperation in disaster reduction is also a major role of the organization. ADRC hosts in its premises UN Office for Coordination of Humanitarian Affairs (OCHA) Asian Disaster Response Unit and OCHA/ReliefWeb Kobe Offices. ADRC is a member of the Inter-Agency Task Force for Disaster Reduction of the UN International Strategy for Disaster Reduction (ISDR) and promotes the implementation of ISDR in Asia.

1. INTRODUCTION

Asia is a region highly prone to natural disasters. Floods, droughts, cyclones, storm surges, earthquakes, landslides and volcanic eruptions periodically affect a large number of countries in Asia. Natural disasters in Asia take away not only thousands of human lives and immeasurable properties each year but they also are the causes of hindering sustainable development of the region. Between 1975 and 2002, 2,676 disasters occurred (38.1% of the world), killing 2,063,633 people (57.2%), affecting more than 4.2 billion people (89.2%), and causing more than 480 billion US$ economic losses (50.0%). (Source: ADRC based on CRED-EM-DAT, 2001) In many countries in Asia, a single disaster could cause damage of more than the annual GDP of the country, as the case of the earthquake in Armenia in 1988 shows. The damage caused by the earthquake was 20.5 billion US$ and the GDP of the country of the same year was 11.65 billion US$. (Source: ADRC based on CRED-EM-DAT data base, 2002, HDI of UNDP, and World Bank, 2002)

The necessity of regional organizations for disaster reduction was stressed in the "Yokohama Strategy" adopted at the 1994 World Conference on Natural Disaster Reduction held in Yokohama, Japan. In 1995, after the Great Hanshin-Awaji Earthquake, a ministerial-level "Asian Natural Disaster Reduction Conference" was held in Kobe for Asian countries, at which the "Kobe Declaration" was adopted. The "Kobe Declaration on Natural Disaster Reduction" includes an agreement to consider a creation of a "system which has the functions of a disaster-reduction center for the Asian region". A series of meetings followed and in the "Chairperson's Summary" of the Asian Disaster-reduction Cooperation Promotion Meeting held on 16-17 June 1997 where 20 Asian countries participated, the establishment of a center to serve as a secretariat of a "system which has the functions of a disaster-reduction center for the Asian region" was agreed.

2. ESTABLISHMENT OF THE ASIAN DISASTER REDUCTION CENTER (ADRC)

ADRC was then established on 30 July 1998 in Kobe, Japan to facilitate exchange of disaster reduction experts from each country and concerned bodies, to accumulate and provide disaster reduction information, and to carry out research into multinational disaster reduction cooperation as the focus of this initiative. At the time of establishment, ADRC comprised 22 Asian countries as member countries, 4 countries outside of Asia as advisory countries, and ADPC as an observer organization. In August 2000, Armenia joined as a member country and Kyrgyz joined, also as a member country, in July 2002. ADRC currently consists of 24 member countries.

24 member countries: Armenia, Bangladesh, Cambodia, China, India, Indonesia, Japan, Kazakhstan, Kyrgyz, Laos, Malaysia, Mongolia, Myanmar, Nepal, Papua New Guinea, Philippines, Republic of Korea, Russia, Singapore, Sri Lanka, Tajikistan, Thailand, Uzbekistan and Viet Nam
4 advisory countries: Australia, France, New Zealand and Switzerland
1 observer: Asian Disaster Preparedness Center (ADPC) in Bangkok, Thailand

3. POLICY OF ADRC

ADRC operates as a center for sharing disaster reduction information in Asian region. ADRC has pursued the following basic goals since its inception.

3.1 Information Sharing

ADRC provides information related to disasters, disaster reduction initiatives, training and education in disaster reduction and emergency drills, disaster reduction technology, and human resources for disaster reduction. ADRC holds regular meetings for government officers in charge of disaster reduction and for experts involved in disaster reduction in member countries and promotes international cooperation in disaster reduction efforts. ADRC receives a limited number of visiting researchers from member countries.

3.2 Capacity Building in Member Countries

In order for member countries to build their disaster reduction capacity, ADRC imparts awareness, education and training programs with them, in cooperation with regional and international organizations, and disseminates results and outcomes to other member countries. ADRC also promotes public awareness programs to raise capacity of communities in member countries through active community participation.

3.3 Cooperation

ADRC promotes cooperation in disaster reduction activities with member countries as well as with national, regional and international organizations, networks and programs. ADRC is a member of the Inter-Agency Task Force for Disaster Reduction of the UN International Strategy for Disaster Reduction (ISDR) and promotes the implementation of ISDR in Asia. ADRC hosts in its premises the OCHA Asian Disaster Response Unit (ADRU) and OCHA-ReliefWeb and conducts joint activities.

4. ROLE AND ACTIVITIES OF ADRC

4.1 Information Sharing

It is of utmost importance for ADRC to establish cooperative relationships with concerned nations and organizations in order to gather extensive and accurate data on disaster reduction for use and dissemination in the Asian region. This being the priority of the organization, ADRC strives to build networks of information and human resources related to disaster reduction by participating in international meetings, visiting various countries to conduct surveys, welcoming researchers for study programs, and holding an ADRC meeting every year for member countries, advisor countries, and regional and international organizations.

ADRC develops a database of disaster reduction systems and other relevant information provided by member countries, which are available on the ADRC website (http://www.adrc.or.jp). ADRC has created a geographical information system for disaster management called VENTEN (http://venten.adrc.or.jp) in order to provide accurate data of disasters with disaster management information including basic geographical map information of Asian region.

ADRC has also developed, in collaboration with the Centre for Research on the Epidemiology of Disaster, Louvain Catholic University (CRED) and OCHA-ReliefWeb, a globally common unique identification code for disasters called GLIDE (Global IDEntifier Number) in order to easily identify and access disaster information. FAO, OFDA/USAID, the NOAA Office of Global Programs (OGP) and the World Bank also joined in the initiative. A GLIDE number is issued every week by EM-DAT at CRED for all new disaster events that meet the EM-DAT criteria (see http://www.cred.be). Ways to cover disasters that fall out of EM-DAT criteria are being sought and will be provided in due course. The GLIDE numbers are now used by ReliefWeb, ADRC and CRED in all documents. As more information suppliers join in this initiative, documents and data pertaining to specific events would be more easily retrieved from various sources, or linked together using the unique GLIDE numbers. ADRC has prepared a specific website for GLIDE (http://glidenumber.net/). Currently, ReliefWeb, ADRC and La Red are developing an automatic GLIDE generator, which will start its function early 2004 to respond to the growing demand for the real-time issuance of GLIDE number for prompt and wider information sharing.

Furthermore, ADRC launched a joint international project in cooperation with the UN Office for the Coordination of Humanitarian Affairs (OCHA), aiming at reinforcing disaster management in Asian region by building a cooperative framework for disaster reduction and response. As a part of this initiative, ADRC hosts the OCHA Asian Disaster Response Unit (ADRU) within the premises of ADRC since February 1999. In August 2001, the OCHA-ReliefWeb Kobe Office started their operations for better provision and sharing of humanitarian and disaster relief information over the Internet.

In cooperation with OCHA-ADRU, ADRC developed and advocates for the “Total Disaster Risk Management” approach and organized meetings with the support from the ASEAN Foundation, Government of Japan, UNESCO, UNU, USAID and other partner organizations to strengthen capacity in disaster risk management among member countries. The TDRM approach looks at the entire cycle of disasters, involves all sectors and disciplines of societies and communities in disaster management and encourages partnership to reduce risk and vulnerability to natural hazards.

ADRC and OCHA-ADRU also conducted jointly a workshop in February 2002 in Kobe to establish a network and cooperative relationship among NGOs of Asian countries in disaster reduction and response. Based on the decision taken at the workshop, ADRC and OCHA-ADRU are serving as the host for the network called Asian Disaster Reduction and Response Network (ADRRN). The ADRRN is to be reviewed at the International Conference on Total Disaster Risk Management (TDRM) held in Kobe on 1 December 2003 to develop the network to be further proactive.

4.2 Capacity Building

ADRC has launched and supported financially and technically cooperative projects with member countries to build capacity in disaster reduction, based on the needs of each country. These projects include awareness raising programs, development of educational programs, community-based flood disaster mitigation project, and activities to increase skills for emergency search and rescue training program.

One of the successful cooperative projects was carried out in Papua New Guinea where it is highly susceptible to tsunamis. The tsunami, which struck the Aitape region immediately after the earthquake of seven on the Richter scale and with the epicenter only 30 kilometers from the coast in 1998, claimed more than 2,200 lives. While the country had experienced many tsunamis, previous experience was not passed on to new generations. ADRC, with the knowledge acquired from the Japanese experiences, produced posters and pamphlets (Figure 1) in both English and local languages and with pictures and illustrations, and distributed them widely to the inhabitants of PNG. The dissemination was further supported by the PNG National Red Cross Society. The lesson to beware of tsunamis when an earthquake occurs and to seek refuge on higher ground spread to the country. An earthquake of eight on the Richter scale affected a wide area of north-east PNG in November 2000. However, while it created a tsunami that destroyed thousands of houses, there were no deaths thanks to the timely evacuation.

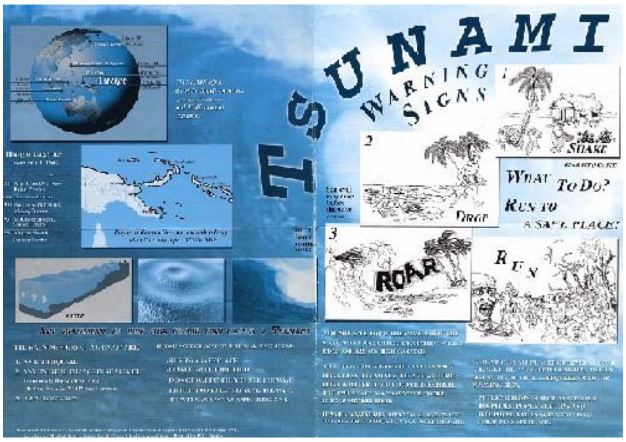


Figure 1: Tsunami awareness poster developed for PNG

After the devastating earthquake that hit the state of Gujarat, India on 26 January 2001, ADRC conducted a multinational investigation mission in Gujarat in June 2001. The investigation group was composed of disaster reduction specialists from several member countries and one advisory country, and was supported by the Indian Government. The main purposes were to inspect the affected areas and to learn lessons from the earthquake disaster to utilize and reflect in the future to plan disaster reduction measures in their own countries. Another purpose of the mission was, in return, for the member countries to propose knowledge and expertise to reconstruct the stricken areas and to reduce future disasters.

A school educational program for disaster reduction was developed in cooperation with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and Asia/Pacific Cultural Center for UNESCO (ACCU) in 2001 to raise awareness and improve preparedness for disasters, in particular geological hazards which the Philippines Archipelago frequently faces. A workshop was held on 1-17 December 2001 in Manila which produced a framework of curriculum for school education on disaster reduction. (Figure 2) ADRC emphasized the importance of raising disaster awareness through school education and the need to stipulate it in the policy.

Figure 2: Disaster drill at school in the Philippines

The urban search-and-rescue training project, conducted with the Singapore Civil Defense Force in October 2001 and November 2002, aimed at building Urban Search And Rescue (USAR) capacity, using the resources owned by a member country to meet the needs of other member countries. The next USAR training seminar with the Singapore Civil Defense Force will be held in January 2004.

ADRC supported, in cooperation with OCHA-ADRU, the seminar for the Improvement of Early Warning System and Response, organized in Bangladesh on 19-24 December 2002 by the Bangladesh Public Administration Training Center (BPATC) and Ministry of Disaster Management and Relief. The seminar was held to enhance the early warning system and to promote close coordination among all stakeholders of disaster management in early warning and response.

The National Disaster Management Office of the Lao People’s Democratic Republic organized the Disaster Reduction Training for Media Staff, co-sponsored by ADRC and OCHA-ADRU, on 4-7 February 2003 to develop collaboration among all stakeholders in disaster management, in particular, collaboration between the Media and other sectors to enhance disaster reduction capacity. The importance of the role of the Media in disaster reduction was emphasized at the training.

In March and May 2003 the Cambodia National Committee for Disaster Management (NCDM) and ADRC co-organized a series of provincial disaster management training workshops with the support of the Cabinet Office of Japan and the ASEAN Foundation. The program aimed to enhance participants' ability to assess disaster damage and needs, and their capacity to provide information at the local level in the case of floods and droughts, which have heavily affected Cambodia in recent years.

Since 2000, ADRC has conducted a seminar on disaster management every year based on a request by the Japan International Cooperation Agency (JICA) and with its support in order to improve disaster management capacity of participating countries. Participants of the seminar are not only from ADRC member countries and come from all regions of the world. The program of the seminar builds on the experiences of Japan in disaster management and tries to transfer knowledge and expertise to other parts of the world.

Building on the experience of the JICA training seminars held in the past, ADRC will carry out a training seminar in Kobe on disaster management for Central Asia and Caucasus to be supported by JICA, starting in 2004. The seminar will be conducted in Russian language, which will facilitate the discussion among government officers responsible for disaster management from the regions. ADRC was invited to participate in a survey mission to Central Asia and Caucasus in September 2003 to identify the status and needs in disaster management of the regions. The findings of the survey mission will be reflected in the program of the training seminar, which should help build capacity of the regions in disaster management.

ADRC has been invited in 2003 by JICA to participate in a series of missions in Turkey to: a) review roles of government officers responsible for disaster management, b) identify outstanding challenges in disaster management, and c) make recommendations on a training course for governors on disaster management. (Figure 3) ADRC stressed the importance of introducing a holistic approach to disaster management, taking into consideration all phases of disasters, i.e. prevention/mitigation, preparedness, response, and recovery/reconstruction. It was recommended to the Turkish government that the TDRM approach be adapted in Turkey with focus on promoting the reinforcement of buildings and public awareness programs & disaster education in schools.

4.3 Cooperation

ADRC cooperates with national, regional and international organizations, networks and programs, among others, ADPC, ASEAN Foundation, CRED, Earthquakes and Megacities Initiative (EMI), Global Disaster Information Network (GDIN), International Federation of Red Cross and Red Crescent Societies (IFRC), International Institute of Earthquake Engineering and Seismology (IIEES), Japan International Cooperation Agency (JICA), Typhoon Committee, UN Centre for Regional Development (UNCRD), UN-ESCAP, UNESCO, UN-HABITAT, UN International

Strategy for Disaster Reduction (UN-ISDR), UN-OCHA, UN-OCHA/ReliefWeb, USAID, UNU, WHO, WMO and World Seismic Safety Initiative (WSSI).

Figure 3: Visit to the Turkish Red Crescent in Ankara

Since April 2002, ADRC is a member of the Inter-Agency Task Force for Disaster Reduction for ISDR. ADRC provided financial and technical assistance, together with the Japanese Government, to the initiative by the ISDR Secretariat to develop "Living with Risk – a global review of disaster reduction initiatives", which was launched on 9 August 2002 in Tokyo.

ADRC and the ISDR Secretariat co-organized a session entitled "Living with Risk – towards effective disaster reduction", on the occasion of the Third World Water Forum (WWF3) held in Kyoto on 19 March 2003 to explore the linkage between disaster reduction and the water agenda, to follow up the WSSD, and to integrate risk and vulnerability reduction of water-related disasters into water management policies and initiatives.

On 4 October 2003, ADRC co-organized a public forum in Tokyo entitled "Living with Risk –Are We Prepared for the Next Big One?" with UNU, Cabinet Office of Japan, WSSI, and ISDR, in active cooperation with NHK (Japan Broadcasting Corporation), to discuss the current status of earthquake disaster preparedness in Japan with a view to raise awareness of earthquake disasters among the general public. The Forum was held on the occasion of the 80th anniversary of the Great Kanto Earthquake and the International Day for Disaster Reduction, inviting four internationally renowned experts to address the pressing needs in earthquake disaster reduction.

Cooperation between ADRC and OCHA is not limited to the development and implementation of cooperative projects developed by the two organizations. ADRC supported the United Nations Disaster Assessment and Coordination (UNDAC) Asian Induction Course held in March 2003 in Kobe and the International Search and Rescue Advisory Group (INSARAG) Asian Meeting held in November 2003 in Kobe to strengthen the capacity in disaster response and to enhance cooperation among concerned organizations.

5. TOTAL DISASTER RISK MANAGEMENT (TDRM)

The Total Disaster Risk Management (TDRM), developed by OCHA-ADRU and ADRC, builds on the gains of the IDNDR and ISDR, and other relevant endeavors, integrating and complementing existing knowledge and techniques on disaster reduction and risk management.

With the aim to promote TDRM and to build capacity in disaster risk management in a holistic way, ADRC and OCHA-ADRU co-organized a series of workshops. The first workshop held in August 2002 in Kobe was intended to improve the awareness of disaster reduction of national governments. The second workshop held in June 2003, also in Kobe, was intended to enhance and institutionalize the capacity in the TDRM approach in Asia, particularly in the critical issues such as hazard mapping, vulnerability and risk assessment, and damage and needs assessment.

ADRC and OCHA-ADRU are co-organizing the Asian International Conference on Total Disaster Risk Management on 2-4 December 2003 in Kobe, supported by our major partners. The Conference is the fourth in a series of multilateral and multi-sectoral forum that promotes the TDRM Approach. Following the conference-workshops that introduced TDRM Approach to delegates of NGOs and national focal points for disaster reduction and response of Asian countries, this Conference intends to further promote TDRM among non-traditional yet critical stakeholders and exponents of disaster reduction. Essentially, it aims to develop among all concerned sectors a strategic understanding of how to integrate TDRM into the national planning process and disaster reduction and response systems of the participating countries towards sustainable development. The Conference is expected not only to advance the promotion of the TDRM approach, but it is also expected to contribute to achieving sustainable development in Asia through holistic and effective management of disaster risks.

6. WORLD CONFERENCE ON DISASTER REDUCTION (January 2005, Kobe)

Owing to the background of its inception, ADRC attaches special importance to the review of the Yokohama Strategy and Plan of Action, which the ISDR Secretariat is carrying out, and is committed to contribute to the process leading up to the consolidating event, World Conference on Disaster Reduction, to be held in Kobe, Hyogo in January 2005. (Year 2005 will mark the 10th anniversary of the Great Hanshin-Awaji Earthquake.) In this context, ADRC supported the session "Effective Early Warning - use of hazard maps as a tool for effective risk communication among policy makers and communities –", organized by the Government of Japan on the occasion of the Second International Conference on Early Warning (EWCII) held on

16-18 October 2003 in Bonn, hosted by the Government of Germany. (Figure 4)

Figure 4: Session on hazard mapping organized by the Government of Japan at EWCII, Bonn, Germany

ADRC supported the First ISDR Asian Meeting held in January 2002 in New Delhi, India, convened by the Governments of India and Japan and co-organized by the ISDR Secretariat, to discuss and promote ISDR with an aim to achieve sustainable development in Asia. ADRC also supported the Second ISDR Asian Meeting held in the context of the Asian Conference on Disaster Reduction 2003 held in Kobe to promote further discussions on the subject. The Third ISDR Asian Meeting is going to be held, co-organized by the ISDR Secretariat and the Governments of Cambodia and Japan, supported by ADRC, on 6 February 2004 in Siem Reap, Cambodia, preceded by the sixth ADRC International Meeting (4-5 February).

7. COMMUNITY BASED HAZARD MAPPING - A SIMPLE AND EASY-TO-UNDERSTAND TOOL FOR PUBLIC AWARENESS

ADRC, with an aim to contribute to the three main goals of the organization described above; information sharing, capacity building and cooperation, implements public awareness programs to strengthen capacity of communities in disaster reduction. TDRM workshop held in June 2003 and the session organized in the context of EWCII in October 2003 on hazard maps emphasized the importance of hazard maps as a simple tool to improve disaster preparedness.

Hazard maps have been recognized as an instrument for disaster management in many countries in recent years. However, most of them are literally hazard maps indicating only dangerous spots and not useful for disaster reduction. It should also be noted that in many countries hazard maps developed by the national and local governments are not distributed to the members of the community.

In March 2003, Ministry of Land, Infrastructure and Transport, Japan developed a "Flood Hazard Map Manual for technology transfer". Utilizing the manual, ADRC developed a tool for "Community Based Flood Hazard Mapping" in cooperation with Fuji Tokoha University. It is a simple and cost effective tool to develop public awareness involving active participation of the community. The tool was developed bearing in mind that, in order to raise public awareness and to ensure smooth evacuation at an imminent flood or other disaster event, maps must be user-friendly and easy-to-understand for the community.

To ensure smooth evacuation in case of a flood, hazard maps need to include not only inundation areas and depth but also information such as:

- Evacuation centers & routes,
- Disaster management center,
- Dangerous spots,
- Communication channels and systems,
- Evacuation criteria,
- Tips for evacuation including emergency kits and other items needed in evacuation, and
- Mechanism and symptoms of hazards.

According to a survey recently conducted in Japan, among the residents who evacuated, those who had seen such hazard maps were 1.5 times more in number and they evacuated one hour earlier than those who have not. (Figure 5) In case of an acute disaster such as a flash flood, the difference would be a critical determinant in evacuation.

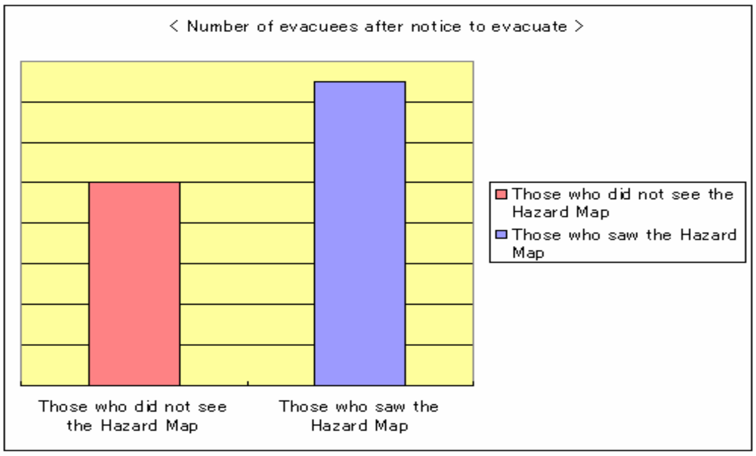


Figure 5: Results of survey on hazard map

The community must be provided with relevant information regarding hazard maps and how to utilize them. Most importantly, it depends on the level of awareness of the community how effectively hazard maps are used. The members of the community must be taught how to understand potential disasters in the community from the map to take appropriate countermeasures.

Figure 6: Walking in the community to understand possible risks

For this purpose, ADRC is advocating an approach whereby the community itself develops a hazard map through the following steps:

1) Members of the community along with experts and local government officials walk around the town or village to find out about, among others, "inundation areas", "evacuation centers & routes", "expected problems in disaster management activities", "disaster related facilities" and "communication channels". (Figure 6)
2) Transfer the field observation and information onto a map using different colors to be visually understandable. (Figure 7)
3) Discuss among the participants about the "possible disasters", "problems to be expected in disasters" and "possible countermeasures".

Figure 7: Making our own hazard map

It takes only one day and we only need a map, a camera and color pens. Through lively discussion, members of the community can find out about their problems with regard to disasters and countermeasures.

The method described above for floods to strengthen disaster preparedness through risk communication among the members of the community can be adapted to other types of disasters such as earthquake and tsunami disasters. ADRC has conducted several projects to develop tsunami evacuation plans with active community involvement in Japan and member countries.

ADRC intends to further promote this simple tool for effective risk communication in member countries in Asia by adapting it by disaster types and to the specific conditions of each country for effective disaster reduction.

Ms. E. Tsunozaki and Mr. T. Ishii from
Asian Disaster Reduction Center (ADRC)

Moments from the Workshop…

Dr. N. H. Phuong from Vietnam with Dr. W. Dong, USA

Dr. D. Dutta, Prof. K. Meguro with Dr. Pennung Warnitchai

Mr. U. T. Myint from Myanmar with Prof. T. C. Pan from Singapore, Member, WSSI Board of Directors

ATTITUDINAL CHANGE FOR RISK REDUCTION ACTIONS

R. SHAW
United Nations Centre for Regional Development
Japan

ABSTRACT

This paper describes author's experiences over last several years in the earthquake risk reduction in both developed and developing countries. The key question was "how to motivate a person to implement risk reduction actions?" A questionnaire survey of high school students in Japan revealed that while 60-70% of students had undergone disaster education in school, only 20-30% of them took risk reduction actions. The survey also pointed out the importance of the community and family in the disaster education, especially in implementing risk reduction actions.

Two examples from Kobe and Gujarat suggested that community played an important role in the reconstruction process after the earthquake. It was concluded that two levels of actions are needed to make attitudinal change for risk reduction: one at the international level, linking earthquake issues with the sustainable development and human security. The other actions should be at local level, through community and family, promoting a culture of preparedness. The paper also urges the important role WSSI can play at both level.

1. INTRODUCTION

Two major issues related to earthquake disaster pose the real challenge to the earthquake professionals. The first one is the nature of the event, which, unlike flood or typhoon, cannot be predicted in advance. The other issue is its occurrence, which, again unlike other events, occurs once in 10 or 50 or even 100 years. Thus, the priorities of preparing for the earthquake disaster in advance is relatively low in many countries. For the developing countries, while the post-disaster reconstruction exercise provides an opportunity for development, pre-disaster preparedness and mitigation measures are the only solution for earthquake risk reduction. However, the painful question is: 'how to motivate an individual and/or community to take pre-disaster risk reduction actions'?

This question is not only critical for the developing countries, but also found to be relevant for the developed country like Japan, which has a high risk of earthquake, experiences of major earthquake disasters, and significant technical expertise and resources. Still the question arises: 'Is Japan prepared for the next big one?' The same question will possibly be valid for other developed countries, and obviously for the developing countries as well.

The author conducted a survey of school children in Japan to understand the effect of education and experiences on earthquake risk perception and the relation of risk perception and risk reduction actions. The author was also involved in several projects in the developing country for pre-disaster preparedness and post-disaster reconstruction exercises. In this paper, the outcomes of the survey and the projects are analyzed to address the key issue: what makes an individual to take risk reduction action. In this paper, two post-disaster reconstruction experiences are described, one from developed country (The Kobe earthquake of Japan), and the other from developing country (the Gujarat Earthquake of India). Beside, the United Nations (UN) initiatives on pre-disaster preparedness are analyzed, and finally, a few words have been stated on the future direction of earthquake risk reduction initiatives.

2. THE KOBE EARTHQUAKE AND ITS AFTERMATH

2.1 Background

The Kobe Earthquake (which is also known as '*The Great Hanshin-Awaji Earthquake*' or '*The Hyogo-ken Nanbu Earthquake*') with a magnitude of 7.2 in the Richter scale, and a depth of 16 km hit the city of Kobe and its surrounding areas in the Hyogo Prefecture on January 17, 1995 at 5:46. Total number of casualty crossed 6,400, with numerous injuries and victims of other collateral damages. Buildings and infrastructures were severely damaged, and more than 200,000 people had to find temporary shelter in different parts of the city. Only within Kobe city administrative area, 70,000 buildings were completely collapsed, and 55,000 were seriously damaged. Public facilities like city offices, schools and hospitals were also damaged extensively, which made the city services paralyzed for several days. Utility services were also interrupted: electricity service was out of order in the entire metropolitan area, 25% of the telephone services did not work, water and gas services were disrupted in the entire city. At several locations, severe fire broke out, and 7,000 buildings were completely burnt in fire, resulting more than 800,000 sq m. of burnt areas. The damage to social and industrial capital stock was estimated at 7 trillion Japanese Yen within the Kobe city. Secondary and tertiary losses in the city and other parts of the province were much higher.

Immediately after the earthquake, most of the people were helped and rescued by their friends, families and neighbors. A case study in the Nishi Suma Area, one of the worst affected areas, pointed out that 60% people were evacuated by themselves, and approximately 10% was rescued by the neighbors (Tsunehiro et al. 2003). This data indicate the importance of the community and neighbor in immediate rescue operation. The main reasons of effectiveness of local people in rescue operation, as appeared from the interview, are: 1) information and knowledge of the community, 2) leadership within the informal and formal community based organizations, and 3) availability of small tools for rescue operation such as saws and crowbars. The same phenomena were observed after the Marmara Earthquake of 1999 in Turkey and Gujarat Earthquake of 2001 in India (Jalali 2002, Shaw 2003).

After the rescue, came the relief and rehabilitation phase, where hundreds of volunteers gathered from different parts of Japan. Different organizations/ voluntary groups had their coordination centers focusing on different parts of the affected areas. Needless to say, the prefecture, city and local governments had their coordination centers as well. In some places, they had cooperation with the NGO networks, in some places they acted independently. The effectiveness of the coordinated NGO network has been observed in other countries like Turkey, where a rescue NGO called AKUT was turned into the coordination center for relief distribution of the government. The same pattern was observed after the Gujarat earthquake of 2001 in India, where the NGO network called Abhiyan played a significant role in information dissemination among the government, non-government and international organizations (Shaw 2003).

The relief phase was followed by the reconstruction phase, where the government took the leadership. Out of the different activities, the creation of the temporary shelters, identifying special zoning areas, restoration of lifelines and infrastructures were the priority issues. From the government perspective, the reconstruction phase persisted for three to five years, until the housing and infrastructures were reconstructed. However, according to the people's perspective, this stage is till continuing, even when the city is entering into the 10^{th} year after the earthquake (Shaw and Goda, in press).

2.2 Issues after the Kobe Earthquake

Issues after the Kobe Earthquake can be divided into two major parts: 1) Local issues related to the reconstruction of Kobe and adjoining areas, and 2) National issues related to future earthquake risk reduction strategies.

In the city (Kobe and other affected cities) and prefecture (Hyogo prefecture), after the earthquake, rehabilitation projects were carried out, focusing mainly on infrastructure restoration. Victims' individual requests were not met because the government took a "no personal compensation" policy at that time. The restoration of lifelines, railways, roads and harbors were focused, and were restored to their previous state within three years. The fact that sufficient assistance was not provided to each victim had harmful effects. Kobe has been stagnant at "80%" recovery since 3 years after the earthquake. "80% rehabilitation" means that urban infrastructure has been fully recovered, however, victims' lives and livelihood have not. This situation was influenced strongly by the fact that the damages were concentrated in the weakest groups and that local communities were unable to become active due to bad socio-economic conditions.

Downtown Kobe had lots of old residence where people used to live together and had strong community bonds. Shifting this group of communities to temporary shelters posed a threat to the community link. Consequently, there were problems in adjustment with new clusters of people in the temporary shelters. Thus, interpersonal relationships did not developed in the temporary shelters. The relatively high percentage of aged people contributed to this issue.

In many local governments, rehabilitation plans approved by the administration were different from what people wanted. For example, only a single-track plan was prepared by the administration for housing: "shelters → temporary housing → permanent housing". However, there were many cases, where victims were at the end of their resources due to constraints in funds, systems and rules. Such a gap in understanding between the administration and the people can be seen in one-sided decisions regarding urban planning during the chaos after the earthquake, and on the promotion of big projects such as Kobe airport. These decisions have resulted in distrust by people toward the administration. The reason for such a situation is that there was no partnership between the administration and the people before the earthquake. In one hand, administration was forceful in decision-making, and in the other hand, the people were too dependent on the administration.

In the national level, issues were more complex, similar to many other parts of the world. On the engineering perspective, there were significant focus on the revising the standard and codes for buildings and infrastructures, incorporating the experiences of damages of the earthquake. Many studies funded by national and provincial governments were started focusing on detection of active faults and geological and geophysical surveys across the country as well as through deep-sea boring surveys. Seismic microzonation and establishment of real time data acquisition system were done in the all the prefectures of Japan within five years after the earthquake. Seismic data collections networks have been upgraded throughout the country. Disaster management control rooms were established and/or upgraded in many prefectures, and coordination mechanism with the emergency services and lifeline services were enhanced.

On the social side, three major changes were observed after the Kobe Earthquake: 1) Increase in the voluntary and non-government activities all-over Japan, 2) Increase of community initiatives, and 3) Increase of multi-disciplinary cooperation, and increasing stress on the social studies to understand the root causes of the earthquake disasters. One year after the earthquake, Hanshin/Awaji Community Fund (HACF) was established in May 1996. Initial amount of the fund was 800 million yen (approximately 8 million US$), which was supposed to spend in three years through three different types of grants: community redevelopment program, philanthropy programs, and NPO activities. In the same year (1996), Japan NPO Center was established to support NPO all over Japan. Nowadays, many similar organizations have been established to support the activities of smaller NPO. After the earthquake, a new law was enacted in 1998: 'Law to Promote

Specified Nonprofit Activities'. While citizens of Kobe and victims of the area did not have time to join in lobbying this law, they were more interested to lobby for the financial assistance, which in turn lead to the enactment of another law: 'Law to Support Disaster Victims' in 1998. The spirit of civil society activities, which gained a high momentum in Kobe earthquake, continued in the environmental disasters in the following years, like the Oil Spill in the Sea of Japan and Tokyo Bay in 1997, where thousands of voluntary groups helped each other to restore the environmental degradation of the sea. The consequences of the Kobe Earthquake made two new realities (Tatsuki and Hayashi 1999): an emerging sense of self-governance, and stronger sense of community solidarity.

2.3 Earthquake Risk Perceptions and Risk Reduction Actions

From the experiences of the Kobe Earthquake, it was observed that many people were rescued by their friends, families and neighbors, particularly in the places, where the community ties were strong (Shaw and Goda, in press). Also, the neighborhoods, which had higher social capital, the reconstruction and rehabilitation were smooth and faster, with better collective decision making among the communities and better cooperation of the community and local government (Nakagawa, 2003). Thus, the lesson is that community and individual awareness are important, and to sustain the community initiatives is crucial to achieve a safer and sustainable society. Culture of disaster preparedness plays an important role in this regard. To build this culture, education is one of the key tools, and thus focusing the school children is considered as an essential element to understand the development of the culture. To understand the direction of education for effective earthquake risk reduction actions, a survey was undertaken with the first grade high school students 15-16 years) in five prefectures of Japan: Aichi, Hyogo, Osaka, Shizuoka and Wakayama. Among these prefectures, Hyogo and Osaka have experienced the damages due to the Kobe earthquake, while Aichi, Shizuoka and Wakayama are expecting a big earthquake called Tokai Earthquake. In total, there were 28 classes from 12 schools, and total number of students was 1065.

A set of questionnaires was prepared based on a model as shown in Figure 1 (Shaw et al., in press). In the model, knowledge, awareness and code of conduct are perceived in the sequence of: Knowing, Realizing, Deepening, Decision, and Action, as the gradual change in behavior from knowing to code of conduct. Knowledge comes from two sources: experience and education. Experience here denotes not only experiences of damaging earthquakes, but also general experience of earthquake. Education has four parts: school, family, community and self-education. School education is divided into two parts: education from teachers (S), and pro-active education with participation of teachers and students (ST). Family education (F) originates from parents, and other family members. Community education (C) is related to education in the neighborhood, community organizations, NGO activities, research workers, and voluntary activities etc. Self education (Se) is acquired from books, internet, newspaper, TV and other sources through student's own initiative. All these lead to 'Knowing' about earthquakes and its impacts.

The next step after 'Knowing' is 'Realizing', which is denoted as Perception (Figure 1). After 'Realizing', comes 'Deepening', which is divided into two parts: Deepening A (which is considered as wish to deepen the knowledge), and Deepening B (which is considered as actual deepening). The next step is 'Decision', which is the wish to take action and disseminate knowledge, denoted as Preparedness A and Dissemination A respectively. 'Acton' comes after it, which are Preparedness B and Dissemination B. In summary, the steps described below has the following meaning:

Knowledge:	Sources of information and knowledge about earthquake and its Impacts
Perception:	Realizing about the earthquakes and its possible Counter measures
Deepening A:	Intending to deepening understanding of earthquake risk
Deepening B:	Deepening understanding of earthquake risk.
Preparedness A:	Intending to take action on preparedness for earthquake
Preparedness B:	Actions to prepare for earthquake/ mitigation measures
Dissemination A:	Intending to disseminate earthquake information and Experiences
Dissemination B:	Disseminate earthquake information and experiences

Thus, through this model gradual change in student's behavior is visualized, from knowing through realizing and deepening and ultimately brining it to code of conduct (action). The gap between the knowledge and code of conduct is actual challenge for earthquake disaster, and it is related to the risk perception and other socio-economic-cultural issues, which are described in the earlier section.

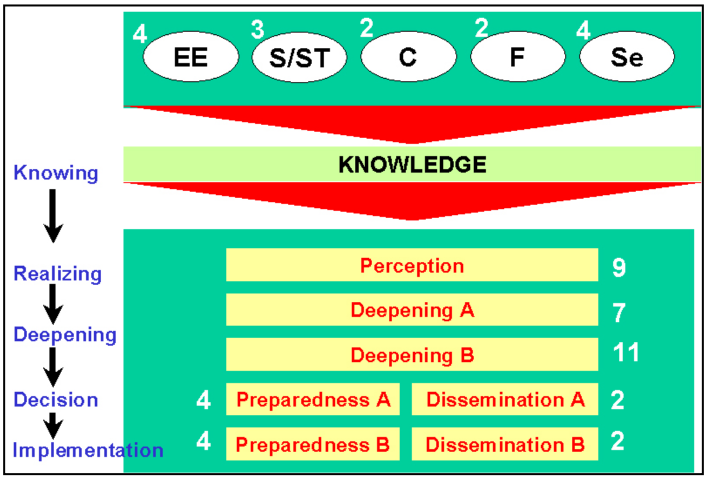


Figure 1: Model showing the concept of survey. EE: Earthquake experience, S/ST: School education/active school education, C: Community education, F: Family education,

Se: Self-education. Numbers show the numbers of questions for each category. For Deepening, Preparedness and Dissemination, 'A' stands for 'wish', and 'B' stands for 'reality'.

Analysis was done by cross tabulation with earthquake experiences and education. Details of each analysis are described in Shaw et al. (in press). The degree of effect of one factor on other is calculated, and the process is repeated for each set of questions for experience and education. Picking up the maximum values from each set of questions (experience, and different sources of education (S, ST, C, F, and Se), a graph is produced showing the effects of experience and education on perception of earthquake risk. This shows that school education (S) and self-education (Se) has the most prominent effect on perception, followed by active education in school (ST) and earthquake experiences (EE). Similar exercises were conducted for other sets of parameters: Deepening A, B, Preparedness A, B, and Dissemination A and B. Integrated results are shown in Figure 2.

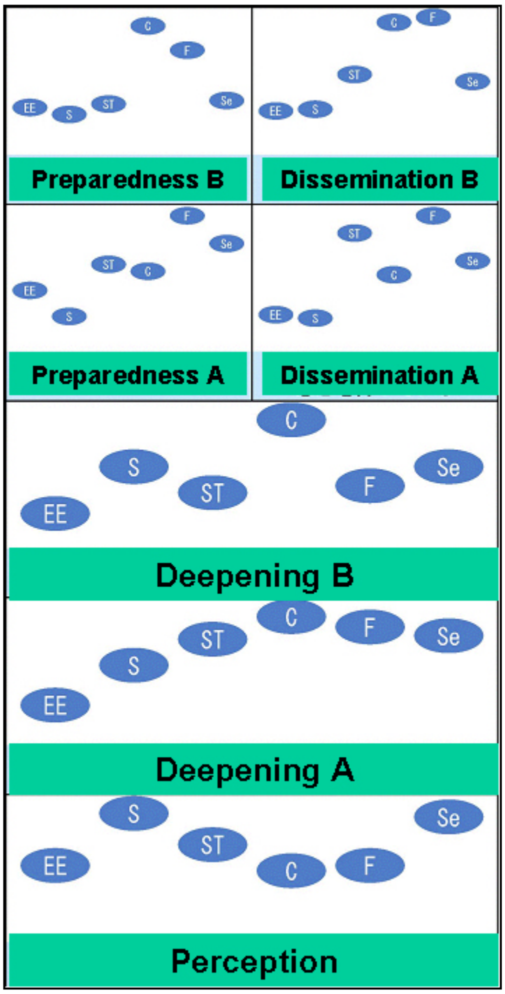


Figure 2: Relative impacts of earthquake experiences (EE), and education (S: school, ST: active school, C: community, F: family and Se: self) on perception, deepening, preparedness and dissemination.

Some interesting observations can be made from this figure. While, earthquake experience and school education (S) are important to develop perception of earthquake risk, active school education (ST) and community and family education play more crucial role in developing the wish and interest to deepening knowledge. Self-education is also an equally important factor in this aspect. However, actual deepening of knowledge is observed through intensive community education. Experience and school education play relatively smaller role in this regard. This is possibly attributed to enhancing perception and deepening through active participation of different types of community activities in the neighborhood. In contrast, when the wish for preparedness is concerned, family education is the most influential factor, followed by self-education. For actual preparedness, it is the community and family education, which are most important. This is attributed to importance of family and neighborhood level preparedness, which is possibly mainly through family and community education.Wish to disseminate experience is enhanced by active school education (ST) and family education, while actual dissemination is promoted by community and family education. In both cases, school education's (S) role is not so prominent.

The survey also pointed out that on an average, 65-70% of the students have undergone earthquake education in schools, 70-75% of the students have high perception on the earthquake risk, including what to do as earthquake countermeasures. In contrast, only 25% performs risk reduction actions, and there lies the actual problem: '*how do we make attitudinal change for risk reduction action*'? As evident from the survey, this is a long-term process of development of a 'culture of preparedness', which should originate through interaction in family and community. The importance of this survey lies in the fact that Japan, even being a highly developed country in terms of knowledge-base, and technological development, has a long way to go for actual risk reduction initiative at individual and community level.

3. EXPERIENCES OF GUJARAT EARTHQUAKE

3.1 Background

The earthquake of 26 January 2001 (magnitude 7.7, USGS) devastated the Gujarat State in Western India with unprecedented and widespread loss of lives and properties. More than 13,000 people lost their lives, and thousands were injured (GSDMA, 2002). The earthquake affected an area stretching more than 400 km, including urban, semi-urban and rural areas. Several villages close to the epicenter were completely destroyed. Over 300,000 buildings were collapsed and more than twice the number were severely damaged. This was a tragic blow to the region that was suffering from a drought conditions and the aftermath of cyclone in last 3 years. The devastation affected the area socially, economically and physically (Shaw et al., 2001).

There was an overwhelming response from all quarters to offer support for relief and reconstruction of the quake hit areas. Such support both material and in kind brought together several institutions/organizations concerned with disaster management to launch a combined effort in the post earthquake response. One such consortium was formed among government, non-government, academic and international organizations from India, Japan and Nepal. United Nations Centre for Regional Development (UNCRD), Earthquake Disaster Mitigation Research Centre (EDM), and NGOs-Kobe, three organizations from Japan joined hands with Sustainable Environment and Ecological Development Society (SEEDS), National Society for Earthquake Technology (NSET)-Nepal and others in India to implement a small-scale project in the affected area in Gujarat, India.

The purpose was to put together the group's strengths and past experiences to help the people of Gujarat in the best possible manner. Patan district, located to the east of Kuchchh district in Gujarat State, and one of the hardest hit districts was chosen as the area of intervention. The village name was Patanka, which was located approximately 270 km north west of Ahmedabad. The area was 70 km west of the epicenter of the earthquake. An initiative called Patan Navjivan Yojna (PNY) was formulated, which had two major components: rehabilitation of a model village, and a shake table demonstration testing for earthquake safer construction.

3.2. Model Rehabilitation

The needs for a model approach in community rehabilitation are felt more than ever before. The reasons contributing to this need are obvious. Disasters in recent decades are causing more deaths than it did earlier in the century. The worse still, same areas get affected by disasters over and over, and yet the relief and rehabilitation carried out following one disaster does little to protect them against the subsequent ones. In the areas vulnerable to recurrent disasters, the approach of not learning from past experiences, has led to a miserable disaster-poverty cycle (Bhatt, 1998). Limited education and awareness among the stakeholders, and lack of confidence in disaster-resistant practices such as construction are regarded as two major reasons for the repetition of the same mistakes and tragedy.

Over many years, attempts are being made to develop sustainable disaster management models that can effectively reduce risk. This has been a rather difficult exercise. Experience shows that most 'models' exist as long as there is external support to the local community (Twigg, 2000). The initiative fails soon after external assistance is withdrawn. Ultimately, this results in the vulnerability of the community increasing to it previous levels. It has also been felt that, increased coordination and capacity building among aid agencies, long-term planning and a greater understanding of the recovery and rehabilitation issues can potentially improve post disaster actions at the community level. Thus, the urgency and need for developing a model approach was strongly felt after the earthquake.

PNY was conceived as a model program right from its inception stage. It sought to empower the affected community to such an extent that they are sufficiently resilient against any future disasters. It attempted to link immediate response in form of relief to mainstream development. An important aspect of the initiative was to establish a framework of mutual cooperation among different stakeholders in the post-disaster scenario. Most importantly, it aimed at successively reducing the role of external agency in local rehabilitation action until a point wherein the local community completely takes over the functions insofar performed only by the external agency. The work was done by a Project Team, which consisted of representatives of different organizations mentioned above.

The Process of Rehabilitation (Shaw et al. 2003a) had three major stages: I: Principles and Planning, II: Implementation and III: Ensuring Sustainability (Figure 3). The first thing was setting up the basic principles for planning the rehabilitation intervention. Rehabilitation was not just a short term, gap filling exercise. In most cases, the community faced threat of recurrent disasters and therefore rehabilitation should be aimed at reducing their vulnerability. This would imply building communities assets, achieving sustainability of their livelihood, building houses that could protect them against future earthquakes and an infrastructure that potentially improved the quality of life of the community to a level better than it was before the disaster.

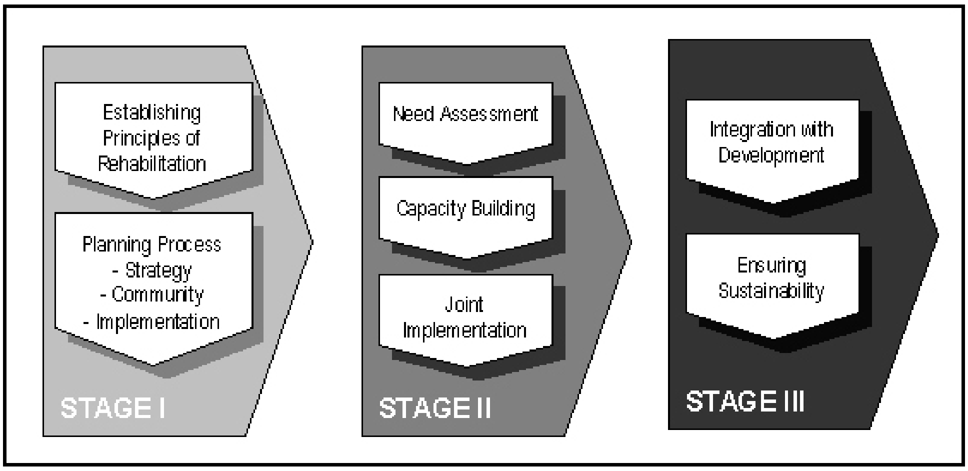


Figure 3: Model of Rehabilitation and Reconstruction

Rehabilitation should be empowering. The Project Team would not, and should not, remain with the community forever. In such a case, the community who were the first responders should be sufficiently equipped to cater to their immediate needs. A well-planned rehabilitation exercise could significantly increase the capacity of the community for a more effective response. Social, economic and psychological aspects were integral part of the rehabilitation program. It was to be understood that the proper rehabilitation was not only to build earthquake resistant houses, but also the restoration of the livelihood, and to restore the normal life with sustainable economic activities. "Livelihood" could not be ensured only by safer housing and suitable income, but would need to include issues such as welfare, health care, medical service, educational facilities, labor condition, disaster prevention and others maintained in good balance.

Rehabilitation should also incorporate the local cultural aspects and should try to inculcate safer construction culture to the community. The rehabilitation program should try to establish a strong bond within the community and also within different related stakeholders. The success of the rehabilitation exercise was judged by the degree to which action were replicated by the community, without intervention from the aid agency. Inputs on capacity building were therefore important. Additionally, the Project Team needed to ensure that conditions would continue to exist for easy replication.

The role of the Project Team was to facilitate the reconstruction process. The composition of the team was therefore very important. Getting appropriate staff members with suitable motivation and skills was difficult, however suitable training and encouragement could help. Establishing good relationship with the community was the foremost responsibility for the Project Team, skills and knowledge came next. The Project Team had to have an attitude of helping the community so that they can help themselves. Maintaining professional and ethical standards while performing amidst the community earns respect and trust of the community. The skills of the Project Team in being able to translate their own knowledge into community acceptable practice was the crucial testing point. Besides, the team would have to ensure transparency in their accounting system and working methods. This helped in establishing credibility for the team.

The most significant part of the project was involvement of house-owners and communities in the reconstruction and decision making process. The Project Team provided know-how, training and building materials, and prepared a model house for the most needy person in the village. However, the construction of houses was done by the family members. Thus, the essential seismic features of the houses were deep-rooted in the persons, and the house-owners were the best quality controller of their own buildings. Thus, an auto-monitoring system was developed within the village, which would be sustainable, even after the completion of the project.

3.3. Shake Table Demonstration Testing

In general, there was lack of confidence in traditional construction methods, lack of available lost cost and affordable technology, and lack of trained, skilled masons. The important aspects of rural non-engineered constructions therefore needed to be identified by demonstration and training that involved the local community in order to provide them with confidence in existing building materials. The main message of this demonstration and training program was that damage was done to rural constructions mainly due to the lack of proper use of technology, not to poor construction materials. The important steps were to build awareness, confidence, and capacity among the people of the local communities, masons and local engineers. A preliminary training program was conducted in the village so that people would understand the importance of earthquake-resistant construction at little additional cost.

Two identical half-size models of rural houses were constructed on a locally built shaking table in the field and tested to underscore the importance of earthquake safety elements. The experiment and training programs were carried out in the presence of the local masons and people in order to engender confidence in the earthquake-resistant construction techniques to be used. Figure 4 shows the first of the test series, in which two models were constructed from stones and mud mortar, after which one was retrofitted with locally available materials. At the end of testing, the retrofitted building had minor cracks, whereas the other building had collapsed. This visual experiment, with explanations, inspection, and measurements gave immense confidence to the community. Four such testing was conducted on houses built with different construction materials and construction techniques (Shaw et al. 2003b).

Figure 4: Shake table testing with rural construction

Another important aspect of the training program was mason training, in which trained masons from Kathmandu, Nepal provided training for local masons from the affected villages. Through that program, the PNY masons had the chance to visit Nepal and see the work of the Nepalese masons. This also gave great confidence and experience to the local masons.

3.4. Issues for Sustainability

Involvement of the community in a participatory way in owning both the problem and solution was undertaken at the local level, by focusing on safety and the sustainability of lives and livelihoods. Involvement of the different stakeholders in India and Japan in working together with the communities, under a framework based on local needs and priorities was another area of emphasis. Sensitization of the international community to those local needs and priorities was done at the international level.

In summary, the basic elements in this initiative were the community, its stakeholders, existing knowledge, confidence in technology, and people's ability to turn knowledge into practice. The goals to be achieved were: to ensure safer living and sustainable livelihoods, to empower the communities, and to motivate people through incentives. The tools used to achieve these goals were partnership, cooperation, self-help, and participation. Although the common practice for cooperation is from the central to the local government, and only then to the community, the scheme used for the current initiative is indicative of the community-centered interaction of different stakeholders. For successful rehabilitation, the important factors are participation and empowerment; flexibility and a time-frame; teamwork; identity and ownership; trust; and evaluation and transferability.

The effort initiated by the Project Team needed to be sustainable long after the interventions were over and the Team was withdrawn. In effect, intervention should be designed from the beginning to ensure that community was able to take care of its development needs and was resilient for future disasters. For Intervention to be sustainable, capacity building and strengthening/building local institutional mechanisms were obvious need. Additionally, local institutions should have adequate capacity and a fixed source of income to be able to exist and carry out its programs. Rehabilitation actions would be sustainable if the individual in the community was empowered and owned the project. The individual should be aware of his rights and know the way to take action on them.

Based on this basic philosophy, the Project Team focused on the people's knowledge more than the physical rehabilitation (Shaw et al. 2003). A pool of trained masons in the community led to the creation of a "mason's guild" that would market its own services not just within Patanka but also to all other neighboring villages. This was regarded as a useful livelihood opportunity in a region where agricultural products were not enough to sustain households.

To ensure the institutionalization of the efforts in the trained masons, Patanka Reconstruction Private Limited was proposed as a Construction Company, promoted by SEEDS, the main implementing partner of the PNY project. The farmers whose livelihood was destabilized due to successive years of drought were trained as skilled masons, and were capable enough of taking up construction work as an alternative means of livelihood. Therefore, to help them get into an organized structure, the idea of initiating a Construction Company came into existence. Thus, it was felt that the proposed name of the Company should have the name of the village from where it had its roots. The company proposed to take up retrofitting, rehabilitation and disaster resistant Construction, which were its unique selling point. Therefore, it was appropriately named as a Reconstruction Company instead of a Construction Company. "Patanka" as a brand name stood for good quality disaster resistant construction using appropriate technology and promoting local resources. Also, in order to promote social development, the company would like to commit 20% of its profits for this cause: 5% each for Research and Development, development of Patanka and local initiatives, capacity building activities, and Community Risk Reduction Fund (CRRF).

The company would be developed in three phases: inception phase (2002-2004), establishment phase (2004-2007), and expansion phase (2007-onward). In the inception phase, SEEDS would act as the sole promoter of the company, responsible for the institutionalization and training for the company. This phase would be the most crucial, on which the future of the company would depend. In this phase, the foundations would be built in core strength areas i.e. construction of disaster resistant buildings and retrofitting activities. In the establishment phase, the company would have been in existence for two years, therefore the focus would be on strengthening its hold in the market. The company would enter into strategic partnerships, which would determine the work area and type of funding. The expansion phase would include: providing a new direction to the company by making itself sufficient and self-accountable. There would be a lot of reorganization in roles and responsibilities. The main aim of establishing this company was that the masons could use their construction skills as the means of their livelihood. So during this stage, the company would start looking beyond the initial promoter SEEDS.

3.5 Dissemination of Experiences

Dissemination of PNY experiences was one of the important aspects of the project. The dissemination could be within the state, in the country and outside the country. To disseminate the experiences within the state of Gujarat, different schemes of cooperation were formulated: cooperation with NGOs working in the Kachchh area for the mason exchange program, new project with GSDMA for sharing the experiences with other parts of Kachchh, proposed training programs in the disaster management resource centers in Gandhidham. All these could be made feasible through constant lobbying, and networking. The PNY video (shake table testing) was broadcasted in the state-wise television, and was used as a training kit for different parts of Gujarat.

The most important dissemination of PNY experiences was in the light of mitigation and preparedness efforts for future earthquakes in northern parts of India. A comprehensive program was conceptualized and implemented by SEEDS, in cooperation with national government (NCDM), NGOs-Kobe and UNCRD. The program was termed as ‘Parvat Yatra’ (A journey to the mountain), in response to the International Mountain Year of 2002. It was planned to cover the whole north and northeastern part of the country. Figure 5 shows one example of this training program in northern hill town in the Kangra Valley in the Himachal Pradesh. NSET-Nepal has helped in this program with technical expertise.

The same exercise was conducted by UNCRD in Kabul, Afghanistan with the technical assistance from NSET-Nepal (Figure 5). This was aimed to train masons and engineers in the post-conflict reconstruction program in Afghanistan.

Figure 5: 1:10 scale shake table testing with rural construction in Northern India (Left) and Kabul, Afghanistan (Right). The photo in the right shows Nepalese mason and engineer with Afghani masons

4. FUTURE DIRECTION OF RISK REDUCTION INITIATIVES

At the beginning of the last decade, there were two major challenges in front of us:

1) How to encourage countries and international bodies to think and act on the pre-disaster mitigation activities as a priority of development work?
2) How to motivate local actions at individual and community level?

Following parts will try to address these two issues.

4.1 The Last Decade

From 1990-1999, United Nations, along with member states observed an International Decade for Natural Disaster Reduction (IDNDR). The IDNDR Secretariat in Geneva coordinated and undertook several initiatives with the national governments, international organizations (UN, bilateral and multilateral donors; and organizations like ADPC and ADRC), and different NGOs (international, national and local NGOs). Many of the projects and initiatives were very successful, and credit goes to all the stakeholders, including the think-tank like WSSI, which proposed, promoted and implemented many of them.

It was until Yokohama Conference of 1994, from when the IDNDR activities took a momentum to accelerate its work in the developing countries. Much of this depended on the commitments from the donor agencies, and Japan became one of the largest donors to the IDNDR Secretariat. Other developed countries like UK, Germany and USA also contributed substantially to the IDNDR activities. Many developing country national governments like China, India, Mexico took leading roles for institutionalization of the efforts in the national, provincial and local government levels. The Kobe earthquake of 1995, at the middle of the decade has changes the concept of earthquake disaster management, and compelled us to see the earthquake issue in a holistic perspective of technical, social and cultural issue. Two major urban earthquakes in Turkey and Taiwan at the end of the decade again pointed out the need for the multi-stakeholder cooperation, and gap between knowledge and practice.

In summary, the success of the IDNDR lies in: 1) Promoting pre-disaster preparedness issues, and urging for a paradigm shift from reactive to pro-active mitigation, 2) To engage with the national governments to develop strategies and policies, 3) To motivate several national governments to establish multi-disciplinary institutions, 4) To enhance regional cooperation in the field of disaster management, and 5) To enhance the awareness of people and communities through educational campaign etc.

4.2 Beyond IDNDR

After the completion of the Decade, UN, though the resolution of the member countries, established an International Strategy for Disaster Reduction (ISDR) Secretariat, and a risk reduction Task Force. Many regional organizations, UN agencies and the country representatives are the members of the Task Force. ISDR Secretariat, under the new dynamic leadership is currently active with different promotion activities. However, as earlier, funding remains a problem, and it will remain until there is a firm commitment from the member states.

Although IDNDR seemed to achieve a substantial progress, it was not able to generate a significant enthusiasm in its own UN system, especially when it comes in the integration in the development activities. Many of the current initiatives of the UN system focus on the Millennium Development Goals (MDGs), which was set up by the countries in the UN Millennium Assembly (MDG 2003). Unfortunately there is limited or almost no mention about disaster reduction, prevention and preparedness aspects in the MDGs. Also, the World Summit of Sustainable Development (WSSD) Declaration of 2002 has limited mention about disaster reduction as one of the major emphasis area in the next decade. Not only UN, very few bilateral and international development agencies have clear-cut policy on disaster related issues. The World Bank was able to establish the Disaster Management Facility (DMF) and Pro-vention Consortium, and it was very effective in different post-disaster reconstruction phase. The soft loan after the Gujarat Earthquake of India from the Asian Development Bank (ADB) has urged to review the ADB emergency assistance policy, and in the new proposal, significant focus is being given to the pre-disaster preparedness (Safron 2003). All these are rather recent developments and its impacts are yet to be proved.

United Nations has established the Human Security Commission (Ogata and Sen 2003) with financial support from the Japanese Government, as is co-chaired by Sadako Ogata, current President of JICA (and former UNHCR High Commissioner) and Amartya Sen (Nobel Laureate in the field of Economy). Human Security has been the most widely discussed topic in the international meetings and forums. Earthquakes and its impacts are very much related to this key issue of "Human Security". This is part of responsibilities of the professionals, how to link the disaster related issues (especially earthquakes) with sustainable development and human security. So long we are not able to do this, it is difficult (not impossible) to prioritize the earthquake issues in the national policy agenda and to promote the pre-disaster mitigation as national strategy.

4.3 Attitudinal Change for Risk Reduction Actions

As exemplified form the questionnaire survey of school children in Japan, it is of utmost important that an attitudinal change is required for the risk reduction actions. The process for this change is different in different countries, based on the local context, including socio-economic, cultural, religious and political affairs, among many other issues.

After the Kobe Earthquake, university students of Hyogo prepared a small booklet titled 'Are you Prepared?' (Toshiharu, 1998). The students summarized major lessons learned from the earthquake as: "The Great Hanshin Awaji Earthquake Disaster teaches us that preparation for disaster applies not only to hardware aspects, but also to software aspects of human relationships and mutual assistance both of which are equally important. A society that is prepared for disaster is a warm society of people willing to extend a helping hand to other." As argued earlier, the major challenge for earthquake disaster is to implement pre-disaster mitigation efforts versus day-to-day priority of other issues. Thus, so long the earthquake issues are not incorporated in everyday aspects, its sustainability are questionable. Japan being an earthquake prone country, there is a general level of knowledge and awareness, which exists among the citizens including the school students. However, to prepare for an earthquake is different issue, and it is only possible through active education in family and community. Human code and conduct during the earthquake is such an issue, which is not written in the form of textbook. Thus, school education alone cannot solve this problem, and cannot motivate a person to take action for mitigation activities. However, school education is useful for the very important first step, which is providing knowledge and activating student's interest.

Fisek et al. (2002), in their studies in Istanbul, Turkey, described that earthquake mitigation is not only a financial matter, but perception and awareness plays an important role. There are numerous examples of similar observations made in Japan. Eastern part of Japan is expecting a large earthquake any time. Shizuoka is one of prefectures in that region, which took sincere efforts to reduce the damages to the possible future earthquake. The prefecture government started 'Tokai Zero' project, which is to enhance the safety of private houses. Government initiated a very generous scheme, with free seismic evaluation of house, provision of grants from government for retrofitting, and provision of soft loan for retrofit. Considering the economic standard of Japan, it is an affordable package, but the number of applicants for this program remains restricted. This is attributed to lack of proper risk perception and awareness and lack of wish to take decision for mitigation activities.

As evidenced from the two examples of reconstruction experiences that involvement of community is one the key issues for the sustainable recovery. The more the communities become the owner of the process, the more the issues are deep rooted in them. Thus, the reconstruction process is one of the useful opportunities to indulge individual and communities in risk reduction actions. This is to be remembered that the reconstruction process should focus on the livelihood and social recovery, beside the reconstruction of buildings and infrastructures.

"What makes attitudinal change?" Possibly there is no clear-cut answer for it. It is observed in many countries that, policy, institution, rules, bye-laws are essential part of the system and creation of the system is important. However, the make the system effective, people and community's participation is essential. There is a need to develop a "Culture of Preparedness", and the role of all stakeholders from government, non-government, academics and international organizations are equally important in this regard.

4.4 Expected Role of WSSI

As evident from Katayama (2003), WSSI has limited financial resource, and therefore the resource should be focused in the right direction, at right location to make maximum impact. This is not to be forgotten that irrespective of financial resource, WSSI has an immense potential of ideas, knowledge, expertise and voices, and these were combined together in the last decade to make a change in many countries, where WSSI had conducted HLM (High Level Meetings). Thus, there are obvious reasons to be optimistic about the important roles WSSI needs to pay in the current years and the coming decades.

A few suggestions on the potential roles of WSSI will include the following:

1) Strategic choice of focus area: Needless to say that earthquake threatened areas all-over the world need WSSI. However, due to limited resource, it should focus on one/several key strategic geographic locations, with visible impacts. One of them might be the transitional countries like Mongolia, Afghanistan and Central Asian Republics (Uzbekistan, Kazakstan, Kirghizstan, Tajikistan, and Turkmenistan). There are several obvious reasons for it: 1) Countries in transition need intellectual help from different sources, apart from the financial assistance. 2) There are very few avenues of information exchange in these countries with outside world, and 3) Since most of them are in transitional stage, it is the right time to intervene to incorporate disaster issues in policy and long-term strategy. Definitely this is not an easy task, and needs patience and energy.

2) Emphasize the Human Security Concept: As mentioned above, the link between the earthquake disaster management and human security should be strengthen. Transitional states are one of the useful avenues for this purpose. The benefit of this link will be reflected in the national and international policies and strategies.
3) Participation in the UN ISDR Task Force: WSSI should be a member of the UN ISDR Task Force. Since there are many important decisions made by this Task Force related to worldwide disaster reduction initiatives, it is important to play a crucial role in this Task Force.
4) Second World Conference on Disaster Reduction: ISDR, along with Government of Japan will organize the Second World Conference on Disaster Reduction in Kobe in Japan on 18-22 January 2005. The purpose of this conference is to review the progress of the Yokohama Strategy in last ten years. WSSI should be actively involved in this event as an organization, as well as collaborative partners with other regional and international agencies.

5. ACKNOWLEDGEMENTS

The observations presented in the paper were derived from different projects of UNCRD and EDM, where the author was involved. Supports from these institutions are highly acknowledged. The author has been benefited from discussions with several experts in many countries. The names of all of them are difficult to mention, but special thanks are due to S. Suwa, M. Murai, K. Shiwaku of Japan, M. Gupta, A. Sharma and S. Iyenger of India, A. Dixit of Nepal, H. Rahayu of Indonesia and so on. Interaction with the students of Maiko High School is highly acknowledged.

REFERENCES

1. Bhatt M. R., 1998. Can Vulnerability be Understood? In Twigg J.,Bhatt M.R. (eds.), *Understanding Vulnerability: South Asian Perspectives*, London, IT Publications.
2. Fisek, G., Yeniceri, N., Muderrisoglu, S., and Ozkarar, G., 2002. Risk perception and attitudes towards mitigation, IIASA-DPRI meeting on *Integrated Risk Management*, Luxemburg.
3. GSDMA, 2002. *Post-earthquake rehabilitation: current status, GSDMA Report*, Gandhinagar, GSDMA Publication.
4. Jalali, R., 2003. Civil society and the state: Turkey after the earthquake. *Disasters*, 26 (2): 120-139.
5. Katayama T., 2003. Ten years with the World Seismic Safety Initiative: *Regional Development Dialogue*, 24(1), 107-114.
6. MDG, 2003. Millennium Development Goals, available at http://www.undp.org/mdg/

7. Nakagawa, Y. 2003. *Social capital and disaster management: A comparative case study of Kobe and Gujarat earthquake*, Master Thesis, Kobe University, Kobe.
8. Ogata S. and Sen A., 2003. *Human Security Now*. UN Publication, NY
9. Safron P., 2003. Draft Emergency Assistance Policy of Asian Development Bank, in: *Rehabilitation of Afghanistan and Community Sustainability*, 79 pages, UNCRD Publication
10. Shaw, R., 2003. The role of non-government organizations in earthquake disaster management: An Asian perspective: *Regional Development Dialogue*, 24(1), 117-129.
11. Shaw, R., Sinha, R., Goyal, A., Saita, J., Arai, H., Choudhury, M., Jaiswal, K., and Pribadi, K., 2001. *The Bhuj Earthquake of January 2001*: Miki, EDM-IIT Joint Publication, 157 p.
12. Shaw R., Gupta M., and Sharma A., 2003a. Community recovery and its sustainability: lessons from Gujarat earthquake of India, in *Australian Journal of Emergency Management*, Volume 18, No. 2, 28-34.
13. Shaw R., Britton N., and Gupta M, 2003b. PNY: Towards sustainable community recovery, 43 pages with CD-ROM, EDM-NCPDP-NGOs KOBE- NSET Nepal-SEEDS-UNCRD Publication.
14. Shaw R. and Goda K., in press. From disaster to sustainable community planning and development: the Kobe Experiences.
15. Shaw R., Shiwaku K., Kobayashi H. and Kobayashi M., in press. Linking experience, knowledge, perception and earthquake preparedness.
16. Tatsuki, S. and Hayashi, H., 1999. Determinants of the changes if residence and life reconstruction among the 1995 Kobe earthquake victims: *The 24th Natural Hazard Workshop*, Boulder.
17. Toshimaru, N., 1998. Are you prepared? Learning from the Great Hanshin-Awaji Earthquake Disaster, Handbook for disaster reduction and volunteer activities, Hyogo University, Kobe.
18. Tsunehiro Y., Goda K., Shaw R., 2003. *From disaster to community development: The Kobe Experience*, 95 pages, UNCRD Publication.
19. Twigg J., 2000. 'The age of accountability?: future community involvement in disaster reduction', *Australian Journal of Emergency Management*, Vol. Summer, pp. 51-58

Dr. R. Shaw from UNCRD

UNU-WSSI: A PARTNERSHIP FOR GLOBAL DISASTER RISK REDUCTION

S. HERATH
United Nations University
Japan

ABSTRACT

UNU and WSSI had a long-standing partnership in Global risk reduction. UNU had indeed taken an active role in the WSSI activities from its inception and similarly WSSI had been a strong partner in UNU initiatives. The common agenda has been directed towards understanding underlying problems that contribute to the unabated increase in the global disaster loses and exploring innovative and effective means to direct resources to reverse the tide. Information dissemination and capacity development activities that play an important role in building disaster resilient communities in most affected and most deserving societies had been and will continue to be a main area of collaboration.

A major challenge facing us in the new millennium is to achieve Millennium Development Goals (MDG) set forth by the global community in order to guarantee basic human security to the majority of the global population. Risk reduction should be an integral part of these efforts as meeting MDG's is unlikely without a clear focus on risks and vulnerabilities. Risk reduction for sustainable development and risk communication, are therefore, important areas where UNU and WSSI can work together in the future.

1. INTRODUCTION TO UNU-ESD

The mission of United Nations University is 'to contribute, through research and capacity building, to efforts to resolve the pressing global problems that are the concern of the United Nations, its Peoples and Member States'. It strives to achieve these goals through coordinated activities of 16 research and training centers with specific regional and global specializations that are located in different parts of the world. A board of 24 eminent scholars acting in their personal capacities advises UNU on its strategic research directions. In addition to its own RTC/RTP's UNU also collaborate with over 30 UN organizations and over 100 research institutes globally. The headquarters located in Tokyo hosts two programs; 'Environment and Sustainable Development' (UNU-ESD) and 'Peace and Governance' (UNU-P&G). The UNU-ESD programme has a long history of close collaboration with WSSI.

UNU's Environment and sustainable Development (ESD) Programme focuses on the interactions between human activities and the natural environment, and their implications for sustainable *human development*. The basic issues of human survival, development and welfare are at the core of the themes covered within the realm of the ESD Programme. To achieve its objectives, UNU's ESD Programme adopts a multidisciplinary approach combining both natural and social sciences. In implementing its activities, the ESD Programme makes special efforts to include perspectives from both North and South as well as from the countries with economies in transition. Networking and capacity building, particularly in the developing countries are given high priority.

Based on an appraisal of current challenges of these issues and the targets set forth by the global community in addressing them through the MDGs, WSSD and Action Plan as well as in response to issues brought about at the WWF3 in Kyoto, ESD has organized its activities under four broad thematic areas focusing on *(a) Sustainable Urbanization (b) Managing Fragile Eco Systems (c) Solutions to Water Crisis and (d) Environmental Governance and Information.* The projects under the theme (a) Sustainable Urbanization is especially relevant to collaborative activities with WSSI, because they address urban risk and vulnerability reduction issues.

2. HISTORY

UNU has long supported the WSSI initiative. It is significant that the first two workshops of WSSI, held in Bangkok, Thailand were sponsored by UNU. There are a number of significant collaborative activities dating back more than a decade. An early workshop in 1993, 'Towards Natural Disaster Risk Reduction', organized as a collaborative effort by, INCEDE, the University of Tokyo, WSSI and UNU as part of the Pacific Science Association Inter-congress was one of the first truly multidisciplinary gatherings to address disaster reduction efforts holistically by looking at risk reduction needs across a matrix of disaster types and stakeholders. This initiative was followed by a second 1995 workshop 'Harnessing communication revolution for natural disaster risk reduction' where the uses of emerging information exchange facilitated by developments in Internet and especially its relevance to developing countries was discussed at length. The UNU – WSSI partnership has enabled organizing studies and seminars in a number of such pioneering areas and was instrumental in raising awareness among academics, practitioners and general public in emerging issues and the necessity for multi-disciplinary dialogue. The most recent activity of this partnership is the Public Forum in Tokyo, 2003 October, titled 'Living with Risk – Are we prepared for the next big one?' where the past experiences, present policies and practices, economic risk and emergency planning were discussed in an event organized to commemorate the 80th anniversary of 'Great Kanto Earthquake'. In addition to such activities, UNU has contributed in many ways to the success of WSSI in various capacities including being a member of the WSSI board of directors in the past.

3. COMMON OBJECTIVES

A clear approach to risk & vulnerability reduction are important in fighting poverty. Today there are tremendous pressures on natural resources by the growing population and urbanization processes. The millennium development goals define a set of targets to address the basic needs to ensure human security, but the success of achieving that is remote without a clear agenda on reducing risk and vulnerability. Risk reduction would ultimately foster economic development and thus is an important development issue. Dissemination of knowledge and experiences of successful approaches to risk reduction is therefore very much a UNU agenda.

Earthquake risk reduction is vital not only for each urban centre, but also for the global community, as in today's highly inter-dependent world society, a local catastrophic disaster can trigger adverse impacts on national, regional and global well being. With the growing realization that preventing or even predicting earthquakes is still a remote goal, more and more emphasis is being placed on mitigating earthquake damage. Urban centres - due to their very nature of constant expansion and dynamic change of infrastructure, together with complex interactions among various sectors of society - pose tremendous challenges for earthquake risk reduction. It is necessary to learn from the past and to work systematically and relentlessly to make cities safer from earthquake damage. The WSSI programs in earthquake risk reduction in Mega Cities as well as in the developing world, therefore, are very much in line with UNU efforts on ensuring sustainable urbanization.

4. RESEARCH AREAS FOR COOPERATION

In addition to general areas of cooperation focusing on activities of common interest, there are two specific UNU programs that provide opportunities for UNU and WSSI communities to collaborate closely.

4.1 Multi-hazard risk assessment

Ensuring human security is one of the priority areas for a sustainable urbanization process. On one hand the rapid changes of urban landscape and ever increasing expansion brings about unexpected risks to urban communities. On the other hand concentration of wealth in major urban centers poses huge economic risks in the event of a catastrophic disaster resulting from events that exceed the design standards. The ESD project on urban risk assessment is composed of two sub programs: a) Multi-Hazards Urban Risk Assessment with Dynamic Spatial Information, and b) Catastrophic Flood Risk Assessment in Asia-Pacific Region. The program component a) focus on assessing and reducing human vulnerability to disasters by looking at the dynamic behavioral patterns of the urban communities to understand the critical urban vulnerabilities brought about by the expanding urban infrastructure, especially those related to underground spaces. The program aims at developing methodologies to collect high resolution dynamic spatial information related to urban infrastructure and human behavior and incorporate them in multi-hazard risk assessment to facilitate implementation of appropriate mitigation measures.

4.2 Global Virtual University

Communicating risks to all stakeholders is an issue of paramount importance. Increasing awareness among the ordinary public to reduce the vulnerability at individual level through the dissemination of knowledge and experiences is one area of contribution. The best practices, the effective methods that have been tested over time, is another area where wide dissemination and knowledge sharing is important. Targeting the craftsmen at village level, who are the ones responsible for non-engineering structures that suffer mostly in the event of a disaster is another important aspect of risk education and risk communication.

The UNU Global Virtual University has been established to respond to similar needs, as a follow up of the education agenda adopted in the WSSD summit, Johannesburg. In addition to conducting on-line courses in environment, GVU develops training modules and information packages addressing specific topics and targeting particular groups. Already a M.Sc. course in Environmental management has been started and production of short topics/course would follow. Over the years WSSI has conducted a number of specific projects addressing earthquake risk reduction issues. It is necessary to widely distribute the best practices to all stakeholders widely. Harnessing the wide reach of UNU-GVU to disseminate best practices collected or initiated by WSSI could be a very effective means of reaching large populations at risk and replicating the successful experiences at a large scale.

5. WAY FORWARD

The UNU – WSSI association in the past has produced tangible positive results that both parties can be proud of. We hope this relationship would be strengthened in the future, and that UNU - WSSI could provide strong contribution to tackle the broader agenda of development process. Eradicating poverty and reducing vulnerability are two of the most pressing problems facing humankind today. It is necessary to find innovative solutions that could address both these issues and implement them through the existing networks of researches and practitioners.

REFERENCE

1. Herath S., and Katayama, T. (ed.) (1994), Towards Natural Disaster Reduction, Proc. VII Pacific Science Association Inter Congress Symposium on Disaster Reduction, INCEDE Report 4, University of Tokyo. p. 195.
2. Herath, S. (ed.) (1996) Harnessing Communication Revolution-Creation of a Global Disaster Information Network, Proc. XVIII Pacific Science Congress Symposium on Disaster Reduction, INCEDE Report 8, University of Tokyo, p. 202.

TRANSFER LIVE LESSONS OF CATASTROPHIC DISASTERS

Y. FUKASAWA
Disaster Reduction and Human Renovation Institution
Japan

1. INTRODUCTION

In the Great Hanshin-Awaji Earthquake of 1995, the people in the affected areas went through a tremendous amount of very strong feelings of anger, fear, sadness, pain, and guilt -- not to mention the acute final suffering of those who died, which cannot even be known to the survivors. In the process of response, relief, recovery and reconstruction the people had many deep regrets about the lack of preparedness, the lack of mitigation, and wrong choices that they had to make in unclear situations. And yet, the people were unexpectedly introduced to the human warmth of their communal living, the goodness in people, and a renewed appreciation for the value of life.

Since the 1995 Earthquake significant improvements in many areas have been made to disaster reduction systems in Japan, from the community level to the top policy level. It is indeed their strong feelings that made people feel greatly motivated and highly responsible for taking concrete steps forward. The passion was shared even by policy makers in the capital. The disaster had a major impact in stimulating the growth of the volunteer movement and the establishment of the non-governmental organization (NGO) sector throughout Japan.

In implementing risk management and disaster reduction policies and activities, it is extremely important and effective to maintain such strong feelings. If live experiences and lessons of severe disasters are appropriately demonstrated and transferred, these lessons can be a very effective way by which individuals, communities, and other stakeholders can be personally motivated to take concrete actions in implementing disaster prevention and reduction policies. These passionate feelings can actively fuel disaster reduction.

On the other hand, such feelings tend to fade rapidly. It is natural that many ordinary citizens wish to forget their harsh experiences and feelings so their lives can return to normal. Thus, special efforts are needed to preserve the strong feelings after mega-size disasters to continue disaster reduction progress, individually as well as collectively. However, until now there has been no comprehensive disaster reduction policy from the standpoint of local communities and individuals. The 1995 Great Hanshin Awaji Earthquake has taught us the importance of the victims’ perspective. By "transferring live lessons of catastrophic disasters" we will help to ensure that future victim numbers are minimized.

2. PROPOSED VIEWPOINTS

From these viewpoints, the following should be proposed.

1. Governments and the people of each disaster stricken area should begin to organize in their respective ways to “transfer live lessons of catastrophic disasters,” in particular to their citizens and communities. Through such activities, the same level of tragedy may be prevented.

2. There are many ways and many methods for transferring these lessons such as museum facilities, story-telling in systematic ways, films, cartoons, music, cultural events and many other educational activities. Major benefits can be gained without incurring a great deal of cost. Each government and supporting organization should recognize the importance of transferring live lessons and start supporting such activities.

3. These viewpoints should be made available to the international community, in particular to the UN Secretariat of ISDR for further consideration. They also should be clearly reflected in the forthcoming discussions concerning disaster prevention to be held in each country and within the international community during the process of preparing for the UN World Conference on Disaster Reduction 2005 to be held in Kobe, Hyogo.

4. The Disaster Reduction Alliance (DRA), consisting of 12 organizations active internationally on disaster reduction issues and situated in HAT Kobe (New Eastern City Center), together with the Hyogo Prefectural Government held the Disaster Reduction Forum 2004, with the theme of "Transfer Live Lessons of Catastrophic Disasters," on February 8 at the International Conference Center in Kobe. The Disaster Reduction Alliance (DRA) plans to argue thoroughly, making the most of the result of that forum.

Dr. Y. Fukasawa from Japan