UNCRD
United Nations Centre for Regional Development
Disaster Management Planning Hyogo Office

Expert Meeting on

The Anti-seismic Building Code Dissemination Project for the Housing Earthquake Safety Initiative

Proceedings

17-19 January 2007
Kobe, Japan

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Mission Statement of UN/DESA

The Department of Economic and Social Affairs (UN/DESA) was created as the result of the consolidation of the Department of Policy Coordination and Sustainable Development, the Department for Economic and Social Information and Policy Analysis, and the Department for Development Support and Management Services.

UN/DESA is a vital interface between global policies in the economic, social and environmental spheres and national action. The Department works in three main interlinked areas: (a) it compiles, generates and analyses a wide range of economic, social and environmental data and information on which State Members of the United Nations draw to review common problems and to take stock of policy options; (b) it facilitates the negotiations of Member States in many intergovernmental bodies on joint courses of action to address ongoing or emerging global challenges; and (c) it advises interested Governments on the ways and means of translating policy frameworks developed in United Nations conferences and summits into programmes at the country level and, through technical assistance, helps built national capacities.

Preface

United Nations Centre for Regional Development (UNCRD) was established in 1971 to promote regional development through training and capacity building of governmental officials and communities. Its work covers three areas of environment, human security and disaster management.

UNCRD Disaster Management Planning Hyogo Office, the disaster management arm of the organization, was established in Kobe, Japan in April 1999. It has implemented numerous projects to reduce disaster risk in disaster prone countries. Its ongoing projects include Community-Based Disaster Management (CBDM), School Earthquake Safety Initiative (SESI), and Housing Earthquake Safety Initiative (HESI).

Under the HESI project, a three-day expert meeting was held in Kobe, Japan in January 2007 to identify problems causing ineffective building code implementation in a number of seismic countries across the world and to discuss measures that can be taken to improve the safety of houses.

The proceedings was prepared and published to disseminate knowledge and ideas generated through discussions beyond a small group of participating experts for the benefit of enhanced housing safety worldwide. UNCRD wishes to thank all the participants for their valuable input to the HESI project.

Expert meeting participants
From left, back row: Mr. Maryoko Hadi, Mr. Amod Mani Dixit, Prof. Shunsuke Otani, Mr. Kishore Thapa, Prof. Javier Pique, Prof. C.V.R. Murty, Mr. Atsuo Okasaki, Mr. Bishnu Hari Pandey; Front row: Prof. Kenji Okazaki, Dr. Shoichi Ando, and Ms. Naoko Mishima

January 2007, Kobe, Japan

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Tatsuo Narafu, Building Research Institute, Japan

Discussion

Prof. Okazaki: May I welcome all of you to this three-day expert meeting on the Anti-Seismic Building Code Dissemination (ABCD) project for the Housing Earthquake Safety Initiative (HESI). My name is Kenji Okazaki. I am a Professor at the National Graduate Research Institute for Policy Studies (GRIPS). I have been requested to chair this first session perhaps because I am the predecessor of Mr. Ando, who is now Coordinator of UNCRD Hyogo Office.

Let us start this session by briefly introducing ourselves. Allow me to do the first introduction. Some of you here know me quite well. I used to work for the International Decade for Natural Disaster Reduction Secretariat in Geneva for about 4 years to implement various projects. After that, I joined UNCRD and worked there for about three and half years, where I had a chance to work with some of you. Then I joined the Ministry of Land, Infrastructure and Transport (MLIT) of the Japanese Government, and after that stint, I moved to GRIPS as a professor. Right now, I am teaching students from developing countries about disaster mitigation in their respective countries in cooperation with the Building Research Institute (BRI) and the Japan International Cooperation Agency (JICA). That is briefly about myself. Now may I call a representative from India to do the introduction. Please take note that the seating arrangement here is in alphabetical order following the name of the country.

Dr. Ando: In order to record our discussions, kindly use a microphone if you would like to speak.

Prof. Murty: Thank you very much. Good afternoon ladies and gentlemen. I am C.V.R. Murty. I am a professor in the Department of Civil Engineering of the Indian Institute of Technology in Kanpur, India. My basic interests are in the area of structural safety as well as building of earthquake-resistant structures. I have been teaching related courses on these fields for the last 14 years in my university at Kanpur. I am also interacting with the Indian community in the area of capacity building for architects and engineers. In addition, I am actively involved in the anti-seismic related policymaking in India. Recently, I am associated with the World Housing Encyclopedia (WHE) as Editor-in-Chief. I am passionately involved in discussing strategies for making safer housing across the world. Today, I will present on the World Housing Encyclopedia but tomorrow, I will discuss issues related to world housing safety. Thank you.

Mr. Hadi: Good afternoon ladies and gentlemen. I am Maryoko Hadi. I am a researcher and am especially interested in structures and constructions. I am affiliated with the Research Centre for Human Settlement based in Indonesia. We are doing research in order to improve structures and constructions, especially for the non-engineered buildings. Since 1995, we have been instituting systems for improved housing structures. So right now, we are doing lots of testing of our system, especially on residential houses. Another research field, which we are also working on, pertains to mitigation of earthquake damage by strengthening the foundation of destroyed houses after earthquakes. In addition, we also disseminate earthquake safe standards for building. Thank you very much.

Mr. Budiono: Good afternoon ladies and gentlemen. My name is Antonius Budiono. You can call me Budi or Antonius. I have been working for the Ministry of Public Works in Indonesia since 1980. I am the Director of the Human Settlement Directorate. My responsibilities include setting up national regulations on building construction as well as preventing disaster from earthquakes and fire. I also facilitate technical assistance activities for local governments and local communities with respect to building improvement, standards and regulations. We are making sure that the residential houses are in a better condition in case of earthquakes. I am here to meet all of you with the hope that after this, I can improve our strategies to prevent damage from earthquakes in Indonesia by enforcing proper regulations and standards. Thank you.

Mr. Narafu: Good afternoon. I am Tatsuo Narafu from the Building Research Institute (BRI). I assume that you know the activities of BRI in developing countries. BRI implements group training courses on earthquake engineering. We also support JICA projects in technical aspects in developing countries. I am happy to inform you that BRI has started a new research and development project for safer housing, particularly for the conventional houses. Today, I will explain this new BRI research and development initiative. Thank you.

Mr. Takahashi: Good afternoon. My name is Nobuaki Takahashi. I am currently the Director of the Building Guidance Division of the Hyogo Prefectural government. I have been in this position for 4 years now. As you may be aware of, today is the 12th year since the Great Hanshin-Awaji Earthquake. At that time, my post was with the Urban Development Division. I saw the extent of damage as I visited affected cities and towns checking the buildings for about a week after the earthquake. Thank you.

Prof. Otani: I am Professor Shunsuke Otani from Chiba University. Previously, I worked for the University of Tokyo but 7 years ago I move to Chiba University. My major area is structural engineering. I don’t know much about policymaking or writing codes. In Japan, I belong to the Department of Architecture or Department of Design and Architecture. However, when I go to the United States or Canada, they ask me to teach in the Department of Civil Engineering. It is very strange. Thank you very much.

Mr. Thapa: I am Kishore Thapa. I am the Director-General of the Department of Urban Development and Building Construction under the Ministry of Physical Planning and Public Works, Government of Nepal. I am an architect and urban planner. I have been in the government service since 1983. In my earlier days of my career as an architect, I designed several buildings and the largest, which I was involved in designing, is the international airport terminal building in Kathmandu. The Canadian consultants were contracted to design and I was part of the team. Later on, I switched over to urban planning. This explains why I am with the urban planning sector now. However, my department still looks after housing, building construction, and urban development, which are three major areas we are working. In this regard, I think my institution can share information that relates to building construction. Thank you.

Mr. Dixit: Good afternoon. My name is Amod Dixit. By qualification, I am an engineer and geologist. I worked for the government for 19 years. Then I switched over to a private company in Nepal for a brief period. Since after the 1988 earthquake in Nepal, I have been working in the area of earthquake risk-reduction and earthquake risk management. Later on, I founded this institution called National Society for Earthquake Technology (NSET). In line with my interest, NSET focused mainly on earthquake risk management that was originally limited to Nepal because of the country's high seismic risks. Later, we came to a conclusion that we had had many experiences and lessons to share so we are now extending activities outside of Nepal. In particular, we want to share our experiences in non-engineered constructions that are prevalent in the many parts of the world. I am very pleased to be here. I am also part of the network, which Narafu-san is leading. I am also working with professor Okazaki in other global initiatives supported by MEXT among other projects. Thus, this meeting is another opportunity for learning and sharing. May I now say, have a nice day to all of you. Thank you.

Prof. Pique: My name is Javier Pique del Pozo. You can call me Javier or Pique. I am a civil engineer. I have been teaching in the Peru National University of Engineering since 1969. I think I am the oldest here, except maybe for Professor Otani. In my university, I am doing research on structural engineering. Currently, I am the Director of the Center for Earthquake Engineering and Disaster Mitigation, which is financed by JICA in cooperation with BRI. Aside from university activities, I am a practicing engineer doing structural designs. In Peru, I also preside a Committee that makes recommendations on projects addressing seismic-related problems and issues. As a civil engineer, I am a member of the Board of Engineers in Lima. In the whole of Peru, there are around 45,000 engineers who are obliged to practice their profession according to the constitution. I am happy to share this information that in 1987, I met Ando-san in a seismic project. Thank you.

Dr. Ando: Good afternoon and thank you very much. First of all, I would like to express my gratitude to all of you for coming to Kobe. I am Coordinator of the Disaster Management Planning Hyogo Office of the United Nations Centre for Regional Development (UNCRD). The UNCRD Headquarters is located in Nagoya and I am happy to inform you that Director Onogawa will come to Kobe to join this meeting tomorrow.

Before I joined UNCRD, I was with the Ministry of Construction, which is the Ministry of Land Infrastructure and Transportation or MLIT now. I entered there in 1980. This time, as Coordinator of UNCRD Hyogo Office, I would like to focus on disaster management issues. Last fiscal year, the

Ministry of Land, Infrastructure and Transportation of the Japanese government provided us a fund to work on a project that aims to contribute to the international society through sharing lessons the Japanese learned from past earthquake experiences, especially the one that happened in Kobe 12 years ago. Japan has many experiences of earthquakes and we believe that the lessons we learned from them may be useful to other earthquake prone countries. Tomorrow morning, representatives of MLIT, the Director of the Building Guidance Division and another, Director for International Codes and Standards, will come here to join this meeting. I hope they can explain in detail the objectives of this project, which UNCRD is coordinating.

Anyhow, we are not saying that Japan is a perfect example. We are not that excellent as other people might think. Last year, the Japanese structural engineering community as well as those who are involved in building control process suffered a scandal. There was an architect who intentionally made false calculations and this became a big scandal. As a result, people became anxious about whether their buildings are really safe or not. Things like this also happen in Japan. Anyhow, what we are focusing in this project that we are coordinating with MLIT is to disseminate not only the learning experiences from Kobe City but also to disseminate new systems developed by the Building Research Institute (BRI) that will give us an idea how to prevent disasters and ensure housing safety. Anyhow, I will discuss details on the objectives, targets, and expected outputs of this three-day meeting during my presentation later today. Thank you very much.

Mr. Pandey: Good afternoon. My name is Bishnu Pandey from the United Nations Centre for Regional Development Hyogo Office. I joined UNCRD in mid 2004 so it is roughly two and half years now. I am a civil engineer by training. Before joining UNCRD, I worked with the National Society for Earthquake Technology (NSET) under Mr. Amod Dixit. My responsibilities at NSET involved many seismic safety-related projects. I also have a brief experience of teaching in university. Coming to UNCRD, I got involved in the World Conference on Disaster Reduction. After that, I've been involved in two projects. One is School Earthquake Safety Initiative (SESI) and another is the Housing Earthquake Safety Initiatives (HESI) that started last year. Thank you very much.

Ms. Mishima: Good afternoon. My name is Naoko Mishima. Although I am not wearing my nametag, I guess most you are familiar with my name because I have been sending email to you all during the preparation of this meeting. It seems that I am the youngest in this group so I don't have a lot of interesting facts to share. Actually, my background is in international trade policy, which made me quite comfortable with numbers. Before joining UNCRD, I worked at the Statistics Division of the Department of Economic and Social Affairs of the United Nations Headquarters in New York. I just joined UNCRD last November 2006 so the field of disaster management is relatively new. I am hoping to learn more about the subject in this workshop. Thank you.

Prof. Okazaki: Thank you very much for your informative self-introductions from the young to the senior. Since this is the first session, it is going to be introductory. You may be asking these questions: Why UNCRD has organized this expert group meeting? How will UNCRD implement this new project? I think the introductory presentations are relevant to answer these questions. I understand there are five presentations and UNCRD will be first to do this. So now, I would like to invite the first speaker, Mr. Ando, Coordinator of UNCRD Hyogo Office, to make his presentation. He will explain the Housing Earthquake Safety Initiative (HESI).

Housing Earthquake Safety Initiative

Shoichi Ando
United Nations Centre for Regional Development
Disaster Management Planning Hyogo Office

ABSTRACT

United Nations Centre for Regional Development was established in Nagoya, Japan in 1971. Since local governments are key actors in regional development, the organization aims to train and build capacity of local government officials in developing countries. In its disaster management branch, in addition to municipal government officials, projects have involved communities, school teachers and children in the project implementation to raise disaster awareness. This is because community empowerment is a key to prevent disaster. The new disaster management project titled "Anti-seismic Building Code Dissemination project for the Housing Earthquake Safety Initiative (ABCD/HESI) will be implemented to improve the safety of houses through effective implementation of building code in the target countries. In so doing, considerations will be given to who are the stakeholders of building code dissemination, what to do to disseminate the code, and how.

1. INTRODUCTION

United Nations Centre for Regional Development (UNCRD) Disaster Management Planning Hyogo Office was founded in 1999, after the Kobe (Great Hanshin-Awaji) Earthquake that occurred on 17 January 1995. The disaster took place in the midst of United Nations International Decade for Natural Disaster Reduction (IDNDR) 1990-1999. After the disaster, Kobe has established itself as one of the centers for international disaster prevention and recovery activities. In January 2005, the World Conference on Disaster Reduction (WCDR) was held in Kobe, which resulted in the Hyogo Framework for Action.

2. UNCRD and Disaster Management

2.1 UNCRD and regional development

UNCRD was founded in 1971. The organization has approximately 60 staff worldwide, distributed among its headquarters in Nagoya, Hyogo Office, Africa Office in Kenya and Latin America Office in Columbia. UNCRD deals with environment, human security and disaster management issues and its activities encompass training and capacity development of local government officials from developing countries in charge of regional development. The organization also offers consultations to developing country governments.

The following figure shows the UNCRD organizational structure.

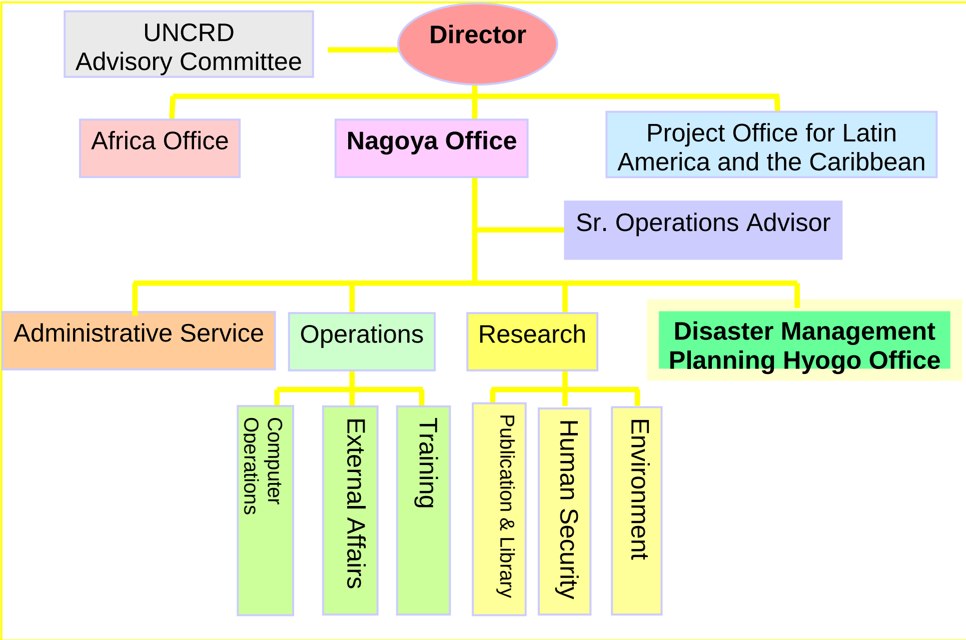


Figure 1: Organizational structure of UNCRD

Municipalities are the main stakeholders in regional development. Their leadership skills, capability, and spirit of cooperation are essential factors for effective disaster management. There needs to be close cooperation among the central government, regional authorities, municipal governments and communities.

What is recommended is planning geared toward immediate action, namely, action planning, which should be flexible and is designed to address real needs and demands. An example is to draw a map of an existing environment including the location of vulnerable facilities, paying special attention to hazard maps and ecological reserves.

Indispensable buildings such as schools and hospitals must be very carefully planned in terms of location, design, construction and maintenance, since those buildings play a crucial role during disasters: attending the injured, maintaining public order, and serving as a place of refuge for the victims.

2.2 UNCRD disaster management projects

Model projects, or demonstration such as shake table test, are used to train local government officials and experts. They are also used to raise awareness within communities and among teachers and children. UNCRD engages communities in its "Community-Based Disaster Management (CBDM)" project and teachers and children in its "School Earthquake

Safety Initiative (SESI)". Houses are targeted under a new project "Housing Earthquake Safety Initiative (HESI)".

The following is an image of activities at UNCRD Hyogo Office and their objective.

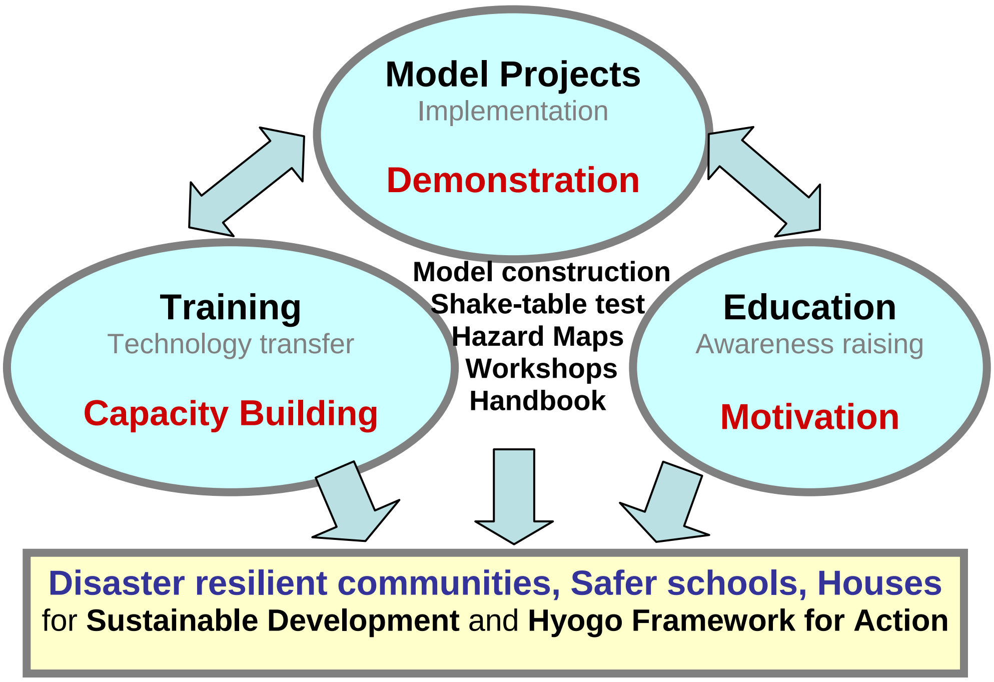


Figure 2: Objectives and activities of UNCRD

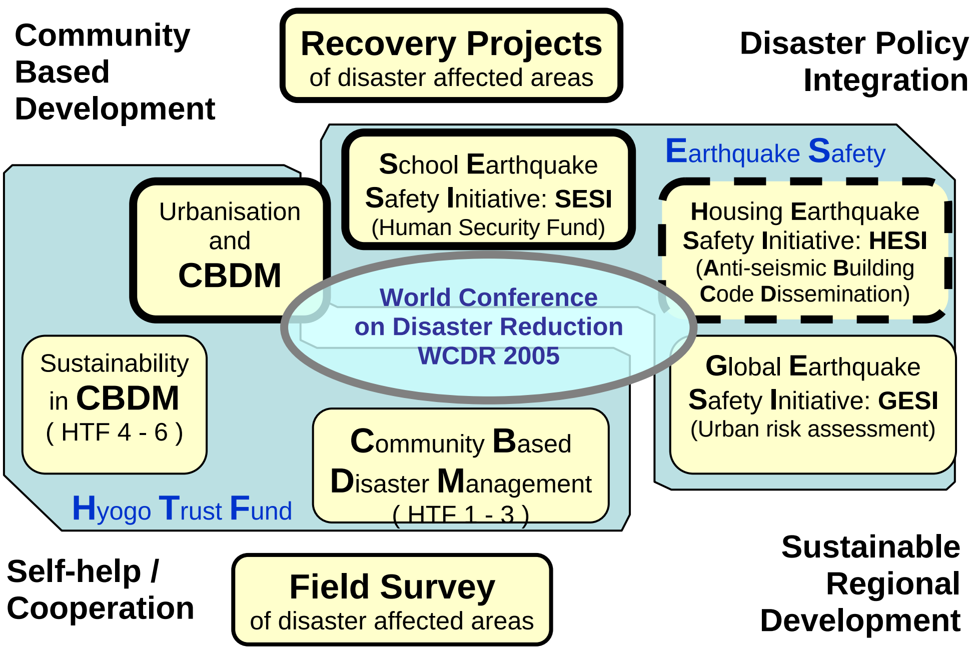


Figure 3: Disaster management projects (1999 – 2006) and concepts

Disaster management integrates many aspects. While other UN agencies such as UN Office for the Coordination of Humanitarian Affairs (UN OCHA) and the International Recovery Platform (IRP) focus on the recovery process, UNCRD activities center on preparedness. Education and community development are examples. Under the HESI project, the basis is institutional development for urban and building control.

Figure 4: Fields of disaster management activities by UNCRD

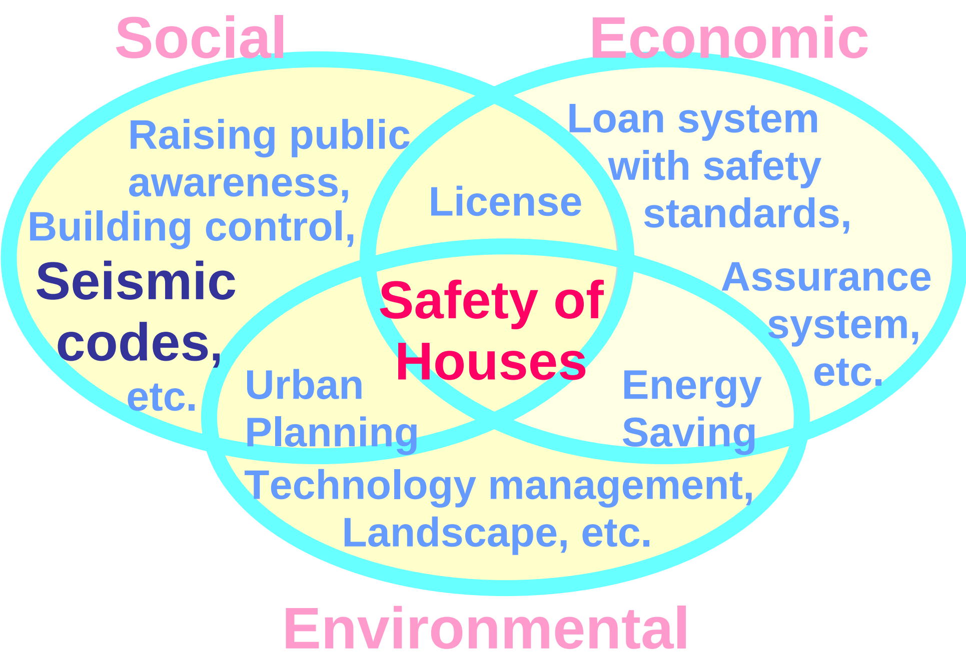


Figure 5: Scope of Housing Earthquake Safety Initiative

The following is a sample image of building code dissemination in Indonesia, which enacted its building code in 2002.

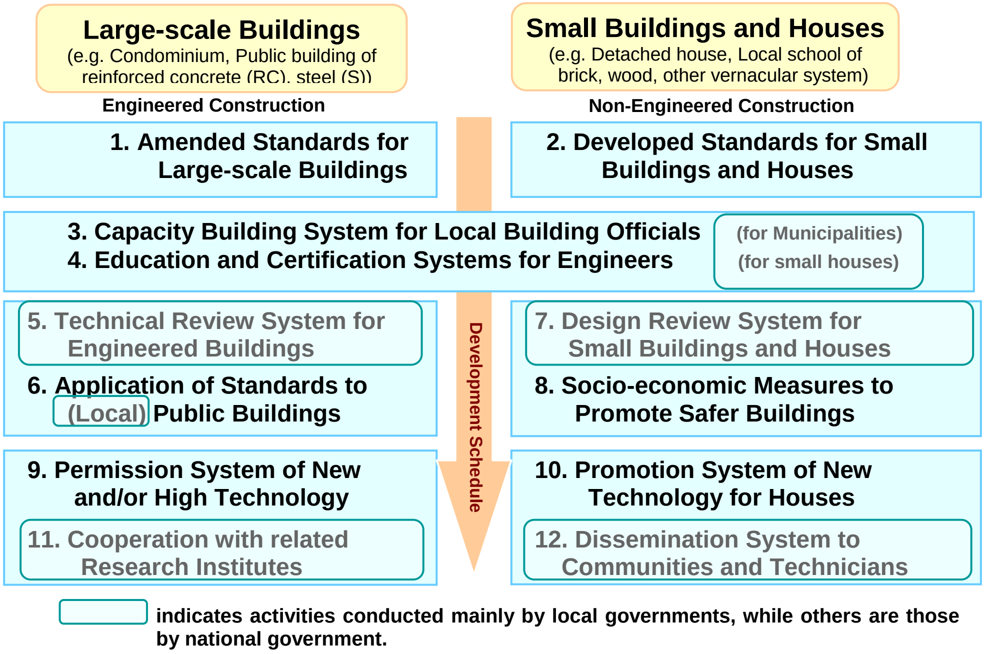


Figure 6: Measures to disseminate Indonesia building code

3. The Anti-seismic Building Code Dissemination project for the Housing Earthquake Safety Initiative (ABCD/HESI)

This project includes the following activities;

1. *Evaluate the former and current systems* related to anti-seismic building codes;
2. *Raise awareness of stakeholders*, including governments, academic institutions, NGOs and communities;
3. *Develop effective and efficient policies* on building code dissemination; and
4. *Build capacity of stakeholders* referring to evaluation and development of policies on building code dissemination.

Suggested policy tools for building code dissemination by MLIT and UNCRD can take several different approaches. The following are samples:

- Administrative and financial institutions, such as building permission charges by execution bodies;
- Research and development tools for non-engineered houses and retrofitting of existing vulnerable buildings;
- License systems for architects, engineers, building officials etc;
- Economic tools including preferential housing loan systems linked to anti-seismic building codes;

- Voluntary tools such as housing performance evaluation system; and
- Others such as information policy, decentralization, deregulation, and role sharing among stakeholders.

Key points to consider in the implementation of HESI project are as follows in the order of importance:

1. *To whom* – Who are the stakeholders?
2. *How*- How to do capacity building?
3. *What* – What we should disseminate?

Survey of Building Code Enforcement/ Dissemination in Seismic Countries

Bishnu Hari Pandey
United Nations Centre for Regional Development
Disaster Management Planning Hyogo Office

ABSTRACT

UNCRD conducted a survey to investigate facts on building codes and their implementation in countries across the world. Although most respondents have their building code in place, there are differences in scope and design as well as the degree of pervasiveness in their countries. The survey found that the building codes are not effectively implemented in many countries because of various obstacles such as lack of capacity of building officials and other stakeholders of housing safety. Shortage of awareness among the public is also a hindering factor for the effective implementation. The paper gives a brief overview of the survey as well as salient facts that were found in the responses.

1. INTRODUCTION

UNCRD Hyogo Office conducted a survey between October and December 2006 by sending a questionnaire to building control officials and experts within and outside governments in countries across the world. The questionnaire covered the following items:

- General information on the building code
- Implementation modality of the code
- Anti-seismic regulation in the code
- Socio-economic issues related to building code enforcement

A total of 30 responses have been obtained so far, covering all continents. Among them, 20 responses (10 under national jurisdiction and 10 local governments) were analyzed for this paper. It was concluded that all respondent national or local governments have their building code in place (Djibouti has a draft code), ranging from one well established with long history (Japan, 1920) to one recently enacted (Bangladesh, 2006).

2. Salient Facts from the Survey

Figure 1 shows shares of different types legal methods used to enforce the building code. Simple issuance of permit is the most common method of building code enforcement.

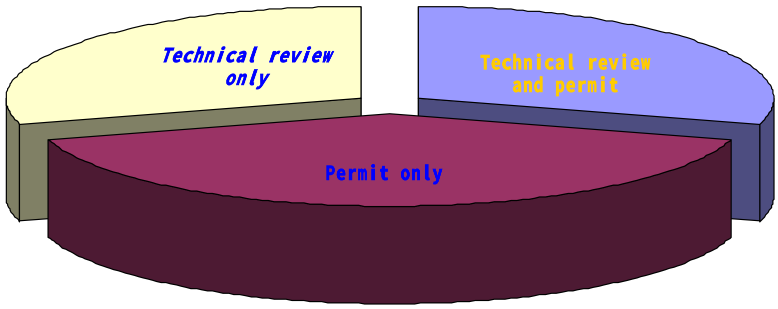


Figure 1: Type of building code enforcement

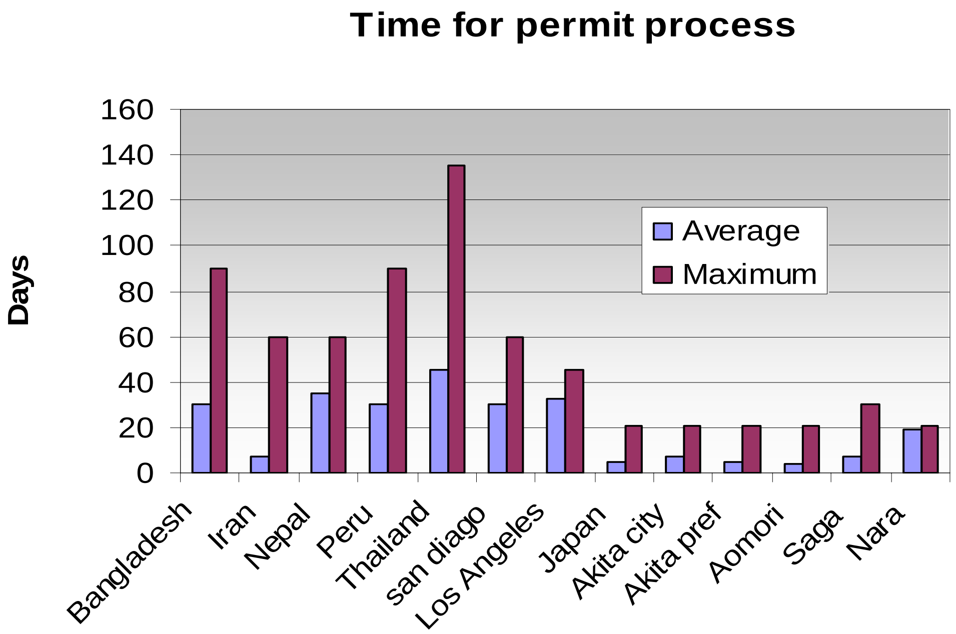


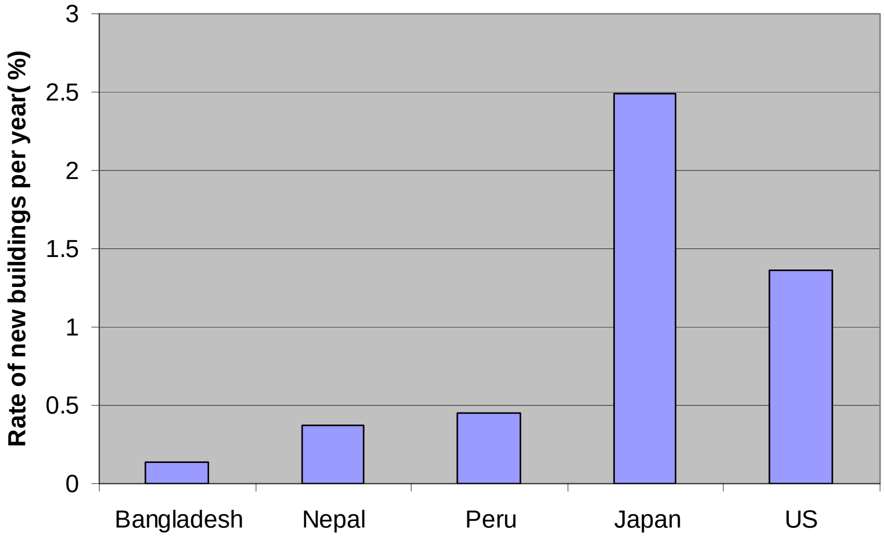
Figure 2: Time for permit process

Local governments are responsible to implement the codes in all cases, except in Romania where corps of engineers implement the code. All countries specify minimum qualification of engineers/ architects for permit application.

Table 1: Documents to submit for permit process

Building layout only	**Layout and structural drawings**	**Layout, drawings and calculation**
Romania	Bangladesh, Nepal and Peru	Algeria, Iran, Japan, Thailand and USA

Rapid population growth in developing countries is not catching up with the construction capacity, resulting in poor construction practices and less formalization of buildings.



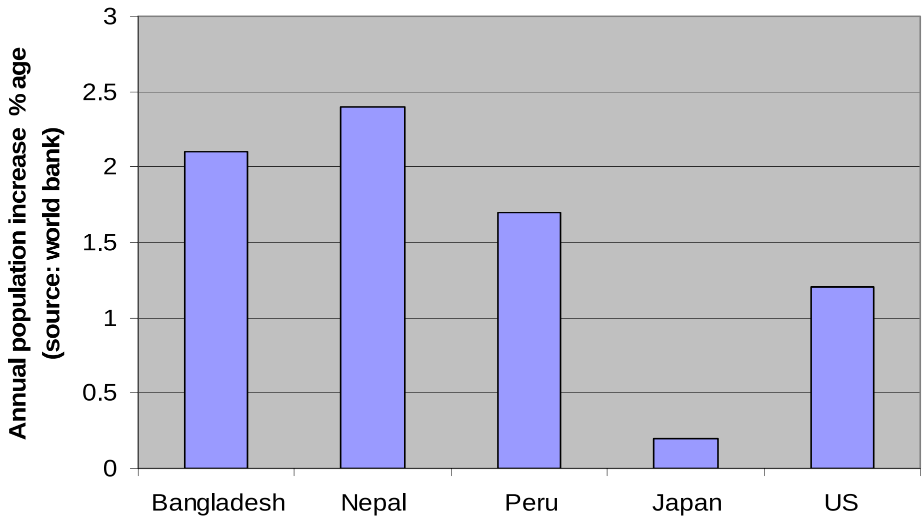


Figure 3 (above): Annual building construction rate
Figure 4 (below): Annual population growth

Figure 5 shows costs of RC construction (engineered) in terms of required numbers of annual per capita income in different countries. In Nepal, for instance, it takes more than 90 years of income to build RC building, thus it is very difficult for people to afford engineered, safe RC houses, which leads to a widespread presence of non-engineered houses (80% of total stock) as shown in Figure 6.

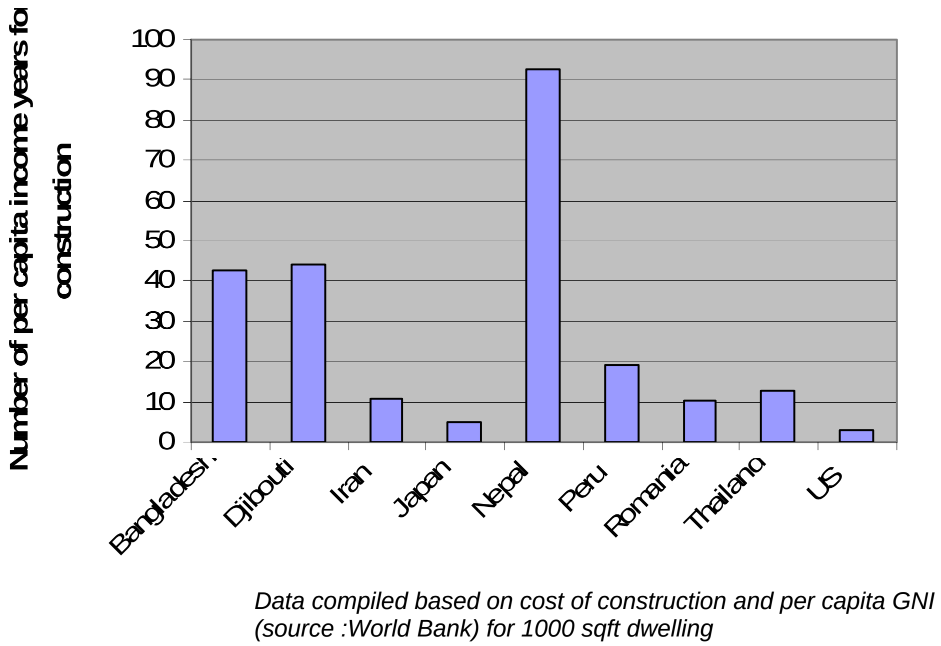


Figure 5: Cost of RC construction

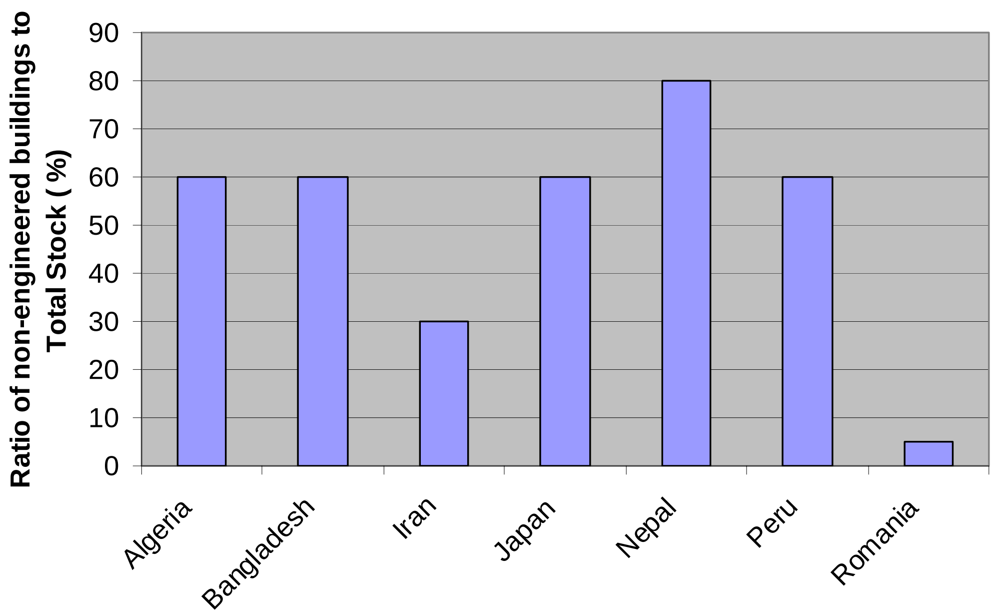


Figure 6: Non-engineered buildings

With respect to whether guidelines for non-engineered construction are available, 75 percent of the respondents said yes and 25 percent said no.

Table 2: Types of building codes

Specification-based building codes	Performance-based building codes
Bangladesh, Iran, Peru, Romania	Algeria, Djibouti, Nepal, Japan (including local governments), Thailand, USA

3. **Opportunities**

The survey revealed the following positive factors:

- Local government are mandated for code enforcement;
- Qualification of building control officers are spelled out in regulations; and
- Seismic provisions are incorporated in the respective building codes.

4. Problems

Below is a summary of problems that hinder the effective implementation of building codes that were identified by respondents in their respective countries:

Implementation system

- Absence of supervision system (Nepal, Peru)
- Non-robust permit process (Thailand)
- Regulation don't cover all buildings (Thailand)
- No consensus sought among stakeholders (Iran)
- Not enough penalty system for violators (Nara)

Building code

- No commentary, no guidelines (Bangladesh, Iran)
- Not revised timely (Nepal)
- Change of codes so frequently (Aomori and Akita)
- Complex and sophisticated (Bangladesh, Saga)

Capacity of local governments

- Lack of skill of building control officers
- Underpaid staff
- No professional trainings and continuing education (Algeria, Nepal, Peru)

Capacity of stakeholders

- Lack of skill/ understanding in designers, petty contractors, and artesian
- Not enough motivation among engineers (Algeria, Bangladesh, Nepal, Peru)

Socio-economic obstacles

- Lack of awareness in public (Nepal, Bangladesh)
- Myth – high cost to follow codes (Nepal)
- Large ratio of self-built informal construction (Nepal, Peru)
- Huge cost for rehabilitation (USA)

Question & Answer

Prof. Okazaki: We can now entertain questions on the two presentations. Since I have not seen any hands yet, I will ask the first question. The ABCD stands for “Anti-seismic Building Code Dissemination”. Does the term dissemination mean enforcement?

Mr. Pandey: Generally, it is about dissemination but enforcement should also come in as a problem. Dissemination and enforcement usually come together.

Prof. Murty: One of the slides showed that guidelines for non-engineered buildings are available in at least 75% of all respondent countries. My observation is that there is only one set of guidelines that is reprinted in all countries and the same picture appears everywhere. It is also my feeling that maybe time has come to see whether that original document of 1980 is still relevant to all countries. Or else each country has to modify those documents and make country-specific documents. It seemed to come out from your slides that 75% of the countries have guidelines available. Yes, we can see that there are guidelines but the differences in the guidelines in each country will be a big question.

Prof. Okazaki: You cited that the Japanese ordinary wooden houses are classified as non-engineered. Theoretically speaking they should be engineered according to the building code because homeowners have to undergo certain specifications, although they might be exempted from this process.

Mr. Pandey: Basically, that was our understanding because almost all respondents reported that. All our respondents from Japan, both national and local governments, indicated 60 percent and I think this is a limitation we need to address. I mean, we notice the need to clarify what we really mean by non-engineered construction in the questionnaire itself. In the previous survey, we offered a definition of engineered and non-engineered construction and the respondent will simply respond to the definition we have. It is our understanding that wooden houses are non-engineered because it is how we defined it in the questionnaire; it is from our perspective – from our side. It could be the other way around. However, in the next survey, we have to address this issue and clarify whether it is really engineered and non-engineered as you mentioned.

Prof. Okazaki: One more question, you said that Japanese people cannot afford to follow building codes because it is very expensive. From that table, it seems to me that it is also very expensive for Nepalese people to build what they call a “poor house”. It is very expensive.

Mr. Bishnu: My point is like this. We know that there are “engineered constructions”, which are generally done by professional engineers. We also have “non-engineered constructions”, which are generally done by local craftsmen and masons. Now if we look at the building code, some requirements are too expensive for Nepali people to afford because it is generally based on the engineered construction standards. Following the engineered standards it is so expensive and would make it difficult for Nepalis to build a house. Thus in most cases, poor people will resort to local materials or the local system or traditional way of constructions, which are generally classified as non-engineered. The issue is that this traditional way of construction is not reflected in the building code. My point is that the building code should address these kinds of constructions as well. In many cases the building code may appear to agree to some of these constructions but in reality it is not the case. We are talking about a building code that should consider how to improve these non-engineered constructions and make them safer. I think we need to discuss the implications that come from this one.

Prof. Okazaki: Thank you very much. Are there any other questions?

Mr. Dixit: I think that this slide on "cost of RC construction" is very interesting. It is very expensive to construct RC but still people construct it. I mean there is compromise on safety. What is the implication of this? Nowadays, we still see RC constructions that are poorly built and it is very common, perhaps everywhere.

Prof. Okazaki: Mr. Thapa.

Mr. Thapa: I don't have a question but I want to share something. Anyway, if there are more presentations then I will share my point afterwards.

Prof. Okazaki: Now I would like to proceed to the next presentation. The next speaker is Professor Murty. He will speak about World Housing Encyclopedia.

The World Housing Encyclopedia :: Documenting Housing Construction in High Seismic Risk Areas of the World

C. V. R. Murty, Indian Institute of Technology, Kanpur, INDIA
Marjorie Greene, EERI, Oakland, CA, USA
Svetlana N. Brzev, BCIT, Burnaby, BC, CANADA
Craig D. Comartin, CD Comartin, Inc., Stockton, CA, USA

ABSTRACT

Recurring and colossal losses of life in earthquakes over the last three decades particularly in the Asian and African countries re-iterated the lack of public domain information on best construction and strengthening practices of housing. The Earthquake Engineering Research Institute and the International Association for Earthquake Engineering initiated in 2000 an Internet-based project called World Housing Encyclopedia (WHE) that today has a framework for sharing such information globally (www.world-housing.net). The WHE is working towards developing a comprehensive categorization of characteristic global housing construction types. This standardized format based encyclopedia provides basic information on current practice (structural systems, materials, construction methods) and its strengths and weaknesses. This information is useful to communities that are interested in safety of houses in seismic areas. In particular, governments and policy makers will find this information valuable towards improving the seismic resistance of their region's housing stock. This paper also describes the new initiatives developed by the WHE since its inception in 2000 as an encyclopedia.

1. INTRODUCTION

The Earthquake Engineering Research Institute (EERI), a nonprofit association headquartered in Oakland, California (USA), has a current project underway jointly with the International Association of Earthquake Engineering (IAEE) to build an interactive web-based encyclopedia of housing construction types in seismically active areas of the world. This project is called the World Housing Encyclopedia (WHE) (Brzev et al, 2002; Brzev & Greene, 2004; Brzev et al, 2004). This endeavor is linking over 180 volunteer engineers and architects from many diverse countries and regions, enabling them to develop and share data, and providing the worldwide housing professionals and general public with the tools to improve housing vulnerable to earthquakes, thereby saving lives and reducing future economic losses. Funding for this project is being provided by the EERI Endowment Fund and the Engineering Information Foundation of New York (NY, USA).

The purpose of the encyclopedia is to develop a comprehensive global categorization of characteristic housing construction types across the world. A housing type being practiced anywhere in the world is presented as a Housing Report using a standard information format. So, every report includes all relevant aspects of housing construction, such as socio-economic issues, architectural features, structural system, seismic deficiencies and earthquake-resistant features, performance in past earthquakes, available strengthening technologies, building materials used, construction process employed, and insurance matters. In addition to the text and numerical information, several illustrations (photos, drawings, sketches) are also included in the report. Each report contains over 20 pages of text and figures. All reports comprise a searchable database of global housing construction. Before posting on the web site, the content of each report is peer reviewed. Once the review is complete and necessary revisions made, the information becomes visible on the web site.

Besides the housing reports, the encyclopedia also contains four significant sections, namely on

- *Tutorials:* summary documents on earthquake-resistant construction related to various housing construction technologies, e.g., adobe constructions, confined masonry houses and RC frame buildings,
- *Shelters:* designs of temporary and intermediate shelters that were used in the post-earthquake scenario across the world,
- *Resources:* a growing general resource section related to the basic earthquake information, earthquake behavior of buildings, earthquake-resistant design and seismic retrofitting. The resources are in the form of animations, PowerPoint presentations, documents and related web links.
- *World Adobe Forum*: documentation dedicated to the adobe constructions across the world in a format similar to the Housing Reports.

In addition to the above, the site offers news (current events & announcement) and archives (past events & announcement, and project-related conference presentations and publications, e.g., 2001 WHE Project Workshop held at Pavia, Italy).

2. The Editorial Board

The technical activities of the WHE are steered by an international team of 25 professionals specializing in different aspects of seismic safety of buildings and structures. They bring relevant experience from 18 seismically active countries across the World (Table 1).

Table 1: Editorial Board Members of The World Housing Encyclopedia

S.No.	Name	Country
Editor-In-Chief		
1	C. V. R. Murty	India
Managing Editor		
2	Marjorie Greene	USA
Members		
3	Vanja Alendar	Serbia
4	Qaisar Ali	Pakistan
5	Christopher Arnold	USA
6	Svetlana N. Brzev	Canada
7	Marcial Blondet	Peru
8	Jitendra K. Bothara	Nepal
9	Andrew W. Charleson	New Zealand
10	Sheldon Cherry	Canada
11	Craig D. Comartin	USA
12	Dina D'Ayala	United Kingdom
13	Dominic M. Dowling	Australia
14	Heidi Faison	USA
15	Jorge Gutierrez	Costa Rica
16	Andreas D. Kappos	Greece
17	Chitr Lilavivat	Thailand
18	Marjana Lutman	Slovenia
19	Ofelia Moroni	Chile
20	Kimiro Meguro	Japan
21	Farzad Naeim	USA
22	Jelena Pantelic	USA
23	Virginia Rodriguez	Argentina
24	Laura D. Samant	USA
25	Baitao Sun	China

3. World Housing

This is the core competence of WHE, where it offers information on broad types of housing practiced worldwide. A number of construction technologies have been and are being adopted worldwide to build houses. These technologies include:

- *Adobe Houses*: This type of housing is built by common man, and generated from raw/processed earth. These are the weakest of the houses built.
- *Wood Houses*: This type of housing is built by common man and by organised communities with formal support of craftsmen. The primary material used is wood in its different forms. There are many forms of these: bamboo frame; plank, beam & post system; and engineered timber houses. Understandably, their quality varies depending on the level of technical inputs used.

- *Stone Masonry Houses*: This is a very widely used housing form worldwide. The main materials used in the walls are blocks of natural stone material available, like granite, laterite, sandstone, and slate. There are stone masonry houses with and without mortars; when mortars are used, they are either mud-based or cement-based. A variety of roofing systems are adopted including tiled roof supported on wood trusses, asbestos or steel sheets on steel trusses, and reinforced concrete slab. It is built by common man as well as by organised communities with formal support of craftsmen.
- *Brick Masonry Houses*: This is another common construction type. Clay mud is used to form regular-sized masonry units. These units are sometimes burnt in a kiln, and simply sun-dried. This is also a very widely used housing form worldwide. Brick masonry houses are made with and without mortars; when mortars are used, they are either mud-based or cement-based. These units are the main materials used in the walls. It is built by common man as well as by organised communities with formal support of craftsmen. Again, a variety of roofing systems are adopted including tiled roof supported on wood trusses, asbestos or steel sheets on steel trusses, and reinforced concrete slab.
- *Confined Masonry Houses*: This type of housing has been practiced in many vernacular forms worldwide, particularly along the Alpine-Himalayan belt. These are load bearing masonry houses improved with the help of wood or concrete frame members introduced in the walls to reduce the masonry walls into smaller panels that are more capable of withstanding earthquake shaking. The masonry could be made with either stone or brick. This system is far superior to the traditional load-bearing masonry houses. A variety of roofing systems are employed with the confined masonry wall system, depending on the geographic region of construction.
- *Reinforced Concrete Frame Buildings*: This type of housing is becoming increasing popular across the world, particularly for urban construction. It employs beams (i.e., long horizontal members), columns (i.e., slender vertical members) and slabs (i.e., plate-like flat members) to form the basic backbone for carrying the loads. Vertical walls made of masonry or other materials are used to fill in between the beam-column grids to make functional spaces. These houses are expected constructed based on engineering calculation. However, in a large part of the developing world, such buildings are being built with little or no engineering calculations.
- *Reinforced Concrete Shear Walls Buildings*: This type of housing is same as the reinforced concrete frame building but provided with a select number of additional thin vertical plate-like reinforced concrete elements called structured walls, positioned in specific bays in the plan of the building. This type of construction requires high level of engineering input like the reinforced

concrete frame buildings. This type of building with structured walls shows superior seismic performance during earthquakes in comparison to that of reinforced concrete frame buildings without shear walls.

- *Precast Concrete Buildings*: The building is built of individual high-quality factory-made components connected at site. Two styles of construction are adopted, namely (a) the components are of the RC frame building alone, i.e., beams, columns, structured walls, and slabs; and (b) the components consist of large-panel prefabricates of walls and slabs only, and not of beams and columns. This type of house construction is used in limited occasions only and that too in urban areas or mass housing projects.
- *Buildings with Advanced Technologies*: Wood houses and reinforced concrete frame houses are being built lately with base-isolation technology. Here, the building is rested on flexible bearing pad-like devices, which absorb part of the earthquake energy transmitted from the ground to the building, thereby reducing the damage in the building. This type of construction is very expensive, but such houses perform very well during the earthquakes.
- *Vernacular Housing*: House building is an activity that mankind has been undertaking since time. Many housing types as practiced today in different pockets of the world are those constructed based on “technology” handed over from one generation to the next by no known formal approach; communicates internalized these construction processes and handed over the same by world of mouth. What is impressive is that these construction schemes have characteristics that address the prevalent local conditions of temperature and other natural effects (like earthquake shaking). There is much to learn from these housing practices.

The choice of a particular type of housing is dependant on locally available materials, skills and level of technology. Current global trends indicate that the newer construction of world housing is being dominated primarily by two types of construction, namely masonry houses and reinforced concrete buildings. Increased use of RC buildings is due to real estate boom in urban areas as part of the global trend of growing number and size of urban agglomerates, and due to the perception in rural areas that this a better form of construction as it is being practiced in the urban areas.

4. Post-Earthquake Shelters

Governments across the developing world are plagued with the sudden and large requirement of temporary shelters for immediate rehabilitation of affected persons. Information on the designs of temporary shelters is sparse in the public domain. In some cases of post-earthquake scenarios, reconstruction of new houses is delayed because of a number of reasons. In such situations, intermediate shelters are required with more public & personal conveniences than those required during the emergency phase of the post-earthquake scenario. Recent experiences from Indonesia (after 2004 Sumatra earthquake) and from Pakistan (after 2005 Kashmir earthquake) emphasised the importance of developing such a database of information in public domain.

Hence, WHE is launching a new initiative to document the post-earthquake shelters that have already been built across the world after past earthquakes where large number of persons was provided shelters. As part of this new section of Shelters on this website, WHE is seeking volunteers to document (a) Temporary Shelters, and (b) Intermediate Shelters.

5. Tutorials and Guides

From the original mandate of developing housing reports, WHE has expanded its scope and would like to play proactive role in promoting earthquake-resistant construction. One way of doing this was by developing housing related technical resources (called Tutorials). WHE would like to use this to play an active role in facilitating governments and interested agencies with the use of these materials in post-disaster reconstruction projects.

Collapse or damage to buildings often contributes to unacceptably high death tolls and economic losses in a large part of the world affected by earthquakes. Countries, in which buildings are built to be earthquake-resistant, have successfully reduced losses of life and property. Hence, a better understanding among owners, designers, construction managers and government officials of how these buildings perform will help influence better building design and construction, saving lives and reducing losses in future earthquakes. With this objective, WHE has embarked on an exercise to publish Tutorials that introduce to the reader basic concepts associated with the performance of different buildings types during earthquakes. Each Tutorial addresses a single construction type, and is a collection field and research experiences from across the world on planning, design and construction of that type of construction. By design, these publications have a number of sketches and photographs for easy reading. Also, the text is kept at an introductory level so that it can be read by all concerned. Also, to reach a larger global audience, attempts are being made to publish in multiple languages.

This Tutorials and Guides section of the website contains online resources related to global housing construction technologies. These tutorials, in addition to outlining key factors affecting seismic performance, offer recommendations for improved earthquake-resistant construction practices for new buildings and for strengthening existing buildings at risk. The Tutorials contain links to the relevant publications and web sites as well as video clips.

So far, WHE has published online three Tutorials, namely (a) Adobe Buildings (in English / Spanish; Blondet, et al, 2002), (b) Confined Masonry Dwellings (in English / Spanish; Blondet, 2006), and (c) Reinforced Concrete Frame Buildings (in English; Murty et al, 2006). Work is underway on another Tutorial, namely on Stone Masonry Houses. WHE envisages developing more Tutorials on other topics like Brick Masonry Houses, Concrete Shear Wall Buildings, Precast Concrete Constructions, Timber Structures, and Advanced Housing Construction Technologies (like base isolation).

6. Library

This web site is becoming a major web-based global resource of relevant earthquake-related housing information, mainly focused on seismic risk reduction. The available resources are of four types, namely

- *Animations*: a set of computer-generated simulations of critical earthquake-related phenomena, e.g., earthquake faulting mechanisms, ductility, torsional failure, seismic response of irregular buildings, and soft & weak story effect. These animation files are rather large and may require several minutes to stream on your monitor. The animations can be best viewed using Windows Media Player.
- *PowerPoint Presentations*: a collection of personal presentations made by professionals on the subject of earthquake safety of housing;
- *Documents*: a number of valuable documents available in the public domain relevant to the subject of seismic safety of housing, e.g., publications of the US Federal Emergency Management Agency. Many of them are accessible over the internet and linked here; and
- *Related Web Links*: a relatively exhaustive related web links of other websites relevant to housing safety.

In each of these types of resources, the available material has been organized into five groups, namely

- *Basic earthquake information*: containing information on recent earthquake information, global seismicity, the nature of earthquakes, and seismic hazard, risk and vulnerability;
- *Earthquake behavior of buildings*: containing literature describing what happens to the built environment when the earth shakes underneath;
- *Earthquake-resistant design*: containing guidelines and manuals that provide information on earthquake-resistant design for various building types and construction materials;
- *Seismic retrofitting*: containing guidelines to undertake retrofitting and strategies being adopted in seismic retrofitting projects across the world; and

- *Public policy on reducing earthquake risk*: containing strategies and policies of governments across the world to reduce seismic risk due to housing and the built environment.

7. Others

In addition to the news and archives section, the WHE website has a number of other related items, including

(a) *World Adobe Forum (WAF):* The World Adobe Forum (WAF) is an exciting new medium for the sharing of information related to adobe research and application, focusing on understanding and reducing seismic vulnerability. WAF is a sub-site of the WHE. WAF includes summary papers from areas related to adobe within a seismic context, including:
- Experimental testing and analysis: soils, bricks, prisms, wall units and houses; static, quasi-static and dynamic;
- Field research: reconnaissance, damage patterns and statistics;
- Application & Implementation: promotion, training, construction, strengthening & repair.

Contributions encompass social and technical, academic and practical aspects of adobe, and focus on the processes and outcomes (inclusive of successes, lessons learned, problems and solutions).

(b) *Farzad Naeim's Annual Prize:* Farzad Naeim, Editor of EERI's prestigious journal Earthquake Spectra, and system developer for the original encyclopedia web site, has generously created an annual prize for the EERI/IAEE World Housing Encyclopedia (WHE). Three prizes ($1500, $1000, $500) will be awarded annually for the best reports on housing construction worldwide contributed to the encyclopedia web site. A subcommittee of the WHE Editorial Board will review all the reports on the web site and select reports that are comprehensive, well-presented, and well-illustrated. Each year this subcommittee will consider all reports on the web site for the prizes. Report authors do not need to apply separately for the prizes-each submission to the web site will be evaluated for one of the prizes. The selection committee will consider all reports submitted by 31 December of each year. The winners of the first three prizes will be announced in the following year.

8. Closing Comments

This encyclopedia contains information contributed by earthquake engineering professionals around the world. All opinions, findings, conclusions, and recommendations expressed herein are those of the various participants, and do not necessarily reflect the views of the Earthquake Engineering Research Institute, the International Association for Earthquake Engineering, the Engineering Information Foundation, John A. Martin & Associates, Inc. or the participants' organizations. Further, this material can be downloaded and used for educational and non-commercial purposes only; but, please acknowledge WHE as the source of the material. Should any part of this material be required for commercial use, in any other publication of the reader, written permission should be taken from the WHE.

EERI and IAEE are actively seeking participants for this project who would be willing to contribute information on the housing in their own countries. A background in architecture or structural engineering is helpful. To date, there are over 160 volunteer engineers and architects from 45 different countries involved; a complete roster of past contributors can be accessed from the left sidebar. Persons interested in contributing to the WHE may send mail to C.V.R. Murty (Editor-in-Chief), or Marjorie Greene (Managing Editor).

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Question & Answer

Mr. Dixit: Actually, there are so many people who are influenced by these concepts you had presented. I think some people are already putting them to application. My comment is that I find it somehow informal and it needs to be formalized. There are many more players in the field that need support as early as possible. That is my observation. However, I didn't see it in your menu of options.

Prof. Murty: That is what I meant when I said that we would like to develop linkages among institutions and agencies. We know that this information is useful but at this point in time, we don't have structures or systems in place. We don't have funding. Thus, we are still looking for a funding agency. Right now, what we have are all volunteers. Your point is important and I totally agree with that.

Amod Dixit: You also mentioned about the technique of support that WHE is providing and in that regard, you want UNCRD to assist you. What should be the mechanism for the World Housing Encyclopedia (WHE) to be interacting with institutions or people in project like this? You know, everyone wants to learn. However, there is no catalytic environment for doing that. The same thing is true to the experiences in India, Nepal, and Pakistan. I mean it is a shame for us if Pakistan simply appears to have no knowledge or any capacity after having all these ideas in our minds.

Prof. Murty: Dr. Ando mentioned that they are looking for people to participate in that project. What I am saying is that if they have an activity, which is aligned to the agenda of UNCRD, then they have to be with it. I think it is a good suggestion. You see they like to develop resources and want to give away resources. In that certain project, WHE will participate in the development of a particular document as well as the dissemination of that document. This is the technical aspect of our service that we can do in the first place. In the second place, we also have this group of people in WHE, who are interested in talking to government agencies in pushing the agenda for housing safety. So if you need people, we have 137 projects and document reports, where 230 people are participating. So we have a good number of people distributed throughout the country who can be your spokesperson on your agenda for housing earthquake safety in each country. There will be few from the editorial board but the large numbers are local people who will be champions to carry out important information down to the community level.

Mr. Dixit: If you don't mind, I was asking whether there is a mechanism for increasing the number of this 230 people or so to 3,000.

Prof. Murty: It is a limitation right now. That is why we need to understand what is causing the blockade. Why are we not having enough number of people? Writing a document for the website is something that is not in the normal stream. Nobody gets an advantage. People in academia don't get any credit for putting anything in the WHE website. Very few practicing architects and engineers are participating in this because it takes time to get into this level. Everybody perceives time as a resource.

Mr. Dixit: Actually, I don't want to talk much. The problem is that I don't understand what are the inhibitions of some people to write? You mentioned that these people don't have time to write.

Prof. Murty: Anybody would know that there is no time to write even just one-page. If we have 137 documents that they sent to us, I guess that is already a great deal of service they have done to us.

Prof. Okazaki: The UNCRD staff intentionally brought this publication to my desk. These are guidelines for construction in Afghanistan. When I was still working with UNCRD, we developed this guideline with the assistance of a professor from EERI (Earthquake Engineering Research Institute). This might be a good input to your project. You may upload this in the website because as you see, this is also translated into local language. This is just for your information. Any other questions or comments? Yes, Mr. Thapa, please.

Mr. Thapa: Mr. Murty, who created this WHE?

Prof Murty: I did much translation in this project but it is the Department of Engineering that initiated this. Some time ago they were looking for people, who would like to implement this concept and EERI showed great interest. That is how it started. In 1996, we were in Mexico and that was the genesis of the idea. There was a need for filling information gap. The EERI and other like-minded people really wanted to help. Then WHE was created.

Prof. Okazaki: How about financial assistance? Is it only from the EERI?

Prof Murty: EERI has nominal financial assistance to this project. In fact, all the materials, which were sent to us, are at their own costs. The only thing that requires a little bit of budget is the website maintenance that is done in San Francisco right now. EERI pays the cost for that. Those publications I mentioned are also generally funded by EERI's money. Right now, most people in WHE are only volunteers. However, if we could find financial support, our activities will increase and then we can recruit people on a short-term basis. After that we will move to another issue that needs to be addressed.

Prof. Okazaki: Now, I would like to invite the next speaker, Mr. Takahashi from the Hyogo Prefectural government. He will speak about the "Execution of Building Administration in Hyogo Prefecture".

Execution of Building Administration in Hyogo Prefecture

Nobuaki Takahashi
Building Guidance Division, Hyogo Prefecture

ABSTRACT

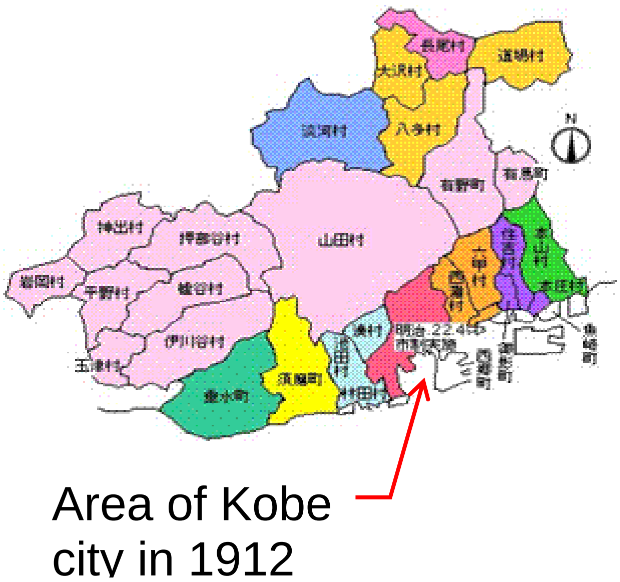
The first prefectural building code was established in Hyogo Prefecture in 1912, which was enforced only in a limited area in Kobe City. Although it did not contain an anti-seismic provision, it was added later after a major earthquake disaster. This paper provides an overview of the historical development of the building code in the prefecture, and later in the country, and the administration of the code in the prefecture. Later, the paper discusses the implications of having widespread vulnerable houses in the event of an earthquake. The Great Hanshin-Awaji Earthquake that struck the prefecture in 1995 caused collapse of many houses, claiming almost 90% of all life losses. Following the disaster, the prefectural government launched various programs and schemes to improve housing safety such as a government financial assistance scheme to help house owners to check seismic safety of their houses and improve earthquake resistance.

1. INTRODUCTION

Hyogo Prefecture is located in the center of Japan. The area of Hyogo Prefecture is about 8,400 square meters and the population stands at about 5.5 million today. The first building control law in Hyogo Prefecture was established in 1912. In addition, the urban building law was established in 1920.

The Hyogo building regulations did not apply to the whole prefecture but only to the center of Kobe city, which is the prefectural capital. The following map shows entire Hyogo Prefecture. The light brown area in the south-eastern part is today’s Kobe City. Within the city, only the green zone that appears in map 2 adapted the regulations.

Map 1: Hyogo Prefecture



Map 2: Map of Kobe City

2. History of Building Control in Hyogo Prefecture

2.1 Building control in the early 20th century

The structural code of the 1912 regulated the building shape but lacked an anti-seismic provision. Similarly, an anti-seismic provision was absent in the Urban Building Law of 1920 when it was first adopted. At that time, the structural strength of most buildings relied on the skills of master carpenters. As a result, a large number of buildings were damaged by the Great Kanto Earthquake in 1923. To prevent repetition of the disaster, an anti-seismic provision was added to the code. In this period, the police was in charge of building administration; hence, government officials regulated building construction in collaboration with the police.

2.2 Building control in the 1950s

The Building Standard Law of Japan was established by the national government in 1950. At that time, the building manager guided the field manager on construction sites. Hyogo prefecutral government had about fifty building officials who were in charge of visiting construction sites and guiding the application of the national building code.

The building managers were guided to put up a notice of a work sheet on the wall etc. If there were no notice on the construction site, the laborer was required to inform the unit officer. The building officials checked the bar arrangement of the reinforced concrete structure. This practice was not mandatory but was exercised in Hyogo Prefecture.

2-3. Housing Loan Law

Housing Loan Law was also adopted in 1950 to improve structural techniques. This law defined the standard of structural techniques and requirements for the inspection on the construction sites. Most people built their wooden houses in light of the Housing Loan Law. The building officials usually checked the application of the standard with construction companies. Then, the officials executed the interim inspection. This practice was useful for the application of the law to all housing construction. Because traditional Japanese houses are made by timber, the skills of master carpenters were very high. In order to fill the gap in skills of carpenters with different levels of experience, the law defined structural requirements for wooden building.

The reinforced concreted structure was not common at that time. The public sector built many houses and schools, and building officials guided field managers to ensure all construction work was carried out in compliance with the law. The interim inspection was especially useful in this regard.

3 Great Hanshin-Awaji Earthquake

3-1. Damage from the earthquake

The 1995 Great Hanshin-Awaji Earthquake revealed structural vulnerability of many houses and buildings. The following pictures show damage of buildings from the earthquake.

Photo 1: Collapsed old wooden houses

Photo 2: Road covered by collapsed houses

Photo 3: Collapsed electric light poles

The number of deaths in this disaster was 6,434 according to the recent data. The number of deaths just after the earthquake was about 5,500. There were several causes for fatalities, but the main cause was the collapse of houses, accounting for about 88% pf total deaths. Housing collapse also caused fire, which claimed about 10% of the victims. Therefore, it can be concluded that most deaths owed to housing collapse.

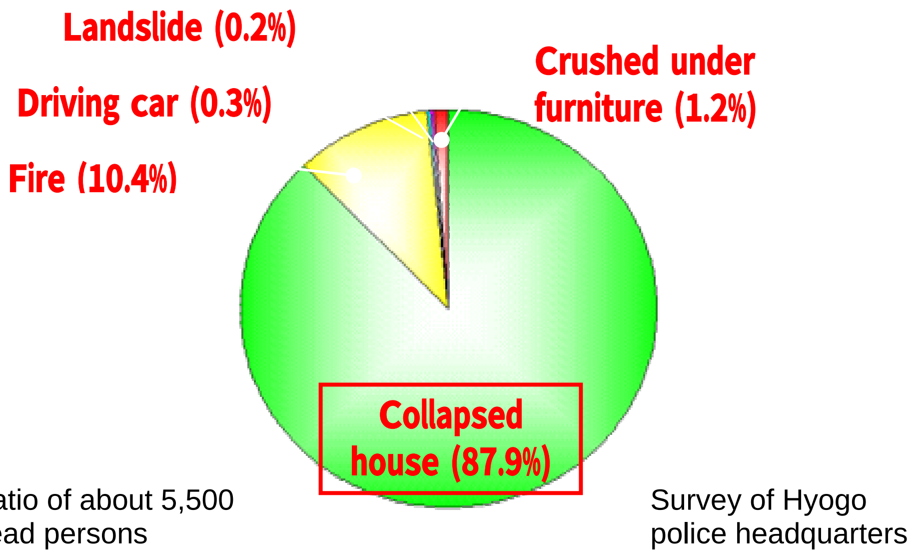


Figure 1: Causes of deaths just after the Great Hanshin Awaji Earthquake

3-2. Disaster prevention measures in Hyogo in the pre-disaster era

Hyogo Prefecture began offering training courses for seismic check-up specialists in 1996. The prefecture also adopted a support scheme for building owners to conduct anti-seismic checks of their houses in 1996. So far, 2000 house owners checked the seismic safety of their houses under this scheme.

The following figure shows the result of the safety checks of houses built prior to the revision of the national building code in 1981. The inspection was carried out between 2000 and 2002.

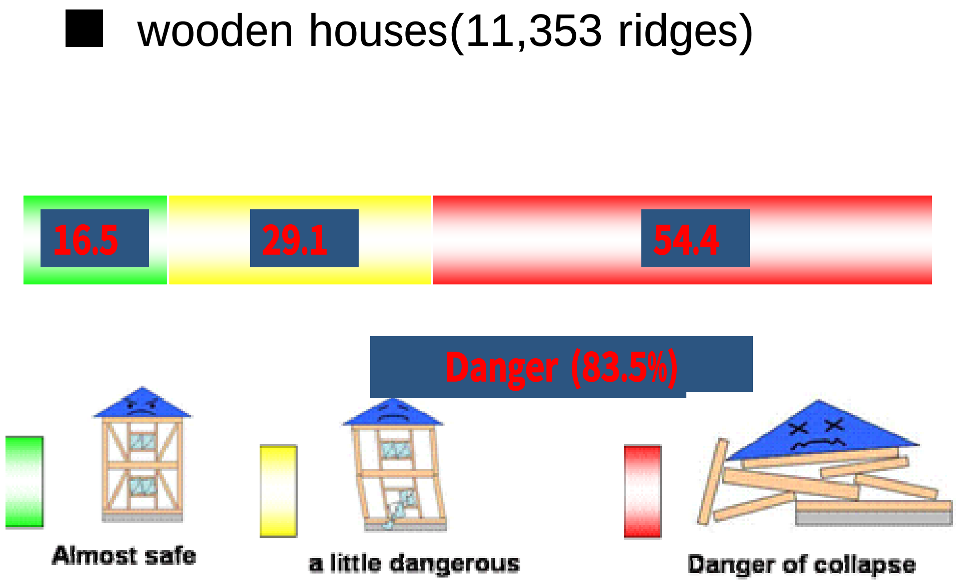


Figure 2: Result of checking earthquake safety of houses

The checking revealed that 80 percent of houses were vulnerable. Subsequently, the prefecture started a new program to support house owners to enhance earthquake resistance of their houses in 2002. To improve the quality and reduce cost of retrofitting of houses, the prefecture also held a competition to develop reasonable methods of housing safety improvement in 2004 and 2006.

3-3. Information for residents

As a means to inform potential danger to residents of old houses, Hyogo Prefecture uses a photograph that captures the result of an experimentation conducted by E-Defense. In the experiment, two wooden houses, both built prior to the revision of the building code in 1981 but one having been given enhanced seismic resistance, are tested on a shake table. The house that has not seismically been reinforced collapses from the same intensity of a tremor in the end. The experiment clearly marks the effectiveness of the anti-seismic retrofitting and helps encourage residents to strengthen their houses.

Photo 4: Shaking table tests on conventional wooden houses at E-defense (21 Nov 2005)

Question & Answer

Prof. Okazaki: Thank you Takahashi-san for your very interesting and informative presentation. Do you have any question about the execution of building administration in Hyogo prefecture? Looks like that you already raised several questions at their office while we were there earlier.

Prof. Otani: I would not ask any question but I would like to make some comments regarding the presentation. This has reference to the Building Standard Law, which was issued in 1950's. This was the time after the war and most of Japan was completely devastated. One of the major agenda of the government then was to reconstruct the country. During that time, the government building officials had more knowledge about structural engineering than private architects. Why? Because most constructions during that time were done by officials belonging to the Ministry of Construction who were required to have more knowledge. In that way, government officials could guide private architects and structural engineers towards better construction. Most of the buildings were 3-storey and those of residential and apartment during that time. However, things have changed now. 60-storey high or high-rise constructions are very common nowadays. This is very different from the situation familiar to building officials who are still in the government now. Thus with this, the government officials do not have the opportunity to design or give instructions to private architects at this point in time. So the situation has completely changed. Private construction engineers now have greater knowledge than the government officials. So if we talk of the Building Standard Law in the context of 1950s then certainly the government officials had more knowledge. However in the present context, it is the opposite. If I may relate this to the findings of the survey, which reported that in some countries government officials have little knowledge about building structural behavior, this explanation may be considered in the case of Japan at the end of World War II. Thank you very much.

Prof. Okazaki: Thank you very much for that comment. It looks like some government officials are losing some capabilities but that is true. Yes, Mr. Thapa, please.

Mr. Thapa: Actually, when the country is in the preliminary stage of development, the government is the largest developer. In a developing country, the government plays the major role. However, as the country develops, the private sector comes into the picture and they take over many functions of the government. I think this is the case in Japan when it comes to knowledge of private engineers and contractors.

Prof. Okazaki: Any other comments or questions? Thank you very much again Takahashi-san for your presentation.

Prof. Okazaki: The last speaker will be Mr. Narafu. He will speak on "BRI R&D Initiative on Housing Safety to Mitigate Earthquake Disasters" particularly in developing countries.

BRI R&D Initiative on Housing Safety to Mitigate Earthquake Disasters in Collaboration with Research Institutes

Tatsuo Narafu
Building Research Institute, Japan

ABSTRACT

Building Research Institute started an initiative on housing safety to mitigate earthquake disasters in collaboration with research institutes focusing on conventional houses. The paper introduces the outline of the initiative and progress so far including Background information, Outline, Research topics and the Justification, Activities in 2006 and Proposed Components (Action Programs) for the next steps.

1. BACKGROUND OF INITIATIVE

Large scale earthquakes always cause tremendous damage to human societies especially in developing country. Building Research Institute has been contributing to mitigate disasters through organizing/managing Group Training Course on Seismology and Earthquake Engineering financed by JICA, offering technical supports to JICA projects for establishing research and development centers in developing countries and related activities.

Based on these experience and expertise, Building Research Institute started a research and development project with three Japanese institutes namely National Research Institute for Earth Science and Disaster Prevention (NIED), National Graduate Institute for Policy Studies (GRIPS) and Mie University in collaboration with research institutes in developing countries.

Figure 1: Participants for the group training courses in BRI

	Country	Project	Period	Counterpart
	Indonesia	The project on the development of appropriate technology for multi-story residential building and its environmental infrastructures for law income people (Structure)	1993-1998	Research Institute for Human Settlements
	Peru	The Japan-Peru Earthquake and Disaster Mitigation Research Center Project	1986-1991	Japan-Peru earthquake and Disaster Mitigation Research Center
	Chile	The joint study project on earthquake disaster mitigation in Chile	1988-1991 1995-1998	University of Catolica
	Mexico	The earthquake disaster prevention project	1990-1996	National Disaster Prevention Center(CENAPRED)
	Turkey	The project for the establishment of Earthquake Disaster Prevention Research Center on the Republic of Turkey	1993-2000	Earthquake Disaster Prevention Research Center
	Egypt	The joint study project on the evaluation of seismic activities in the plate boundaries in Egypt	1993-1996	National Research Institute of Astronomy and Geophysics (NRIAG)
	Kazafstan	Continuation and improvement of the seismological monitoring system for earthquake preparedness and risk in the region of Almaty city in theRepublic of Kazakhstan	2000-2003	Institute of Seismology, Ministry of education and Science, Republic of Kazakhstan
	Romania	The project on the reduction of seismic risk for buildings and structures in Romania	2002-2007	National Center for Seismic Risk Reduction, Ministry of Transports, Constructions and Tourism (MTCT)

Figure 2: List of JICA/BRI Projects for establishing R&D centers in developing countries

2. OUTLINE OF COLLABORATIVE R&D IN 2006 – 2008

2.1 Project Summary of the R&D

2.1.1 Background of the Project

Each of large scale earthquakes causes serious damages to human societies with enormous number of loss of lives and the injured. We experienced Northern Pakistan Earthquake in 2005 and Off Sumatra Earthquake in 2004, which reminded us that mitigation of disasters is one of the most urgent task for research community in Asia.

2.1.2 Purpose of the Project

The purpose of the project is to enhance capability of research and development for earthquake disaster mitigation of each country in earthquake prone areas in Asia, which is expected to be basis for development of strategies and policies on their own initiative.

2.1.3 Outline of R&D Activities

We implement collaboration in R&D with five Asian countries, Indonesia, Nepal, Pakistan, Turkey and Japan, for three years focusing on the most essential research topics for mitigation of disasters listed below with an additional participant of Peru. We will share information and experiences through workshops, video conferences, and mutual visits of researchers and implement joint research/surveys/ experiments.

Topic 1: System for Estimation and Management of Seismic Risks of Buildings
Topic 2: Feasible and Affordable Seismic Constructions
Topic 3: Strategies for Dissemination of Technologies to Communities

2.1.4 Contribution for Mitigation of Disasters

Each of countries is responsible for its people to provide safe constructions and needs to develop capacity of R&D of their own as the basis of development of the strategies and policies. In this context we propose a collaborative research and development among six countries with full utilization of IT tools such as video conference system and internet. We are to share experiences and achievements of each partner country to make the best use of them through collaborative R&D activities and will further disseminate them to neighboring countries through international symposiums or other events.

2.1.5 Management of the Project

R&D activities of each topic are to be facilitated and managed by the designated researchers listed below. BRI coordinates activities among the three topics for integrated approaches for mitigation by organizing annual workshops and video conferences.

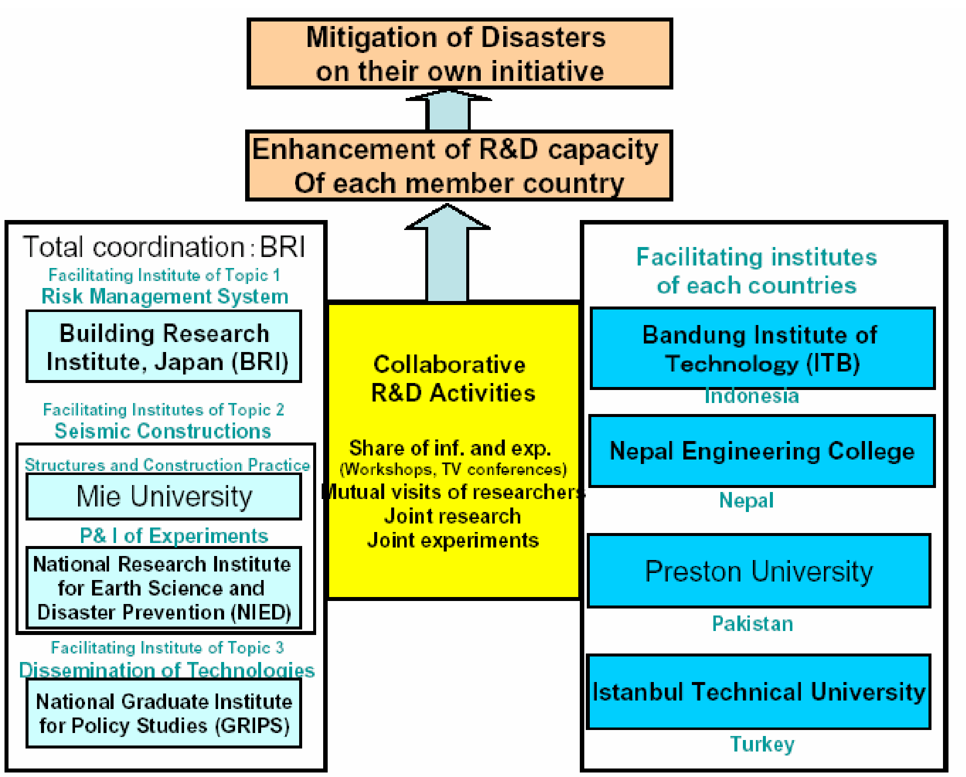


Figure 3:Organization Chart of the R&D

Topic 1: System for Estimation and Management of Seismic Risks of Buildings
Toshiaki YOKOI
Chief Research Scientist, Building Research Institute, Japan (BRI)

Topic 2: Feasible and Affordable Seismic Constructions
Co-Facilitator on Structures and Construction Practices

Toshikazu HANAZATO, Professor, Mie University
Co-Facilitator on Planning and Implementation of Experiments
Chikahiro MINOWA, Chief Research Engineer
National Research Institute for Earth Science and Disaster Prevention (NIED)

Topic 3: Strategies for Dissemination of Technologies to Communities

Kenji OKAZAKI, Professor, National Graduate Institute for Policy Studies (GRIPS)

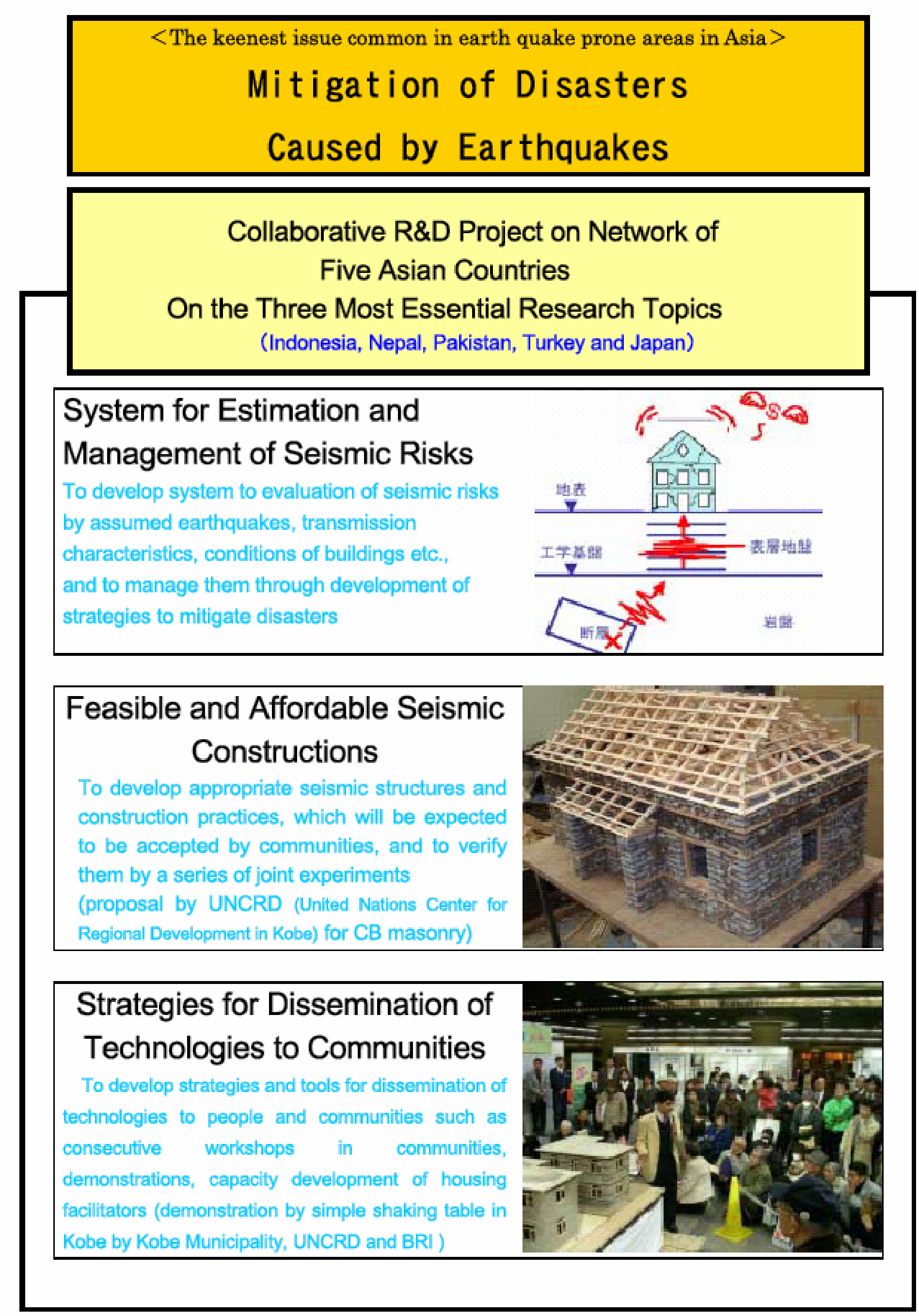


Figure 4:Target and Research Topics of R&D

2.2 Focus and its Justification

2.2.1 Focus

The R&D focuses on realization of mitigation of disasters, not research achievement, and concentrate to conventional houses which is the main cause of human losses. R&D is to contribute to prepare complete proposal of strategies for mitigation without "missing ring".

2.2.2 Justification

- Why mitigation of disasters by earthquake?

Because earthquakes cause serious damages to human societies.

- Why conventional houses in developing countries?

Because developing countries are more vulnerable as they could not afford to be prepared and conventional houses should be focused as it is the main cause of human losses.

- Why feasible and affordable technologies?

Because excellent technologies in industrialized countries can not necessarily improve the situation in developing countries. We need appropriate technologies which are affordable and feasible for developing countries and have to learn every aspects of each of the communities such as materials, structures, labor skills, relevant industries, local economies, and households.

- Why dissemination of technologies to communities?

Because technologies can work only when people/communities accept and introduce them into their life. Therefore dissemination of technologies to people/communities is the key issue. We have to be aware that developing countries do not have social infrastructures for disseminating technologies such as enforcement of building codes or standards.

- Why risk management system?

Because evaluation and awareness of potential risks of earthquakes is the very first step for the mitigation strategies. It allows us to prepare future possible earthquakes effectively and could contribute to enhance awareness of policy makers, people in practice, people in communities and all relevant people.

- Why wider range of people to be involved?

Because mitigation of disasters requires comprehensive approach including science, engineering, socio-economic studies, policy studies, development studies and other relevant studies.

3. ACTIVITIES in FY 2006/2007

Basic scheme of R&D

- Platform for collaboration among participating institutes

Mutual visits, events for sharing information and discussion, communication by IT tools like video conference system and internet

- R&D components for collaborative works

Any people/institute is eligible to propose and participate in them. All the institutes are requested to contribute in any of possible ways like planning and elaborating activities, management of implementation, preparation works, field survey, analysis, financial support and others. The achievements will be shared through the Platform mentioned above.

Tokyo International Workshop on Earthquake Disaster Mitigation for Safer housing

Plenary Meeting was held on November 22 connecting nine venues in five countries as follows. Total participants including people who accessed by PC on Web Streaming Service is 189.

Main venue: Tokyo, Japan
Sub venues:
Japan: Tsukuba
Indonesia: Jakarta, Bandung, Banda Aceh
Nepal: Kathmandu
Pakistan: Islamabad
Turkey: Istanbul, Ankara

Group discussions on each of participating countries were organized as follows connecting each country and Japan. (Japan Time)

Group Discussion on Peru:	10:00 – 12:00 (only Tokyo)
Group Discussion on Indonesia:	12:00 – 14:00 (Jakarta, Bandung, Banda Aceh and Tokyo)
Group Discussion on Nepal:	14:30 – 16:30 (Kathmandu and Tokyo)
Group Discussion on Pakistan:	15:00 – 17:00 (Islamabad and Tokyo)
Group Discussion on Turkey:	17:30 – 19:30 (Istanbul, Ankara and Tokyo)

Figure5:Plenary Meeting of Workshop

Figure 6: Group Discussion on Turkey

4. PROPOSED ACTION PROGRAMS (COMPONENT)

Following seven action programs for three-year R&D were proposed and to be elaborated for the implementation.

Research Topic 1
<System for Estimation and Management of Seismic Risks>
Component 1-1
Contrivance for Seismic Risk Recognition by Communities
Component 1-2
Compilation of Available Information/Data on Seismic Risks

Research Topic 2 <Feasible and Affordable Seismic Constructions>
Component 2-1
Research on Feasible and Affordable Seismic Constructions with Full Scale Model Experiment
Component 2-2
Bridge between Engineering and Construction Works
Component 2-3
Development of Simple and Affordable Seismic Isolation

Research Topic 3
<Strategies for Dissemination of Technologies to Communities>
Component 3-1
Strategies for dissemination of Technologies to Communities
Component 3-2
Compilation of Manuals/Guidelines/Brochures for Safer Housing

5. ACTIVITIES FOR COMING YEARS

BRI and the partner institutes will carry our R&D activities on seven components mentioned above in cooperation with any institute which are interested in safer housing to contribute mitigation of disasters.

Question & Answer

Prof. Okazaki: Thank you very much Narafu-san for your presentation. I would like to supplement his presentation, particularly concerning the dissemination of technologies. With the assistance of the 4 countries, we are going to conduct a field survey. This is aimed at understanding and analyzing peoples' perception on seismic risk and the incentives for safer houses. In particular, we want to know how people perceive the safety of their houses and lives or how they think about improving the safety or something like that. We are going to conduct interviews to 800 households in these 4 countries. I think this may be of interest to you. I think this is particularly interesting to Professor Murty because we are requesting the 4 countries to take photos of the 800 houses. These photos might be fantastic input to the World Housing Encyclopedia. Do you have any comments or questions? Yes, please.

Prof. Pique: I would like to point out that in the listing of BRI projects, the second project listed here mentioned Japan-Peru Earthquake and Disaster Mitigation Center, where in fact my university (Peru National University of Engineering) is the partner that created this. I am surprised why the name of my university does not appear here. Maybe it is the reason we are not receiving invitations because the name of the university is not written. I think when I go back to Peru, I need to organize our group again so that we can do more active participation in this.

Mr. Narafu: I am sorry I forgot to mention Peru. Earlier I just referred to Asian areas but actually, we prepared another budget for Peru and some other countries. BRI prepares this budget. In fact during our last workshop last November, we invited a professor from Peru.

Prof. Pique: Yet, I did not know this. I was not informed.

Mr. Narafu: I am sorry we have not informed you. However, we informed several people in Peru. Time difference was one of the considerations during the last workshop. Actually, we were not able to connect with Peru during that time. The meeting was conducted from 4 o'clock in the evening until 9 o'clock at night in Japan. This is around 9:00 pm until 12:00 midnight in Peru. However, we have the web-stream services that you can access through the Internet. If you'll access our homepage, you will see the whole situation. The video is also available on the website of World Bank.

Prof. Okazaki: Any other comments or questions? Yes, Professor Murty.

Prof. Murty: I just want to get an idea as to what are the specific projects under the different components you mentioned. Are these activities been already implemented?

Mr. Narafu: The project that has already started is the one, which we work with Professor Okazaki. The other projects may be implemented in the next fiscal year while some others may be implemented within this fiscal year.

Prof. Okazaki: Under this component on dissemination of technologies, as I said earlier, we are going to conduct a field survey this year. We are also collecting basic data on success stories about the community-based disaster management for the dissemination of technologies. For the field survey, we already conducted the pre-testing to more than 60 households. If you are interested, I can share to you the preliminary results.

Prof. Okazaki: Any other questions or comments? Ok, thank you very much Narafu-san. Actually, this session is scheduled to finish by 6pm but if you have any general comments or questions, we will welcome it to the floor.

General Discussion

Mr. Thapa: I want to thank all the presenters for excellent and informative presentations. I am a delegate from Nepal. I just knew that among the countries surveyed, Nepal ranked first on the prevalence of "non-engineered" buildings. It is true. Most of those houses are in the rural parts of the country, where the access of engineers and architects is very difficult. In addition, the building process is "owner-built" system. The owner is responsible for the design and construction of the building, explaining why most houses are non-engineered.

The problem in my country is that concrete building has become a status symbol. A person who builds a concrete house is considered rich. Let me cite one example. During the time of my father, when a person would like to marry, the girl will ask what type of house he has. If he has a concrete house then he is desirable. However, concrete technology is a delicate matter. I feel that it should be 100 percent engineered technology. We cannot just close our eyes to people who build the house for the purpose of status symbol alone. It may create disaster. The problem is that in the rural areas of Nepal, especially in the Himalayas, people are using concrete buildings without perfect knowledge of concrete technologies. Masons and craftsmen just go there and build these concrete houses. I am very scared that during earthquakes, these buildings are the most vulnerable. I am thankful to BRI project because this capacitates the masons and craftsmen through training and information awareness. They will know that concrete houses are not just for status symbol at all. Concrete technology need to be adapted with precision and calculations for building. I think that without raising the level of awareness, people will remain confused. On one hand, they were told that concrete is stronger in making building. People like us told them. The reality is that the buildings which are constructed that way are also vulnerable. That is my experience. Thank you.

Prof. Okazaki: I am not only worried about the concrete buildings in the rural areas but also the concrete buildings in midtowns. Yes, Professor Otani, please.

Prof. Otani: Let me tell you a Japanese experience. In 1950s reinforced concrete constructions were not so popular in rural areas. It might be popular in urban areas but not in the rural areas. At that time, the Ministry of Education started to replace wooden school buildings with reinforced concrete. The structural engineers and the architects of Japan assisted in writing the standard specifications and also the methods of structure calculations. They then started to construct buildings using reinforced concrete. Actually that was a very good approach to transfer the reinforced concrete technology to rural areas. Anyone who wanted to build reinforced concrete could see how the school buildings were made, they could look at the construction process, and they learned how to build better reinforced concrete buildings. Without this experience, I don’t think we could build better reinforced concrete constructions in various households in the rural areas.

Prof. Okazaki: Thank you very much for your comment, Professor Otani. Mr. Hadi, please.

Mr. Hadi: Thank you. We are experiencing a somewhat similar problem in Indonesia. People simply want to build nice and big houses. As researchers in this field, we are scared because most of these houses are poorly constructed and they don’t follow the building standards. For example, in the urban areas, there are thousands of houses that are built using reinforced concrete. Although they use materials like sand, gravel, etc., they don’t know how to arrange them. We already anticipated that these houses would collapse whenever there is an earthquake. Indeed these buildings collapsed when an earthquake struck. After that we did research on how to improve new houses. However, we are faced with another problem. How about those already constructed buildings, which are probably poorly built or weak? This is one area where maybe you can help us think about.

Prof. Okazaki: Actually, the retrofitting of existing houses is another area to think about.

Mr. Dixit: Going back to Nepal, we are importing steel and cement because we are not producing these. Some people are using these imported materials but the majority is using the traditional house construction, which is stone masonry. So in the case of Nepal, we really need to teach people how to build better stone masonry. I have a query address to Mr. Takahashi. I noticed in his report that in terms of anti-seismic system in Hyogo Prefecture, there have been various activities including training courses for specialists, support for owners in checking buildings and improving houses, as well as the competition for developing anti-seismic construction methods since 1996. This shows that Hyogo Prefecture has wealth of information in this field. May I request then some documentation of these efforts? I don’t mind if these are in Japanese, we could easily find someone who could translate it into English.

Prof. Okazaki: I believe that tomorrow Mr. Okasaki will explain the case study of Japan on building control system and codes, and maybe on the area of anti-seismic system. Details like subsidy for specific diagnosis, financial assistance for retrofitting, etc. will be explained. If these items don't get explained tomorrow, I will do it for you. However, if you specifically want the anti-seismic system of Hyogo Prefecture then we will help you get some of the documents. According to Mr. Takahashi, Hyogo prefecture has several publications in this regard and these documents are readily available.

Prof. Murty: In Chile, after the 1960 earthquake, they issued regulations on reinforced concrete walls and frame buildings. They said that frames alone are not good enough to prevent earthquake damage. They further said that they learned such things through observation of the experiences of Japan.

Prof. Otani: That is a very interesting story. Perhaps it refers to the experience after the 1923 Kanto Earthquake. This was the case before the earthquake happened. Professor Naito Tanaka designed one bank building using midi structure walls. When an earthquake occurred, it didn't suffer any damage at all. We compared this case with the steel construction that was built by American company from the East Coast, which collapsed because it didn't have structured walls. Learning from that experience, many people since then have been promoting the use of structured walls.

Now, going back to reinforced concrete construction, I don't think non-engineers should do this. For me, this is very complicated in terms of materials and design. This should not be left alone to non-engineers. One should have good knowledge of the behavior of reinforced concrete. This is crucial because reinforcements are covered by concrete. Thus, it is impossible to judge reinforced concrete buildings after they are constructed. In Japan, we have vulnerability assessment method but that is based on the premise that once a reinforced concrete building is constructed, it used 20% seismic forces. This is the assumption. Without this assumption, I don't think the Japanese vulnerability assessment method works. All buildings in Japan after 1950 followed the building code. This means that buildings possess minimum lateral form of resistance. It is through this that we can easily judge the performance of existing buildings. In other countries, perhaps without these similar regulations, I don't think it is possible to judge the performance of those already constructed or completed reinforced concrete buildings.

Prof. Okazaki: Thank you very much, Professor Otani. Mr. Murty, please.

Prof. Murty: I would like to react to what Professor Otani has just said. Traditionally, if the intensity scale of the earthquake is 10 then RC buildings will collapse, correct? In India, even if the intensity scale is 7, the buildings will collapse. One of the reasons is that we don't have systems in place to judge the performance of constructed or completed buildings. Now, let me go back to the question regarding concrete walls. Do you have any regulation allowing concrete walls or frames to be designed?

Prof. Otani: Yes, the building code requires the use of 20% seismic force when building reinforced concrete.

Mr. Budiono: This is in addition to what Mr. Hadi said earlier. In Indonesia it is really difficult to control building constructions because the government needs help of the local government officials. Considering this, I am very interested in knowing the dissemination techniques and targets. The first is how to disseminate to local officials and professionals the information about building law. The second is how to disseminate the information to communities and non-engineers. Those buildings that collapsed were those that didn't follow the building standards. This is complicated because when the local officials approved the permit to construct the buildings, they lack the capability to check whether the constructors follow the standards. It is in these contexts that I am interested to know the appropriate approaches and targets for information dissemination. Thank you.

Prof. Okazaki: I think that is one of the reasons why UNCRD initiated this expert meeting and discussion to help address those problems. Mr. Thapa, please.

Mr. Thapa: This question is addressed to Professor Murty. I am sorry to tell you that I knew about this World Housing Encyclopedia before I met you. In third week of last December, I attended a conference on Housing and Urban Settlement in New Delhi. There were so many experts there and so many people. However, I was wondering what the World Housing Encyclopedia was doing there?

Prof. Murty: India is not the only country that is facilitating this housing safety related conferences or meetings. There are many other countries too, but the seismic safety is not on their agenda. That is why the World Housing Encyclopedia is not invited to these meetings. We only find the information about the meetings in some publications and newspapers. The World Housing Encyclopedia is participating in many of these conferences and meetings to inform people in governments and those in power about the seismic safety. This is where we found ourselves to have strong role to play, which is to inform governments across the world about seismic safety and send them documents about construction safety designed for their respective countries. We don't send general documents but specific documents for their countries.

There are two types of documents we are distributing. One is just a brief document describing the vulnerable aspects. The other is detailed document for officials to read. This is exactly our agenda and I am glad that there are some people here who have common interest like BRI, UNCRD, and some of you here. I am sure that partnership will grow here because there is so much to do. We are not competing here. We are not eating other people's lunch. We are here working together saving people's lives. Thank you.

Dr. Ando: I would like to respond briefly to the problem raised by Mr. Budiono of Indonesia regarding appropriate dissemination of technology as well as capacity building for non-engineered constructions. With regard to Japanese experience, which was also explained by Mr. Takahashi, the

Director of the Building Guidance Division of Hyogo Prefecture, the Public Housing Loan Corporation provides detailed instructions to the carpenters. Well, this corporation is now privatized. Anyhow, before privatization, perhaps half of the newly constructed houses were built using the assistance provided by the corporation. Through the Public Housing Loan Corporation system, the carpenters follow guidelines and can invite representatives to do interim and final inspections. I think this is one example of the system in ensuring housing safety.

Mr. Pandey: Let me make some comments about the case of Nepal. You may ask why there is so much training now regarding RC construction. There is a story behind this. In 1988 we experienced an earthquake. In the rural areas, there were lots of buildings made of stone and bricks that collapsed. However, as I read in many reports, some of the buildings that were made with RC that time stood still. It withstands the earthquake. Based on that experience, people got an impression that RC construction is good. They think that is better than those made of bricks and stones. However, this notion has not been analyzed carefully. Training in the construction of RC building continues without clear experience whether or not RC buildings will resist earthquakes. We don't have experience. We don't have lessons learned. However, we have some information about the experiences of other countries like Turkey and India showing that RC constructions collapse during earthquakes. My point is, if I may quote an idea I heard yesterday, is that "experience is good but the costs is very high". We already saw how we paid for the experiences we had in Kobe, in Turkey, and other countries. In this regard, I think it is good to collaborate with WHE here not just about constructions and buildings but also to come with documentation on collapsed houses. For me this kind of documentation is very important to convince and to show to the people how vulnerable some constructions can be. I knew that in New Zealand, they really stopped constructions of RC buildings on the bases of the experiences they learned from Turkey and other countries. New Zealand government learned about these experiences through the newsletters, documentation, and other circulations. These are the kind of stuff we can do. Once we've done these we can circulate them in other countries.

Prof. Okazaki: We will continue our discussions tomorrow so let me adjourn this meeting for the time being if you don't have any specific request or question. Thank you very much.

II. OFFICIAL OPENING SESSION

III. CASE STUDY PRESENTATIONS: Indonesia and Japan

January 18, 2007 (Thursday)
Chair: Mr. Kishore Thapa

Historical Development of Building Codes in Japan
Shunsuke Otani, Professor, Chiba University, Japan

Case Study of Indonesia: Building Administration
Antonius Budiono, Director, Directorate of Building and Neighborhood Development, Ministry of Public Works, Indonesia

Research and Development in Indonesia: The Anti-seismic Building Code Dissemination
Maryoko Hadi, Researcher, Research Center for Human Settlements, Ministry of Public Works, Indonesia

Outline of Building Regulation in Japan, 2007
Atsuo Okasaki, Director for International Codes and Standards, Housing Bureau, Ministry of Land, Infrastructure and Transport, Japan

Discussion

Historical Development of Building Codes in Japan

SHUNSUKE OTANI
Chiba University, Japan

ABSTRACT

The development of building codes in Japan is briefly reviewed. The modern seismology in Japan as well as in the world started after a small earthquake in Yokohama. Japanese seismic design requirements have been revised after bitter experiences of earthquake disasters, such as the 1923 Kanto earthquake, the 1968 Tokachi-oki Earthquake, and the 1995 Kobe Earthquake disaster. For the protection of society from earthquakes, it is important to provide (a) vulnerability assessment procedures of existing buildings, (b) methods to strengthen vulnerable buildings, (c) evaluation methods of damage levels of affected buildings and (d) methods to repair and strengthen the damaged structures.

1. INTRODUCTION

A small earthquake (M 5.5) jolted Yokohama, causing minor damages to buildings. This earthquake attracted the attention of visiting scholars from Europe and the United States, invited by Japanese Government to teach western technology in Japan. The Seismological Society of Japan, the world first scientific organization on seismology, was established in 1880 under the leadership of John Milne (1850-1913), the pioneering researcher of modern seismology in the world. Prominent visiting scientists and engineers joined the society, such as J. Milne, J. A. Ewing, T. Gray, C. G. Knott, T. C. Mendenhall, John Perry, and William Ayrton. The transaction of the society was published in English.

Modern seismographs were developed by Ewing, Gray and Milne. A method was introduced to estimate the maximum ground acceleration during an earthquake from the overturned tomb stones (Milne, 1885).

A huge intra-plate earthquake (Nohbi Earthquake, M 7.9) hit Nagoya areas in 1891, which killed more than 7,000 and injured more than 17,000. More than 142,000 houses collapsed and more than 80,000 houses suffered heavy damage (see Photo 1). Then modern brick factories and buildings were severely damaged in Nagoya. John Milne observed that "… buildings on soft ground … suffer more than those on the hard ground." and pointed out that "… we must construct, not simply to resist vertically applied stresses, but carefully consider effects due to movements applied more or less in horizontal directions." Although he stressed the need of seismic design, no quantitative design forces were proposed after this earthquake.

Photo 1: Damage of timber houses by the 1891 Nohbi Earthquake

The first quantitative design seismic forces were required in Royal Decree No. 573 (April 29, 1915) in Italy after the 1907 Messina Earthquake in Sicilia, which killed approximately 83,000. The height of the buildings was limited to two stories, and the first story should be designed for a horizontal force equal to 1/8 the second floor weight and the second story for 1/6 of the roof weight.

2 Urban Building Law

The research on earthquake resistant construction progressed in Japan after the 1891 Nohbi Earthquake. Some researchers studied the earthquake damage of buildings from the 1906 San Francisco Earthquake. Design earthquake forces were proposed by Toshikata Sano in 1916 (Sano, 1916 and 1917).

The first law (Urban Building Law) to regulate building construction in then six major cities was proclaimed in 1919. The Urban Building Law Enforcement Order, in 1920, limited the building height to 100 feet and outlined the structural requirements for timber, masonry, brick, reinforced concrete and steel constructions. The Urban Building Law Enforcement Regulations, in 1920, outlined the structural design specifications, allowable stresses, quality of materials, dead and live loads, but no seismic requirements. The construction of large buildings was permitted only when the government aproved the application.

The 1923 Kanto Earthquake (M7.9) caused significant damage in Tokyo and Yokohama. Approximately 105,000 were killed dominantly by fire and 104,000 were injured. The damage by fire was quite large because the earthquake occurred just before noon. The Naigai building collapsed, which was nearly completed at the time of the earthquake (Photo 2). The statistics of damage on reinforced concrete buildings in Tokyo revealed relatively light damage; only 22 out of 553 reinforced concrete buildings suffered heavy damage (Table 1) although the buildings were not designed for earthquake forces. In other words, the intensity of ground motion must be not so large in Tokyo, approximately 100 km away from the epicenter.

Photo 2: The Naigai Building near completion collapsed

Table 1: Damage of reinforced concrete buildings in Tokyo

Damage level	No. of buildings
Collapse	7
Severe damage	11
Major damage	4
Minor damage	69
Light damage	462
Total	553

The Urban Building Law Enforcement Regulations were revised in 1924 to introduce seismic design of buildings, requiring that seismic design forces at each floor level should be 10 percent of the weight of the floor. This value 0f 0.1 was selected by dividing estimated maximum ground acceleration of 0.3 G (G: gravity accleration) in Tokyo by the safety factor of 3.0 used in determining the allowable stress of materials.

It should be noted that practical structural analysis methods were not available to structural engineers although the government requjired the seismic design forces in the structural calculation of buildings. Structural analysis methods used at the time were Castigliano’s theorems (1875) and the slope deflection method (1918), which were not practical for routine strcutural analyses. More practical Cross’s moment distribution method (1930) and Muto’s D-value mehthod (1933) were published later.

The Urban Building Law was gradually applied to smaller cities during the World War II. The materials for construction became difficult to obtain throughout the country. Major cities were air-raided and devastated toward the end of the war.

3 Building Standard Law

After the World War II, major cities in Japan fell into ruins (Photo 3). It was an urgent matter for Japanese to reconstruct the country from ruins, and to build new infrastructures for the society. New constitution was proclaimed on November 3, 1947, to establish democracy in the country and enforced six months later. The constitution guaranteed the human rights and freedom as long as the public welfare was not offended. It became a right of a people to construct buildings.

Photo 3: Osaka after the World War II

For reconstruction of the country, the country needed

(a) Minimum quality of buildings for safety, health and utilization,

(b) Smooth execution of construction according to the contract, ensuring the quality of construction,

(c) Conformation of legal requirements in design and construction, and

(d) Training of qualified engineers for architectural and structural design.

The following laws were issued to accelerate the orderly and efficient reconstruction of the country;

(1) Building Standard Law (1950) to safeguard the life, health, and property of people by providing minimum standards concerning the site, structure, equipment, and use of buildings.

(2) Architect Law (1950) to define the qualification of engineers who can design buildings and supervise construction work.

(3) Construction Trade Law (1949) to improve the quality of those engaged in construction trade and to promote fair construction contracts.

Building codes of Japan consists of (a) Building Standard Law (national law), (b) Building Standard Law Enforcement Order (cabinet order), (c) Notifications by Minister of Land, Infrastructure and Transport (MOLIT), and (d) Ordinances of Municipal Governments. Academic societies, such as Architectural Institute of Japan and Japan Concrete Institute, publish standards, guidelines, specifications and manuals, which are not legal documents but are considered as technical references. The technical requirements are outlined in the Building Standard Law Enforcement Order and Notification of MOLIT.

The allowable design scheme was maintained in the Building Standard Law. However, two levels of allowable stresses were adopted for (a) long-term loading and (b) extraordinary loading; accordingly, the level of seismic design forces was revised. The seismic zoning map was introduced in 1955. Height limitation to 100 feet was removed in 1963 to allow the construction of high-rise buildings; the 36-story 147-m tall Kasumigaseki Building was completed in April 1968.

The 1968 Tokachi-oki Earthquake (M7.9) hit the northern part of Japanese main island, causing damage to reinforced concrete buildings (see Photo 4), which were then believed to be earthquake resistant and safe. No one was killed in reinforced concrete buildings, but the government as well as researchers and engineers were surprised by the failure. Therefore, the Ministry of Construction organized a national project, involving researchers in universities, national research institutes and construction companies, to study the cause of the damage in reinforced concrete buildings and the method to prevent the brittle failure.

Photo 4: The Hakodate Technical University building collapsed after the 1968 Tokachi-oki Earthquake

On the basis of research, the Building Standard Law Enforcement Order was revised in 1971 to require narrow spacing of column ties. At the same time, it was generally recognized that the design requirements should be improved to reduce the damage of new construction, but that the existing buildings designed and constructed in accordance with old requirements should be retrofitted. Therefore, research efforts were made after the 1968 Tokachi-oki Earthquake, to develop (a) vulnerability assessment procedures for existing buildings, and (b) methods to strengthen vulnerable buildings. It was also studied (c) to evaluate damage levels of affected buildings in order to judge if the building could be immediately occupied for use and (d) to repair and strengthen damaged structures to the performance level required for new construction. The standard for vulnerability assessment for reinforced concrete buildings was published in 1977.

A national research project was launched to developed new seismic design requirements from 1972 to 1977. On the basis of the findings in the project, the Building Standard Law Enforcement Order was revised in 1981; i.e., the design earthquake forces are specified

(a) by story shear rather than horizontal floor forces, rather than the horizontal forces at floor levels,
(b) in terms of fundamental period of the structure,
(c) for serviceability and safety levels.

The performance of buildings under serviceability level earthquakes is examined by the traditional allowable stress procedure; the maximum stresses in the structure under combined gravity loads and earthquake forces should be less than specified allowable stresses of materials. The story drift angle under serviceability earthquake forces should be less than 1/200 of the story height for the protection of architectural elements.

The performance of buildings under safety level earthquakes is examined by the story shear resisting capacity at the formation of a collapse mechanism of the structure. If the distribution of stiffness along height and the eccentricity in plan between centers of mass and stiffness exceeds given limits, the story shear capacity should be increased to prevent failure caused by the concentration of damage in the weak story or by the torsional oscillation.

4 Damage Statistics in the 1995 Kobe Earthquake Disaster

The 1995 Hyogo-ken-Nanbu Earthquake (M7.2), commonly known as Kobe earthquake disaster, killed 6434 by direct and indirect causes. Approximately 88 percent of those died immediately after the earthquake were killed by the collapse of traditional timber houses and 10 percent due to fire.

The architectural Institute of Japan investigated the damage level of approximately 3,900 reinforced concrete buildings in the most heavily shaken areas. The damage level was classified by external observation to (a) none, (b) light, (c) minor, (d) major, (e) collapse (including those removed at the time of investigation).

Figure 1 shows the damage statistics of reinforced concrete buildings constructed before 1971 (revision of hoop spacing requirement), between 1971 and 1981, and after 1981 (introduction of comprehensive seismic design requirements). The ratio of heavy damaged buildings decreased with the construction age; i.e., the damage decreased with the improvement of seismic design requirements.

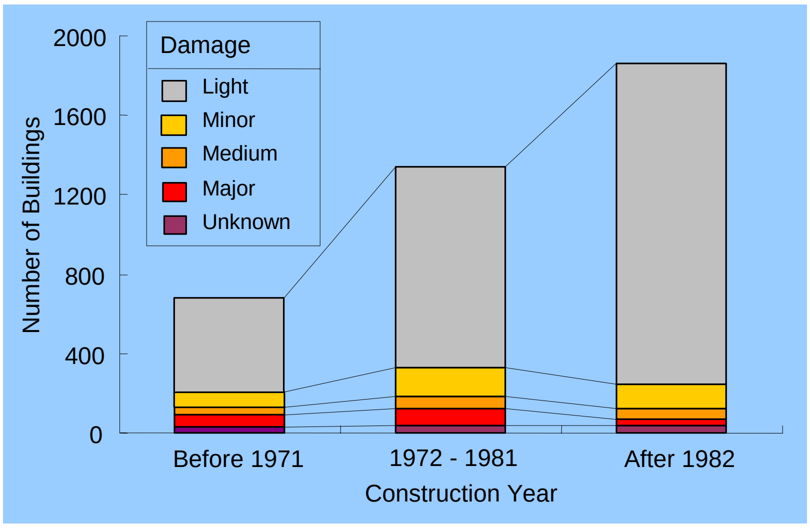


Fig. 1: Damage statistics of reinforced concrete buildings

5 Introduction of Performance-based Requirements

The Building Standard Law was revised in 1998 and the performance-based requirements were introduced in the Building Standard Law Enforcement Order in 2000 under foreign demand to open Japanese construction market. Fire-resistance and fire-prevention t requirements were significantly revised from specification requirements to performance requirements.

It should be noted that the building officials cannot determine if the performance requirements are satisfied or not in the design document. If the performance-based requirements are to be introduced in the building code, higher responsibility should be given to design engineers because high technical knowledge and ability are required and because most building officials cannot follow such high technology.

6 Summary

The modern seismology was developed in Japan by the visiting scholars from Europe and the United States, invited by Japanese government under the leadership of John Milne.

The first quantitative design seismic forces were used in Royal Decree No. 573 (1915) in Italy. The Urban Building Law Enforcement Regulations, revised in 1924, introduced seismic design forces, but practical structural analysis methods were not available at the time.

After the World War II, the following three laws were introduced to reconstruct the devastated country; (a)Building Standard Law (1950) to safeguard the life, health, and property of people by providing minimum standards concerning the site, structure, equipment, and use of buildings, (b) Architect Law (1950) to define the qualification of engineers who can design buildings and supervise construction work, (c) Construction Trade Law (1949) to improve the quality of those engaged in construction trade and to promote fair construction contracts.

The seismic design requirements were revised after each bitter experience of earthquake disasters. The aim was not to repeat the same errors in the design and construction of new buildings.

For the protection of society from earthquakes, we should provide (a) improved design procedures for new construction, (b) vulnerability assessment procedures for existing buildings, (c) methods to strengthen vulnerable buildings, (c) evaluation methods of damage levels of affected buildings, and (d) methods to repair and strengthen damaged structures.

The damage statistics of reinforced concrete buildings revealed that the damage rate decreased with construction age, indicating the benefit of improved seismic design requirements.

The performance-based design requirements in the building code should be introduced with care. High technical knowledge and ability are required for application by engineers as well as examining building officials.

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Case Study of Indonesia: Building Administration

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ABSTRACT

Indonesia faces a high disaster risk owning to frequent earthquakes and other natural disasters. Despite the fact, many buildings in the country are under risk of severe damage in the event of an earthquake because the national building code, which is designed to ensure safety of buildings, is not effectively enforced. Rapid urbanization in the country is further exacerbating the situation and many citizens remain vulnerable to a potential disaster. This paper outlines problems on building safety in Indonesia, background on the code revision in 2002 and current issues, and provides a brief explanation of the revised code and administrative process of code implementation.

1. INTRODUCTION

Indonesia is a disaster prone country with a history of diverse disasters such as earthquake, tsunami, flood and landslide. As a result, many buildings in the country are exposed to risk of damage. Some of the risk factors undermining building safety in Indonesia include:

- Not all buildings have building permit;
- Many of buildings that have building permit do not meet the building technical requirements; and
- Building design does not consider bearing capacity (traffic jam, slum area, flood, crime etc.) or refer to spatial planning (slum area, tsunami, land sliding).

2. Background

Indonesia is experiencing rapid urbanization, especially in large cities, bringing significant impacts on the developed areas as well as on their surrounding areas. The massive growth has become a significant factor in shaping and characterizing the urban form. As population density increases, integrating disaster prevention and mitigation measures in urban planning and building construction has become ever more crucial; however, until the end of year 2002, the Government of Indonesia had not had a proper national building law.

Building regulations and standards in Indonesia have not been thorough enough compared to other Asian countries. Reference to building regulations and standards was dependent on the completeness of local regulations, and particularly, on the commitment of architects, engineers and contractors. Only 70% of a total of 320 municipalities had local building regulations. Among those regulations, no more than 20% had technical provisions.

In 1996, the Government of Indonesia and the Government of Australia signed a Memorandum of Understanding on harmonization of regulations and standards. By the end of 1998, the Minister of Public Works enacted the Indonesian Building Code. Yet, due to limited technical standards, the use of international standards is recommended.

3. Law No. 28/2002 on Buildings

The draft of a national building regulation was set up in 1964 and was just legalized on 16 December 2002 as the Law of the Republic of Indonesia No. 28 year 2002 regarding Buildings. The law regulates:

- Building functions
- Building requirements
- Building process
- Role of the community
- Role of government
- Sanction

Under this law, all building constructions carried out in the territory of the Republic of Indonesia are obliged to comply with all the provisions in the law. The law regulates the principle and normative matters, and the provisions on its implementation will further be laid down by Government Regulation and/or other statutory regulations and standards, including Local Government Regulation.

The proceeding figures explain the regulatory framework and scope of the code and the administrative process of the code implementation.

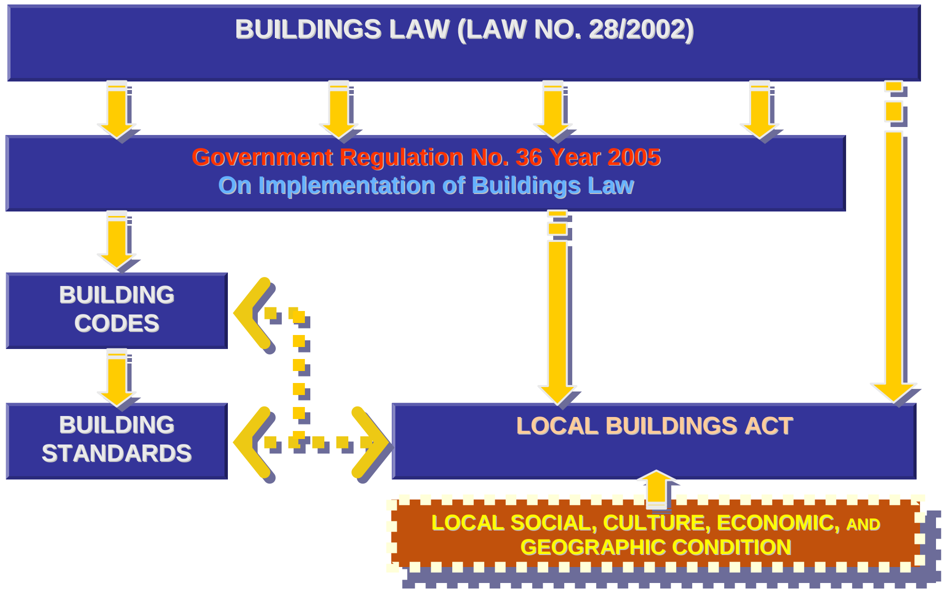

Figure 1: Building law and regulation in Indonesia

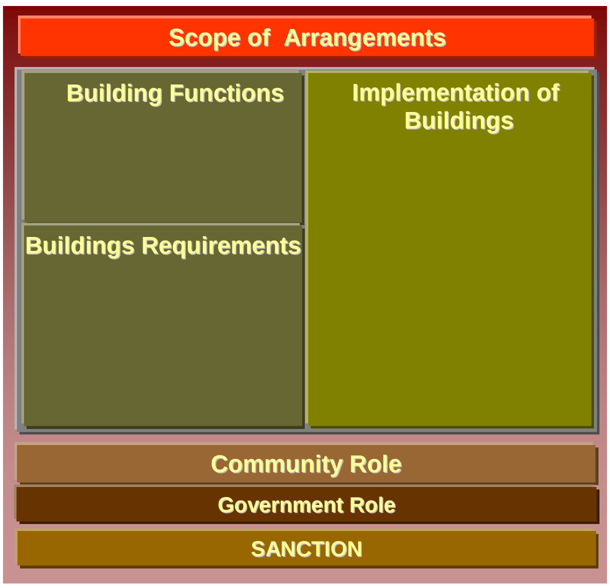

Figure 2: Scope of arrangements

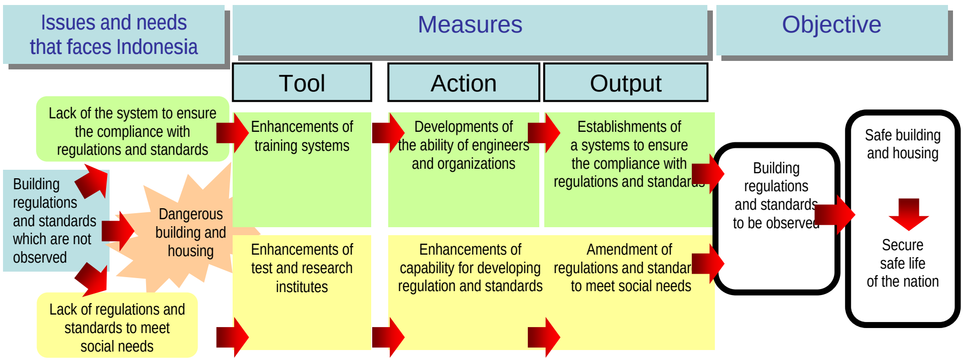

Figure 3: Indonesian disaster reduction plan

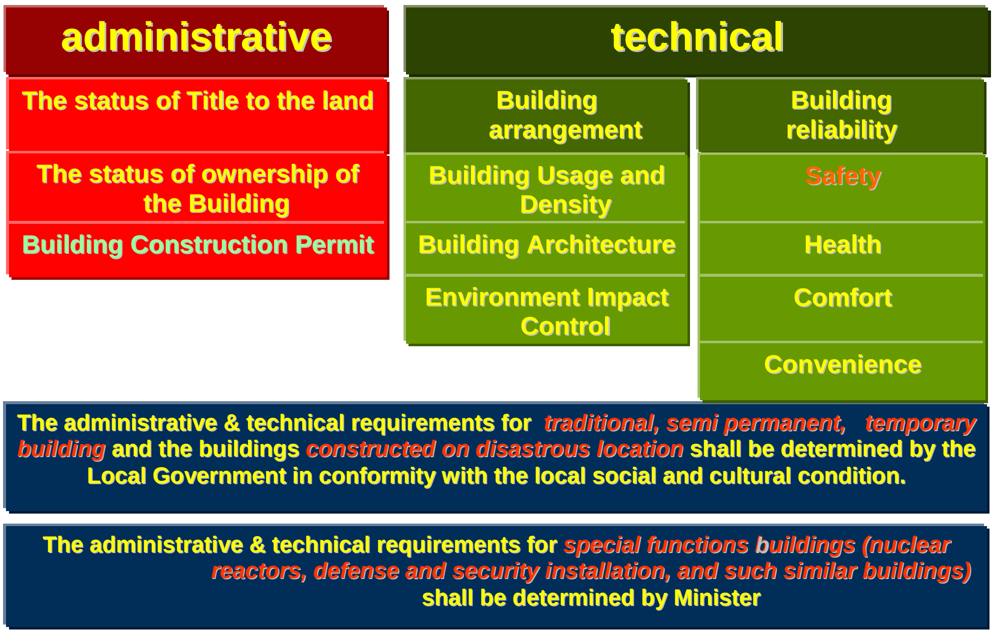

Figure 4: Requirements of Law NO. 28 Year 2002 for buildings

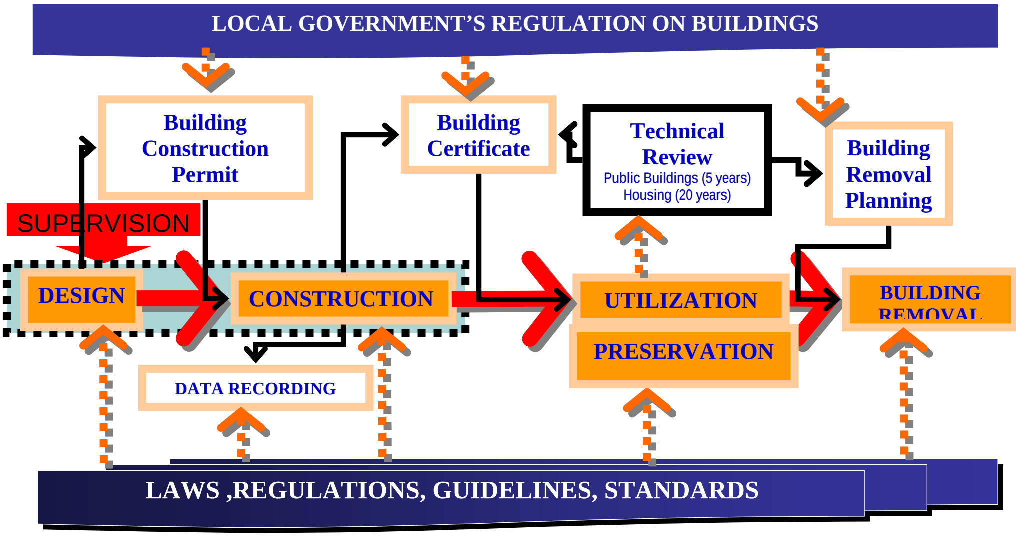

Figure 5: Building Construction Process based on the Law NO. 28 Year 2002

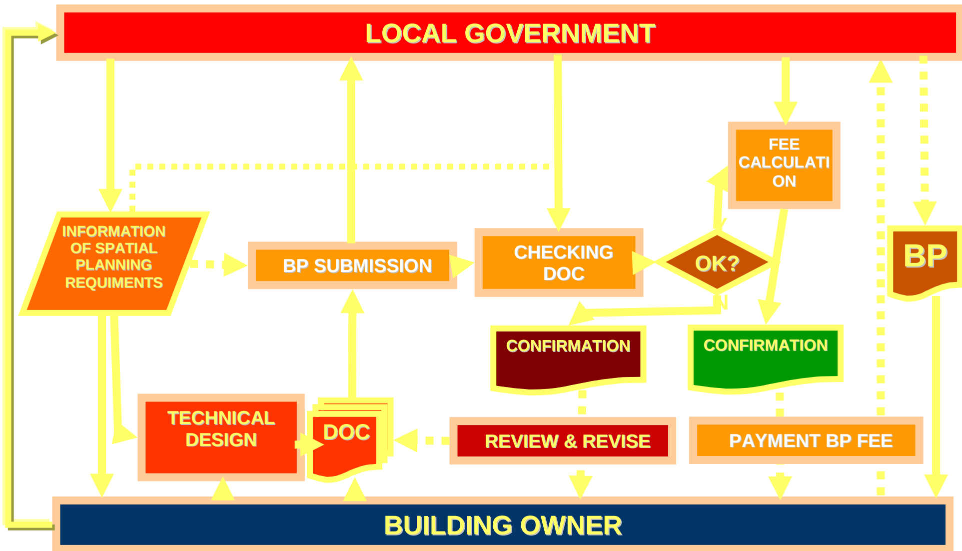

Figure 6: Building Permit Process for housing $\leq$ 2 floors

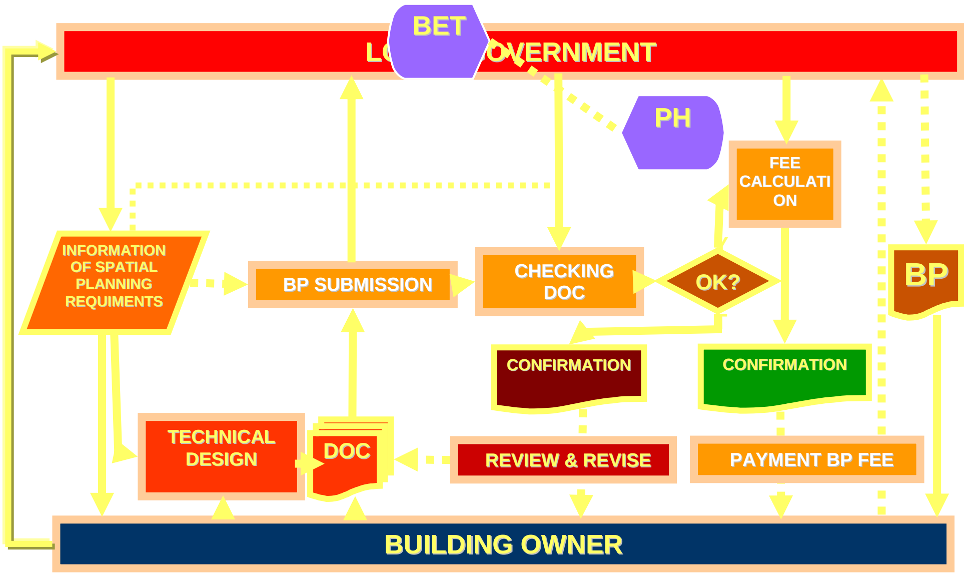

Figure 7: Building Permit Process for public buildings

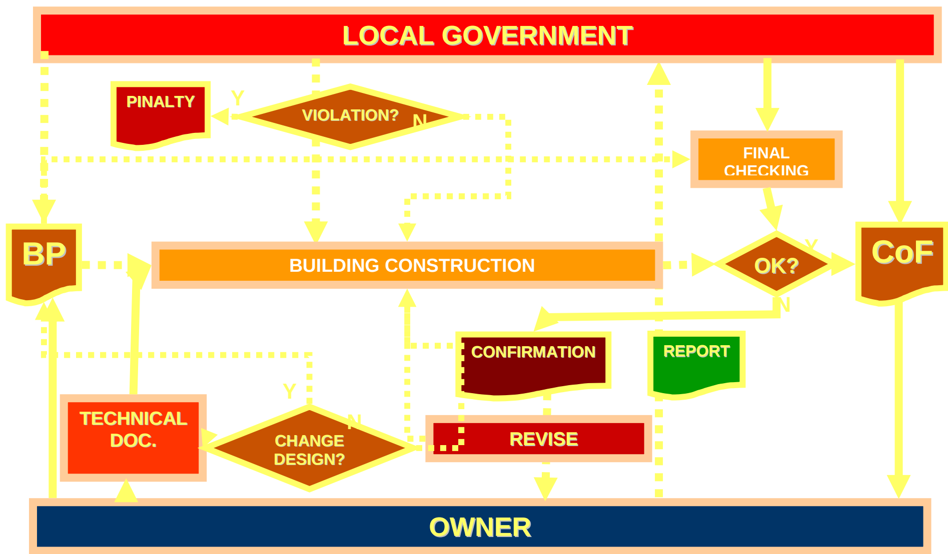

Figure 8: Certificate of Fitness process

Certificate of Fitness is first issued when construction is complete. Extension of Certificate of Fitness is required every five years for public buildings and every 20 yeas for private houses.

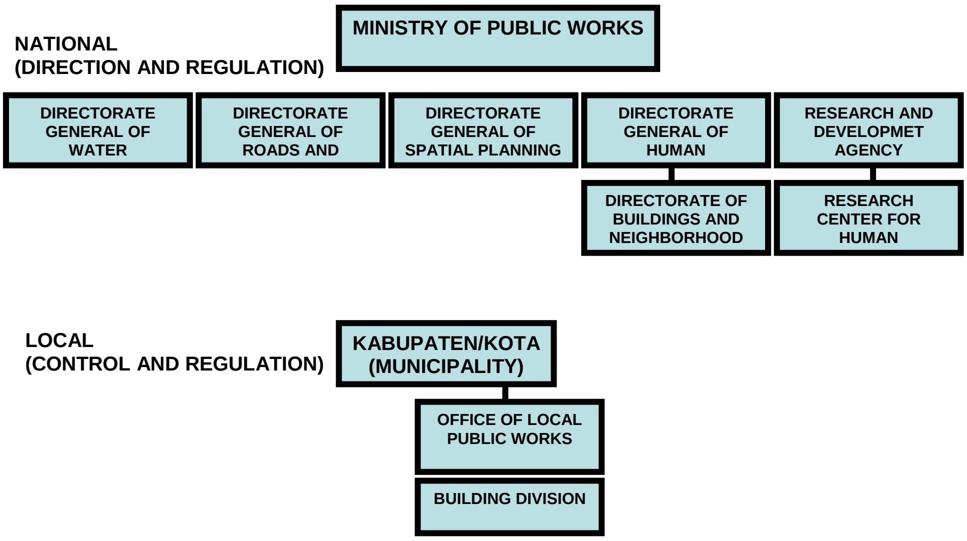

Figure 9: Executor body

4. Indonesian Regulations & Standards in the Future

Based on the provisions regulated in the Building Law and the Construction Services Law, the government and other professionals are required to review and improve all previous regulations and standards related to buildings process.

In the year 2010, all kabupaten/kota (more than 450) are expected to have Local Building Acts and all public buildings are expected to have Certificate of Fitness.

Research and Development in Indonesia: The Anti-seismic Building Code Dissemination (ABCD)

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Research Center for Human Settlements
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ABSTRACT

Being a country surrounded by three huge tectonic plates of Eurasia, Australia and Pacific plates, Indonesia is one of the most seismically active countries in the world. The fight against potential damage, destruction and lost life from earthquakes using appropriate mitigation measures have been done continuously. One important aspect is the designs and construction of anti-seismic buildings. Consequently, to reduce the catastrophes of earthquake disasters, the activities of the Research Center for Human Settlements (RCHS) are concentrated, among others things, on research and development of anti-seismic building technology for houses, to produce and disseminate earthquake resistant code (standard) and organize seminars/training, etc. to improve earthquake preparedness to local community.

Keywords : Earthquake, anti-seismic building, code

1. INTRODUCTION

Indonesia is an earthquake country which in very active seismically, because it is surrounded by three huge tectonic plates, namely, Eurasian Plate to the North, Australian Plate to the South and Pacific Plate to the East. In the past three years, tragic major earthquakes and tsunamis struck Nanggroe Aceh Darussalam and Nias Island (earthquake and tsunami) followed by Yogyakarta (earthquake) and Pangandaran (tsunami) killing about 150.000 people and destroying cities, buildings and houses. Earthquake disasters affect the country's economy and deteriorate its entire social infrastructure.

There are activities, projects, and programs that can be used for reducing the effects of earthquake disasters, among which the most important are the design and construction of anti-seismic houses. Based on experiences and field survey at the disaster location, the destruction appears when the requirements on materials, structures and constructions of building are not fulfilled.

Therefore, public campaign should be carried out concerning anti-seismic technology and standard. The activities of the Research Center for

Human Settlements (RCHS) are concentrated among other things on research and development of anti-seismic building technology for all kinds of buildings, to produce and disseminate the standard on earthquake resistant buildings, and to organize seminars/training etc. to increase earthquake awareness and preparedness within local communities.

2. Research and Development On Anti-Seismic Building Technology

Research and Development of earthquake resistant houses, according to government structural system, is under the Ministry of Public Works and is implemented by RCHS, which is also under the Agency for Research and Development (ARD).

Since the 2004 Aceh and Nias disaster, however, many institutions and universities as well as research centers related to earthquake studies conducted research and development and implemented in particular the reliability of building structures against earthquake force.

3. Research Center for Human Settlements (RCHS)

The task for research and development on human settlements is given to RCHS, which is also responsible for the lay-out, building technology and its equipment. RCHS is directly responsible for ARD, which coordinates all research and development within the Ministry of Public Works. The Ministry of Public Works is a technical department which is responsible for the infrastructure readiness in the country.

3.1 Research on Anti-seismic Building

Research, studies and development on anti-seismic building have been conducted within four decades with variety of topics. Many research products have been made up to the present. In the implementation of research activities, cooperation has been made with local governments, universities and private companies as well as with foreign governments, universities and private companies.

Some of research products are listed below:

1. Method for making a microzonation map for earthquake risk.
2. A non-engineered anti-seismic house (reinforced concrete structure and timber structure)
3. A non-engineered anti-seismic precast concrete house (RISHA)
4. Anti-seismic precast concrete structural system for multi-story residential building

3.2 Standard Preparation

The demand for standard in human settlement field is rather high, although many professionals in this field seem to avoid the use of standards in their projects. This can happened, because the regulation concerning compulsory use of standards has not been issued. Consequently, it is up to the professionals to use standard in their projects.

RCHS prepared the standard items that are technical for publication, while the legality of publication is done by the National Standardization Agency (BSN). The RCHS makes use its research product, but it may also adopt foreign country standards which are suitable for Indonesian condition. The preparation of a standard is done by a group of experts, researchers, academics, professional association members and government officials who are related to the prepared standard.

The following are some standard prepared by RCHS,

1. Standard for design of reinforced concrete structure building
2. Standard for design of steel structure building
3. Standard for design of timber structure building
4. Standard for design of Anti-seismic building

3.3 Dissemination of Standard

Dissemination of standard are carried out by the central as well as local government by means of trainings in the construction of anti-seismic houses.

The following are the dissemination activities;

1. Mataram and Bali Dissemination (2004)
   - Information to the construction community by means of structural joint model.

2. Nabire (Papua) Dissemination (2003-2004)
   - Information to participants from all districts in Papua three months prior to the earthquake (6^{th} February 2004).
   - Building destruction evaluation due to 6^{th} February 2004 earthquake.
   - Construction of an anti-seismic church designed by RCHS.
   - Building destruction evaluation due to 26^{th} November 2004 disaster (second earthquake)
     - The anti-seismic church designed by RCHS, construct by the professional contractor stayed in good condition.
     - The anti-seismic church designed by RCHS, construct by the owner was destroyed.

3. Aceh & Nias Dissemination (2004-2006)
   - Destruction evaluation due to 26 December 2004 disaster.
   - Technical advice to some buildings in Banda Aceh.
   - Construction of the model of anti-seismic house type-36, using open frame reinforced concrete and timber structures.
   - On the job training to construct an anti-seismic house for the community, surrounding the model of anti-seismic house.

4. Concluding Remarks

To improve earthquake awareness of the communities in seismically active regions, a public campaign should be held concerning earthquake preparedness, especially on the structure and construction of anti-seismic building technology that is suitable for the up-to-date anti-seismic building. Furthermore, it should be suitable for the traditional technology for the construction of residential building.

Question & Answer

Dr. Ando: This question is addressed to both Mr. Hadi and Mr. Budiono. I need clarifications whether there is a significant difference between building standard and building code. In the presentation of Mr. Hadi, it is not clear to me when we could say structural codes or structural standards. So what is the difference?

Mr. Budiono: The Building Law or Code is the basis to formulate the building standard. The Building Code is formulated by the Ministry of Public Works while the Building Standard is formulated by the national standard agencies. Thank you very much.

Mr. Hadi: In addition, the Building Code is more general while the Building Standard is more technical. The code describes what building should be like and the building standard provides the technicalities to do it.

Mr. Thapa: In addition to laws and standards, do you have these municipal building by-laws?

Mr. Hadi: Yes, we do. That's technical standards but we don't have regulations that punish some people in that aspect. We have our standards but some municipalities said that few are using foreign standards like UPC, IPC, whatsoever. In our government, we cannot sue them because of that. This is how it is like as far as the condition of building standards in our country is concerned. I think we need to make our standards clear to the people. Some people can hardly understand the standards, perhaps because the level is designed for engineers or people from the academia. The development of our standard is very slow, especially those referring to technical matters. In the Agency of Standardization, they are addressing this problem quite well now but it is only on the arrangement of administration side. On the technical matters, research institutes, academia, and professionals are working on this.

Mr. Budiono: I may add some information. When it comes to safety, building standards should strictly follow mandates of the law. However, for other matters, it depends on the desire of the owners. So again when it comes to safety, we should refer to the law. This is the reason why we want to go down to the local government levels to help implement the law. So whoever violates will be sued and penalized.

Outline of Building Regulations in Japan, 2007

Atsuo Okasaki
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ABSTRACT

Building Standard Law of Japan comprehensively regulates building construction in the country. It consists of three major provisions: general provisions, building codes, and city planning codes. The paper explains the general provisions and building codes in detail. The general provisions prescribe administrative, miscellaneous and penal matters related to the application of the building standard law in building construction. Building codes lay out structural, fire safety, and equipment and sanitary requirements to be met to ensure building safety.

1. Principal Laws Concerning Building Construction

Building Standard Law (BSL) – To safeguard the life, health, and property of people by providing codes concerning site, structure, equipment, and use of buildings

City Planning Law – To support efficient urban activities, achieve a pleasant urban environment, and create townscapes by establishing urban land use planning system and infrastructure development system

Fire Service Law – To protect people, people's life, and property from fire and minimize damage caused by fire and other disasters by providing codes concerning extinguishment and alarm facilities etc.

2. Composition of the Building Standard Law (BSL)

2.1 General provisions

General provisions of BSL consist of: a) administrative provisions, b) miscellaneous, and c) penalty. Its administrative provisions lay down necessary regulatory processes for building construction and interim inspection. Figure 1 shows the flow of the administrative process of building construction. The procedure for interim inspection is shown in Figure 2.

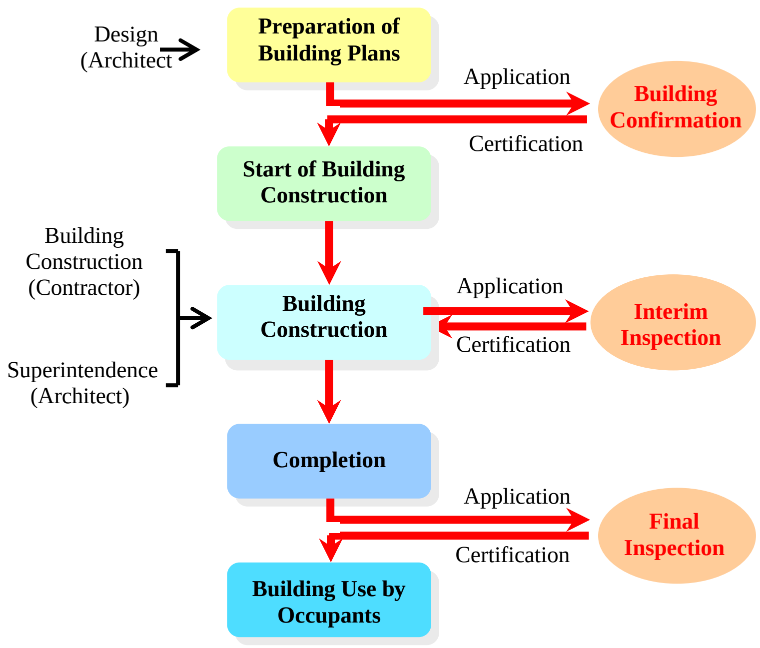


Figure 1: Regulatory process for building construction

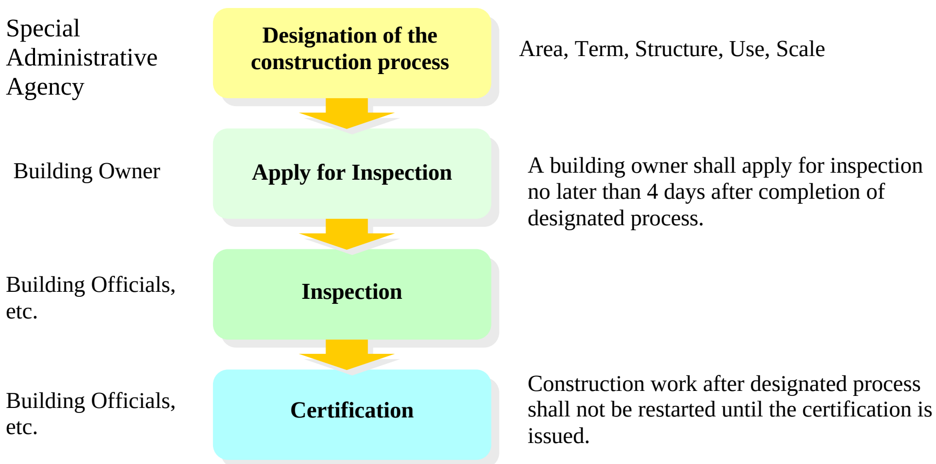


Figure 2: Procedure of interim inspection

Building regulatory authority has been opened to the private sector. The table below shows the distribution of the work for public and private sectors.

Table 1: Building regulatory authority

	Special administrative agency (public sector)	**Designated confirmation and inspection body (private sector)**
Number (April 2006)	417 (approx. 1800 building officials)	125
Number of building confirmations (2004 federal year)	333,665	418,871

Design should be done by Kenchiku-shi (qualified architect). Kenchiku-shi can be divided into three types:

1) *1st class Kenchiku-shi* can design buildings and superintend construction work covering all buildings;
2) *2nd class Kenchiku-shi* can design and superintend construction work mainly for small buildings;
3) *Mokuzo (wooden structure) Kenchiku-shi* can design and superintend construction work of only small wooden buildings.

Table 2: Number of Kenchiku-shi (as of March 2005)

1st class Kenchiku-shi	**2nd class Kenchiku-shi**	**Mokuzo Kenchiku-shi**	**Total**
316,840	681,855	14,322	1,013,017

3. Building code of BSL

Building code of BSL consists of: 1) structural requirements, 2) fire safety requirements, and 3) equipment and sanitary requirements. These requirements must satisfy set performance criteria. The following two flow charts show the composition and process flow of the code:

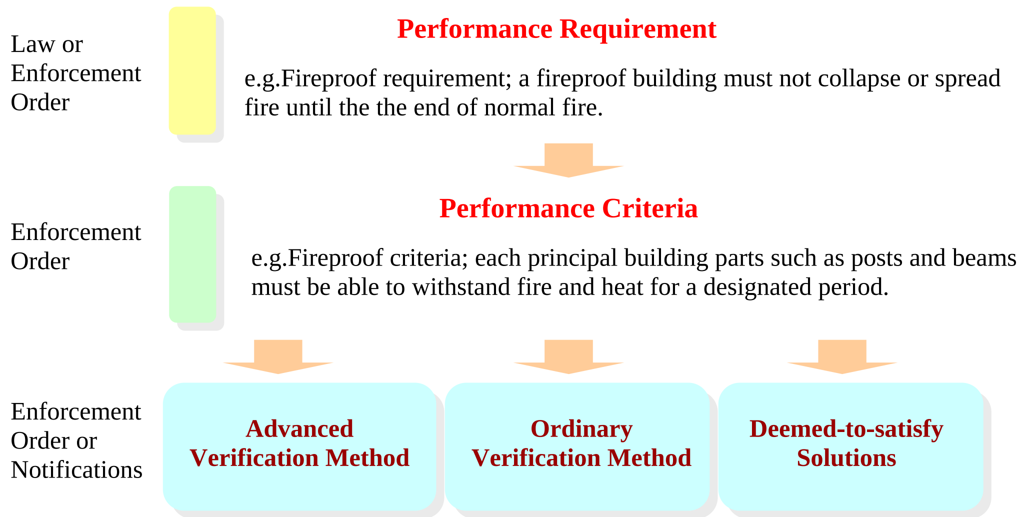


Figure 3: Composition of performance-based building code

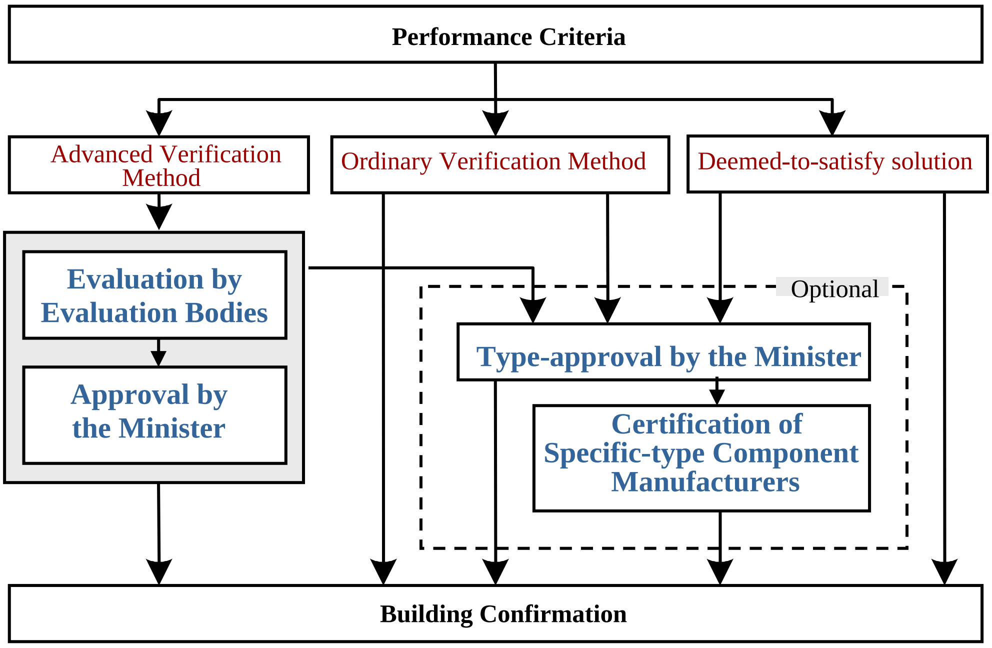
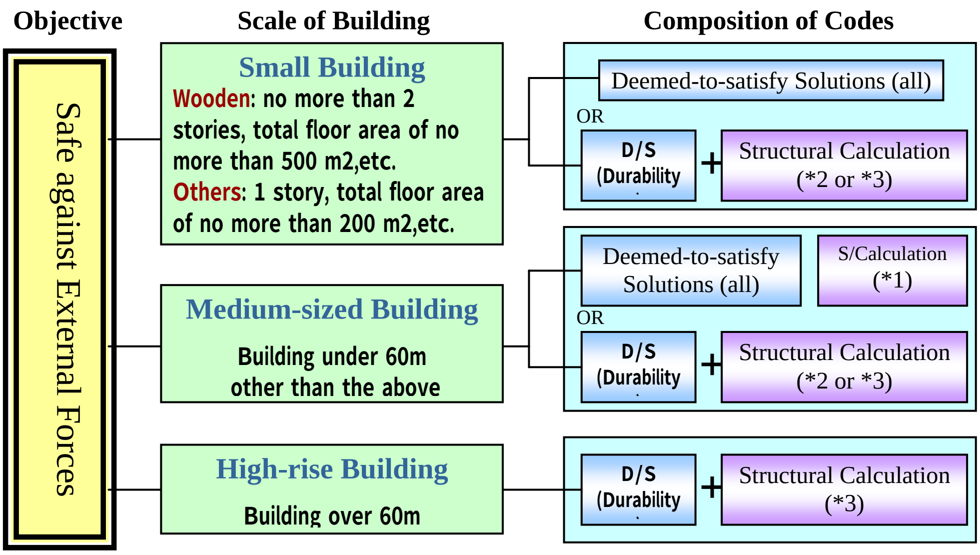


Figure 4: Flow of performance-based building confirmation under BSL

There are two types of evaluation bodies: designated and recognized. The former comprises only Japanese bodies, which accept applications from both Japanese and overseas manufacturers. The latter comprises only overseas bodies and can only accept applications from foreign manufactures.

The structural code of the Japanese building code has been amended three times in its history. The first amendment was made in 1971 following the 1968 Offshore Tokachi Earthquake. It reduced the stirrups spaces to improve ductility of RC columns. The second amendment was made in 1981 after the Offshore Miyagi Earthquake of 1978. This amendment introduced the current design principle/ methods. The third revision was made in 1998 following the 1995 Great Hanshin-Awaji Earthquake. It expanded pre-verified methods/ technologies with the introduction of the interim inspection scheme. Figure 6 shows the composition of the structural code.



*1) Allowable unit stress calculation *2) Critical strength calculation *3) Approved by the Minister

Figure 6: Composition of structural code

3.1 Load and External Force

- Dead load: Load of each element of a building;
- Live load: Differs depending on the use of a building;
- Snow load: Snow depth should be measured by a Designated Administrative Agency;
- Wind pressure: Wind velocity pressure calculated in accordance with regional conditions;
- Seismic force: Obtained by calculating the inertial force generated through movement of both ground and the building (allowable unit stress calculation).

3.2 Structural Calculation Method

- Allowable Unit Stress Calculation
  - To confirm that the stress generated in each of the elements does not exceed the allowable unit stress of the material.
- Critical Strength Calculation
  - To calculate directly the stress and deformation of a building.
- Seismic Design Method based on Energy Method
  - To compare the seismic energy and the energy the buildings can dissipate.
- Advanced Methods Approved by the Minister
  - An overall vibration model shall be prepared accounting for resistance of each part of the building with the passage of time.

Question and Discussion

Prof. Pique: Who made this grading of 1st class, 2nd class architects?

Mr. Okasaki: Japan's Ministry of Land, Infrastructure and Transport made the classification. The 1st class architects have nationwide coverage while the 2nd class architects are usually confined to local governments.

Prof. Pique: Is there any organizational body created by law, which regulates the profession or ethical exercises of architects? I am asking this because in my country, government regulates the engineers and there are NGOs watching their ethical exercises. What is it like in Japan in this respect?

Mr. Okasaki: The system in Japan is that the Ministry regulates the 1st class architects. For the 2nd class architects, the local governments can regulate and give licenses. In case there are many different levels of architects, the local officials and national officials discuss these matters.

Dr. Ando: I would like to give supplementary comments. When I was still with MLIT, I worked at the licensing section. The 1st class architects can design all types of building anywhere in Japan. However, the 2nd class architects can only design medium and small-sized buildings. With this, the governor of a prefecture can provide license to 2nd class engineers. To answer Professor Pique's question, in Japan, the architects and building engineers are the same under one license. This is difficult to explain to people coming from other countries. In the university, the architects and engineers belong to the same class, the same department, they are classmates, and there is no difference between them. In Japan, however, there is an Association of Architects. The members of this association are only those licensed architects. They provide information to their members regarding building laws and standards but they don't impose sanctions. Only the national government and prefectures can do that. That is the system in Japan.

Prof. Pique: Professor Otani, you mentioned about performance-based code. Is that already in effect in Japan?

Prof. Otani: I used the word "performance-based design" carefully when I first introduced this in 1998. At that time, there were three methods of structural calculation. The first is performance based design or the capacity spectrum design method. The second is allowable-stress design method. The third is the Ministry of Constructions–approved method. So there are three types of structural calculation methods. The capacity spectrum method is very difficult to understand, especially for regular engineers. In my estimate, I think 2 or 3% of the buildings are made using this capacity spectrum method or performance-based design. Anyway, structural design is always performance-based design. There should be no damage from frequent earthquakes, there should be no collapse from a very rare major earthquake, and these are all performance-based designs. The point is we can use different methods to examine resistance and so on.

By the way, in Japan, there is an examination to get an architect license. In order to take this examination, one must be a graduate from the architecture department for both the 1st and 2nd class architects. This is the qualification to take the examinations. Once you pass the examination, you can practice as a building engineer.

Prof. Murty: Is there any provision in the new building code, which require old buildings to be upgraded or should it be left to the owners to decide?

Prof. Otani: The Building Standard Law is applicable only to new houses. So it is about future constructions. However, there is also a clause in the law saying that the building owner should satisfy building performance required in the code. So it is only a recommendation but not a requirement. There is another law for seismic requirement of existing buildings. This Law requires owner to upgrade their buildings if it is found to be vulnerable to earthquakes.

Prof. Murty: How about public buildings?

Prof. Otani: For public buildings, the government is responsible for this. This is totally government responsibility.

Mr. Dixit: I am impressed by the logic presented by Professor Otani, especially the proactive approach for anti-seismic buildings. This gives us hope for the future in my country. However, we are still struggling with the issue of non-engineered constructions. Our problem is how to make these non-engineered constructions safer. Let me bring up the case of Pakistan. We observed that none of the buildings in Pakistan, including public buildings, are engineered. To make things worse, despite Pakistan being the Center of Excellence in Architecture, their constructions still appear to be below standards. What does this tell us? Thank you very much.

Prof. Murty: If I may go back to the previous presentation, there is a building code applicable to all of Japan and there is a Planning Code for specific cities. Am I right? What happens to the planning aspect if a small area becomes a city?

Dr. Ando: I was also involved in urban planning before. The urban planning system in Japan is divided into two areas. One is referring to the “urban-controlled” area, which is usually located at the center of the city. The other is referring to the “outside the urban-controlled” area, which is also part of the city. If anybody wants to construct a building within the urban controlled area, then permission from the city government is needed. If construction is to be built outside the urban-controlled area, permission from the city government is not needed but it has to comply with the national building code specifications.

Mr. Thapa: Maybe we can hear comments from Mr. Takahashi.

Mr. Takahashi: I think that the situations in which we make and implement the building code or how we enforce it are different in each prefecture in the country. With this in mind, I guess we need to look for a simple and most appropriate scheme to address common problems. I agree with Director Onogawa that we need to focus our discussion on certain schemes addressing common problems because we have limited time for this meeting. He also pointed out that we have limited resources.

Prof. Murty: This is also related to the point raised by Director Onogawa. We have limited resources and what should we focus on? After listening from all of you here, I think UNCRD or the UN system could focus on improving non-engineered constructions. However, it must have at least a sensitization or education-related program of the multi-story buildings because we are going very fast towards the urban system. The education component must be there in each nation that is involved in this project. I think we don't need detailed research or analysis at the field level. The fact that many people in cities are constructing "unsafe" multi-story buildings, these people must be informed of their vulnerabilities. I think this should be definitely considered by UNCRD. We have to inform people in the world about vulnerabilities. Yes, the field level activities can go on, especially on the detest housing, which cover around 60% but sensitization must be included in the strategy. Thank you.

Mr. Thapa: We are now about to end this session. As chairman for this session, allow me to recapitulate what we had discussed. Professor Otani's opening speech dealt with engineering and design aspects of buildings in terms of earthquake resistance. Then the case study presented by Mr. Antonius Budiono dealt more on building laws and regulations in Indonesia from 1998 – 2002. He also presented a very ambitious target for year 2010. That target is that all municipalities must have their own local regulations and that all government buildings will have certificates. I think this is very ambitious and I wish you good luck. Then the presentation of Mr. Hadi, also from Indonesia, dealt with building research, especially on materials, components and building systems. As we saw in the slides, there were timber constructions, RC constructions and many other types of constructions. He reported that as part of their activities, they are now preparing some guidelines and are training the people. I think training is very important. However, I think that training should not focus only on architects and engineers but also peasants, masons, craftsmen, small contractors, and so on as well. This is very important because all stakeholders should be aware of certain standards.

We also had a very informative presentation from Mr. Okasaki of MLIT. Japan is country that faces many disasters like typhoons and earthquakes. Through his presentation, we understood how building standards and city planning in Japan have developed over time. In our country and even in India, we were accustomed to the British system wherein engineers and architects are entirely separate fields. In Japan, however, we learned that both are somehow the same or similar. Personally, I always differentiate architects and engineers. Another very interesting figure I know is that there are almost 1 million architects in Japan. Is this around 1% of the population? In Nepal, our population is around 5 million and architects count for more or less 500 people.

The comment of Dr. Ando also caught my attention. He commented that urban planning system in Japan has boundaries for urban-controlled and non urban-controlled areas. It is quite similar in Nepal. The municipalities provide building permit. However, beyond municipality limit (as the city is growing) there is what we call the Village Development Authority, which provides a symbolic building permit. They simply stamp the application and it is ok. They don't go to any technicalities in the process of giving permits because it only functions to get revenues. I think this session was informative and quite provoking. We heard the experiences of different countries and we had very lively discussions. So I thank all the presenters and participants. Thank you.

IV. CASE STUDY PRESENTATIONS: Nepal and Peru

19 January 2007 (Friday)
Chair: Mr.Maryoko Hadi

Experiences in Implementation of Nepal National Building Code in Nepal – A Case of Lalitpur Sub-Metropolitan City
Kishore Thapa, Director General, Department of Urban Development and Building Construction, Ministry of Physical Planning & Works, Nepal

Challenge of Improving Seismic Performance of Buildings in Nepal: Dissemination and Implementation of the National Building Code
Amod Mani Dixit, Executive Director, National Society for Earthquake Technology - Nepal

Peruvian Experience in Seismic Standards
Javier Pique, Professor, Peru National University of Engineering

Discussion

Experiences in Implementation of Nepal National Building Code in Nepal: A Case of Lalitpur Sub-Metropolitan City

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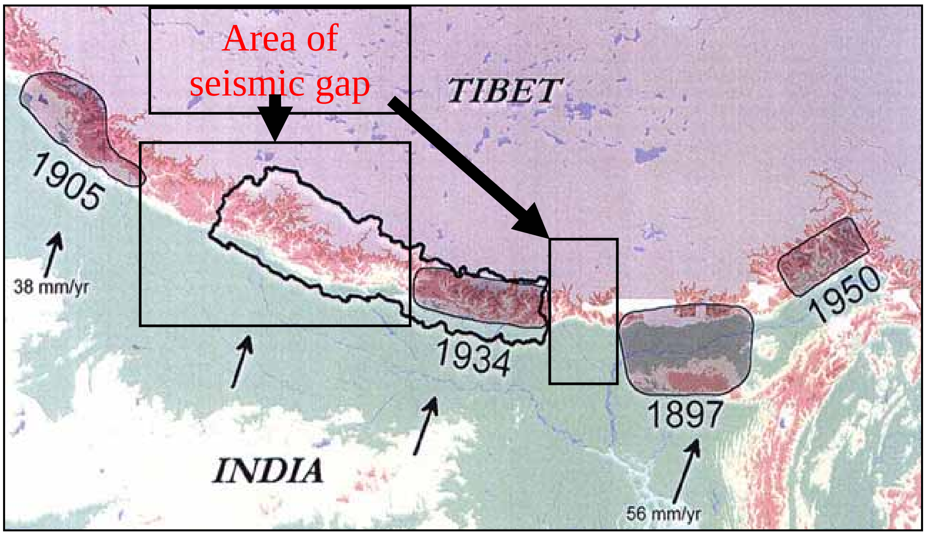
ABSTRACT

In Nepal, only about 5% of buildings are constructed with proper engineering design and supervision. The Department of Urban Development and Building Construction (DUDBC) prepared and implemented a master building code in 1993. However, the code was not implemented at the local government level due to many legal and administrative reasons. Recognizing the need to implement the code in municipalities, it was implemented in Lalitpur Sub-metropolitan, which is in the national capital region of Kathmandu. The code was revised ten years later and experts concluded it could be implemented more effectively at the local government or municipal level. Several problems have been encountered with the implementation of the building code. Furthermore, the code needs to be revised and upgraded to M 20 quality standards in the near future to upgrade.

1. INTRODUCTION

Nepal is a small country between India and China with a population of about 25 million. There are five municipalities in Nepal. They have been categorized as metropolitan cities, sub-metropolitan cities, and municipalities. Kahmandu metropolitan city is the largest municipality and also the capital. Lalitpur sub-metropolitan city joins the Kathmandu capital city. The urban population is 14% (3.2 million). The population growth rate is 2.27% and the urban population growth rate is almost 6.67%. A high concentration of population in high density, unplanned urban areas, and poor housing conditions are among the features of Nepal’s organization. There is a high possibility of human loss in case of natural disaster such as earthquake, fire, flood, or landslide.

The map on the next page is a seismic land map of Nepal. Nepal had an earthquake in 1897, 1905, 1934, and 1950. Another earthquake is expected to occur in the western part of the country.



Map 1: Seismic hazard of Nepal
(Map courtesy of National Seismological Centre, Department of Mines and Geology, Lainchour, Kathmandu, Nepal)

Untrained individuals construct more than 90% of the buildings in Nepal. Only 5% of the buildings are constructed with the proper engineering design and supervision; as a result, few building units meet proper building norms and standards. A 6.7 Richter scale earthquake in 1958 caused 600 deaths, the collapse of 20,000 buildings, and extensive damage. Engineers realized the need for changes and improvement in building construction and design methods only after the 1988 earthquake.

2. Nepal National Building Code

The Department of Urban Development and Building Construction (DUDBC) prepared the Nepal National Building Code (NBC) in 1993 with the assistance of the United Nations Development Programme and United Nations Centre for Human Settlement (Habitat). The building code was determined based on the findings of a project consortium conducted by three international consultants: Beca Worley International (New Zealand), Golder Associated (Canada), and Urban Regional Research (USA).

Following the consortium the building code was divided into four different categories. The first level is International State-of-Art. Under this category, if a foreign consulate wishes to design a building in which to run an embassy in Nepal, the consulate may adhere to the building code of its respective country. The second level refers to professionally engineered structures. The third category refers to buildings of restricted size designed with simple rules-of-thumb, and mostly applies to remote areas outside the city where simpler buildings are prominent. Finally, the fourth level pertains to construction in rural areas and provides guidelines for remote rural buildings where control is impractical.

3. Legal Provisions

The NBC was revised in 2003 and three additional volumes were added: architectural design requirements, electrical design requirements, and sanitary and plumbing design requirements. Legal issues prevented immediate implementation and enforcement of the building act. One of the major problems was that the law required all building codes be published in the National Gazette. Experts at DUDBC felt it was impractical to publish the full building code in the Gazette. Instead they planned to provide a simple notice and to allow people to purchase a copy of the building code from their office.

Since then an official notice was published in the National Gazette and the building act is in effect, and citizens now know the act is official with legal provisions. This was a cabinet decree in 2003 applying the building code to all the public buildings in Nepal. All government buildings are supervised by DUDBC. In the case of private buildings DUDBC cannot have a substantial effect because of much needed amendments to the bill, which are currently in place.

4. Public Dissemination

DUDBC cannot implement the building code with legal and administrative provisions alone. Thus, demonstrations are held with engineers, architects, etc; they also receive training provided by members of our department in different parts of the country. This is very effective as almost more than 80% of them receive training. Under the scheme, 1000 masons are trained every year. This training is very popular and DUDBC plans to train at least 3000 masons per year in the near future.

Currently the earthquake section is working with the building section. Before, they worked separately and now they work together. There is an earthquake safety committee within the municipal board. This committee consists of people within the municipality and professionals from outside as well. There is an earthquake engineering sub-committee and buildings permit section that work together. The main section checks structural designs and building construction. They conduct monitoring and training programs regularly.

5. Experiences from Lalitpur Sub-Metropolitan City

Lalitpur sub-metropolitan city was the first municipality in Nepal to implement the NBC since January 16, 2003. Initially, a technical cell first carried out the NBC for 6 months. The “Earthquake Safety Section” was established parallel to the “Building Permit Section” on November 27, 2003 to promote more effective implementation of the NBC. Main activities of the Earthquake Safety Section include verifying structural designs, regular monitoring of building construction, playing an advisory role for homeowners and contractors, raising earthquake risk and preparation awareness, and conducting training programs on earthquake resistant building construction for masons in Lalitpur.

6. Challenges Ahead for DUDBC to Implement NBC

There have been several problems encountered with the implementation of the building code. The greatest problem lies in the lack of professional ethics among designers. Sometimes buildings are designed without attention to technical details, which is very problematic. Building construction sometimes takes place without technical supervision by the architect. In addition, people sometimes add additional stories to existing buildings.

The lack of knowledge among masons and contractors on earthquake resistant building construction technologies is also a major issue. Trained professionals request higher wages because of their skill and knowledge. However, the untrained professionals are usually hired because they require a lower wage.

While DUDBC has requested the Ministry of Local Development implement the NBC, only three municipalities follow it. The others do not because they lack adequate manpower or trained masons, engineers, and architects, etc.

7. Conclusion

DUDBC hopes to receive technical support from the ABCD project to improve the existing building code, conduct demonstration projects in all municipalities in Nepal, and initiate additional methods of information dissemination. For example, DUDBC is working to convince universities to the NBC in their curriculum as well.

Nepal's building code is very weak in terms of fire. Great importance must be placed on training engineers and masons in Nepal. Research support is needed in the mountainous regions of the country to help DUDBC obtain its goal of implementing the NBC in all municipalities.

Further, in India, the building code has been revised to reflect a minimum of M 20, but the minimum quality standard in Nepal is still M 15. Since upgrade to M20 has not been realized, the code must be revised in the near future. Prevention is preferable and certainly better than a cure. The NBC is a precautionary measure to reduce the hazards of earthquakes. Lalitpur sub-metropolitan city has been implementing the NBC successfully through its building permit process since 2003. The performance ability of NBC followed buildings has yet to be seen, but these buildings are expected to withstand earthquakes better than those that have not followed the NBC.

Question & Answer

Mr. Hadi: Thank you very much, Mr. Thapa, for that informative and clear presentation. Do you have any comment or question?

Prof. Murty: Just few questions came to mind. You mentioned that engineers are not having specific guidelines. Are you talking about models or documents concerning engineered calculations for the typical 2 or 3-story buildings for both framed structures and masonry structures?

Mr. Thapa: Actually, we have prepared some kind of a standard operating procedure, where government engineers have to check buildings using a checklist. For the designers, they are supposed to sign an affidavit that they are following the National Building Code. There is also a checklist for them.

Prof. Murty: What I meant is, are engineers following detailed calculations?

Mr. Thapa: Actually, we tried to ensure that but not successfully.

Dr. Ando: Thank you very much for the many expectations you have on the ABCD project. However, I am afraid we can't meet all those expectations. Yet, we have several experiences in training masons. Let me also make this comment. I think Peru has an excellent system of training for the laborers. There is a national organization that is responsible for all over the country. Unfortunately in Japan, we don't have any national system of training construction laborers except maybe for some small programs. For instance, MLIT has started some training courses for carpenters under the Housing Bureau. Maybe we can learn something from Nepal or Peru in this aspect.

Another point I would like to make is the publication of the Japanese Building Code. In Japan, the building code, the thick one you saw in BRI, is published not by the government but by academic societies like the Japan Institute of Architects (JIA) where Professor Otani is the vice president. So in Japan, there are several institutions or academic societies that publish the Building Standard Law and distribute it not only to their members but to other stakeholders as well. Actually, this is also a good revenue resource for academic societies. I don't know the reason why the Ministry is not publishing it. In addition, you can find a CD version of the Japanese Building Standard Law.

Mr. Dixit: Let me respond briefly to the comment of Dr. Ando. In Nepal, we don't expect much about training, capacity building, or those technicalities from UNCRD. What we expect more is learning the "process". The cooperation between UNCRD, government and non-government institutions of Nepal already constitutes a certain form of process. When we work with UNCRD the outcomes we produce will be a strong process or work process. I think without this cooperation, other things become meaningless – such as the training of mason, training of engineers, we have so much of these activities but are not well coordinated. Thank you.

Prof. Otani: Firstly, with regard to publication, I think one option is to refer to the internet. The World Housing Encyclopedia may be an important source of knowledge. Secondly, Mr. Thapa, you mentioned the building code for new constructions. How about the existing buildings, which are the majority? I think you should also consider assessing these existing buildings. I think this is very important. In addition, it is also important to know how to reinforce or strengthen them. So, assessment is one thing. Strengthening and reinforcement is second thing. And third thing, in case of earthquake, how could we evaluate the damage and then how do we repair such damage? Unfortunately, we don't have any experience on seismic constructions in Japan. I think one of the good references for this may be the World Housing Encyclopedia. That is my comment. Thank you.

Prof. Okazaki: This is in reference to the publication of Building Standard Law of Japan. I want to inform you that this is also available in English but not in CD. I have requested one of the Centers here in Japan to also make CD versions free of charge. However, if you want the thick version, which is very heavy, maybe you can ask Professor Otani informally.

Mr. Thapa, you mentioned in your report that the implementation part is weak. Fortunately there is an effort by the Ministry of Land, Infrastructure and Transport of Japan in cooperation with the Thai government in strengthening local capacities. Somehow this shows some improvement in the implementation. I have one question. There is also this project with Katmandu in Nepal concerning strengthening capacities and there is a problem of human resources in the government, particularly in the area of inspection. If I understand correctly, without inspection certificate, the government cannot issue the permanent certificate for the building. I wonder if the Nepalese government has sufficient human resources to do the inspection on the site of this Katmandu project.

Mr. Thapa: Actually there is a problem on the site. The municipality cannot hire many engineers because of budget constraints. They have to rely only on 5 or 6 people. To somehow mitigate this problem, I am trying to develop a mechanism where designers themselves could take full responsibility and not only the municipal engineers. Why? Because municipal engineers cannot inspect all houses, it is impossible. However, for all government buildings, my department will take care of that. For private buildings, the designers should sign an affidavit that they are responsible for the buildings. This is some kind of legal mechanism or regulations that designers will be held responsible. This has to be done because we cannot really rely on municipalities because of lack of resources. By the way, I would also like to inform you that we have CD version of our building code and it is also accessible in our webpage. It is in PDF file. You can download it but you cannot change it.

Mr. Hadi: Thank you very much, Mr. Thapa. Any other questions or comments?

Mr. Okasaki: With regard to the Japanese Building Standard Law, one semi-public organization is selling popularized versions. There are two versions of this. One of them costs 3,000 yen and the other costs 2,000 yen. So if we have two versions, we will pay 5,000. In the part of MLIT, we have not appropriated money to buy these documents. However, may I request UNCRD, particularly Mr. Ando, to buy these documents and provide them to the participants? Thank you.

Prof. Murty: Maybe this comment comes ahead of time. However, this is with regard to what UNCRD can do. Some years ago, IAEE published collections of codes worldwide. That time, the collection was published in hard copies but now they have soft copies. Since they have limited fund, the soft copies are cheaper and in the publications, they only focused on the important part – the hazards part – and all not the details. For now, I think there is a need to collect information related to masonry and RC structures, which have become common in a large part of the world. After collecting them, put it in a place where they could be used. What we are doing in India is telling people that disaster costs so much. However, putting valuable information in the internet costs only few rupees. It is our way of helping them. Nepal is doing this already. This is a very important step in trying to remove mind block concerning expenses.

In this regard, I suggest that UNCRD collect various codes and put them online as world list of codes for valuable use. This is one suggestion. The second suggestion is that in 1998, there was this Handbook, edited by Mario Paze, about commentaries of different building codes. Now 10 years has passed and there is much new information. In this regard, I recommend that the ABCD project consider redoing such handbook. I think this is very useful to compare across countries. This could be a meaningful activity for the ABCD project. I think title of this document is “International Handbook of Codes”, edited by Mario Paze contributors were from many countries. It was published in 1998. I will give you the formal reference before I go.

Mr. Hadi: Thank you very much for the comments and suggestions. May I call the next presenter, Mr. Amod Dixit of the National Society for Earthquake Technology -Nepal.

Challenges of Improving Seismic Performance of Buildings in Nepal: Dissemination and Implementation of the National Building Code

AMOD MANI DIXIT
National Society for Earthquake Technology, Nepal

ABSTRACT

The dissemination and implementation of the National Building Code (NBC) is an urgent task in Nepal. This is evident in the current conditions of buildings, which are highly vulnerable to earthquakes. An estimated 90% of the buildings in Nepal are non-engineered and only about 10% are engineered. This condition calls for proper code dissemination in order to reduce earthquake risk due to building collapse. However, Nepal is experiencing several challenges in the dissemination of the code. Among these challenges are in the areas of (1) legislation and policies, (2) education, (3) level of earthquake awareness, (4) seismic code in the building permit process, (5) training activities, and (6) mental fatigue. In addressing these challenges, the National Society for Earthquake Technology (NSET) has designed strategies by identifying appropriate disseminators and implementers as well as designing the methods for dissemination. In order to improve the seismic performance of buildings in Nepal, there is a need to institute the following reforms: (1) radical changes in the institutional arrangement, (2) enhancement of municipal capacities in both organizational and personnel level, and (3) involvement of a third party in the check and audit of building performance.

1. INTRODUCTION

In Nepal, there is a need to disseminate the National Building Code (NBC) to reduce earthquake risk due to building collapse. There are two specific purposes for disseminating the code. The first purpose is to assist in the improvement of seismic performance of the buildings by conforming to the philosophy of the NBC. If we conform to the philosophy of the building code, we could avoid deaths during large earthquake, limit the damage to the buildings for possible repair/retrofit by local efforts after an earthquake, and delay the collapsed in case of buildings that are constructed of traditional materials such as adobe, masonry buildings with mud-mortar. The second purpose is to make the Code accessible to all people and ensure that the wisdom of the Code is understood and acted upon.

Below is a rundown of the conditions in Nepal in terms of building typologies and the build up of vulnerabilities.

- The existing building stock in Nepal comprises of 90% non-engineered structures and only about 10% engineered structures.
- The new building constructions are almost the same as the old ones. For example, even those buildings constructed under the urban building permit process are still non-engineered.
- There is actually no engineering design. The reason for this is that the building permit is generally looked upon as revenue generating process.
- For long time and up to the present, the conformation to planning by laws is already considered enough as far as building construction is concerned.
- The cement-based construction has been increasing in urban areas despite its inherent vulnerability-causing factors.
- The quality control of construction materials is not considered seriously.
- Even the quality control of the process of construction (*e.g.* C:W ratio, proportions, concrete mixing, splicing, bar bending, overlap. etc.) are also not considered seriously.
- In the rural areas, cement-based construction is also increasing specifically among the richer population and the situation is getting worst because a concrete column or a beam is considered as the replacement of wooden beam. This has been used accordingly but the joints between the elements are not taken as seriously as the wooden beam because local people don't know anything about the joints.
- Un-reinforced masonry in mud/cement/lime mortar is constructed in rural areas.
- In a way, the traditional wisdom of construction has already been forgotten.
- Finally, there are many strange combinations of materials, architecture, and processes in building structures because these are mostly constructed by informal mechanisms. These structures are characterized by the use of very little construction equipment, done by petty contractors with little site inspection by the municipal inspector. Moreover, there is no third-party involved in the inspection.

With these conditions at hand, the need for dissemination of the code is certainly obvious. In the dissemination of the code, NSET has focused on improving the non-engineered constructions. It is recognized however, that the boundary between engineered and non-engineered construction has a grey area for private residential buildings.

A question arises as to who are targets for dissemination. NSET perceives that all stakeholders in the building production process should be the ideal targets for dissemination. This includes homeowners, masons, head masons, petty contractors, municipal inspectors, officials, sub-engineers, engineers/architects, mayors, building permit and urban planning departments of the municipality, and decision-makers and policymakers at the national levels. Since NSET believes that dissemination implies implementation, the guiding philosophy is that, "There is no need of dissemination if there will be no implementation and there is no need of implementation if there is no dissemination".

2. Factors Affecting Dissemination

There are of course various factors that affect dissemination. In Nepal, the contributing and hindering factors for dissemination are noted in six different areas. Namely, (1) legislation and policies, (2) education, (3) level of earthquake awareness, (4) seismic code in building permit process, (5) training activities, and (6) mental fatigue.

First, in the area of Legislation and Policies, the contributing factors are (a) the NBC exists in Nepal; (b) the Building Act makes the Building Code mandatory for all public constructions; (c) the NBC provides that municipalities have to implement it; and (d) the code will also make it mandatory for all private constructions in near future because an amendment of the Act is now being considered in the parliament. However, there are also hindering factors for dissemination. These are (a) the code is not written in the Nepalese language, even for the rural guidelines and (b) its not widely available. This is not even press-printed though recently it has become available in CD; (c) the Act is still being amended to accommodate mandatory nature. Thus, the mechanisms of dissemination are still being talked about.

Second, in the area of education, the major contributing factor is that some private universities have been trying to teach the code and seismic resistance in the undergraduate courses. However, dissemination in this area is hindered by the following factors: (a) lack of awareness at all levels from policymakers to house owners; (b) even the government buildings are not made earthquake-resistant; and (c) those who propagate the idea do not practice what they are preaching.

Third, in the level of earthquake awareness, the major contributing factor is the availability of good and successful practices in Kathmandu and in some other cities. The only need is to propagate these practices widely. However, the dissemination of information in this area is hindered by the fact that the satisfactory practices are only in the parts of Kathmandu while in other 53 municipalities, the practices are very unsatisfactory. In addition, there are about 41 other rapidly urbanizing areas that need an increased level of earthquake awareness.

Fourth, in the seismic code and building permit process, the major contributing factor is that the municipalities are encouraged to adopt provisions of the building code into the building permit process. Many municipal governments like the idea and want to do it. However, the hindering factors are (a) there is no standard provision in the municipal building permit process; (b) many municipalities do not have enough trained personnel; (c) earthquake is considered separately from environmental disaster management and urban developmental process; and (d) in the planning by laws, the building permit process is traditionally considered as a revenue generating process.

Fifth, in the area of training, the 6 years of teaching in the university is not delivering significant results; yet, there are suggestions for a six-day training to deliver the goods. This does not prove to be enough. In six days you can train people on aspects concerning technicalities but not on how to make buildings safer. As far as the NSET experience is concerned, the project implementers have to work with these people to overcome the ages of neglect.

Lastly, there is an issue concerning mental fatigue. There is a general assumption in Nepal that people are afraid of development. Why? Because development, as it is implemented in the last 4-5 decades, has been suspicious. People suspect that development is a career for some to make money at the cost of the downtrodden. Well, selling poverty is the job for some and as a result, the building code is also looked upon as yet another harness to control.

3. Strategies

With recognition that building code needs to be disseminated and after weighing the contributing and hindering factors for dissemination, NSET has designed various strategies. Firstly, the disseminators were identified. This should include the Nepal Bureau of Standards, academic institutions, trade schools, specialized NGOs, and other relevant stakeholders. Secondly, implementers were also identified. This includes the Department of Urban Development and Building Construction, municipalities, private consultants, contractors, and other relevant agencies.

3.1 Strategies for Dissemination

The strategies include the use of all possible methods because of the obvious urgency to disseminate the code. In addition, the vulnerabilities are being built-up; however, this urgency is not felt by many, including donor agencies.

3.2 Where to Disseminate What?

Priority is given to rural-urban areas that are highly vulnerable and wherein the need to disseminate the following is essential: (a) How to make safe what you make? (b) How to construct proper foundation, walls, and floors? (c) How to tie the elements of the structure to one another properly? (d) How to join elements properly? (e) How to ensure good quality of materials?

3.3 Methods of Dissemination

The methods of dissemination include (a) publication of the guidelines in the Nepali language, (b) instructive publication such as flyers, calendars, etc. (c) advocacy such as slogans, (d) conduct of Earthquake Safety Days, wherein some drama, posters, and the like are also presented, (e) training for masons and consultation to house owners and other players of building production process, and (e) dissemination of the knowledge through programs such as School Earthquake Safety Initiative (SESI).

4. Proposed Solutions

The challenges of improving the seismic performance of buildings in Nepal call for the need to institute reforms. Firstly, some radical changes have to be made on the institutional arrangement. This includes the redefinition of the roles of the main players such as the DUDBC, municipalities, private designers, academic institutions, and advocacy institutions such as NSET. Secondly, there is a need to enhance the municipal capacities in both organizational and personnel level. Thirdly, a third party must be involved or encouraged to check and audit building performance. Finally, there is obviously a need to improve the legal environment in Nepal. These reforms are doable because of the following opportunities: (1) Nepal is a small country, where many champions have already realized the urgency of reform mainly due to the learning from the recent earthquakes and the demonstration of feasibility such as that of the LSMC; (2) This is already a notable gradual change in mind set of people; (3) Many strategic approaches have already been initiated; and (4) There is already an established cooperation mechanism among government, academics, and NGOs.

Broadly, the requirements are as follow:

1. Organized approaches by supporting those who are making it happen, those who are doing it, and those who are championing it.
2. Use of opportunities created by international, regional, sub-regional platforms such as SAARC, Global Platforms (e.g. ISDR), and networking.
3. Financial/Technical support to the government departments such as DUDBC and leading municipalities.
4. Commitments from international support partners such as the UN system.
5. Conduct of research for better understanding of the ground realities: (a) modern vs. traditional materials and their construction processes, (b) differences in the rural and urban constructions, (c) knowledge on the state-of-the-art structural analysis vs. code-based design, (d) knowledge on the traditional wisdom, and (e) seismic retrofitting.
6. Strengthening of training institutions and training processes/curricula, specifically, government training institutions and other relevant training institutions.

7. Strengthening and/or establishment of Building Research Centers with research facilities.
8. Support and audit of existing programs of academic/educational institutions.
9. Support to the ongoing dissemination programs.
10. Recognition of the synergy of the close cooperation of government and non-governmental institutions.
11. A better understanding of the problem.
12. Conforming the research, education, training, and awareness efforts to suit the local needs.
13. Adaptation of the knowledge to the local condition.
14. Institutionalization of the efforts with demonstrated success.

Meeting these requirements could facilitate appropriate dissemination and implementation of the NBC.

PERUVIAN EXPERIENCE ON SEISMIC STANDARDS

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ABSTRACT

The Peruvian Seismic Standards has evolved in response to the lessons learned from the building performances during major earthquakes. The First Peruvian Seismic Standard was developed in 1970 after an earthquake struck Lima in 1966 and Chimbote-Huaraz in 1970. The Second Peruvian Seismic Standard was developed in 1977 after the country experienced another moderate earthquake in Lima in 1974. Then in 1997, the Third Peruvian Seismic Standard was developed based on lessons learnt from the Nazca earthquake in 1996 as well as other earthquakes that occurred in Mexico in 1985, Loma Prieta in 1989, Northridge in 1994, and Kobe in 1995. When the ATICO earthquake hit southern Peru on June 23, 2003, engineers were able to compare the performance of buildings with 1977 standard against the 1997 standard. The comparisons were made in terms of (1) category, structural system and regularity, (2) base shear coefficients, (3) drift limits, and (4) displacements. The findings of these comparisons led to the development of the 2003 Revised Peruvian Seismic Standard. Following conclusions derived from the comparisons of 1977 and 1997 standards, the engineers recommended that the 2003 code should incorporate (1) restrict displacements, (2) limit irregularities severely and that the essential buildings should be regular, and (3) either assure safe collapse mechanisms or limit the use of frame systems alone.

1. INTRODUCTION

In 1966, Peru experienced an earthquake in Lima and another earthquake struck Chimbote-Huaraz in 1970. Below is a photo depicting the damage incurred to the adobe constructions during the 1970 earthquake.

Photo 1: Damage to adobe constructions in the 1970 earthquake

The photo has been shown in many publications that some engineers are already acquainted with the damages to buildings and loss of lives. There were many lessons learned from these two devastating earthquakes. The lessons and information gathered from these experiences resulted in the development of the First Peruvian Standard of 1970. This standard had a nationwide coverage.

In 1974, another moderate earthquake occurred in Lima followed by another moderate tremor. Again, the lessons learned from those two earthquakes resulted in the development of the Second Peruvian Standard of 1977.

In November 1996, Peru experienced another earthquake in Nazca. This building was typical school structure during the government of President Fujimori. Thousands of it were built, which made him very popular. But as can be seen in photo 3 & 4, the classrooms, the labs, and the columns designed using the 1977 Standard were damaged. These are some of the typical types of configurations.

Photo 2: School Fermín del Castillo

Photo 3 & 4: Damaged school building in Nazca

During the 1996 earthquake, the engineers from Peruvian Permanent Committee for Seismic Design took the opportunity to analyze the limitations of the 1977 Standard by looking into the extent of damages to these buildings. It was observed that the “allowable displacements” of the

1977 Standard could result in damage of building when earthquakes occur. Figure 4 shows the allowable displacements (in centimeters) as applied in 1977 Standard**.** Photo 5 shows the damage of the classrooms based on these allowable displacements.

Table 1: Lab building
Earthquake in X direction Maximum Displacements (RNC-1997)

Floor	Displacements (cm)		Drift	
	x	y	x	y
2nd floor	6.494	0.000	1/144	<1/5000
1st floor	4.091	0.013	1/90	<1/5000

Photo: 5: Damaged classrooms

The lessons and information learned from this experience, including those lessons from other earthquakes that occurred in Mexico in 1985, Loma Prieta in 1989, Northridge in 1994, and Kobe in 1995, have resulted in the development of the Third Peruvian Standard of 1997.

2. Comparison of the "1977 Standard" with the "1997 Standard"

In June 23, 2001, Peru experienced yet another earthquake. This was known as the Atico (Arequipa) Earthquake that hit southern Peru with a magnitude of 8.2. The occurrence of this earthquake allowed the engineers to compare the performance of buildings designed under the 1977 Standard with the 1997 Standard. Photo 6 shows buildings designed with the 1977 Standard. It was observed that the allowable displacements of the buildings resulted in damages at occurrence of the earthquake. In Photo 7, the buildings designed with 1997 Standard are shown. As can be seen, the buildings have stiffer structures. These have regular structural system, which is mandatory. As evident from the photos, these buildings showed no damages during the 2001 earthquake.

Photo 6: Damaged schools built with 1977 Standard (Photos: E. Fierro)

Photo 7: School buildings built with 1997 Standard (Photos: E. Fierro)

The lessons and information learned from this another earthquake had resulted in the development of the 2003 Revised Standard. This is called a revised standard because it is not much different from the 1997 Standard.

Comparison was made between 1977 Standard and 1997 Standard in four areas: (1) the category and structural system; (2) the change of standards; (3) the based shear coefficients; and (4) the drift limits.

2.1 Category, Structural System and Regularity

As shown in Table 2, the structural system differs according the occupancy category, the structural regularity, and seismic zone.

Table 2: Category and Structural System

Category and structural system			
Occupancy category	Structural regularity	Seismic zone	Structural system
A (*) (**)	Regular	3	Steel frames Reinforced concrete shear walls Reinforced and confined masonry Dual system
		2 Y 1	Steel frames Reinforced concrete shear walls Reinforced and confined masonry Dual system Timber
B	Regular or irregular	3 Y 2	Steel frames Reinforced concrete shear walls Reinforced and confined masonry Dual system Timber
		1	Any system
C	Regular or irregular	3, 2 Y 1	Any system

(*) To comply with design objectives buildings will be specially structured to resist severe earthquakes.
(**) Rural constructions may use traditional materials according to specific codes.

Figure 1 below shows the formula of computing V (base shear). The result signifies that in 1997, there was a change of standard.

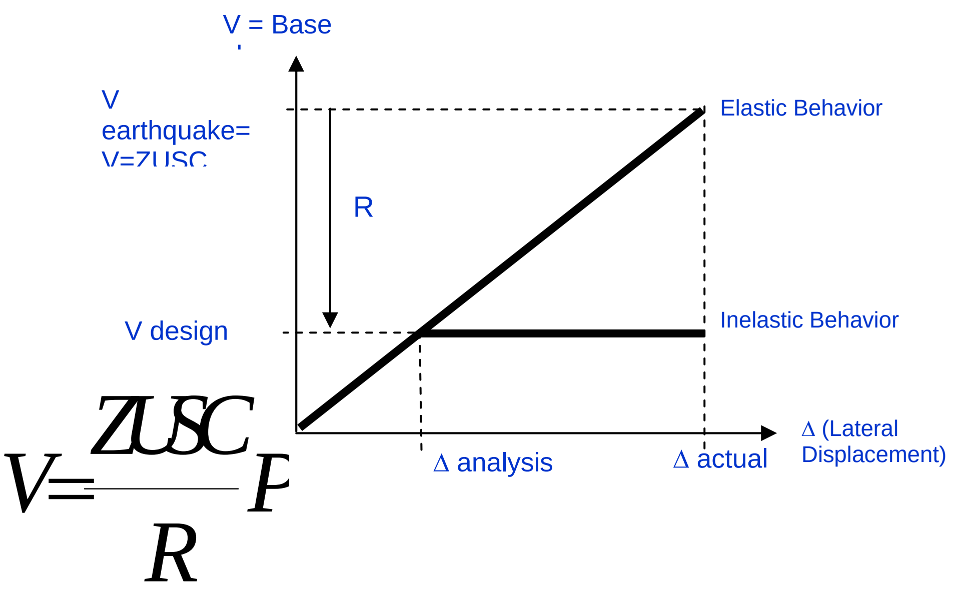

Figure 1: Formula of computing V (Base shear)

2.2 Base Shear Coefficients

Table 3 below shows the comparison of base shear coefficients. For factor Z, it's 1 in 1977 and 0.4 in 1997; for factor U, it's the same 1 for both years; for factor S, it's the same 1 for both years; and for factor C (short periods), it's 0.4 in 1977 and 2.5 in 1997. The ZUCS is 0.4 in 1977 and it's 1 in 1997. Thus, to obtain similar base shear, R factors has to 2.5 times greater.

Table 3: Comparison between base shear coefficients

Seismic standards	1977	1997
Factor Z	1	0.4
Factor U	1	1
Factor S	1	1
Factor c (short period)	0.4	2.5
ZUCS	0.4	1

2.3 Drift limits

Table 4 shows that the drift limits were also reduced. For instance, reinforced concrete is reduced from 0.010 in 1977 to 0.007 in 1997; steel is reduced from 0.015 in 1977 to 0.010 in 1997; masonry is reduced from 0.010 in 1977 to 0.005 in 1997; and timber is reduced from 0.015 in 1977 to 0.010 in 1997.

Table 4: Drift limits

Standard	**1977**	**1997**	**Increment of demand**
Reinforced Concrete	0.010	0.007	43%
Steel	0.015	0.010	50%
Masonry	0.010	0.005	100%
Timber	0.015	0.010	50%

2.4 Displacements

As Figure 2 shows, the displacements for 1997 standard were at least 2.5 x 4/3, which is 3.33 times larger and compared against a stringent drift.

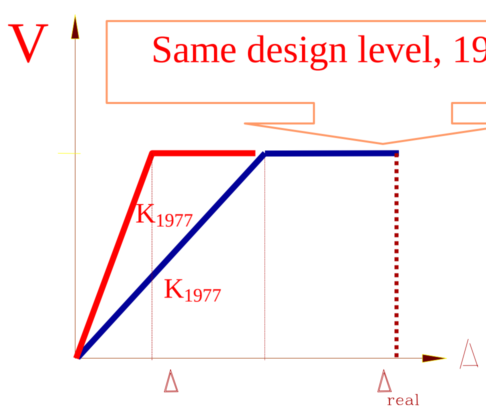

Figure 2: Comparison of displacements

3. 2003 Revised Standards

The 2003 Revised Standard is not much different from the 1997 Standard. Many provisions of the 1997 Seismic Code are maintained in the 2003 Seismic Code. Among these are (1) the quantification of irregularities of the trend, (2) the reduction of allowable distortions, (3) the increase design of intensities, making it more consistent with other kinds of changes, (4) the declaration to try to "avoid collapse". Essentially, the engineers must guarantee that they will avoid collapse. The regular structural configuration required for essential buildings is also maintained.

The 2003 Revised Standard may be said to have the following strengths:

- Buildings built with this standard have ultimate strength (base shear x 1.25)
- The displacement is slightly reduced
- There are more "R" values
- There is a slight change in design spectrum descent

The Design Philosophy behind the 2003 Revised Standard is:

- To avoid loss of life
- To ensure continuity of basic services
- To minimize property damage

However, the 2003 Revised Standard has limitations, which will be addressed in the very near future. Among the current limitations are:

- It has only one set of objectives, independent of building importance
- The seismic performance level is combined with design seismic level, expressed as intensities
- We use only one set of forces corresponding to severe earthquake reduced by "R" to satisfy three performance levels

In a way, with one bullet at hand, the intention is to kill three birds by a single shot. It is very difficult challenge.

4. Conclusions and Recommendations

Here are some of the conclusions made after comparing the performance of buildings with 1977 Standard and 1997 Standard.

- All school buildings in Southern Peru designed with 1977 Standard experienced structural and nonstructural damage, whereas none of the schools designed and built under the 1997 Standard experienced damage.

- The Peruvian seismic standards require higher computed lateral displacements. The structures have to be much more rigid than before.

- Changes in structural element dimensions to achieve additional stiffness in case of school buildings increase structural costs by 30% (Actually, not only structures but also the foundation). However, the schools built with 1997 Standard incurred no cost after the earthquake because of absence of damage.

- The structures designed with 1977 Standards had to be repaired. These structures could not be used for several months. The costs for retrofitting and stiffening of these structures reached up to 40% of initial cost.

Following these conclusions, the engineers recommended that the 2003 code should incorporate (1) restrict displacements, (2) limit irregularities severely and that the essential buildings should be regular, and (3) either assure safe collapse mechanisms or limit the use of frame systems alone. Among other recommendations are:

- To implement programs to support retrofitting with training and long-term credit or subsidies;
- To relocate non-engineered heavy housing in high intensity areas;
- To place greater emphasis on the importance of configurations; and
- To assure stable mechanism on ultimate conditions (capacity design).

There are still various possible future changes of the 2003 Revised Standard. For instance,

- There is a need to go for performance based design at least in 2 design levels;
- There is a need to modify load factors;
- There is a need to determine the ultimate lateral resistance;
- There is a need to define the stable energy dissipation mechanisms (the capacity design, most likely); and
- The need to improve the use of energy dissipation devices.

At the moment, many agenda are still pending. Among these are:

- The need to convince users of the benefits of good design;
- The need to convince policymakers that it is less costly to invest in prevention than through retrofitting;
- The need to introduce collapse prevention at the design stage; and
- The need to implement policies for non-engineered housing.

Question & Answer

Mr. Hadi: Thank you very much Professor Javier Pique for your technical and clear presentation. We will now entertain questions and comments. Mr. Thapa, please.

Mr. Thapa: You mentioned that building configurations are irregular. Do you mean symmetrical or structural?

Prof. Pique: Structural. You may have a regular shape but you can extend something to make stronger.

Mr. Thapa: Another thing is, you want frames to be more rigid than flexible?

Prof. Pique: The walls have dual system, you are right.

Dr. Ando: As far as education of this type of technology is concerned, for engineers the universities can provide this. However in the last part, you mentioned about non-engineered. My question is, does the building code of Peru provide some system for the non-engineered buildings?

Prof. Pique: We do have one standard for adobe, which is part of our national code. We still use adobe for small schools and hospitals. So there is a standard for adobe. Other than this we don't have standards. However, there are some books or booklets produced by universities, academic groups, and other organizations but not by the government. There are many but it seems to be not enough. Once there are devastations from an earthquake, people will build again with the same defects. So we don't have standards except for adobe. In retrofitting also, there are booklets and documentation but these are not official.

Dr. Ando: Thank you. One more question. How about confined masonry, is it engineered or non-engineered?

Prof. Pique: In Peru, it is fully engineered. Actually, it is the most popular way of building houses. We just had a new standard in place last July based on ultimate strength. Lots of research has been there and it proved to be an adequate system – mostly clay bricks and also include concrete blocks. There is a standard in this. It is fully engineered.

Dr. Ando: One additional question. Is the design for confined masonry permitted to engineers or not?

Prof. Pique: Designs of confined masonry are permitted to engineers.

Prof. Okazaki: If I will construct an adobe house in Peru do I need to submit a plan to the municipality and an inspection will be conducted?

Prof. Pique: The reality is I don't know. That is true. Adobe is usually found in small communities and sometimes in cities but they are mostly informal. Actually, our standards are used as reference and NGOs are utilizing this. That is a very interesting question and I don't know the right answer.

Mr. Hadi: I think there are no more questions. I observed that in developing countries, we have some common problems. Although most of us have building codes but the implementation seems to be the real problem. Perhaps this has something to do with the economic conditions of most people. We can also add factors like lack of education and limited knowledge in these areas. Considering these factors, it is difficult to enforce our codes, which are based on ideal standards. I think an incentive for these people is something to consider. I believe that people should understand the value or importance of disaster preparedness. Once they know how to prepare, this in itself is an incentive for saving lives or to stay safe. I think that is what I can conclude about this session's discussions. Thank you.

V. DISCUSSSION FOR FUTURE DIRECTION

19 January 2007 (Friday)
Chair: Dr. Shoichi Ando

Prof. Murty: I think the definition of retrofitting has not penetrated down to the community level. Thus, retrofitting has to be clarified. Part of the ABCD project would be to consider informing the community of the retrofitting concept itself.

I can readily share about this paper. I have two copies of this very special booklet and everybody will get a copy as I understand. This is "*Construction and Maintenance of Masonry Houses*" produced in Peru under the leadership of Marcia Grande. It is an outstanding document in a sense that it has pictorial representation of the various elements of the process of making housing. Also it uses confined masonry as the bases. Actually, this document will be one of the valuable documents for us when we embark on making masonry houses safer. Confined masonry will be the way to walk forward now. From that point of view, we heard, each one of us here should have a copy of this document. It is available on the website for download also but if Dr. Ando here is kind enough to print copies to share with us all, I have two copies here and later you can get it from me. Thank you, Dr.

Dr. Ando: Actually, this information is on the website of the World Housing Encyclopedia. If you need the paper, I have just 2 copies. I found this on the homepage. Originally, it is a Spanish version.

Prof. Murty: Yes. This has both Spanish and English versions. Similar documents are also available in Windows software and another document in Adobe version. Again, adobe version is both in Spanish and English. Thank you.

Dr. Ando: I just would like to introduce to you briefly other documents that we have requested. The first one is the contents of the "*Japanese Building Standard Law*". I just received the ordinance by fax and we are now copying the document. When it's done, Mr. Okasaki will briefly explain it to you. The next one is, "*How have Earthquakes Affected Japanese Anti-seismic Building Standards*?" Dr. Yuji Ohashi of the Building Research Institute wrote this, but unfortunately, he died seven years ago. He was a researcher of the Structure Section of the Building Research Institute. He summarized the Japanese history on the structural code or structural engineering development. So maybe, in the last part there are related photos. These documents are just for your information. I think that the outline was already explained by professor Otani yesterday in the morning. This is just a little more detail. In the last page, the second to the last page you can find three tables for 1924, 1950, and 1980 – these are just the seismic force.

We will start from the one with Chapter III on building codes. This is just an outline of the Japanese building control system and ordinance on building codes and so on. The second last one, the PowerPoint presentation – one-page full size power point presentation. This is the "*Building Codes and Control Systems*". Also, this is written by a researcher from the Building Research Institute, Mr. Kikitsu. He made this power point presentation. He is also an expert of construction engineering. He is involved in the development of the Japanese structural code also. This may be also used for presentation. Mr. Okasaki asked for those information provided by MLIT. So if you have some additional comments, please.

And last one is just a simple one, the Japanese urban planning system. This was also developed by MLIT – the Urban/City Planning Division of MLIT. You can see the economic and social aspects and also the bottom right side the Japanese governmental organizations. Just parallel organizations, central government and local governments include 47 prefectures and 3,226 municipalities including 672 cities. Within those cities 12 are designated. Designated city means there is over 1 million population. So this is the outline of the government. There is so much urban planning-related information. One more thing that I would like to introduce to you is about disaster-related urban planning is included in this document. Later, I will explain to you. So Mr. Okasaki, would you kindly introduce the building standards and later we will ask for comments.

Prof. Okazaki*:* After World War, what Japan had to do was to complete its planning. Please refer to Chapter 3 or Governmental Order. I mean, Cabinet Order. Following the type to structures – we have many types, many articles, as shown on this page from 439 to 443. To explain on this system, because there are many parts separated and the core of the system is shown on this paper. In this occasional paper, it is on page 14. The third column is ongoing system on structural calculations. You can see some indicated numbers. So, on the Ministerial Order, we decided and fixed the calculation system or each number of the indicated number. And following this system, the engineers can calculate the seismic force and this number, the number of seismic force. If that number of seismic force is lower than the calculated values of building, then we understand that this building is safe. And maybe, if we only see this paper, it is difficult to understand.

Dr. Ando: Are there any questions? So, now we open the table for questions. What is the relation of both documents? The Japanese Building Standard Law, which you see in handwriting, is a law. The second is a part of the Cabinet Order. The Cabinet Order is very long, so this is just Chapter III that I asked them to send a copy.

Prof. Murty: I have a question. This is regarding the structure of calculations. Does the Building Standard Law have all the calculations to be done, or just the main calculations only?

Mr. Okasaki: As regard to the size of the structural type, we can fix or determine depending on what size of building should be created or to be created in some way. For example, in the case of the small size buildings to be located on the bay and in the other areas, where the structure is medium, the planner has to make sure that the building is safe. This calculation system is very easy. In case of medium size building, the strength of the structure depends on the wall size and its bracing. So counting like the number of walls, the planner can understand easily. But in case of high rise buildings, the planner has to check it in accordance with this way.

Prof. Murty: I understand process. I just want to get all the steps as shown in the Building Law. The information tells us about this and that, which is a kind of specifications. In addition to specifications, do you also have calculation steps to be followed?

Prof. Otani: Historically or until now or few years ago, our building standard law are enforced by the order, that is Cabinet Order, or by the order by the Ministry of Construction. I don’t like to use MLIT. Anyway, they do not include technical items. Technical items should belong to the academic societies. So the academic societies publish many guidelines with regard to that though it does not have any legal background. So the laws and enforcement orders and so on they each just describe what it should be the desired forces. What should be allowable stresses or the resistance of the structure and the computation method that belongs to another part? So it doesn’t say those requirements and does not state by the computation method.

Dr. Ando: Thank you very much. I also hope that the new group should transmit the fund to information of the Building Standard Law. So now, we would like to move to the discussions and summary of this meeting. I think that today’s presentation by Mr. Dixit provided the best summary to continue the discussions to cover the global issue related not only to capacity building but also other issues. But because our time is limited, we would like to concentrate on the dissemination or the implementation of the laws. We are clear that we need some kind of training or capacity building of key stakeholders, so the purpose of the discussions or the meaning of this workshop is not how to develop the code itself, several issues discussed on the code itself, or the development process. But this time, we would like to concentrate on how to distribute or how to implement or disseminate the information on building code to the stakeholders. First, I note the capacity building is important. There are several approaches just for additional information. Professor Otani, would like to say something?

Prof. Otani: This (a paper) will give you some information. This will also introduce some Japanese requirements.

Dr. Ando. Thank you very much. I forgot to distribute the paper. You have now the background. Let me explain why I did not give to you the paper first. Now regarding this project, MLIT has already prepared the fund. But actually, New York has not authorized yet. So that is the problem for us. We will of course wait for New York to authorize this project but still it’s pending and we will have to wait. I am not so sure why there are problems, but anyway, this time, the ABCD project has not yet started formally. We have a fund from the UN to do disaster-related issues but this time the Building Guidance Division of MLIT has already prepared the fund to provide us. So we prepared the proposal for the project to MLIT and MLIT has already agreed.

Anyway, so ABCD may disappear. But HESI will start anyway or has already started today. So, the objective is to enhance the safety of houses. The first point is that building code is one of very useful tools for housing safety. For the government, as I understand, the implementation of the building code is a kind of the objective or target. We have discussed many things as Dr. Ohashi said just before he died, “the building code is the very useful tool for the dissemination of technology but it is only for the developing stage of the country. After developed stage maybe there is a need to disseminate the new technology and so on or in another way that it exists”. That is his message. So I think, in the first stage of upgrading the technology in each country, the building code is just one of the tools but a very useful tool to disseminate building technologies. So that is my fundamental understanding of the concept to be said of ABCD project.

Now, I think we are free to discuss everything. I hope that we don’t need to concentrate on building code issue but every issue has to be related to Housing Earthquake Safety. So that is the first comment. I hope that we can discuss in just 1 hour about the ideas of the Housing Earthquake Safety. And finally, I would like to introduce you this, not the building code but kind of a specification made by the Government Housing Loan Corporation for owners who want to build traditional udon houses in Japan. All owners who want to apply for a government loan have to submit this document to the bank. Just first 4 pages are for the owners others are not actually for the owners but for the carpenters.

As I said before, until ten years ago, half of the Japanese new houses were constructed using public housing loan, which means that all carpenters understand this document. I have the English version. Just 10 years ago, they had published, not really published but translated the document into English. For the specification, there are many pictures and tables for the carpenters. So I think, this type of document is also very useful to disseminate the earthquake resistant technologies or other technologies, for instance, energy-saving technologies and barrier free technologies for handicapped persons.

The law of the Government Housing Loan was very big and they successfully distributed new technologies to all the Japanese carpenters through this document. But this document also follows the Japanese building code. In Japan, as Mr. Okazaki mentioned, the building code is revised every year, and in some years, twice or three times per year. Not only the structural part but also, as you can see later, the building code includes zoning code, the relationship between the urban planning and other related laws, and fire laws and there are many junctions or connections. So if another law is revised or the name of another law change, the corresponding part in the Building Law has to change. That kind of individual changes are included but every year, the Japanese Standard Law has changed. So, that is the reason that this document is revised every year.

Also the publication of Building Standard Law, maybe you have seen in BRI, the thick one – the Japanese Standard Law in Japanese, it is also revised every year. That is very good related income source for the Japan Architecture Institute. Every year, people, experts, engineers, and architects have to buy. So, that is also a kind of dissemination system. It is a compulsory system, so every year, they have to buy. Business? Yes. Publication is……. Now, that's all. So, if you have some comments. Any comment, we will welcome.

Mr. Thapa: Thank you Dr. Ando. As we discussed about this ABCD Project, I thought that this ABCD Project has started already. That was my thinking. But anyway, we are part of HESI now. This meeting is not part of HESI but ABCD. Like any other project, I was told that this project will cover Nepal, Peru, and Indonesia. So, I feel that this project is our project, or a Government of Nepal project. So we have to make preparation on ourselves. You know in our respective countries, we have to make preparations. We have to organize ourselves. We have to organize the local governments, the academia, the NGOs, and the national government will take the lead. So, once we organize ourselves, this project could be launched in these respective countries. So, although we are applying for the fund and it may take some months or even one year, let us start the preparation process in each country. You tell us what we are supposed to do. We don't need any from you right now. I mean, we will organize ourselves; we will make provisions for some parts. There is no problem in my country. I mean, in early as say March, we will finalize the program for the next fiscal year that starts from July 16. So, we can make provisions. We can ask our Ministry of Finance and the National Planning Commission to make funds for this project. So, give us the Framework of Action, and then we will start.

Prof. Otani: Yes, I am looking at the title of this session. It said, "Discussion on the Questionnaire to the Government Officials in Developing Countries for the ABCD project". But I don't think we are discussing this problem but we are now working on the second session this afternoon on "Comments and Discussion on the Future Direction of ABCD project for HESI". My suggestion for each of you presenting this is that I want you to just pick up 2 or 3 items from your presentation for discussion. What should be discussed during this session? And some of them maybe just an introduction of some building code system in the country that might not be useful in this purpose. But for example, Mr. Amod M. Dixit pointed out many things for discussion in this group. So why don't we just pick up what should be discussed from your presentation? Each of you can suggest what should be discussed. And then probably we can focus our discussion on such subjects. Otherwise, I think we'll just talk this and that and there will be no conclusions.

Dr. Ando: Thank you very much, Professor Otani. It is now coffee break. But if you don't mind, I would like to continue. Is that all right? But before we start hearing comments, I would like to introduce Professor Kameda. Prof. Kameda is former professor of Kyoto University. Now, he is executive or head researcher for Earthquake Disaster Mitigation Research Center (EDM). Could you kindly introduce yourself?

Prof. Kameda: Thank you very much. I just came in and I don't know much what's going on. I am very happy to be here with you. Actually, I was Director of EDM until three years ago. I still have some responsibility in a kind of project promotion, which we called DRH or Disaster Reduction Hyperbase, which some of its members are also highly involved. Knowing that this event is going on, I just came in to see what is going on and to increase my information base. Thank you very much.

Dr. Ando: Thank you very much, professor Kameda. Later, each one can introduce himself to Prof. Kameda. Another person, he comes from MLIT at its Kinki Branch. He's Chief of the Housing Section. Just a name, please.

Mr. Sato: My name is Kazuma Sato. I am working at MLIT, Kinki Branch, Housing Division. My boss Katsumata was scheduled to come here today but he couldn't come. That's all. Thank you.

Dr. Ando: So, instead of your Director, you are here. So, from Murty-san please raise your question.

Prof. Murty: Thank you, Dr. Ando. Since I am speaking first, it is my responsibility to also write something on what we have discussed. So, I was thinking that keeping community based approach in mind, I would like to broadly discuss on the three X's. One is availability of information on housing safety. Second is understanding of the urgency of ensuring housing safety. Third is implementing housing safety. Three parts. The reason why I broke it down into three parts is, first of all, to embark on the project to any country, you will require information about the housing in that country and the documents you want to disseminate in that country. So that is why the availability of the information on housing safety is the first one I want to discuss. The second one is the understanding of the urgency of ensuring housing safety. What I mean here is, like we want to penetrate into national governments, local governments, and into the community. So we will require undertaking activities of sensitization at these three levels in each of these countries. The third one is implementation of housing safety. This means we are going down to demonstration level, and which will include some amount of training of the people, local artisans, and also making demonstration structures, which will develop confidence in that model community level. Model community or sample community that we are taking care of. So this is a broad framework in which I was thinking that HESI could consider under it. That was my first tier statement.

Question: Excuse me, could you repeat the three parts again?

Prof. Murty: Ok. Availability of information on housing safety. That is the first one. Second one is, understanding the urgency of ensuring housing safety. Third one is, implementing housing safety.

Question: The third one again?

Prof. Murty: Implementing housing safety, which means that we will not do the entire country's housing but we will do one house or one house each block or one village, one town, whatever, and demonstrate to them. That way, too many requests like training of peasants, training of artisans, training of carpenters, and so on will be linked and accomplished in that sense. So engineers, architects, and artisans are going to be part of the capacity building in that sense, but locally. That was the broad three boxes under which we could consider activities under HESI. That is my broad proposal. Because I am an associate of the World Housing Encyclopedia, I can see that I prefer very clearly to the first part, which is information about each country and building documents specific to that country and we will be happy to participate on that particular section. Thank you.

Dr. Ando: Thank you very much. Next is Mr. Hadi. From your viewpoint please.

Mr. Hadi: Yes. I agree with Professor Murty because this is also a big problem in our country. Especially the implementation. I believe that we have a good standard but in the implementation, we lack human resources and then for inspection and then to explain and then also from the people, it is very hard to make them understand. So we have to have some system of making them follow our standards. Thank you.

Dr. Ando: Thank you very much. Next is Mr. Okasaki.

Mr. Okasaki: In this meeting, we hope that we understand each country's conditions and of course every country is troubled to establish their own system and their building code. On this way, it is the same condition as my country. It would be useful for us if say, we can chart information from other countries, if say we can get some place or survey of the building codes in several areas.

Dr. Ando: Thank you very much. Yes, Professor Otani.

Prof. Otani: For my presentation, I don't think there is anything to discuss but about the problem of implementation of housing safety then I would suggest to discuss the use or employment of private organizations. I don't think it is possible for our government or even local government to control for complete building safety implementation. Probably, we have to rely on some assistance or aid from private organizations. Without assistance from private engineers and so on, the capacity of government is not sufficient. I think we should discuss this problem. How to implement the code requirement and so on, then I think we need some assistance.

Dr. Ando: Professor Otani, may I ask? I understand that private organizations mean not only private companies but also academic institutions?

Prof. Otani: Oh yes. For example, in the United States or probably Japan in the very near future, we will have "peer review" of designed works. We will ask private structural engineers or any engineers to review the work done by other engineers in the application of building permit. So, if the examination of design work is done only by government building officials, I don't think the number of government building officials will be sufficient or the knowledge and technology of the building officials may not be sufficient for the checking purpose. I think we need assistance from other practicing engineers.

Dr. Ando: Thank you very much. Now, Professor Okazaki.

Prof. Okazaki: In order to elaborate the project document, I would like to suggest to concentrate on the beneficiaries of this project. Who will be the beneficiary of this project? Will it be the central government, the local government, the people or some others? Then you could elaborate what other things should be done under this project. So, that is my first suggestion. As professor Otani pointed out, I also recognize the big problem of existing houses. How this problem could be incorporated in the project or establishment of the building code. For example, in the Japanese building code, it is stipulated that all the building should follow the building code. Not only the new constructions but also the existing ones but that is just a concept or idea and there is no concrete strategy. And so what I want to suggest is to incorporate such idea. That is how to deal with existing or the number of existing houses in the building regulations.

Dr. Ando: OK Mr. Thapa.

Mr. Thapa: Thank you. Like Mr. Murty, he has clearly outlined three areas in which we could fit ourselves. For myself, who belongs to the central government agency, implementation is my first priority. And there are so many things to be done in this stage. Implementation means not only preparing the code and training the engineers and peasants but also designing our system, whereby the academia, the private sector, and the local government may fit. I like that idea of Professor Otani, the idea of peer review. In my presentation, I mentioned that in my country, since the municipal engineers are not sufficient enough to look after each and every building, the designers would be responsible for this building permit process, and even in the issuance of the completion certificate of the building. So that there will be less corruption. The efficiency will be improved. And all the community of designers will benefit and society would acknowledge their contributions in this regard.

Dr. Ando: Thank you.

Mr. Dixit: Well, everything has been said. Then, I don't know which one should be included. But, if you agree with this project, at least I wish that this project would have two boxes. One is what it does. And the second box is what it encourages after the completion of this project. So, it is about sustainability. So looking at the longer path and looking at the project path. That one approach or multiple approaches if that could be done. Then whatever could be done within whatever period, the launch of the ABCD project would be very useful. That is number one regarding the approach. So obviously, two points are there. One thing is that in the research component, the research that is required for specific non-engineered construction should be spelled out and perhaps that could still be met. In whatever form I don't know. But that will help spell the conclusion, which sometimes the implementers and the disseminators are confronted with.

Because the problems that are there are sometimes away from the conventional problems that are discussed in scientific area. So, something like that the research or at least the minimum of research and perhaps it could be defined what could be the minimum of the research. That is necessary for what we call the quantification of the quality, or the quantification of damage reduction or whatsoever. The other element is the training and capacity development. This includes strengthening of existing training institutions. Priorities should be given to understanding the probability assessment, damage assessment, and priority assessment and the techniques for repair of the building. So, I don't know whether I am talking sense or not but these are the points that came to my head, right at this moment. Otherwise, we may not be able to sustain the initiative that we will be implementing in this project. That's all, thank you very much.

Dr. Ando: Thank you very much. Dr. Pique, please.

Prof. Pique: If I recall the reality of Peru, we do have non-engineered constructions not only made up of adobe but also let's say, modern materials also built as non-engineered. There is certain number of brick, clay-brick houses with a concrete to reinforce and everything built non-engineered. So, made by masons and such things but these are good materials and let's say made informally. So, one of my concerns that I like maybe to be discussed is how to, as suggested by Ando-san, "how to raise the awareness of the people". That is really wasting their money, important money. Not only to say that they are using adobe but they do not see the benefit of concrete. The authority does not enforce it because they do not have the capacity to enforce it. They have important legislation on normal construction but not on non-engineered. So, I could see that as one important point. Then, with the existing construction, I think also, we should maybe conclude, or discuss, or agree on which will be the policies or the topics for these existing non-engineered houses. How to reduce the probability? Is it on their financial decisions? Are there legal decisions? What is our work on that? Those are the things that I like to be considered.

Dr. Ando: Thank you very much. For the roundtable, the implementation is one of the keywords for this housing safety project. We have received many suggestions. Also, this is just the reversed way but Mr. Murty's second topic, understanding or awareness of the community or people is maybe the second issue. How to increase public awareness? And also included is maybe the experts' awareness. And there are many suggestions including the availability of information. Maybe the most important keyword is implementation. In case of Mr. Hadi, for instance, the implementation of standards. And in case of Mr. Thapa, the implementation of the building code. For the professors, Dr. Pique, Dr. Otani, and Professor Okazaki and Mr. Murty, how to involve or support such activities, is maybe the point. Also, from the community-based or NGO viewpoint, as mentioned by Mr. Amod, how to get involved in such kind of implementation process? Now, I would like to ask you to one more comment in a little detail, key point on what you are now thinking about, or key point of implementation of building code or building standard or some kind of norm. From the comment of Mr. Thapa, some keywords are raised, such as the building code itself, and also training or capacity building, and also design system, process, or procedure are also important. Maybe from each of you, you have some viewpoint or the key point of the implementation. Now, Mr. Pandey would like to make some comment. So before the next round, I would like to ask Mr. Pandey.

Mr. Pandey: Just few points I would be discussing. As I move to HESI, Housing Earthquake Safety Initiative, when we put housing things, it means to cover more things all dwellings, buildings, and everything. So, we go in a broad range. So that is the scope. I see here, when we say implementation and capacity building, again we see a lot of things encompassing to those stone engineered buildings. How to bring those things into the picture of engineering or the design system, or whatever capacity building or implementation? So, you know, when Ando-san says implementation, then we discuss implementation. It would be useful if we can make some suggestions on how to bring non-engineering into the designs process or the implementation process. As of now, we are talking. You know we can freely talk on the design portion of an engineered building. So, why not have a system that non-engineered buildings can be also looked up in that way? So, how can we start on that one? Let’s have discussion on that.

Dr. Ando: Maybe this is the first comment. You are the key person of the project, anyway. Implementing person of this project. Yes, Mr. Amod. Now, we are free.

Mr. Dixit: Reflecting on what Professor Murty said. You talked about demonstration structure and you talked about training of masons. And that was what made me to tinkle deeper. Say, it is not necessary to define what to do. Perhaps, if a progressive project like ABCD, I would prefer not to define how to do it. But I would like it to be, how to implement the process. No structure demonstration. Somehow, I think that we can do it with demonstration but it is not like a demonstration building but demonstration process. Not the product, right. The need is, in every country, we know the technology, we know the “how to”, we know “what to”, but the question is to do it and to do it in such a way that it fumes the entire country. It has to go over like cloud. It has to cast a very big shadow throughout the country.

Dr. Ando: Mr. Murty, please.

Mr. Murty: I will respond to Mr. Bishnu’s question, which was on non-engineered housing. How to make non-engineered buildings towards engineered. Also the theme I had yesterday with professor Otani. I see a real proof in what Peru has done. It has confined masonry under calculations. It is an engineered product. I see that there is a lot of strength if we can start from that point, where we already have experience from Peru on making confined masonry through calculations. And that will be again, involving basic calculations. I am sure that the core will give us a great guidance in this kind of document they have. Maybe our discerning guidance for this is to start building similar documents in each country, knitting it with the existing building codes or basic requirements. In addition, the confined masonry can be then modeled in line with that particular national standard. I see that we can begin with confined masonry. If I am talking with stone masonry, brick masonry, lateral masonry, or any masonry we can talk about, confined masonry may be the first step that we want to do.

Today, if I look at any document, the Afghanistan document, the IA document, anybody, it is talking about bands – vertical and horizontal bands without any calculations. That is the point I made. It is time to take out that document and put it away. It is over. That is the past. Knowledge has grown beyond that and we need to go forward from there. 1982 document of IAEE cannot be the standard in 2007. I have due respect to practice at that time but today, time has taught us much more and we have to create the new document – with that experience of the last 25 years and the experience of having implemented bands and the vertical reinforcements. It means such a challenge to put vertical bands in masonry structures – the vertically stone masonry, the way as shown in the IAEE document. To put a vertical band through brick-wall or to put a vertical band to stone masonry, Mr. Dixit will know the challenge behind that. It is not simple. I would say to the extent that it is not implementable in some occasions. It is a great challenge to make vertical reinforcement. They can get rusted and they become useless after sometime. The kind of mortars people use with high water content will just render in 6 months or 1 year depending on exposure conditions. So time has come to give formal vertical reinforcements to these masonry houses and that is where the directions of confined masonry. Personally, I would like to propose confine masonry as one way of trying to address or formalizing non-engineered houses. I believe that in the long run we will use less of this word "non-engineered", and more of engineered even in the confined masonry. I don't want to leave masonry to masons. Masonry has to be done by formal engineering calculations. That is my proposal for the project.

Dr. Ando: Thank you very much. Yes, Professor Otani.

Prof. Otani: I don't think I catch it timely with Professor Murty. Engineered constructions should be done by engineers; well educated, professionally educated people. Confined masonry, if not designed by engineers, is still non-engineered construction. In some countries, the use of confined masonry may be in the category of non-engineered construction. So as long as in that stage, in that particular community, that should be treated as non-engineered construction. And in non-engineered construction, the important thing is training. For engineered construction, it is education. There is background of education, high or professional education. So I don't think we need any additional training. Training part should belong to education at the university. So I think we should discuss two items: Engineered construction and non-engineered construction. I think the direction maybe somewhat different. For example, in engineered construction then yes, we can talk about peer review. But when we talk about non-engineered construction, then I don't think it is worth talking about peer review at all. So I think maybe we have to categorize the constructions into two and then we will continue to discuss.

Mr. Murty: I think I was not clear enough. When I said we need to encourage confined masonry and that it will be done through calculations, I meant that the leader of the community should put it in that way. And the people, the common men, are going to try that way. Everyday that happens to be in a country like India and Nepal, you see, whatever the government does, whatever the rich man does, the poor man wants to emulate. Like today, reinforced concrete has become a dream of every citizen in those countries. So what I am saying is if they see this vertical concrete like columns, if they see a base beam from the start, maybe they would want to emulate. In that process, their current practice will slowly change over time as they see all these. So that is one part, I just say one part to start developing a culture of better quality non-engineered. At some point in time, if the country has a document of confined masonry with calculations, the formal engineering houses, like the housing societies, the government colonies, and the peasants living there will go back to their respective villages and try to emulate these structures. That is the hope for which I am proposing confined masonry. Not as a replacement of the engineered houses. As regard to the non-engineered structures, we need to go ahead with training and still a lot of miles to take and we need to put more research in this effort.

Prof. Pique: Yes, if I may add some information. In Peru, we define engineered structures as the ones done by professionals and it follows steps. You can build a brick confinement masonry, engineered or not-engineered. People who do not hire professionals, let's say, they use these columns with 4 bars but our standards set a minimum and you could see some difference. Based on reported difference, right? There is a standard that will tell you some specifications on the wall, and that what is to be built should not exceed the standards. And you can also do it without that. So whoever spends the money, and build without following the standards, does know how much force it can resist. That is why I said when Ando san asked me, if it has to go to construction process, I said yes. But many people just don't do it. And they spend almost the same amount of money and they don't know what is going to happen to their houses. So I think there is a point to what Mr. Murty says that we should try to promote that people are better served if they follow the standard and they hire an engineer to do these simple things. Unless you give away the plans, look, use the plan for free. This is it. You can do a house with these designs and all that. That could be one way of disseminating this information, just give away the plans. Or, you play engineer but just give the plans and so on. But I think, the point is when you give the plan, people will use that, they will try to back their investments in their structures. Then, they are better served.

Dr. Ando: Mr. Hadi, please.

Mr. Hadi: Thank you. So, in our understanding and then with regard to the case in Indonesia about the non-engineered structures and the engineered structures. For the non-engineered, we just give them the guidelines. In the guidelines, everything is already there. So just look, how the columns, the size, and everything. So the user will be the one to calculate. So besides the guidelines, of how we make the guidelines, the size, and everything that is the engineering part. So we have to do research, as to what size we have to tell them. So that is the different side. For the owner, this is non-engineered, but in how we make the guidelines, we have many engineering methods in there. Anyway, in Indonesia, so many experiences I have visited because of the earthquakes. So the basic part is the budget. They don't have the budget for making safe houses. That is the very basic. I think maybe we can give them something. For the engineered part, maybe the scientists, engineers, and everyone are thinking hard how to make safer houses but with very low cost in construction. And then on the side of the governments that decide it, maybe also the economists and everything, it should be on how they can make the systems that can help them. Maybe by loan. Maybe we can start to go to that track. Thank you very much.

Dr. Ando: Thank you very much. OK, Mr. Thapa.

Mr. Thapa: I feel that during this discussion, we are concentrating more on the design part. I think, I mean, we cannot differentiate building as engineered or non-engineered simply by looking whether the designs are prepared or not. For example, the quality of concrete in developing country like ours is very important. In actual sense, in the university, I have been taught that the concrete has to be mixed by weight not by volume. In our country what they do, they can 1-2-4. It means 1 cement, 2 sands, and 4 aggregates. This "1-2-4" is a very common practice. So even if the engineer has calculations, the columns, the beams, the designs, the proper joints, if the quality of concrete is not designed, then there is a problem. The simple 1-2-4 and 1-3-6 are not a engineered calculations.

Dr. Ando: So Mr. Murty.

Mr. Pandey: The point is non-engineering and engineering. I guess we are coming back to that point. Now, yesterday and today, I wanted to already mention that. There is this concept of pre-engineering that is reflected in the Nepal National Building Code although it belongs to another division. But there is already this bringing of non-engineered. This is a mandatory rule of thumb. Probably, you know, the common man who does not know the design, there is this prescriptive dimensions and everything but based on basic calculations by the professionals. So there are already set guidelines. So those kinds of things are covered under the mandated rule of thumb, from pre-engineering towards engineered buildings. In reality, there is an engineering calculation path and they can follow again. You know, with the formulas and everything, the structures and other configurations. In the mandated rule of thumb, it is somehow applied in a limited path, in limited time, in limited configurations, and everything. There is a constraint. But if one wants to go beyond that, then he has to calculate that one. And that is basically the engineered path. In the pre-engineered one, this is carried out by non-engineers or technicians. So that is what I think. Maybe we can go on that track also.

Dr. Ando: Mr. Murty.

Mr. Murty: I guess, this is the point that we need to do some research. To find out what we can prescribe for those common simple structures so that they don't have to do calculations. But somehow because somebody else has conducted studies, sort of build confidence. So, this is what I think that the IAEE document has sets of prescriptions but I don't have the background whether any research was done or any testing was done in 1982 when that was proposed. There were bars going horizontal and vertical directions. But today we have the equipment and facilities to develop the so-called "pre-engineered" or prescriptive type of construction as intermediate between the formal confined masonry calculations and the pre-engineered or prescriptive type of the mandated rule of thumb, as what Bishnu said. And then the intention of all these is again to develop a type of construction, which will be emulated by the economically weaker section. We want them ultimately to think that it is fashionable to be doing confined masonry and they should also be doing confined masonry. When we go to the Himalayan sector and then see some structures of walls that just fall apart when the shaking comes. I think it is very clear we need to have confined masonry. That is my suggestion.

Dr. Ando: Mr. Amod.

Mr. Amod Dixit: Actually, to add to that. That is exactly what I mean that each country should have a minimum population capability. You know to address and respond to the locally identified problems and to find out the solutions. And that is exactly what I mean by "You need to quantify the qualities". You tell them why you need to give the horizontal and the vertical bands. It has to be told and tested.

Prof. Otani: I think if we are going back to the 1982 document, I think there was a significant input by Professor Roberto Marie of Mexico. They have done significant experimental work and they provided some information in detail.

Mr. Murty: There are reports that these got rusted easily.

Prof. Otani: I am not denying that structural engineers should not use confined masonry. Structural engineers can use the confined masonry for economical construction or construction using local materials. I am not quite certain if we can allow technicians and masons to use confined masonry just to follow a guideline. Because yes, they know how to compute some amount of building enforcement by just following the guidelines and then put some lateral enforcements. That is fine. But without knowing the rationale and by just simply following the guideline is very dangerous. Engineers know why they have to put such and such reinforcements in these locations. But the guideline does not describe why this is required in this particular location. If that is done then, I am quite afraid that something may happen to those buildings. But I don't think we should confine this discussion to confined masonry.

Dr. Ando: Thank you, professor Otani. Maybe the non-engineered or engineered may be one of the classifications of the discussion. From the viewpoint of the United Nations, as Professor Okazaki said, the beneficiary is very important and we know our beneficiaries. So in many cases, from the viewpoint of the United Nations, the member is the country and also in case of UNCRD, the theme of our organization is regional development. The national and local government will be the beneficiaries of this project. From that point, I would like to ask comments. Maybe I begin with Mr. Thapa about the discussion so far.

Mr. Thapa: Yes. Actually for me, the discussion has been an eye-opener to me. I always think how ideas generated in the seminars and conferences can be related to action. That is how I think. It is part of my thinking process. So the ideas cannot be translated into action until and unless there is a system or procedures. And by systems, I mean the regulations, laws, and procedures. And there should be a human resource, financial resources, and administrative resources. So, on one hand, you should concentrate your activities on strengthening the institutions or either creating new procedures or improving the existing procedures and influencing the national government to have a proper legislation. That means to add some regulations. In developing countries, there is a notion that people will not strictly follow the guidelines until and unless there is some regulatory mechanism. There should be some system of "reward and punishment"; otherwise, people will not follow at all. So as a part of this HESI or ABCD project, it has to comment in terms of having these regulations put in proper place. That includes laws, regulations, building codes, and standards. At the local government this would be building regulations and building permit processes. How can the building permit processes can be streamlined and the training of the municipal engineers and masons? How we can influence the national and local governments?

Dr. Ando: Thank you very much and one more from the National Government of Japan. Mr. Okasaki, please make your comment.

Mr. Okasaki: I think the building control system should take into consideration the actual condition of the society. Sometimes, for the same structures, we need to ask engineers to build them while in other countries there is no need for structural engineers. This fact is very natural, actually. On the other side, not only in this aspect for example as I explained, my country's manpower or implementing building officials, even though that the number is higher than in your country, we think that such number is so small in our system. So, I invite the private company to assist in this work. This one is an example to answer or to resolve it using a tool, but maybe one of many types of tools. But for foreign countries' experiences, certain work is very important for each country. On the other side, I said I find some similar theory or that it is safe to follow under that building control system. To see the actual condition of the society is one theory I think. And of course included in this theory is more on costs. For example, the capacity of owner or payer to the cost or otherwise the building owners don't want to pay much for their house. Maybe this one is theory.

I think the most importance aspect of this theory is that there is a need to study the actual condition. This aspect is very important. And of course, on the other side, I think that the building code or the building control system is not only one solution to the buildings because in case of non-engineered constructions, in many cases the building owner cannot bear the cost to meet the building code. In this case, maybe one solution is to try the contractor or the local specialist to make such buildings, or to reduce or go down the required level of the building code. Otherwise, if we keep the level as high as in the building code, no one will follow this code. This is why there is no effect for the society. So in discussing my portion, I want to make such opinion and study as the case maybe. Thank you.

Dr. Ando: Thank you very much. Professor Okazaki, please.

Prof. Okazaki: If we have good specifications and classifications and these people are willing to follow or comply with such regulations, we will see no unsafe houses. As Mr. Thapa pointed out, enforcement is very important. In that sense, I don't think that lower–income does not necessarily make a safer house unaffordable. I believe people can build safe houses if they believe that the investment for their safety will pay off eventually. Again, in that sense, regulation is very important. Therefore, we should discuss what kind of environment and information can convince people to follow safety regulations and the information tips will finally pay off. The second point I would like to make is related to Indonesia, Aceh to connect some research about the structure and safety of houses. We found that the design is OK but the construction is not. Therefore, maybe sufficient supervision system within the contractors or masons assigned by owners together with appropriate inspection systems may be discussed. Maybe this is very technical but an important issue.

Dr. Ando: Thank you very much. Maybe we will have 2 to 3 points. Professor Okazaki, Mr. Thapa, and Mr. Okasaki from the viewpoints of the government. We would like to think about these issues very well. So are there any additional proposal or comment? Yes Professor Otani, please.

Prof. Otani: Simple question. Why are simple requirements not followed? Is it due to ignorance – because the technician or the engineer does not understand the requirements therefore he does not follow – or is it due to deliberate criminal action? Or is there any other possibility? If that is just ignorance then we can provide information. If it is a criminal action to reduce the construction cost, then we have to do some legal actions against such things.

Prof. Murty: I think it is a very nice point. I see two parts. When I see non-engineered constructions in one-half of the country, then I see that it is because of lack of knowledge and lack of information or inadequate sensitization of the seismic hazards. But the second part, I do see that the deliberate, willful misconduct of professional services is in the urban areas. If we talk about 2-story buildings, these have been done by degree holders graduating from big colleges. They, I think, are all in a passive way participating in willful misconduct in providing substandard services to the community. I do see that. That is why I always keep on saying that in the entire housing, there is two parts to housing. The engineered and non-engineered masonry houses on one side. And on the other side is the reinforced concrete housing. Reinforced concrete buildings are causing the increase of our buildings globally and I look at a large number of countries having the same ethics in the professional circle. Some are just building them with no proper design and such buildings are just being built. It is very scary. So that is the two parts.

Dr. Ando: Mr. Amod, please.

Mr. Dixit: Actually, some 10 or 20 years ago, the technology or the knowledge was not there. Now the knowledge is there. But still these are not yet implemented and I don't think it will be properly implemented. The case, which Dr. Murty reported, is good. It makes sense in organized construction business. There are two causes. One is lack of information. The information has not trickled down to those who are making the buildings. The second thing, which is more important, is the lack of mechanisms. The government simply does not have the mechanism and the creation of this mechanism has never been a priority of the government. In the last 40 years, our government all the time provided priority for basic health, education, and infrastructure development; and during these times by doing that it created probabilities. They said, OK we need basic education. They created thousands of schoolrooms per year. The Japanese government is helping us to build 4,000 schoolrooms per year but it is questionable whether all the 4,000 schoolrooms are earthquake-resistant. So there is lack of mechanism. The government is simply confused regarding this. So it is necessary to make mechanisms. And how do we make the mechanism because every government has its concern and has its own way of thinking? I remembered just now a statement of one of the leading scientists, who in one of his writings said, "if the government does not want to implement the building code, why should any other government help at all?" If the government does not install the mechanism of implementing the building code for its own safety, perhaps it is a criminal act that should be eliminated. So the one element is "naming and shaming". That is, where they can do very well. You know you can publicize the good things that had taken place but that you are shaming others who have not done these things.

Dr. Ando: Mr. Thapa, please.

Mr. Thapa: The statement of Professor Otani is quite fundamental in my country, because number one is basically ignorance. Concrete technology is a new technology. People do not know how to deal with it. And even the engineers or the qualified engineers, they are not taught properly in the universities about earthquake engineering. They are taught how the structure should be designed ok. They are taught how to design an important frame, but they are not taught how to make these structures earthquake-resistant. They don't have that mechanism. So that is where I am stressing my presentation in Nepal. We are trying to incorporate this thing in our curriculum in the universities. Because it is not part of their culture; it is not part of the engineers' culture to design buildings with this earthquake dimension. Their culture is different. So we have to make it a part of their culture. Third is the architect. I am also an architect and I must confess that we want to build some fancy type of buildings just to impress the community that we can make very fantastic buildings. But we never understand that this building has to withstand the forces of nature. This is always like this in our country. In India, there is a conflict between structural engineers and the architects. They always fight with each other. I mean, the architect criticizes the engineers that they design very ugly buildings. And the engineers complain that the architects don't care about the safety and strength of the building. So Japan there is no problem. I found that there is a good coordination between them. But in my country there is a lot of problem. So many buildings are public buildings. Very important buildings have been designed but they are very poor in terms of structural aspects.

Dr. Ando: Mr. Hadi.

Mr. Hadi: Thank you. So in addition, it is quite the same in Nepal. The architects always fight with engineers because they have different views. So to address professor Otani's question, in Indonesia, when an engineer builds buildings and we know that they are below standards, it's a criminal act because the designer or engineer knows what is the right thing to do. But some contractors cheat. We recall the slim dimension of steel bar. Some would say, oh, this is 10mm. So we mention it is only 9mm, something like that. So many criminal acts if the buildings are below standards. And then for the non-engineered, the tradition is like what Mr. Thapa said. We don't have the tradition of having earthquake-proof buildings so they just think about the gravity load. So do they have the traditions? 10 years ago, I built this house and now it is still there, no problem because there was no earthquake at that time. So there is no tradition. Also, they fill up to the business matters. If it is mentioned that they have to make the steel bar's configurations for the columns or beams, the businessman will say, "Oh, this is a good business". So they will make like instant beam or reinforcements and bars. They mentioned also that it is very easy to make columns and beams, so no connections between columns and beams. So this is very common in Indonesia. That is why when an earthquake strikes, the joints would be loosened. Thank you very much.

Dr. Ando: Thank you very much. We are having a lot of problems and difficult situations. Maybe we have to finalize our meeting because the problem is funding of this project. I hope that New York will reply in a good away. And also, we have another kind of project and we will continue this HESI part using some kind of community-based project or the school safety project. I hope that the next time, UNCRD can provide good news in the next fiscal year. In Japan, a new fiscal year starts in April. For the moment, I am very sorry we can't provide the next schedule or the next plan that I can confirm the funding. Lastly, I just would like to invite all of the participants to make a brief comment of the roundtable at the end of this session, just one minute or shorter comment.

Prof. Murty: Thank you Dr. Ando. At the outset, I would like to say that it is wonderful sitting here and sharing discussions on housing. I thank UNCRD for inviting me here and giving us the opportunity to present the WHE. I see that there might be a number of occasions that WHE can play a proactive and synergetic role with the UNCRD and I am very happy to be part of this activity. Personally, it is very nice to be in Japan. This is my first visit to Japan and I am touched by the hospitality and I learned a lot even in just a couple of days I was here. I will go back with very fun memories. Thank you.

Mr. Hadi: Same as Professor Murty, this is a very good opportunity for us, especially for me to sit here and share information with you. Maybe I can tell all of the problems to UNCRD for the next weekend and solve these problems together. I would also like to thank you very much for this opportunity. Thank you very much.

Mr. Okasaki: Thank you very much to all the participants of this meeting. On the government side, we need to put order to have better understanding. But maybe I hope that next time, we can make a good condition and to make clearer discussions on this meeting. Thank you very much.

Prof. Otani: In response to my question, I have the following recommendations. Recommendation one, professionals should continue to provide state-of-the-art education to practicing engineers. Two, the local and national government should provide good training to technicians. Three, engineered designs should be "peer reviewed" to limit misconduct of engineers. That is what professor Murty suggested. The structural design and the construction quality control should be comparable or should be in the same level. Four, good structural design does not mean good construction. So, if construction itself is not good then we will have very poor structure. Therefore, we have to also control quality of construction. I can point out 4 points based on my question.

Prof. Okazaki: I am conducting joint research for the developing countries including Nepal to develop the practical retrofitting or information on technologies for conventional houses. Therefore, as professor Murty pointed out, maybe we can contribute something for confined masonry or some other typical construction, which is common in developing countries. We look forward to close cooperation with you. Similarly, I am responsible for the dissemination of the technology and we are conducting field research on risk conception generally in poor countries. The tentative results will be reported on 15th March. It is connecting four countries by video on the internet. So if you are interested, you are most welcome. At the same time, we are also conducting a research project on disaster-education. We are compiling information about disaster education, especially conducted at elementary school level or college or university level or even at the community level. Also NSET-Nepal is cooperating with us. The report will also be presented on the same day. The first will be the conference on disaster education from 1 o'clock until 4 o'clock and from 4 o'clock, we focus on the recent update of the program. So if anybody is interested, you are most welcomed.

Dr. Ando: Mr. Thapa.

Mr. Thapa: I feel honored to participate in this important meeting. Personally, I learned so many things from the presentations of different countries and the experience of Japan. In our case, we have to move forward whether there is an ABCD project or not. If the project comes, that will benefit us in many ways. But even if the project does not come, we will move forward. We have already decided in our department that we will start the implementation of the building code. So we are committed to that and I thank UNCRD, especially Dr. Ando for the excellent venue and the hospitality extended to the government of Nepal. I hope that in the future also, we can help each other. We can share so many things not only between UNCRD and Nepal but among different countries of the region also. We are always there to help other countries, particularly on what we have already learned. Thank you.

Dr. Ando: Thank you very much.

Mr. Dixit: All of the efforts pertaining to seismic zones have been criticized and I have been listening for the past 10 years about non-implementation of the building code. Very serious criticism. Now, there must be some, you know, this is a big challenge. There must be some factors at play that are forcing the government not to implement the building code. It is not simple to understand in its totality and for others too. In that case, I just want to remind UNCRD that HESI and ABCD projects are challenging jobs and it requires a lot of networking and tell us how we can help you to do that. If you need our help, I am talking about everybody here, if there is a way that could be found. So it was nice talking to you all in this three-day workshop. This is something like, for me, a dream come true. Because we tried to meet in November but we could not and now we are meeting. So this means that we are going ahead. So we wish you all the success. Thank you.

Dr. Ando: Yes Professor Pique.

Prof. Pique: Yes. I think we have identified the common problems. These are of different degrees. 90% is about non-engineered structures and 50% or so about engineered. I am just giving imaginary figures. So the count, as I can see it, is useful. That means we should identify a common strategy. Then I will tell you a story. You know in Peru in the 80's, we had a tremendous inflation. People would wonder and my friends would say "Can you live there that the inflation was not 100% but 2000%?" Yes, I can manage it. That is what I am saying because you see, the Peruvians, but developed this kind of reaction to survive economically. They do their own business – they do this and that. Still now, there is a show or something that some people will take into account. I don't know how they learned but you will see people selling around or so. But this being said, maybe the solution at the end is addressing the financial problem. How can we give support for this or financial incentive on this house if they will comply with the code and maybe it would cost lots of money? But in my impression, I think that works. That moved the world, right? Money. They see there is benefit from there. They need that. If that is a long-term strategy, I don't know but maybe we could do that.

And also I would like to point out that we have a small network here. I hope we can keep it functioning. Maybe through you (pointing to Dr. Ando) or you (Mr. Murty). That is important because we can benefit from and share the information. I just left my own brochure on this but it's all in Spanish I am sorry but I can translate it into English. I left it with Mishima-san to share. You know document counts and we can share to the world. I guess that is very useful. And to report also to our authorities of different levels the existence or the convenience of this project and that this is just a policy to be. So maybe we will find some illuminated man there and say "Look, this is the way, we'll do that". There are always some. Not many, but there are some, right? So just keep on looking. Finally, thanks to Ando-san. I came to Japan in 1988 for the first time. Mr. Murty, you should have stayed longer. I have a great impression. The Japanese are not only kind people, they are very clean, that's it. And very honest. I really admire the Japanese people. We are very close. We have this long relation with my university and colleagues. I hope we still keep working together and giving whatever we can for the benefits to all of us. Thank you.

Dr. Ando: Thank you very much. Now we don't have much time so we have to close. On behalf of UNCRD, I express our gratitude, thank you very much for your participation in the past three days. I hope we will keep in touch in the future. At least we will inform you the results of this three-day workshop. Thank you very much.

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