Wider Application of Building Code for Safer Housing

Proceedings of National Workshop

23 August 2007 / Lima, Peru

UNCRD

United Nations Centre for Regional Development

Disaster Management Planning Hyogo Office

National Workshop on the Housing Earthquake Safety Initiative

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Japan-Peru Center for Seismic Research and Disaster Mitigation
Peru National University of Engineering

Peru Engineering College

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Preface

Peru is an earthquake-prone country having experienced a number of disastrous earthquakes in recent history. The affected areas include Lima (1966), Chimbote-Huaráz (1970), Nazca (1996), Atico (2001) and Pisco (2007). Peru also has a long history of building regulation. The first Building Standard Law entered into force in 1970 followed by revisions in 1977 and 1997. Each revision incorporated lessons learnt from several earthquake disasters in and outside Peru. The third standard was updated in June 2006 in an effort to improve its effectiveness.

On 15 August 2007, a powerful earthquake of magnitude 8.0 struck off the coast of Peru, some 150km south-south-east of Lima. It claimed more than 500 lives and caused severe damage to buildings and houses, schools, hospitals, roads and other important infrastructure. The damage was most acute in the coastal city of Pisco, where 69 percent of deaths occurred. The city was also hit by a tsunami, which exacerbated the disaster. Approximately 40,000 buildings and houses completely collapsed and additional 30,000 were partly damaged by the earthquake. Many of these buildings were made with adobe, one of the most commonly used building materials in Peru. The major cause of the vulnerability of adobe houses is that they are typically built by residents without applying necessary engineering techniques for structural safety.

At the same time, it was evident that buildings that were constructed with the latest 1997 Building Standard were more likely to withstand the earthquake while those that were built according to the previous 1977 Building Standard were prone to damage. Hence, it can be concluded that buildings and houses can be protected and human deaths be avoided if buildings are built in compliance with the Building Standard currently in place.

In Peru, the implementation of the Building Standard Law is limited, particularly outside city areas, and there are wide-spread informal buildings constructed without building permit. These buildings will remain vulnerable to future earthquakes unless they are reinforced. Furthermore, the number of vulnerable buildings can rise unless the Building Standard Law is implemented effectively throughout the country.

UNCRD launched a new project titled “Housing Earthquake Safety Initiative” in January 2007. The project aims to improve the safety of houses in project countries including Peru, through effective implementation of building codes. Under the project, UNCRD, in collaboration with the Center for Seismic Research and Disaster Mitigation, held a national workshop on “Wider Application of Building Code for Safer Housing” in Peru. Coincidentally, the event took place one week after the Pisco Earthquake when building safety was at the center of national concern. The discussions in the workshop focused on two challenges facing Peru: (1) ensuring the safety of future constructions, and (2) making existing houses safer.

This proceedings is a record of the workshop. UNCRD sincerely hopes that discussions on the improvement of housing safety will continue and will be followed by concrete actions to make it happen.

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Cover design, layout and editing:
Naoko Mishima

Transcription:
Leslie Chan

Translation:
Leslie Chan
Mariana Coolican

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Welcome Remarks

ROBERTO MORALES
Rector
Peru National University of Engineering (UNI)

Mr. Jesús Vilalón, Vice Minister, Ministry of Housing, Dr. Shoichi Ando, Coordinator, Disaster Management Planning-Hyogo Office, United Nations Centre for Regional Development (UNCRD), Dr. Javier Pique, Dean, Peru Engineering College, Director of CISMID, professors from Japan, CISMID members, and representatives of the various Municipalities of Lima. As the Rector of the National University of Engineering it is a great honor for me to give the welcome remarks of this workshop on "Wider Application of Building Code for Safer Housing". After the earthquake of August 15, this work has become very important.

Recently, CISMID celebrated its 20th Anniversary and one of its missions is to develop an adequate technology for seismic disaster mitigation. I want to congratulate Ando-san for taking the initiative of organizing this workshop which is aimed for government officials. Usually, technical experts know about the issues at hand, but the local governments do not have that knowledge and most of the time their decisions are hastily made, with good intentions but not with the required knowledge.

The main idea of this workshop is to understand in a simple way the main issues related to seismic design codes and the responsibility of the municipalities on the application of the codes. We have to make them understand that the specifications of the codes are essential for better behavior of buildings and lifeline facilities. Each earthquake gives a lesson and the codes integrate that information. I want to mention the presence of distinguished researchers from Japan, such as Prof. Otani from Chiba University and Dr. Yamazaki from Yokohama University. Welcome to this workshop and I am sure that the accomplishments of this workshop will be positive. To the organizing committee and to all the participants, welcome to this workshop.

Opening Remarks

SHOICHI ANDO
Coordinator
United Nations Centre for
Regional Development (UNCRD)
Disaster Management Planning
Hyogo Office

Good morning. Mr. Jesús Vilalón, Vice Minister of Housing, Engr. Roberto Morales, Rector of the National University of Engineering, Japanese Mission and CISMID members, thank your very much for coming. I am the Coordinator of the Disaster Management Planning-Hyogo Office of the United Nations Centre for Regional Development in Kobe, Japan. Today, together with CISMID, we are holding a workshop on "Wider Application of Building Code for Safer Housing. At the beginning of CISMID 20 years ago, I was one of the original members when cooperation between the Japanese Government and UNI was established. During that time, Engr. Morales was the Dean of the Civil Engineering Faculty, Dr. Pique was the Chief of the Computer Center, Dr. Zavala was a member of CISMID, and the Laboratory of Structures was under construction.

The objective of this workshop is to disseminate or to spread the construction of safer housings through the building code. A couple of months ago, I asked Dr. Pique and Engr. Kuroiwa about this workshop, and the original objective was specially to improve the knowledge of the people about the code and to improve the situation of earthquake-vulnerable houses, aimed especially for the local and national governments which are in charge of the application of the building code. Regardless of the recent earthquake, the municipalities are more interested in prevention and safer housings. But right now the interest of the local governments is very low. Therefore, our objective is to increase the knowledge on anti-seismic measures in the cities, municipalities or local governments. In the first place, CISMID and the Ministry of Housing are the most suitable organizations to prepare the measures and materials for these objectives. I just want to point out that earthquakes do not kill people, but the collapse of houses kills people. Therefore, anti-seismic measures for housings and buildings are most important for damage prevention, as we have seen last week. Thank you very much. I want to thank you for being here and to discuss about what we can do to spread and disseminate anti-seismic measures.

Inaugural Address

JESUS VILADON
Vice Minister, Ministry of Housing

Engr. Roberto Morales, Rector of the National University of Engineering; Dr. Shoichi Ando, Coordinator of Disaster Management Planning Hyogo Office, United Nations Centre for Regional Development, Dr. Zavala, Director of the Peru-Japan Research Center for Earthquake Engineering and Disaster Mitigation, Dr. Javier Pique del Pozo, Former Director of CISMID and Dean of Peru Engineering College, Japanese Mission, Representatives of Municipalities and other related organizations. It is a great pleasure and honor to be with you in the opening of this important workshop in which we will discuss the mechanisms and plans to be used for wider dissemination and application of the building code. As the Rector of the National University of Engineering mentioned, this workshop is very appropriate when our country is starting to recover from a natural disaster which has brought many personal and material losses. But at the same time it is also an opportunity for the affected area, the city of Pisco, to be reconstructed and relocated in non-vulnerable areas which are in harmony with the natural environment, and to have a safer and sustainable Pisco. This is a new opportunity for the organizations to think seriously about the building code, construction permit policies, and mechanisms that all the organizations such as the local, regional and national governments, professional associations and other related entities to have a better and safer future. The task is absolutely complex; the reality has shown us that Pisco and Ica have been built on risk zones. Malpractice in constructions methods has been applied in adobe and masonry houses. Moreover, there is a high rate of informality.

The problem that we face is multidimensional; 70% of buildings do not have construction permits, 90% of which are residential buildings of low-income families that were constructed without construction permit or the help of a professional. Unfortunately, the organizations in charge of the inspections and urban control are ineffective. This is the only reason that explains the terrible reality shown in Pisco and Ica. Buildings collapsed due to poor construction methods without any technical criteria. So we have a lot work to do to analyze our problems in an integrated way.

Also, sociologists have to take part; why don’t people apply the building codes and make their houses less vulnerable? Why don’t people have construction permits which should be a mechanism for a technical review and inspection? We should work from the point of view of the code and the connection between the code and the people. What are the procedures to reduce informality? How do we bring the people, who build without any technical criteria, to a safer and sustainable solution? I want to congratulate the organizing committee for this appropriate initiative. Today, I am here on behalf of the government which is interested in a technical discussion for a solution that guarantees safer construction with more technical criteria and safety. I am sure that events like this one will allow us to reduce risks and have a better chance for a future community and building development. Thank you.

Historical Development of Building Codes in Japan

SHUNSUKE OTANI
Professor, 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

Japan closed the country from early 17th century to mid 19th century by the Tokugawa shogunate government to prohibit the propagation of Christianity in the country. The foreign trade was allowed only at a small man-made island in Nagasaki, Kyushu, with Netherland. During the isolation period, Japan could enjoy the development of its own culture, but lost all channels for the exchange of scientific, medical, technical and military developments with the rest of the world. Japan re-opened the country in 1854, first to the United States, and then to other western countries. The Tokugawa shogunate government was overturned in 1868, and the imperial government under the Emperor Meiji was established.

An important task of the new regime was to strengthen military power to maintain national independence under the western imperialistic pressure and also to develop strong industry for the improvement of people's life by the promotion of science and technology. The Meiji government established College of Engineering (Kobu Daigakko) under the Ministry of Technology in 1873, and invited "young" western and U. S. practicing engineers to provide practical training to young motivated students. Henry Dyer (1848-1918) of Glasgow University, Scotland, was invited as the principal of the college when he was 25 years old. He outlined the education principle of the college with emphasis on practical training. Civil engineering, mechanical engineering, house building (architecture), telegraphy, practical chemistry, mining and metallurgy were taught at the college. John Perry (1850-1920) and William E. Ayrton (1847-1908) joined the college in 1873. John Milne (1850-1913) arrived at the college in 1876 to teach mining engineering. It should be noted that these invited teachers came to Japan in their early twenties. Josiah Conder (1852-1920) started architectural education in 1877.

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. The Seismological Society of Japan, the world first scientific organization on seismology, was established in 1880 under the leadership of John Milne, the pioneering researcher of modern seismology in the world. Prominent visiting scientists and engineers joined the society. The transaction of the society was published in English. Modern seismographs were developed by James A. Ewing (1855-1935), Thomas L. Gray (1850-1908) and Milne. The seismograph provided us with actual ground movement during earthquakes. A method was introduced to estimate the maximum ground acceleration during an earthquake from the overturned tomb stones (Milne, 1885).

The University of Tokyo was founded in 1977 consisting of faculties of medicine, law, science and literature, and was reorganized as the Imperial University in 1886, absorbing the College of Engineering of the ministry of technology. Visiting western professors were gradually replaced by Japanese faculty members in the Imperial University.

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.

Note that 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.

The Imperial Earthquake Disaster Mitigation Investigation Council was set up in 1892 to promote the study on seismology and earthquake engineering, and earthquake resistance and further to investigate earthquake disaster mitigation methods. The Seismological Society of Japan was absorbed into the council.

Structural engineering was taught in the department of architecture, Imperial University, although the architectural education was initiated by a British architect. The safety of houses and buildings from earthquakes was convinced to be an important issue in Japan.


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

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 Riki Sano (1880-1956) in 1916 (Sano, 1916 and 1917).

2. Urban Building Law and the 1923 Kanto Earthquake

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. 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 using U.S. construction method (Photo 2). The statistics of damage on reinforced concrete buildings in Tokyo revealed that only 22 out of 553 R/C 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.

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

Photo 2: The Naigai Building near completion collapsed

The Urban Building Law Enforcement Regulations were revised in 1924 to introduce seismic design of buildings; buildings should be designed for seismic force equal to 10 percent of the floor weight. 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 at the time although the government requjired the seismic design forces in the structural calculation of buildings. Structural analysis methods 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 Japan 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. 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.

For immediate 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.

Photo 3: Osaka after the World War II

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 Ministry 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 MOLIT Notifications. Building Standard Law, its Enforcement Order and MLIT Notifications were revised from time to tome.

The Building Standard Law requires that the owner of the project should submit his plan of building construction with architectural drawing and structural calculation documents to the local government in charge before the construction work starts, and that the building officials should examine the construction site, architectural drawings and structural calculation for the conformity of the construction project to all the applicable building regulations.

The licensed architect is allowed to exercise architectural design, including structural calculation and other building related engineering (air conditioning, water piping and others), and to supervise construction work. The architect is expected to make best use of his technical knowledge in his professional work to assist the owner.

The allowable stress design scheme was maintained in the Building Standard Law Enforcement Order in 1950. However, two levels of allowable stresses were adopted for (a) long-term loading (gravity loads) and (b) short-term loading (earthquake force, wind pressure and rare snow load); accordingly, the level of seismic design forces was revised. The seismic zoning map was introduced in 1955. Height limitation of 100 feet was removed in 1963 to allow the construction of high-rise buildings; the 36-story 147-m tall Kasumigaseki Building (steel construction) was completed in April 1968.

4. The 1968 Tokachi-oki Earthquake

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 (current MLIT) 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.

5. Damage Statistics in the 1995 Kobe Earthquake Disaster

The 1995 Hyogo-ken-Nanbu Earthquake (M7.2), commonly known as the 1995 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.

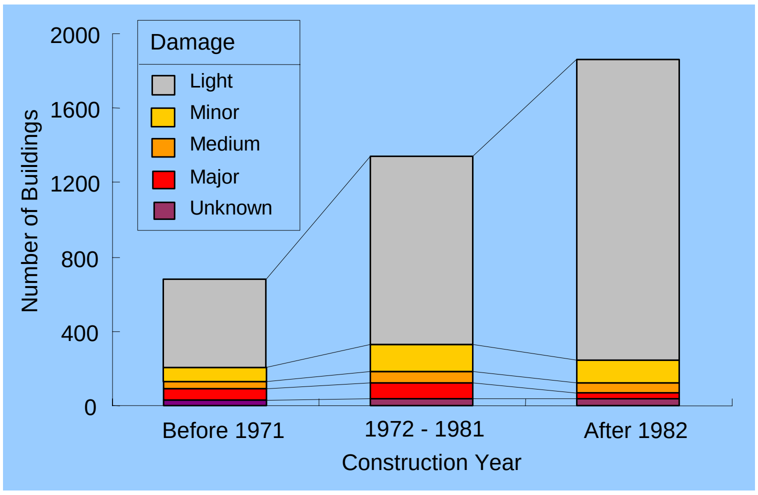

Fig. 1: Damage statistics of reinforced concrete buildings

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.

6. 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 requirements were significantly revised from the specification-type requirements to the performance-type 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.

With the application of computers in engineering work, various computer programs for structural calculation were developed and used in structural design. For the convenience of examining structural calculation by building officials, the minister of construction decided to approve the reliability of such programs in structural design after strict examination by the appraisal committee. These programs take in building configuration from architectural drawings, and evaluate design loads and forces on the basis of drawings. Structural calculation is automated in the program so that a structural engineer is not required to use his judgment. Therefore, inexperienced person can input structural data without good structural engineering knowledge, and examine if the input data satisfy the building code requirements. If the data do not satisfy the requirements, he can modify the data until the data satisfy the requirements.

A licensed architect changed the computer output in his structural calculation document and pretended if the structure designed satisfied the regulation. The forgery of structural calculation documents were found in November 2005. The earthquake resistance of some buildings was found less than one half of that required by the Building Standard Law. The Building Standard Law and associated building regulations were revised in 2006 to outline the structural calculation methods in detail. The structural calculations of large construction are to be examined by experienced structural engineers rather than building officials.

7. Summary

The building code requirements have been improved after each earthquake disaster not to repeat similar errors in design and construction.

The modern seismology was developed in Japan by young visiting scholars, such as John Milne, from Europe and the United States, invited by Japanese government.

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, and

(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,

(d) 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. More damage was observed in structures designed and constructed in accordance with out-dated building code 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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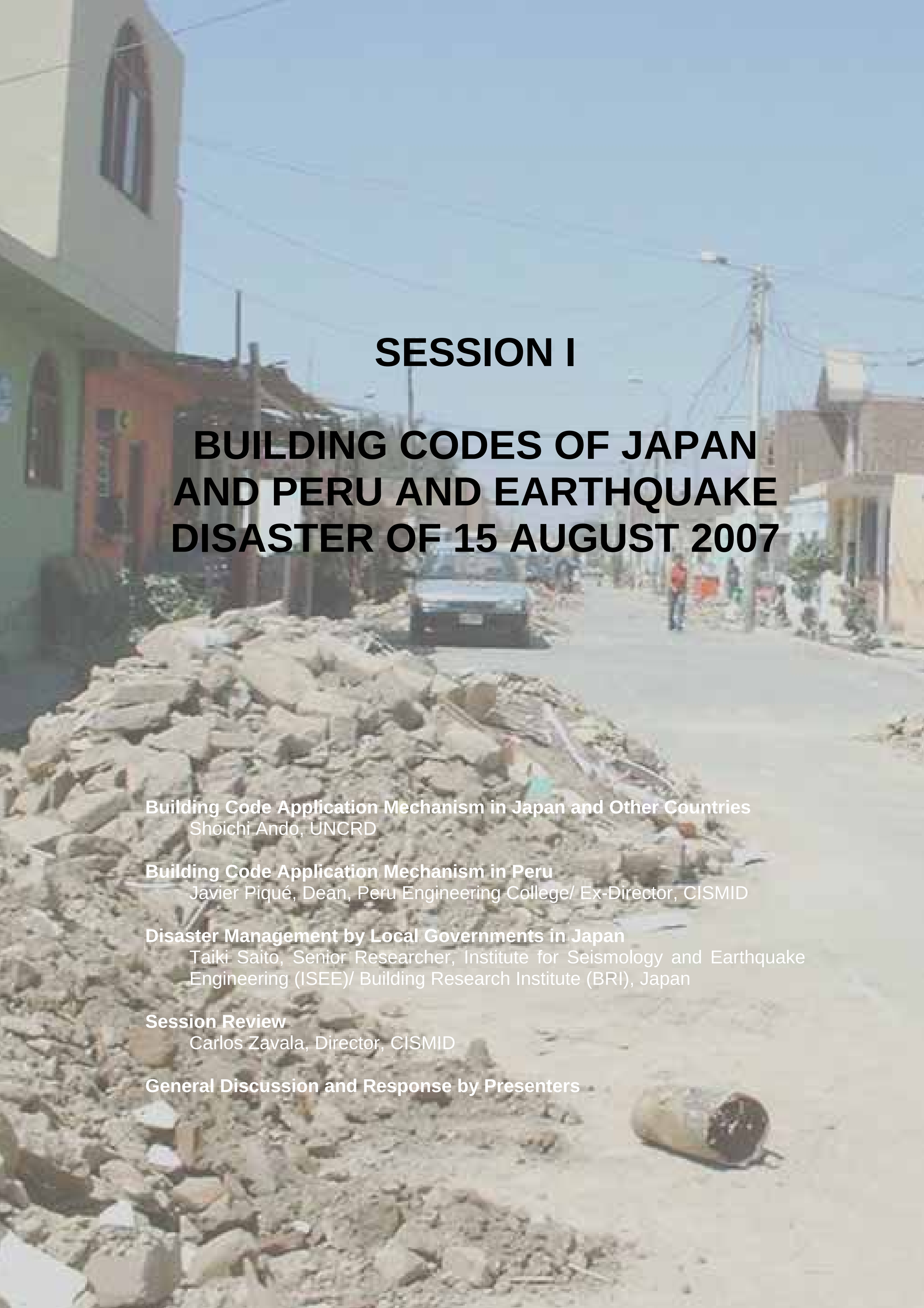

SESSION I

BUILDING CODES OF JAPAN AND PERU AND EARTHQUAKE DISASTER OF 15 AUGUST 2007

Building Code Application Mechanism in Japan and Other Countries
Shoichi Ando, UNCRD

Building Code Application Mechanism in Peru
Javier Piqué, Dean, Peru Engineering College/ Ex-Director, CISMID

Disaster Management by Local Governments in Japan
Taiki Saito, Senior Researcher, Institute for Seismology and Earthquake Engineering (ISEE)/ Building Research Institute (BRI), Japan

Session Review
Carlos Zavala, Director, CISMID

General Discussion and Response by Presenters

Mechanism of Building Code Implementation in Japan and Other Countries

SHOICHI ANDO
United Nations Centre for Regional Development
Disaster Management Planning Hyogo Office

ABSTRACT

Building code is one of the most effective and economically viable policy tools to ensure building safety. In seismic countries, structural safety is an integral element in the code to prevent building collapse from earthquakes. However, there are many unsafe houses that are not earthquake resistant in many earthquake-prone developing countries. This is because the codes are not effectively implemented due to various obstacles. The United Nations Centre for Regional Development (UNCRD) is currently implementing a project titled "Housing Earthquake Safety Initiative (HESI)", which aims to help project target countries to implement their national building codes effectively.

1. INTRODUCTION

In seismic countries, ensuring structural safety of houses is crucial in preventing loss of lives, property and livelihood caused by collapse of buildings and houses. The establishment of building code that ensures earthquake resistance and its enforcement to building construction play an important role in this regard. However, the codes are not effectively implemented in many earthquake prone developing countries due to various obstacles.

2. Kobe Earthquake of 1995 and UNCRD Disaster Management Activities

2.1 Kobe Earthquake in 1995

An earthquake of magnitude 7.3 struck Kobe, Japan 12 years ago. The following pictures show the conditions of the city after the disaster.

Photo 1: Kobe in flames after earthquake

Photo 2: Collapsed houses in Kobe

The HESI project aims for better implementation of building codes since the collapse of buildings and houses is the single largest cause of human deaths caused by an earthquake. In case of Kobe Earthquake, housing collapse owned to 87.9 percent of the deaths. Fire killed further 10 percent of the victims who were most likely caught under collapsed houses and were unable to escape. This means that making houses earthquake resistant is the most effective disaster prevention measure. A similar conclusion can be drawn from the August 15th earthquake in Pisco, Peru and the 2006 earthquake in Pakistan.

2.2 Activities of UNCRD Hyogo Office

UNCRD Disaster Management Hyogo Office implements disaster management activities with the objective of promoting disaster resilient communities, safer schools and houses for sustainable development and the achievement of the Hyogo Framework for Action (HFA). It implements model projects for demonstration, carries out training for capacity building, and promotes education for awareness raising with a focus on disaster preparedness and prevention.

3. Housing Earthquake Safety Initiative

3.1 Policy Tools and Key Elements for Housing Safety

Following are some of the policy tools that can be used to secure safe houses:

1. Regulatory tools such as building permission system and license for architects and engineers;
2. Economic tools including preferential housing loan system linked to compliance with anti-seismic building codes;
3. Voluntary tools such as housing performance evaluation and rating system;
4. Research and development tools for houses and retrofitting of existing vulnerable buildings; and
5. Others such as information policy, decentralization, deregulation, and role sharing among stakeholders.

These tools can be compared for their effectiveness, economic efficiency and administrative feasibility, among which the last aspect is most important for both national and local governments. The following table shows the evaluation of all the aforementioned policy tools. For instance, building code, which is a regulatory and compulsory tool, scores high in all the evaluation criteria. Economic tools can be effective but economically not as efficient because they require financial resources such as government subsidies. In contrast, effectiveness is not high for rating and manual because they are not compulsory and replies on people's voluntary action. Therefore, it can be concluded that building code is one of the most effective tools to secure housing safety.

Table 1: Policy tools for housing safety

Evaluation criteria	Effectiveness for safety	Economic efficiency	Administrative feasibility	Total Policy Evaluation
Code	Highest	High	High	Best
Loan	High	Low	High	Middle
Rating	Low	High	High	Middle
Manual	Low	High	Highest	Better
Fund	High	Low	High	Middle

There are three key prerequisites for improving housing safety. These are: a) capacity building for local governments, b) awareness raising of construction workers and house owners, and c) support by national government and academia. Capacity building for local governments includes financial resource allocation for code implementation and training for technical staff. Awareness raising is required because raising awareness among construction workers and house owners is not sufficiently high. Also, in many countries, relationship between national government, local governments and the academia should be improved to facilitate code implementation. Housing safety encompasses diverse social, economic and environmental policies as shown below.

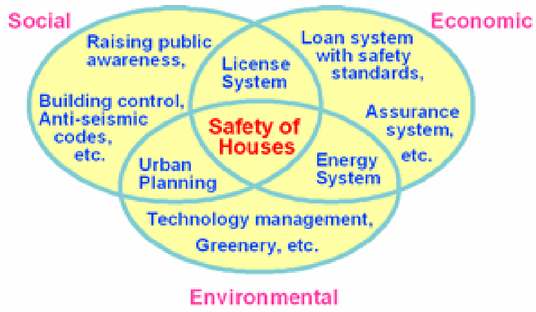

Figure 1: Policy areas for HESI

3.2 Housing Earthquake Safety Initiative

The HESI project was launched in January 2007 to be implemented in Algeria, Indonesia, Nepal and Peru. The following is four core activities of the project:

1. To evaluate the current systems related to anti-seismic building codes;
2. To raise awareness of stakeholders including governments, academic institutions, NGOs and communities;
3. To develop effective and efficient policies on building code dissemination; and
4. To build capacity of stakeholders for development and evaluation of policies on building code dissemination.

A questionnaire on building code was sent to approximately 50 countries last year. A total of 26 replies (13 national and 13 local governments) have been received so far. Some salient facts stood out. One was the ratio of non-engineered constructions in total building stock, which is shown in Figure 2. Non-engineered buildings are those that are built without designs or structural calculations done by architect or engineer. In case of Japan, 60 percent of all buildings and houses fall in this classification, and they are one or two story wooden structure. The ratio is the same in Peru.

Figure 2: Ratio of non-engineered building

Figure 3: Ratio of owner self-built houses

Figure 3 shows the owner self-built ratio of non-engineered buildings. In Peru, 30 percent of non-engineered buildings are built by the owners. The high proportion of non-engineered buildings in Peru might be due to a significant cost difference. In Lima, the cost of constructing an engineered building is 7-10 times higher than the cost of constructing a non-engineered building.

An expert meeting for the HESI project was held in Kobe, Japan in January 2007. Some of the key conclusions drawn were: (a) There is a need for training and capacity development including strengthening of training institutions; (b) Role of the private sector in building code implementation should be explored; (c) Peer review of design and structural calculation can be useful when municipal engineers are not sufficient to examine all buildings; and (d) Guidelines will suffice for non-engineered houses. They should be based on technical research but should be readily understandable for people with no technical background. In Peru, SENCICO is one of the key institutions to be strengthened to invigorate training of engineers.

4. Japanese Building Code

The Japanese building code uses the words building confirmation instead of building permit. Japan had a specification based building code until performance based code was introduced in 2000. Buildings must ensure structurally safety from the permanent load, imposed load, snow load, wind load and ground pressure. However, the specification based code can still be used. The process starts with Design checking, issuance of building confirmation, commencement of construction work, interim inspection, and final inspection upon completion. The historical development and revision of the Japanese building code followed disastrous earthquakes. For instance, new seismic standards were introduced in 1980 following the Tokachi-oki Earthquake of 1968 and the Miyagi-oki Earthquake of 1978. Similarly, interim inspection was introduced in 1998 following the Kobe Earthquake of 1995.

Figure 4 shows the scope of the Japanese building code. The code specifies not only structural and fire safety requirements but also aims to ensure healthy environment and compliance with urban requirements including population density and transportation. The HESI project emphasizes structural safety since it is a core element of building codes in seismic countries.

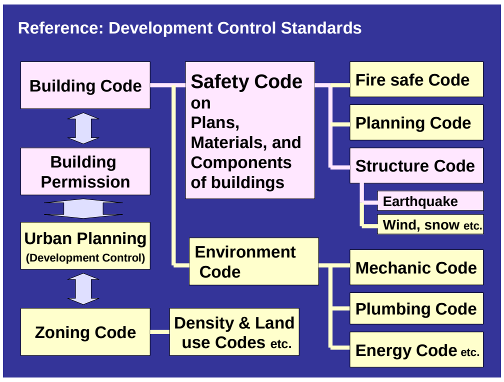

Figure 4: Scope of the Japanese building code

At present, the private sector plays a large role in building code implementation in Japan. The figure shows the changes in the number of specified administrative agencies and designated building inspection agencies (private sector). The figure shows that currently, more building inspections are done by the private sector than the public sector.

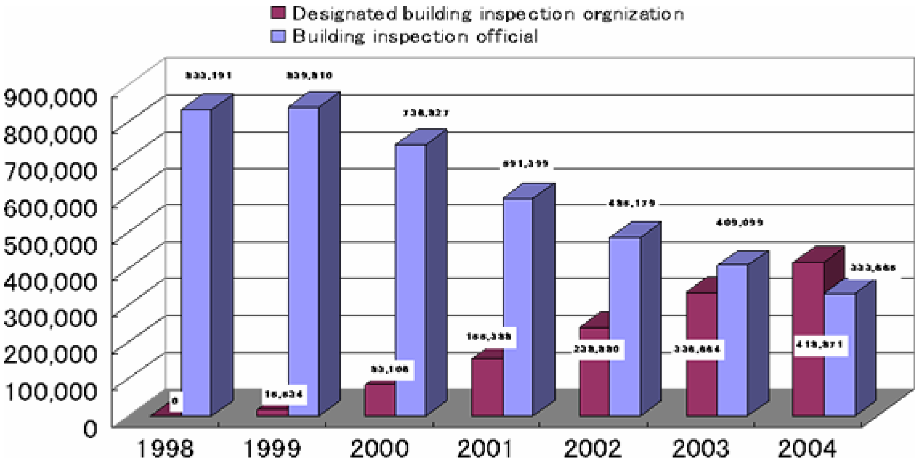

Figure 5: Comparison of the number of building confirmation issued by municipal officials and building private sector confirmation bodies

5. Housing Safety and the United Nations Millennium Development Goals

The HESI project has an objective of achieving the Millennium Development Goals (MDGs) set to be met by the year 2015. The MDGs aims to: (1) Eradicate extreme poverty, (2) Achieve universal primary education, (3) Promote gender equality, (4) Reduce child mortality, (5) Improve maternal health, (6) Combat HIV/AIDS, malaria and other diseases, (7) Ensure environmental sustainability, and (8) Establish global partnership for development.

Disasters caused by earthquakes might severely undermine efforts made by disaster prone developing countries to achieve MDGs. With respect to poverty reduction, an earthquake pushes the poor into graver poverty through destruction of their homes. Because the poor are not able to afford houses that are earthquake resistant, their houses are more vulnerable to collapse. This might lead to an increase in the number of slum dwellers.

The achievement of universal primary education will also be hampered because reconstruction of houses would deplete household asset, making schooling less affordable. Adverse health effects are also inevitable because financial constraint makes clean water, food and medicine less accessible. At the national level, fiscal constraint of the affected government results in reallocation of international assistance from development and recovery operations.

Effective implementation of building code can prevent these negative consequences. Safer housing and urban environment could safeguard people’s lives and ongoing economic activities even during earthquakes. Financial resources that would otherwise be lost can be spent for investment in human and physical capital. Sustainable development, which is a key aspect of MDGs and is vital for any development activities, is attainable only if human lives and critical infrastructure for livelihoods and economic activities remain safe from natural hazards. The HESI project aims to create an environment for people in the project countries to live with lower disaster risks and improve their economic and social security and general well-being.

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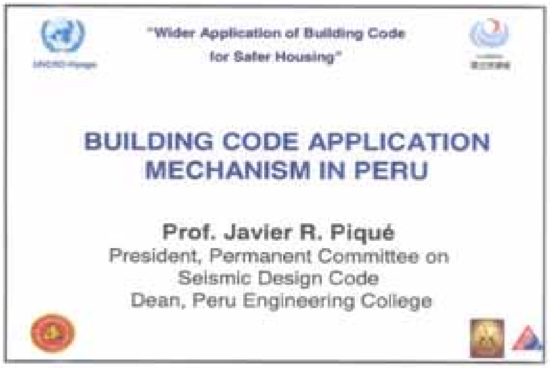
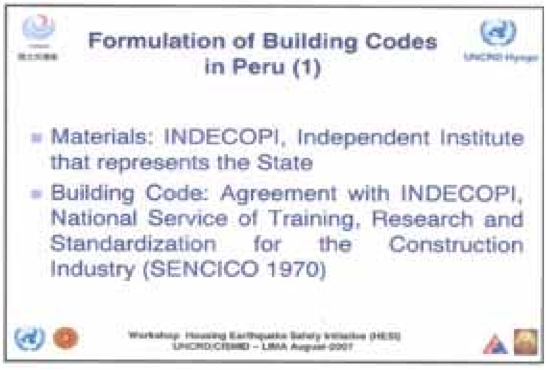
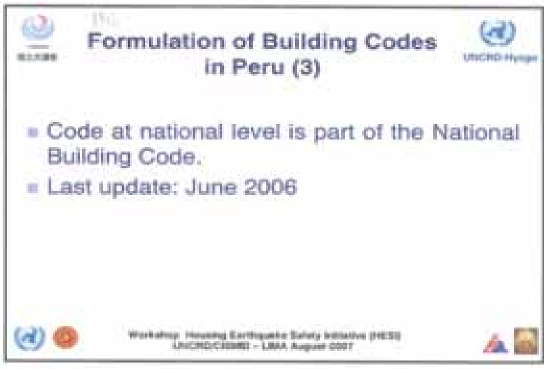
Building Code Application Mechanism in Peru

JAVIER PIQUE
Permanent Committee on Seismic Design Code/
Peru Engineering College







Approval Procedure

Final Version, put forward for public discussion by SENCICO.

Committee proposes a final version to the Vice Ministry of Housing.

Ministry approves it by ministerial resolution. It becomes compulsory at national level.

Application of Building Codes (1)

- INDECOPI supervises the application of all the codes, for protection of consumers
- Application of the codes is the responsibility of the Municipalities

Operation and Control of Building Code Application

- Construction Permit should be obtained in each municipality
- Peru has 1,832 districts and 195 provinces
- Urban Development is a provincial responsibility
- Construction Permit is the responsibility of the local municipality

Operation and Control of Building Code Application

- The Municipality should create a Technical Revision Committee which should approve the project before issuing the permit.
- The technical committee consists of architect representatives and four professional representatives of the College of Engineering (Civil, Electric-Mechanical, Electrical, Sanitary, Electric and Electronic).

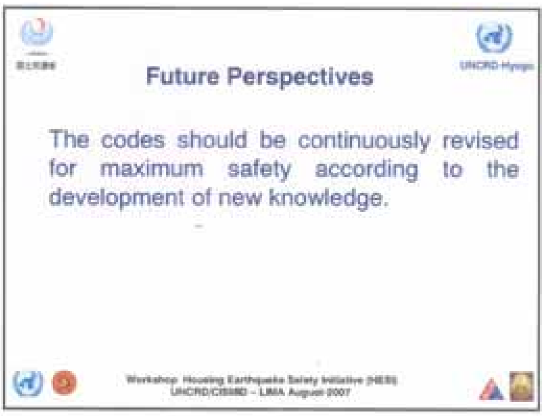
Operation and Control of Building Code Application

- The construction work must be supervised by the Municipal Committee, which consists of representatives of College of Engineering (civil engineers) and College of Architecture.
- This is often neglected, and becomes a cause of many disasters.

Operation and Control of Building Code Application

- The Law allows the regularization of building construction without construction permit or supervision.
- It only requires architectural plans.
- It does not require verification or evaluation of structural safety.


UNCRD Hyogo
Future Perspectives
The municipalities should be aware of their important role in the supervision of construction for safety.
A proposed new law have been approved by the Peruvian Congress Housing Committee. This law allows construction of 5-story, up to 3000-square-meter buildings without prior revision of the project.
Workshop Housing Earthquake Safety Initiative (HESI)
UNCRD/CISMID – LIMA August 2007


UNCRD Hyogo
Future Perspectives
The codes should be continuously revised for maximum safety according to the development of new knowledge.
Workshop Housing Earthquake Safety Initiative (HESI)
UNCRD/CISMID – LIMA August 2007


UNCRD Hyogo
Thank you
Workshop Housing Earthquake Safety Initiative (HESI)
UNCRD/CISMID – LIMA August 2007

DISASTER MANAGEMENT OF LOCAL GOVERNMENT IN JAPAN

TAIKI SAITO
Senior Researcher
Building Research Institute, Japan

ABSTRACT

This paper introduces activities of local governments and communities of citizens to mitigate earthquake disasters in Japan. As for the action "after" an earthquake disaster, the quick damage inspection system is introduced which has been developed in Japan, especially after the 1995 Great Hanshin-Awaji Earthquake Disaster. As for the action "before" an earthquake disaster during the normal life, it is important to increase public consciousness for disaster management and take measures such as promotion of seismic retrofit of vulnerable houses to prevent collapse and reduce casualty in case of earthquake. The community-based voluntary organization for disaster management is introduced. Also, the examples of local government actions to promote seismic retrofit of private houses and concrete block fences are introduced.

1. INTRODUCTION

Japan has a long history of earthquake disasters. Various actions have been taken by the central and local governments to mitigate earthquake disasters. In the national level, the Central Disaster Management Council chaired by the Prime Minister formulates and executes disaster management plan. Prefectural Governments and Municipalities also have their own Disaster Management Councils and formulate and promote disaster management local plans. However, at the 1995 Great Hanshin Awaji Earthquake Disaster, the central government failed to capture the damage situation correctly and delayed making right actions. The disaster caused more than 6,000 casualties. Most of them were killed by the collapse of old wooden houses. Since this disaster, many voluntary disaster management organizations have been established in the community level and voluntary activities for disaster mitigation have been conducted widely. Also, the central government issued regulations for promoting seismic retrofit of old buildings and many local governments provide free seismic evaluation to the citizens and prepare subsidy for retrofit of old wooden houses.

2. ACTION AFTER EARTHQUAKE DISASTER

Post earthquake quick damage inspection of buildings is the first essential step immediately after a major earthquake disaster to mitigate the secondary disaster caused by aftershocks. The purpose of this inspection is to quickly inspect and judge the risk of collapse of damaged buildings or falling of building components due to after shocks and to inform the habitants about the safety of their houses as soon as possible to prevent secondary disaster due to aftershocks. The result of quick inspection also provides the basic information to estimate the number of temporary houses and refuge centers necessary for the displaced people. Figure 1 shows the time table of typical actions after an earthquake disaster. Quick inspection of building damage must be done in the first stage of actions. In this chapter, the post earthquake quick damage inspection system in Japan is introduced.

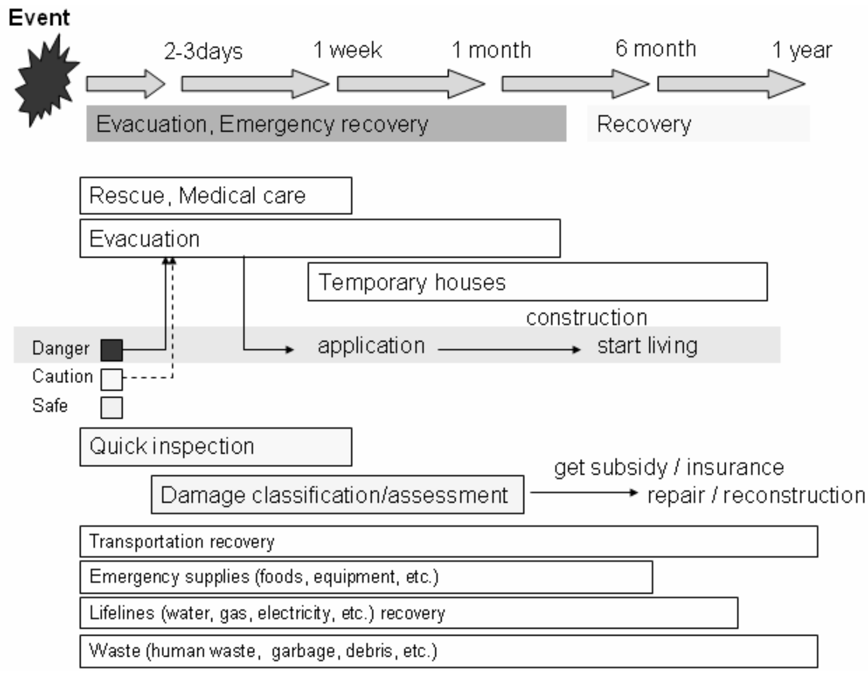


Figure 1: Time table of actions after an earthquake disaster

The operation of quick risk inspection and safety declaration must be completed in a very limited period on the basis of visual observation of damaged buildings. To implement the risk inspection practice using a large number of inspectors smoothly, it is quite important to formulate a well-planned organization structure in a local government. Figure 2 shows the process to establish a quick risk inspection headquarter in a local government after the event of earthquake. Figure 2 shows the plan of risk inspection work force in Japan, where, inspection work is done by a team of two inspectors. The direction from headquarter is transferred through a coordinator to group leaders and inspectors.

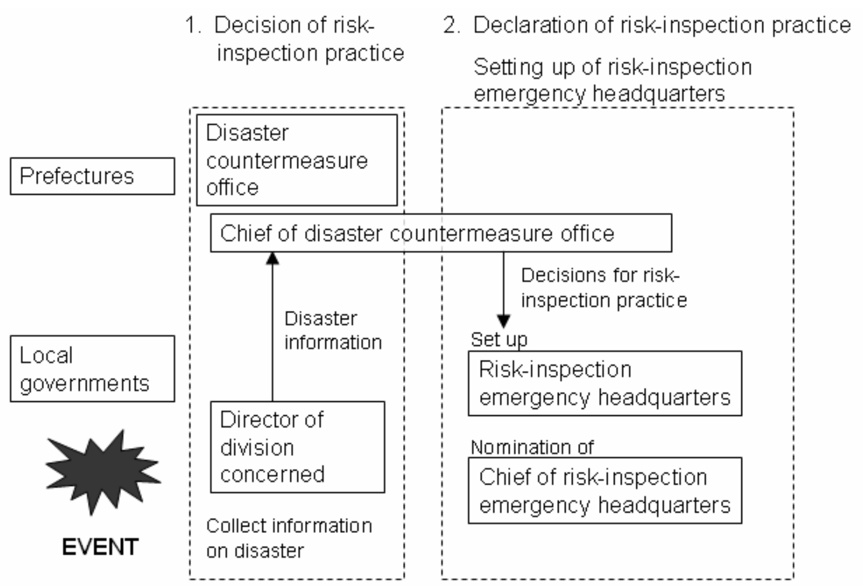


Figure 2: Implementation of risk-inspection work

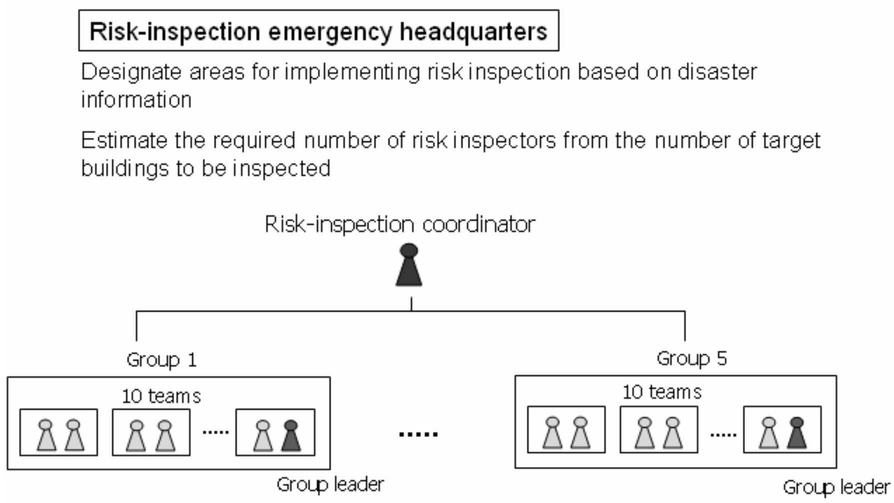


Figure 3: Plan for risk-inspection work force

Since the quick risk inspection of building damage must be done as soon as possible to assure the safety of human life from secondary disaster, the inspection methodology is relatively simple based on visual inspection. There is another damage assessment methodology which is more detailed and accurate but time-consuming and complicated, which is used for the following purposes:

- Damage classification for repair and retrofitting done by engineers in construction companies,
- Damage assessment for subsidy from Government done by officials in local government,
- Damage assessment for earthquake insurance done by engineers hired by insurance company.

3. ACTION BEFORE EARTHQUAKE DISASTER

3.1 Increasing disaster management consciousness

1) Memory of the Great Kanto Earthquake Disaster

In Japan, September 1st is "Disaster Management Day" to commemorate the Great Kanto Earthquake Disaster on September 1st in 1923, the most devastating earthquake disaster in the history of Japan. Also the period from August 30th to September 5th is declared as "Disaster Management Week" and a variety of events such as the Disaster Management Fair, Disaster Management Seminar and Disaster Management Poster Contest are held to increase disaster management consciousness and disseminating disaster management knowledge.

2) Memory of the Great Hanshin-Awaji Earthquake Disaster

Additionally, various events are held to promote volunteer activities and local disaster management activities based on neighborhood associations on "Disaster Management and Volunteer Day" on January 17th and during Disaster Management Volunteer Week (January 15th – 21st) to commemorate the Great Hanshin-Awaji Earthquake Disaster on January 17th in 1995.

Figure 4: Prize winning posters of the Disaster Management Poster Contest (from Cabinet Office, Government of Japan)

3.2 Local voluntary disaster management organizations and volunteer activities

At the Great Hanshin-Awaji Earthquake Disaster in 1995, the number of building collapse or heavily damaged is around 250,000 and the number of people captured in the buildings is around 35,000. After the earthquake happened, in the situation that telephone didn't work and there was a heavy traffic on the road, 27,000 people were rescued by neighbors and 80% of them were alive. However, 8,000 people were rescued by Army, Police or Fire Fighters and less than 50% of them were alive. This fact gives us a lesson that the activity of local community is the key to mitigate earthquake disaster.

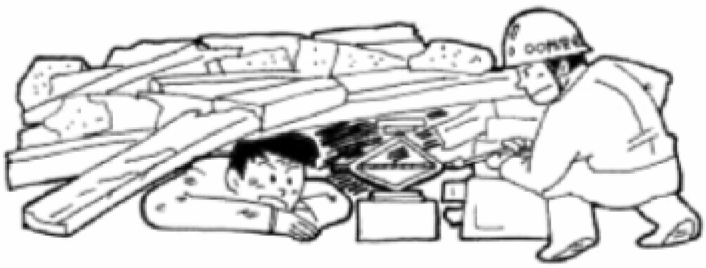


Figure 5: Lesson from 1995 the Great Hanshin-Awaji Earthquake Disaster

Based on this lesson, the number of community-based organization is increasing rapidly in Japan. In 2003, there are more than 100,000 organizations covering more than 60% of families in whole country. For example, the city of Kobe has 416 community-based organizations covering 81.8% of member families. Each organization has a structure consisting of headquarter and team leaders as shown in Figure 7. The basic activity of community-based organization is listed in Figure 8.

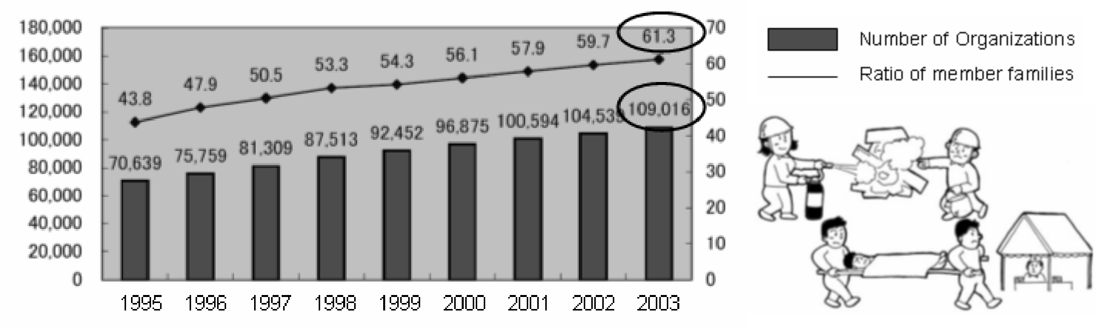


Figure 6: Number of community-based organizations in Japan

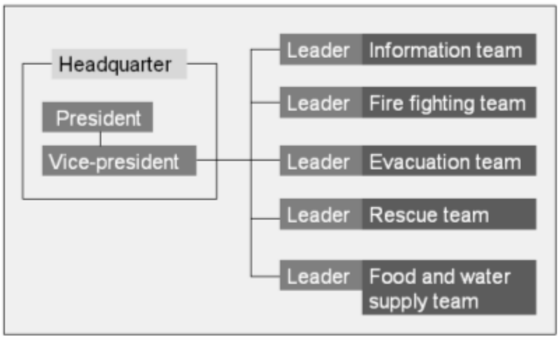


Figure 7: Community-based organization structure

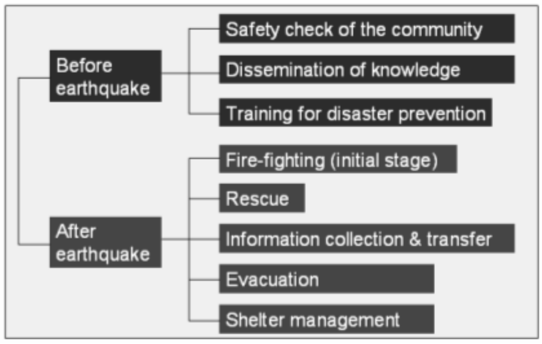


Figure 8: Activity of community-based organization

For example, since the capability of fire-fighting in the community-based organization is limited, they can be in charge of initial stage of fire-fighting until the arrival of professional fire-fighters. Also collaborations with other organizations such as schools, hospitals and private companies are important as shown in Figure 9.

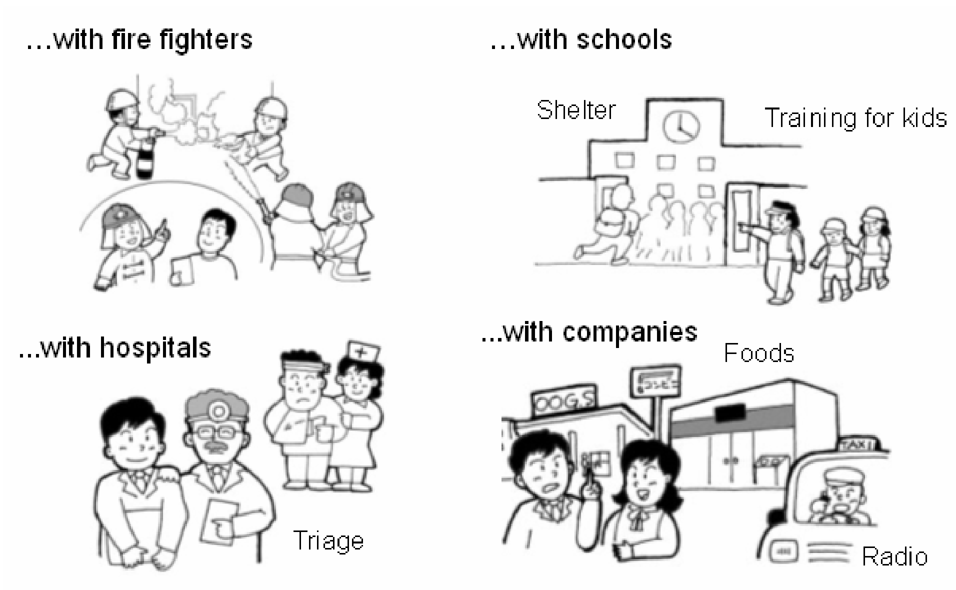


Figure 9: Collaboration with other organizations

One of effective activities to increase consciousness of people about the safety of community is making a map to indicate locations of essential facilities or dangers in the community in case of earthquake as shown in Figure 10.

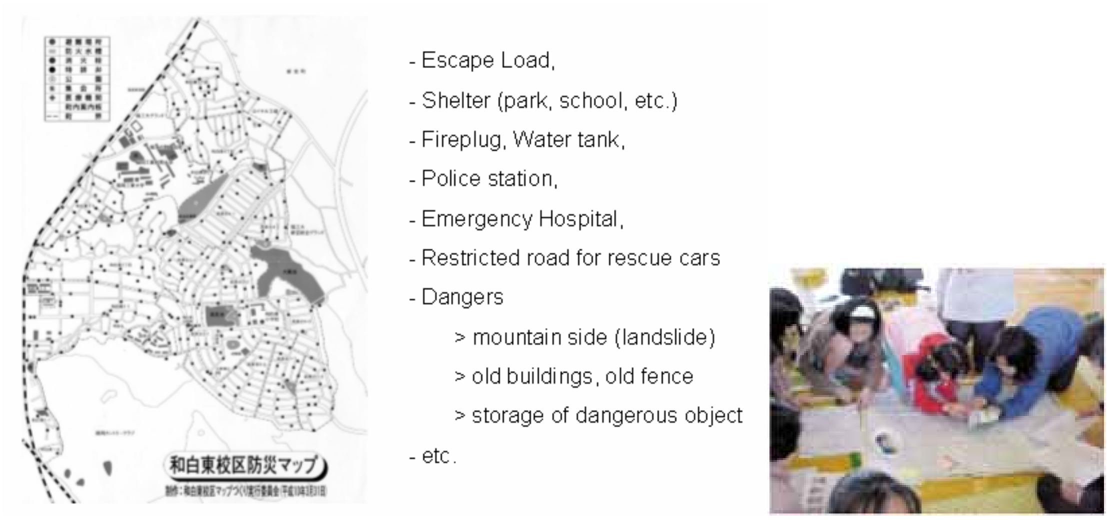


Figure 10: Map for disaster prevention made by Community

3.3 Promotion of seismic retrofit by local government

The most effective way to reduce human casualty in case of earthquake disaster is to retrofit vulnerable buildings to prevent building collapse. Most of the local governments in Japan prepare the service of free building seismic evaluation of the wooden houses to promote seismic retrofit. This evaluation work is done by "Wooden House Seismic Evaluators" certified by the Mayor and the evaluators check the seismic resistance of the citizen's houses and give advices for retrofit. Citizens who want seismic retrofit of their houses can apply to the local government a financial grant or a loan with no interest to cover part of the retrofit cost (Figures 11 and 12).

Figure 11: Pamphlet in the city of Yokohama

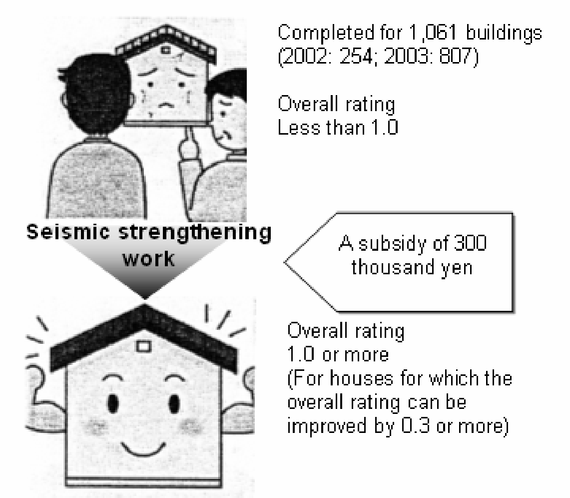


Figure 12: Promotion in Shizuoka Prefecture

Since many people have been killed under the concrete block fences fell down by the earthquakes, the Shizuoka Prefecture provides a subsidy to replace or improve concrete block fences (Figure 13).

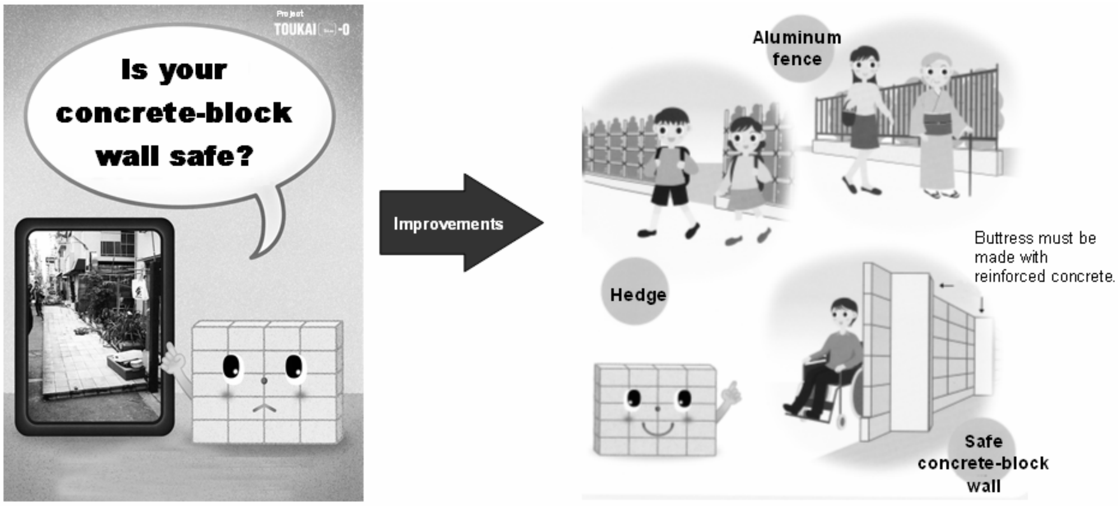


Figure 13: Subsidy system in Shizuoka Prefecture to replace or improve concrete block fence

4. CONCLUSIONS

For effective disaster management, it is important that the Central Government, the local governments, the designated public corporations and even private citizens must work out their roles appropriately. Especially, in Japan, after the 1995 Great Hanshin-Awaji Earthquake Disaster, the role of local governments and private citizens is getting more and more important. Such experience and knowledge of disaster mitigation action in Japan should be shared with other countries by taking consideration of local conditions in each country.

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Session Review

Moderator:
CARLOS ZAVALA
Director, CISMID/UNI

The morning session was very instructive for all of us, especially for the stakeholders. First, I want to make a summary of the discussed topics. Dr. Otani showed us sincere and critical development of the building codes in Japan; for me it was like a catharsis of the building code problems. He showed us the pros and cons during the development of the code, and how they were able to improve their earthquake engineering techniques. Dr. Ando showed us the outline of the cooperation and the dissemination of the code with some examples. Dr. Pique showed us that in our country, there are codes and laws to be applied to makes houses earthquake resistant.

An important comment was given by Vice Minister Vilalón who showed real figures that prove our informality. I am a member of the organizing committee, and when we started to organize this workshop, we thought that the municipalities and regional governments must attend this workshop. How sad it was to see that many of them did not come when this workshop was aimed for them. I feel sorry for the people of Pisco because it shows that the municipal government was inefficient, and now, we have the opportunity to learn from the experience that Japan has acquired. Dr. Pique proposed a very important issue; at present, if a building collapses, the engineer is blamed. But actually, the responsibility should be shared with the government officers who reviewed the proposal for the construction project. Therefore, a modification of the law should be proposed so that government officers are also responsible if something happens to any engineering work.

Dr. Saito has showed us some examples of quick evaluation in Japan. We have this kind of quick evaluation; in fact, INDECI has the form but unfortunately it seems that they did not use it this time. Dr. Saito showed us the outline of the actions taken before and after a disaster as well as the recommendations taken from a quick evaluation such as obtaining the number of reparable houses, evacuated houses, people in shelters, damage classification, strengthening and others that are useful for disaster management. He also mentioned that in Japan, there are some commemorative dates. In Peru, May 31st is the "Natural Disaster Reflection Day" to commemorate the avalanche debris in Yungay due to Chimbote Earthquake. Each year drills are carried out, and CISMID celebrates it with a symposium where everybody is invited. We are concerned about community organizations; the president of Civil Defense Committee is the mayor of each municipality, and if the mayor doesn't organize his committee effectively, then it won't work well in case of disasters. Dr. Saito explained very well the actions that must be taken after an earthquake.

I was studying in a small apartment in Tokyo, Japan when an earthquake hit Kobe in 1995. I remember that during the earthquake the shelves and books fell but fortunately I got hold of one of the shelves. Nothing happened in Lima during the earthquake of August 15th, but all the books and kitchenware fell in my house that is located in La Molina, one of the most vulnerable areas of Lima because of the sand. In La Molina, a slight acceleration of 78 cm/s^2 was recorded, but for an earthquake of 350 gals we will expect the shelves to turn over. Arch. José Sato prepared a guide for earthquake prevention and we should disseminate it. As a final comment, we have a building code and it has been proven to be effective. In Pisco, some well-constructed buildings did not collapse, but sometimes the newspaper confused people. If a house is well-constructed, it will not collapse as was proven in Pisco. But if a house is constructed over bad soil without any engineering criteria, then it will be a disaster. And if we add our lack of foresight, a pandemonium will break out. We have to start working on prevention and mitigation in all coastal cities. We do not know when an earthquake might occur, but we know from studies, which are often kept in the mayor's drawer, which zones are at risk. Also, there are many areas that have not been studied, and it should be done. It is time to make an appeal to the municipalities and authorities that have not come today, to become aware of these issues and learn from the Pisco earthquake disaster. Let us avoid this kind of disaster in other places of the country, let us start to mitigate. Campaigns such as those shown by Dr. Saito must be done and supported by the media so that during the next earthquake, less damage will occur. Here in CISMID, we work to reduce the costs of reconstruction when an earthquake occurs.

General Discussion and Response by Presenters

Juan Carmona (Participant):
I visited the city of Pisco and saw what always happens in areas with intense seismic activity and where people easily forget previous disasters. The results are what we always see and as always I ask myself, "What is the building code for?" The building code must be used for everything. When a person travels across cities, he always finds that there is no control of buildings before construction. We have to divide the buildings in two parts. One is important facilities for which prepared codes are always satisfactory. We have seen the consequence of Hospital San Juan de Dios in Pisco, in which new blocks did not have any crack whereas old blocks collapsed or were seriously damaged. It was clear that certain stage had not been accomplished and some old constructions need to be strengthened. What I am really concerned about is the other part: typical houses of one or two stories without any engineering criteria. And that is the reality. A special code must be made available for self constructed houses and I believe that there are already such recommendations in Peru.

Yesterday, Dr. Blondet and others talked about the minimum requirements for adobe construction. The issue is how to apply it to old houses and at the same time what to do with the new houses that are under construction. I am going to tell you about our experience in San Juan (Argentina). In the 1944 earthquake, we had similar adobe houses; around 15% of the population died and there was complete destruction. Then the national government took matters into its hands and undertook federal intervention. First, it created a governmental organization in charge of technical inspections. Any building of one, two or twenty stories had to go through technical inspections and to submit construction plans of the projects. From this point of view the job of the municipality was eliminated and a provincial office was created. In 1945 a technical office was established in San Juan in which any construction worker had to be registered as construction worker. They had to submit construction plans, which had to be approved by the technical authority. Then for the construction, an inspection must be carried out. First, the foundations had to be inspected because some people did not build in accordance with the plans; so the inspection was carried out on the project level as well as construction level. The result of these measures was that the 1977 earthquake in San Juan caused no damage or collapse of buildings and houses and nobody was killed. That is hard to do because there is a constant action and many times professionals do not want to feel obliged. Also, construction workers do not want to learn the correct way to construct again. They say they already know how to construct; but an earthquake would prove that in reality, they don't. The municipality needs a program to control building projects, whether the house is small or big. That way, tests shown during this meeting and what were interesting in the last three days' conference can be applied in the construction site.

Then, society is responsible for any damage during an earthquake because they are the ones who formulated laws on the minimum requirements during the construction. The engineer is not solely responsible anymore. All the members of the community have to bear the responsibility. If the code is flawed, then we should be patient because the development of the code involves the participation of everybody. It is very important to carry out technical inspection, but the code has to be very simple for small houses so that construction workers can apply it. Even for houses with less technical input, there have to be minimum requirements. In our case, for economical houses, drawings of how to construct are enough for compliance with the code. Also, some material tests on bricks and concrete have to be carried out by the technical office for inspections. Easy seismic codes for small houses and technical inspections are needed. Thank you.

Zavala:
I totally agree with the comments made by Engr. Juan Carmona. INDECI has the mechanism to make technical inspections like the ones that Dr. Saito showed us. I agree with Dr. Pique about punishment of government officers. Why are engineers solely responsible? Why is the responsibility of the government officers ignored?

Carmona:
Let us apply the law but not yet punish those who do not follow it; instead, let us first follow the laws. Each municipality has to establish technical inspection procedures. Government inspectors have to visit all construction sites everywhere and if they find constructions without structural plans then it must be considered a crime. This is the way to fix things.

Zavala:
Only some responsible municipalities of Lima apply the law; but Lima is not Peru.

Carmona:
I propose that law has to apply to all the municipalities of Peru.

Zavala:
The government has to be very persistent about the law. If a government officer does not work efficiently, then he must be reprimanded. Why do engineers have seven years of jail sentence? If something happens to the house, the engineer has seven years of penal servitude. What about the officer who did not check the structural plans or did not conduct the required inspection or did not check the quality of the materials, or those who received something under the table to turn a blind eye? Now is our opportunity to get serious.

Carmona:
If the constructor or engineer cannot be found and the owner changes in seven years, then there is no one to take responsibility. The key issue is to have a technical inspection before the construction starts. Officers have to know what the violations are. The violation is to start construction without construction permit and quality control.

Rafael Torres (Participant):
I definitely think this seismic disaster will get us in trouble if we misjudge the problem. We should think about the future. Past measures have failed so I propose emergency measures for these areas, such as emergency shelters and 40,000 houses with previous zoning, research and cleaning of the area, and construction of emergency hospitals. What should we do in the future? If a strong earthquake like the one that hit Pisco occurs in Lima, I am pretty sure that many people will lose their houses. The Peruvian government has to conduct a census of each house. The other day the president said: “What are the engineers doing? We have paid for their education and now engineers do not give back the knowledge that we gave them.” The president is against the engineers. It is important to organize a committee to conduct a technical census, to know how many persons have houses or not, and how many houses need reinforcement. With this information, a reinforcement program can start all over the country. It will take many years, but it is necessary to do it to avoid disasters caused by earthquakes, landslides, etc. Thanks.

Carmona:
Engineers alone are not guilty. The community or society is the one who has not done technical inspections. All the communities are guilty.

Zavala:
I want to make a final comment. If our building codes are fine, then we should start on prevention and mitigation. In short, a manual or code for reinforcement with drawings for better

understanding should be prepared. SENCICO has some construction guides but we have to think about guides for houses that are already built. The morning session is adjourned.

SESSION II: PANEL DISCUSSION

"WIDER APPLICATION OF BUILDING CODE IN VIEW OF AUGUST 15TH EARTHQUAKE IN PISCO"

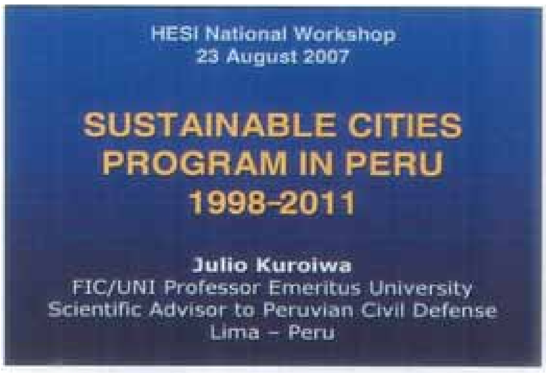
Sustainable Cities Program in Peru 1998-2011
Julio Kuroiwa, Emeritus University/ Civil Defense of Peru

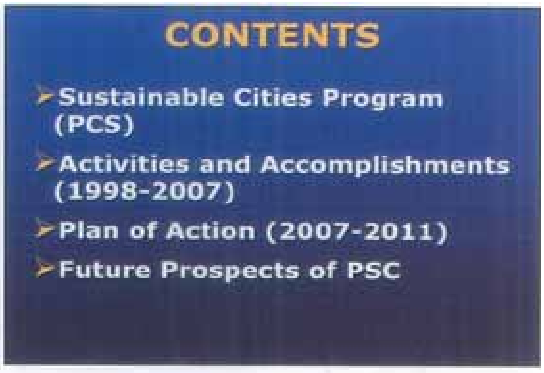
Panel Discussion
Moderator:
Shoichi Ando, UNCRD Disaster Management Planning Hyogo Office

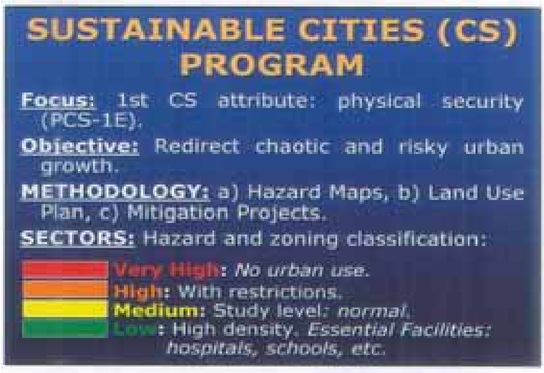
Panelists:
- Julio Kuroiwa, Emeritus University/ Civil Defense of Peru
- Arvindo Aliaga Ministry of Housing, Construction and Sanitation
- Ruben Segura, Ministry of Housing, Construction and Sanitation
- Javier Piqué Peru Engineering College (CIP)
- Carmen Kuroiwa, National Service of Training for the Construction Industry (SENSICO)

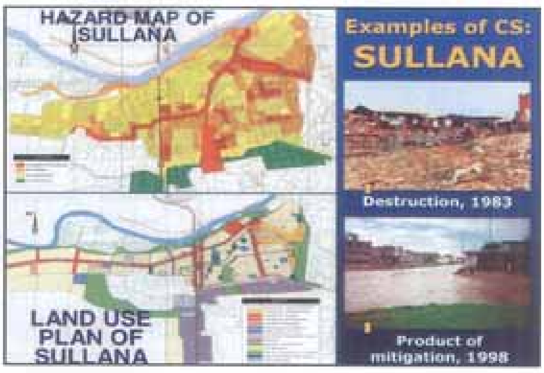
Sustainable Cities Program in Peru 1998-2011

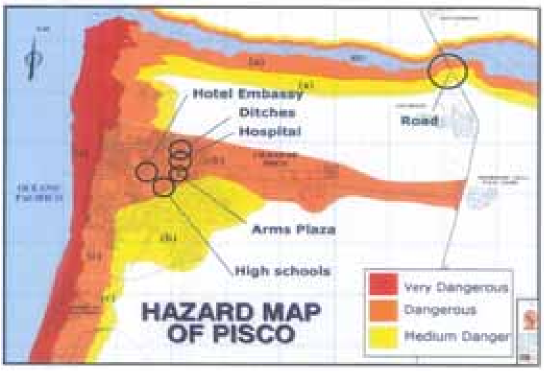
JULIO KUROIWA
Professor, Emeritus University
Scientific Advisor to Civil Defense of Peru

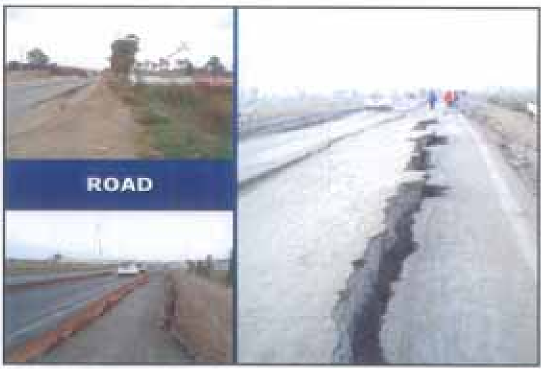












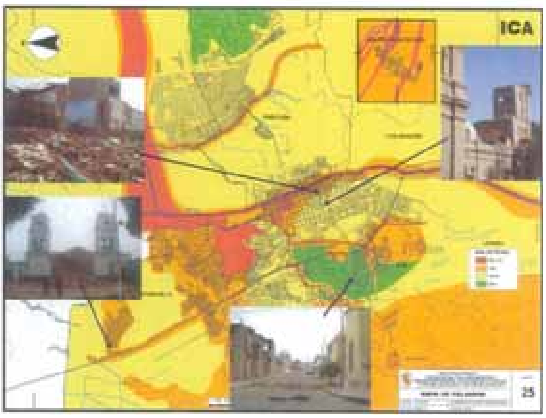

ARMS PLAZA


HOTEL EMBASSY


HOSPITAL

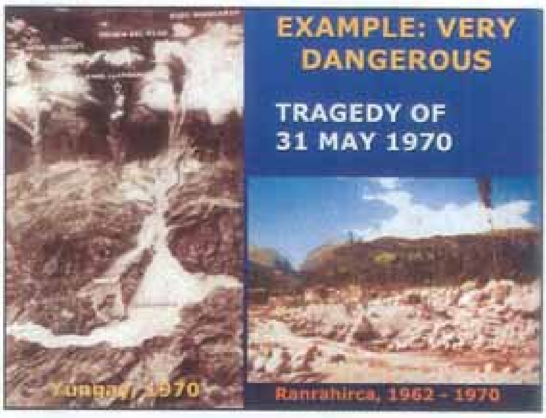

DITCHES: sandy and wet soil

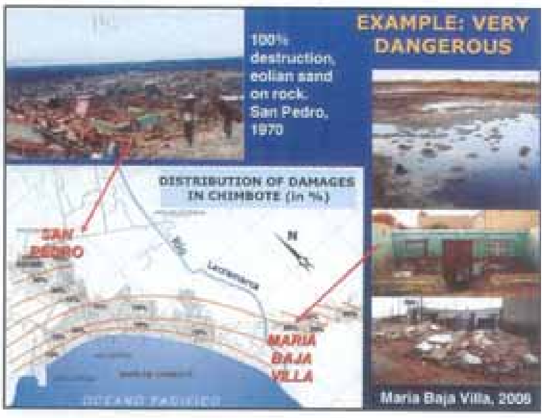

Peru Bandera High School (damaged)
Julio C. Tello High School (no damage)

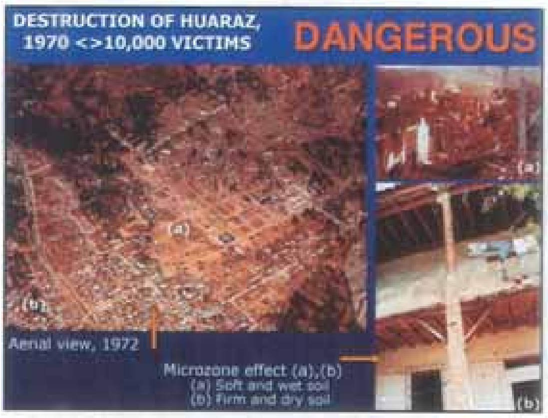

ICA
25


PUEBLO NUEVO
CHINCHA ALTA
CHINCHA BAJA

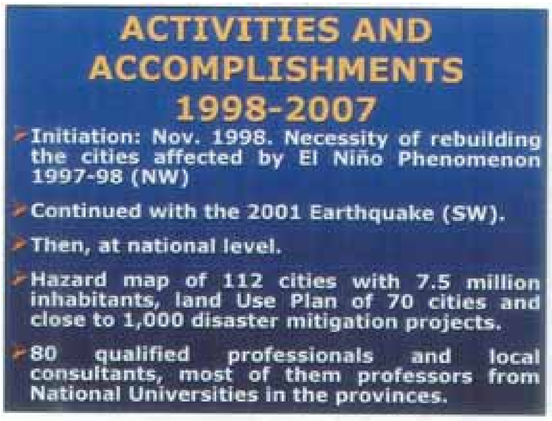

SAN VICENTE DE CAÑETE

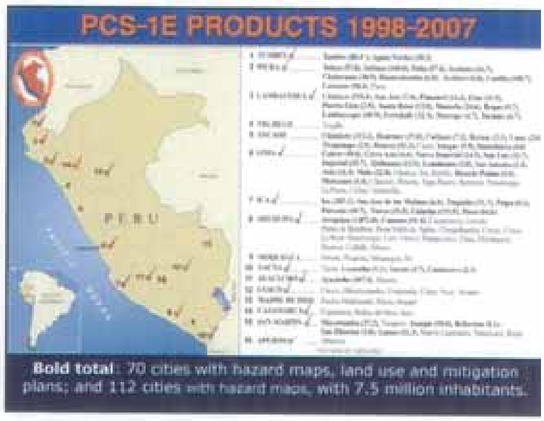

EXAMPLE: VERY DANGEROUS
TRAGEDY OF 31 MAY 1970
Yungay, 1970
Ranrahirca, 1962 - 1970

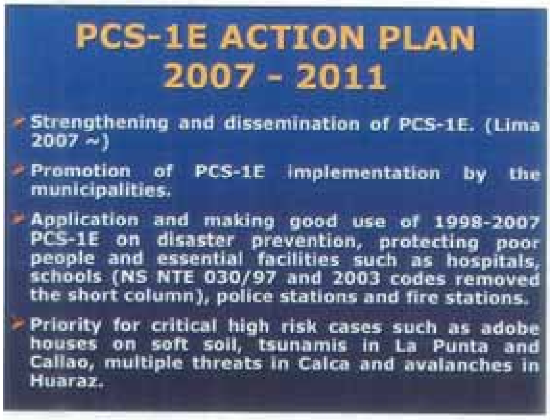

EXAMPLE: VERY DANGEROUS
100% destruction, eolian sand on rock. San Pedro, 1970
DISTRIBUTION OF DAMAGES IN CHIMBOTE (in %)
SAN PEDRO
MARIA BAJA VILLA
Maria Baja Villa, 2006

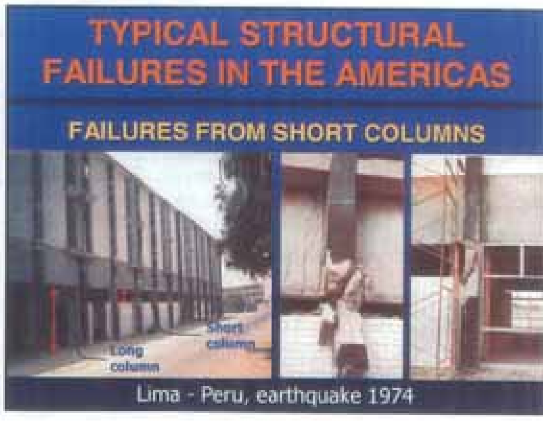

DESTRUCTION OF HUARAZ, 1970 <>10,000 VICTIMS
DANGEROUS
(a)
(b)
Aerial view, 1972
Microzone effect (a),(b)
(a) Soft and wet soil
(b) Firm and dry soil

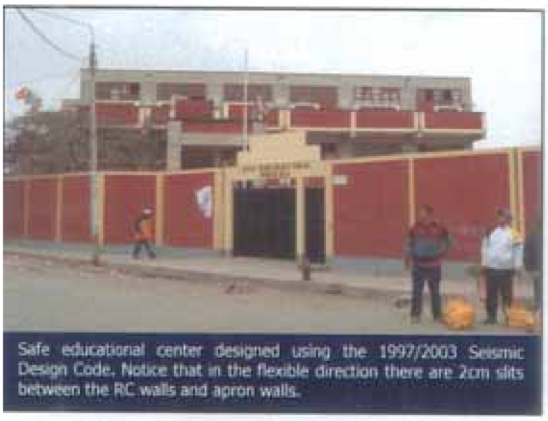

DANGEROUS
EARTHQUAKES IN MEXICO IN 1957, 1979 and 1985
4%
1985
A
B
ZONA DE TRANSICION
C
ZONA DEL LAGO

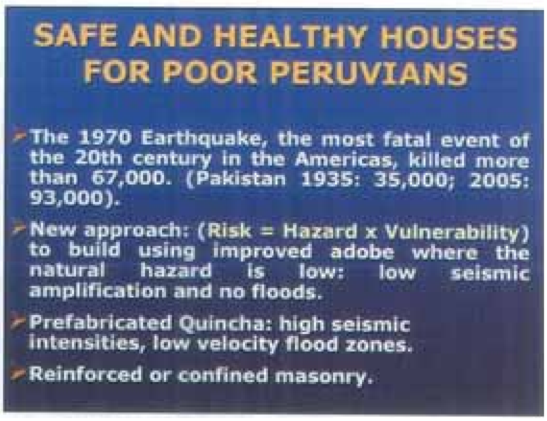

ACTIVITIES AND ACCOMPLISHMENTS 1998-2007
Initiation: Nov. 1998. Necessity of rebuilding the cities affected by El Niño Phenomenon 1997-98 (NW)
Continued with the 2001 Earthquake (SW).
Then, at national level.
Hazard map of 112 cities with 7.5 million inhabitants, land Use Plan of 70 cities and close to 1,000 disaster mitigation projects.
80 qualified professionals and local consultants, most of them professors from National Universities in the provinces.

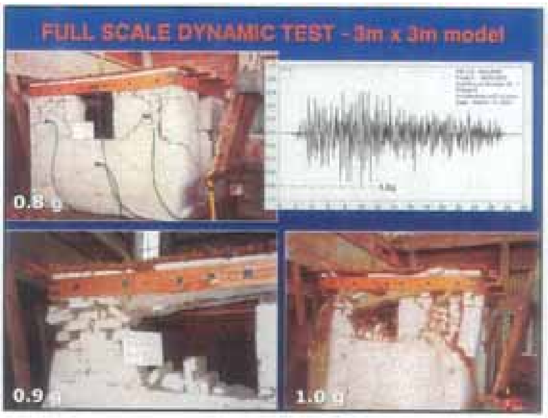

PCS-1E PRODUCTS 1998-2007
PERU
Bold total: 70 cities with hazard maps, land use and mitigation plans; and 112 cities with hazard maps, with 7.5 million inhabitants.


PCS-1E ACTION PLAN 2007 - 2011
Strengthening and dissemination of PCS-1E. (Lima 2007 ~)
Promotion of PCS-1E implementation by the municipalities.
Application and making good use of 1998-2007 PCS-1E on disaster prevention, protecting poor people and essential facilities such as hospitals, schools (NS NTE 030/97 and 2003 codes removed the short column), police stations and fire stations.
Priority for critical high risk cases such as adobe houses on soft soil, tsunamis in La Punta and Callao, multiple threats in Calca and avalanches in Huaraz.

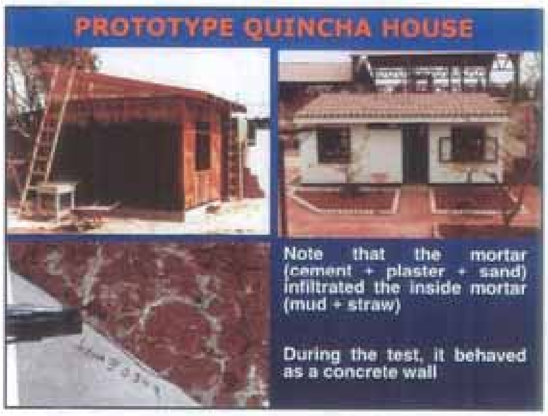

TYPICAL STRUCTURAL FAILURES IN THE AMERICAS
FAILURES FROM SHORT COLUMNS
Long column
Short column
Lima - Peru, earthquake 1974

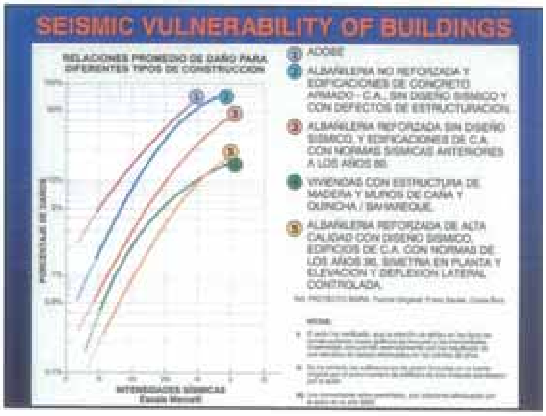

Safe educational center designed using the 1997/2003 Seismic Design Code. Notice that in the flexible direction there are 2cm slits between the RC walls and apron walls.


SAFE AND HEALTHY HOUSES FOR POOR PERUVIANS
The 1970 Earthquake, the most fatal event of the 20th century in the Americas, killed more than 67,000. (Pakistan 1935: 35,000; 2005: 93,000).
New approach: (Risk = Hazard x Vulnerability) to build using improved adobe where the natural hazard is low: low seismic amplification and no floods.
Prefabricated Quincha: high seismic intensities, low velocity flood zones.
Reinforced or confined masonry.

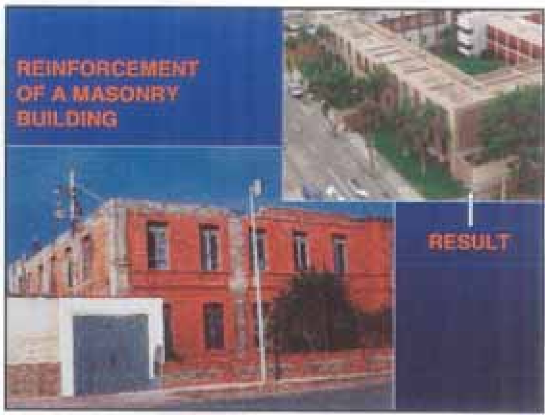

FULL SCALE DYNAMIC TEST - 3m x 3m model
0.8 g
0.9 g
1.0 g

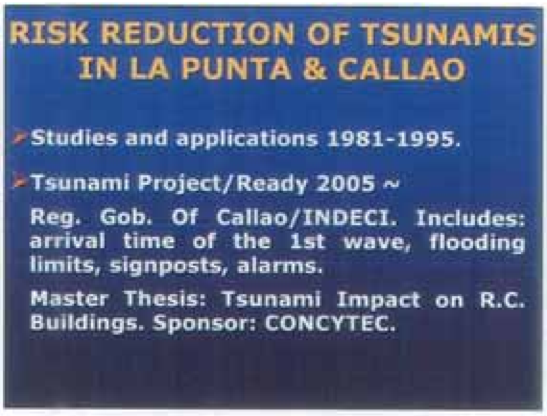

VIVIENDAS CON MODULOS PREFABRICADOS DE QUINCHA
a) PLAN
PANELS: WALL, DOOR, AND WINDOW, WITH THEIR WOODEN PARTS FOR ASSEMBLY
e) PRINCIPAL ELEVATION
f) SECTION A-A
g) SECTION B-B

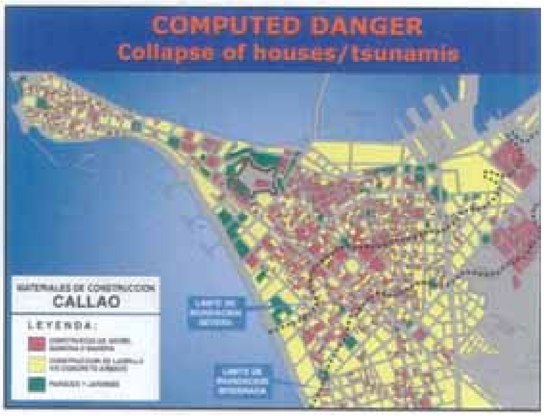

PROTOTYPE QUINCHA HOUSE
Note that the mortar (cement + plaster + sand) infiltrated the inside mortar (mud + straw)
During the test, it behaved as a concrete wall


SEISMIC VULNERABILITY OF BUILDINGS
RELACIONES PROMEDIO DE DAÑO PARA DIFERENTES TIPOS DE CONSTRUCCION
1 ADOBE
2 ALBAÑILERIA NO REFORZADA Y EDIFICACIONES DE CONCRETO ARMADO - C.A., SIN DISEÑO SISMICO Y CON DEFECTOS DE ESTRUCTURACION.
3 ALBAÑILERIA REFORZADA SIN DISEÑO SISMICO, Y EDIFICACIONES DE C.A. CON NORMAS SISMICAS ANTERIORES A LOS AÑOS 80.
4 VIVIENDAS CON ESTRUCTURA DE MADERA Y MUROS DE CAÑA Y QUINCHA / BAHAREQUE.
5 ALBAÑILERIA REFORZADA DE ALTA CALIDAD CON DISEÑO SISMICO, EDIFICIOS DE C.A. CON NORMAS DE LOS AÑOS 90, SIMETRIA EN PLANTA Y ELEVACION Y DEFLEXION LATERAL CONTROLADA.
PORCENTAJE DE DAÑOS
INTENSIDADES SISMICAS

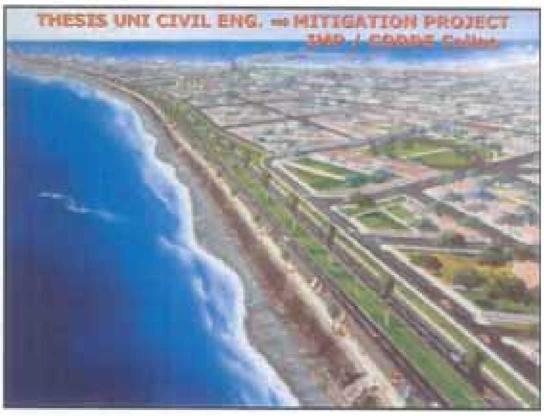

VSA INDEX
DENSIDAD DE MUROS
muros sin columnas
muros con columnas
DAÑOS EN MUROS
GRADO DE DAÑOS
0) Sin daño en muros
1) Fisuras
2) Grietas (> 1mm.)
3) Grietas y desplazamiento
4) Colapso parcial
MUROS SIN COLUMNAS:
Perpendicular a la fachada
Paralelo a la fachada
MUROS CON COLUMNAS:
Perpendicular a la fachada
Paralelo a la fachada


REINFORCEMENT OF A MASONRY BUILDING
RESULT

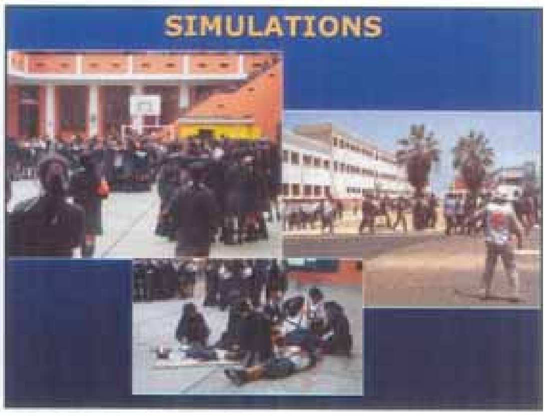

RISK REDUCTION OF TSUNAMIS IN LA PUNTA & CALLAO
Studies and applications 1981-1995.
Tsunami Project/Ready 2005 ~
Reg. Gob. Of Callao/INDECI. Includes: arrival time of the 1st wave, flooding limits, signposts, alarms.
Master Thesis: Tsunami Impact on R.C. Buildings. Sponsor: CONCYTEC.


COMPUTED DANGER
Collapse of houses/tsunamis
CALLAO
LEYENDA:

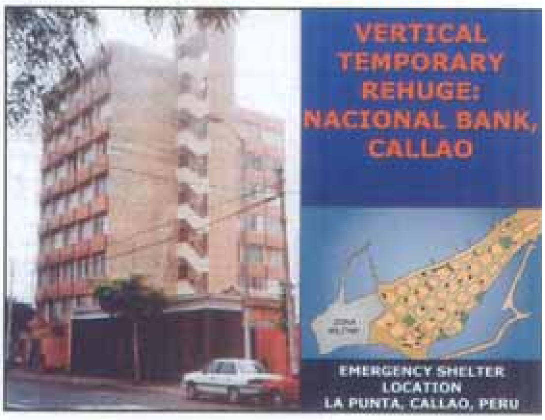

QUICK EVACUATION OF VEHICULAR ROUTE FROM LA PUNTA
(Thesis: Civil Eng. A. Iwamoto CISMID FIC/UNI)
BAHIA DEL CALLAO
OCEANO PACIFICO

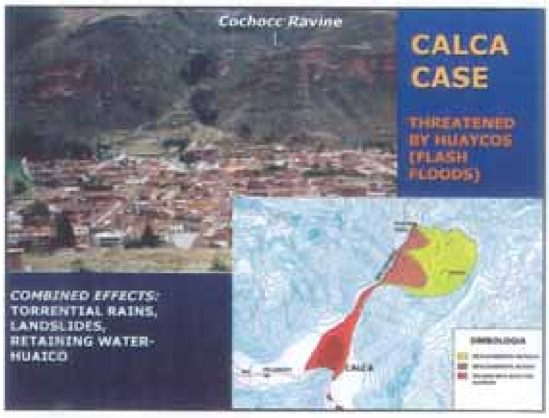

THESIS UNI CIVIL ENG. ⇒ MITIGATION PROJECT


SAN JUAN DE DIOS HOSPITAL IN PROCESS OF REINFORCEMENT

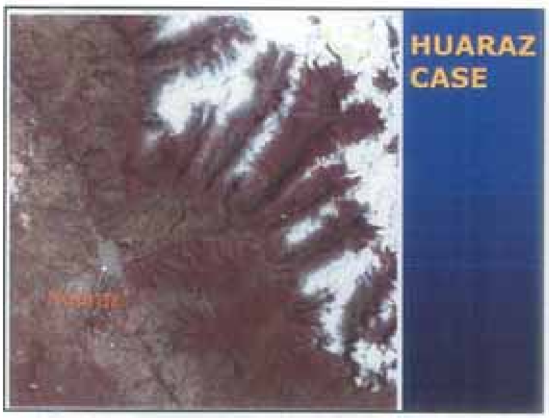

SIMULATIONS

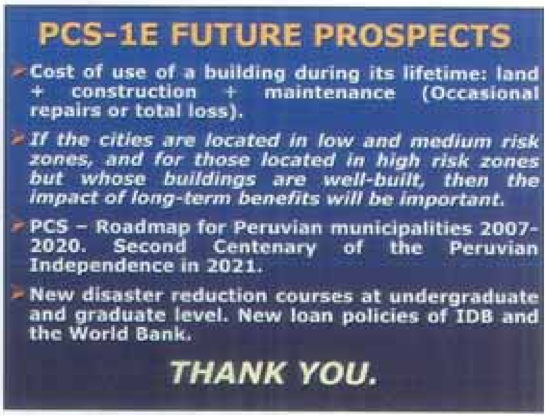

TEMPORARY REHUGE COMPLEX
TEMPORARY REHUGE: 900 TENTS


VERTICAL TEMPORARY REHUGE: NACIONAL BANK, CALLAO
EMERGENCY SHELTER LOCATION LA PUNTA, CALLAO, PERU


Cochocc Ravine
CALCA CASE
THREATENED BY HUAYCOS (FLASH FLOODS)
COMBINED EFFECTS: TORRENTIAL RAINS, LANDSLIDES, RETAINING WATER-HUAICO


Active escarpment
ACCHA LANDSLIDE (CALCA)


HUARAZ CASE


PCS-1E FUTURE PROSPECTS
Cost of use of a building during its lifetime: land + construction + maintenance (Occasional repairs or total loss).
If the cities are located in low and medium risk zones, and for those located in high risk zones but whose buildings are well-built, then the impact of long-term benefits will be important.
PCS – Roadmap for Peruvian municipalities 2007-2020. Second Centenary of the Peruvian Independence in 2021.
New disaster reduction courses at undergraduate and graduate level. New loan policies of IDB and the World Bank.
THANK YOU.

Panel Discussion

"Wider Application of Building Code in View of August 15th Earthquake in Pisco"

Moderator: Shoichi Ando, UNCRD Disaster Management Planning Hyogo Office

Panelists: Julio Kuroiwa, Emeritus University/ Civil Defense of Peru
Ruben Segura, Ministry of Housing
Arvindo Aliaga, Ministry of Housing
Javier Pique, Peru Engineering College (CIP)
Carmen Kuroiwa, Manager, Research and Standardization, National Service of Training for the Construction Industry (SENSICO)

Ando:
What should be done to construct safer houses after the August 15th Earthquake?

J. Kuroiwa:
I want to mention that this first issue is our main project or program for 2007-2011. We have been working in sustainable cities for eight years, which is unusual for a poor country like Peru. Four governments and 10 prime ministers have passed and all of them had supported and strengthened the program of sustainable cities. We have 112 hazard maps and most of them are supported by professors from national universities in the provinces who are qualified to give technical support to local and regional governments.

When the earthquake occurred, I was inspecting two-story adobe housuzco Region. One es in the Sacred Valley of the Incas, Cuzco, but not for imposing laboratory test results in places far away from Lima. I was inspecting two-story adobe houses with the President of the Cof the plans of Dr. Ricardo Yamashiro was how to strengthen two-story adobe houses. I told him that we did not have two-story adobe houses. Now unfortunately I see two-story adobe houses, and I do not know how but we have to strengthen them. Last year a new parameter was added, so now it is not enough for a house to be safe, but it should be healthy as well. So what are healthy houses? In the Andes, the houses are big rooms with tall walls, which are prone to flexural failure. The families in these houses most naturally sleep and cook inside. But when people cook inside the house toxic gasses are released and they suffer from it. For cold zones in the Sacred Valley of the Incas, the kitchen is located inside the house to use the heat produced when people cook. To solve this problem the chimney must go outward and a new kitchen has to be developed.

But flexible tall walls need a dividing wall instead of buttress. In the Sacred Valley of the Incas the houses have long rooms so it will not be a problem to put a dividing wall to strengthen them. What happens to adobe constructions? Adobe constructions are vulnerable. And remember that hazard depends on two factors. In downtown Lima, there are adobe houses that are more than 100 years old, and that during the 20th century those houses have been hit by the 1908, 1932, 1940, 1966 and 1974 earthquakes. If compact and dry soils, non flood areas, far away from landslide are chosen, then safer houses can be built. You have seen some strengthening alternatives showed by UNI, PUCP and others, but I prefer collar beams. With the equipment donated by JICA, we have tested 1/6 scale models to verify the type of failures in adobe houses.

We have verified that collar beams over the walls or added outside using good joints help adobe houses to avoid flexural failure at the corners. In February of this year, I had a meeting with the Chief Executive of BRI and I asked him to help us with new technology to join pieces together and to behave as a whole system. Walls automatically changed their behavior from flexural failure to shear failure and the use of canes can increase the shear resistance of walls.

What are we going to do in soils like those in Huaraz, or other soft soils where seismic waves are highly amplified? This condition is repeated in the jungle and in some valleys like Cañete where cane grows. It is a good opportunity to apply prefabricated systems in these areas. In high risk zones families that can afford new houses have to build confined masonry houses. We have to build houses taking into account the characteristics of the soil, geology and topography. Taking into account the type of soil and economic status one of three alternatives has to be chosen; the first one is the construction of adobe houses in good soils using collar beams over walls and footings. I think we all agree on this and there are only small technical discrepancies. The recommendations that have been used for the strengthening of confined masonry houses are similar to the ones used in Pakistan. Dr. Blondet has prepared a guide for the strengthening of confined masonry houses. Thank you very much.

Ando:
Thank you to Dr. Kuroiwa. I want to have a panel discussion on two questions. First question: How do we prevent the collapse of houses/buildings like what happened in the August 15 earthquake, especially adobe houses? Second question: What are the duties of each governmental organization such as CISMID, CIP and SENCICO.

Segura:
Good afternoon everybody. As we know Peru is a country where seismic activities frequently occur. It is also important to consider the type of soil before a construction starts. In May of 2006, the National Building Code was published. The contributions and comments from many organizations were gathered to update it. Since 1970, the National Building Code had not been updated and it was not suitable for new buildings. There are two important issues, i.e., the soil and the building itself. These issues are considered in the National Building Code which has three important titles and easy to understand. General concepts, rights and responsibilities are given in Title I. Rights and responsibilities of the engineers in charge of the structural, electrical and plumbing plans are discussed.

Previously, the code did not include the responsibility of the engineers and many of them used to sign plans without checking them to earn some money. Structural, electrical, plumbing and architectural designs are discussed in Title II. It is about urban development and its types. The code specifies the zones where the buildings must be constructed. The code gathers all these variables and questions. The ministry has disseminated this code at national level and to all the municipalities, universities, organizations and regional governments. But it seems that engineers do not take it seriously. There are many techniques to construct a building, but nobody follows this code. The code clearly specifies the importance of structural design, but people keep constructing without using the code, or a construction permit for their projects. If a building is constructed in good soil but without taking into account the requirements of the code, it would collapse any time. I ask Municipalities, which are in charge of inspections, to be more careful in that sense.

Aliaga:

Good afternoon everybody. The ministry as a regulatory organization published the National Building Code in May of 2006, which is compulsory in Peru. At the same time, the Ministry went to the disaster zone and took certain measures. In general, we have short-term and medium-term plans. For short-term plans, we are giving shelters and doing surveys of the disaster zone through INDECI, CAP, CIP and others. For medium-term plans, we will construct temporary houses made of wood or other prefabricated material. And finally, the Ministry is promoting programs like Techo Propio to give houses to those affected by the earthquake. These measures have been applied and we are modifying some laws to bring aids easily.

As for the adobe houses, the Ministry has been working for 5 months for the creation of a new rural housing program in which the houses are going to be built using materials from the zone. In the Andes, the houses are going to be built using adobe. But due to the recent earthquake, this project is presently put on hold. First of all, the houses need to have as its main element the economic activity of the town. The house has an infrastructure to develop this economic activity and to become a sustainable city. Secondly, we ask many organizations about the better way to construct adobe houses and to improve them using an improved kitchen for healthy houses. Thanks.

Pique:

How do we prevent collapse of houses during an earthquake? This question is impossible to answer because many cities similar to Pisco have a big percentage of buildings that have similar characteristics such as material, age, and informality. I assume that a program for reduction of vulnerability can be carried out. Strengthening techniques for adobe houses are successful and we can start working on this plan. But I think it is important to think not only about houses but also the important facilities, because in coastal cities the school buildings, hospitals and medical centers are made of adobe. We have to start working on schools and hospitals. If these facilities are made of adobe, the most suitable technique must be used whether it has been developed in UNI or in PUCP. There are techniques to strengthen adobe houses as Prof. Kuroiwa mentioned. So we have to teach people how to strengthen their houses with a wide range of mechanisms that the government has.

As for the adobe houses, I think that it should not be allowed anymore. Because nobody is likely going to use new technologies; nobody will apply it. It has happened before when El Niño Phenomenon took place in the North and the water dissolved the adobe bricks. In that moment a new technology was developed to address the problem. I have seen adobe bricks stabilized with asphalt under water and after a couple of hours the brick was intact. But who is using this technology? This technology has been here for 20 years and nobody is using it. Adobe dwellings were constructed using this technology but people stopped constructing these dwellings. The main idea was to build them and at the same time to teach people how to do it. In Pisco, the government wants to construct adobe houses using new technologies, but after a couple of years the people will continue constructing in the traditional way. A group of foremen has to be formed so the people will take this technology as traditional. But I think it is very irresponsible to build new houses using adobe. Existing adobe houses can be repaired, but the government should not invest in new technology because the people will not use it continuously. The wood is an example; the government has spent millions of dollars in researches for wood constructions but people do not construct wooded houses. We have a code for wooded constructions, but the suppliers do not offer this material for construction and people are ill-informed about this technology. It is a mistake to rebuild using adobe

About the duties of each organization, Arch. Segura talked about the National Building Code but the Ministry of Housing has proposed a new law that allows people to construct 5-story 3000-square-meter buildings without previous revision of the project. This proposed law is a big contradiction from the ministry. The Ministry published a code but later proposed a new law, which is an atrocity. People will be allowed to construct 5-story 3000-square-meter buildings without previous revision of the project, so the Ministry has the opportunity to vindicate itself. Now the Ministry is taking part on the reconstruction of Pisco, but it is not really their business because they will only be there for one year. Some municipalities where invited to this workshop but they did not come. It means that they are not interested and they will let people continue doing what they want. One of the issues of this workshop is to point out what is wrong, why people are not conscious about the importance of the building code, which is going to save their lives? It is because nobody tells them and the municipality does not stop people on make more mistakes. Each agency has to be conscious about their duties, but organizations such as the Civil Defense do not work. Thanks.

C. Kuroiwa:

I have two requests from the audience. One of them is to include strengthening guidelines in the Seismic Design Code. We only want guidelines because for the strengthening itself, an engineer is required. The second one is to make a simple guide with some drawings of the Seismic Design Code because only engineers can understand it but people do not.

A project about adobe houses was carried out between CISMID and SENCICO. And to our surprise, we found out that adobe houses did not have foundations. People dug to a depth equal to the height of two adobe bricks, and then filled it with adobe and over this the house was built. In addition, the thickness of the adobe brick was similar to the common clay brick, thus the house became even more vulnerable. There is a code for adobe constructions; if we apply it, adobe houses will be seismic resistant.

SENCICO constructed 20 adobe houses in the Andes and right now these houses are in good condition. These houses were constructed using technical support foundations and collar beams. About the Ministry of Housing, I do not know why they have asked for international cooperation. Firstly, they should have asked SENCICO for information because SENCICO together with JICA have constructed adobe houses in Pacarán and Lunahuaná, which are in good condition. SENCICO has three main functions; one of them is to train people for the reconstruction. Right now the President of SENCICO is in Chincha, Ica and Pisco, training people. Also, SENCICO does research and standards. Before a code is published, we make tests in the laboratories of CISMID and PUCP.

Segura:

I want to make a comment regarding adobe. There is a code on which we are still working. In the 2005 El Niño Phenomenon, many adobe houses collapsed because of the lack of collar beams and other elements that were established in the code. The ministry together with SENCICO trained people. SENCICO gave the technical workmanship. First, a prototype house was constructed with the collaboration of the people. An 18-square-meter adobe prototype house was built from the foundation up to the roof. The people were very grateful because they learned the correct construction method for a safer house. These prototypes were constructed in some places on Cajamarca. Cajamarca is an inaccessible place during rainy seasons and where people construct without any technical support. They used to construct without foundations. SENCICO taught them how to choose the soil, the size of the straw, how to prepare the mixture, how to make a brick, the thickness of the mortar and all the specifications. After the earthquake those houses are still in good condition and well constructed. I think that adobe is not a bad material; I think we should pay attention in the construction methods and the place. If people learn these techniques, they will apply it. Also we should use the available materials at the sites such as stone, adobe, straw, etc. If new materials such as clay brick or concrete are brought to inhospitable places, the construction cost increases three times its normal cost. We should take into account many factors; we cannot just say that adobe is not suitable for construction.

Aliaga:
Regarding the new law which allows people to construct 5-story 3000-square-meter buildings without previous revision of the project; firstly, this is a proposal and it has not been approved by the Congress yet. Secondly, this proposed law does not exclude technical inspections from the municipalities. Although an automatic approval of the project already exists, it does not exempt municipalities from making technical inspections of the project. If the officer finds a structural parameter or requirement that has not been obeyed, then the construction work has to be stopped. Nowadays, this mechanism already exists and it is called Automatic or Provisional Construction Permit. The owner submits the project proposal to the municipality, the owner pays a fee, and then a construction permit is given to start the construction works, and the project is evaluated by a committee. If it is not approved, the construction works are stopped. With this proposed law, the municipality has to find mechanisms to check the project and whether to approve it or not. We are not ignoring the technical inspections from the municipality because it is their duty. I think we can discuss this issue in another moment.

Participant:
I have had the opportunity to work in Huaraz for the United Nations. Adobe houses with buttress and collar beams have been built there using eucalyptus, a locally available material. The problem is that people do not construct using the technology. What Dr. Pique told us is true. More dissemination is needed about how to construct prototype houses like the ones that we built in Recuay, Ancash. What can we do to make people apply the code? We have a good building code but the problem is its implementation. In upper-middle and high districts, the code is applied but not in rural areas. My question is: What can we do to make people to apply the code?

Pique:
ININVI, which now belongs to SENCICO, had some videos to show how to construct using adobe. At that time people learned from the videos, but right now they are not using these construction methods anymore. This shows us the reality that people are not interested to use new technologies. I am not saying that adobe is not a good material, and I am sure that it can be earthquake resistant. But people will not change the typical construction methods for new technology. It has happened before and it will happen again. On the other hand, if the government is going to spend money, let us make people construct right. It will not be convenient to apply new technology that will not be used in the future. I am concerned about the expectations that will be generated among people if we say that adobe is appropriate for new constructions. After a few years people will relate adobe with mud but not with the technology. In Trujillo there is a neighborhood composed of two-story adobe houses. In the next earthquake the people who live in this neighborhood will likely die. Worst of all, the research project of this

area was give to the Mayor and he has not done anything about it, not even to warn the neighbors about this threat.

Arch. Aliaga told us that this new law has been approved only by the Housing Committee. This new law will be discussed in the Congress but congressmen are ignorant regarding this issue. This new law says that the municipality has to make a technical inspection after the construction works are completed. This morning the Vice Minister said that 70% of the projects did not have construction permits. Now the municipalities will only want to impose penalties and collect money for these violations. Do you think that the municipality is going to inspect those projects? They only inspect a small number of projects, and when all of these projects have been legitimized via the imposed penalties and corresponding money thus collected, they will not inspect them. Which construction work has been stopped because it does not fulfill all the code requirements? I only know about one building which is located in Javier Prado Ave, San Isidro. San Isidro is the only district that has the capacity to do it. This new law, that the Ministry of Housing is proposing, is irresponsibility on their part. If we tell the congressmen that they will go to jail when another earthquake occurs, then I am sure that they will not approve it.

Aliaga:
It is true that many municipalities do not have good urban control and technical inspection system. But the actual law has not been applied, so in both cases the municipality is responsible. Regarding adobe, I agree with Dr. Pique's comments because if there are no technical inspections from the municipality, any house will not be safe regardless of the material. In rural areas there are no technical inspections from the municipality so it is more possible to have unsafe houses.

Segura:
I want to make a question to everybody. Were adobe houses the only ones that collapsed, or did masonry houses too? You have the answer. There is no bad material; the construction methods are bad, which means the problem is the technical inspection.

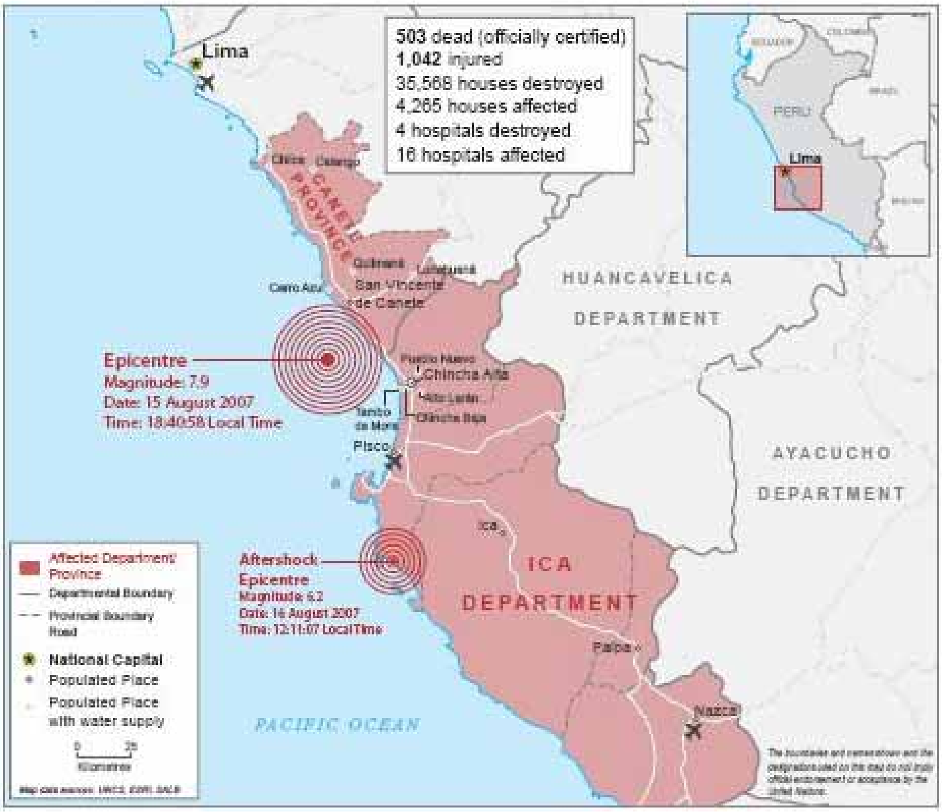
Zavala:
I have gone many times to Pisco and I have seen that adobe houses collapsed because they are very old. Some quincha houses are still standing. New masonry houses were severely damaged because they used horizontally perforated bricks, which exhibited fragile failure, as demonstrated in laboratory tests by Engr. Salinas. In this regard, the code should ban the use of balconies, horizontally perforated bricks, etc. Some RC buildings collapsed because they were originally designed for two stories, but the owners decided to construct more than three stories. Embassy Hotel is one of the examples of this case, and the responsibility for it should be shared by the owner and the government officers. There was another building that had a permanent deformation because it did not have enough stiffness in one direction so that there was a defect in its structural configuration. This earthquake taught us that new buildings failed because materials such as horizontally perforated bricks were not appropriate. In the case of adobe, houses many of those were old. San Juan de Dios Hospital collapsed because it was constructed without columns, whereas there is a new building that did not suffer any crack because it was constructed according to the code. There is also another undamaged three-story building, thus proving that our building code works in soft soils.

Otani:
We want to have earthquake resistant buildings, and that is true. Adobe buildings are susceptible to earthquake damage, and that is true. How long does it take to retrofit all adobe buildings to make them earthquake resistant? 20, 30 or 50 years. But people have to continue to live, and they need shelters or some place to live in, so we cannot just talk about earthquake resistant houses. We have to guarantee that people will have a place to live in; that is a

requirement as a member of human society. If possible we want to make those houses earthquake resistant, so whenever people want to rebuild their houses we should provide all the possible technology or advice to those who are planning to build. But I do not think it is possible to just replace all adobe buildings or remove all earthquake susceptible buildings. People have to live and we have to consider that situation. But at the same time, we should help them to build earthquake resistant buildings whenever possible. That is my feeling. Thank you very much.

Appendix

August 15th Earthquake-related information and photographs



Map 1: Location of epicenters and surrounding areas
Source: Relief Web, UN Office for the Coordination of Humanitarian Affairs

Table 1: Statistical data on human casualties and economic damage

Deaths already officially certified	519
Injured	1,366
Houses destroyed*	56,363
Houses affected	14,959
Hospitals destroyed*	14
Hospitals affected	96

*(*according to Peruvian Government preliminary assessments)*

Source: UN Office for the Coordination of Humanitarian Affairs.
"Situation Report: Peru Earthquake – 27 September 2007."

Table 2: Composition of damaged building type

Building Material/Structure	Number of buildings	%
Brick（Including reinforced concrete and block）	66,445	45.19
Masonry	168	0.11
Adobe（Including tapial）	69,946	47.57
Quincha（cane pluster with mud walls）	4,382	2.98
Mud and stone mixture	171	0.12
Timber	536	0.36
Estela（Knitted bamboo）	5,021	3.41
Others	364	0.25
Total	**147,033**	**100.00**

Source: Institute Nacional de Estadística e Informática (INEI)

Photo 1: Destroyed adobe house in Ica City

Photo 2: Destruction of quincha in Pisco, Ica Province

Photo 3: Demolition of five-story Hotel Embassy in Pisco City

Photo 4: Self-help initiative: reproduction of adobe blocks

United Nations Centre for Regional Development
Disaster Management Planning Hyogo Office

Hito-Mirai Kan 5th Floor
1-5-2 Wakihama Kaigan-dori, Chuo-ku
Kobe, Hyogo 651-0073 Japan
Tel: +81-78-262-5560 Fax: +81-78-262-5568
E-mail: rep@hyogo.uncrd.or.jp
Website: http://www.hyogo.uncrd.or.jp