ON COLLABORATION IN GEOLOGY, SEISMOLOGY AND EARTHQUAKE ENGINEERING FOR DISASTER MITIGATION IN PAN-PACIFIC AREA - IN RELATION TO SEISMIC DESIGN CODE

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Abstract

This paper will deal with the necessity of collaborations of regional persons for the disaster mitigation induced by seismic event and other hazards by earthquakes in the Pan-Pacific region. For this, we need the collaborations of geologists, seismologists and earthquake engineers, not only in our region, but also all over the world. Even though, the necessity of establishing regional code and standard is also emphasized.

INTRODUCTION

There are two big issues for us, Pan-Pacific earthquake engineers. For the disaster-mitigation in a particular area, we should study on the specific key issues in each local areas.

In Pan-Pacific area, two major types of earthquake mechanicsms are dominant, that is, the shallow earthquake in crust and the large magnitude earthquake in the plate boundary. The vibration characteristics, duration and other factors of ground motions of an earthquake, which has the effect on local structures, are quite different point by point. So, to establish the good practice for the protection and counter-measure of seismic disasters caused by failure of local structures and facilities, we should study on geology and seismology as well as earthquake engineering.

Another key issues, how to overcome the difference of local structures for generalizing a local code or standard. There are many traditional techniques to build structures as to meet their environment, local climate, soil condition, available materials and so on. Also, it should be pointed out, that there are modern structures, which are controlled by active, semi-active systems in city-areas, whose seismic conditions are much serious compare to other seismo-techtonic areas.

The Design Basis Earthquake is a starting point for seismic design code to mitigate our seismic disaster in general. Since Landers earthquake-1992, the empirical green function method has been extremely developed by seismologists. By using this method for deciding DBE, the scenario of

deciding asperities of active faults is one of key issues. To establish the good scenario, the co-operation of geologists, seismologists and engineers is important. The author has been discussing on subjective nature of scenario, and tries to become it more objective through such an activity.

The author will treat major topics by over looking such key issues for the collaboration of these three fields. The Institute, NIED organized the 2003 Pan-Pacific Symposium for Earthquake Engineering Collaboration last October, and to invite OECD/NEA Workshop "Seismic Input for Nuclear Power Plant" in 2004 in this regard,. The author will try to list up the subjects of the sessions both for these Symposium and Workshop.

Through these meetings, we should examine the possibility to establish our regional code and standard based on the discussion about regionability of seismic input and local structures. And in the near future, we are going to work together for our final target, establishing our regional code and standard.

ASIA AND EUROPE

Both areas have long cultural histories, and they have densely populated areas. However, the feature of towns and local structures are quite different. And the seismic hazards of both areas are different. Even we ignore the difference of religions and customs in each area, features of seismic disasters would be different. Of course, the difference of seismic disasters in Europe are very large area by area. Back to the code, especially "Building Code" is rather uniform.

For industrial matter, countries in South-east Asia have been using British Standard, B.S. in general. However their Building Codes are based on UBC except Japan. Recently, the proposal of European Building Code has been drafted. The author doesn't have enough knowledge of it, but he understands it aims that the uniformity through European nations.

The recent modern structure, such as ultra-highrise building are enormous in Asiantypical cities. On the other hand, there are various kinds of regional structures in Asia, and they are different from European style buildings including most of them in Balkan Peninsula, where destructive earthquake should be expected. Again, the author doesn't know their details on materials in Asia, but he imagines that most of structural materials have been prepared based on BS or ASTM and so on in Asia.

In conclusion, most of areas in South Asia have been strongly influenced by European code and standards and we need the original code for seismic design. Even through, in the industrial view point, the collaboration between Asia and Europe is necessary.

LOCALITY

The author has had chances to most of these countries, but only once or twice. Therefore, he can say that he doesn't know well the locality of structures in these areas as well as environmental conditions.

Even though, he dares to list up these as follows:

i) Major effects of various types of earthquake

ii) Soil conditions
iii) Tsunami effect
iv) Geological configuration
v) Population density
vi) Type of local housing
vii) Type of modern structures
viii) Environment, climate and living
ix) Configuration of urban area
x) Infra-structures in urban area
xi) Lifeline system in areas, both urban and low density area, or different configuration of areas.

We have been discussing on the disaster prevention and mitigation of modernized, and densely populated areas like large cities in Asia, U.S. and Europe. Those of some areas are not much different from the situations where we have been discussing, but those of most of areas in South Asia are different from we are discussing in some factors.

The author can't refer to the details. Here only points out these factors related to keep seismic safety in the region. Also, we should consider combined situations which we have been never considered in the area like Japan, where established the standard countermeasure under their own conditions.

COLLABORATION BETWEEN EARTHQUAKE ENGINEERS AND REGIONALS

Most of engineers are working in large engineering companies, organizations and universities in general, and rather few such engineers are working for design and construction of local structures. The engineer working for local structures are mostly technicians with highly trained skills according to the situation of the region. They have various experiences to build their local structures. However, against on a destructive earthquake, they can't protect their own structures, because they have never experienced it in a particular region in general, where an earthquake comes every several hundred years. In such areas, we need collaboration or education for them to exchange our knowledge and utilize their skills and experiences for improving their structures.

Higher level engineers sometimes try to combine their own structures with recent new techniques. They have been using maisonry structures since European came to their region. And they modified it to meet their environmental condition well. And now they develop them as a reinforced maisonry structures. However, the population density of urban areas in Asia is usually high, and they want to make it higher and higher.

The ordinary maison structures in Europe are usually several stories, and also consideration of vertical force. Especially, after crashing its walls by seismic motions, the behavior of vertical column should be considered through testing and theoretical analysis. This has been done, and this is an example of collaboration(1) through Edm, NIED.

Large cities in Asia, highrise buildings are well developed, and now many of them have various kind of structural control devices. In general, such cities less experienced ground motions of a long-distance, high magnitude earthquake in general. However, actually they must expect such an event in someday in the near future. Therefore, they need seismic hazard map on such long distance earthquake in regard to long period ground motions.

The exchange of knowledges between local engineers including designers and seismologists, geologists and specific earthquake engineers with wider scope in their special area.

PAN-PACIFIC SYMPOSIUM

Our NIED had been planned "the 2003 Pan-Pacific Symposium for Collaboration in Earthquake Engineering" since the summer of 2002. Then the preliminary meeting was held in December 2002 in NIED, and the Symposium was held in October 2003, last month in also NIED (Table 1). This Symposium is in relation to E-Defense, which has been constructed in Miki city for the future we use of shaking test upto 1,200 ton speciment. The details of E-Defense is talked by Mr. Ohtani[(2)] in this meeting.

Edm, Earthquake Disaster Mitigation Research Center, NIED had the 5th Workshop for the Asia-Pacific Region in December 2002 in Bangkok for almost the same purpose. Both groups in NIED organized such Symposium and Workshop for the same target; Collaboration in Earthquake Engineering and Disaster Mitigation Work. Edm has been working for the regional collaboration, not only for the theory and testing, but also their implementation. On the other hand, our target of NIED is, how to utilize E-Defense for future engineering studies in the region.

The Pan-Pacific Symposium was organized three themes and six topics. These themes are, hazard, vulnerability and risk, and these three are almost the same as those by Edm. To concentrate more collaboration of testing and research, the six topics had been listed as follow:

Topic 1, Ground Motion in Different Locality.
Topic 2, Earthquake Resistant; Local Structures including Historical Structures.
Topic 3, Practical Lowcast Base-isolation and Vibration Control Techniques.

The above three topics are major, and next three are more specific ones,

Topic 4, Seismic Instrumentation Networks in Low-populated Area; as well as lifeline systems.
Topic 5, Ground-motions and Countermeasures in Widely Spreaded Soft-soil Area.
Topic 6, Establishing Asian Earthquake Engineering Network.

The some areas including Japan Island are facing to the Pacific Ocean, this means we should expect trench-type huge magnitude earthquake from Alaska to Oceania. And site in inland, we should expect near-fieled type earthquakes by the activity of seismic fault near by the surface.

As the author discussed in the previous chapters, the effect of large magnitude events, the long-period ground motions may be very significant for the safety of highrise buildings in the densely populated areas in some cities.

And the disaster of tsunami triggered by earthquakes of rather near-field in critical because of the short duration and direct effect of waves. We had many loss of lives killed by tsunamis caused by large magnitude earthquakes in the Ocean, but some recent disasters came from short duration tsunami. But islands in Oceania region also have serious disasters combined both type, which flew over a

populated area of low highland from the sea level.

There are wide soft soil areas near by sea and isolated towns are scattered. We need the information of future earthquakes, and practical design of lifelines including a seismic instrumentation network in such an area, however, no one working for such subjects for low populated area.

The author doesn't want to enter the details of each topic, because he is not specialized in them.

REGIONAL STRUCTURES AND SEISMIC CATALOG

In China, they have a record of an eclipse in B.C. 4¢. I don't remember well how the oldest earthquake in China, but that in Japan is A.C. 5¢. The period of occurrence of a destructive earthquake in a particular region is distributed from 30 years to 20,000 years and more. To estimate the time of occurrence of such a periodic earthquake, the seismic catalog is very important. In Japan, several seismologists have been working for the survey of old records since Meiji era, 1900's. Musha collected the records in 1940's, and Kawasumi established the concept of "Seismic Catalog" and since 1925's the catalog has been published as a part of "Rikanenpyo", (Annual Table of Scientific Events) from Maruzen Pub. Co. every year. In the first edition, edited by Imamura, 312 earthquakes were listed. Eleven Korean earthquakes between A.C. 27 and 664 were included. Since early-1980's, Usami has been working for the survey and publishing the results as "Nihon Jishin Sohran[(3)]" under the financial support of the Japan Electric Association. The reprint of the original documents reached more than one meter thickness, and his activity is still continuing. To convert the original description in documents on failures of structures, such as Shrine, Temple, various type of local residential houses, commercial buildings, castle ware house, various kind of civil engineering structures and stone walls, and liquefaction to the modern intensity scale like JMA Sale, we should know the strength of these various type of structures at that time where the earthquake came.

In Japan, the previous intensity scale is combined one of a subjective scale and an objective scale. JMA Intensity IV or higher, key description is "failure of several typical structures" and "liquefaction". Liquefaction is quite independent to the era of earthquakes, but the details of structural failure is changing era by era.

We haven't paid much attention on this issue to decide the intensity distributions of historical earthquakes in Japan. However, Korean, Seoul Nat'l Univ. and Korean Atomic Energy Research Institute, KAERI, have been working for several kinds of simulated historical structures including civil engineering structures, stone wall and old monumental stones, for calibration of failure levels of historical structures in documents. Recently this study developed into local wooden houses. The author believes that this is quite unique study. In Japan, some engineers and research groups have been working for modern wooden structures and its improvement of seismic strength, because of large number of loss of lives by the failure of wooden residential houses.

PROTECTION OF MEDICAL FACILITIES

The study on base isolated surgery operation room is planned by Univ. of Southern California and also FEMA, U.S.A.. After we talked together with Prof. Masri, USC, it will be developed to technical meetings and a symposium of "protection of medical facilities under and after destructive earthquakes. How we need utility supply for continuing the surgery operation undergoing when strong ground

motions come. Of course, structural safety of medical facilities is important, then it should be protected by base-isolated system and/or other structural control device. However, even though they are protected enough, still we need utilities for continuing the function of various kind of medical cares and operations to keep their daily functions under the over burden for emergency treatments. Addition to ordinary utility functions, it is important to keep the continuous supply of medical material and medicine as well as food supply.

These subjects are usually considered for densely populated areas like urban area. However, how to keep the function of those facilities in low-population area is also significant, including transportation of patients to them. In this occasion, the author is going to learn the situation of the study in Taiwan.

CONCLUDING REMARKS

Even though the author emphasizes to establish a regional code and standard, he feels difficulty as discussed in Chapter 2.

We need to continue the survey on seismic environment in individual area. In some areas like Manila, the survey has been done well, but we should have the map of seismic faults and the seismic catalog in each significant urban areas through the regions.

We need much studies on potential seismic event in the ocean near by. We don't know about both shallow earthquakes near by coast lines and those in plants. Both effects are serious; this is a feature of destructive earthquakes in our region.

We need to know the specific feature of traditional local structures and the history of seismic damages. And also it is quite new area how to combine recent development of modern techniques like structure control and traditional construction technique and structure.

ACKNOWLEDGEMENT

We would like to express our sincere thanks for inviting us to this meeting to Dr. Loh, NCREE and Dr. Renda, JRC. Through this meeting, we expect the establishment of disaster mitigation policy and techniques in Asia

REFERENCE

N. Inoue: Development of Seismic Design for Composite Block Masonry Buildings and its Implementation, *Edm Technical Report, NIED*, No. 16 (Mar. '03), #3 paper of Session 2, CD-Rom Proc., 6pp.

K. Ohtani: On Recent Development and Future Use of E-Defense, Large Shaking Table in Miki, Kobe, To be presented.

Table 1, Programme of
2003 Pan-Pacific Symposium for Earthquake Engineering Collaboration

Sept. 30 (Tue)

Morning Session		Chaired by K. Ohtani
10:00 ~ 11:20	Opening Session	
10:00 ~ 10:15	Welcome Speech	T. Katayama
10:15 ~ 11:00	Special Lecture: Liquefaction Potential and Following Settlements of Deposits	K. Ishihara
11:00 ~ 11:20	Purpose of Symposium, Three Themes and Topics	H. Shibata
Afternoon Session		Chaired by C. H. Loh
13:00 ~ 14:30	Session 1: Three Main Themes	
13:00 ~ 13:30	Report on “Defining the Hazard”	K. Irikura
13:30 ~ 14:00	Report on “Reducing Vulnerability”	S. Cherry
14:00 ~ 14:30	Report on “How to Achieve Acceptable Performance of Civil Infrastructures against Extreme Earthquake Motion”	H. Iemura
14:30 ~ 15:40	Session 2: NIED and E-Defense	
14:30 ~ 15:10	Activity of NIED and E-Defense Research Project	T. Hayama
15:10 ~ 15:40	E-Defense and E-D net	K. Ohtani
15:50 ~ 16:20	MEXT Research Project ： Enhancement of Earthquake Performance of Infrastructures Based on Investigation of Fracturing Process	M. Hamada
16:20 ~ 16:50	Seismic Performance of Wooden Structure in Japan –from Tradition Buildings to Modern Houses	I. Sakamoto
16:50 ~ 17:30	Invited Lecture (1) Seismic Protection and Keeping the Function of Medical Facilities	S. F. Masri

Oct. 1 (Wed)

Morning Session		Chaired by S. Cherry
09:00 ~ 09:10	Introduction of Task Group Assignment for Third day and Short Discussing	H. Shibata
09:10 ~ 09:40	Preliminary Lecture (1) Wind Hazard Prediction–a new approach-	Y. Fujino
09:40 ~ 10:20	Preliminary Lecture (2) Policy for Promotion of Researches on Earthquake and Disaster Mitigation	S. Itakura
10:40 ~ 12:25	Session 3: Topic 1, Hazard, Ground Motion and Instrumentation	
10:40 ~ 10:55	Y. Okada, Recent Progress of Seismic Observation Networks in NIED	
10:55 ~ 11:10	C. H. Loh, Strong Motion Array, GPS Array and Building/Bridge Array Network in Taiwan: Emergency Response and Researches	
11:10 ~ 11:25	J. Cui, Effect of Solid Phase Deformation and Soil Layers on Ground Motion	
11:25 ~ 11:40	K.-L. Wen, Study the Ground Motion Characteristics in the Urban Area by Using the Microtremor Survey	

11:40~ 11:55	P. Warnitchai, Reducing the Vulnerability of Buildings and Structures in Bangkok to the Effects of Distant Large Earthquakes
11:55 ~ 12:10	A. G. Lanuza,
12:10 ~ 12:25	Discussion
Afternoon Sessions	Chaired by H. Iemura
13:30 ~ 14:00	Preliminary Lecture (3), Historical Structure, Record and Testing, J.-M. Seo
14:00 ~ 15:00	Session 4: Topic 2, Historical Record of Damage, Wooden Building, Local Structure, Real Time Network
14:00 ~ 14:15	C. Minowa, A Collapsing Behavior of Timber Structure House Subjected to Seismic Motion
14:15 ~ 14:30	Y. Hayashi, Comparative Study on Wooden House Damage Between 1995 Kobe Earthquake and 2000 Tottori Earthquake of Japan
14:30 ~ 14:45	J. Lin, Post-earthquake Field Safety Assessment of Buildings
14:45 ~ 15:00	Discussion
15:30 ~ 17:00	Session 5: Topic 3, Base Isolation, Structural Control and Response, Low-cost Base Isolation, Post Earthquake Inspection
15:30 ~ 15:45	T.-C. Pan, Building Response to Long-Distance Sumatra Earthquake
15:45 ~ 16:00	J. S. Hwang, New Design Formulations of Structures with Viscous Dampers
16:00 ~ 16:15	K.-C. Chang, Evaluation and Demonstration of a New Seismic Isolation Bearing
16:15 ~ 16:30	H. D. Setio, Experimental Simulation of Active Mass Damper of Two Story Structure Using Artificial Neural Network
16:30 ~ 16:45	K.-C. Tsai, Networked Pseudo-Dynamic Testing in Taiwan: Framework and Applications
16:45 ~ 17:00	Discussion
17:00 ~ 17:45	Invited Lecture (2), Role of Earthquake Geology for Earthquake Disaster Mitigation Y. Kinugasa

Oct 2 (Thu)

	Chaired by S. F. Masri
09:00 ~ 09:30	Preliminary Lecture (4) Low Cost Base-Isolation K. Seto
09:30 ~ 11:45	Closing Session Chaired by S. F. Masri
09:30 ~ 11:30	Themes and Topics
	Topic 1 C.-H. Loh & K. Irikura
	Topic 2 S. Cherry & C. Minowa
	Topic 3 S. F. Masri & H. Iemura
11:00 ~ 11:30	Closing Lecture; Future Direction for Pan-Pacific Collaboration W. D. Iwan
11:30 ~ 11:45	Final Report on P.-P. Symp., T. Hayama