Compilation of ICUS Newsletters From 2001-2006

By

ICUS

August 2006

ICUS: International Center for Urban Safety Engineering, IIS, The University of Tokyo

Compilation of ICUS Newsletters

from April 2001 – March 2006

Taketo Uomoto

Director and Professor of ICUS, IIS, The University of Tokyo

ICUS Report No. 13, August 2006

Abstract

Realization of safer cities is one of the challenges of the 21st century. For this purpose, it is necessary to study urban safety engineering including the maintenance and management of infrastructures from an international point of view. ICUS Newsletter was started with the inception of ICUS in 2001 to disseminate accurate and comprehensive information on urban safety engineering. Over the past 5 years, we have considered the newsletter an important communication media of the center, publishing 20 regular newsletters and 1 special issue compiling information from all parts of the world. Much of the information is contributed by ICUS network members who reported on urban safety issues in their countries. ICUS Newsletter with a circulation of about 2000 distributed in over 148 countries has a wide and loyal readership. This compilation consisting of volumes 1 to 5 was made at the request of many of our readers for a complete set for reference.

Keywords: Structure deterioration mechanism, non-destructive testing, retrofitting technology, standard specification, city safety, disaster prevention, disaster environment simulator, disaster countermeasures, remote sensing, geographic information system, space data analysis, city warming, city information network

International Center for Urban Safety Engineering

ICUS NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

SPECIAL ISSUE
January 2005

Central Part of Niigata Prefecture, Japan was Striken by M 6.8 Earthquake on October 23, 2004

By

Kimiro MEGURO

A magnitude 6.8 earthquake, with a focal depth of 13 km, stroke the central part of Niigata Prefecture, Japan, at 17:56 on October 23, 2004. Due to this earthquake, strong ground motions up to 1.7 g were recorded. Forty people were killed and 2,800 houses collapsed or were heavily damaged. Many landslides and liquefied sites were observed. Civil infrastructure such as highway facilities, bullet train system, and many other lifeline systems were also damaged. ICUS dispatched reconnaissance teams to the affected sites several times to investigate various damage due to the earthquake. This is a quick report summarizing these site surveys.

On October 23, 2004, at 17:56, a magnitude 6.8 earthquake, with a focal depth of 13 km, stroke the central part of Niigata Prefecture. The Japanese Meteorological Agency (JMA) named this event the 2004 Mid-Niigata Prefecture Earthquake. Due to this earthquake, strong ground motions with JMA seismic intensity, I_{JMA}, 7, which corresponds to the highest intensity in this scale, were observed. This is the first time since the JMA changed its intensity definition, from a human perception based definition to an instrumental observation based one, that this intensity was observed.

Peak ground accelerations up to 1.7g and peak ground velocities up to 133 kines were observed. These are much higher than those of the ground motion recorded during the 1995 Kobe Earthquake. I_{JMA} 7 was observed at Kawaguchi town and Ojiya city. Yamakoshi village and Oguni town experienced I_{JMA} 6+ while I_{JMA} 6- was observed at Nagaoka city, Tookamachi city, Tochio city, Koshiji town, Mishima town, and Horinouchi town.

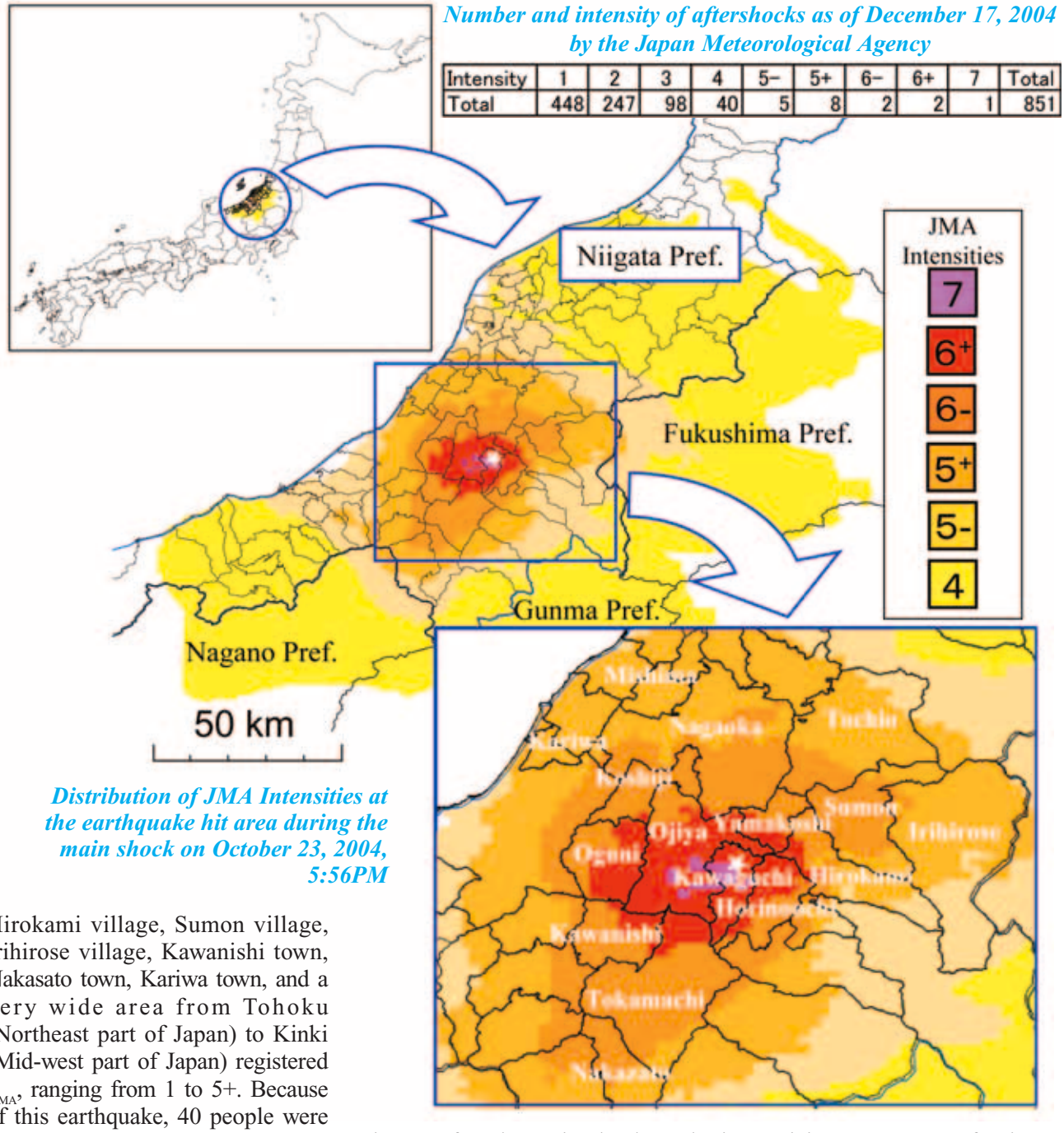
(Urasa-agaoka, Joetsu-Shinkansen, Nagaoka city, 25/10/2004)

The bullet train derailed for the first time since it started operations in 1964.

Very strong ground motion was observed...

Number and intensity of aftershocks as of December 17, 2004 by the Japan Meteorological Agency

Intensity	1	2	3	4	5−	5+	6−	6+	7	Total
Total	448	247	98	40	5	8	2	2	1	851



Distribution of JMA Intensities at the earthquake hit area during the main shock on October 23, 2004, 5:56PM

Hirokami village, Sumon village, Irihirose village, Kawanishi town, Nakasato town, Kariwa town, and a very wide area from Tohoku (Northeast part of Japan) to Kinki (Mid-west part of Japan) registered I_{JMA}, ranging from 1 to 5+. Because of this earthquake, 40 people were killed and 4,500 were injured.

This earthquake was the first event in which the derailment of a bullet train was observed since they entered service in 1964. Fortunately, no fatal victims were reported. This service line is not very congested and at the time of the earthquake only one of the lanes was being used.

One of the most important characteristics of this earthquake is the huge number of large aftershocks. On the same day of the main shock, three aftershocks with magnitude 6 or more stroke. The first occurred at 18:03, just seven minutes after the main shock, and had a M6.3 and a maximum recorded I_{JMA} 5+. Eight minutes after, at 18:11, a M6.0 event with a maximum recorded I_{JMA} 6+ was felt. At 18:34, a M6.5, maximum I_{JMA} 6+ stroke the same region. Beside these three events, three more with I_{JMA} 6+ were felt on October 23, 19:45, M5.7, maximum I_{JMA} 6-, on October 27, 10:40, M6.1, maximum I_{JMA} 6-, and on November 8, 11:15, M5.9, I_{JMA} 5+, as shown in the table at the top of this page. This table shows the number of aftershocks and the corresponding maximum recorded intensities. Because of a large number of aftershocks, landslides and structural damage gradually progressed and consequently affected the life of the people living in the area.

The statistics of human casualties and structural damage are introduced in the table on the next page. Because of this earthquake, 40 people were killed, 9 of them due to structural collapse. The other victims died for other reasons such as shock, exhaustion, stress, and the economy class syndrome. The latter was caused by the long periods that

the residents had to sleep in their cars, in uncomfortable positions, because of the insecurity of their houses and their fear due to the huge number of aftershocks. The number of collapsed, moderately damaged, and slightly damaged houses were 2,800, 10,600, and 88,500, respectively.

The ground motion due to the 2004 Mid-Niigata Prefecture Earthquake was very large. Peak ground accelerations (PGA) up to 1.7g and peak ground velocities (PGV) up to 133kines were observed. The response spectra depicted below shows the earthquake high power in the high frequency, or short period, range, from 0 to 1sec. Response accelerations over 6,000 Gals are observed. This is much higher than the power of the ground motion during the 1995 Kobe Earthquake for a similar frequency range. However, on a longer period range, from 1 to 2 sec, the Kobe ground motion power was higher. The frequency content characteristics of the Mid-Niigata Prefecture Earthquake may partially explain the relatively small structural damage observed as compared to that during the Kobe Earthquake. However, other reasons such as the high structural strength of the dwellings should also be taken into account.

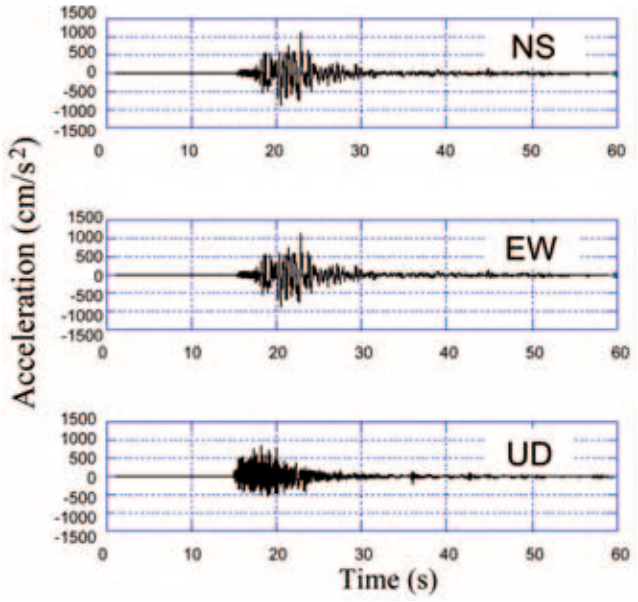
Due to the severe winter and huge snow fall that is common in this area, houses are built with small openings, to keep them warm, and robust foundations and structural elements, to resist the snow weight. These features increase the overall structural strength. It is not surprise to observe that most of the collapsed houses were either old or presented soft stories in the 1st floor were open spaces were allocated. On the other hand, the extremely high power in the high frequency range may explain the huge number of rock falls and landslides, non-tensile material structures, which are more affected by this type of excitations.

Casualties, damaged buildings, and fires caused by the earthquake at different prefectures (as of December 24, 2004 by Fire and Disaster Management Agency)

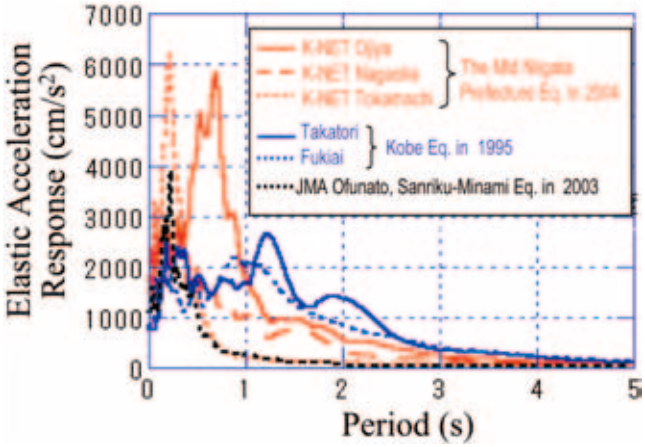
	No. of Casualties		No. of Damaged Residential Houses			
	Death	Injured	Collapsed and Heardly damaged	Moderately damaged	Slightly damaged	Burned out
Niigata	40	4,536	2,842	10,568	87,492	9
Nagano		3				
Saitama		1				
Fukushima					1	
Gunma		6			1,031	
Total	40	4,546	2,842	10,568	88,524	9

(Kawaguchi, Kawaguchi town, 27/10/2004)

Graveyard at Kawaguchi town where I_{JMA} was 7



Strong ground motion recorded at the K-Net Ojiya station (PGA: 1500.7gal, PGV: 133.4kine, I_{JMA}: 6.73)



Response spectra corresponding to the 2004 Mid Niigata Prefecture and the 1995 Kobe Earthquakes

Landslides and rock falls blocked roads...

The 2004 Mid-Niigata Prefecture Earthquake occurred in a mountainous area which was hit by heavy rainfalls and typhoons just prior to the earthquake occurrence. These previous events saturated and loosen the soil, and therefore when the earthquake stroke the mountain slopes where particularly vulnerable. For this reason, the geotechnical related damage was widespread and much more considerable than the structural damage.

Geotechnical related damage to people and buildings. (as of November 26, 2004 by Ministry of Land, Infrastructure and Transport)

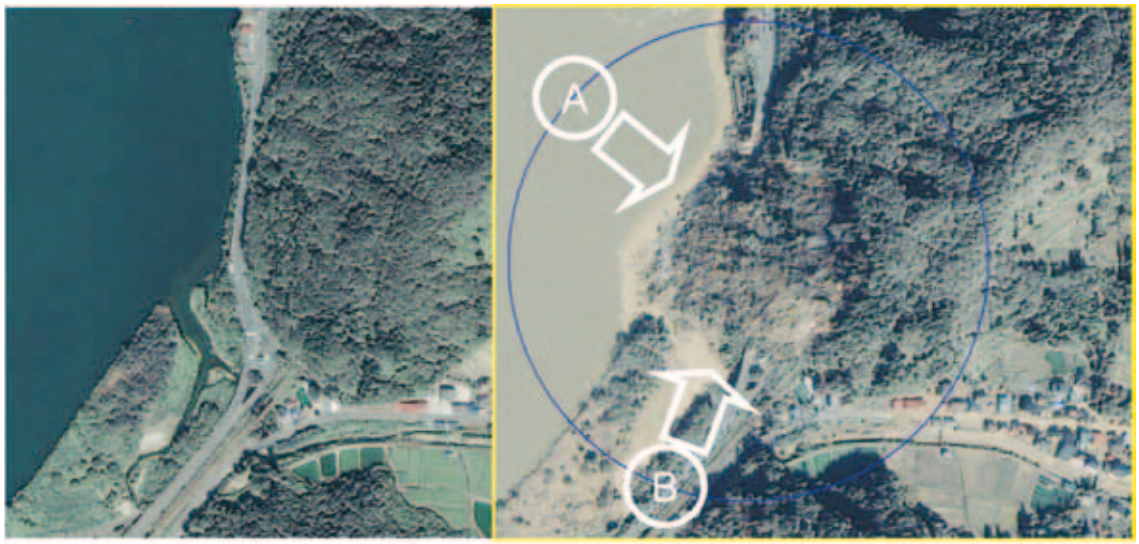
	No. of events	No. of Casualties		No. of Damaged Residential Houses		
		Death	Injured	Collapsed and Heardly damaged	Moderately damaged	Slightly damaged
Debris Flow	21	0	0	0	0	1
Land Slide	131	2	0	15	23	31
Rock Fall	115	2	1	0	1	14
Total	267	4	1	15	24	46

Route 291 which connects Ojiya to Yamakoshi was blocked. (Yokowatashi, Ojiya city, 26/10/2004)

Route 291 which connects Ojiya to Yamakoshi was blocked. (Kawai, Ojiya city, 9/12/2004)

(Myoken, Nagaoka city, 25/10/2004)

Huge landslide on the riverside of Shinano River
View from the riverside opposite to the landslide



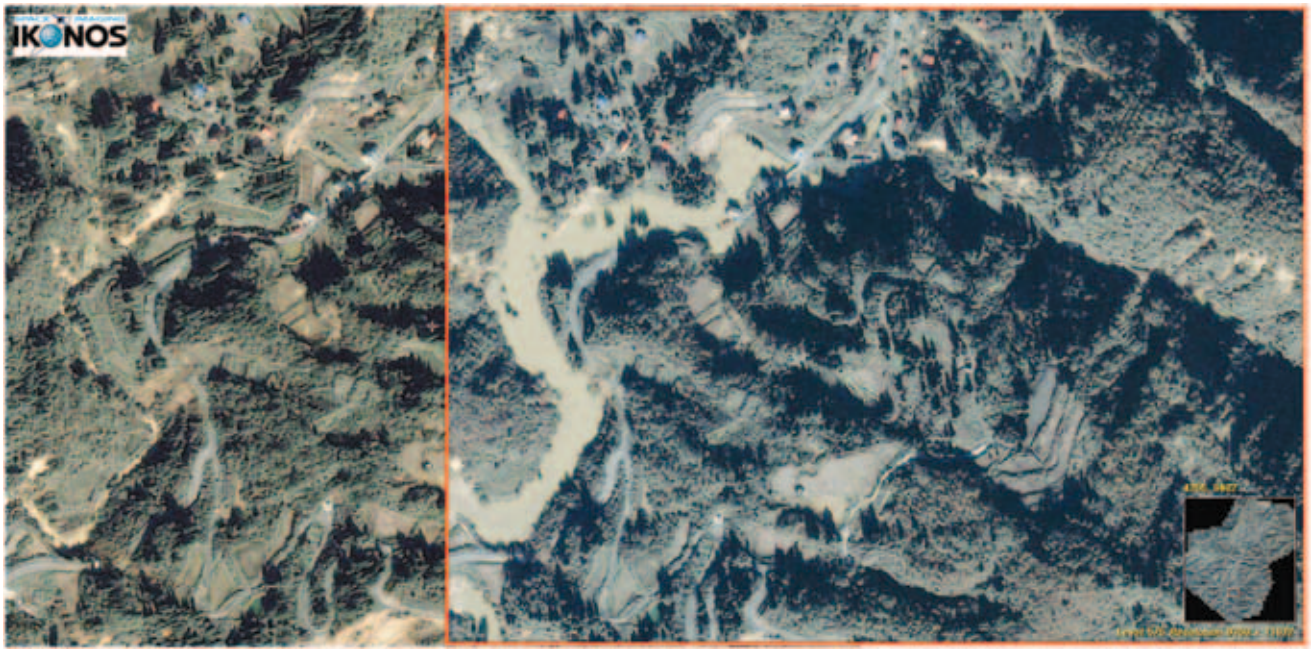
(Myoken, Nagaoka city, 25/10/2004) (Myoken, Nagaoka city, 24/10/2004)

Satellite view of the area before (left) and after (right) the earthquake

(Myoken, Nagaoka city, 26/10/2004)

View of the landslide from the riverside where it occurred

Landslides also blocked riverbeds forming natural dams and causing flooding...



(Higashi-Takezawa, Yamakoshi village, 24/10/2004) (Higashi-Takezawa, Yamakoshi village, 29/10/2004)

Satellite image of the area one (left) and six (right) days after the earthquake

(Higashi-Takezawa, Yamakoshi village, 24/10/2004) KOKUSAI KOGYO CO., LTD.

Aerial view of the landslide affcted area

(Tanesuhara, Yamakoshi village, 24/10/2004) KOKUSAI KOGYO CO., LTD.

(Iketani, Yamakoshi village, 24/10/2004) KOKUSAI KOGYO CO., LTD.

Aerial view of the landslide affcted area

(Uragara, Ojiya city, 26/10/2004)

House turned into dam due to a landslide that blocked the river flowing next to it before the earthquake

(Uragara, Ojiya city, 26/10/2004)

Uragara, Ojiya city was flooded due to over flowed water from the dam shown in the photo on the top of this page.

Liquefaction induced severe damage...

(Wakaba, Ojiya city, 27/10/2004)

Numerous manholes uplifted by the increase in the pore water pressure associated with liquefaction induced by the earthquake

(Katada-cho, Nagaoka city, 29/10/2004)

(Kawaguchi, Kawaguchi town, 27/10/2004)

In the left photo, the concrete belt along the centerline of the road is a snow melting water system. This system is widely used in the affected area and together with other lifeline systems, it was also severely damaged due to liquefaction.

The photo on the right shows a temporary snow melting system prepared for winter.

(Kawaguchi, Kawaguchi town, 09/12/2004)

Weak houses collapsed...

(Kawaguchi, Kawaguchi town, 27/10/2004)

Because of severe winter condition in the affected area, such as cold temperature and heavy snow fall, houses are built with small openings, to keep them warm, and robust foundations and structural elements, to resist the snow weight. The roofs are made of light materials to prevent snow accumulation.

Furthermore, due to the weather conditions in the area, there is less deterioration of wooden structures

(Kawaguchi, Kawaguchi town, 27/10/2004)

(Kawaguchi, Kawaguchi town, 27/10/2004)

...but, new strong houses remained intact.

due to termite attack. These features increase the overall structural strength against earthquake motion.

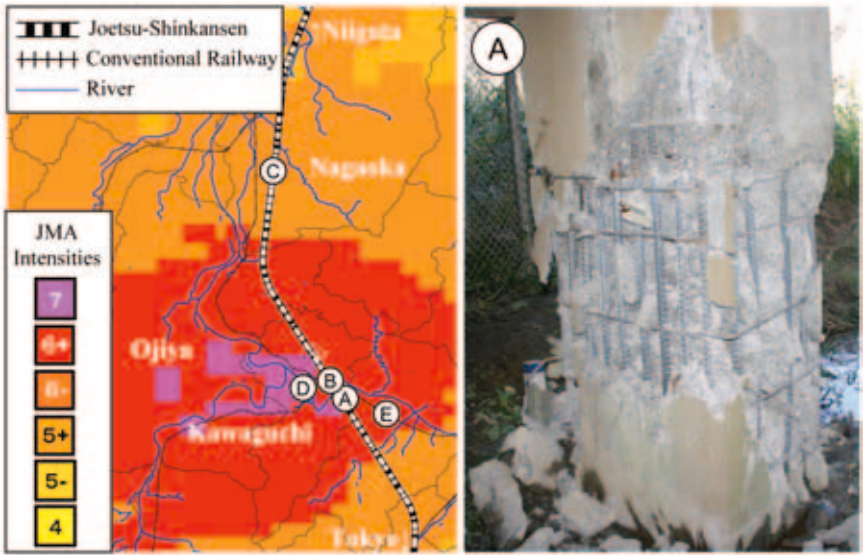
Most of the collapsed houses were old and had soft first story, without enough walls, used for parking or shop. Relatively new and typical houses, constructed considering the winter weather condition in the affected area, remained intact even at the locations where very strong ground motion was recorded.

(Kawaguchi, Kawaguchi town, 07/12/2004)

(Kawaguchi, Kawaguchi town, 27/10/2004)

(Shimojima, Horinouchi town, 26/10/2004)

Bullet train derailed and its service was disrupted...



(Urasa-Nagaoka, Joetsu-Shinkansen, Kawaguchi town, 29/10/2004)

A bullet train viaduct pillar with little transverse reinforcement failed in shear.

(Urasa-Nagaoka, Joetsu-Shinkansen, Kawaguchi town, 26/10/2004)

Bullet train viaduct pillars exhibited concrete spalling at the sections where longitudinal rebars were cut.

(Urasa-Nagaoka, Joetsu-Shinkansen, Nagaoka city, 25/10/2004)

The bullet train derailed for the first time since it started operations in 1964.

The 2004 Mid-Niigata Prefecture Earthquake was the first event in which the derailment of a bullet train, Shinkansen in Japanese, was observed since they entered service in 1964. Fortunately, this service line is not very congested and at the time of the earthquake only one of the lanes, the one bound for Niigata, was being used. No fatal victims were reported. If two trains had been running in opposite directions when the earthquake stroke, most likely the consequences would have been more severe. The photos show damage to the pillars of the bullet train viaduct. At several columns, concrete cover spalling was observed at the points where a portion of the longitudinal rebars were cut. On others, the few amount of transverse reinforcement caused column shear failure.

The Urgent Earthquake Detection and Alarm System, UrEDAS, system, whose objective is to stop running bullet trains before the major earthquake wave reaches them, was in operation during this earthquake. This system is very useful when the distance between the epicenter and the running train is long enough so

...other train facilities were also disrupted.

that the alerting signal arrives before the earthquake motion. However, when the train is too close to the epicenter, as in this event, the UrEDAS system cannot accomplish its objective.

Not only the bullet train but also local lines were disrupted. Landslides blocked railways, embankments settled and left railways hanging, and pillars constructed according to old standards failed.

(Echigo-Kawaguchi-Uchigamaki, Iiyama-line, Kawaguchi town, 29/10/2004)

Pillars constructed according to old standards failed.

(Echigo-Kawaguchi-Uchigamaki, Iiyama-line, Kawaguchi town, 29/10/2004)

Embankments settled and left railways hanging.

(Kita-Horinouchi-Echigo-Kawaguchi, Joetsu-line, Horinouchi town, 26/10/2004)

Railway facilities were damaged at many locations by landslides.

Highways and roads were damaged...

(Ojiya-ohashi bridge, Route 17, Ojiya city, 26/10/2004)

A bridge pillar suffered concrete spalling at the location where the longitudinal rebars where discontinued and where there was a drastic change of the pillar cross section.

(Ojiya-Tokamachi, Route 117, Ojiya city, 26/10/2004)

Settlement of the bridge abutment caused damage to the bridge access section.

(Horinouchi-Echigo-Kawaguchi, Kanetsu Expressway, Horinouchi town, 24/10/2004) KOKUSAI KOGYO CO., LTD.

(Ojiya-Yamakoshi, Route 291, Ojiya city, 26/10/2004)

Geotechnical related damage caused disruptions at several locations along highways (top) and national roads (bottom).

Lifelines were disrupted...

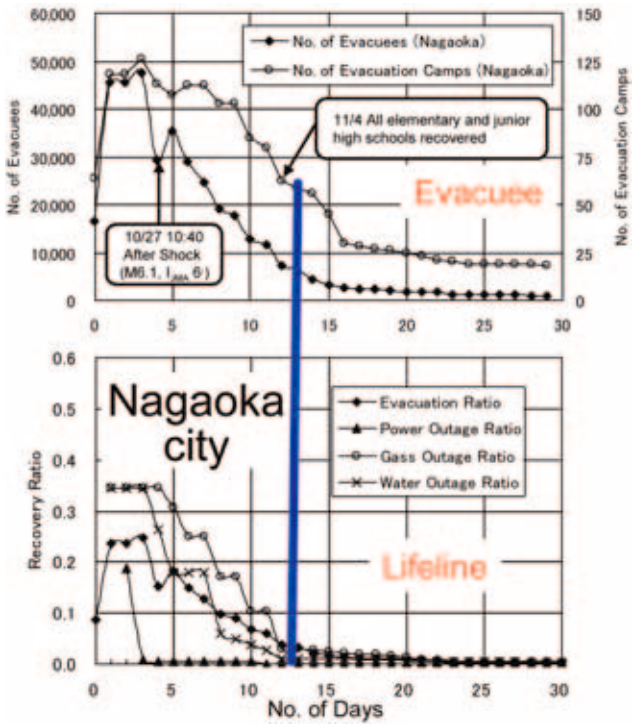
Another feature of the Mid-Niigata Prefecture Earthquake is the large number of evacuees if the extent of the structural damage is considered. The main reason for this is the large number of aftershocks, which caused 100,000 people to flee to evacuation centers. The graph below shows that after lifelines were restored, the number of evacuees dramatically decreased. The city with the largest number of evacuees was Nagaoka.

As mentioned in the previous paragraph, this earthquake evacuees were people who flee to evacuation centers due to fear of the aftershocks and lifeline disruption. After these factors were eliminated, most of them were able to promptly return to their homes. During the Kobe earthquake, evacuees were people whose houses collapsed and therefore had no place to go. As result, the earthquake indirect victims were numerous. This phenomenon will most likely not be observed for the Mid-Niigata Prefecture Earthquake.

The Mid-Niigata Prefecture Earthquake also put in evidence the importance of coordination among lifeline recovery activities for efficient recovery operations.

(Misawa, Nagaoka city, 01/11/2004)
THE JAPAN GAS ASSOCIATION

Gas pipe line was filled with leaked water from damaged or under reparing water supply system



Relation between number of evacuees and recovery ratio of lifeline system in Nagaoka city

(Echigo-Kawaguchi Station, Kawaguchi town, 30/11/2004)
NOMURA RESEARCH INSTITUTE, LTD.

Damage to power supply system

... but life continues in the affected areas

Quick inspection of buildings was carried out to determine damage levels. Seals - red, yellow, and green, in order of damage severity - were posted accordingly.

(Honcho, Ojiya city, 27/10/2004)

(Tamugiyama Branch of Higashii-Kawaguchi Nursery, Kawaguchi town, 07/12/2004)

A center for collection of relief material sent to the affected area

A disaster relief operation center at Nagaoka city hall

(Nagaoka city hall, Nagaoka city, 07/12/2004)

Life of the victims in the affected areas

Portable kitchen facilities prepared by Self Defense Force

(Kawaguchi, Kawaguchi town, 07/12/2004)

Tents prepared by Self Defense Force

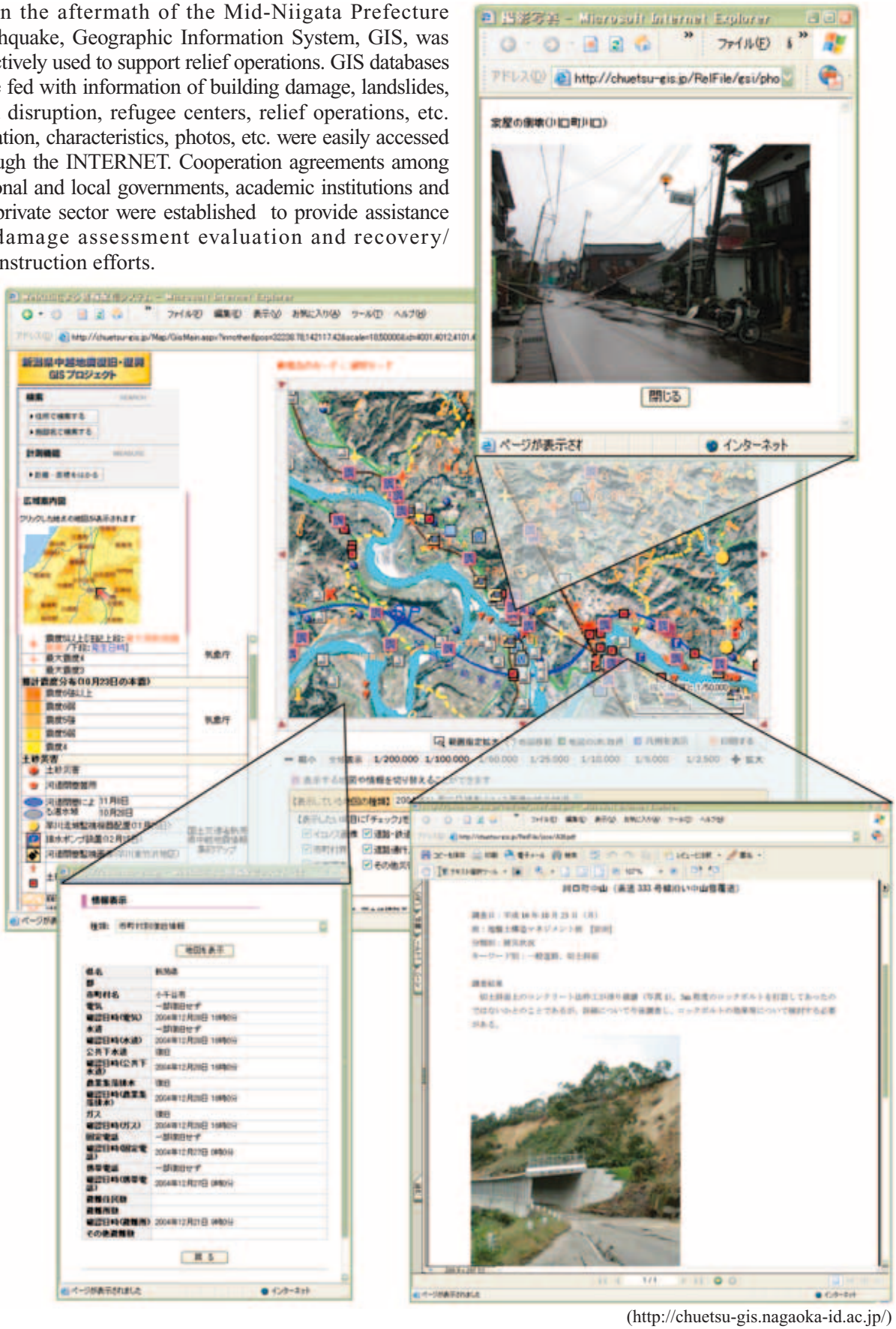
(Asahi-cho, Ojiya city, 07/12/2004)

Temporary housing for the people displaced by the earthquake was set up before the arrival of the winter season.

(Tamugiyama, Kawaguchi town, 07/12/2004/)

Geographic Information System greatly contributed for damage assessment, quick recovery and reconstruction activities

In the aftermath of the Mid-Niigata Prefecture Earthquake, Geographic Information System, GIS, was effectively used to support relief operations. GIS databases were fed with information of building damage, landslides, road disruption, refugee centers, relief operations, etc. Location, characteristics, photos, etc. were easily accessed through the INTERNET. Cooperation agreements among national and local governments, academic institutions and the private sector were established to provide assistance on damage assessment evaluation and recovery/ reconstruction efforts.



(http://chuetsu-gis.nagaoka-id.ac.jp/)

GIS database was quickly set to assist the relief operations.

Editor's Note

The 2004 Mid-Niigata Prefecture Earthquake was characterized by high seismic intensities and a large number of aftershocks. In spite of this, the observed structural damage was relatively minor. This is clearly showing us that structural strength is the key issue to reduce overall earthquake damage. Obviously, other issues, which have not been previously discussed, such as the economy class syndrome, were observed. However, if the structural damage would not have been so minor, these issues would have not been highlighted.

Because the stricken area was mountainous and huge number of landslides occurred, many areas and its residents were isolated. Under these circumstances, the use of helicopters proved to be essential. In the future, similar situations will be faced in mountainous areas and therefore we should device procedures to deal with them.

Another lesson learnt from this earthquake is related to how to perform recovery activities when a severe winter season is very close to the earthquake occurrence. In this case, there is a very short time period to perform reconstruction activities and furthermore, heavy snow loads acting on already damaged structures are enough to cause their collapse. In the case of the Mid-Niigata Prefecture Earthquake, all recovery/ reconstruction activities have been postponed until spring. Up to that time, how to maintain the remaining structures and how to prevent more damage needs to be addressed. Lifeline recovery, especially the water snow melting system, which is currently stopped, should also be given careful consideration for future events. As observed during the Kobe Earthquake, coordination among the entities in charge of repairing different lifelines was essential for an efficient and prompt service restoration.

Another point that needs to be addressed is the issue of house damage certificates. According to the current system in Japan, the authority in charge of emitting damage certificates is different from the one that provides the financial compensation to the house owner. The amount of the compensation is decided according to the damage certificate. Because two entities are involved in this process, it is difficult to conceal their approaches. This may eventually lead to an unrealistic large number of highly damaged structures, which are eligible for huge financial compensations. Because damage was limited during the Mid-Niigata Prefecture Earthquake, this problem did not cause a huge burden to the government. However, if a larger scale event strikes Japan, the financial compensation system may collapse.

The photos shown in this special issue were taken by members of ICUS unless otherwise stated. The institutions that kindly granted permission for using their materials are gratefully acknowledged.

Dr. Paola Mayorca, Post Doctoral fellow, and Mr. Shinya Kondo, Ph.D candidate of Meguro research group of ICUS contributed to the preparation of this special issue.

(K. Meguro)

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FROM 2001 - 2006

REGULAR ISSUES

ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering

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VOLUME 1 NUMBER 1
APRIL - JUNE 2001

TOWARDS SAFER URBAN CITIES IN THE 21ST CENTURY

By
Taketo UOMOTO

I take pleasure in greeting you on behalf of the International Center for Urban Safety Engineering (ICUS) created at the Institute of Industrial Science of the University of Tokyo in April, 2001 with the objective of carrying out research and disseminating information related to different aspects related to urban safety engineering and creating a safe urban environment in the 21st Century. The Center was created after the International Center for Disaster-Mitigation Engineering (INCEDE) completed its ten-year term, during which it served as a major driving force in international cooperation in areas related to disaster mitigation engineering, disaster preparedness, and field surveys, especially in the aftermath of floods and earthquakes.

There is an urgent need to develop a more responsive system for urban safety that comprehensively encompasses areas such as, evaluation of urban infrastructure, management of disasters such as earthquakes or floods, and effective utilization of available information for preparedness. Besides seeking cooperation from researchers from other countries, efforts are being made to involve the Japanese Government agencies, consultants and construction companies, and local bodies, in the research activities of the center.

The central objective of the International Center for Urban Safety Engineering (ICUS) is to develop new technologies for evaluation of safety and integrity of structures taking into account the deterioration of the materials used and changes in the required performance levels, in-service maintenance and management systems for structures to ensure the safety of urban infrastructure in the event of natural disasters such as earthquake, flood, etc., long term implications of urbanization, and use of techniques such as Remote Sensing in creating a safe urban environment.

Professor Taketo Uomoto
Director of ICUS/INCEDE

The following three groups have been created at the ICUS to promote research work in different related areas:

Sustainable Engineering Group for the development of new technologies for in-service maintenance and management systems for evaluation of structural safety, repair and rehabilitation measures.

Urban Safety and Disaster Mitigation Group for the development of management technologies to ensure the structural safety of urban infrastructure in the event of natural disasters such as earthquake, flood, etc., development and dissemination of information relating to prediction of disasters and their effects on social and economic activities.

Infrastructure Information Dynamics Group for the development and evaluation of technologies for monitoring information related to urban infrastructure. The group

will also work on applications of techniques such as Remote Sensing, Geographical Information System, Global Positioning System, Information network, space data analysis, etc. in urban safety.

Activities of the ICUS will be carried out using Grant-in-aid and other projects funded by the Departments of Education, Science and Technology, etc of the Government of Japan. Funding is also being sought from other sectors for specific projects. I would like to invite suggestions from you also and look forward to formulating joint research projects, which could then be processed for funding and execution. A workshop was held at Bangkok recently and an effort made to identify areas of common areas between researchers at ICUS and the Asian Institute of Technology and other Universities in Thailand.

This newsletter also gives a brief background of the faculty and staff of the center at present. In addition to their responsibilities to ensure a smooth working of the center, the faculty members are also engaged in normal academic activities, including teaching and research. I hope that more manpower will be available to be able to expand the activities of the center.

In order to better understand the needs of the society, and provide publicity to the activities of the Centre, it is proposed to hold national and international seminars, etc. and regularly update the website of the center, in addition to giving brief details in the Newsletter. I invite you to join our members' Network and participate in formulating new programmes.

Though there was a delay in getting this first newsletter off the ground, I hope to keep you informed of our activities through regular newsletters and updates on our website (*http://icus-incede.iis.u-tokyo.ac.jp*). The ICUS is fortunate to have inherited a strong international network of researchers and academicians in different parts of the world and I look forward to your cooperation in helping the center achieve its goals

Introducing the staff of ICUS/INCEDE

The staff at the International Center for Urban Safety Engineering at present comprises of two Professors, two Associate Professors and two Research Associates, besides supporting and administrative staff. There is also a provision to have three Visiting Professors and graduate students to work at the Center.

Dr. Sudhir Misra is currently a Visiting Professor at the Center from the Indian Institute of Technology, Kanpur, India.

ICUS/INCEDE staff members

Sitting from left: Ms. Chiharu Murakami, Ms. Noriko Shiuchi, Prof. Taketo Uomoto, Ms. Akiko Nagashima, Ms. Kaoru Iwata
Standing from left: Dr. Shirou Ochi, Prof. Kimiro Meguro, Prof. Ryozo Ooka, Dr. Vasanthadevi Aravinthan, Prof. Yoshifumi Yasuoka, Dr. Dushmanta Dutta, Prof. Sudhir Misra

1st ICUS/INCEDE Open Lecture

ICUS organized the first Open Lecture May 22, 2001 at the Institute of Industrial Science of the University of Tokyo as the continuation of the series of Open Lectures initiated by INCEDE 10 years ago. The main objective of the initiation of the Open Lecture has been to share the knowledge and information with general public directly. During the period of INCEDE, the major emphasis was to share the knowledge on natural disasters and understand what happens during and after hazards. With the intent of continuing this innovative method of sharing knowledge with people on issues of urban safety, ICUS organized the first open lecture.

The open lecture was inaugurated by Prof. Taketo Uomoto, Director of ICUS. In his introductory remarks, Prof. Uomoto outlined the objectives and briefly discussed the current and future activities of the Center. He was followed by Prof. Ken Sudo, former Director of INCEDE, who shared his vision of ICUS future from his vast experience of work in INCEDE and UN for IDNDR activities. Following these presentations Prof. Yoshifumi Yasuoka, Dr. Kimiro Meguro and Dr. Ryozo Ooka, who are involved in the activities of the three main groups of ICUS, spoke on their present and planned research activities. Over 140 persons attended the Open Lecture.

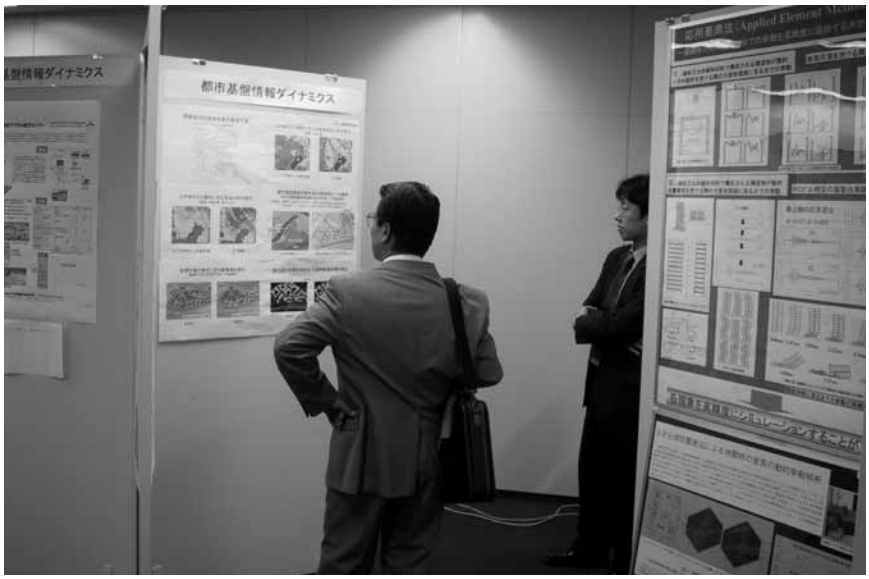
Prof. Uomoto, Director of ICUS welcomes the audience.

(by D. Dutta)

ICUS/INCEDE participated at the IIS Open House

Every year IIS organizes an Open House for two-day period in the first week of June. During these two-day period, all the laboratories and research centers of the institute display their activities to the visitors. On average about 5,000 people visit the institute for the Open House in two days, including people from various research organizations, industrial sectors, academic organizations from high school to university levels as well as Tokyo based international organizations. With great enthusiasm ICUS participated for the first time in the Open House of Institute of Industrial Science (IIS), the University of Tokyo during June 7-8, 2001.

ICUS divided its display booths in the Open House into four categories: general information; sustainable engineering; urban safety and disaster mitigation and infrastructure information dynamics. The center demonstrated to the visitors some of the on-going research activities of three divisions of the center as well as the future goals. ICUS members were encourged by the interests of many visitors in the activities of the center and by their invaluable comments in various aspects of its planned activities.



A graduate student explains ICUS activities to a visitor.

Editor's Note

Urban safety has attracted a lot of attention in the recent years. Major concern has been expressed for a proper evaluation of the capability of existing infrastructure, and enhancing it whenever required. There is also a need to study possible application of developments in other fields such as GIS, Remote Sensing, Material Science and Engineering, Earthquake Engineering, etc. in Urban Safety Engineering. There is an urgent need to develop a responsive system that understands the needs of the society and work towards creating a safe urban environment.

The International Center for Urban Safety Engineering (ICUS) has been created at the Institute of Industrial Science (IIS), University of Tokyo to serve as a nodal center for carrying out research and disseminating information in areas related to Urban Safety. This center, created after the International Centre for Disaster-Mitigation Engineering (INCEDE) had completed its ten-year term, has embarked on an ambitious programme to involve people from different walks of life in research related to different aspects of Urban Safety. For example, efforts are being made to involve people in financial and social sectors in research related to urban disaster and safety.

It has been decided that the center will endeavour to expand the activities of the INCEDE and seek active cooperation and support from the network members. The Newsletter that you are now reading is the first issue from the new center. While wishing you and your family the very best for the New Year, I take this opportunity to request you to actively participate in formulating future research activities of the center. You may send in your comments and suggestions by post or email. Of course, you are most welcome to drop in and meet us in person!!

With your cooperation, we hope to create a niche for the center in the emerging area of Urban-Safety Engineering.

(K. Meguro)

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The University of Tokyo

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Traditional Architecture in Saint Lucia and Seismic Responses

By

Anne L. D. French

Deputy National Disaster Coordinator, Saint Lucia

INTRODUCTION

Saint Lucia is an island country located in the southern section of an archipelago of volcanic islands, which comprise the Lesser Antilles. The island is about 500 km north of Venezuela and is 616 km^2 in size. A mountain range forms the backbone of this volcanic island with the highest point at Mt. Gimie (height =1040m).

The island is 30 km long and is made up of pliocene to recent basalts and andesitic basalts, which originate from largely unknown and strongly dissected centers. This means that the island is made up predominately of igneous rock. The other rock type to form the island is sedimentary. This type of rock shows distinct layering and can be folded or fractured by movement of the earth's crust. The stratification and layering of permeable and impermeable beds is frequently responsible for slope instability.

Over 43% land of the island has a gradient of more than 30^o. As a result, much of the island's structures are on stilts. This design feature is popular for its ability to provide additional storage on the underside or to allow for expansion at a later date.

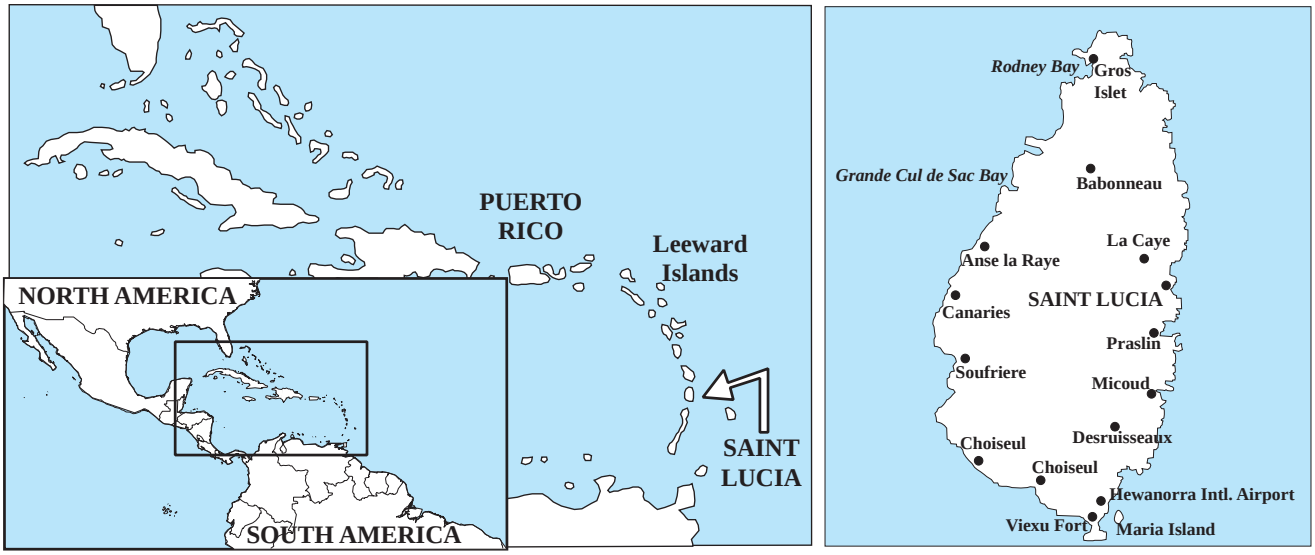
SEISMIC ACTIVITY IN SAINT LUCIA

The Caribbean plate runs through Guatemala in Central America to the east between Jamaica and Cuba, around Hispaniola and Puerto Rico in the Caribbean, joins the boundary east of the Caribbean islands and follows the archipelago. In the Southern Caribbean near Trinidad, the eastern boundary joins the southern boundaries along the pacific side of Central America.

Tectonic plate boundaries are not neatly cut lines of activity, but dispersed zones of movement. Of the three types of motion: 1) sliding past each other; 2) converging and 3) diverging where the plates move apart; the islands of the eastern Caribbean, are an example of plates that are sliding past each other.

The Caribbean plate is moving slowly eastward, in relation to the North and South American plates. These plates are made up of land (continental crust) and ocean (Atlantic Oceanic crust) masses. As the Atlantic Oceanic crust is denser than the Caribbean crust, the Caribbean along the eastern Caribbean chain of island is driving down the Atlantic. This movement gives rise to earthquake and volcanic activity. The primary cause of damage to buildings by earthquake results from the ground shaking which is generated by the movement of tectonic plates.

The historical records of Saint Lucia contain many references to tremors and earthquakes felt by the island as the written records coin-



Location Map of Saint Lucia

cided with the arrival of Europeans in the mid 1600s. Although, the instrumental records are less than 100 years old, and they carry strong evidence of seismic activities in the region.

Damage due to earthquakes is rather small in Saint Lucia when compared to other neighbouring islands. A quick examination of past events indicates that Saint Lucia's concern should be for the cumulative effects of frequent tremors. History shows that the island is not exempt from major earthquakes. A 7.0 magnitude earthquake had hit the island on February 16, 1901, another earthquake of magnitude 7.5 occurred on March 19, 1953. In recent period, between 1990 to 1995 the island has experienced continuous earthquake activity with the highest registering earthquake of magnitude 4.5 on May 19, 1990 (refer to the tables in the right side and next page).

VOLCANIC HAZARD RISK

The most active volcanic center on the island is the Qualibou Caldera, which is located in the Southwest. This Caldera was formed over 35, 000 years ago. There are several volcanic domes within the Caldera Region. The only site of historic activity is at the Sulphur Springs. All descriptions of this area indicate that salfataric and funarolic activity has continued at a fairly constant level through historic time.

The one-recorded incidence of great disaster was observed in 1789. It seemed to have been a small pheratic eruption. Because the last explosion of this volcano dates back over 20,000 years ago, it is considered less likely to erupt in the near future as in the case of volcanoes in Saint Vincent, Martinique and Guadeloupe.

Despite the lack of recent explosive activities, there is evidence of activity at shallow depths below the region. This gave rise to the occurrence of several earthquake activi-

Earthquakes of magnitude 3.5 and above occured between February 1990 and November 1995 in Saint Lucia

Year	Month and date	Magnitude
1990	February 5	4.0
1990	May 19	4.5
1990	May 23	3.6
1990	July 2	3.5
1990	July 25	3.5
1991	July 18	3.9
1991	November 27	3.5
1992	May 5	3.8
1992	September 20	3.6
1992	September 20	3.6
1992	November 1	3.5
1993	July 30	3.7
1993	September 23	3.7
1994	January 5	3.6
1995	March 5	3.7
1995	November 8	4.3
1995	November 25	3.8

ties through out the decades. The most recent one started in May 1990 and went on afterwards for about 14 months.

Several thousand people actually live within the Caldera and a few km away from the Soufriere Springs. The population of Soufriere at the 1990 census was 7683. The vulnerability factor therefore is high. The hazards posed by the volcano are all associated with its violent eruptions.

EXISTING HAZARD MONITORING SYSTEM

The Seismic Research Unit in Trinidad maintains four high sensitivity seismographic stations on the island. While *Le Observatoire Volcanoloqiue de la Montagne Pelee* in Martinique maintains one station. These are sufficient to detect initial abnormal conditions. By means of this system, the relevant authorities can be provided with advanced notice so as to evacuate threatened population.

TRADITIONAL ARCHITECTURE

The traditional architecture, though lacking in pretensions, are collectively a monument no less important to a once strong native building tradition which we have virtually lost. The architectural tradition of Saint Lucia and her sister islands come from many sources through a long period.

One of the main sources was Amerindian people. Amerindians were sea faring people. The modern fisherman's hut, canoe, fishing nets and baskets of Saint Lucia are all influenced by Amerindian culture. Their construction style made their houses cool, rainproof and flexible, which were the elements needed on an island that can experience constant earth tremors, sweltering heat and hurricanes. This construction style is referred to as "fuchette en terre" this is where a 'Y' shaped piece of wood was dug deep into the ground and the 'Y' end support the roof.

Next comes the influence of Europeans. The time frame of influence of the Europeans ranges approximately from 1600 to 1950. This covers about three hundred and fifty years of European architectural influence. Saint Lucia became more valuable as the years went by, mainly because of the magnificent natural deep-water harbor at Castries, which was and still is protected on three sides by hills. Today the areas surrounding Castries are dotted with nu-merous military buildings. These once impressive and imposing structures have been converted and absorbed into civilian life.

The main building material of historical structures in Saint Lucia were stone. They have withstood wars, fires, hurricane and earthquakes. However, the combined onslaught has begun to have an effect on the structures.

The earliest Churches on the island were usually built of timber with a thatch roof and stone paved floor, reminiscent of Amerindian construction. These Churches were damaged or destroyed by the devastating hurricane of 1780 except the Church at Dauphin, which was constructed of stone. The Churches were rebuilt using stone to resist hurricanes and the earth tremors. Despite this precaution, cracks occurred in many Churches due to tremors.

Not long after the Europeans settled themselves in the Caribbean, the slave trade began. The Africans were discouraged from bringing with them their languages, religions, music or anything remotely cultural. In reviewing the architectural aspect of the island's African heritage, it is a miracle that anything remotely African remained to influence society. At the time of emancipation, many of the slaves were not

Earthquakes of 1990 in Saint Lucia

Month and date	Magnitude
February 5	4.0
March 18	3.0
April 16	3.3
May 18	3.4
May 19	4.5
May 23	3.0
May 23	3.6
June 1	3.3
July 2	3.5
July 7	3.9
July 25	3.5
August 1	3.2
August 25	3.4
September 9	3.3
September 30	3.2
October 13	3.3
October 25	3.2
October 26	3.0
November 4	3.0

directly from Africa, but born and raised in Saint Lucia. In 1838, when slavery was finally and completely over, two-thirds of Saint Lucia was under virgin soil belonging to the crown. Land was readily available for the people for construction.

The hillside houses (known as Tapia) evolved and remains an identifiable feature in Saint Lucian society. These structures are made of timbers. Small saplings made the frame of the structure while mature trees were held in place by the dead weight of the structure, forming the foundation. The splitting of further trees provided the cladding. The floor, which is also of timber, is raised slightly off the ground to allow for ventilation of the beams and to avoid moisture penetration while accommodating the gradient of the island. The material of choice was timber not stone, as timbers were readily available. Without the proper tools, stone is a difficult material to manipulate, while timber is fairly malleable and can resist both hurricane and earthquake forces. As time moved on, hand cut saplings were replaced by machine cut lumber and piles of stones were replaced by concrete blocks or reinforced columns. Individual lots became hamlets and then communities. With each new building erected, the design of the structures became more sophisticated. Interestingly, timber remained the material of choice. The Tapia dwelling can be seen almost everywhere on the island, from Gros Islet in the north to Vieux Fort in the south, even in developed areas such as Castries.

With the advent of modernism, many buildings on the island are made of reinforced concrete with flat roofs and large glazing. The design of most of the office buildings in Saint Lucia are influenced by this modern style. Due to large destruction of hurricane Allen August 1980, the Saint Lucia had to be rebuilt in a short period. Due to the short period of constructions, many schools were constructed of pre-stressed concrete slabs. Most of these new buildings were ground floor structures, which are considered to be relatively safer during an earthquake. However, many of the new buildings in the city are of reinforced mass concrete erected on reclaimed land. These new buildings are very much vulnerable to earthquake and soil liquefaction.

PROBLEMS

The tendency to build on reclaimed land is increasing in Saint Lucia, although the trend is not yet rampant. Such land heightens ground movement e.g., the vibrations of heavy goods vehicle can be felt by the occupants of nearby structures. Therefore, the effects of an earthquake on structures placed on such soil are magnified many times over.

Destruction from earthquakes in Saint Lucia could be worse than it is at the moment given the lack of seismic design standards for virtually all construction. Added to this deficiency is the probability of major landslides being triggered by these quakes.

Another concern is design of structures in areas prone both to hurricane and earth tremors, with two kinds of movements. Hurricane forces move in a horizontal fashion while earthquake forces move in a vertical fashion. It is difficult to design a structure for both. Therefore, despite the inevitable earth movement, Saint Lucians have decided that the annual hurricane season, from June to November, is more of a threat. Despite statistics, which could prove otherwise, the reality of Saint Lucia's situation is that residents do not consider the island as " earthquake country" and therefore they design for the perceived threat from hurricanes and not from earthquakes.

RECOMMENDATIONS

A disaster upsets infrastructure and ecosystems and puts strain on the already limited resources of a developing State like Saint Lucia and her citizens. Such a situation can set dangerous precedents of dependency and underdevelopment. Sustainable development for a society like ours is not possible without addressing the damage done to development as the result of a disaster, particularly earthquakes in case of Saint Lucia.

How one responds to or during an earthquake is not something to be decided during the event. Preplanning or preparedness is the key. Mitigation against any disaster requires cooperation. As such, there should be cooperation between social, economic and political actions from local, regional and international governments. Also the communities and their corresponding groups can play an important role and so must be encouraged to take part in such actions.

Some approaches that can be taken to mitigate earthquake effects are:

Culture: The mitigation activities of a community must be acknowledged and incorporated into any action plan. Many people execute a tradition without knowing why. Traditional buildings have the ability to withstand both earthquake and hurricane forces. In addition to which it is cheap and easy to build and in many cases, this is the main concern of individuals. Mass concrete or concrete blocks replace many timber structures as these materials are perceived as stronger and are used as a measure of an individual's financial success.

Information: It must be ensured that the public is aware of alternate traditional construction practice, emergency plans, what they entail and what their role is in the plan. Attempts have been made to edu-

cate and inform the various publics on response actions to an event. One must ask though is it enough? Does the public know how to react during an earthquake? Creating the posters and flyers and distributing them may not necessarily mean that the message is being perceived or received. Sectors such as the media, construction industry, schools etc., must be sensitised. Is interest in an event only triggered by the event? In other words, will members of the population only be interested in earthquakes the next time a series of quake occurs?

Preparedness: It must be acknowledged that the successful management of a risk is dependent on the level of preparedness of the area to be affected. Many craftsmen are still available in the community and are willing to hand down the skills as they were handed down to them. This should be encouraged.

Cooperation between Sectors: Disaster Managers need to be incorporated into the planning process while Planners should be involved in disaster reduction in an effort to forge a closer working relationship for a more comprehensive and holistic approach to development.

Development Control: The examination of landslide prone areas should become a material consideration for developments. Environmental Impact Assessments (EIA) are already required for certain developments, however governmental EIA for state property would provide a representation of the risk factor of the area under consideration for development.

Landuse: Development of areas should be based upon hazard and mitigation plans. Development in high-risk areas should be firmly discouraged. Should such land need to be developed, it should be reserved for projects considered as least critical facilities.

Building Codes: In the absence of a national building code, a suitable code for interim use is the Caribbean Uniform Building Code (CUBiC). CUBiC places Saint Lucia in a Z factor of 0.75, which equates to a zone 2 and 3 of the USA Uniform Building Code (UBC). The level of activity is Saint Lucia is thus moderate but not to be ignored. A structure built using seismic building codes is expected to fare better then one that does not. One of CUBiC's many recommendations are that the buildings should be symmetrical. This is a feature common among the vernacular architecture of Saint Lucia and a practice that of late is being exercised less and less.

Government Control: Land with high landslide risk should be declared to potential investors. Such declarations would have resulting consequences in the banking and insurance sectors.

Insurance: Insurance should be relatedto the level of hazard under consideration and the mitigation steps being taken. The important issues such as proper consideration of building regulations in structure design are to be incorporated in insurance policy. Such policies will motivate people to adhere the strict building design codes in construction practice.

CONCLUSION

Saint Lucia has been blessed with infrequent fatal events of earthquakes. However, it experiences frequent tremors of low magnitude. The last earthquake of significance was in 1990 when the island experienced a quake of magnitude 4.5. It caused the collapse of a bridge. Due to long intervals between major earthquakes, developments spring up in areas which are vulnerable against major earthquakes. Awareness of citizens should be increased against such infrequent but catastrophic events. Design codes should be improved to consider such adverse affects. There are lessons to be learnt from the traditional construction practices and these lessons should be utilized in present day construction of the fast paced modern world.

From Editor's Desk: *This article was originally submitted to INCEDE Newsletter by Dr. French, Who is our network member. Due to unavoidable circumstances, it remained unpublished. We have decided to publish it in ICUS/INCEDE Newsletter.*

Second ICUS/INCEDE Open Lecture on January 24, 2002

On January 24, 2002, ICUS/INCEDE is going to organize an open lecture titled 'Towards the Safe Cities in 21st Century' by inviting some prominent Japanese researchers and decision makers as speakers. The main speakers in this event will be Dr. T. Katayama, Director General, National Research Institute for Earth Science and Disaster Prevention; Mr. T. Takahashi, Director for Disaster Management, Cabinet Office, Government of Japan (and Visiting Professor at ICUS/INCEDE) and Prof. S. Murai, Professor Emeritus, University of Tokyo. The speakers will focus on various aspects of urban risk management in their presentations.

The Lecture will be held from 13:00 - 17:30 at the Seminar Hall of the Institute of Industrial Science, University of Tokyo. This will be the second Open Lecture organized by ICUS/INCEDE. The series of Open Lectures are organized with the aim at building a forum for sharing knowledge and information between experts and general public. You are most welcome to participate in the second ICUS/INCEDE Open Lecture.

ICUS/INCEDE Workshop on Urban Safety Engineering in Thailand

ICUS/INCEDE organized a workshop on 'Urban Safety Engineering 2001' at the Asian Institute of Technology (AIT), Thailand during September 21-22, 2001. The workshop mainly focused on three areas: 1) the tools: Remote Sensing, GIS, GPS, etc., 2) the object of risk of urban structures, and 3) the management and mitigation policy of disaster. The major objectives of the workshop were: 1) promoting better understanding between the researchers from prominent research institutes in Thailand and ICUS/INCEDE in the areas of urban safety engineering and environment, and 2) identifying possible areas for future collaborative research. The future collaborative research works are expected to emphasize on: a) development of the inspection method and enhancement of durability of urban structures; b) preparation of synthetic hazard map and development of the real-time monitoring technology; and c) preparation of the effective disaster-prevention manual.

Prof. T. Uomto, ICUS/INCEDE Director, during his opening speech

The first day of the workshop was designed as plenary meeting with distinguished speakers from the University of Tokyo, AIT, Chulalongkorn and Thammasat Universities of Thailand. The workshop was kicked off with two opening speeches from Prof. Worsak Kanok-Nukulchai, Dean of School of Civil Engineering, AIT and Prof. Taketo Uomoto, Director of ICUS/INCEDE. It was followed by technical presentations. A total of 14 technical papers were presented by the researchers from Japan and Thailand. The workshop was attended by about 50 participants including the researchers and students from AIT. At the end of first day of the technical sessions, a technical visit was arranged for the participants to the laboratories of the School of Civil Engineering and Asian Center for Research on Remote Sensing (ACRoRS) for demonstration on the their research facilities and ongoing projects.

The second day was devoted for a close consultation on proposed activities of ICUS/INCEDE for collaboration with Researchers from Thailand, which hopefully can be extended to include a full international network in future. First, the participants introduced the research topics of their own interests and it was followed by a lengthy discussion to identify the most important research issues in urban safety engineering in Thailand where ICUS/INCEDE can participate as a collaborative organization and can support in transfer of knowledge and technology. The areas identified as the focal areas for future collaboration are grouped into three categories:

Participants pose for a group photo at the end of the workshop

1) improvement of sustainability of urban structures, 2) prediction, assessment and management of natural and artificial disasters, and 3) information technologies and systems for urban safety.

Finally, a resolution was made by the workshop participants where it was agreed that continued cooperation between researchers and practitioners in participated institutes be encouraged, and mechanisms for improved technology exchange and sharing be explored, and based on the results of this workshop, opportunities for collaborative research and information sharing should be further explored, and potential funding sources for such collaborative research should be identified and contacted within Japan and Thailand. The participants recognised the need to closely monitor the work identifying joint projects and share information. To this end, it was resolved that the next meeting of the research team may be held in 2002.

A report of the proceedings of the workshop is currently being prepared at ICUS/INCEDE. Those who are interested to receive a copy of the report may contact us.

(By D. Dutta)

International Events participated by ICUS/INCEDE Staff

Prof. T. Uotomo, Director of ICUS/INCEDE participated in two international conferences: 1) International Conference on Fibre Reinforced Plastic for Reinforced Concrete Structures (FRPRC-5) which was held in Cambridge during July 15-20, 2001, and 2) Second International Conference on Engineering Materials held in San Jose, California, USA during August 16-21, 2001.

Prof. Y. Yasuoka participated in the Eighth Asia-Pacific Regional Space Agency Forum held during July 23- 25, 2001 in Kuala Lumpur, Malaysia. In this forum, he chaired a session "Earth Observation - Integrated Monitoring System", and gave a special lecture "Integrated Monitoring System for Environment and Disaster Management with Earth Observation Satellite".

Dr. K. Meguro participated in the "Peru-Japan Joint Workshop on Earthquake and Tsunami Disaster Mitigation in the Asia and Pacific Region" held during July 19-20 in Lima, Peru and carried out site investigation of Atico earthquake.

Editor's Note

By the time this newsletter reaches you, we will step into the dawn of 2002. I would like to take this opportunity to express my best wishes to all the readers for a happy and prosperous new year.

With a decade long experience of INCEDE in disaster mitigation engineering, ICUS/INCEDE expands the center activities to urban safety issues. Together with the expanded research areas, we are continuing many of the activities initiated by INCEDE, one of those is the publication of this quarterly newsletter. We also continue the INCEDE networking with various members around the world. The main article of this newsletter was originally submitted for INCEDE newsletter by a network member. We hope to receive the contributions of the network members to this newsletter as before.

Many of us have the illusion that once the buildings and infrastructures are built, they will last long without any maintenance. In reality, urban structures are not safe and long lasting without proper maintenance. We have got the proofs in Japan through many recent incidents such as, falling of concrete in tunnels, etc. With the rapid urbanization, our cities are getting full of structures. We have to find out the ways to maintain the safety of our urban environment. ICUS/INCEDE carries out research on finding innovative methods for urban safety. Recently, we have organized a workshop on Urban Safety Engineering in Thailand. Through this workshop, we have identified many common areas of interest for future collaboration with the researchers from Thailand. We would like to work together to share our experiences with the research communities from other countries too. We encourage you to write your ideas to us. Let us work together for urban safety.

(D. Dutta)

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ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

VOLUME 1 NUMBER 3
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Earthquake Safety of Existing Dams for Irrigation and Water Supply in Rural Areas

By

Dr. Martin Wieland*

Up to now no incidents have been reported in the literature, where people have been killed due to the failure of a well-engineered dam during an earthquake. This is very encouraging, indeed. However, this favourable performance of dams does not necessarily mean that dams are inherently safe against earthquakes. For example, during the Bhuj earthquake of January 26, 2001 in Gujarat Province in India, about 200 earth dams were damaged and need repair and/or strengthening. Because the reservoir levels were extremely low during the time of the earthquake, no catastrophic release of water took place from the reservoirs of the severely damaged dams.

Despite the fact that these earth dams with a height of less than 30 m, which are often built by local communities, are different from the well-engineered dams for hydropower projects, we have to

Cracks along the crest and vertical settlement of the Suvi dam damaged during the January 26, 2001 Bhuj earthquake (Mw 7.7) in Gujarat, India (courtesy: JSCE, Japan)

recognize that plenty of similar dams exist all over the world. The water stored behind these earth dams is mainly for irrigation and water supply.

Moreover, there are very few large dams, which have been exposed to ground motions that may be expected during the maximum credible earthquake (MCE), an event which a dam must be able to resist successfully according to the current International Commission on Large Dams (ICOLD) guidelines prepared by the Committee on Seismic Aspects of Dam Design (CSADD), which is chaired by the author of this paper.

The Bhuj earthquake has also shown that in countries with inadequate earthquake preparedness, strong earthquakes can cause large number of casualties and huge economic losses. The problem is the largely unknown and often insufficient earthquake safety of the existing buildings and infrastructure projects as earthquake actions may not have been taken into account properly in the design. Earthquake regulations exist in most countries. If they are followed properly, they apply to new structures only and the earthquake safety of the many old structures is essentially ignored. Unfortunately, the same applies to the existing irrigation dams in most parts of the world. Although it may be known that these relatively small dams do not comply with today's rigorous design criteria, the owners and dam safety authorities are still reluctant to look into the safety of these dams as long as no catastrophic incident has occurred.

In the subsequent part, the reasons and justification for a program of earthquake safety evaluation and seismic upgrading of existing irrigation dams are given, which we hope, will encourage the dam owners and dam safety agencies to address this issue.

If we ignore the call for increased safety of the existing infrastructure projects with large damage potential - dams belong to this category of projects - the many groups, who are already opposing new dams, will use the earthquake safety as one of their arguments. This is already true for quite a number of large dam projects.

Background

The majority of the older dams were built using methods of seismic analysis and seismic design criteria, which, today, are considered as obsolete or outdated. Therefore, in many cases, it is not known if an old dam complies with the current seismic safety guidelines published by ICOLD (1989). Therefore, at the Annual ICOLD Meeting in Antalya, Turkey in September 1999, CSADD was given the task to address the issue of the earthquake safety of existing dams. This is also one of the subjects, which will be discussed during the forthcoming ICOLD Congress in Montreal, Canada in 2003.

According to the current ICOLD guidelines, large dams have to be able to withstand the effects of the so-called MCE. This is the strongest ground motion that could occur at a dam site. In practice, the MCE is considered to have a return period of several thousand years (typically 10,000 years in countries of moderate to low seismicity).

Because of the very long return period of destructive earthquakes in many parts of the world and because relatively few dams have been severely damaged by strong earthquakes, it is rather difficult to convince the dam owners and decision makers of the benefits of a seismic reassessment and upgrading of deficient dams.

Risk analyses, carried out for several dams in industrialized countries, have shown that the failure of a large dam and the resulting flood wave may cause a large number of casualties and huge economic and environmental damages exceeding billions of US$. Earthquakes may cause failure of dams, with inherent weaknesses. These weaknesses are often not known. But the statistics on dam incidents show that quite a number of deficient dams fail during the first few years after construction.

During the last decades, significant progress in the assessment of the seismic hazard at a dam site and the dynamic analysis of dams has been achieved. The trend goes towards higher intensities of the earthquake ground motion at dam sites, which is usually characterized by the peak ground acceleration (PGA). To illustrate this problem: most dams were designed against earthquakes using a so-called pseudo-static approach and a PGA of 0.1 g (g: acceleration due to gravity). An MCE with a magnitude of larger than 6 can generate (locally) a PGA of more than 0.5 g, i.e. a value, which is five times larger than the design value. Because of this large discrepancy between the design acceleration and the PGA values to be expected during the MCE, it is often not possible to make a reliable statement about the earthquake safety of an existing dam.

The main conclusion that can be made is that the earthquake safety of most existing dams is unknown and some may even be unsafe. If a dam should turn to be unsafe, then the easiest way to comply with safety standards would be to lower the reservoir level or decommission a dam. Because there are very few viable alternatives to dams in many developing countries, decommissioning of dams or lowering the reservoir level would be the last resort.

Based on our experience with the seismic safety evaluation of dams in countries of high and moderate seismicity like Iran and Switzerland respectively, we can state that well-designed dams will also satisfy to-

day's seismic safety criteria. We feel that it would be appropriate to address this important subject and take adequate action as structural safety stands in the first place of any dam project, i.e. way ahead of economic, environmental, ecological and socio-political concerns. This fact may have been overlooked in the recent debate on benefits and concerns of dams.

It is also in the interest of the dam community to have a clean record, as the failure of a single large dam may increase opposition against any new dam projects worldwide.

Proposed plan for action

Investments in the seismic safety of dams generally receive low priority as there is no visible immediate return on the investment. This has been a problem with all projects related to natural disasters with a very low probability of occurrence.

These investments into the future do seldom reap benefits for those, who have taken the decisions, as the horizon of politicians may be a few years and that of managers is often even much shorter. A long-term view in such programs is a prerequisite for sustainable safety improvements of the existing dams.

As there is a steadily increasing demand for water, flood protection and clean energy, safe operation and dam safety are prerequisites. Unfortunately, seismic safety of dams (and other infrastructure projects) has been an area, which has been neglected despite the fact that the decade 1990 to 2000 was declared by the UN as the International Decade for Natural Disaster Reduction, in which earthquake hazard played an important role. Earthquake safety of a dam is a must, as it seems that strong earthquakes cannot be predicted in the near future. By means of water alarm systems for critical dams, a large number of people could be saved from a flood wave but economic and environmental losses cannot be avoided in the case of a dam breach.

Shi-Kang water supply weir damaged during the Chi-Chi earthquake (Mw 7.5) of September 21, 1999 in Taiwan (courtesy: K. Meguro)

The main benefits of a seismic safety evaluation program for large dams are as follows:

i) Compliance with current safety requirements: all parties responsible for the safety of a dam can be ensured about its safety during very strong earthquakes (legal protection of owners against claims of negligence).
ii) Socio-economic and political acceptance of dam: the safety of the people living in the downstream area of the dam and their property can be guaranteed.
iii) Sustainable economic benefits: the dam and the reservoir can be used as initially planned.

Awareness is the first step towards improved earthquake safety. Seminars would be a cost-effective means to raise awareness in this problem and a first step towards a comprehensive program for the seismic upgrading of existing dams. Such a program has, for example, already been implemented successfully in California in the 1990s. During these seminars, the optimum methods for the reduction of the seismic risk posed by deficient dams could be discussed as well.

As the first step, this issue shall be put on the agenda of dam safety agencies and dam owners. Next, seismic re-evaluations of the older dams, especially those located in seismically active regions shall be performed and finally measures shall be taken to improve the safety of any deficient dams.

Finally, we have to realize that we have not yet solved all seismic problems completely. Every time there is another strong earthquake, we have to improve the earthquake standards and guidelines.

** Chairman, Committee on Seismic Aspects of Dam Design, ICOLD, Tel: (+41-76) 356 28 62; E-mail: martin.wieland@ewe.ch and ICUS Network Member*

From Editor's Desk

Half a year has past since the starting of ICUS/INCEDE. With the time, the center is expanding its activities to cover broad aspects of urban safety engineering. We are pleased to see that our network is expanding as well, which gives us a broad platform to share our views and outcomes with the members around the world. In this newsletter, we include the articles on our expanded activities regularly along with the research outcomes. We welcome the articles on various activities of network members on urban safety in this newsletter so that other members can share your views. Please feel free to send us your articles on your activities, your achievements anytime by e-mail or mail. We shall put effort to include it in newsletter in time. Let us share our activities among our network members for our common goal.

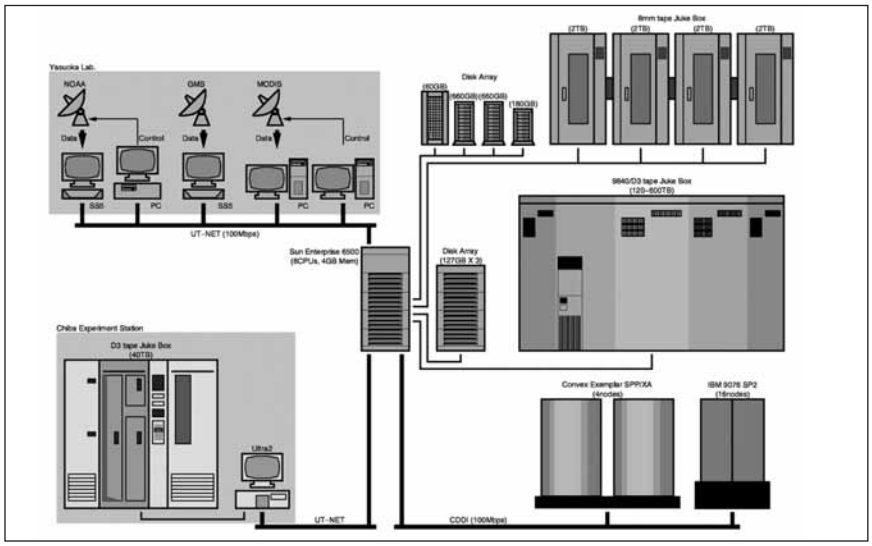
Analyzing "Heat Island" from Space

By
Yoshifumi Yasuoka

Prof. Yoshifumi Yasuoka, a professor at the Division of Information Dynamics of ICUS/INCEDE, has the research specialization in the field of remote sensing. As a part of the research of his team, a MODIS receiving station was installed at IIS last year. In this article, Prof. Yasuoka introduces the expanded research activities of his team on heat island phenomenon using data from MODIS receiving station.

In December 18, 1999, NASA launched the Terra satellite, which is the first Earth Observing System (EOS) platform and provides global data on the state of the atmosphere, land, and oceans, as well as their interactions with solar radiation and with one another. MODIS (Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra (EOS AM) and Aqua (EOS PM) satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands, or groups of wavelengths.

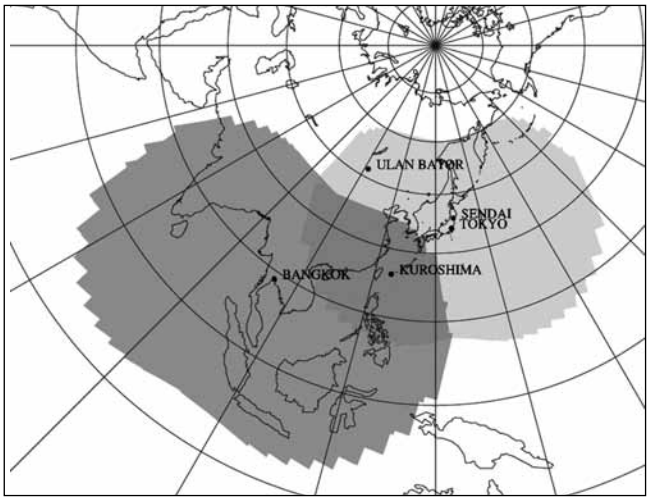
To monitor the environment and disaster parameters around the East Asia as a part of our research, two MODIS receiving stations were installed by our research team, one at the Institute of Industrial Science (IIS) of the University of Tokyo and another at the Asian Institute of Technology (AIT), Thailand, from which we started receiving data since May, 2001. In addition to our existing satellite receiving systems of NOAA HRPT and GMS S-VISSR, a new X-band satellite reception facility was installed in IIS, University of Tokyo, which has been initially used to collect data from MODIS. The dish has been placed on the roof of the 8-storey IIS building. In order to acquire Terra data for expanded continental-scale change researches into the Southeast Asian sub-region, the IIS has provided Asian Center for Research on Remote Sensing (ACRoRS), AIT one identical MODIS receiving facility. That station is managed by the Joint Management Committee composing of ACRoRS, Geo-Informatics and Space Technology Development Agency (Thailand) and IIS. The MODIS raw data from AIT receiving facility is transferred to the IIS archiving system as well through Internet in real time.



The Tape Archiving System for Satellite Data at IIS

MODIS has 3 different modes of spatial resolutions - 250m, 500m and 1000m - with 36 spectral bands

MODIS receiving antenna on the roof of IIS

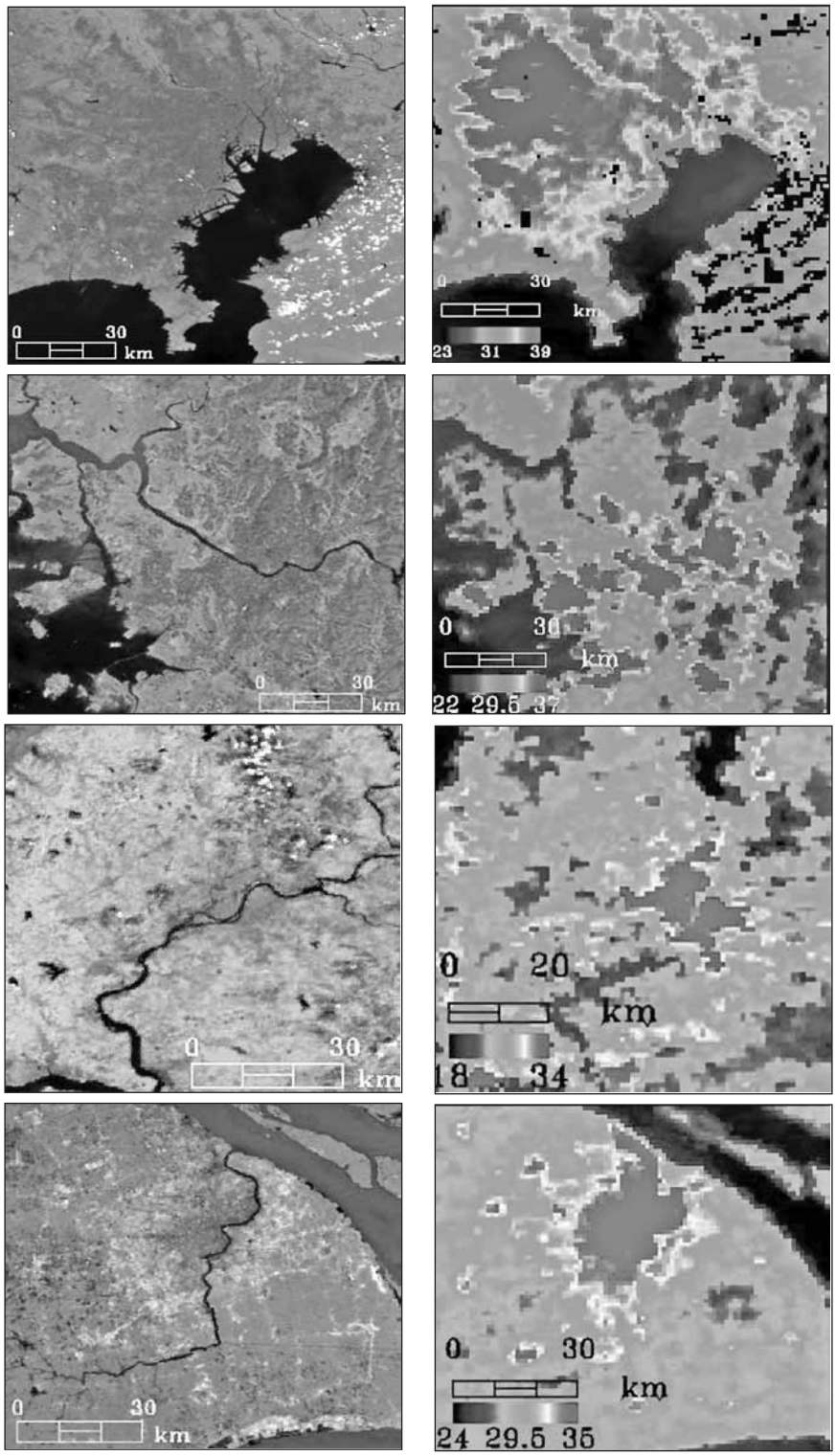


Satellite coverage by IIS and AIT receiving stations

in total. The IIS Station covers the east part of Asia including the east Siberia, and the AIT Station covers the southeast Asia including India, a part of Pakistan and Tibet Plateau. At present, our research group is preparing satellite data products relating to the global and regional environmental studies.

As a part of our research activities using the MODIS data, we have carried out a research project to monitor "Heat Island" by analyzing the land use/land cover characterization and heat parameters around cities. For conducting the research study, we have selected five cities in the East Asia region, those are: Tokyo (Japan), Seoul (South Korea), Pyongyang (North Korea), Beijing and Shanghai (China), which are within the range of IIS receiving station coverage.

In the study, the land cover characterization and the "Heat Island" intensity are analyzed by comparing the images of summer versus winter, and day versus night time for the cities. The first step of the study is to make the land cover classification of the areas using 250m resolution optical images. Build up, forest, grass, water body and bare soil are classified in order to give the emissivities of the land cover categories. The emissivity is then used to estimate the land surface temperature from the brightness temperature value in the thermal band image with 500m resolution data. Finally the "Heat Island" impact is analyzed. The land surface temperature is of course influenced by the geographic condition such as the climate and whether at the time of the area. In order to compare the "Heat Island" impact among the cities, the standardized surface temperature images are prepared by equalizing the temperature values of forested region in suburbs where the "Heat Island" effect is supposed to be unrelated. As the intermediate report, the study concludes that



MODIS 250m optical and 500m thermal images covering Tokyo, Seoul, Pyongyang and Shanghai (from top)

the intensive of the heat island impact is ordered by Tokyo, Seoul, Pyongyang, Beijing and Shanghai.

Continuous observation will be made for more quantitative analysis using more stable satellite information which avoid the temporal error such as whether condition and sensor anomalies. Our group expect that the study can define the vegetation function to the "Heat Island". Furthermore, some more cities from South East Asia such as Bangkok, Hanoi, Ho Chi Minh City, Jakarta, Kuala Lumpur, Singapore, covered by AIT broadcasting station will be added for the study.

For further information on this particular research topic or on any of our research activities, the author can be contacted by e-mail at yyauoka@iis.u-tokyo.ac.jp.

Bridging between Policy and Research

By
Takefumi Takahashi

ICUS welcomes Mr. Takefumi Takahashi, the Director General for Disaster Management at the Cabinet Office of the Government of Japan, as a Visiting Professor to the Urban Safety and Disaster Mitigation Division. In this article, Prof. Takahashi introduces his new activities at ICUS.

I have been serving as a Visiting Professor in the Urban Safety and Disaster Mitigation Division of the International Center for Urban Safety Engineering since 1st December, 2001. In my official capacity as the Director General for Disaster Management of the Cabinet Office, I am responsible for coordinating disaster-related administrative activities in the national government of Japan.

As you may know, Japan is very susceptible to natural hazards because of its geographic location, topography, climate and other conditions. Thus, it is subject to frequent earthquakes, volcanic eruptions, floods, typhoons, etc. Furthermore, 50% of population and 75% of the property are accumulated on alluvium plains which cover 10% of the countryís total area and are at a very high risk of suffering floods. Due to such land use patterns, Japan is very vulnerable to natural disasters. Although we can not avoid such natural hazards, we should have countermeasures in place in order to mitigate potential damages.

Two years ago, Mt. Usu in Hokkaido and Mt. Oyama in the Miyake Island near Tokyo erupted. They brought economic losses, but no one was killed or injured. The absence of human casualties can be attributed to the coordinated efforts made by researchers, administrative organizations and citizens. In particular, three factors are worth mentioning. First, an accurate prediction prepared by continuous observation made a great contribution. Second, an effective network among research organizations and national and local governments enabled proper information dissemination and timely evacuation orders. Third, a good response on the part of local residents facilitated swift evacuation. With these three factors in a good combination, the whole system proved to be functional and negative impacts were minimized.

It would be possible to further reduce negative impacts caused by natural hazards if we prepare proper countermeasures based on a good understanding of potential disaster risks. Towards this goal, many hazard maps for earthquakes, volcanoes, floods, geo-hazards, etc. have been developed in recent years. They have been disseminated to citizens and related organizations who understand their importance.

Prof. T. Takahashi

I would like to investigate how to disseminate disaster-related information, such as observated information and research outcomes, so as to implement effective disaster countermeasures. I would also like to examine how to prepare proper disaster manual to be distributed among administrative offices, representative persons and citizens. Being in charge of disaster management, I will do my utmost to improve coordination between the research organizations and administration.

I would like to have many opportunities to exchange ideas. Therefore, it is my strong wish that everyone works together for disaster management in Japan as well as other countries.

ICUS ACTIVITY RECORDS

* *Prof. Y. Yasuoka attended the 22nd Asian Conference on Remote Sensing held in Singapore from November 5-9, 2001.*
* *Prof. T. Takahashi joined ICUS as Visiting Professor on December 1, 2001.*
* *Profs. T. Uomoto and S. Misra attended the International Commission on Concrete Model Code for Asia (ICCMC) held in Kuala Lumpur, Malaysia during December 3-4, 2001.*
* *Dr. S. Ochi attended the 1st Asian Eco-Seminar held in Kathmandu, Nepal from December 3-5 , 2001.*
* *Dr. D. Dutta attended International Hydrological Programme (IHP-5) regional meeting at Hanoi during November 18-20, 2001. After the meeting, he carried out a field survey in the lower Mekong basin together with his colleagues from IIS.*
* *ICUS held the Civil Engineering Seminar on Urban Safety at the Komaba Campus of IIS on 11 December, 2001.*

ICUS held Civil Engineering Seminar on Urban Safety

The 8th Civil Engineering Seminar, organized by the Comprehensive Research Foundation and the School of Civil Engineering of the University of Tokyo, was held on December 11, 2001 at IIS with about 60 audiences. The theme of the seminar was "Urban Safety Engineering" and the speakers were the five faculty members of ICUS, who presented on the following themes.

Prof. Y. Yasuoka presented a lecture on "The Assessment of Safety and Amenity of Urban Infrastructure using Information Technology" in which he explained that Remote Sensing technology and Image Processing can be a powerful tool to describe the quality of the urban environments.

Assoc. Prof. R. Ooka presented on "Urban Climate Simulation Model for Urban Planning" in which the mechanism of Hear Island phenomenon was explained and a simulation model for urban climate analysis was introduced.

Prof. Uomoto, ICUS Director, presenting his views on urban safety

Assoc. Prof. K. Meguro presented on "Towards Tokai Earthquake -Balancing Structural and Non-structural Measures for Minimizing Earthquake Damage" in which he stressed the importance to retrofit existing weaker houses and to have proper disaster manuals for implementing good countermeasures.

Prof. T. Takahashi presented on "National Policy and Countermeasures of Japan for Urban Safety and Disaster Reduction" in which the strategic idea of Government of Japan was introduced.

Prof. T. Uomoto presented on "Current Status and Future of Non-destructive Inspections for Concrete Structures" in which several advanced technologies to assess the safety of the concrete structures were introduced.

Further details of this seminar are available at the home page of ICUS.

(By Ochi)

International Symposium on Geoinformatics in September 2002

An International Symposium on Geoinformatics for Spatial Infrastructure Development in Earth and Allied Sciences (GISIDEAS' 2002) is going to be held in Hanoi, Vietnam during September 25-28, 2002. It is organized by the Japan-Vietnam Geoinformatics Consortium.

The Symposium will focus on integration of Information Technology tools for the development of spatial databases and the utilization of spatial data for mathematical modeling and computer simulation of processes related to our natural and social environment. It aims not only to serve as a forum for scientific exchanges but also as a conduit for technology transfer through short courses that will be organized within the framework of the symposium. In order to promote a better understanding of specific needs, field excursions and visits are also being planned.

The further details of the Symposium information are available in web site http://gisws. media.osaka-cu.ac.jp/gisideas, which provides on-line registration facilities for participating in the Symposium.

Visitors to ICUS

During the period of October-December, 2001, ICUS received the following visitors.

- *Mr. Raffaele Raja, Regione Lambardia Unita Organizzativa Protezione Civile, Italy (Oct. 24).*
- *Mr. Jia Kunji, Chinese Embassy, Tokyo, Japan (Nov. 15).*
- *Dr. Bui Ta Long, Director of Institute of Applied Mechanics, Vietnam (Nov. 19).*
- *Dr. Jorge F. Meneses-Loja, Assistant Scientist, University of California, San Diego, USA (Nov. 21).*
- *Prof. Tso-Chin Pan, Director of the Protective Technology Research Centre, Nanyang Technological University, Singapore (Nov. 27).*

Four students from ICUS won the prize at JSCE conference

This year, the annual conference of Japan Society of Civil Engineers (JSCE) was held at the Kumamoto University, Kyushu during October 2-4, 2001. In the conference, about 4,000 technical papers were presented in seven sessions and over 7,000 research engineers and university students participated. From ICUS/INCEDE, the faculty members and students attended the conference and made their presentations. Our center's research outcomes got good impression from the participants as the result of that four students listed below won the prize of best presentation by young researcher. Comparing the average ratio of the prize winners with that of our center, our center's winner ratio was very high. It showed the high quality of ICUS/INCEDE's researches and high performance of the center.

Names of the winners are: Ms. Ema Tsukahara (supervised by Prof. Uomoto), Mr. Ms. Misaki Enomoto, Mr. Muneyoshi Numada and Mr. Suguru Fujita (supervised by Prof. Meguro).

Editor's Note

Not only researchers for urban safety, but also the most citizens are conscious of comprehensive safety of our society and its functions, after the September 11 terrorist attacks in New York, USA. The affair awoke us that it is actually impossible to go on without risks in this complex and international society. We, Japanese also remember our experience of the sarin gas attack on Tokyo subway system in 1995.

ICUS does not directly target on the researches for the counter-terrorism at this moment, however, it aims to develop systems to prevent social emergency and the countermeasures for them from engineering aspects. ICUS has timely welcomed Prof. Takefumi Takahashi as an expert of disaster politics from the Cabinet Office of the Governmentent of Japan on December 1, 2001. By his joining to ICUS, we expect ICUS can contribute more effectively to the strategy preparation of domestic as well as international disaster policies lead by the Japanese Government.

(S. Ochi)

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ICUS/INCEDE NEWSLETTER

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Institute of Industrial Science
The University of Tokyo

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Maintenance of Concrete Infrastructure - A New Challenge for Civil Engineers -

by

Taketo Uomoto and Sudhir Misra

Civil Engineers have been traditionally involved in design and construction of infrastructure - road networks, buildings, bridges, industries, or any other structure. Even as engineers have endeavored to develop innovative design methods, materials and construction techniques, a lot more needs to be done. Shown below are clippings from the local press expressing alarm at some of the deterioration observed in concrete structures. Also shown is a now well-known collapse of a section of the Hanshin expressway, after the Kobe earthquake of January 26, 1995. Such failures of engineered structures and the public outcry associated with that, only highlight the effort that still needs to be put in to create a safe environment.

Now, creating a safe urban environment needs,

- a better understanding of the forces of nature,
- building the structures in a manner that their performance remains satisfactory during the service life, and,
- methods to evaluate and strengthen existing structures in terms of their ability to withstand loads. Initiation of appropriate maintenance action is a necessary corollary to this.

Traditionally, a civil engineer is trained to deal with forces of nature in terms of structural loads and adopt appropriate tools for design and construction. A new dimension

Warning of safety problems of concrete structures in Japan (left) and failure of Hanshin Expressway due to Kobe Earthquake of 1995

- nondestructive testing and evaluation of existing structures, initiating appropriate maintenance action, understanding environmental conditions in terms of 'loads', and trying to better understand the performance of structures over the period of time, is being added to the responsibilities of a civil engineer.

Efforts are being made all over the world to train civil engineers for the new role, and given Japan's vulnerability to earthquakes,typhoons, etc. the issue has been taken up on war footing here. This article briefly discusses some of the actions being taken, citing examples in the area of concrete structures.

Developments in concrete engineering

Though concrete has been used in the last 50 years in various structures - bridges, tunnels, nuclear power plants, dams, roads, and of course buildings, better construction materials and techniques along with an improved understanding of its mechanical behavior, has only widened its applications as a construction material.

Use of *fibre-reinforced plastic materials*, as a possible replacement for steel reinforcement in cases where corrosion could not be allowed, or in external prestressing especially in the case of repair of deteriorated structures, is an example of use of alternative construction materials for specialized use. There have also been advances in the use of concrete reinforced with short discrete fibres when cracking in concrete needs to be controlled and to improve the post-cracking load-carrying capacity of concrete. Airport runways and tunnel linings are examples where *fibre-reinforced concrete* has been often successfully used.

High performance self-consolidating concrete is another development that has contributed to improve the quality of concrete construction, especially in areas where it would otherwise be extremely difficult to ensure adequate vibration and consolidation of concrete. Though use of such concretes is still less than 5%, it is increasing rapidly. The figure above shows an example of shotcreting using automated equipment, and utilization of FRP rods in conjunction with conventional reinforcement in a parking lot (where presence of steel reinforcement hampers the working of operating equipments).

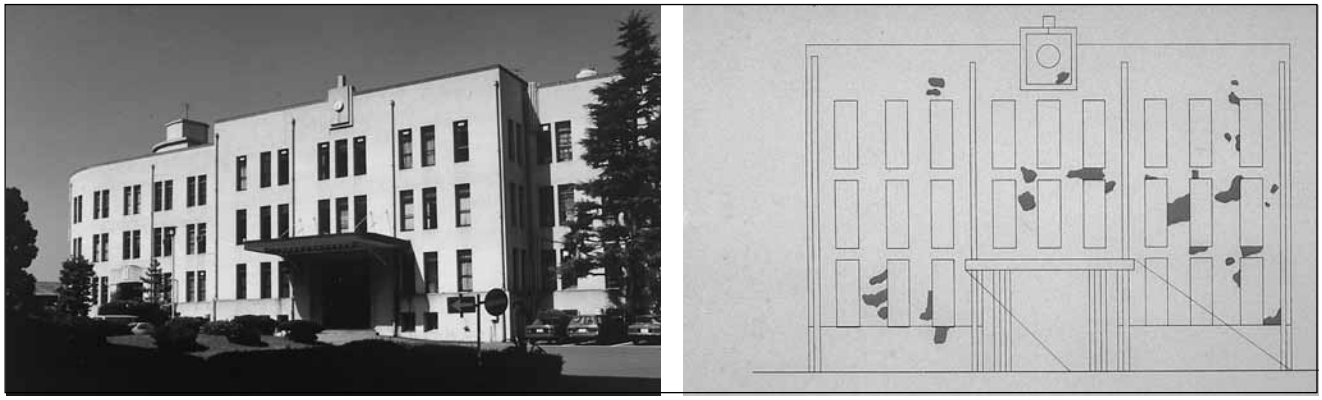
Shotcreting using automated equipment

Use of FRP rods along with conventional steel reinforcement

Development in nondestructive testing and evaluation methods

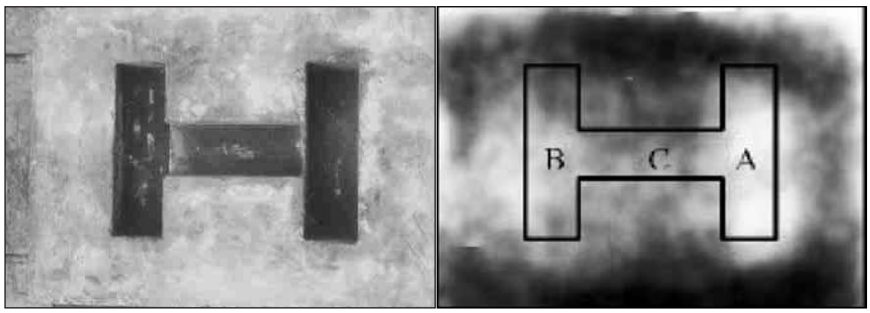
The construction of structures at any time reflects the state-of-art in design and construction at that time, and the construction during the 50s and 60s in Japan is no exception. These structures were built with only limited knowledge of the effect of different environmental conditions. Viewed in that light, it is not surprising that a lot of these structures have begun to show signs of deterioration. Efforts are being made to develop new techniques for an accurate assessment of the levels of deterioration, so that corrective steps, as may be required, can be initiated.

Given that concrete structures are often quite large, it is important to narrow down smaller areas, which could be used for 'representative' testing. Use of *infrared theremography* is emerging as a valuable tool in this area. An example of a photographic and thermographic images of a building is shown below. The presence of air pockets under the



Application of infrared thermography in non-destructive testing and evaluation of buildings

surface causes a difference in the heat absorption and conductivity characteristics of the concrete leading to a difference in the surface temperatures in portions with voids and delaminations, which is captured in a thermographic image. The technique can also be used to indentify areas that may have voids behind an apparently smooth concrete surface. The two figures in righthand side show examples where infrared theremography has been used to 'look' at an H-shaped void in a 150 mm thick concrete block. It may also be pointed out that in this study, the depth of the void (in the regions A, B and C, the thickness of the concrete behind the smooth surface), is varying, and that is also reflected in the varying 'clarity' with which the void is mapped.



Use of infrared thermography to detect voids hidden bihind smooth concrete surfaces

Development of repair and rehabilitation methods

Minor repair and maintenance action are often undertaken locally and with locally available materials and expertise. However, in addition to such minor actions, formal rehabilitation works are needed when it is desired to extend the service life or upgrade the performance level of the structure, or at the time of change in the (design) loading for the structure, or during post-event (e.g. earthquake) rehabilitation. In such cases, it is important that the following are carefully examined:

- extent of removal of concrete required (all loose concrete, or that contaminated with chlorides, etc., should be removed)
- need to provide additional reinforcement
- properties of the material to be used and method of repair
- compatibility of the repair material with the parent concrete
- behaviour of the repaired (composite) structural member under the action of loads

In the last about 15-20 years, several method have been developed largely on a 'trial and error' basis. From among those documented in literature, the following methods have perhaps been more commonly used:

- reinforcement with a steel plate
- reinforcement with continuous fibre-reinforced plastic sheets
- application of (cementitious or epoxy based) repair mortar or concrete by shotcreting
- jacketing the affected members or increasing the cross-section

The figures below show examples of using external prestressing cables as a means for strengthening beams in a bridge deck and an example of using flexible sheets made of continuous fibres woven in two directions around columns in several layers and applying binder material in much the same manner as making a rigid cast in the case of a plaster used by doctors during the period of allowing broken bones to repair!!

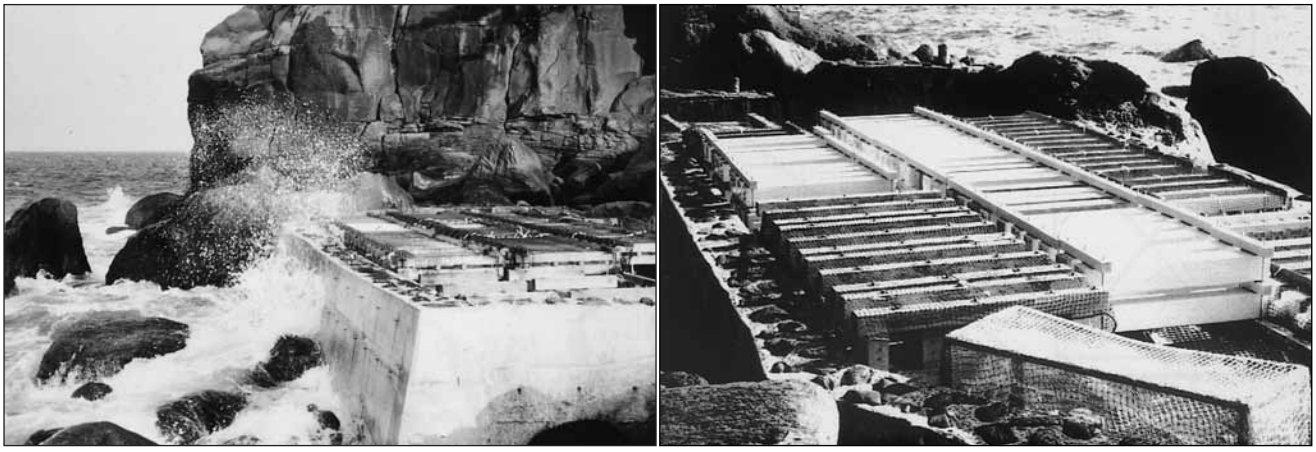
An extensive repair material evaluation programme involving more than 15 companies is presently in progress. The figure on the next page is a view of the exposure site where specimens prepared under varying conditions and using different materials are being tested to test the durability of repair materials.

Steps by professional bodies

The Japan Society of Civil Engineers and the Japan Concrete Institute are among the several professional bodies in Japan, that have taken steps in the recent past in response to the new responsibilities that civil engineers are being asked to shoulder - whether they work for construction companies, government and semi-government organization, or consulting organizations. Several publications brought out in the last ten years dealing with testing and use of new materials and techniques. This shows the importance being placed on development of specifications and standardization of use of new materials and methods.

Using external prestressing for strengthening structures

Jacketing of columns with continuous fibre sheets for strengthing structures



Two photographs of the Izu exposure site showing a bird's eye view and the specimens in place

Design of new structures

In the Standard Specification for Design and Construction of Concrete Structures (JSCE) presently in force, a performance based durability design approach has been adopted. Most standards in the world lay down limits for parameters, such as, the maximum flexural crack width, grade of concrete used and cover to the reinforcement, which are known to play a part in the susceptibility of a structure to future deterioration. However, the new approach suggested in the Japanese standards provides a framework to model deterioration processes in a manner that during the service life of the structure, a predetermined level of deterioration is not exceeded.

In other words, as recognition of the fact that concrete structures are not maintenance free, a certain amount of deterioration has been 'allowed'. Now, on the basis of quantitatively defined parameters, a certain critical level of (acceptable) deterioration has been fixed (A_{lim}). Thus, the designer is required to check that the extent of likely deterioration during the service life of the structure, A_d, (called 'designed deterioration', because, that is the amount or extent of deterioration, estimated to occur over the sevice-life at the time of design) does not exceed this critical level. Further, the extent of difference between the designed deterioration and the critical deterioration needs to be related to level of importance of the structure. In other words, it should be ensured that,

$$\gamma_i \frac{A_d}{A_{lim}} < \mathbf{1.0}$$

where, γ_i is a coefficient representing the importance of the structure. It may be taken to be 1.0 in most cases, but may be increased to 1.1 in case of important structures.

Efforts are now being made to publish some of the important standards in English, to enable non-Japanese speaking professionals better understand the thinking among Japanese designers, and promote a fruitful exchange of ideas. It is hoped that the volumes will be available for wider circulation by May 2003.

Introduction of professional examination

As mentioned above, an understanding of nondestructive testing and evaluation is fast becoming very important for practicing civil engineers. The work involves a knowledge of the deterioration mechanism operating in concrete under different conditions, awareness of the various tests available, and a clear understanding of the limitations associated with different tests. With a view to impart the required professionalism and promote awareness among the engineers, in 2001 the Japan Concrete Institute introduced an examination to 'qualify or license' engineers in the area. This exermination has been called the *'concrete shindan shi test'*. Interstingly the japanese (*kanji*) character used for shindan are the same as used in the term '*kenko* (health) *shindan* (chek up)!!'

In other words, the effort is directed to creating awareness towards the fact that,

(a) much like our health, concrete structures should be subject to a regular check up, so that any symptoms of deterioration, can be caught early and appropriately rectified, and,

(b) such examination and decisions for further action should be carried out by appropriately qualified personnel.

Concluding remarks

Repair and rehabilitation of concrete structures has become a multi-billion dollar industry in the world, and all out effort is required to ensure that not only new structures are designed and constructed with adequate care, even the existing structures are appropriately modified to be safe. Some of the steps taken in Japan in this direction have been briefly discussed here. However it is clear that closer cooperation between researchers and designers in the world would go a long way in a more effective utilization of the limited resources.

Editor's note: Readers may also refer to an extended version of this article at our website (http://icus-incede.iis.u-tokyo.ac.jp).

2nd ICUS/INCEDE Open Lecture

The second ICUS/INCEDE Open Lecture was held on January 24, 2002 at the Institute of Industrial Science of the University of Tokyo with major focus on issues to be considered in urban safety. It was attended about 100 participants from Tokyo and its neighboring cities.

There were four speakers in the lecture. Two of them were renowned Japanese technocrats; Dr. Tsuneo Katayama, the Director General of National Institute of Earth Science and Disaster Prevention and Prof. Shunji Murai of Keio University, both of them are also Professor Emeritus of the University of Tokyo. Other two speakers were Profs. T. Takahashi and M. Setojima, both are the visiting professors at ICUS/INCEDE.

Dr. Katayama presented a lecture on the purpose of earthquake disaster prevention research in Japan in which he elaborated the history of earthquake disaster prevention research in Japan and its expected future development.

In his talk, Prof. Murai presented a proposal to wealthy urban planning the role of space information technology. He covered various aspects of this proposal during the talked and emphasized that role of space information technology was important to estimate and realize the proposal.

Dr. M. Setojima spoke on evaluation of urban environment using remote sensing technology in which the importance of evaluation of landscape was emphasized and remote sensing technology was expected as a powerful tool for such evaluation.

Prof. T. Takahashi presented on administration for earthquake disaster prevention of Japan. He talked in detail the various countermeasure taken by Japanese Government towards disaster prevention.

The following two articles summarize the talks of Dr. Katayama and Prof. Murai in this lecture.

(R. Ooka)

Dr. T. Katayama (left) and Prof. S. Murai during their talks in the 2nd ICUS Open Lecture

Smallness Can Be a Culture

by Dr. Tsuneo Katayama

ICUS/INCEDE is small, and I know that the INCEDE part of it is even smaller. Encountered with such a difficult problem as disaster mitigation in developing nations, one often feels that it is almost impossible to single-handedly do anything significant.

Although almost six years have passed since I left INCEDE, I strongly remembered those days in which we worked so hard to internationally establish INCEDE. It is true that the work was hard because the organization was small. But don't be discouraged.

We saw very recently that a single individual can change the future of a nation. Aung San Suu Kyi, leader of the pro-democracy movement of Myanmar, has been released after a year and seven months under house arrest. It has already been 12 years since Suu Kyis National League for Democracy won the general election by a landslide in 1990, but the generals refused to cede power. Now neighboring countries clearly suggest that the only way for Myanmar to develop of its situation is to adopt democracy.

Smallness is undoubtedly one of the important attributes of the Japanese culture and I do believe that it is also one of the vital characteristics of ICUS/INCEDE.

You can do whatever you believe is right, because ICUS is small, and you can strongly show your identity, because you work in a small organization. Shortcomings can be made into strong points. Best wishes for the bright future of ICUS/INCEDE.

Safety vs. Disaster

by Prof. Shunji Murai

As a former professor of Intitute of Industrial Science, the University of Tokyo, first of all, I congratulate ICUS/INCEDE for a good start with the well organized team works.

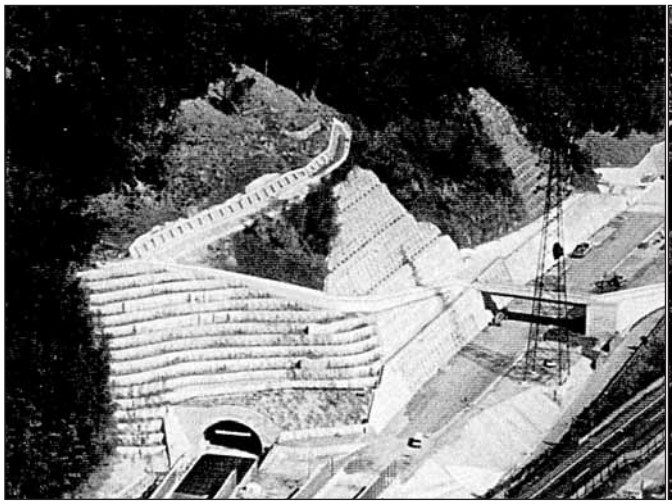
I would like to propose my viewpoints with respect to safety vs. disaster for the consideration of future direction. As different from the existing definition, I think that disaster will be a negative effect incurred before and after a natural phenomenon or a human activity. In other words, disaster is a negative change. Therefore in my view, if an urban planning and design was not done properly that resulted in traffic jam, ugly city landscape, dirty streets, etc., it is a disaster.

On the other hand, safety in my definition will be a positive effect to be guaranteed for future. Regardless of safety or danger in the current condition, it could become safety if one can guarantee the future. In spite of my view, safety is considered by many people to be in the condition of no danger. My thought is that it should be a positive promise. Therefore a safe city will be environmentally healthy, beautifully scenic, making people happy and comfortable, free from fear, etc.

As I deliver this lecture at ICUS workshop in January this year, most of the Japanese cities are a disaster with spider nets of electric poles and not a safety to me. The reclaimed coast, which replaced a beautiful beach, is a disaster and not a safety to me. I hope that the readers may understand my view points.

I wish all the best for ICUS and I am sure that ICUS is not a disaster but a safety to all. Lastly, I myself should be careful that I do not become a disaster but a safety.

The photographs presented below are kindly provied by the Green Bench Research Group-Chairman: Prof. Shunji Murai



February 1995: The construction with steep slopes was a disaster

April 1998: The slope was not yet safe in spite of the plantation of trees instead of grasses

September 1998: The slope was much improved with trees growing

August 1999: Green Bench Method certified how to change from disaster to safety condition

International Symposium on
NEW TECHNOLOGIES FOR URBAN SAFETY OF MEGA CITIES IN ASIA

This one-day symposium is being organized by the Center (ICUS) at the Grand Pacific Hotel, Bangkok, in collaboration with the Asian Institute of Technology (AIT), Thailand, on October 28, 2002. The objective is to create awareness towards issues related to urban safety engineering and disseminate information about use of latest techniques such as Remote Sensing, GIS, GPS and other computational tools, in creating databases and inventories of urban infrastructure. Additional information about the schedule, and other details will be available at the center website (http://icus-incede.iis.u-tokyo.ac.jp).

Tenth International Conference on Structural Faults and Repair

An International Conference on Structual Faults and Repair will be held in Commonwealth Institute Kensington, London, UK during July 1 - 3, 2003. It is organized by University of Edinburgh.

The main theme of this conference is extending the life of bridges, concrete, composites, buildings and civil structures. The deadline of the abstract (within 200 words) is August 31, 2002.

The adress for futher information is as follows. Prof. M. C. Forde, School of Civil and Environmental Engineering, University of Edinburgh, The King's Buildings, Edinburgh EH9 3JN, Scotland, UK FAX +44-131-452-8596, E-mail : m.c.forde@ed.ac.uk.

The Fifth International Conference on Urban Climate (ICUC-5)

The Fifth International Conference on Urban Climate (ICUC-5) is going to be held in Lodz, Poland during September 1 - 5, 2003. It is organized by the International Association for Urban Climate (IAUC) and the University of Lodz in co-operation with the World Meteorological Organization.

ICUC-5 is the continuation of a series of similar conferences starting in Kyoto, Japan in 1989, followed by those in Dakha, Bangladesh in 1993, Essen, Germany in 1996, and Sydney, Australia in 1999. The success of this series helped to create a cohesive international community of urban climatologists that led to the formation of the IAUC (http://www.geography.ohio-state.edu/UrbanClimate/) in 2000. ICUC-5 is the first conference to be organised by the new Association.

The aims of the conference remain as before, to provide an international forum where the world's urban climatologists can meet to showcase and discuss modern developments in research, and the application of climatic knowledge to the design of better cities. ICUC-5 wishes to cater to the interests of a diverse community of meteorologists, climatologists, hydrologists, ecologists, engineers, architects and planners and others interested in these topics.

The futher details of this conference information are available in web site http://www.geo.uni.lodz.pl/~icuc5.

The United Nations World Disaster Reduction Campaign
Disaster Reduction for Sustainable Mountain Development

As every year since the early nineties, the United Nations is organizing a World Disaster Reduction Campaign, which culminates on International Disaster Reduction Day, the second Wednesday of October,9 Octorber this year. The World Disaster Reduction Campaigns are organized by the Secretariat of the International Strategy for Disaster Reduction, located in Geneva, Switzerland.

The first aim of the 2002 World Disaster Reduction Campaign is therefore to increase globale awareness of successful disaster reduction efforts in mountain areas so that vulnerable mountain populations can benefit from already existing experiences. The second aim of the 2002 Campain is to raise awareness more generally on disaster reduction, so that past and new solutions in vulnerability and risk reduction can be explained and shared.

Visitors to ICUS

Some of the visitors to ICUS/INCEDE during Jan. - Mar. 2002;

** Prof. D. K. Paul, Department of Civil Engineering, Indian Institute of Technology (Feb. 19).*

** Dr. Pennung Warnitchai, School of Civil Engineering, Asian Institute of Technology, Thailand (Mar. 21-22)*

** Dr. Somnuk Tangtermsirikul, Sirindhorn International Institute of Technology, Thammasat University, Thailand (Mar. 21-22)*

** Dr. Marek Rebow, Institue of Heat Engineering, Warsaw University of Technology, Poland (Mar. 26)*

ACTIVITY RECORDS

During the period of January-March, 2002, ICUS staff have participanted in various international research activities including filed surveys, conferences and project meetings. Some of those are listed:

Prof. Yasuoka visited AIT to participate in a research meeting. (Mar. 21-23)

Prof. Meguro visited New York to study the on-going rehabiliation activities aftermath of the WTC disaster. (Feb. 24-Mar. 3)

Dr. Dutta visited Switzerland to attend the international conference on Flood Estimation in Bern. (Mar. 4-9)

Dr. Dutta also visited Thailand to participate in a field survey for flood modeling. (Mar. 13-17)

Editor's Note

As a research center, ICUS/INCEDE is involved in various research activities towards urban safety. The word safety has a broad meaning. There is no doubt that it is most important to protect a human life from natural disasters, such as earthquakes, floods, etc., which is dealt with in the conventional disaster-prevention engineering field. However, that is not enough to secure safety for a society. There are equally important other issues to be dealt with to attain that. For example, in recent years the global environmental problem has become a very serious issue. This problem has occurred because the human activities exceed the environmental capacity of the earth. This has caused many adversed effects, such as climate change on an earth scale, broader-scale air pollution, sea pollution, a change of ecosystem, exhaustion of natural resources and energy, etc. These phenomena are threatening the safety of human beings after all. The similar thing has occurred also in urban scale. In order to secure urban safety, we must pay attention not only to natural disasters but also to environmental and social problems widely.

ICUS/INCEDE has been developed and reorganized from INCEDE with the aim of carrying out intense research for tackling various issues towards urban safety covering such broad aspects.

As ICUS/INCEDE is a small research organization, it is impossible for it to tackle all these problems alone. However, We want to aim at such a large target. Moreover, in order to tackle such large research domains, cooperation of many people related with these problems is expected.

(R. Ooka)

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ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

VOLUME 2 NUMBER 1
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SEPTEMBER 11 2001 EVENT AND LESSONS FOR DISASTER REDUCTION

By
Kimiro MEGURO

On the morning on September 11, 2001, terrorists destroyed the World Trade Center Buildings 1 and 2 using two hijacked airplanes as missiles. Over 2800 people were killed and 135-million m^2 of office space destroyed. Rescue operations were carried out for several days and demolishing activities at Ground Zero lasted eight months. Though this event was not caused naturally, the response activities after the event, including rescue and relief operations, information collection, actions for prevention of secondary damage, etc. were very similar to those usually carried out after a large-scale urban natural disaster. The economic damage inflicted by this event was the worst in US history. Besides structural damage, the effects due to the disruption of operations and businesses at the organizations and companies that had offices in the collapsed structures were considerably large. Indices such as the NASDAQ and Dow Jones were affected. Considering the situation explained above, we identified this event as a new type of urban disaster, which was brought by the concentrated vulnerability of complicated urban functions. We visited New York to go over the lessons learnt and study the methods of using them for better future preparedness. Over 40 members having various specialties from many organizations joined the survey team. This article gives a brief outline of the findings of the group A, which I had the opportunity to lead and also

WTC Complex, Lower Manhattan, New York, Before (Left) and After (Right) September 11 2001 Attack

presents the results from our study on the failure mechanism of high-rise buildings. The report of the group (in Japanese) is available at *http://infoshako.sk.tsukuba.ac.jp/~toshiw3/Labo/murao/wtc/.*

STUDY GROUP VISITS NY

From February 25th to March 2nd, 2002, I had the chance to visit New York on a survey after the World Trade Center attack. I was part of a team assembled for the purpose of evaluating the damage inflicted by the collapse of the Twin Towers and the subsequent response/recovery actions. Disaster mitigation cannot advance through theoretical approaches only but also through investigation into actual damage. The main objectives of our survey were to assess the preparedness, response, recovery and reconstruction processes surrounding the World Trade Center attack, and, to understand the influence of the elements of the urban environment in the magnitude of the disaster.

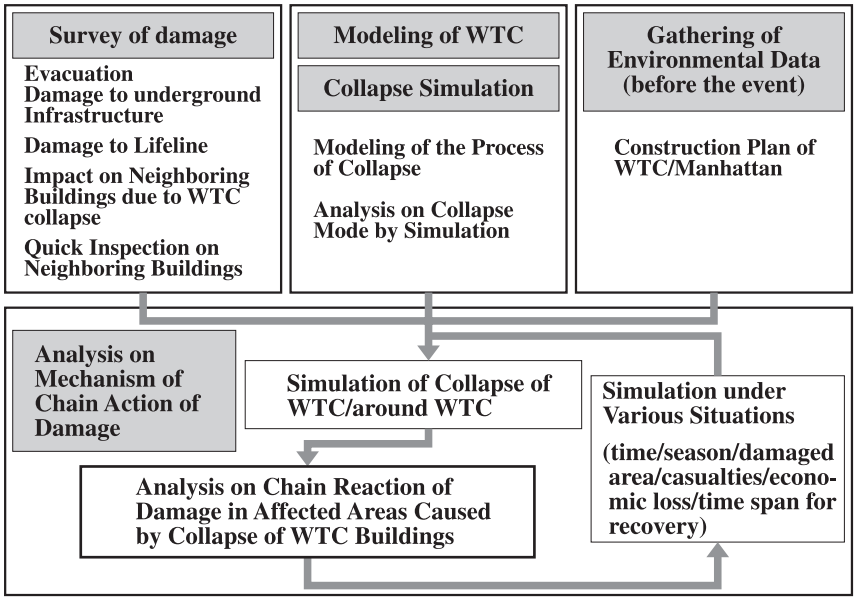
The team consisted of members coming from different Japanese Governmental Agencies, universities, research institutes, and private companies. The members were experts in a variety of fields such as structural collapse analysis, economic loss evaluation, insurance, evacuation, social sciences, etc. The team, led by Professor Yoshiaki Kawata from Kyoto University, was composed of four groups, whose responsibilities are briefly described below.

Group A) Structural damage and its effects on City functions, and recovery process

Group B) Fire-fighting and rescue operation activities at the site, and disaster management system of City, State and federal levels of organizations

Group C) Overall impact of the event, including that on world finance, etc. over time

Group D) Crisis management and response activities of Japanese companies and Japanese tourists



General Objectives of the Team Survey (Group A)

I had the privilege to be appointed as head of Group A. We gathered information related to the World Trade Center Towers facilities and surroundings (structures and utilities), damage to underground structures and lifelines, impact on neighboring buildings, quick inspection results, evacuation, disaster response activities among others. For this purpose, we visited many offices and sites as listed below: Con Edison, Inc., United States Environmental Protection Agency, Fire Department, MTA New York City Transit, FEMA Regional Office, NYC Long-Term Recovery Office, Disaster Assistance Service Center,

Debris processing at Fresh Kills. All debris was checked for objects that could help in identification of victims

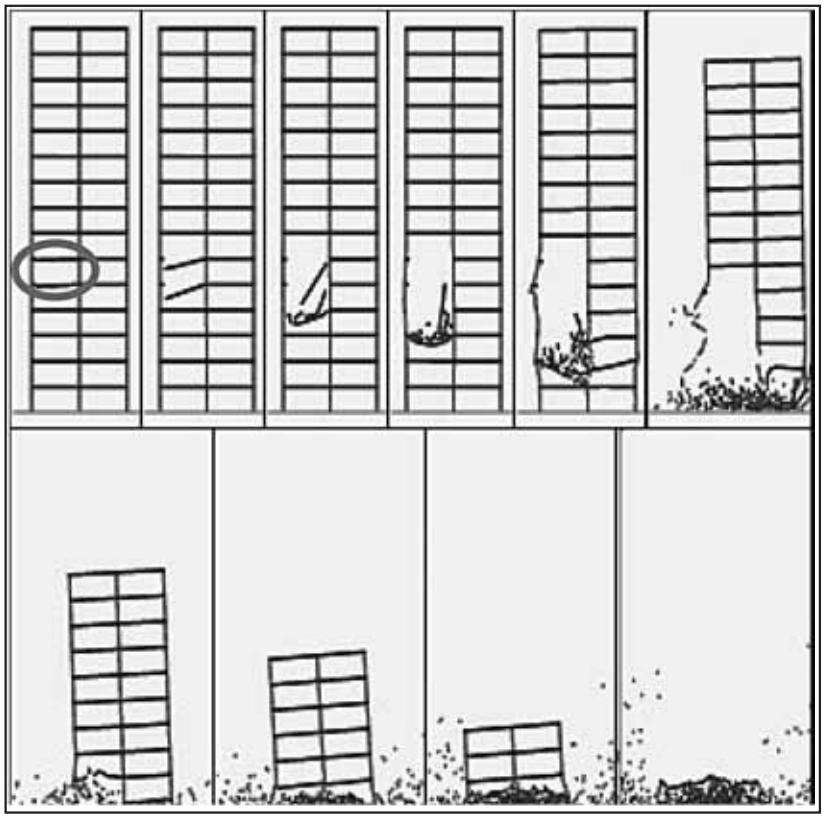
A fire fighter truck smashed by falling debris of the collapsed tower

Metropolitan Transportation Authority New York City Transit, Port Authority of NY/NJ, Emergency Mapping Center of NY, Fresh Kills at Staten Island, etc. On the final day of survey trip, we had a half-day joint workshop with US researchers.

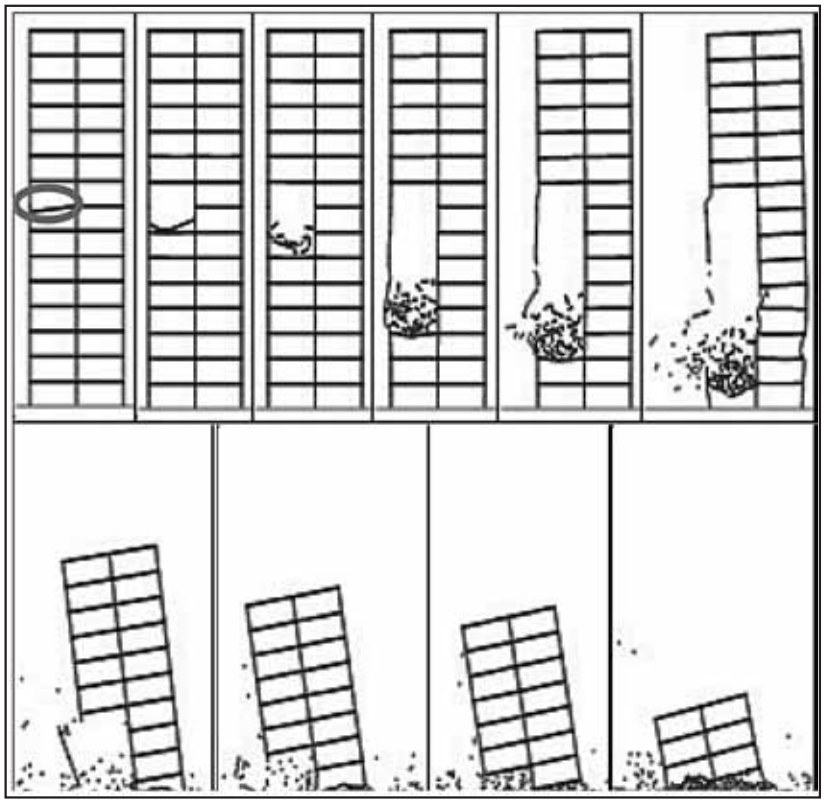
FAILURE OF HIGH-RISE BUILDINGS

Currently, we are working on the modeling of the collapse behavior of the Twin Towers. In this study, the key issue is to identify the process of collapse and the most critical elements in the structure that led to the complete collapse. Once these objectives are accomplished, the mechanism of chain action, the effect of different environmental conditions, and the effect around the WTC can be discussed.

At present our research efforts are directed to better understand the real behavior of the phenomena, which will help in developing a new type of disaster related database. With this tool, we can discuss the problem from different points of view: time, location, leader organization, etc. Using this database combined with a new generation of interactive disaster manual, which is being developed in our research group, an efficient course of action to follow in a disaster situation, with a great potential for disaster reduction, can be designed. The second task of our research group is the simulation of the WTC structure collapse. If we can understand the failure mechanism, we can discuss measures to protect the structures from any attack or ways to prevent the complete structural collapse and to prolong the time upto total collapse for evacuation. For this type of analysis, the Applied Element Method, which has been developed within our research group, has been adopted. Although the complete model is not ready yet, the adjoining figures show some preliminary results, which correspond to the collapse mechanism of a 15 storey steel building when exposed to fire in the 9th floor, and in the 6th and 7th floors. It can be clearly observed that the failure mechanism is quite different. It may be mentioned that the collapse through the stages shown in the figures was complete within about 7 seconds of the time



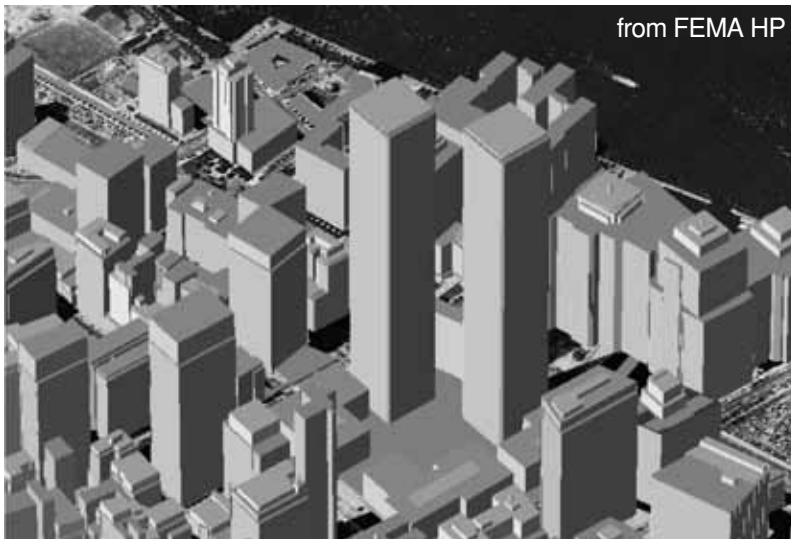
Dynamic analysis of failure mode in case of fire in the 6th and 7th floors by AE Simulation



Dynamic analysis of failure mode in case of fire in the 9th floor by AE Simulation

***AE Simulation:** The AE simulation is a new method develop at our research group that allows the analysis of structures from the initial stages of load application until complete collapse. In the simulation shown above, the thermal effect on the steel structure is considered in the collapse process analysis.*

that the first members 'collapsed' as a result of changes in stiffness from the simulated heating. This type of analysis is helpful to identify the most critical structural elements whose failure should be avoided to prevent the total collapse of the structure.The adjoining figure shows an example of using the latest tools in remote sensing, GIS, and available information, records and experience to have a higher degree of disaster preparedness.



By combining 3D-GIS and past disaster survey reports, lessons and/or Newspaper articles, a new style disaster information database that can really contribute increase disaster reduction capability is beeing prepared

NATURAL AND MAN-MADE DISASTERS

The study discussed above is mainly oriented towards structural countermeasures against a possible terrorist attack. Though it can be argued that there are several important points of difference in the two situations, I would like to emphasize that although man-made disasters and natural disasters have quite different triggers, the scenario is basically the same, once a disaster situation arises.

For instance, an earthquake strikes all the population, including those who should take disaster response actions whereas in a terrorist attack the affected target group is more limited, and the affected geographical area may also be smaller. However, a situation similar to the tragedy arising from the gas-leak in the town of Bhopal in India, or a major terrorist attack as September 11, 2001, though surely not a natural disaster had severe implications and called for massive relief and rehabilitation operations.

Thus, it may be appropriate to consider that the countermeasures and response actions are similar in both cases. This is the reason why we should take this opportunity to learn valuable lessons, understand the process and evolution of a disaster situation, and improve our preparedness and response capacity under these situations.

ACKNOWLEDGEMENT

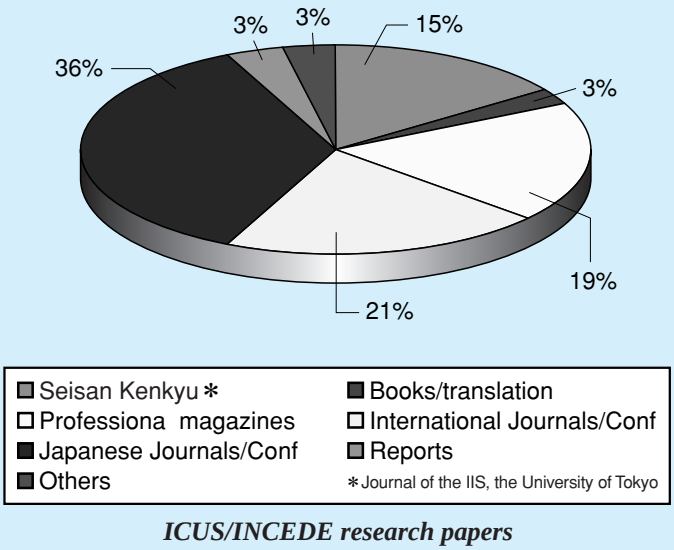
I would like to take this opportunity to express my deepest sympathies to the people of New York as well as my gratefulness to all the institutions and officials, especially Dr. Kozo Aoyama, Institute of Public Administration, NY University who kindly shared their experiences and information with us during our interviews.

(Kimiro MEGURO)

ICUS/INCEDE Annual Report —2001—

In the first year of activities ICUS/INCEDE faculty published about 270 papers and reports, and an approximate break-up is given in the adjoining figure. Besides, four open lectures from experts in different fields and workshops were held to provide a forum for experts to exchange views and information on latest research and development efforts, and, bring professionals in different sectors closer.

A workshop held in Bangkok, Thailand has set the pace for closer international cooperation between researchers in the region. Closer links are also being established with the Asian Institute of Technology, Bangkok for collaborative research. More information can be obtained from our website *http://icus-incede.iis.u-tokyo.ac.jp*.



ICUS/INCEDE research papers

ICUS/INCEDE participates at the IIS Open House

The SEIKEN KOKAI (Open House) is an annual event during which all the research facilities at the Institute of Industrial Science (IIS), University of Tokyo are thrown open for the people. Panels showing ongoing and completed projects are displayed, and faculty and staff are available for direct interaction. Typically, professionals from different companies and organization use the Open House as an opportunity to obtain information about the latest directions in research at IIS. Groups of school children also visit the campus during the Open House.

Visiting Professor Setojima explains to visitors

This year the event was held at the Komaba Research Campus on 6th and 7th June. About 4,600 persons from private enterprises, academic and research organizations, visited the campus during the two days. Groups of junior and senior high school children also came on a tour to the Campus.

Entrance of ICUS/INCEDE

The theme of the results exhibited by the ICUS/INCEDE this year was ***"Role of a research organization of university for urban safety design".*** The three groups of the center exhibited their results under the following banners:

Sustainable Engineering

"Non-Destructive Inspection and Evaluation of Existing Concrete Structures" - this concentrated on the development of software to evaluate the degree of deterioration in existing concrete structures. This software is being developed using principles of database generation and management and expert-system design to help professionals obtain and interpret data using nondestructive tests without direct participation of experts.

Urban Safety and Disaster Mitigation

"Against Coming Tokai Earthquake, Hazard and Software Based Measures for Damage Reduction" - several groups drawn from government departments, and public and private sector, are engaged in planning for disaster mitigation in the event of the Tokai earthquake, which is likely to hit the eastern parts of Japan any time. The group at ICUS presented a manual based on user-needs for response at the time of the disaster. The manual also describes optimum management of resources including personnel in event of disaster.

Infrastructure Information Dynamics

"Remote Sensing for Environmental Monitoring and Measurement & Sustainable Urban Space Design" - proposes a new methodology for collection and analysis of information about urban structure, development of urban 3-D model using Three Line Scanner (TLS), and a system for supporting decision making for urban environmental management using GIS technology.

About 150 persons visited the Center's panel display during the open house, with about 80% of the visitors being drawn from private companies. This only goes to show that the private sector has high expectations from the Center and will look forward to the impact on the efforts towards creation of a safer urban environment. We will do our best to attract a wider audience in the coming years!!

ICUS/INCEDE secretaries Ms Shiuchi(L) and Ms Murakami(R)

Industry - ICUS/INCEDE Interaction (RC-39)

— Research Committee (RC-39) —

A new Research Committee (RC-39) titled ***"Research Committee on Sustainable Engineering for Urban Safety"*** has been established by the ICUS/INCEDE. Besides the members of the faculty of the Center, the committee comprises of 16 private companies and research organizations. (The complete list of participating companies and the members is available at our website *http://icus-incede.u-tokyo.ac.jp/*).

The broad spectrum of the primary activities of the member organizations is proof of the keen interest the Center has evoked within the short period of its existence. The committee will work for a two-year period and address issues related to:

1. Difference in the response of different structural systems to an urban disaster
2. Optimum method(s) for carrying out monitoring and evaluation of structure
3. Appropriate methods for repair and retrofit of deteriorated structures
4. Application of new technologies for Urban Safety Engineering

The first introductory meeting of RC-39 was held on June 26 at ICUS, where the faculty of the ICUS made brief presentations about the activities currently underway in their groups, and their perspective of the needs of further research and development activities in order to realize the goal of sustainable urban development.

In order to make optimum use of the available expertise and time, it was decided to constitute smaller 'working groups' to examine the following issues in greater detail.

1. Methods to handle an aging infrastructure, including nondestructive testing and monitoring, retrofitting, etc.
2. Global environment including levels of carbon dioxide, etc.
3. Study of the phenomenon of formation of heat islands in urban environments
4. Disaster prevention and response, including development and dissemination of suitable literature
5. Developments in sensing technology and its applications in studies related to urban safety

Through exchange of information and interactions, efforts will be made to identify common areas of interest and initiate joint studies.

Professor T Uomoto, ICUS/INCEDE Director, at the introductory meeting of RC-39

The introductory meeting of RC-39 in progress

Visitor to ICUS/INCEDE

Ms Chada Narongrit, Department of Geography, Faculty of Social Science, Kasetsart University, Thailand, arrived at the Center for a six month stint (April 1-September 30, 2002) to carry out research work on ***"Estimation of daily evapo-transpiration from rice paddy field by using TERRA/MODIS data"***. She belongs to Yasuoka Laboratory.

Dr. K. Meguro Awarded from ISSS

Dr. K. Meguro, ICUS/INCEDE won the prize for the Best Paper of the Year from the Institute of Social Safety Science, Japan, on the 1st of June 2002. In this paper, he proposes a new system for promotion of retrofitting of low earthquake resistant houses. With this new system, both house owners and government at national and local levels would greatly benefit and the total damage that would occur in case an earthquake strikes could be drastically reduced. Although retrofitting weak structures is the most important issue for earthquake disaster reduction, in reality, its importance and usefulness is not popularly understood. Moreover, the national government cannot compel owners to strengthen their houses because they are private property. As a consequence, only very few people have retrofitted their houses. In Japan, there is the principle that people affected by natural hazards should recover by themselves and governmental money cannot be spent in private property. Paradoxically, when the earthquake strikes and houses collapse, the government invests a lot of resources to take care of the affected people. Most of this money, however, would not be spent if the houses were not damaged or did not collapse. This post-earthquake investment can be more efficiently used in pre-earthquake preparedness. Currently, Japan is facing a population decrease accompanied by an increase in the elderly population ratio. In this context, the only way to preserve a high quality housing stock is by building long-lasting houses. These houses should be built at suitable locations and be given proper maintenance and/or retrofit if needed so than they can be used for long time. In this way, the efforts of successive generations will be added and each person's individual contribution will be reduced and focused on keeping the quality of the housing stock. By recognizing this situation, Dr. Meguro proposed a scheme for promoting the retrofitting of houses and he is currently trying to establish a legal system based on it. Dr. Meguro sincerely hopes that in the near future, this system becomes a national law that will help Japan to ensure the high quality of its housing stock as well as to save human lives when future earthquakes strike.

Dr. K. Meguro

Forthcoming Conferences of Interest to ICUS/INCEDE

The Ninth East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-9)

EASEC-9 to be held in Bali, Indonesia (December 16-18, 2003) is organized by the Dept. of Civil Engineering, Institut Teknologi Bandung, Indonesia. The main theme of the conference is Embracing the Challenges in 21st Century. It highlights the needs of immediate regional cooperation to meet the demand of free market and globalization. Further details and information can be obtained from *http://si.itb.ac.id/ easec9/*.

The 4th International Conference on Concrete Under Severe Conditions of Environment and Loading (CONSEC-04)

CONSEC 04 to be held in Seoul, Korea from June 20 - 23, 2004 will have presentations on latest development in the subject by experts and aims to continue the transfer of advanced technologies across the world. Further details about the Conference are available at *http://conlab.snu.ac.kr/consec/*.

ICUS/INCEDE Activity Records

Some of the international conferences in which members of ICUS/INCEDE faculty participated during the period April - June 2002, include the following:

Prof. T. Uomoto, Director, ICUS/INCEDE participated in the 30th Annual Conference-Canadian Society of Civil Engineering held at Montreal, Canada (June 5 - 8, 2002).

Prof. Y. Yasuoka participated in two international conferences: 1) 29th Intl Symp on Remote Sensing of Environment at Buenos Aires, Argentina (April 8 - 12, 2002), and, 2) 2002 Intl Geoscience and Remote Sensing Symp at Toronto, Canada (June 23 - 27, 2002).

Dr. D. Dutta was in Australia during May 5-22 to participate in Joint Research Studies on Urban Flood Risk Management and Improvement of Topography Data for Hydrological Modeling. Dr. Dutta spent time mainly in University of Western Australia, Australian National University and Macquarie University.

Editor's Note

ICUS/INCEDE entered the 2nd year this April. Looking back last year - many activities, such as a joint workshop with Asian Institute of Technology (AIT), workshop on civil engineering and open lecture, have been done.

Dr. M. Setojima (Kokusai Kogyo Co., Ltd.) and the undersigned have joined ICUS as Visiting Professor and Assistant Professor, respectively. It is expected that activities at ICUS will increase with more persons joining in.

ICUS functions as the aggregate of specialists drawn from diverse research fields. Team action reconfirmed that various problems related to urban safety are solvable. In the current fiscal year, it is planned to set up a liaison office at the AIT to coordinate joint research projects and promote better understanding among researchers in the region.

The world was gripped by the soccer World Cup during the period April to June. That Japan lost in the first game of the second round was regrettable. However, it was a good tournament for the region, with Japan and South Korea advancing to the Second Round, and the latter making it to the last four. We congratulate South Korea on their splendid performance, and indeed if only there was a little more cohesion, the World Cup story may have been quite different.

(Y. Kato)

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ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

VOLUME 2 NUMBER 2
JULY-SEPTEMBER 2002

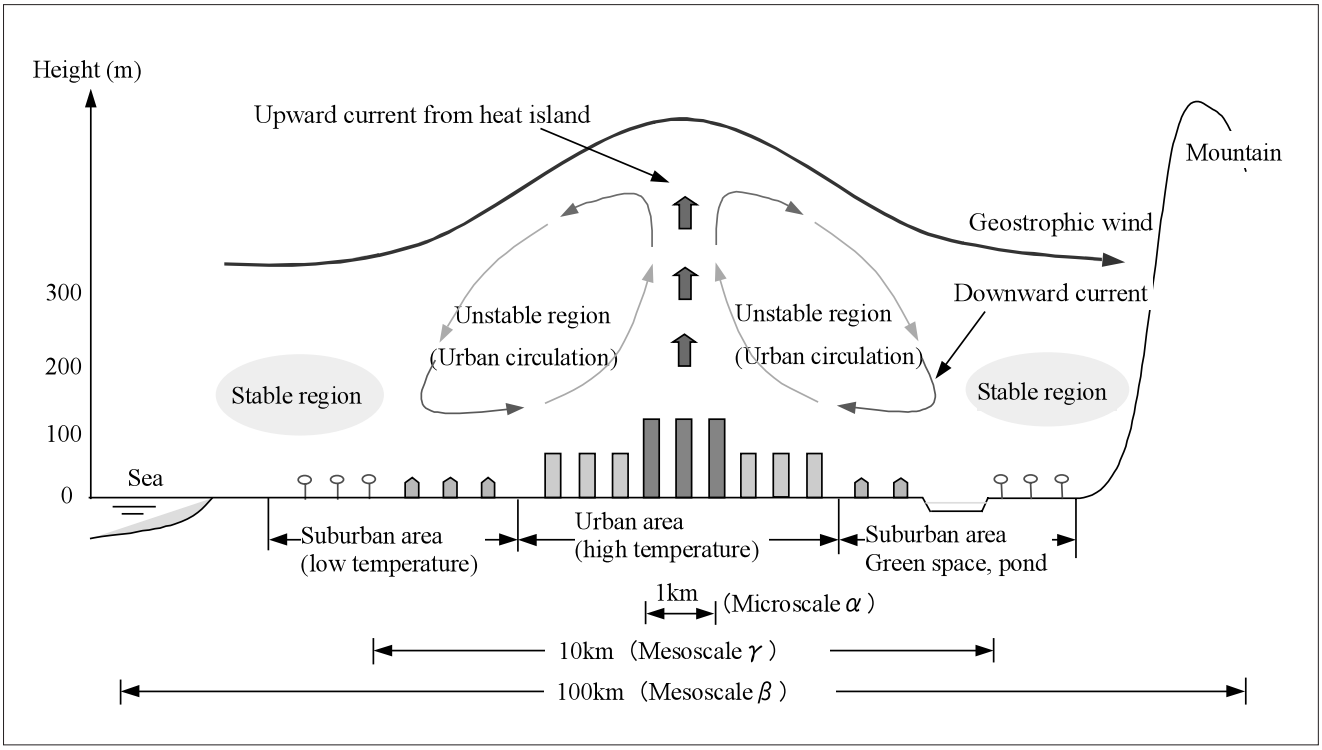
Urban Warming and its Control

by
Ryozo OOKA

Rapid urbanization has significantly affected the urban climate and is at least partly responsible for the phenomenon, which is being termed *'urban heat island'*. It refers to localized small regions of relatively higher temperature created in the neighborhood of urban centers on account of the massive consumption of energy and lack of appropriate heat sinks. These local changes caused in the urban environment, cannot be captured using normal meteorological methods, and have been described to extend over a range of 10 ~ 100 km horizontally and 100 ~ 1,000 m vertically in a large city such as Tokyo.

A brief description of factors leading to the emergence of heat island and the steps that may be taken to control the phenomena is given here along with the research effort made being for analytical modeling. Appropriate examples for the Tokyo metropolis are included.

The figure below is a schematic representation of the model that can be used to describe



Schematic model for creation of urban heat island

the emergence of heat islands. It can be seen that warmed air in the urban area rises through buoyancy, is cooled in the upper reaches of the atmosphere, and descends into the surrounding suburbs. Also, the air currents descending further converge in the metropolis, generating so-called urban circulating currents.

The figure at the bottom left shows the growth of urbanized area in Tokyo in the last about a hundred years. The radius in the Tokyo metropolitan area can be seen to have expanded to about 50km from 5km over the period. The variation in the air temperature during the same period is also given in the figure at the bottom right, and it can be seen that the mean air temperature measured at a height of 1.5 m above the ground has risen by as much as about 2°C. It may also be noted that the number of tropical nights (summer nights following days when lowest temperature is higher than 25°C) in Tokyo rose from less than three in the 1920s to more than thirteen in the 1980s.

Factors leading to urban warming

Increase in artificial heat release in urban areas, decrease in evaporation from land, heat storage by urban construction materials, decrease in heat exchange with the atmosphere due to urban structures and the greenhouse effect due to presence of fine dust and atmospheric contaminants can be listed as some of the factors that lead to formation of urban heat islands. It may be noted that artificial waste heat in three wards in the Metropolitan Tokyo reached approximately 700,000 Gcal/y/km^2 in 1986, which is more than the incident solar heat radiation (approx. 650,000 Gcal/year/km^2). Also, urbanization leads to a loss of permeable areas such as green space, marshland, rivers, ponds, etc. which affects the consumption of latent heat by evaporation from the land surface, causing the surface temperature in urban area to rise higher than in the suburbs.

Controlling urban warming

As can be seen from the above, warming of the atmosphere in the neighbourhood of mega-cities such as Tokyo is advancing at a far faster pace than the global warming. Thus, unless steps are taken immediately, it is almost certain that the problem will acquire a very serious dimension in the future. The following could be considered as steps that could help control emergence of heat islands:

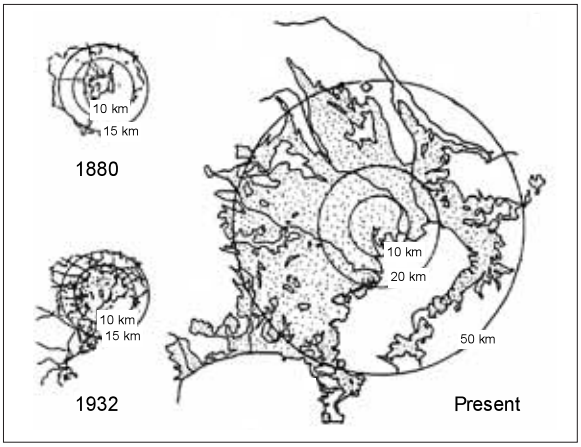
a) Reduction in artificial heat releases by promotion of appropriate energy saving systems,
b) Promotion of evaporation from land surfaces using appropriate construction materials,
c) Promotion of heat absorption by heat sinks,
d) Promotion of heat exchange between the urban structures and the atmosphere achieved by improvement in the ventilation performance of the urban area by the suitable arrangement of building, and,
e) Control of atmospheric contaminants

Implementation of plans incorporating 'Ventilation paths' in Struttgart, Germany, is an example of layout of buildings to facilitate ventilation.

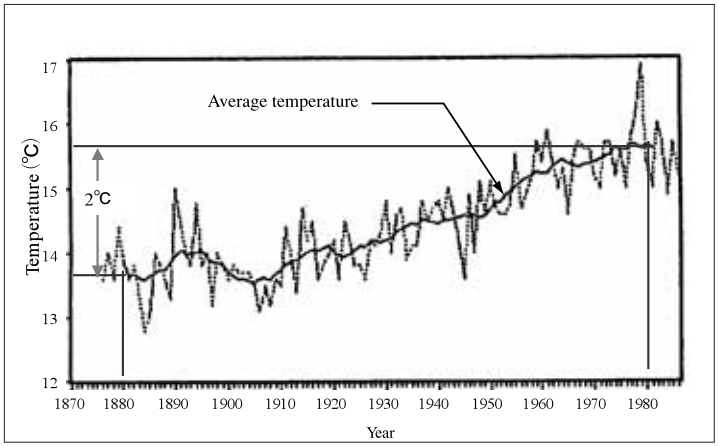
Numerical climate models for urban warming

Although the control methods against urban warming mentioned above, have a reasonably sound qualitative basis, given the extremely complex inter-relationship between the various variables, it is very difficult to quantitatively evaluate the effect of each method through empirical and experimental studies alone. Thus, one of the ways to study the problem is formulation of appropriate analytical climate models for the purpose.

An analytical hydrostatic model taking into account the different factors that affect the microclimate in the neighbourhood of mega-cities has been used to study the variations in temperature. It is likely that such techniques based on the numerical climate model may become a powerful tool from the viewpoint of synthetic environment assessment technology, including studies for air pollution, etc. The model uses



Urbanization of Tokyo over the last 120 years



Increase in air temperature in Tokyo

fundamental principles of heat, mass and momentum transfer, thermodynamics, water vapor and mass and radiation heat transfer to study local climate changes.

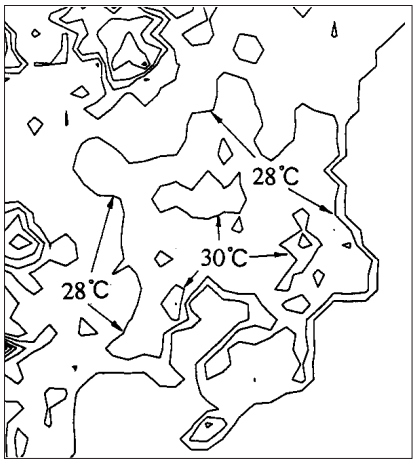
The figures below show the results for the simulated studies of changes in the microclimate in the Tokyo metropolitan area, over the last about hundred years. The effects of factors such as land use, and heat releases are incorporated in the model. Whereas the figure (a) shows the simulated distribution of ground surface temperature in the present day Tokyo area for late afternoon on a summer day in August, a similar distribution for the area during the Edo era, about 150 years is shown in Figure (b). It can be seen that that whereas the peak temperature of about 34°C, is observed in the central part of the present day Tokyo, the maximum in only about 30°C for the Edo period Tokyo. It may also be noted that the temperature in the suburban areas has remained at the same level of about 28°C. It is of interest to study these variations in temperature in light of the urbanization of the Tokyo metropolis that has depicted earlier. A plot of the ground surface temperature of the Kanto district recorded during the summer using the artificial satellite (NOAA-AVHRR) is also shown for reference, and clearly shows a high temperature region in the central part, which has the maximum concentration of buildings, and urban infrastructure, compared to the suburban area.

Though the results do provide an estimate to the warming in the Tokyo region that has been observed, there is an apparent need to refine the model to obtain better quantitative estimates. A better modeling of the complicated air-flow and temperature field in the neighbourhood of urban structures could possibly help to improve the model.

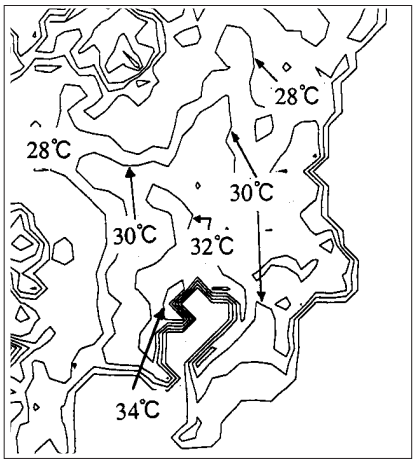
Concluding remarks

The phenomenon of generation of heat islands as a result of urbanization and resulting consumption of energy has been demonstrated above along with the results from a numerical simulation.

It can be seen that the model presented can simulate climatic changes considering geographical features over a range of 10 to 100 kilometers, though more effort is required to improve the accuracy.

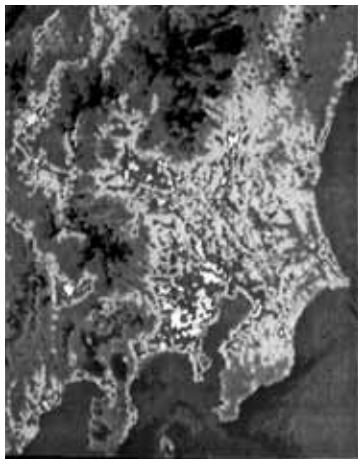


(a) Present



(b) About 130 years ago

Changes in the temperature patterns in the Tokyo metropolis



Ground Surface temperature in Tokyo region (NOAA-AVHRR)

ICUS Activities Recognised

Mr. T. Sugiyama and Mr. K. Miyamoto of the Uomoto Laboratory bagged Prizes for excellent presentation at the 2002 Annual Meeting of the Japan Concrete Institute. Mr. Sugiyama is a research engineer in the Uomoto Laboratory and works for the Master Builders Technologies. Mr. Miyamoto is a graduate student of the Shibaura Institute of Technology.

Mr. Sugiyama also won an award for his presentation in the 2002 Annual Meeting of the Japan Cement Association.

Mr. Y. Ishizeki, Mr. Y. Hosokawa, Mr. T. Nishimura and Prof. T. Uomoto won the Development of New Technology Award for their work on development of high quality shotcrete in May 2002 from the Japan Concrete Institute. Mr. Ishizeki and Mr. Hosokawa are employed with Kumagai Gumi Company and Taiheiyo Cement Corporation, respectively, and are research engineers at the Uomoto Laboratory. Mr. Nishimura is a Technical Associate at the Institute of Industrial Science.

Foreign graduate students Mr. Bishnu Hari Pandey (Nepal) and Ms. Paola Mayorca (Peru) working with Dr. K.Meguro, Associate Professor, ICUS, earned a Recognition for their presentations at the 4th International Summer Symposium of the Japan Society of Civil Engineers held on August 3, 2002, at Kyoto.

Expert Systems in Visual Inspection of Concrete Structures

The end of the Second World War saw the onset of a major construction boom in Japan, and concrete was used extensively in the construction of buildings, bridges, etc. The figure at the bottom left, with the data for bridge construction shows an example of the construction boom. Indeed, the structures built during that time, are all more than 35-40 years old, and have begun to show signs of deterioration to varying degrees. It is clear from the figure that the structures that need inspection and maintenance are likely to increase at a very rapid rate from now.

Another representation relating the maintenance required and the life in service is given in the figure at the bottom right. It shows that whereas some bridges may require maintenance and repair as early as 10 years after construction, more than 50% need repairs in about 50-60 years of service.

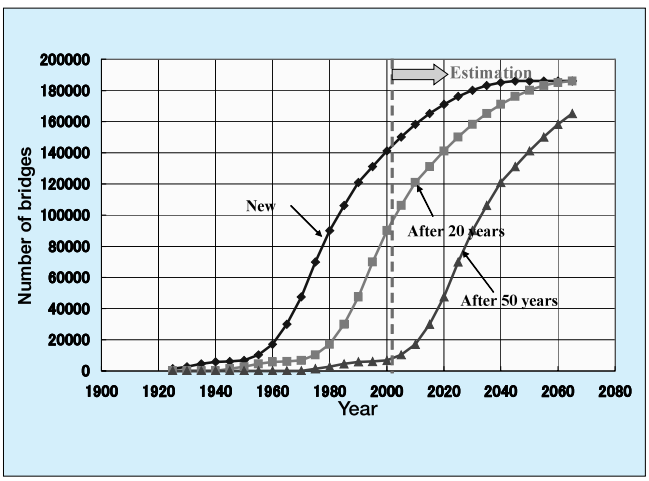
Though the figures show the examples of only bridges, the pattern is similar for other structures, such as buildings, etc. also. Information in a report compiled by the Ministries of Construction, Transportation and Agriculture and Fisheries in 2000 showed that about 40% of the concrete structures have been repaired after a service life of about 50 years.

Now, no matter what the *'design life'* of the structures built in the post-war construction boom was, given the cost of dismantling and building new ones, leaving the technical problems of working in congested urban environments apart, it is only likely they will be expected to remain serviceable for as long as possible, even as long as say 100 years. This clearly outlines a mammoth task for the engineers in terms of carrying out inspection of structures and repair/strengthening works in existing structures. The high level of public awareness and concern for safety of structures should also not be lost sight of. The following picture is a clipping from the Press warning of the consequences of overlooking 'dangerous' (deteriorated) concrete structures, and describing developments including new inspection systems and the examination introduced by the JCI.

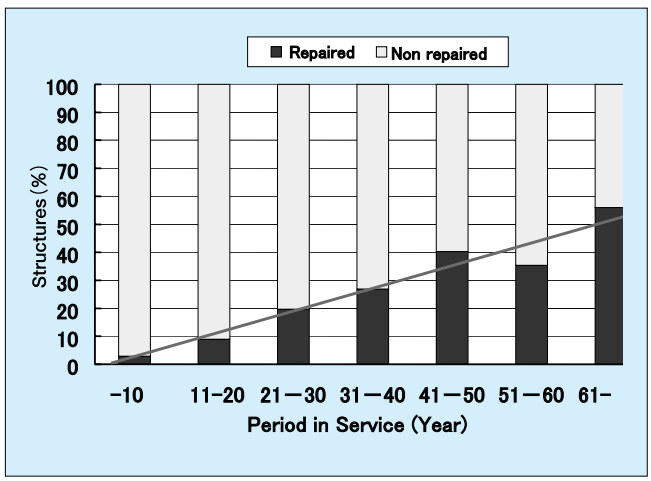

危ない構造物、見逃すな
コンクリート判定の新システム
診断士の試験も

Press reports (February,2000)

Structures, both in the private and public sectors, are periodically inspected to ensure that they are serviceable, and to look for signs of deterioration and distress. The possibility of injury to not only the users but also 'third parties' by way of spalling of concrete, etc. is also kept in mind during these inspections. Depending upon the degree of importance, location and environment of the structure, the inspection may use different nondestructive testing tools, or be simply visual. In fact, in most cases, a detailed inspection using appropriate tools is carried out in cases (only) when visual inspection shows a need. Even in cases when a decision has to be made regarding carrying out repair and/or strengthening the structure, visual inspection is usually the first step.



(a)



(b)

Representation of progressive aging of bridges and required increased attention for older structures

(a) *(b)*

Sample displays for software to aid in inspection of structures

Though visual inspection yields excellent data but the subjectivity in the results sometimes makes it's reliability quite poor. Not only different inspectors may view a certain degree of cracking as 'serious' or 'routine' depending upon personal judgment, but their understanding and interpretation could also depend on their professional backgrounds, i.e. whether they are essentially trained in repair systems of cracks or they are structural engineers.

Further, the life-span of a structure is quite long, and not only it is difficult for the same person to continue to inspect the structure, but his own 'evaluation' undergoes substantial changes with age and experience.

Though the Japan Concrete Institute has instituted professional examinations to bring about some standardization in the area of inspection of concrete structures, it is important that other avenues for better standardization and utilization of results from visual inspection are explored.

In this context, Dr. Taketo Uomoto, Director ICUS, and Professor at the Institute of Industrial Science, University of Tokyo, has led an effort on the possibility of using personal computer based expert systems in visual inspections, and formulated a basic outline of the system about two years ago.

The system is being developed to introduce a certain degree to uniformity and objectivity in testing and evaluation, and enable an engineer with only a marginal understanding of the deterioration processes in concrete to carry out routine inspections. The interactive system guides the inspector through inspection process using the built-in data for commonly encountered deterioration. The adjoining figures are samples from the displays on the computer screen during the execution of the software developed. Figures (a) and (b) abore are examples of kind of assistance the system offers to the inspector and prompts him with questions about the environment of the structure, extent of cracking, etc. The adjoining figure shows an example of the 'diagnosis' made by the expert system on the basis of the data fed in during the course of the inspection. The results are given in terms on an 'overall index' which gives the possibility of a certain mechanism of deterioration operating.

Sample display of 'diagnosis' using the software

At present, Professor Uomoto is leading a team of researchers, including engineers drawn from ten consulting and construction companies, to develop a practical expert system for a scientific collection and analysis of data from bridges, tunnels and wharfs.

Though it is hoped that the required software will be ready in another year, it is likely to take some more time before the package is translated in English, etc. and is available for use in other countries.

(Sudhir Misra)

Editor's Note: Readers may also note that Vol 1 No 4 of our Newsletter also carried a related article on Maintenance of concrete infrastructure.

3rd ICUS Open Lecture

The phenomenon of global warming has been recognized for quite sometime now, and has been studied by scientists and environmentalists from the point of pollution and pollution control, rising sea levels, and environmental conservation. Recently, however, research effort is also being directed to study different aspects of the 'Heat Island' phenomenon, which essentially refers to creation of localized pockets of heat in the neighborhood of major urban centers.

The theme for the 3rd Open Lecture organized by ICUS scheduled for September was delayed and held on October 7, 2002, at IIS, Komaba-II Campus, University of Tokyo was "Urban Heat Environment - The Risk of Heat Island". The theme had been chosen to draw wider attention to the problem and the directions in current research. About 80 engineers and scientists from various organizations listened to presentations by Prof.R. Ooka of the ICUS and three other eminent researchers.

At the outset, Prof. Y. Yasuoka provided a brief overview of the Open Lecture, and thanked the speakers and participants for taking time out of their schedules and coming to IIS for the event. He then invited the speakers to make their presentations.

Dr. Ryozo Ooka, Associate Professor, ICUS, Institute of Industrial Science, University of Tokyo, made a presentation dealing with the issue of urban warming and methods that could adopted during architectural design and urban planning to control the development of heat islands. He also gave a summary of the current projects in his research group dealing with microclimate modeling and application of advanced technologies for the mitigation of urban heat conditions.

Prof. Takehiko Mikami, Department of Geography, Tokyo Metropolitan University, gave a lecture on "Investigation of Urban Heat Island in Tokyo metropolis Based on the Ground Monitoring System". His presentation was based on data collected and the evidence available to show the growing Heat Island phenomenon in the Tokyo metropolitan region, and emphasized the importance of developing a network system for accurate monitoring of parameters related to Heat Islands, in order to better understand the changes in urban micro climate on account of urbanization.

Mr. Kohtaro Takemura, Advisor, Water Resource Environment Technology Center, made a presentation titled "Global Warming and Urban Disaster", and discussed the present trend in water related natural disasters such as flood and draught. His presentation focused on the situation in Japan in relation to the changes in microclimate by urbanization, and global warming. Mr. Takemura also put forward the mission of the government and government agencies in mitigation of damage by these disasters.

Prof. Yutaka Inaba, Department of Epidemology and Environmental Health, Juntendo University School of Medicine, presented a talk on "Mortality rate due to heat disorder by place of occurrence using vital statistics in Japan". His presentation contained the statistics about the mortality rate by heat disorder over the last about 40 years collected during hot days in Osaka, Tokyo and Nagoya. Prof. Inaba observed that the mortality rate was markedly high among the persons over 65 years old and those 0 to 4 years old, and did not show a gender bias. However, in the other age groups and places of occurrences, mortality rate for women was lower than that for men. Further, the mortality rate from 1990 to 1999 was higher than that from 1959 to 1968, while the age-adjusted mortality rate remained the same. significant Positive correlations were observed between the mortality rate of heat disorder and the annual peak temperature as well as the occurrence of hot days in Tokyo, Nagoya and Osaka.

Through comments and questions on each of the presentations, the audience expressed their interest in the various issues. At the end of the Open Lecture Prof. Y. Yasuoka thanked the speakers for the excellent presentations, and invited them to join the participants for informal interaction.

A view of audience at the Open Lecture

ICUS/INCEDE Activity Record

Prof. T. Uomoto attended the International Congress on Challenges of concrete Construction held at Dundee, UK from 5th to 11th September, and also attended the meeting of the ISO panel TC 71 on Concrete.

Prof. K. Meguro attended the Earthquake Related Insurance and Financial Risk Management and the 27th Annual Hazards Research and Applications Workshop during 3rd to 8th July and 14th to 19th July, respectively. The Conferences were held at St. Petersburg Russia and Boulder USA, and highlighted the need to involve professionals from sectors such as banking, finance, insurance, etc. in developing a comprehensive approach to disaster mitigation.

Prof. R.Ooka participated in the Landscape Frontier 2002 held at Kita Kyushyu in Japan from Sept 30th to Oct 3rd.

Dr. D.Dutta participated in the International Symposium on Geoinformatics for Spatial Infrastructure Development in Earth and Allied Sciences 2002 held from 25th to 28th August at Hanoi in Vietnam.

Dr. S. Ochi participated in The 2nd Regional Seminar on Geo-Informatics for Asian Eco-System Management (India) from 10th to 12th September, organized by the Asian Institute of Technology (AIT) and the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) at the Indian Institute of Remote Sensing, Dehradun, India. 23 resource persons and 39 participants from India, Japan, Malaysia, Nepal, Thailand and Vietnam attended the seminar.

Dr. S. Ochi also participated in the MAP Asia 2002 at Bangkok, Thailand from 7th to 9th August. More than 500 delegates from over 30 countries attended the conference held at the initiative of the AIT, the Centre for Spatial Database Management and Solutions (CSDMS), India, and the Geo-Informatics and Space Technology Development Agency (GISTDA), Thailand. Professor S. Murai, Emeritus Pro. of the University of Tokyo was awarded the "Life Time Achievement Award" for his contributions in the field of remote sensing by the organizing committee.

Professor Uomoto (Right, Front) with some other Japanese delegates

Visitor to ICUS/INCEDE

Dr. Seok-Kyun Park, Associate Professor, Department of Civil Engineering, Taejon University, South Korea visited ICUS, IIS on July 31st.

Prof. Park specializes in nondestructive testing of concrete structures and is a former graduate student of the Department of Civil Engineering. at the University of Tokyo. He completed his D.Engg in 1996 on application of radars for monitoring of concrete structures, under the supervision of Professor Taketo Uomoto.

ICUS personnel

Ms Yuriko Ochi and Ms Eiko Yoshimoto joined as Secretaries at the ICUS in September.

Dr. Sudhir Misra joined as Visiting Professor on July 15th for about a year from the Department of Civil Engineering, Indian Institute of Technology, Kanpur India. This is his second stint at ICUS after a brief stay last year. During this stay here, Dr. Misra will work closely with Prof. Uomoto and participate in teaching and research activities. He will also devote part of his time to work with a sub-committee of the Japan Society of Civil Engineers translation with the responsibility of publishing the English translation of the Japanese standard specification for design and construction of concrete structures. Dr Misra is an alumnus of the Tokyo University and worked during his graduate studies here (1984-1989) with Prof. Uomoto.

Welcome to ICUS.

Ms.Yuriko Ochi

Ms.Eiko Yoshimoto

Editor's Note

During late July and August, the University of Tokyo observes summer vacation, and this year it was a very hot and humid period with the temperatures reaching more than 33°C even in the beginning of July. I used the vacations this year to visit Hida-Takayama with my students in August and attend an International conference in Dundee, Scotland in September.

Hida-Takayama, one of the historical cities in Japan, is set in picturesque setting and has architecture and culture quite different from Tokyo. Located on the west side of Japan North Alps and known for the heavy snow falls in winter, the city of Takayama is just like Kyoto, with old houses still being used. Such houses having sloping roofs are to be found only in a small limited area and are built using the traditional "Gassho-zukuri" (literally meaning 'made in the manner of folded hands') method. I hope the following photograph conveys the idea.

Weather in Dundee in September was quite cool and the temperature difference with Tokyo was more than 15°C!!. I had the opportunity to have dinner in Gramis Castle, where H.E. Queen Elizabeth spent her younger days. The castle is beautiful and I enjoyed the bug pipes at the welcome and nice drinks and traditional food - indeed an experience that we cannot have in our country.

At the moment, we are busy preparing to hold an International Symposium and to open a network office in Bangkok, Thailand. At the end of September, we bid farewell to our secretary, Ms. Murakami, who left Japan to join her family in Shanghai. New secretaries, Ms. E.Yoshimoto and Ms. Y.Ochi have joined ICUS during this period, and I am sure we will be able to keep you posted on the latest developments here.

(Taketo Uomoto)

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ICUS/INCEDE
INSTITUTE OF INDUSTRIAL SCIENCE THE UNIVERSITY OF TOKYO
International Center for
Urban Safety Engineering

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International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

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Remote Sensing Activities in India

by

R. S. TIWARI and Onkar DIKSHIT

Remote Sensing (RS) activities, in India, may be said to have started in 1962 with the formation of the Indian National Committee for Space Research. In the same year, work on equatorial rocket launching station at Thumba (TERLS) was started from where the first sounding rocket was launched in 1963. The early remote sensing scene was primarily dominated by the Geological Survey of India (GSI), where with the advent of low-flying aircraft for aerial surveys, large sections of the country were surveyed using magnetic, electro-magnetic and radiometric sensors. Aerial magnetic surveys over parts of states of Rajasthan, Bihar, West Bengal and Andhra Pradesh, covering nearly 90,000 sq. km, were carried out in 1967-68 under 'Operation Hardrock', which yielded a wealth of information on geophysical anomalies.

The Indian Space Research Organization (ISRO), which is the nodal agency for various RS activities India was established in 1969. ISRO has been involved in the development of satellite launch vehicles, sensors, aerial surveys, image analysis and interpretation and planning of satellite based resource surveys. A number of successful RS surveys for a variety of applications, in collaboration with other user agencies, have since been carried out by ISRO. The establishment of the Space Applications Centre (SAC) at Ahmedabad in 1972 put RS activities in the country on a more organized basis and sound footing. Following the launch of India's first satellite Aryabhatta in 1975, ISRO has sent a number of satellites in space and has initiated actions for future space programmes.

REMOTE SENSING IN INDIA

The widespread RS activities in India are presently taken care of by the central and state government departments, academic institutions and private enterprises. Primarily, the Department of Space (DOS), a nodal department of the central government, is involved in RS activities through its various wings such as ISRO, National Natural Resources Management System (NNRMS), and National Remote Sensing Agency (NRSA). ISRO, through the Space Application Center (SAC) at Ahmedabad and Regional Remote Sensing Service Centres (RRSSCs) situated at Nagpur, Bangalore, Kharagpur, Dehradun, and Jodhpur, promotes regional and national RS applications. Besides undertaking various application programmes, an important aspect on which ISRO has directed its efforts, all along since its inception, is to develop technology for sending country's own satellites in space. The NNRMS is responsible for ensuring optimized utilization of the country's natural resources through a proper and systematic inventory of various resources. For this, it has created the Natural Resource Information System (NRIS) where resources data at district, state and national level has been maintained. It also facilitates establishment of infrastructure, generation of

trained manpower and supports collaborative efforts in development of hardware and software for processing of satellite and other data.

The establishment of NRSA in 1974, an autonomous organization of the Department of Space, has further strengthened RS activities in the country. Its objectives have remained as remote sensing data acquisition, archival, processing and dissemination; operation of flight facility to provide aerial remote sensing; applications of remote sensing for survey and monitoring of natural resources and research and development. It has carried out a number of projects that include airborne geophysical survey for the Department of Atomic Energy (DAE) and aerial photographic surveys for the Survey of India (SOI). It also imparts training in various application areas to the personnel from user departments through the Indian Institute of Remote Sensing (IIRS), Dehradun. IIRS, established initially as a part of the SOI, was brought under the NRSA in 1976 with the primary responsibility of developing trained manpower in RS. The IIRS campus at Dehradun has another unique facility at the initiative of United Nations, known as the Center for Space Science and Technology Education in Asia and Pacific (CSSTE-AP), to provide education and training in remote sensing to personnel from Asia and Pacific region.

The Indian space programmes have remained directed to three aspects, i.e., development of remote sensing satellites called IRS series, development of communication and meteorological satellites called INSAT series and development of different types of launch vehicles to put the satellites in proper orbits. So far seven IRS satellites known as IRS-1A, IRS-1B, IRS-1C, IRS-1D, IRS-P3 and IRS-P4 (OCEANSAT), and Technology Experiment Satellite (TES) have been launched. Out of these the first two, IRS-1A and 1B, have completed their useful life while the remaining five form the largest constellation of remote sensing satellites in the world, offering a variety of data in different spectral bands and spatial resolutions. Some important characteristics of Indian satellites and sensors have been listed in Table given below. The TES, launched on board PSLV-C3 on October 22, 2001, is an

Table: Characteristics of (a) Indian satellites for earth observation, and (b) the on-board sensors

(a)

Parameters	**Bhasakara-I & II**	**IRS-1A/1B**	**IRS-1C/1D**
Class	Spin-stabilized	3-axis stabilization	3-axis stabilization
Weight (Kg)	444	975/989	1247
Power (W)	47 W from solar panels and Ni-Cd batteries	709 W from solar array (EOL) 2 Ni-Cd batteries	813 W from solar array (EOL) 2 Ni-Cd batteries
Mission life	One year	Three years	Three years
Launch	1979, 1981	1988 / 1991	1995
Orbit			
Height (km)	Apogee 557 Perigee 572	904	≈ 817
Inclination (degrees)	50.7	99.028	98.12
Type	Near circular	Sun-synchronous	Sun-synchronous
Equator crossing time		10:25 Hrs.	10:30 Hrs.
Repetitivity (days)	-	22	24

(b)

	Bhasakar I/II TV	**Bhasakar I/II SAMIR**	**IRS-1A/1B LISS-I/II**	**IRS-1C/1D LISS-III**	**IRS-1C/1D PAN**	**IRS-1C/1D WiFS**
Type	TV camera microwave radiometer	Dick-type	CCD camera	CCD camera	CCD camera	CCD camera
Spectral Bands (μ m)	0.54-0.66 0.75-0.85	19, 22, 31 (GHz)	0.45-0.52 0.52-0.59 0.62-0.68 0.77-0.86	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	0.50-0.75	0.62-0.68 0.77-0.86
Ground resolution	1 km	125 km	73 m/36.5 m	≈23.5 m (Visible) 5.8 m ≈70.5 m (SWIR)		188 m
Swath (km)	≈341	148/2X74	≈141 ≈148	70	810	
Steering	Nadir	Nadir	Nadir	Nadir	Steerable ±26°, stereo	Nadir looking

experimental satellite to demonstrate and validate in-orbit technology that could be used in the future satellite programmes. TES also carries a panchromatic camera with a spatial resolution of 1 m.

INSAT system is the largest domestic satellite communication system in Asia Pacific Region comprising of four satellites, INSAT-2C, INSAT-2D, INSAT-2E and INSAT-3B. The earlier satellite INSAT-1D, launched in June 1990, was used for meteorological imaging and a few other services. INSAT-2B, which was launched in July 1993, has been decommissioned from regular services but is being used for Satellite Aided Search and Rescue and Data Relay Services and a few other scientific experiments.

The successful first test-flight of Geo-synchronous Satellite Launch Vehicle (GSLV-D1) from Sriharikota on April 18, 2001 has been a significant milestone in the development of country's space launch vehicle programme. Another important event, during this period, has been the successful flight of PSLV-C3 on October 22, 2001 from Sriharikota. In this fifth consecutive successful flight, PSLV placed three satellites- Indian TES, Belgian PROBA and German BIRD into polar sun-synchronous orbit thus establishing the reliability of PSLV for launching multiple satellites.

Besides above, almost all the state governments have established state remote sensing application centers to take care of their RS related activities. Further, several other departments such as Oil and Natural Gas Commission (ONGC), Forest Survey of India, Department of Agriculture and Cooperation, Department of Environment and Forest, and GSI

Locations of major Remote Sensing facilities in India

Table: Academic and other institutions offering degree and other programmes in Remote Sensing

No.	Name of Univ. / Institute	Course
1.	Aligarh Muslim Univ..	M. Phil and Ph. D.
2.	Andhra Univ., Visakhapatnam	M. Tech.
3.	Anna Univ., Chennai	M. Tech. and Ph. D.
4.	B. M. Birla Science and Technology Center, Jaipur	M. Tech.
5.	Bharatidasan Univ., Tiruchirapally	P.G. Diploma, M. Phil. and Ph. D.
6.	Indian Institute of Technology, Kanpur	M. Tech. and Ph. D.
7.	Indian Institute of Technology, Mumbai	M. Tech. and Ph. D.
8.	Indian School of Mines, Dhanbad	M. Tech.
9.	Jamia Millia Islamia, New Delhi	M. A. / M. Sc.
10.	Indian Institute of Technology, Roorkee	M. E. and Ph. D.
11.	Regional Engineering College, Warangal	M. Tech. and Ph. D.
12.	Jawahar Lal Nehru Technical Univ., Hyderabad	M. Tech. and Ph. D.
13.	Indian Institute of Remote Sensing (IIRS), Dehradun	Training programmes of varying lengths of time. These programmes are usually attended by staff of various user organizations.
14.	Survey Training Institute (STI), Survey of India, Hyderabad	
15.	National Bureau of Soil Survey and Land Use Planning, Nagpur, Bangalore	
16.	Forest Survey of India, Dehradun	
17.	Geological Survey of India Training Institute, Hyderabad	
18.	National Natural Resources Management System, Bangalore, Dehradun, Jodhpur, Kharagpur, Nagpur	
19.	Space Application Center, Bangalore	
20.	National Remote Sensing Agency, Hyderabad	

etc., and private organizations such as ROLTA India (Mumbai), Speck Systems Limited (Hyderabad), HOPE Technologies (Delhi), RMSI (Delhi) etc. are also involved in remote sensing applications related project.

The location of the some of the facilities involved in RS in India is shown in the map of the country given on the previous page.

EDUCATION, TRAINING AND RESEARCH

The names of the universities/institutes and other institutions offering degree and other training programmes in remote sensing - on regular basis are given in the Table on the previous page. It can be seen that education and training in RS and allied subjects in various institutions has, unfortunately, not been undertaken at the desired pace, in spite of the fact that there is a growing need for trained personnel in these fields. The result is that there is a dearth of trained personnel to handle and efficiently utilize the large amount of data available from country's own satellite system. In fact, the school and college level education in this field is practically non-existent.

Non-availability of qualified and trained personnel in RS and allied fields has not only hampered proper exploitation of the available data but has also affected the related research programmes in various application areas. The research in RS and related areas is being carried out either at the government departments/organizations or the academic institutions and the funding generally comes from government departments such as University Grants Commission (UGC), Department of Science and Technology (DST), All India Council for Technical Education (AICTE), Indian Space Research Organization (ISRO) and Defense Organizations. There is a need, however, to have more concerted efforts to generate coherent research and education programmes than the present isolated efforts on the part of individuals.

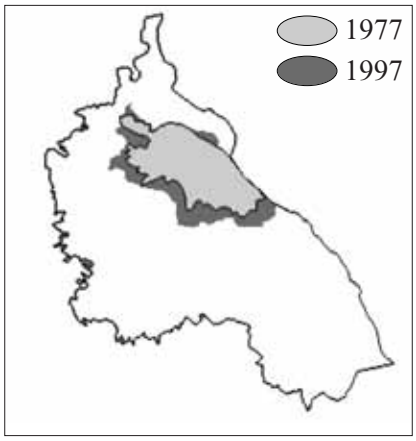
APPLICATIONS OF REMOTE SENSING

As mentioned earlier, RS applications started in the country with the advent of aerial photography, particularly in the field of geology and mineral exploration. Subsequent applications in the field of natural resources exploration were taken up, after the development of space borne multispectral sensors. Some major applications carried out at the national level include the mapping of forest cover, wasteland, soil resources and land use mapping for agro-climatic zoning. With the availability of more sophisticated sensors, the application areas have been extended to urban mapping, industrial site selections, pollution studies, engineering applications and disaster management such as floods and drought monitoring, landslide hazard zonation, earthquake damage assessment etc.

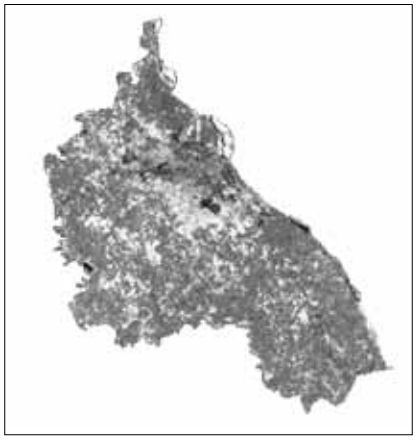
Two examples of RS applications are briefly explained using the adjacent figures. The top two photographs show the urbanization observed in the neighbourhood of the city of Kanpur during the last 20 years, and a false color composite of the district using IRS 1C LISS III sensor data. The photographs at the bottom show the emergence of channels due to liquefaction in Rann of Kachchh in western India after the major earthquake in Gujarat in January 2001.

The following projects are also noteworthy from the viewpoint of RS application in the country:

- Mapping and monitoring of major floods in the country

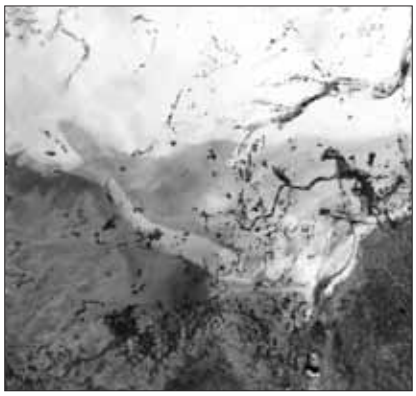


Urbanization in the Kanpur district over 20 years



FCC of Kanpur district using IRS 1C LISS sensor data

(a)Pre-earthquake(Jan 2,2001)



(b)Post earthquake(Jan 29,2001)

Channel formation in the Rann of Kutch due to liquefaction during earthquake

using IRS (optical) and RADARSAT (microwave) satellite data to get district level inundation information for relief operations
- Change detection analysis of Gujarat earthquake of January 2001 for damage assessment using LISS-3 and PAN data, including changes in ocean parameters,
- Landslide hazard zonation mapping at 1:25,000 by merging LISS-3 and PAN data
- Preparation of district level zoning atlases for environmental risk assessment in siting of industries
- Change detection and growth trend analysis for planning urban development
- Integrated mission for sustainable development
- Carrying capacity based development planning for Delhi and Doon valley
- Mineral targeting on a regional scale under project Vasundhara

FUTURE PROGRAMMES

RS activities in India have come a long way to make the country as one of the leading nations in space programmes. Future programmes, besides routine applications, are more interesting and ambitious. These envisage using satellite data for advanced cartographic applications, launching of recoverable satellites so that payload could be reused to cut down the cost of future missions and launching of a satellite for telemedicine purposes. For cartographic applications such as cadastral mapping, urban and rural management, coastal land use and regulation, utilities mapping and development etc., CARTOSAT series satellites have been planned. IRS-P5 (CARTOSAT-1), having spatial resolution better than 2.5 m, will be launched by PSLV in polar sun-synchronous orbit at an altitude of 618 km with a 30 km swath. The satellite will carry two steerable panchromatic cameras suitably mounted to provide stereo pairs of images. Likewise, CARTOSAT-2 will also be launched in polar sun-synchronous orbit at an altitude of 630 km and a special orbit of 560 km, so as to have a revisit period of 4 days and 1 day respectively. It will carry an advanced panchromatic CCD camera with the spatial resolution of less than 1 m with 10 km swath.

Another satellite, IRS-P6 (RESOURCESAT) will have a polar sun-synchronous orbit at an altitude of 817 km. The payload of this resource satellite will have multi-spectral camera LISS-3 having 23.5 m spatial resolution in all four bands with a swath greater than 140 km, a high resolution multispectral camera LISS-4 to provide 5.8 m resolution in three bands and an Advanced Wide Field Sensor (AWiFS) camera with a spatial resolution better than 70 m in three bands with a swath of 700 km.

ACKNOWLEDGEMENT

The information derived from various publications of ISRO and NNRMS, Bangalore, NEERI Nagpur, and Current Science, Bangalore, for this paper is gratefully acknowledged.

Editor's note: Due to limitations of space, some tables, etc could not be included here. An extended version of this article, including a historical review of the remote sensing activities in the country, is available at the ICUS website. Though the readers could write to ICUS also, the authors will be only too glad to assist and provide additional information. Correspondence to the authors can be addressed to onkar@iitk.ac.in

- Authors -

Prof. R. S. Tiwari is Adjunct Professor in the Dept of CE at Indian Institute of Technology, Kanpur, where he joined after a distinguished career spanning more than 35 years at the IIT Roorkee. Prof Tiwari has been one of the pioneers in Remote Sensing activities in India, and his research interests include applications of close range photogrammetry in engineering and biomedicine, and applications of remote sensing and photogrammetry for mapping and natural resources evaluation.

Dr. Onkar Dikshit is Associate Professor at Dept of CE at Indian Institute of Technology, Kanpur. His research interests include applications of remote sensing, photogrammetry, GIS, GPS, and digital image processing to engineering and natural resource management problems.


Dr. Tiwari


Dr. Dikshit

ICUS Activities Recognized

Mr. H. Kanada working with Prof. Uomoto, and Mr. S. Fujita, Ms. M. Enomoto and Ms. P. Mayorca working with Prof. Meguro, won a prize for excellent presentation at the 2002 Annual meeting of the Japan Society of Civil Engineers held at Sapporo in September. The names of awardees were announced in November.

Mr. W. Takeuchi a graduate student working with Prof Yasuoka won the Best Paper award for his paper at the autumn meeting of the Japan Society for Photogrammetry and Remote Sensing.

International Symposium on

New Technologies for Urban Safety of Mega Cities in Asia

The International Center for Urban-safety Engineering (ICUS) of the Institute of Industrial Science (IIS), the University of Tokyo and the School of Civil Engineering, Asian Institute of Technology, Bangkok organized a one-day International Symposium on New Technologies for the Safety of Mega Cities of Asia on October 28th at Bangkok. The symposium sought to bring together all the participants involved in creating and maintaining the present day urban environment - policy makers, planners, engineers and architects.

The Symposium was inaugurated by the Honorable Minister of Transport HE Mr Suriya Jungrungreongkit of the Royal Thai Government and Honorable Senior Vice-Minister HE Mr Kenzo Yoneda in the Cabinet Office of Japan.

In his inaugural address, HE Mr. Suriya Jungrungreongkit welcomed the timely discussion on the subject of Urban Safety, and mentioned the urgent need to address the issue of partially completed building structures in Bangkok, whose present integrity needs to be established before a decision on their further development can be taken. In his inaugural address, HE Mr. Yoneda briefly outlined and reiterated Japan's continued support and participation in efforts related to disaster mitigation and urban safety. He also emphasized Japanese willingness to share with the other countries know-how and expertise gathered over the ages in dealing with natural forces such as earthquakes and typhoons.

The inaugural session of the symposium was co-chaired by Prof. Y Yasuoka, Deputy Director-General, IIS, University of Tokyo and Prof. JL Armand, President of AIT. Speaking at the symposium, Prof. Armand welcomed the delegates and participants, and lauded the important role Japan had played in building and maintaining the international stature of AIT. In his message to the Symposium read out by Prof. Yasuoka, the Director General of the IIS, University of Tokyo, called for a closer cooperation between the researchers and academicians of the region to ensure better utilization of scarce technical and human resources.

Prof. Shunji Murai, Professor Emeritus, University of Tokyo and Professor, Keio University, delivered one of the two Keynote lectures. The title of his talk was Advanced Technologies in Geoinformatics. Dr. Wicha Jiwalai, Chairman, Executive Board, Geo-Informatics and Space Technology Development Agency of Thailand (GISTDA), delivered the other Keynote lecture on the Information Needs for Urban Safety Assessment.

Dr. Suvit Vibulsresth, Director, GISTDA, and Prof. Worsak Kanok-Nukulchai, Dean, School of Civil Engineering, AIT, also delivered Special Lectures in the morning session of the Symposium. While Dr. Vibulsresth's talk concentrated on the Satellite Observation Programs in Asia, Prof. Worsak highlighted the different facets of activities for urban safety at the AIT.

In the afternoon session of the Symposium, more than 20 technical papers were presented by researchers and professionals from Thailand, Japan, Singapore, and Hong Kong, highlighting the advanced technologies, such as remote sensing, GIS, GPS and other computational tools that can be used to devise appropriate methodologies for the management and maintenance of urban buildings and infrastructures in mega cities, and disaster mitigation.

Readers may also visit the ICUS website for more information on the Symposium, The Proceedings of the papers presented has also been published, and readers may write to us for more information - Editor

ICUS Director(Extreme left)with other dignitaries

Participants at the symposium

Regional ICUS office inaugurated

At a simple ceremony on October 29th, 2002, the School of Civil Engineering, Asian Institute of Technology (AIT) and the International Center for Urban-safety Engineering (ICUS) of the Institute of Industrial Science (IIS), the University of Tokyo established a Regional Network Office for Urban Safety (RNUS), at the AIT's School of Civil Engineering (SCE). An agreement towards developing joint research programmes and cooperate in developing strategies for tackling issues related to urban safety was also signed.

Prof. Jean-Louis Armand, AIT President, Prof. Mario Tabucanon, Provost, AIT, Prof. Yoshifumi Yasuoka, Vice Director-General of IIS, University of Tokyo attended the ceremony in addition to Prof. Taketo Uomoto, Director, ICUS and Prof. Worsak Kanok-Nukulchai, Dean, School of Civil Engineering, AIT, and other members of the ICUS and AIT faculty.

In their brief remarks, the dignitaries recalled the longstanding partnership between the AIT and the University of Tokyo, and the agreement for long-term cooperation between the AIT and the Institute of Industrial Science/University of Tokyo. It was unanimously felt that the establishment of the RNUS could serve as an important milestone in closer cooperation between the academicians and researchers of the region.

The brief ceremony was followed by a meeting between faculty members of the ICUS, and the SCE, AIT, and academics and researchers from some of the academic and research institutions in Bangkok, besides the AIT such as the Thammasat University and the Chulalongkorn University. The meeting focused on identifying areas of common interest for future collaborative research. During the meeting, the importance of developing accurate databases for large cities was emphasized. It was decided to form two working groups to work in the following areas:

(a) collection of information related to concrete structures including the incomplete and 'abandoned' buildings', deteriorated infrastructure such as highway bridges, etc., and,
(b) use of remote sensing data for applications such as mitigation of damage on account of floods.

With the opening of the Regional office at AIT, it will become possible for an ICUS faculty to spend more time there and participate in the formulation and execution of joint research programmes.

Prof. Uomoto and Prof.Worsak sign a MOU for mutual cooperation

Some of the AIT and ICUS faculty at the regional office opening

ICUS/INCEDE Activities Record

Besides the symposium on New Technologies for the Safety of Mega Cities of Asia, the following are some of the International Conferences and Symposia attended by the ICUS staff.

Prof. T.Uomoto and Prof. S. Misra attended the meeting of the International Concrete Committee for Model Code and the Asian Concrete Forum at Seoul from 1st to 4th November. Prof. Uomoto also attended the 9th Intl. Conf. on Shotcrete for Underground Support at Kyoto from 17th to 20th November.

Prof. Y.Yasuoka attended the Third Intl. Asia-Pacific Symposium. on Remote Sensing of the Atmosphere, Ocean, Environment, and Space, at Hangzhou China from 22nd to 27th October.

Prof. R.Ooka participated in the 2nd Intl Workshop on Energy and Environment of Residential Building China from 13th to 17th October at Shanghai, China.

Visitor to ICUS/INCEDE

Ms Natacha Matsunuma, of the CIRMM - CNRS, Paris, visited ICUS on December 6th and met Prof. T.Uomoto, Director, who briefed her about the activities of the ICUS and the setting up of the office at AIT.

Editor's Note

Konnichiwa. I feel happy and privileged to have the opportunity to work on the present issue, and I hope you find it interesting. I also hope that our Newsletter has now become a regular part of your office library, as this seventh issue reaches you after the Center was established in April 2001.

I joined the center in July and have now gotten more or less used to the working here, though Japan is not a new place for me, as I did my graduate studies at the University in Tokyo, and also worked here for about 5 years. Apart from the tremendous proliferation of the mobile phones (keitai), its business as usual. Only, as part of an rationalization of portfolios at the highest level, the Ministry of Construction (Kensetsusho), which played a tremendous role in the rebuilding of Japan after the Second World War, and was a 'dream job' for many a Japanese civil engineer has been reorganized into a 'Ministry of Land, Infrastructure and Transport'. Well, old order changeth!!

Some of my time here has been spent on helping in the organizing the symposium at Bangkok and opening of the regional office at AIT, as reported in the current issue. I hope that this marks a new era in regional cooperation and sharing of scarce human and technical resources. The growth of the number of cities with a population exceeding one million from 28 in 1950, to 136 in 1995 and projected to be almost 250 in 2015, is a clear indication of the burden on the urban infrastructure in the years to come.

Besides the work at the center, I have tried to update my information about the developments in the traditional Japanese sport of Sumo. I have discovered that Asashoryu, a fighter from Mongolia, is the new 'emerging' star, and should be in line for attaining the (highest) rank of yokozuna, if he does well in the January tournament.

On behalf of the ICUS, I invite you to send us a short communication on research and other activities at your end, which we could include in future issues of the Newsletter. You can send mail at icus@iis.u-tokyo.ac.jp.

(Sudhir Misra)

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ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

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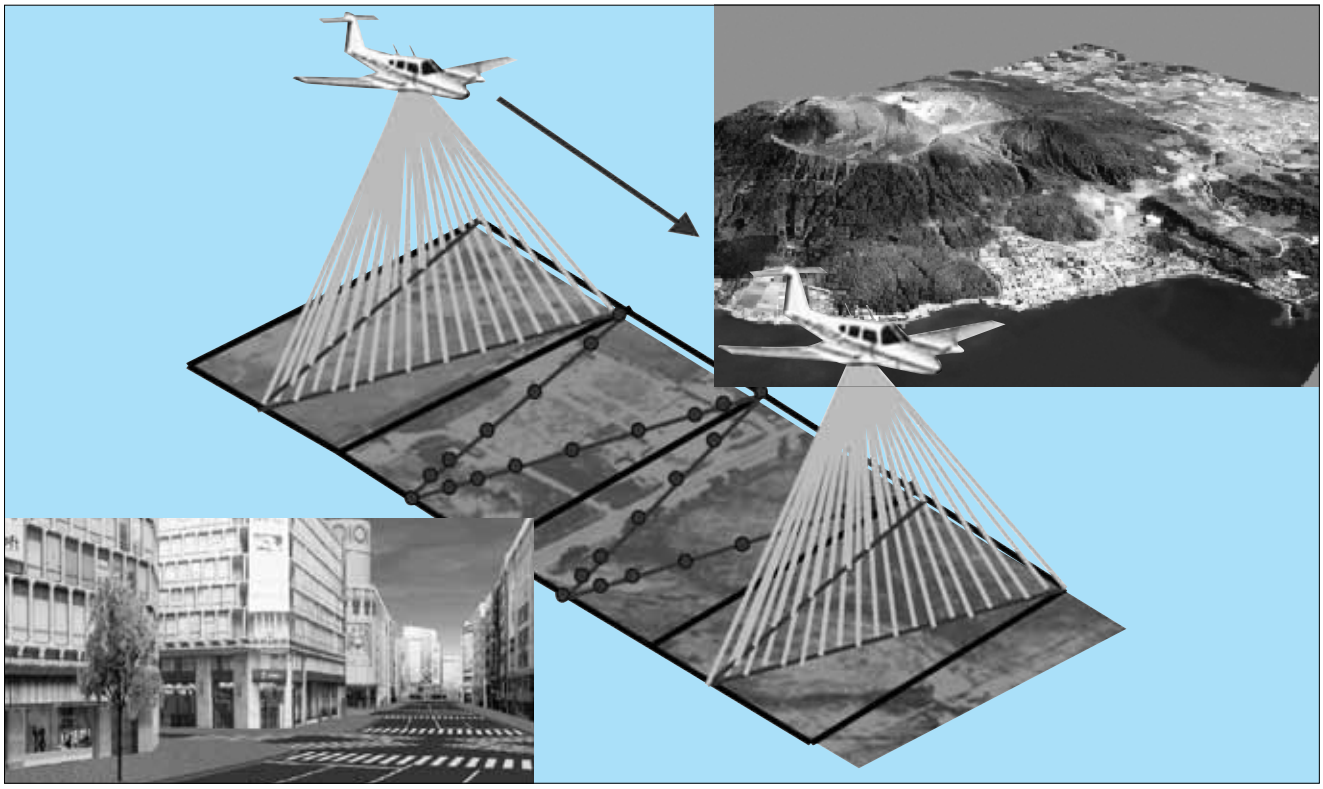
Creation of DEMs for Urban Areas from Airborne Laser Scanner Data and Their Applications

By

Masahiro SETOJIMA*

In recent years, many cities and their surrounding areas in Japan have faced difficult problems associated with natural disasters and global environmental changes. It is only eight years since the Kobe Earthquake (January 17, 1995) killed over 6,400 people, and the fear of the urban disaster is still vivid in our memory. Moreover, there is an apprehension about a big earthquake in the Tokai region. Besides large-scale disasters such as large magnitude earthquakes, a number of river floods, especially urban floods due to drainage overflow caused by intense rainfall are increasing in the cities and their surroundings.

In the surrounding areas of cities, on the other hand, there are many occurrences of landslide disasters due to the degradation of



Concept of measurement by airborne laser scanner

the natural environment and the devastation of suburban forests resulting from ongoing urbanization. In addition, we had experienced serial volcanic eruptions in the past decade, beginning with the eruption of Mt. Unzen-Fugen (Nagasaki) in 1990 followed by the eruptions of Mt. Usu (Hokkaido) and Miyake Island (Tokyo).

As for the global environment, the heat island phenomena occurring in the cities have drawn people's attention in recent years, and urgent countermeasures need to be taken immediately. In addition, urgent reduction of the greenhouse gases, such as carbon dioxide, causing global warming, is needed.

To solve these problems related to natural disasters and environmental issues occurring in cities and their surrounding areas, it is indispensable to construct and utilize geographical information databases storing a wide variety of geographical information associated with those areas. Among various types of geographical information, Digital Elevation Models (DEMs) are the most fundamental geographic information.

This article describes the basics of airborne laser scanners (hereinafter, abridged as airborne LS), which have recently drawn attention as a means to speedily generate DEMs at high accuracy, and their applications.

Method to rapidly generate DEMs with high accuracy

Traditionally, aerial photogrammetry has been widely used to generate DEMs. It uses a pair of aerial photographs to measure topography, and is useful in preparing DEMs with relatively high accuracy. But, photogrammetric processes are usually time and labor consuming. It is also possible to create DEMs using a pair of images taken by remote sensing satellites. However, DEMs created from satellite remote sensing data are usually less accurate than those generated from aerial photographs. Besides, radar interferometry, which uses radar data captured by the radars mounted on artificial satellites or aircrafts, can be used to create DEMs. But, radar interferometry has some problems in terms of the available wavelength range and operability.

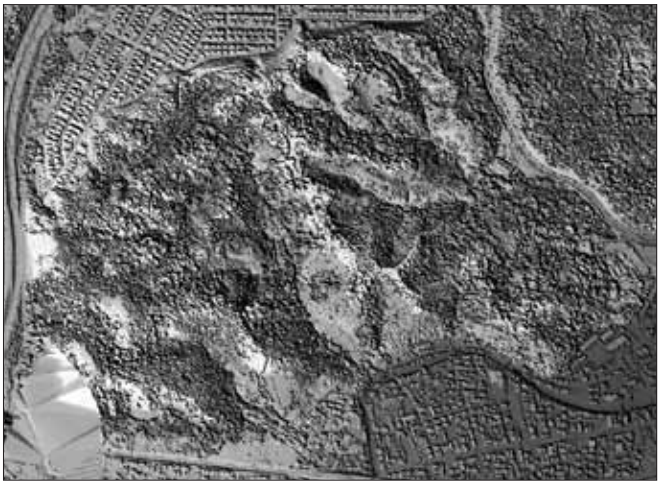
The use of airborne LS has been increasing as a method to rapidly generate DEMs at high spatial accuracy. Its great advantage is that it can acquire data through relatively easy operation.

Airborne LS is mounted on an aircraft or helicopter, and emits laser pulses towards the ground orthogonal to the flying direction (while scanning leftward and rightward); it receives the reflection of the pulses from the ground with a light receptor panel. The distance between the scanner and the target on the ground can be calculated from the time necessary for the laser pulses to make a return trip between the sensor and the target. At the same time, aerial images are taken with a high-resolution digital camera synchronously with the laser measurements. In this case, the aircraft is equipped with a Global Positioning System (GPS) and an Inertial Measurement Unit (IMU), so that the position and inclination of the fuselage at the moment of each laser measurement can be obtained by analyzing the data recorded with those equipments together with the measurement data of another GPS installed on the ground.

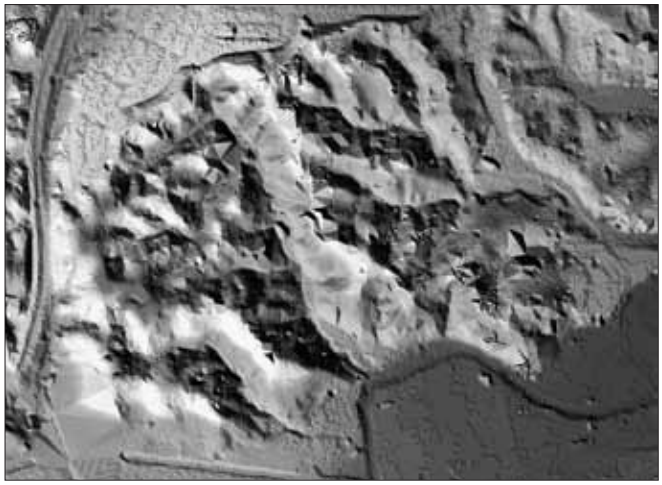
In general, the measurement altitude of airborne LS is 300 to 3,000 m, the scanning angle of airborne LS ranges between 5 and 45 degrees, and the scanning width is within 80 to 2,000 m. The measuring accuracy is ±30 cm in horizontal direction and ±15 cm in vertical direction.

Measurement of airborne LS data and DEM generation

Data collected with an airborne LS are three-dimensional (3D) point clouds corresponding to the surfaces of spatial objects on the ground such as the ground surface, buildings, bridges, roads, trees, vehicles, etc. They are called Digital



Shading drawing of DSM



Shading drawing of DEM after filter processing

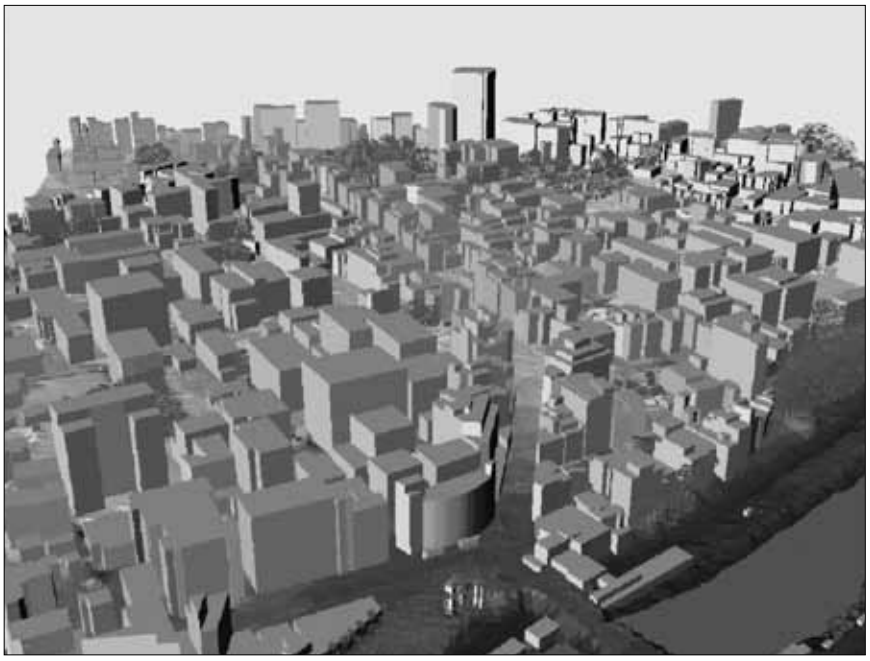
Surface Model (DSM) and distinguished from DEMs.

Data filtering is needed to create a desired DEM from a DSM. Data filtering consists of two major processes: i) elimination of noises and ii) elimination of ground objects such as trees and buildings. To remove noise from DSMs, the points reflected from dusts in the air, clouds, etc. are eliminated first. Then, the noise due to mirror surface reflections from building walls covered with glasses, etc. are removed. To eliminate trees and buildings from DSMs, the search size and threshold are determined respectively for tall, middle height and low height buildings, trees and small areas first. Next, the points come under these thresholds are sequentially removed. A DEM is generated through such processes.

Creation of 3D city model

3D city models constructed using airborne LS data can be utilized as the essential information for predicting the damages of urban disasters such as earthquakes and floods. In addition, it can be used as the basic information for the maintenance and management of urban facilities. Frequent updates of the geometrical information of ground objects are needed in these applications. Airborne LS, which allow us to conduct measurements of the shapes of ground objects rapidly, may be an optimal means for 3D city modeling.

The two figures of this page show 3D city models created by extracting point clouds corresponding to buildings and trees on the ground through high-pass filtering with Fast Fourier Transform applied to an airborne LS data, and by applying a polygon processing technique to the aerial image data taken with a CCD camera simultaneously with the acquisition of the airborne LS data to reconstruct spatial objects such as buildings and trees.



Three-dimensional expression of close-range view of a city made by laser scanner

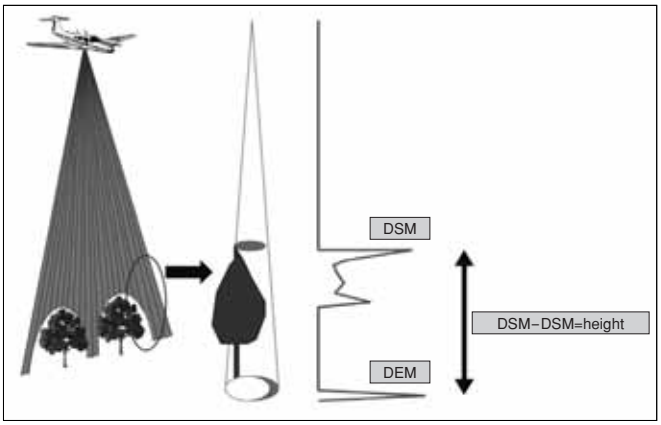
Use of DEMs for topographic analyses of slope lands

Debris flows, slope failures and landslides often occur in the outskirts of many cities in Japan. For those areas, detailed geomorphologic studies of the slope lands should be carried out for planning countermeasures against slope disasters. Ground surveys are not optimal for the purpose, because the high labor-cost due to the heavy vegetation cover in those areas. The use of airborne LS, on the contrary, appears to be a good alternative for surveying terrain features of the slope lands.

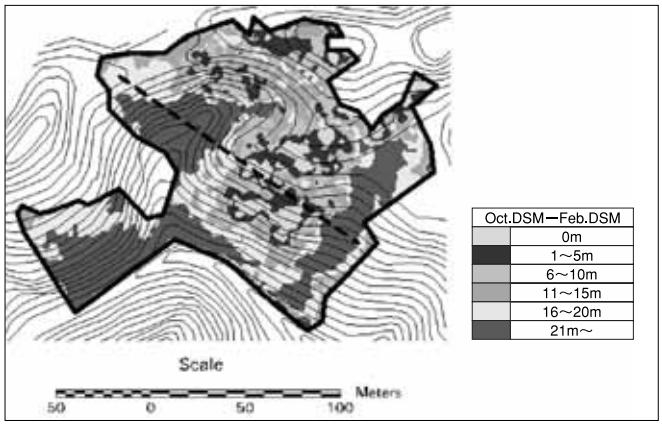
Tree height measurements and forest structure analyses

Measurement of the tree heights of a forest, as well as the identification of the forest structure, provides important information for estimating the amount of carbon dioxide absorbed or fixed by the forest. Tree heights can be obtained by subtracting the height values at root positions of trees recorded in a DEM from

Three-dimensional expression of bird's-eye view of a city made by laser scanner



Concept of tree height measurement by DSM and DEM



Amount of change in vertical direction of DSM before and after defoliation

those at treetops recorded in a DSM.

In case of a deciduous forest, the vertical tree structure of the forest can be identified by comparing multi-temporal DSMs generated from airborne LS data taken before and after defoliation. Furthermore, with the technique mentioned above, the horizontal distribution pattern of the vegetation, such as shrubs and grasses, covering the lowest layer of a deciduous forest can be identified.

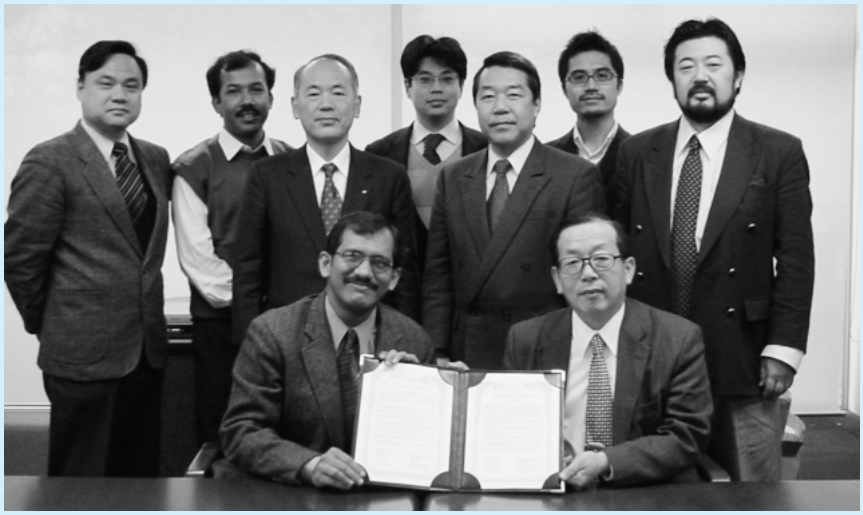
**Dr. Masahiro Setojima is a Visiting Professor at ICUS from Kokusai Kogyo Co., Ltd., Tokyo, Japan.*

ICUS Signs MOU with BES and NCEE of Bangladesh

On February 21, 2003 ICUS signed a Memorandum of Understanding (MOU) with Bangladesh Earthquake Society (BES) to work together to achieve common objectives towards urban safety. BES was founded in 2002. The aims and objectives of BES are mainly directed towards promoting research, development and awareness in the field of earthquake engineering.

On the same day, ICUS also signed an Agreement for Collaboration in Research, Education and Training Programs with the National Center for Earthquake Engineering (NCEE) of the Bangladesh University of Engineering and Technology (BUET). Through this agreement both the parties agreed to cooperate in the fields of mutual interest. Dr. Mehedi Ahmed Ansary, Associate Professor, Department of Civil Engineering, BUET, represented both the organizations in the signing ceremony, which took place at ICUS. Several staff members of ICUS attended the ceremony.

Through these MOU and Agreement, ICUS hopes to strengthen its working relationships with the researchers from Bangladesh for future collaborative activities.



Signing cermony was held at ICUS

WWF3 and First International Symposium of APHW held in Kyoto

The 3rd World Water Forum (WWF3) was held from March 16-23, 2003 in the three neighboring Japanese Prefectures of Kyoto, Shiga and Osaka holding 351 separate sessions on 38 interlocking themes dealing with water, especially on how to bring safe water and sanitation to the entire world. Some 24,000 participants from 182 countries, more than triple the number of participants expected, attended the sessions.

The Asia Pacific Hydrology and Water Resources Association, which was established in September 2002, organized its first international conference on "Hydrology and Water Resources in Asia Pacific Region" during March 13-15, 2003 in Kyoto. More than 350 people from over 30 countries participated in the conference.

Eight Years after the Kobe Earthquake

- Its impact on Earthquake Disaster Reduction Strategies in Japan -

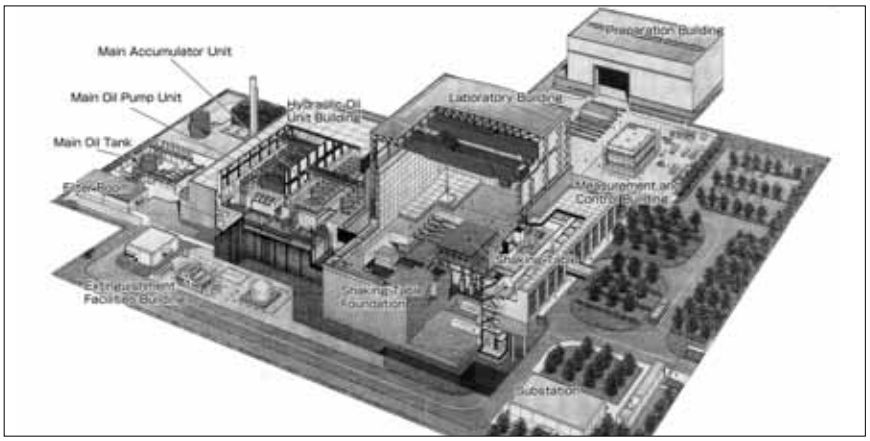
January 17, 2003 marks the eight anniversary of the Hyogo-ken Nanbu (Kobe) Earthquake, which killed about 5,500 people just after the event and eventually 6,433 people as of Jan. 2003. This devastating earthquake shattered the beliefs of Japanese engineers and researchers regarding building and infrastructure protection against earthquakes. During this eight-year period, many changes have taken place in earthquake disaster mitigation strategies in Japan.

One of the major impacts of the Kobe earthquake has been the changes taken place in the Japanese government organizations, from national to local levels, in order to efficiently implement countermeasures before and after a disaster event. Many local governments have established high positions to implement and manage proper disaster countermeasures.

Another effect has been the increased support of Japanese government to research on earthquake disaster reduction. Several new research centers, such as the Earthquake Disaster Mitigation Research Center, Disaster Reduction and the Human Renovation Institution, have been established in Kobe city.

Seismic monitoring and testing facilities have also improved. 1,000 seismometers (K-net) have been installed by the National Institute of Earth Science and Disaster Prevention (NIED). Now around 4,000 strong motion stations including K-net together with 1,200 GPS stations are regularly monitoring ground motion and seismic activity throughout Japan. A large 3D earthquake simulator (shown in the figure) is also being constructed by NIED. Once completed, it will allow experiments of total failure using full-scale structures.

Although these developments have contributed a lot towards improving the resistance of Japanese society against earthquakes, there are still several important and urgent issues to be addressed. The most important is retrofitting of old structures. In the Kobe disaster, over 80% of the victims were killed within 15 minutes after the earthquake due to collapse of structures, mainly residential houses. Furthermore, the main cause of firebreak and spread was structural collapse. Also, around 15% victims, who were killed by fires, could not escape from fires as they were trapped under damaged houses. Over 60% of the monetary loss was due to damage to residential houses. If structural damage were limited, the various problems generated after the event, such as community disruption, temporary shelter and refuge camps, construction demolition among others might not have been so severe. This is the most important lesson learnt from the Kobe event.



Schematic diagram of the world's largest 3D shaking table being constructed in Japan (Max. capacity: 1,200tf, 200kine, ±100cm)

The Kobe experience showed us that the structures constructed following the latest seismic code revised in 1981 performed well even in case of a severe ground motion. However, nearly 60% of the existing structure stock in Japan were constructed before 1981. These structures need urgent retrofitting to avoid a catastrophic disaster. To overcome this situation, a good environment is needed under which house owners are encouraged to retrofit their houses. The key issues are development of efficient low cost technologies and a new social system/law for retrofitting promotion. Role of the government in the latter issue is very important.

A government system that supports house owners to retrofit before an earthquake is not realistic as it needs a huge budget considering the number of vulnerable houses, while a government system that supports house owners in reconstruction of their collapsed houses after an earthquake is not a proper approach as it reduces the motivation of house owners for retrofitting and that leads to increased damage in the next disaster event. Japanese government should rather encourage the owners to retrofit their houses on their own. People can be motivated to retrofit if the government guaranties financial support to damaged houses only if they are retrofitted. Various simulations have clearly shown that this system with low cost retrofitting technology would give larger benefit to both citizen and government and definitely help reducing casualties and large-scale damage.

Within coming 30 to 40 years, Japan is going to be rocked by a series of M8 class earthquakes. At the present conditions, it is estimated that these earthquakes may cause an economic damage equivalent to 20 to 60% of the Japanese GDP. As natural hazards cannot be prevented, all the governments, local communities and individuals must make every possible effort before the events to reduce the vulnerability of buildings and infrastructure and avoid huge unbearable losses.

(K. Meguro)

Announcement: International Symposium on Oct. 30-31, 2003
- New Technologies for Urban Safety of Mega Cities in Asia -

Over half of the world's population is concentrated in urban areas covering just 4% of the world's surface. Mega cities are in particular characterized by a high population density. Rapid urbanization is a distinctive feature of Asia with a tremendous rate of population growth. It is estimated that by 2015, over 50% of the mega cities in the world are going to be in Asia. Due to rapid economic development, there has been a phenomenal growth of high-rise buildings and other infrastructure in the Mega Cities of Asia. However, this growth of infrastructure is not adequately balanced by the appropriate measures for their maintenance and management and that has led to a deterioration of urban infrastructures and resulted in urban disasters in many cities. Moreover, dense concentrations of populations are leading to high rates of water-related illnesses from lack of safe drinking water or adequate sanitation or environmental problems.

The recent developments of various advanced technologies including Remote sensing, GIS, GPS and other computational tools have generated scopes and motivation to focus on devising appropriate methodologies for management and maintenance of urban buildings, infrastructures, mitigation of urban disasters and environmental problems for sustainable development of the Asian Mega Cities with adequate safety and security.

As a large number of population is under potential risk, safety and security of Asian Mega Cities deserve increased attention of various concerned groups including the researchers and decision makers. With this realization and recognition of the importance of advanced tools in urban safety, ICUS is organizing a 2-day international symposium during October 30-31, 2003 on the use of advanced technologies towards development of methodologies for safety and security of Mega Cities in Asia. This is the second symposium organized by ICUS on this particular topic.

The prime objective of the symposium is to bring together decision makers, practitioners and researchers involved in these fields to share their expertise, knowledge and experience for tackling the critical issues of urban safety with advanced technologies.

The topics of the symposium include various issues related to advanced technologies for urban safety and security covering the following broad areas:

- Urban Disaster Mitigation
- Safety and Security Assessment of Urban Infrastructure
- Environmental Impact Assessment of Urbanization
- Space Technologies and GIS for Monitoring and Assessment of Urban Safety

For further details about the symposium, please visit the symposium home page at ICUS(http://icus.iis.u-tokyo.ac.jp/isus03/). The Symposium Secretariat can be contacted by telephone (+81-3-5452-6472), fax (+81-3-5452-6476) or, e-mail (icus@iis.u-tokyo.ac.jp).

ICUS Staff Activity Records

Some of the international activities carried out by ICUS faculty members during the period of January-March 2003.

- *Dr. D. Dutta carried out a field survey in the Pak-Mun River Basin in Thailand during February 16-20 for gathering data and information for hydrologic modeling.*
- *Dr. Shiro Ochi participated in the Regional Conference on Digital GMS held at AIT, Thailand during February 26-28.*
- *Dr. Yoshitaka Kato visited Bangkok, Thailand during March 11-14 for a field experiment and demonstration related to urban infrastructure health monitoring.*
- *Prof. Y. Yasuoka attended the Second EU-Japan Symposium on Climate Research held in Brussels, Belgium during March 13-14.*
- *Dr. Kimiro Meguro visited Maui, Hawaii, USA from March 23-26 to attend the 7th US-Japan workshop on Urban Earthquake Disaster Mitigation.*

Visitors to ICUS

Some of the international visitors to ICUS during the period of January-March 2003 are listed below:

- Prof. Ehrhard Raschke, Institute of Meteorological University, Hamburg and Visiting Professor, CCSR, The University of Tokyo (Feb. 5).
- A delegation of academicians working in Urban Environment fields from several regional universities of China (Feb. 10).
- Dr.Mehedi A. Ansary, Department of Civil Engineering Banladesh University of Engineering and Technology (BUET) (Feb. 21)
- Prof. Ashim Das Gupta and Prof. Tawatchai Tingsanchali, School of Civil Engineering, Asian Institute of Technology, Thailand (Mar. 11).
- Prof. A. W. Jayawardena, Hong Kong University, Hong Kong (Mar. 11).

ICUS held 4th Open Lecture on Water Related Issues in Mega Cities of Asia

As a large number of population is under potential risk, solving urban water issues in mega cities deserves increased public attention. With this realization, ICUS held its 4th Open Lecture on "Water Related Issues in Mega Cities of Asia in the 21st Century" in Tokyo on March 11, 2003. In this forum, five internationally renowned academicians and experts in the field of water from Asia Pacific region delivered talk on important water related issues in Mega Cities of Asia.

A snapshot from the Lecture Hall

The first speaker of the forum was Prof. Ashim Das Gupta of the Asian Institute of Technology (AIT), Thailand, who delivered a talk on "Emerging Challenges in the 21st Century to Meet the Demand of Water Supply in the Fast Growing Mega Cities of Asian Developing Countries". In his talk, Prof. Das Gupta covered a wide range of issues on new challenges facing by the developing countries of Asia to provide clean water to the residence of its growing mega cities. He has pointed out the need of coordinated efforts by all the concerned authorities to institute a framework to solve these problems, so that the future generation will not suffer adversely due to water crisis.

Prof. Katumi Musiake of the University of Tokyo talked on ìIntegrated Urban River Basin Management: Experiences from Past and Future Directions in Japan . In his lecture, Prof. Musiake gave the audience much insight of the Japanese experiences of managing water and the future directions with several examples and case studies.

Prof. Tawatchai Tingsanchali of AIT delivered a talk on "Strategic Framework and Institutional Arrangement for Flood Disaster Management in Large Cities in Thailand". In his talk, he elaborated the present strategy of the Government of Thailand for flood disaster mitigation in Thailand. He strongly emphasized the need of adopting a pro-active flood disaster management strategy of development instead of the existing reactive strategy to overcome the challenges of flood disaster reduction under changing socio-economic and climatic conditions.

Prof. Jayawardena from the Hong Kong University talked on issues "Towards Sustainable Development and Management of the Water Supply of Hong Kong". Through his presentation, he explained in depth how Hong Kong has been managing the increasing water demand. Hong Kong can be a model example for many Mega cities of Asia, especially in developing nations, in their efforts to manage the increasing water demand.

Prof. Kuniyoshi Takeuchi of the Yamanashi University, Japan talked on "Importance of Hydrological Forecasting for Integrated Urban Water Management". With the emphasis on need of hydrological forecasting and limitation of hydro-meteorological ground observation, he stressed on developing new initiatives to come out with alternatives for hydrologic predictions. He introduced the recent initiative of International Association of Hydrological Sciences (IAHS) on that direction about prediction in ungauged basins (PUB). It is envisioned that success of PUB will help the scientific community to come closer to the common public with better predictions.

Dr. Dushmanta Dutta of ICUS coordinated the forum. For any further information on the forum proceedings, please contact ICUS.

Prof. Musiake of IIS, the University of Tokyo, during his talk

Editor's Note

Advancement in technologies in the recent years has made it possible to undertake many new research activities in the fields of urban safety engineering. The main article of this Newsletter elaborates the generation of high precision DSM and 3D city model using airborne laser scanners. Such high precision data are very useful for advanced and fine scale mathematical modeling of urban environments and behaviors. ICUS is going to hold an international symposium on New Technology Tools for Urban Safety of Mega Cities in Asia in October this year. This is a very important and timely topic and through this symposium, ICUS wishes to bring together the concerned people of the Asian region to share the knowledge on new technologies and their uses towards making our mega cities safer and securer. I am very sure that the symposium will provide an opportunity to establish strong connections among the decision makers, practitioners and researchers of the region for future collaboration.

While we talk on advanced technologies, I would also like to emphasize that the advanced technologies alone are not enough to achieve our objectives of safety and security for all urban dwellings without proper use of basic technologies, e.g., retrofitting of existing housing is essential to ensure safety against a strong earthquake. After the devastating Kobe earthquake disaster, Japanese earthquake engineers and researchers have been focusing on development of advanced technologies for design and construction of earthquake resistant structures and for quick damage estimation and monitoring. We must also continue our focus on how to reduce damage to the existing old structures, especially, residential houses in various parts of Japan with low cost basic technologies. House owners of such structures cannot afford to reconstruct their structures with advanced technologies. These low earthquake resistant structures are highly likely to be collapsed by a strong earthquake causing large casualties and huge economical loss. To overcome such situations, we should prepare a good environment under which house owners can easily retrofit their own structures. The key issues are development of basic low cost retrofitting technologies and a new social system/law having driving force function. These issues are important for all the Asian countries to reduce the vulnerability of urban infrastructure.

(K. Meguro)

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ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

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FLOOD DISASTER TRENDS IN ASIA IN THE LAST 30 YEARS

By

Dushmanta Dutta

Few years before, the Director General of the United Nations Environment Program said that war over water would be a distinct possibility in the 21st century. Similar view is reflected by many other experts from the United Nations and other international organizations highlighting the seriousness of the problem of "water too little" in the 21st century. Another equally important and pressing water issue is "Water too much" - the floods, although that do not lead to a war but kill millions and cause big hindrance in socio-economic development. Floods are a constant threat to life and property. It has been observed that more and more people have been affected by riverine floods in the recent years. From 1990 to 1996, there were six major floods throughout the world in which the number of fatalities exceeded 1,000 and 22 floods with losses exceeding US$1 billion each. The majority of these recent

Devastating floods in Central Vietnam in November 1999

disastrous floods have occurred in Asia. The highest material losses were recorded in China during the 1996 and 1998 floods: about US$30 and 26.5 billion respectively. Is the flood frequency increasing in Asia? If it is increasing, how rapid is the increment? Why are floods increasing? These are some of the important issues that need to be addressed to understand the gravity of the problem of floods in the 21st century. This article closely looks at the flood disaster trend in Asia in the past three decades and analyzes the major causes of the changing characteristics of flood disasters in Asian countries and their consequences.

An example of damage due to frequent flash floods in Japan

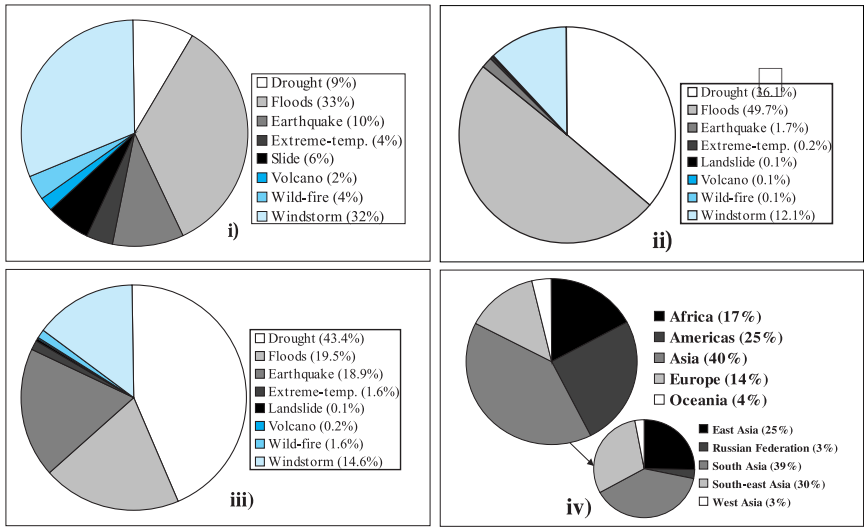
Floods in Asia from global perspective

Out of over 7,000 natural disasters occurred around the world during the last 30 years, more than 74% were water related disasters including floods, drought and windstorms. Among these, floods are the most frequent natural disasters. Floods account for about 33% of all the natural disasters. In the past 30 years, floods have been the most catastrophic natural disaster affecting half of the total population affected by any natural disaster, i.e., on average about 80 million people per year and caused economic damage of over US$11 million annually around the world. Annual statistics of natural disasters of the past 30 years show that number of floods and windstorms are rapidly increasing around the world compared to all other disasters. Floods have the highest increasing rate of occurrence. In the last 30 years annual flood frequency has doubled. There were on average about 50 flood events annually in 1970s, it became100 in 1990s, and in the last three years it has increased to about 150 events per year. Windstorm has been following a similar trend as these two disasters are closely related. The same statistics show that except landslides, which have been increasing at a low rate, no other natural disasters exhibit any increasing trend unlike floods and windstorms in the past three decades.

Floods occur in most of the countries around the world. Having the highest amount of average rainfall and volume of river water (13,500 km3/year), Asia is the most frequently affected continent by floods. During the past 30 years, total flood disasters occurred in Asia is the largest, 40% of the total events, compared to any other continents: America (25%), Africa (17%), Europe (14%) and Oceania (4%). In terms of casualties, floods are the most devastating and widespread in Asia. 98% of the total population affected globally by floods are located in Asia.

Flood Trend in Asia

Almost all the Asian countries are affected by floods. The regional distribution of flood events in Asia shows that South Asia is the most frequently affected region by floods (about 39%), followed by South-east Asia (about 30%) and East Asia (about 25%). The West Asia region including Russian Federation is the least affected region (6%). The floods and windstorm in Asia in the past 30 years follow a similar



Global statistics of natural disasters in past 30 years: i) ratio of different natural disasters around the world, ii) percentage of affected people by natural disasters, iii) percentage of economic damage caused by natural disasters, and iv) continental level distribution of flood disasters and regional distribution in Asia

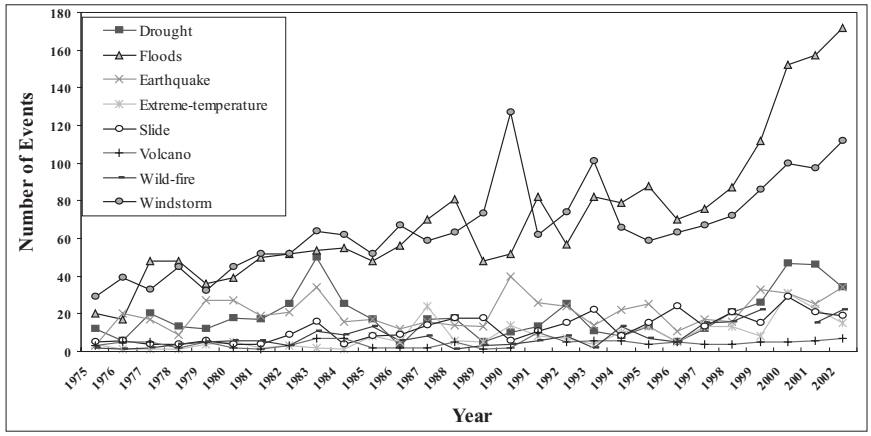
increasing trend as the global trend. The frequency of floods in Asia has doubled during the period of 1978-1999. The rate of increase of flood frequency is more prominent in the last 10 years, especially, the recent three years statistics show rapid increase of floods in Asia.

Among the Asian countries, China is the most frequently affected country by floods followed by India. The other eight of the top ten flood affected countries are Indonesia, Philippines, Bangladesh, Iran, Thailand, Sri Lanka, Vietnam and Pakistan in descending order. Except China and Iran, all these countries are located in South and South-east Asian Regions. The 5-year average flood statistics of last 30 years show that flood frequency is increasing in all these countries. China shows higher rate of increase of frequency than India in the last 10 years. Thailand also shows a higher rate of increase of flood frequency compared to its neighboring countries in the last 15 years. Among these 10 countries, the rate of increase of flood frequency was the lowest in Sri Lanka and the Philippines in the last 15 years.

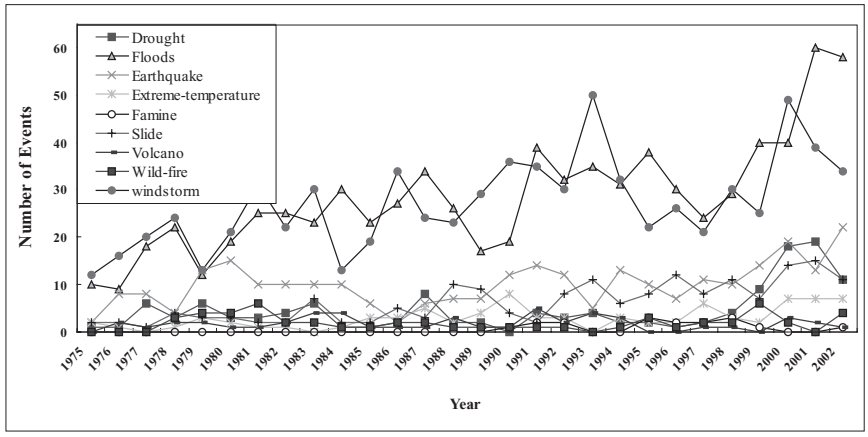
Causes of increasing floods in Asia

According to several research studies and observations, the causes of growing trends of floods in Asia can be attributed to mainly two factors: i) climate change and ii) landuse change and surface degradation.

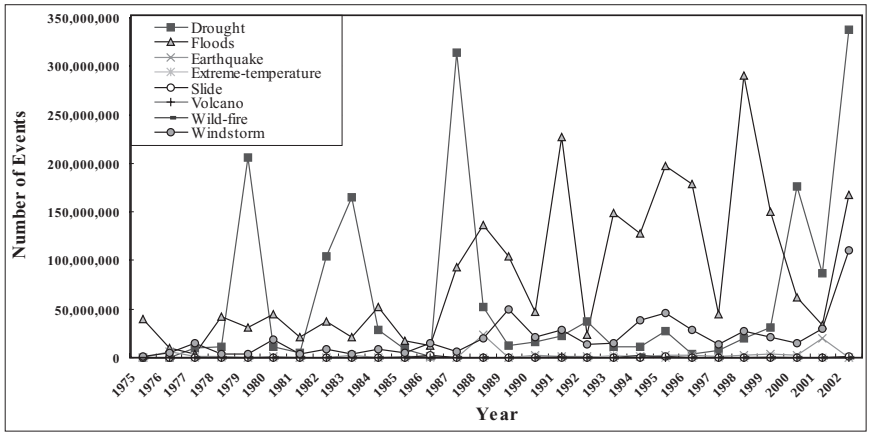
Climate change and floods: With the rapid increase of extreme climate events in the past few years, it is a common understanding that the major reason of increasing flood magnitude and frequency in most of the regions around the world is the climate change. The general direction of change in extreme water related events in Asia is broadly consistent with the climate scenarios presented by the



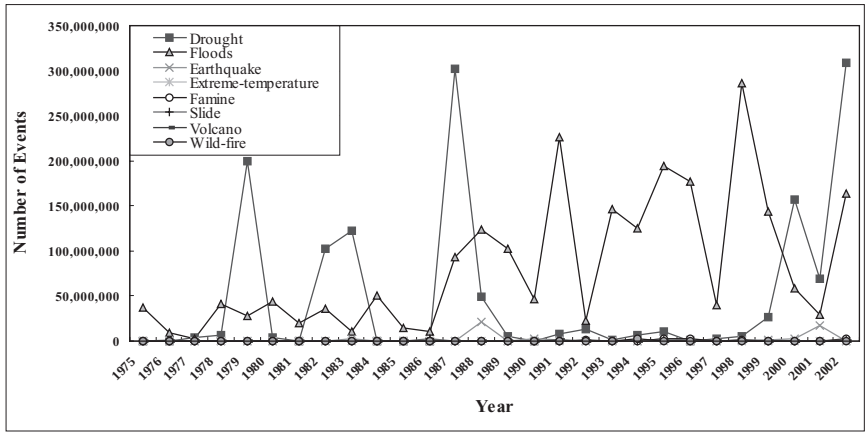
Worldwide trends of flood disasters in the last 28 years compared to other natural disasters



Trends of flood disasters in Asia in the last 28 years compared to other natural disasters



Global trend of number of people affected by natural disasters in the last 28 years

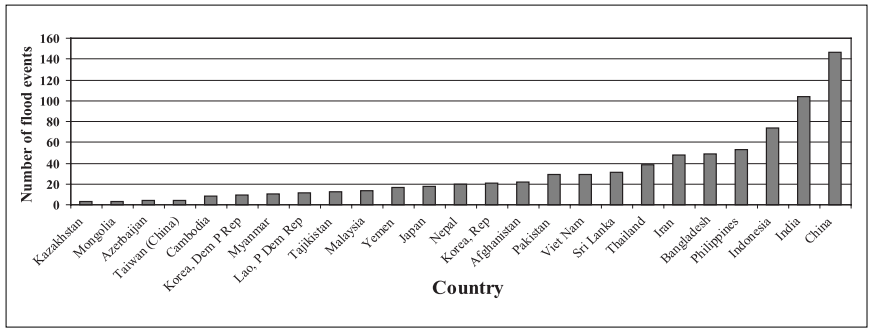


Trend of number of people affected by natural disasters in the last 28 years in Asia

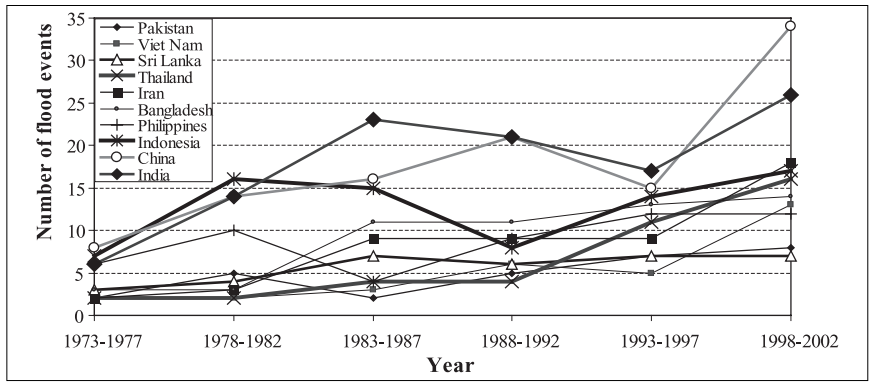
Intergovernmental Panel on Climate Change (IPCC). The observed increase in the incidence of great floods was found to be consistent with results obtained from the climate models, and the model results suggest that the trend will continue. Although only a few studies have assessed the effects of climate change on flooding frequencies, there are a number of possible reasons why, in a warmer climate, the frequency of floods increase in any particular region. Out of that the most related issues to Asia that have been observed are:

i) an increased frequency of extreme precipitation events

ii) increased magnitudes of precipitation events of high intensity



Flood events in different Asian countries in last 28 years



Flood trend in most frequently flood affected 10 countries in Asia

In 1997, some studies showed that flood discharges in the major river basins in India and Bangladesh (Ganges, Brahmaputra and Meghna) were estimated to increase by 6-19%. The statistics of the flood records of the past few years also indicated the effects of climate change in the flood frequency in Asia. The average annual flood events in the past three years are 1.5 times of that of 1990s and 3 times of 1970s.

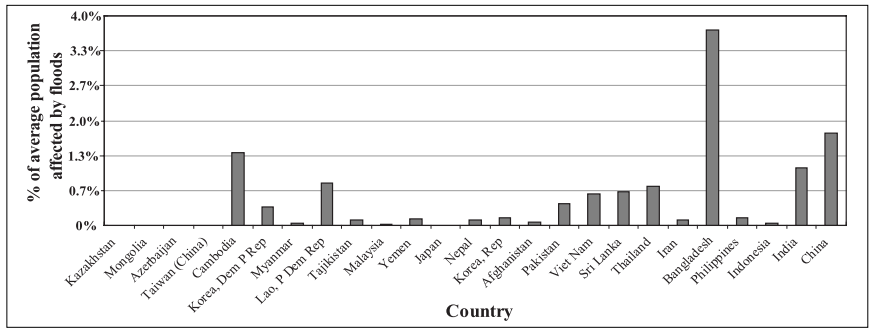
Landuse changes and floods: The effect of climate change alone is not triggering the high rate of increase of flood frequency in Asia. It can be observed from the time series of flood data that they are not exactly in tune with climate-change-related prognoses, but they reflect complex responses that may be due to other non-climatic factors such as deforestation and urbanization.

Under the pressure of high population growth and economic development, a great change in landuse pattern has taken place in most of the Asian countries in the last few decades. One of the major changes is the deforestation caused by conversion of forest to agricultural or inhabitable land. Thailand is a good example of that. Between 1976 and 1989, Thailand lost 28 percent of its forecast cover. A recent study at the University of Tokyo has showed that deforestation has greatly influenced the changes in rainfall patterns in Thailand. Additionally, deforestation also causes the increase of surface runoff and thereby increases the flash floods. In several Asian countries, where deforestation is very prominent, increase of flash floods can be witnessed in the past few decades.

The tremendous economic development and migration of population to urban centers in most of the Asian countries in the past few decades have caused rapid urbanization. Urban growth in most of the Asian countries in the last three decades is more than 4%. Nepal shows the highest growth rate (7.5%) followed by Bangladesh (5.9%). The urbanization has not only led to reduction of pervious areas but also change in catchment use of manipulation of water within the channel (e.g., dams, abstractions, canalization). These factors have directly contributed to increase of urban floods.

Impacts of increased flood frequency in Asia

Economic losses and human casualties from flood events have



Percentage of total population affected by floods annually in different Asian countries in last 28 years

increased five folds between the 1970s and 1990s in Asia. These losses largely reflect an increase in the vulnerability of our society as a whole to extreme events. Although part of the observed upward trend in losses can be linked to socio-economic factors, such as economic developments, population growth, etc., increased flood frequency attribute more to the observed growth in human casualties and economic losses in the past three decades. Although it is difficult to quantify the effects, the increasing flood frequency certainly seem to have adversely affected many Asian countries. In the recent years, floods have had increasingly detrimental and disruptive effects on various aspects of socio-economic conditions in Asia including: human health (through diseases such as diarrhea in flooded areas); buildings and infrastructure; settlements; coastal areas; financial services (including insurance and reinsurance); transport; water supply; agriculture and ecosystems.

Conclusions

The statistics of the flood events of the past 30 years in Asia clearly show an increasing trend of flood disasters in most of the Asian countries. Combined effects of climatic changes, landuse changes and urbanization are considered to be the main reasons of this increasing trend. Due to several devastating flood disasters and droughts in different parts of the world in the past few years, extreme weather and climate events have received greater attention. A recent study of 2002 that analyzed the outputs of 19 climate models predicts that very wet summers in the Asian monsoon region will probably rise up to five folds increasing the risk of flooding. This is a very serious concern for Asian countries. Proper consideration of long-term climate change scenarios in flood risk management strategies is utmost important to cope with the increasing flood frequency. Population in Asia is expected to grow by more than 25% in the next 20 years exceeding 4.9 billion by 2025, and urban growth is going to continue in a similar rate as the past decade in most of the developing countries in Asia. Unless appropriate countermeasures are taken to establish better preparedness and prevention of flood disasters, uncontrolled development in developing countries will certainly result in increased flood damage due to the greater concentration of population, most notably the poor, in disaster-prone areas. This will make it difficult to break the vicious cycle of poverty in Asia.

The author gratefully acknowledges the usefulness of the International Disaster Database of Centre for Research on the Epidemiology of Disasters in preparing this article.

ICUS participated in IIS Open House

This year, ICUS participated in the Open House of the Institute of Industrial Science (IIS) with the theme "Towards safety and security of Mega Cities" which was held during June 5-6, 2003. The Open House is an important annual event of IIS held for two days in the first week of June every year to demonstrate the research and development activities of the different laboratories and departments of the institute to the public. Open House saw a large increase in the number of visitors this year, with the total number exceeding 5,100, compared to the past few years. A new trend of young participants from junior high or high school could be observed. It was overwhelming to see the interest of these young people in the new scientific and technological developments in this frontier institute of Japan.

A snapshot from the ICUS booths on the 2nd day of the Open House

The three research divisions of ICUS prepared their own sub-themes for the Open House under the banner of the main theme and displayed their past and present research activities. ICUS also arranged a video display of its international activities carried out in the last two years. About 200 persons visited ICUS booth in two days. They showed deep interests in ICUS activities in urban safety and security of mega cities.

New Developments in ICUS Staff

Farewell to Dr. Ochi

After serving ICUS as a Research Associate for a period of two years from April 2001 to March 2003, Dr. Shiro Ochi has moved to Kinki University, Nara, Japan to join its Faculty of Agriculture as an Associate Professor. During this period, Dr. Ochi played a very important role at ICUS and strongly contributed to the various activities of the center including its collaborative research project in Thailand. Dr. Ochi is going to continue his research activities in the fields of GIS, remote sensing and environmental monitoring in the Kinki University. We wish him all the best and great success in his new career in Nara. The new contact address of Dr. Ochi is: Faculty of Agriculture, Kinki University, 3327-204 Nakamachi, Nara-City, Nara 631-8505, Japan.

Congratulations to Dr. Dutta

ICUS staff Dr. Dushmanta Dutta was promoted to Associate Professor from June 1, 2003. At ICUS, Dr. Dutta has been involved in academic and research activities in the fields of hydrology and water resources engineering. For the last few years, he has been mainly focusing on physically based modeling for urban flood risk management and water resources analysis. Dr. Dutta is currently acting as a team leader of a collaborative research project of ICUS in Thailand on urban flood risk mapping. We extend our hearty congratulations to Dr. Dutta.

Welcome to Dr. Endo and Ms. Yoshimura

We are glad to introduce our new colleagues Dr. Takahiro Endo and Ms. Miho Yoshimura, who joined ICUS as Research Associates from April 1 and June 1, 2003 respectively.

Dr. Endo received his D. Eng. degree from the Department of Civil Engineering of the University of Tokyo in March 2003. His research interests are environmental monitoring and modeling with remote sensing. Presently, he is involved in developing detection method for concrete degradation, and estimation of terrestrial ecosystem parameters such as biochemical content and carbon dioxide absorption of vegetation using advanced hyperspectral remote sensing.

Ms. Yoshimura received her M. Eng. degree from the Department of Civil Engineering of the University of Tokyo in March 2001. Prior to joining ICUS, she worked a Research Associate with Prof. Meguro of ICUS. Her research interests include retrofitting promotion system for low earthquake-resistant structures in earthquake prone countries.

We welcome Dr. Endo and Ms. Yoshimura and wish them great success.

New Assistant for ICUS Intl. Symposium

ICUS welcomes Ms. Shravani Hazarika, who joined ICUS from June 2003 to assist in the activities of the 2nd International Symposium of ICUS on "New Technologies for Urban Safety of Mega Cities in Asia". She can be contacted for any matters related to this symposium by e-mail (icus@iis.u-tokyo.ac.jp).

Dr. T. Endo, Ms. M. Yoshimura and Ms. S. Hazarika

ICUS ACTIVITY RECORDS

* *Prof. Y. Yasuoka visited AIT, Thailand during May 28-31 to attend a meeting on MODIS Satellite Receiving Station.*
* *Dr. D. Dutta visited AIT from June 8-17 to start his term as a Visiting Faculty from ICUS.*

Registration for ICUS International Symposium on October 30-31, 2003

The activities of ICUS 2nd International Symposium in Tokyo on "New Technologies for Urban Safety of Mega Cities in Asia" are progressing very well. The deadline for submission of abstract was over at the end of June. We have got a very good response from many professionals around Asia and Europe. Please note that the deadline for submission of full paper and advanced registration is August 31, 2003. The registration form is available at the Symposium Website (http://icus.iis.u-tokyo.ac.jp/isus03). You may also contact the Symposium Secretariat by e-mail (icus@iis.u-tokyo.ac.jp) for a copy of the registration form. We welcome any interested person to attend the symposium.

ICUS Publishes Two Technical Reports

ICUS has recently published two reports of the ICUS/INCEDE Technical Report series.

The first report is ICUS/INCEDE Report 2003-01. It contains the proceedings of the International Symposium on the New Technologies for the Urban Safety of Mega Cities in Asia, which was held in Bangkok, Thailand on October 28, 2002. It was jointly organized by ICUS and the Asian Institute of Technology (AIT), Thailand. The symposium was very successful in bringing together a large number of participants from different disciplines including policy makers, planners, engineers and architects to create greater awareness towards the issues related to urban safety. This report contains a total of 14 technical papers presented in the symposium by the participants from different countries covering a wide range of issues in the areas of new technologies for urban safety. The report is jointly edited by Prof. Sudhir Misra and Dr. Yoshitaka Kato of ICUS.

Cover pages of Report 2003-01 and Committee Report 2002-01

The second report is ICUS/INCEDE Committee Report 2002-01. It contains the technical papers and research activity reports of the Research Committee-39 that was initiated by ICUS a year ago as a part of its collaborative research activities with private sectors in areas of urban safety. The report contains a great deal of information about the on-going activities of this Research Committee. This report is available only in Japanese.

Those who are interested to receive a copy of these reports, please contact ICUS by e-mail (icus@iis.u-tokyo.ac.jp) or fax (+81-3-5452-6476).

Visitors to ICUS

During the period of April-June, 2003, ICUS received the following visitors.

-Dr. Somnuk Tangtermsirikul, Associate Professor, Sirindhorn International Institute of Technology, Thammasat University, Thailand (April 14).

- Dr. Cintia Marquetti, Geological Mining Survey of Argentina, Argentina (May 22).

- Dr. Kenichi Kurihara, Japan Mining Engineering Center for International Cooperation, Japan (May 22).

Dr. Masaharu Toyama, Japan Mining Engineering Center for International Cooperation, Japan (May 22).

- Dr. Yoshii Kakimoto, Japan International Cooperation Center, Japan (May 22).

Dr. Dutta joins SCE, AIT as a Visiting Faculty

From the beginning of June 2003, Dr. Dushmanta Dutta of ICUS has joined the School of Civil Engineering (SCE) of AIT as a Visiting Associate Professor from the University of Tokyo. At AIT, Dr. Dutta will coordinate the activities of the ICUS Regional Network Office for Urban Safety (RNUS), which was established at SCE in October 2002 to work in areas of mutual interests of AIT and ICUS. RNUS focuses on collaborative research activities with different organizations in Asian countries in the fields of urban safety engineering with advanced technology tools such as numerical models, remote sensing, geographical information system, global positioning system, etc., for devising appropriate methodologies for management and maintenance of urban buildings, infrastructures, mitigation of urban disasters and environmental problems for sustainable development of Asian cities with adequate safety and security.

In addition to the activities of RNUS, Dr. Dutta will be involved in research and academic activities at the Water Engineering and Management program of SCE, AIT. He can be reached at AIT by telephone (+66-2-524-5794) or fax (+66-2-524-5565) or e-mail (ddutta@ait.ac.th).

Editor's Note

In the past few decades, various problems associated with water are increasing rapidly. The seriousness of water related problems was brought to the attention of the whole world by the 3rd World Water Forum held in Japan at the beginning of this year. The main article of this issue of the ICUS Newsletter shows that water related extreme events are on rise around the world and this trend is going to continue due to change in climatic conditions. Asia is going to be most severely affected by water related disasters due to the combined effects of its high rate of population growth and urbanization with climatic changes. The article shows that flood frequency is increasing in most of the Asian countries in the last three decades. To cope with the increasing problems of floods in Asia, large scale and long term mitigation measures are required. Flood problems have to be addressed together with other water issues in basin scale not as a standalone issue confined within the floodplain. It requires adaptation of integrated river basin management policies incorporating various issues of water. Transbasin water sharing is another important aspect to be focused into for mitigating the problems of "water too much and too little" .However, such measures need long-term planning and high cost. Emphasis should also be given to short term measures for reduction of devastating consequences of major floods by taking proactive strategies of proper guidelines for floodplains, hazard and risk mapping, early warning and real-time risk management.

From the beginning of June 2003, I have joined AIT as a visiting faculty from ICUS. At AIT, I am going to be involved in coordinating the activities of the Regional Network Office for Urban Safety (RNUS) established jointly by ICUS and AIT last year. The main objective of RNUS is to expand the international activities of ICUS by collaborating in research and sharing information with leading institutions of Asia for urban safety. One of the major issues that I would like to focus on at RNUS is urban flood risk management. It is our strong believe that through mutual cooperation with AIT and other institutions, ICUS would be able to adequately address the problems and contribute towards urban safety and security of the region.

(D. Dutta)

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International Center for
Urban Safety Engineering

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ISSUES RAISED BY THE RCENT SUBWAY FIRE IN SOUTH KOREA

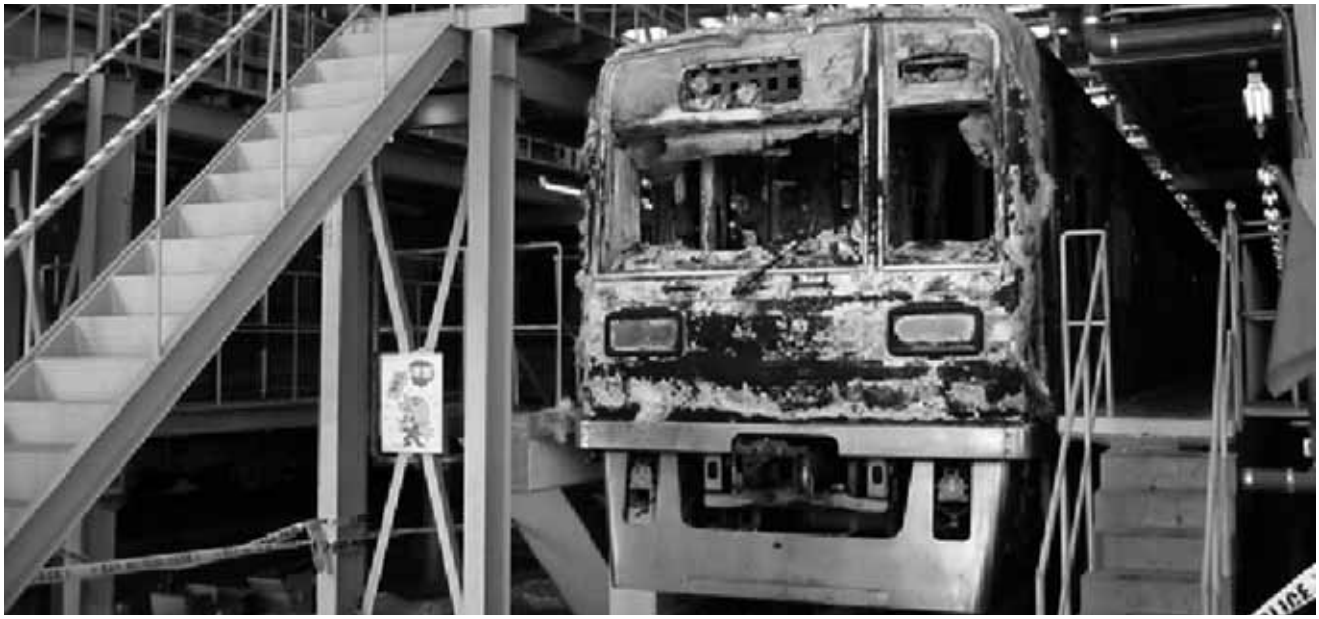
By

Makoto TSUJIMOTO*

A train was set on fire with two liters of gasoline at the Jungangno Subway Station in Daegu, South Korea at about 9:53 a.m. on February 18, 2003. This incident killed 192 people, which without doubt accounts for the largest number of deaths resulting from a fire in a subway train. It was reminiscent of another recent accident involving a mountain train in Salzburg, Austria (November 11, 2000). In both cases, the passengers died because their escape routes were cut off by flames and smoke, with the trains burning over an extended period of time. However, the case in Korea was an incendiary fire caused by setting fire to gasoline, and ultimately the issue presented here is how to make disaster prevention plans for these kinds of intentionally-caused and rapidly-spreading fires. The table in the following page shows the items of disaster prevention equipment on each floor of the station and the figure shows the general conditions surrounding the incident at the Jungangno Station.

Floor plan of the station

The stairways that serve as escape routes at the Jungangno Station are very well planned, both in location and width. Another small station from which the author boarded a train has a single



Front of the train No.79 , where the fire started (Photo by Atsushi Okajima)

stairway from the platform to the concourse positioned in the central area; however, Jungangno Station, the location of this fire, has wide stairways at both ends of the platform, from which a smooth escape seems to have actually been made. Many were found dead at the ticket gates that provide exits from the central stairway from platform B3 to concourse B2.

Area and apparatuses of different floors of Jungangno Station

Floor		Total floor area (m^2)	Apparatuses against fire
Basement 1	Concourse Office Room	3,847	CO2 suppression systems, portable fire extinguishers, sprinklers, automatic fire detectors, smoke control installations, fire hydrants, direction lights, emergency lights, fire alarms
Basement 2	Concourse	4,586	
Basement 3 (fire floor)	Platform	2,004	Automatic fire detectors (by smoke), fire hydrants, fire alarms, emergency lights, direction lights

The concourses on floors B2 and B1 are large, although their extensive size could disorient people when filled with smoke, and are all provided with stairways at either end connecting to adjacent floors and there are no basic layout problems (they do not, for example, narrow down immediately before coming aboveground as seen in subway stations in Japan).

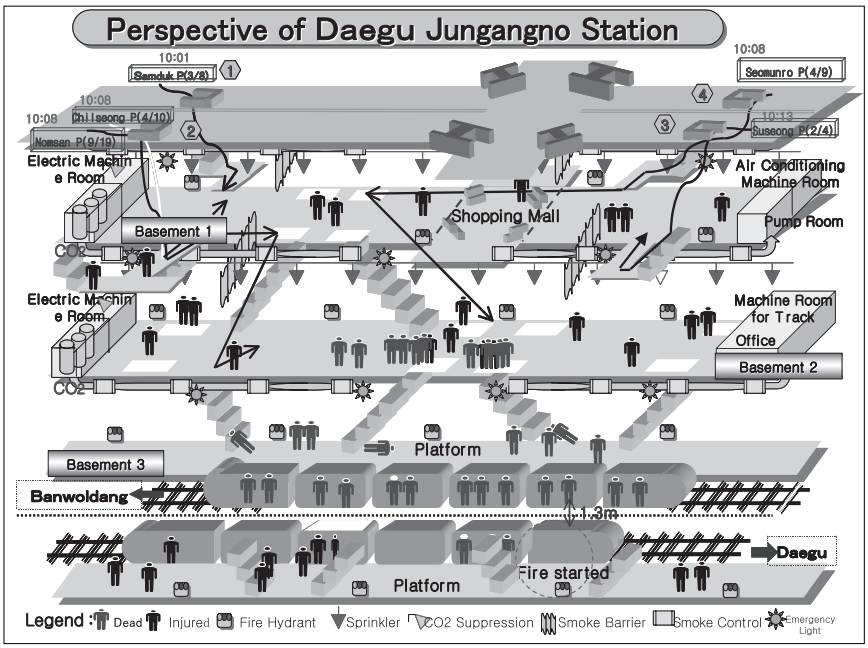
Also, according to the data provided by Mr. JAE Jim-Joo (at 06:00 a.m. of February 28, 2003, Fire Fighting Situation Daily Report, Central Emergency Rescue Headquarters Situation Office), concourses are required to have smoke barriers at each 40 m diameter boundary; for this reason, concourses B2 and B1 are divided into three sections with 50-meter high hanging walls, which ironically worked to effectively concentrate the heat of the fire in the central section.

However, there are problems with the passageway to the underground shopping area on floor B1. The underground shopping area runs perpendicular to concourse B1, and has a floor level approximately two meters higher than the floor of the concourse, which does not provide easy access either, although the reasons behind this are not clear. In addition, a fire shutter doubling as an access control point is installed across the entire width of the opening where the stairway from the concourse reaches the shopping area. Smoke detectors are installed on both sides of the shutter, and these were activated to close the shutter during the fire (the author saw the shutter close on a TV news show at approximately 10:00 a.m. of March 3, 2003 at Pusan Airport; details unknown). A structurally very complex access door is installed at door 1; it is unknown whether it was used during the escape. Also, many people seem to have died at the shutter because their escape route was cut off when the shutter closed suddenly. On the other hand, the shopping area seems to have sustained no damage and was able to continue operation because the shutter closed early on, and this demonstrates that the shutter served its primary purpose. However, the sudden loss of an escape route when the shutter closed remains a problem.

Disaster prevention equipment in the station building

As shown in the table, the basic specifications for disaster prevention equipment in the station building are roughly equal to or exceed those in Japan. Unfortunately the fire was started in a train; however, such extensive damage would not have been sustained if the fire had been started in concourses B1 or B2 because the sprinklers would have been activated. No-one at the site commented on the smoke control system because it may constitute an issue in court. However, the concourses are divided into approximately 35-meter sections to satisfy the requirement to extract smoke at a rate of 40,000 cubic meters per hour in each section.

There is no knowing under the present conditions whether the smoke control system worked or had any effect; however, the airflow volume according to regulations must be approximately



Perspective of Daegue Jungangno Station

10 times the ventilation frequency, which is considered manageable by diverting the general air-conditioning equipment. It is necessary to wait for the results of the investigation on how the equipment operated during the fire, including how it was related to the supply/exhaust openings in the sidewalks aboveground.

Subway cars

The most significant issue may be the combustibility of interior materials in the subway cars.

Japanese technical standards (Ministerial Ordinance Interpretation Criteria III-19 defining technical standards for railways) require: 1) the use of noncombustible materials; and 2) the use of noncombustible surface coatings for ceilings, outer panels and linings. Noncombustible materials in this case must satisfy incombustibility standards for railway vehicles stipulated by the Ministry of Transport (now the Ministry of Land, Infrastructure and Transport), in which a 182 mm x 257 mm sample may be passed as noncombustible if it meets criteria such as not igniting over an ethanol flame as small as 0.5 cc, and carbonization or deformation of less than 100 mm. Though referred to as noncombustible, these materials are quite different from the noncombustible materials specified by building codes (included in the specifications are concrete, glass, rock wool, etc.; testing methods used are the corn alcohol calorimeter test, etc.), and it may be more accurate to describe them as not easily igniting with a match or lighter.

There is no knowing at this point whether the interior materials in the Daegu subway cars came up to the level of performance required by Japanese standards for trains; however, it is not possible to say that the high level of heat generated by two liters of gasoline in a Japanese subway train would not ignite the interior materials and develop into an extensive fire.

Front of the train No.80, most far from the fire (Photo by Atsushi Okajima)

Furthermore, devices to manually open platform access doors in emergency (hereinafter referred to as emergency handles) are marked with red borders to indicate their locations; emergency handles are located in pairs on the seat side cover at each access door in Daegu, while they are provided in the cars but not indicated in Japan, because Article 74 of the ministerial ordinance stipulates an exception for cars traveling in the third rail line section, etc., which allows them to be inaccessible to passengers other than those who are well-informed.

In the case of a subway train, it is difficult to walk between the train and the tunnel (a gap of 50 cm) after exiting from an access door when the train stops between stations. Thus the Japanese measure does not necessarily pose a danger; however, it will reduce the possibility for passengers to escape from danger on their own if a train stops at a station as in this incident.

Other Issues

The six cars of the train No. 79, where the fire started, and the train No. 80, that is12 cars altogether, burned uniformly and almost completely.

Judging from the conditions of the melted plastic in concourses B2 and B1, the temperature was high in the central area, and the severest scorching occurred to the tunnel ceiling slab above the center portion of train No. 80, exposing two layers of steel reinforcing bars, although the fire started in No. 1 car of train No. 79. These points remain big questions. Fire damage seemed to be fairly distributed as a result of the firefighting efforts which continued over an extended period of three hours starting from the tunnel side considering that the fire was controlled in stages from the outside inwards; however, thermal contamination was also the severest in the central area on floors B2 and B1 as mentioned before, although the fire started at the end of the station. The fire spread extremely fast in the early stages, and may have reached the rearmost car of the train by the time the oncoming train had drawn into the platform. It is therefore important to examine carefully what effect the draught generated by the train played in spreading the fire.

Professor, Department of Environmental Studies, Nagoya University, Japan

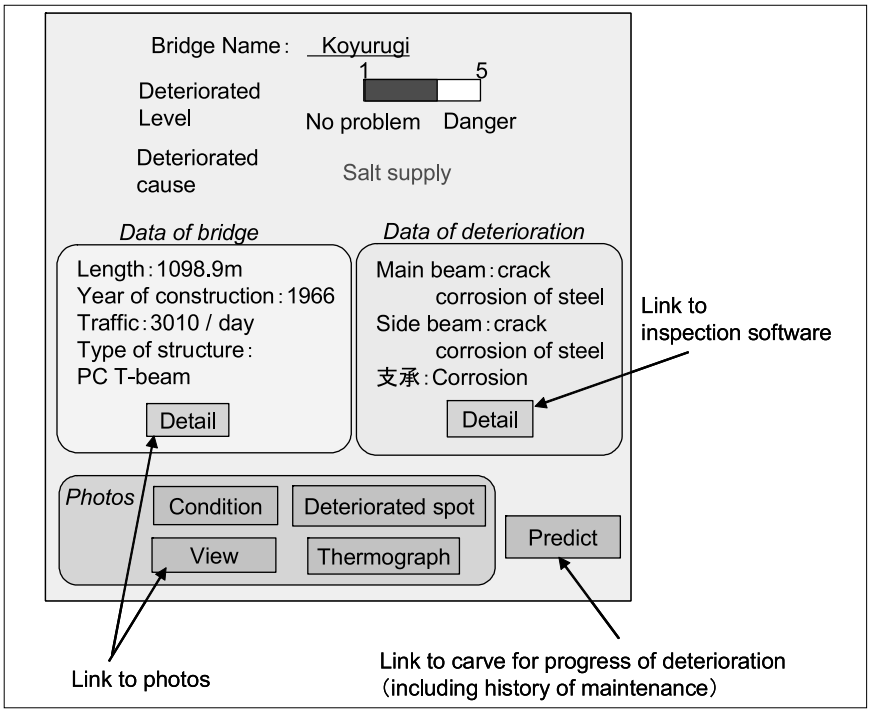
Study of Making a Database for Deteriorated Concrete Bridges

by

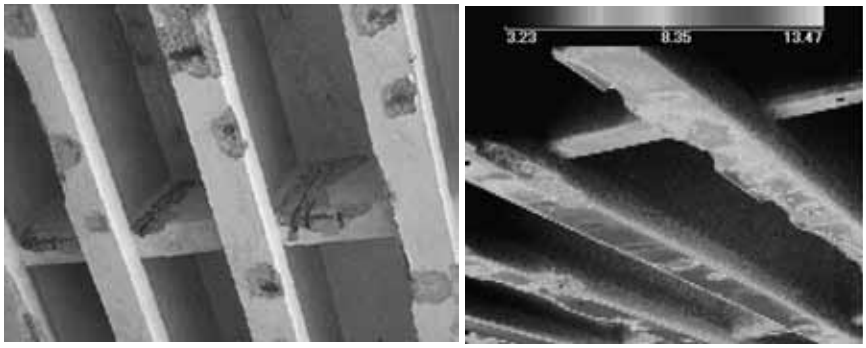
Yoshitaka Kato and Somnuk Tangtermsirikul

In most of the Asian regions, the fragility of a structure, which is based on the defects from design criteria, inadequate construction management and maintenance management, etc., is high and therefore, poses a major threat to safety. As most of these structures were built almost at the same time during the Asian 'bubble' economic growth, there is almost clear and certain possibility that, these structures would cause huge and fatal structural problems at the same time in near future causing extensive damage to the society and the economy as a whole. Thus an amicable solution to the same is a demand of time and needed to effectively guard against this hidden disaster. In order to deal with the problem, ICUS has been focusing on related research activities equipped with advanced technology and tools, such as, numerical models, remote sensing (RS), GIS, GPS, etc. for devising appropriate methodologies in order to manage and maintain the urban buildings and infrastructure, and working actively towards mitigation of urban disasters and environmental problems for sustainable development of Asian cities with adequate safety and security.

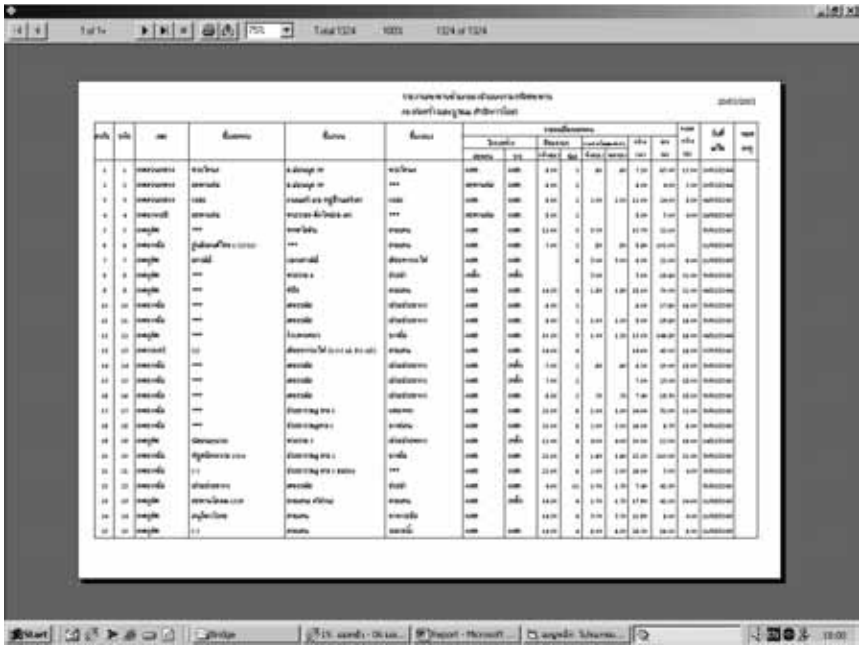
ICUS along with the School of Civil Engineering of the Asian Institute of Technology (AIT) established a Regional Network Office for Urban Safety (RNUS) last October at AIT in order to meet and deliver its above-mentioned objective more effectively and efficiently. Recently, RNUS has successfully initiated two joint projects on 1) Study on Making a Database for Deteriorated Concrete Bridges and 2) Urban Flood Risk Mapping using GIS, RS and Mathematical Model in Bangkok.



A schematic diagram of the database



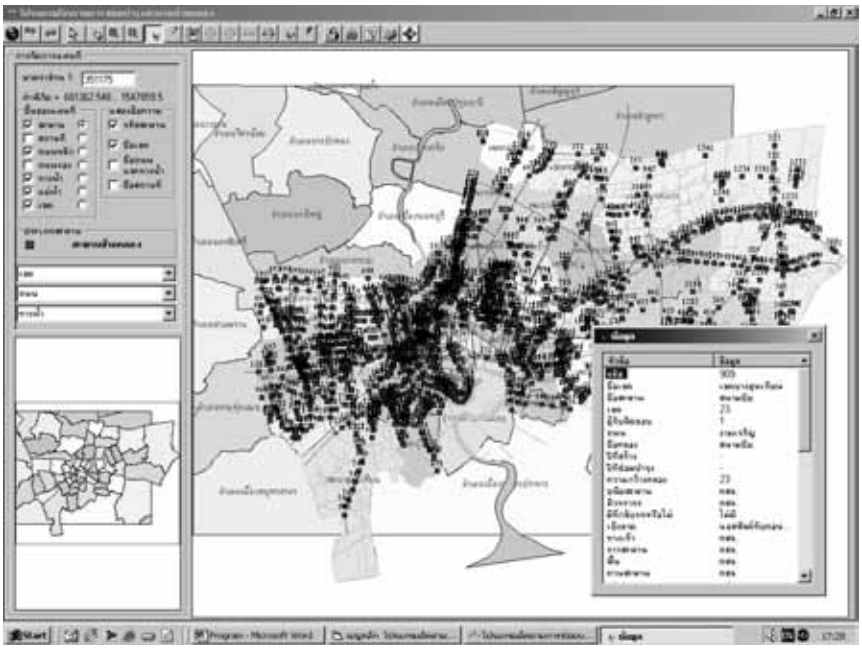
Example of detailed data (digital still camera & thermograph)



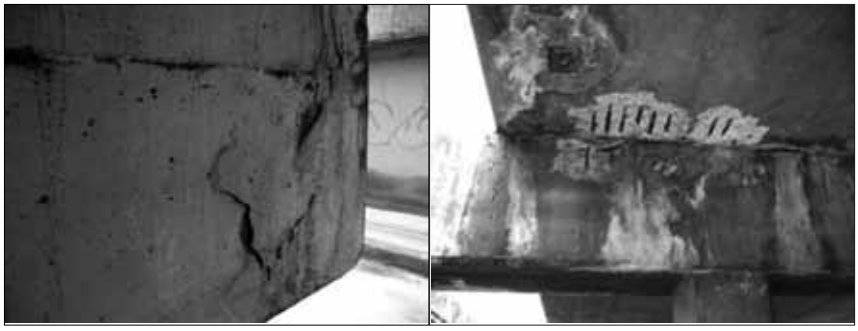
Example of the tabulated information of the bridges

This article presents a brief overview the activities of the Project 1.

A total of 9 concrete bridges from Bangkok metropolitan area were selected as targets for investigating and making a database in this research. The structural data for each bridge were collected from the organization responsible for maintenance of the same. A specialist in diagnosis of concrete structures investigated these bridges by visual inspection in order to understand the deterioration levels. At the same time, the photos of the deteriorated spots on the concrete bridges were taken by digital still camera and thermograph for the database under development. The schematic diagram of database in this research is shown in the previous page. It not only provides the location of structures, but also causes and levels of deterioration. Each column links with the corresponding data.



GIS based information of bridges in Bangkok



Example of data of digital still camera

In 2003, a total of 1953 bridges are under the responsibility of the Bangkok Metropolitan Administrative Office (BMA). These include a total of 31 flyovers, 598 pedestrian bridges, and 1324 canal bridges. The designed GIS based information system shows the location of the selected bridge on the map of Bangkok. All the mentioned 1953 bridges have been put into the system. An example of the GIS information for the canal bridges and an example of the tabulated information of the canal bridges are shown on the right side of this page and lower part of the previous page. The tabulated information of the bridges indicates location of bridges on the map, name of the bridges, types and size of pier, beam, girder, slab, year of construction, and information about repair and maintenance work. The two photos in the right side show an example of the visual data collected with digital still camera.

Readers may also refer to an extended version of this article available at ICUS homepage (http://icus.iis.u-tokyo.ac.jp).

News from ICUS Regional Network Office, RNUS, in Bangkok

After joining of Dr. Dutta of ICUS as the Coordinator of the ICUS Regional Network Office for Urban Safety (RNUS) in June, 2003, the activities of the Network Office have been expanding. A homepage of RNUS has been prepared, which includes its activities (http://www.sce.ait.ac.th/rnus/). The two mini-projects of RNUS initiated last year are in progress. A brief report of Project 1 is presented in the previous article. Two near future events of RNUS are 1) a seminar on "Water Resources in the 21st Century under Climate Change Scenarios" to be held on November 14, 2003 and 2) International Workshop of WSSI on "Seismic Risk Management for Countries of the Asia Pacific Region" to held during December 7-8, 2003 in Bangkok. RNUS is the local organizer of this workshop.

Dr. Dutta gave the following two invited talks in Bangkok:

-on "Hydrological forecasting of flood and inundation damage" at the International Seminar on Innovation Model for Sustainable Water Resource Management, Kasetsart University, Bangkok, Aug. 20, 2003 and

-on .Flood Risk Management: Role of Hydrologist and need of integration of MetSAT and Hydrologic Model. at the UNESCAP Eight Meeting of the Regional Working Group on Meteorological Satellite Applications and Natural Hazards Monitoring, Sep. 8-10, 2003.

5th ICUS Open Lecture Focused on Urban Fire Disaster

The 5th ICUS Open Lecture was held with the theme of "Urban Fire and Its Safety Countermeasures: Lessons Learnt from Urban Fire and Countermeasures against It".

The pattern of fire occurring in cities has been diversified along with the advancement of urban landscapes and its increased complexity. Still fresh in our memory, the fatal subway fire in the city of Daegu, South Korea on February 18, costing 192 human lives was one of the worst disasters ever happened in the world. An urban fire in today's world may cause the damage far beyond our imagination by destroying costly urban infrastructure and paralyzing information infrastructure for a long time.

In the Open Lecture, each presenter delivered a lecture discussing on the countermeasures to be taken in the future in context of (1) the present situation of complicated recent urban fire, (2) fire in the tunnel on urban highways and (3) subway fires based on the lessons learnt from the Daegu subway fire. A fourth important point of discussion was on (4) safe and efficient ways of evacuation, in case of any of the above fire occurrences.

The Open Lecture was held on July 3, 2003 at the Auditorium of the Research Center for Advanced Science and Technology (RCAST) of the University of Tokyo. Despite the sweltering heat on that day, about 150 audiences attended the meeting and interacted with the presenters.

Prof. Taketo Uomoto, Director of ICUS, gave an opening address and then introduced the outcomes of research activities carried on by ICUS during the last one year. The following four lectures followed thereafter.

A snapshot from the meeting hall during the Open Lecture

The first speaker was Mr. Toshiaki Kitazato, who is the Representative Chief of the Local Development and Disaster Prevention Association Former Deputy General Manager of Fire and Defense management Agency, Former Councilor of Cabinet Office. Mr. Kitazato presented his lecture on "Present situation of urban fire in our country and the countermeasures". He began with describing the history and the present situation of urban fire, and then reported on the countermeasures for urban fire implemented so far from the viewpoints of urban planning, Fire Defense Act and reinforcement of fire defense force. Moreover, he talked on the necessity to revise the Fire Defense Act, referring to the reinforcement of risk management system in Japan after the Kobe earthquake and past building fires occurred in Japan. Lastly, he touched upon the countermeasures for fire defense and disaster prevention.

Mr. Toshiaki Tachimori, Director of Metropolitan Expressway Public Corporation, was the second speaker at the Open Lecuter. He gave a lecture on "Counter-measures for the prevention of tunnel disasters on Metropolitan Highway." He introduced many examples of tunnel fires occurred in the metropolitan highway in the past and countermeasures taken against them. He reported that, if the scale of a tunnel fire is large, the tunnel is often destroyed by the fire and it takes longer time for the restoration in many cases. He also stated that, the first 10-minutes from the onset of the fire is important for the fire fighting and evacuation, and it is important to study how and what activities can be done during this time. Therefore, the tunnels on metropolitan highways are equipped with the system to automatically detect the occurrence of an accident by image processing using CCTV installed at the interval of 100 m, Mr. Tachimori informed.

The third speaker was Professor Makoto Tsujimoto, Department of Environmental Research Major of Urban Environmental Science, Graduate School of Nagoya University. Prof. Tsujimoto spoke on "Issues in the Daegu City subway fire in South Korea." He

explained the transition of phenomena from the onset of Daegu City subway fire, and reported that the fire accident was recorded by 16 sets of TV camera, and the transition of phenomena during the fire can be grasped by analyzing these records. He said that the "Guideline for the utilization of extra deep underground. has been decided by the Cabinet Meeting in Japan, in which the actions to be taken for 7 risks (fire, earthquake, active fault, inundation, etc.) have been indicated. According to him, a study will be made in the future on the counteractions to be taken at the time of accident like the one that happened in Daegu City.

Prof. Tachimori during his talk in the Open Lecture

The fourth and final speaker of the Open Lecture was Prof. Kimiro Meguro, Associate Professor of ICUS. Prof. Meguro gave his lecture on "Urban fire and countermeasure for evacuation." He showed some cases such as, the expansion of damages by earthquake or fire, and analysis of human behavior during evacuation by mathematical simulation and GIS. He reported that many precious lives were lost just after the onset of the accident at the time of Kobe earthquake, and stated the importance of prior arrangements to restrain the damage as a countermeasure against the earthquake. He also stated that it is important to train the ability of imagination of people to recognize what will happen at the time of accident, in addition to hardware countermeasures adopted to physically restrain the damages.

Finally, Prof. Yoshifumi Yasuoka of ICUS made the concluding remarks of this Open Lecture, and expressed gratitude to the participants; and the 5th ICUS Open Lecture was adjourned.

(by Masahiro Setojima)

Visitors to ICUS

During the period of July-September, 2003, ICUS received the following visitors.

- *Dr. Phisan Santitamnont, Assistant Professor, Survey Engineering Department, Chulalongkorn University, Thailand (Aug. 4).*
- *Prof. Ioan Olariu, Structural Mechanics Department, Technical University of Cluj-Napoca, Romania (Sept. 3).*

3rd International Workshop of WSSI in Bangkok during December 7-8, 2003

The World Seismic Safety Initiative (WSSI), an undertaking of International Association of Earthquake Engineering (IAEE), is organizing the 3rd International Workshop on "Seismic Risk Management for Countries of the Asia Pacific Region" in Bangkok, Thailand during December 7-8, 2003. Since its inception in 1992, WSSI has worked with many countries around the world in general and in Asia Pacific Region in particular. WSSI and its programs during those ten plus years had some remarkable successes in some countries and in others; they have not been able to make an impact in terms of implementation of risk mitigation strategies. WSSI in 2003 has more experience of what works and what does not work. WSSI understands the limits of what it can achieve with the resources it has. To take stock in its own programs and to learn from its past experience and the experience of countries WSSI has worked with, it is decided to hold the this Workshop. The main purposes of this Workshop are to:

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

The local organizing activities of this workshop are being carried out by the ICUS Regional Network Office in Bangkok, RNUS, as the Local Organizer.

Awards received by students of Sustainable Engineering Divsion of ICUS

Two graduate students, Mr. Hisashi Kanada and Mr. Misuzu Yoshikuni, of Prof. Uomoto's Laboratory of the Sustainable Engineering Division of ICUS received the Incentive Awards for their papers and presentations at the Annual Conference of the Japan Concrete Institute held on July 28, 2003. The title of the paper of Mr. Kanada was "Application of multi-spectral method to inspection of salt damaged concrete structures". Mr. Yoshikuni presented the paper on "Elucidation of the fundamental theory of concrete conveyance system using DEM". ICUS Staff congratulate both the students.

Editor's Note

This afternoon (October 15, 2003) we had a quite big earthquake in the Kanto area. The seismic intensity around Tokyo was reported as the rank of 3 to 4. When it occurred, I was in my office on the 5th floor in the Institute of Industrial Science building. The vibration was the biggest that I have ever felt in my office. Frankly speaking, at that instance, it was not easy for us to recall what we should do. In particular for students and staffs from foreign countries it seemed difficult to understand how to behave.

This issue of the ICUS Newsletter features the fire in urban areas, where the main article is on the serious fire at a subway station in Taegu, Korea. Fire is one of the most serious damages induces from the earthquake. Today's earthquake has evoked me the importance of the first behavior, that is, stopping all fire sources, even in shaking. Attention !!! In Japan we may have big earthquakes anytime in these years!!!

(Y. Yasuoka)

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Institute of Industrial Science
The University of Tokyo

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PROTECTING BUILDINGS AGAINST MULTIPLE HAZARDS

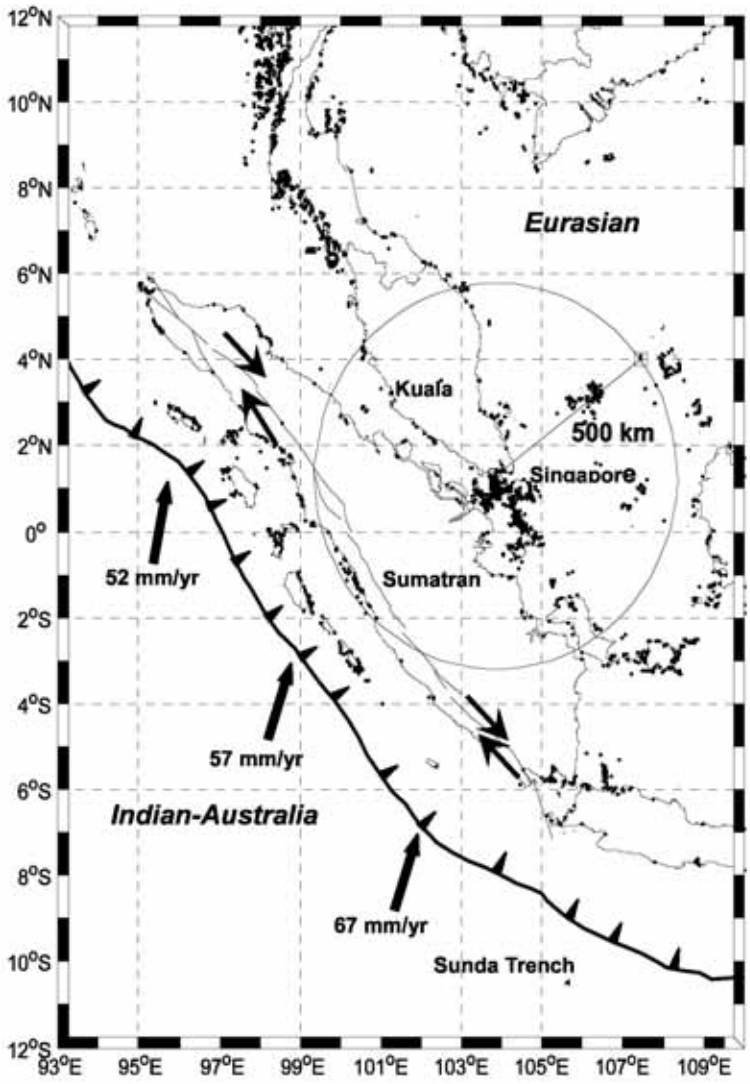
By

Tso-Chien PAN*

Effects of Long-Distance Major Earthquakes

Although Singapore is believed to be located within the stable Sunda plate with mild winds, it is about 350 km away from an active earthquake belt, comprising the Great Sumatra Fault and the subduction zone of Sunda Trench, as shown in the sight figure. Singapore has never experienced any earthquake damage, and hence buildings are generally not designed against the horizontal earthquake loadings. However, tremors caused by distant Sumatra earthquakes have been felt in Singapore for many years.

The largest subduction earthquake that has occurred in the Sunda trench is the great 1833 event with an estimated Mw between 8.8 and 9.2. The earthquake, with an average Mw of 9.0 at an epicentral distance of 723 km, is thus selected for a recent study as the maximum credible earthquake (MCE), the figure at the top of next page, that the Sumatra subduction zone is capable of generating. The larger of the two horizontal components of



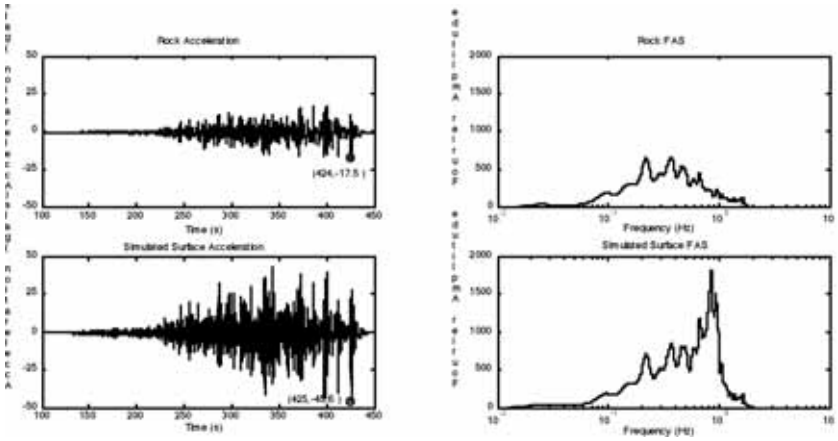
Seismotectonics of Sumatra region

the synthetic MCE ground motions is used in the convolution process to obtain the surface accelerations at a soft soil site. The seismic response of a typical high-rise residential building in Singapore to the synthetic MCE ground motions at a soft soil site has recently been investigated.

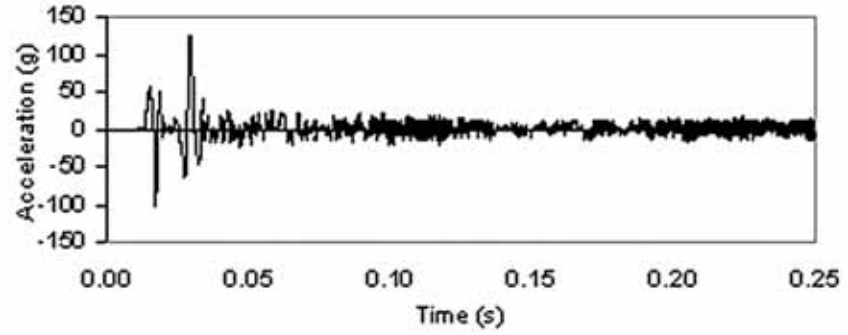
The typical high-rise residential building is a 15-storey, reinforced concrete (RC) building. The overall height of the building is 42.8 m, with the first storey of 3.6 m and the others 2.8 m. The dimensions of the floor plan are 94.5 m in the longitudinal direction and 11 m in the transverse direction. The lateral load resistant system of the typical building is a RC frame-shear wall dual system. The frame system consists of a series of two-bay frames spanned in the transverse direction, with 3 m spacing between frames along the longitudinal direction. The maximum base shear force resulting from the soft soil site response to the MCE event is about 14% of the total building dead weight. This maximum base shear force ratio exceeds the notional horizontal load specified in the local building code as 1.5% of the characteristic dead weight of a building.

Effects of Explosion-Induced Ground Shocks

As part of the national effort to intensify the land use of the land-scarce country, Singapore has explored the possibility of using underground facilities for various purposes. One of initiatives is to move the surface ammunition storages underground, which will reduce the precious land surrounding the surface storages that have been sterilized for safety reasons. As a result, the dynamic response of building structures to explosion-induced ground motions (EIGMs) or ground shocks that may result from underground explosions has been investigated. The results are discussed in terms of the dynamic failure of RC buildings subjected to



Acceleration time-histories and Fourier spectra for the maximum credible earthquake at rock and soft soil sites

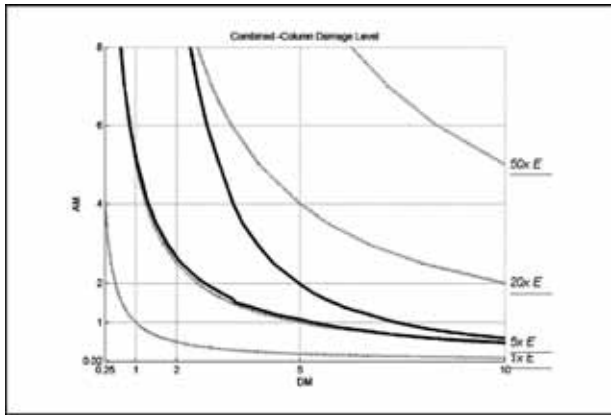


Horizontal acceleration time history of a simulated EIGM

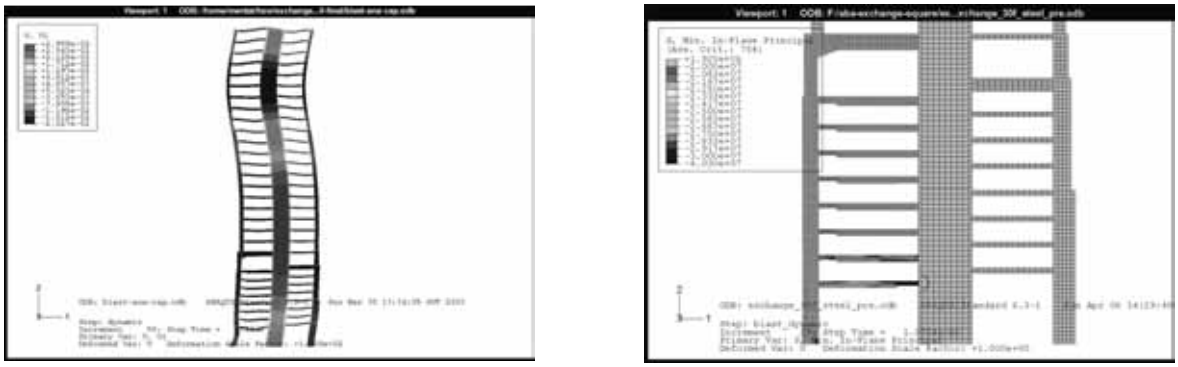
ground shocks, which in turn affects the minimum radial distance within which no residential buildings should be erected.

A non-seismically designed 6-storey RC frame was subjected to a simulated EIGM. The simulated EIGM for the horizontal ground motion at a distance from the explosion source is shown in the second figure. The simulated EIGM has a peak ground acceleration of 124 g and a predominant frequency of about 200 Hz. To understand the effects of the duration and the input impulse of EIGMs, duration multipliers (DM) and amplitude multipliers (AM) were applied on the above EIGM. Both shear failure and joint failure were investigated for the first storey interior column where the maximum shear stress occurred.

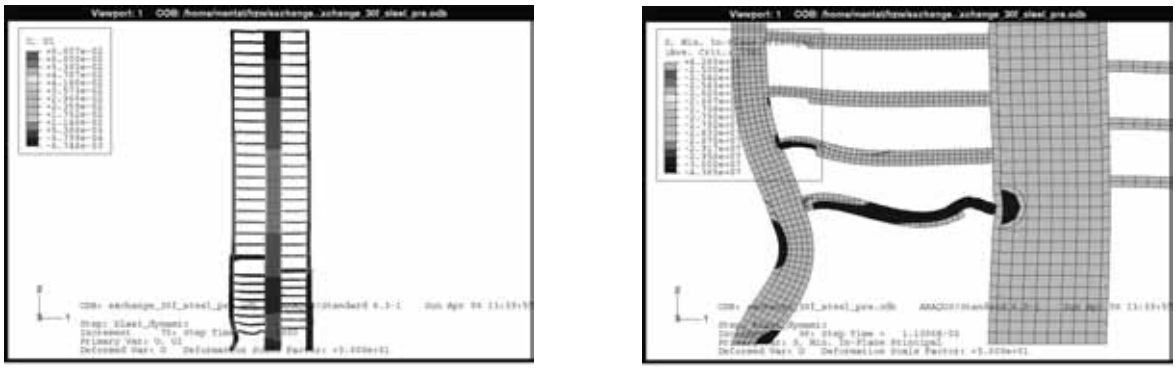
Combinations of DM and AM can lead to joint and/or shear failure during the forced vibration (Phase I) or the free vibration (Phase II). The damage level for the first storey column is presented in the figure bela. One bold line shows the boundary between the moderate and



Zones of failure patterns for different response phasesc



Deformation and stress distributions of a long standoff case



Deformation and stress distributions of a short standoff case

the severe damage levels for Phase I, Severe (I). The other bold line shows the boundary between the moderate and the severe damage levels for Phase II, Severe (II). Iso-impulse lines are shown as dotted lines in the background. Therefore, it can be seen that the damage level computed based on the damage index defined for seismically design buildings does not reflect adequately the shear failure and joint failure caused by scaled EIGMs.

Effects of External Blast Loading

Recent terrorist bomb attacks around the world have demonstrated the ferocity, cruelty and unpredictability of the hazards posed by terrorism. Instead of trying to predict the next terror attack, it appears to be more important to protect critical assets like waterworks, seaports, airports, major buildings, etc. The transient dynamic response of a high-rise commercial building to a postulated external explosion load resulting from a vehicle bomb at the ground level near the building has been investigated.

The high-rise commercial building selected for the study is a 30-storey RC structure with frames and a shear wall core. For a long standoff distance, the local damage index based on curvature is used to evaluate the flexural performance of structural elements under blast load. The second and the third storey beams were found nearly in complete failure. Severe damage appeared in columns on the first and the second storeys and in the beams at the fourth and the fifth storeys, as shown in the top figure.

For a short standoff distance, The second figure shows that partial collapse or moderate damage may appear in the columns on the first and the second storeys. The beams at the second and the third storeys were destroyed completely. Compared with the long standoff case, damage in the short standoff case was more localized.

Multiple-Hazard Protection of Buildings

In summary, in protecting building structures in Singapore, there is a need to investigate systematically the effects of multiple hazards which may include both natural and man-made events. The multiple hazards that have been investigated so far comprising the effects of long-distance major Sumatra earthquakes, explosion induced ground motions, and blast induced overpressure. The dynamic response of the non-seismically designed building structures in Singapore to these postulated multiple hazards has shown a variety of different characteristics. This will pose a challenge to structural engineers who must strike a balance between safety and economy in designing a building structure to resist the multiple hazards which may result from both natural and man-made events. It is important to realize that the dynamic effects of these events have drastically different loading characteristics as well as frequency of occurrence.

**Professor, Director Protective Technology Research Centre, School of Civil and Environmental Engineering, Nanyang Technological University, Singapore 639798*

ICUS organized International Symposium on New Technologies for Urban Safety of Mega Cities in Asia

The recent developments of various advanced technologies including Remote sensing (RS), GIS, GPS and other computational tools have generated scopes and motivation to focus on devising appropriate methodologies for management and maintenance of urban buildings, infrastructures, mitigation of urban disasters and environmental problems for sustainable development of the Asian Mega Cities with adequate safety and security. With the realization and recognition of the importance of advanced tools in urban safety, the International Center for Urban Safety Engineering (ICUS) of the Institute of Industrial Science and the 21st Century COE Program entitled "Center of Excellence for Sustainable Urban Regeneration" of the University of Tokyo organized an international symposium during October 30-31, 2003 on New Technologies for Urban Safety of Mega Cities in Asia. The symposium, held at the Sanjo-kaikan conference hall of the Hongo campus of the University of Tokyo, was attended by 126 participants from 13 countries around the world. This was the second international symposium organized by ICUS on the same theme after the very successful first international symposium held in Bangkok on October 28, 2002.

The two-day long program of the symposium was arranged in 12 technical sessions including two plenary sessions, where one keynote speech and six special lectures were delivered by invited distinguished academicians and researchers from several Asian countries. The symposium was inaugurated by Prof. Shin-ichiro Ohgaki, Dean of the Faculty of Engineering, University of Tokyo

Symposium Staff

and it was followed by the Keynote speech of Prof. Worsak Kanok-Nukulchai, Dean of the School of Civil Engineering, Asian Institute of Technology (AIT), Thailand. The other invited speakers for the plenary sessions were Dr. Sudhir Misra, IIT Kanpur, India; Prof. T.-C. Pan, Nanyang Technological University, Singapore; Prof. W.C. Fan, University of Science and Technology, China; Dr. Suvit Vibulshresth, GISTDA, Thailand; Dr. Pennung Warnitchai and Prof. Tawatchai Tingsanchali of AIT.

A total of 72 papers were presented in the ten technical sessions, some of which were held in parallel, covering a wide range of issues in the areas of urban safety including earthquake, fire, water management, infrastructure management, disaster mitigation and environmental problems. Several presentations were made on newly developed advanced tools

Participants at the symposium

and methodologies for addressing these issues. The active participation of the audience in discussions that followed each of the presentations was noteworthy and that brought out many urgent issues to the attention of the participants. The discussions raised a very important question of how the new advanced technologies can be effectively used for urban safety in developing countries of Asia, where financial resources and technical know-how are limited. Several speakers pointed out the need of collaborative research among the researchers of developed and developing countries for developing low-cost and locally adaptive technologies and capacity building for new technologies to tackle the urgent issues towards urban safety. This point was addressed by Prof. Yoshifumi Yasuoka of ICUS in his closing remarks by highlighting the purpose of this symposium for developing a network for future collaboration and focus of ICUS on collaborative research projects with colleagues from Asian countries. A network office of ICUS has been already established at AIT for coordinating such activities in the region.

The proceedings of the symposium have been already published both in hardcopy and digital formats. The digital format of the proceedings is now available on the home page of ICUS. If you are interested in obtaining a hardcopy of the proceedings, please contact ICUS.

ICUS Activities Record

Some of the international activities carried out by ICUS faculty members during the period of July-December 2003 besides 2nd ICUS International Symposium.

Professor Uomoto visited Sydney, Australia during July 20-24 for participation in 10th ISO/TC71 Committee.

Professor Uomoto attended International Symposium on Non-Destructive Testing in Civil Engineering held at Berlin in Germany during September 14-21

Professor Yasuoka participated in the International Symposium for Commemorating, Tenth Anniversary of Korean Society for Geo-spatial Information System, held at Seol, Korea on 26 September.

Professor Yasuoka and Dr. Endo attended the Asian Conference on Remote Sensing 2003 at Busan, Korea during November 5-7.

Dr. Meguro visited Istanbul, Turkey during October 5-9 for participation in Turkey Disaster emergency measure study project.

Dr. Meguro visited Teheran, Iran during December 20-26 for participation in Iran National Earthquake prevention of disasters and administrative plan investigation for big earthquake in Tehran

Dr. Ooka attached 5th International Conference on Urban Climate held at Lodz, Poland during September 1-5.

Ms. Yoshimura attached 28th Annual Hazards Research and Applications Workshop held at Denver, U.S.A. during July 13-18.

Ms. Yoshimura visited Berkly, U.S.A. during for participation in a scholarship program for young researchers supported by the U.S.-Japan Cooperative Program on Urban Earthquake Disaster Mitigation.

Prof. Andre Ozer(right) and Prof. Uomoto(left)

Visitor to ICUS

During the period of October - December, 2003, ICUS received the following visitors.

-Prof. Jianhua Lin, Vice-President of Peking University(November 28)

-Prof. Dr. Andre Ozer, University of Liege(December 12)

Highlights of Recent Activities of RNUS

The Regional Network Office for Urban Safety (RNUS) of ICUS at AIT has been expanding its collaborative research and academic activities with researchers of AIT and other organizations in Asia. During the last three months from October to December, 2003, RNUS has successfully organized various activities including one seminar and two workshops. It has received a research grant for a research project on flood modeling in the Mekong River Basin.

Seminar on Water Resources in the 21st Century

RNUS and Water Engineering and Management field of AIT jointly organized a seminar on "Water Resources in the 21st Century under Climate Change Scenarios". Held on 14 November, the event gave a venue for the discussion of issues on water resources under high stress and climate change. It was graced by Guest Speaker Associate Professor Dr. Taikan Oki of the University of Tokyo, an internationally-renowned researcher in the field of land-atmosphere interaction, variation of global climate, global water resources analysis, virtual water, and isotope analysis. He was joined at seminar by his two colleagues from the University of Tokyo, Associate Prof. Dr. Shinjiro Kanae and Research Fellow Mr. Kei Yoshimura, who have been actively involved in various projects including the GEWEX, GLASS, GSWP, and the IAHS PUB. The workshop was rated highly by participants that included visiting scholars from Japan, researchers from Thammasat University (Thailand), representatives from Thai Meteorological Division (TMD) and faculty members, staff and students from AIT.

The three speakers of the Seminar

Workshop on Collaboration between Yamanashi University and Research Organizations in Thailand

RNUS assisted the University of Yamanashi, Japan in organizing activities of the Workshop on "Collaborative Research and Education Program of the University of Yamanashi COE with Thai Organizations and AIT" that was held on 25 November ,2003 at the Conference Center of AIT. The objective of the workshop was to establish a strong tie for research collaboration between the he University of Yamanashi, Japan and various water-related Thai organizations through AIT. The one-day activity was graced by Prof. Kuniyoshi Takeuchi of the Yamanashi Unviersity, who introduced the "UY COE Research and Education on Integrated River Basin Management in Asian Monsoon Region" and Prof. Kengo Sunada who talked about the Fuji River Basin. Several experts from AIT and Thai organizations presented papers on hydrology and water resources in Thailand, water use management, water quality and solid waste management, among other topics.

A snapshot during the workshop

Third International Workshop of WSSI

RNUS spearheaded the organization of the 3rd International Workshop of the World Seismic Safety Initiative (WSSI) on "Seismic Risk Management for Countries of the Asia Pacific Region" at the Miracle Grand Hotel in Bangkok during 7-8 December, 2003. WSSI is an undertaking of the International Association for Earthquake Engineering (IAEE) in support of the International Decade for Natural Disaster Reduction (IDNDR) of the United Nations. Since its inception in 1992, WSSI has been working with many countries around the world through its programs. To utilize and share the experiences learnt over the past ten or more years, WSSI 2003 was organized to allow participants to: 1) learn from countries where WSSI programs have made positive difference in terms of risk mitigation and management; 2) learn from countries where WSSI programs have not made any major impact in terms of risk mitigation efforts, and 3) develop a plan in consultation with all the attending countries about what WSSI should do for the next five years and where they should focus their human and financial resources. The workshop was attended by over 55 representatives from 19 countries.

The workshop participants pose for a group photo

Research Project on Urban Flood Modeling in Mekong River Basin

RNUS has received a financial grant from the Engineering Consultants NEWJEC Inc. of Japan to conduct a research project entitled "Urban Flood Inundation Modeling in Mekong River Basin Using a Physically Based Surface-River Model". The main scope of the project includes conducting research for improvement of an existing physically based distributed model for urban flood inundation simulation and its application and verification in the Lower Mekong basin. The project work aims at regional development and cooperation. This one and half year duration project has started from December, 2003.

3rd International Symposiumon Urban Safety Engineering on Octorber 18-19, 2004

On Octorber 18-19, 2004, 3rd International Symposium on Urban Safety Engineering will be held at Deli, Agra. Dr. Sudhir Misra, Associate Professor of IIT(Indian Institute of Technology) is a secretariat of this symposium(sud@iitk.ac.in). Application of registration and submission of abstract will start in April, 2004. Reader can see the following URL page for the information of this symposium (http://icus-incede.iis.u-tokyo.ac.jp/isus04/index.htm). Further details will be updated soon.

ICUS Activities Recognized

Mr. Shirase, Mr. Okuyama, Mr. Sugiyama and Mr. Kaneda working with Professor Uomoto, and Mr. Oda and Ms. Kan-no and Ms. Yoshimura working with Dr. Meguro, won a prize for the excellent presentation at the 2003 Annual meeting of Japan Society of Civil Engineers held at Tokushima in September.

Editor's Note

I took charge of the secretariat of ICUS second international symposium. This was good and a severe experience for me.

There were some first and adventurous things at this international symposium. First of all, it was the first event that I was the secretariat of an international symposium although I am very lazy. I think that this choosing was a strategy of ICUS head for educating me.

Moreover, it was the first time to have recruited general speakers widely. I thought we cannot make the wide discussions concerning urban safety engineering if the speakers were selected by only ICUS staffs as in the first international symposium.

It was necessary to make First Circular by April last year to recruit general speakers widely. However, I am not good at English. When I was embarrassed, Dr. Dutta made it instead of me.

Then, the papers recruitment started. Fortunately, many mails of registrations and the inquiries gathered. Unfortunately, I could not afford processed them all. Ms. Sharvani who was the secretary of ICUS received those all instead of me. I wish to express my gratitude to her sincerely.

After papers gather, it was necessary to make the symposium program. When I was nonplused, Dr. Endo and Ms. Yoshimura made the program instead of me.

At this symposium, I thought that I wanted to invite a lot of speakers. It is necessary to think about the arrangement of the budget for that, and to secure the rooms for stay. Ms. Ochi, Ms. Yoshimoto, and Ms. Fujita who are the secretary of ICUS did all those works. Moreover, they prepared the symposium hall.

Because the symposium ended safely, I was deeply relieved. I noticed only the work that I had done was to have worried, when I thought calmly. No matter how I wish, I cannot express my gratitude to all staffs of this symposium. However, it is uncertain whether ICUS head's strategy succeeded or not.

(by Ryozo Ooka)

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International Center for Urban Safety Engineering

ICUS/INCEDE NEWSLETTER

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STRUCTURAL DAMAGE TO BUILDINGS DUE TO BAM EARTHQUAKE OF DECEMBER 26, 2003, IRAN

By

Kooroush NASROLLAHZADEH NESHELI*

On December 26, 2003 at 01:56:56 GMT (05:26:56 a.m., local time), a destructive earthquake hit Bam City (29.09°N, 58.35°E) in Kerman Province, SE Iran. The Bam Earthquake caused numerous casualties (more than 45000 dead) and extensive damage to different types of buildings. Considering the earthquake focal distance was around 7 km, the buildings in Bam experienced a near-source earthquake. The majority of buildings were made with adobe and mud. In fact, the worldwide fame of Bam is due to its historical adobe houses. The most ancient adobe citadel in the world (more than 2000 years old) is located in this city and was severely damaged in this earthquake. The other building structural types include: un-reinforced masonry (URM) building, confined masonry building, steel frame, and reinforced concrete frame. In this article, building damage in terms of their structural types is discussed.

Earthquake-damaged view of historical adobe citadel (Arg-e-Bam)

Introduction

Regardless of some special characteristics of the Bam Earthquake (e.g. near-source location of structures), the observed failures of buildings were very similar to past earthquakes in Iran. What has been repeatedly observed is that construction and design do not conform to seismic resistant codes. While Iranian code of practice for seismic resistant design of buildings (the so-called Standard No. 2800) was revised by the Building and Housing Research Center (BHRC) in 1987 and became mandatory after Roodbar-Manjil Earthquake (1990), we still face many newly-constructed buildings which are not following the code. In Bam Earthquake, the buildings which observed main requirements of Standard No. 2800 could survive, demonstrating the efficiency of the code. There is, therefore, a high demand to establish a system so as to make sure that the standards come into effect.

In this article, buildings in affected areas are classified by construction material and method, and damage to each structural type is discussed.

Adobe

Adobe buildings are found in most areas of Bam city. Thick walls, heavy roofs, low strength of constituent materials (i.e. mud) and lack of integrity between components are characteristics of these houses. As there is no structural system to resist lateral loads, adobe buildings suffer large damage in earthquakes. The roofs in some adobe buildings were constructed in the form of a vault or a dome. Such roofs could partially survive during the earthquake, due to their special shape, provided that the walls support them. However, lack of integrity between roof and wall is a common problem in this type of buildings, causing total collapse of house.

Failure of unreinforced masonry walls and collapse of roof beams

Although the Iranian code prohibites new construction of adobe buildings, there is still a question about what we can do with the existing adobe houses, which are extensively distributed in rural areas in the country. It is recommended to conduct research on developing effective and cheap retrofitting techniques for adobe buildings.

Unreinforced masonry

The walls in this type of buildings are made of bricks and the roofs are constructed by laying bricks and mud between steel beams (this type of low-rise arch roof is called as “Jack Arch” in Iran). Because there are no confining ties or other types of reinforcement in these buildings, they are likely to collapse during earthquakes. In the absence of vertical and horizontal concrete ties, there is no integrity for an unreinforced masonry building. Therefore, as lateral forces apply to the structure, the supporting walls separate from each other at the corners of the building and are subjected to the out-of-plane deformations. Consequently, the roofs fall due to weak connection between roof beams and supporting walls.

Confined masonry

This type of building demonstrated good seismic performance. As indicated in Standard No. 2800, in all structural walls of all masonry buildings, one or two stories, irrespective of whether they are constructed with bricks, cement blocks or stone, confining ties must be constructed. Vertical and horizontal confining ties provide integrity for the building and make a seismic-resistant structure. By constructing tie-columns in the main corners of the buildings, the connection of

Vertical and horizontal ties maintain the stability of building

Tilt of building due to soft story formed in the first floor

walls at the intersections can be maintained.

It should be noted that good seismic performance of confining ties could be expected only if the ties are well executed. In other words, the ties with poor quality of concrete are not able to develop a seismic resistant mechanism.

In order to have a three-dimensional resisting system, tie-columns should be properly connected at all intersection points to tie-beams. If there is no suitable detailing for reinforcing bars in the concrete joints, the building can not stand against earthquakes. Moreover, the distance between axes of two successive tie-columns should be limited to 5 meters according to Standard No. 2800. The confined masonry buildings, which did not observe the above-mentioned points, failed during the Bam Earthquake.

Steel frame

Among steel-framed buildings in Bam City, those which had a seismic resistant system by using, for instance, steel bracings in two orthogonal directions could stand during the earthquake.

One common problem that was observed in several buildings in the city was the formation of soft stories. Other problems were related to inadequate design and poor detailing. For instance, the connection plate of x-bracings to the beam-column joint did not have enough dimensions and/or the welding at the interface of the connection plate and column was not adequate. Consequently, the bracings were cut from the beam-column joint during the earthquake. This, in turn, led to a lateral stiffness decrease of the corresponding story and caused the change of the location of the rigidity center, generating additional undesirable torsion to the building. Another major problem in steel connections was poor quality of welding. This came from lack of trained workmanship to perform appropriate welding during the construction process.

Separation of x-bracing elements from the column due to poor quality of welding

Concrete frame

Reinforced concrete (RC) frames were fewer in number in comparison with the other types of buildings in Bam City. These RC buildings performed relatively well in this earthquake. Some of observed damages were related to bond slip and lack of column confinement in the plastic hinge.

Conclusions

What has been observed in earthquake-damaged areas in Bam City was mostly related to “seismic vulnerability” rather than “seismic hazard”. In other words, the buildings suffered much damage mainly because the structures did not follow the seismic-resistant codes of practice. In this regard, just to have a good code does not work. What is strongly needed is to establish a system so as to control different stages of construction process including: design, on-site performance, quality of materials, and so forth. On the other hand, the problems that are associated with the existing structures are mainly related to lack of an effective system for promoting retrofitting procedures. Such a system should provide financial incentives for owners along with economical retrofit techniques so as to encourage people to strengthen their buildings.

** Scientific Board Member, Building and Housing Research Center (BHRC), Iran*

PROPOSAL OF A NEW ECONOMIC RETROFITTING METHOD FOR MASONRY STRUCTURES

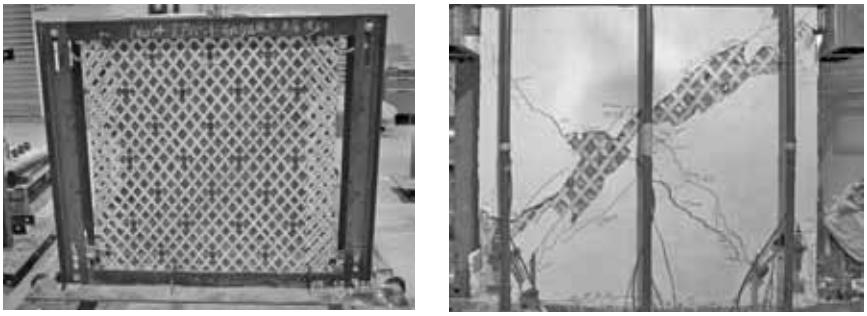
By

Paola MAYORCA*

Introduction

Masonry is a construction material widely used around the world due to its low cost and construction easiness. More than 30% of the world's population lives in a house of unbaked earth, which is one type of unreinforced masonry. During the last century, human casualties during earthquakes were mainly caused by structural damage, being the failure of unreinforced masonry structures responsible for more than 60% of them. The vulnerability of masonry structures under seismic loads has been recognized long ago and efforts to provide guidelines for the construction of sound earthquake resistant houses have been remarkable. In spite of this, every year casualties due to collapsing masonry houses during earthquakes are reported.

Several types of retrofitting have been developed for unreinforced masonry structures. For strengthening this type of houses in developing countries, a suitable retrofitting technique should guarantee not only its efficiency in terms of improvement of the seismic resistant characteristics of the structure (strength, ductility and energy dissipation). It should also be considered that: 1) the used material is economical and locally available and 2) the required labor skill is minimum. In this context, a new retrofitting method for unreinforced masonry structures is proposed.



Retrofitted wall before mortar overlay setting and after test

Proposed retrofitting method

Considering the previously mentioned conditions, a novel retrofitting method consisting of polypropylene bands (PP-bands) arranged in a mesh fashion and embedded in a cement mortar overlay is proposed. These bands are worldwide used for packing. They are cheap, resistant, and easy to handle.

At first, meshes are prepared with the PP-bands. The pitch and inclination vary according to the required earthquake resistance. Then, the masonry wall surfaces are cleaned and holes are drilled through the wall at a spacing of approximately 4 times the mesh pitch. After this, the PP-band meshes are set on both wall sides and fixed at the borders. Galvanized steel wires are passed through the wall holes and used to fix the meshes. The photo below shows the wall at this stage. Finally, a mortar overlay is placed on the wall surface.

To assess the retrofitting by PP-band meshes, masonry walls with and without reinforcement were constructed and tested in-plane.

Retrofitted wall performance

The PP-band meshes have a relatively low stiffness compared to the masonry walls. Because of this, they did not contribute to increase the wall peak strength. The mesh contribution was only observed after the wall cracked.

Immediately after the peak, corresponding to the diagonal cracking, the unreinforced wall strength dropped to 10 to 40% of the peak. On the other hand, the reinforced walls exhibited a 60% residual strength after the peak, which was sustained for at least 2% lateral drift. In the reversed direction, the reinforced walls also exhibited larger post-cracking strengths. The effect of the connectors and the mortar overlay in the wall performance was also observed in the tests.

These results showed the potential of using PP-band meshes as an effective and cheap masonry retrofitting method. Scaled model houses for testing on a shaking table are currently been prepared to further verify this technique.

** Post-doctoral fellow,*
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A STUDY ON APPROACHES TOWARD BUILDING DISASTER RESISTANT COMMUNITIES IN CALIFORNIA

By

Miho YOSHIMURA

Recent damaging earthquakes have clearly revealed that retrofitting low earthquake-resistant structures is the key issue for earthquake disaster reduction. In spite of this, retrofitting activities are not being carried out efficiently especially for non-public structures in Japan. Some local governments in California, USA are promoting retrofitting more successfully than Japanese governments by providing various kinds of economic incentives for it. I investigated the current strategies, history, and clues for successful promotion, mainly in the City of Berkeley and the San Francisco Bay Area, through interviews and reference collection from Nov. 5 to Dec. 4, 2004. This research was done with the scholarship program for young researchers provided by the US-Japan Cooperative Research Program on Urban Earthquake Disaster Mitigation by the US National Science Foundation and the Japanese Ministry of Education, Culture, Sports, Science and Technologies.

The City of Berkeley (104,603 inhabitants) in San Francisco Bay Area has achieved several goals to improve building safety since the 1989 Loma Prieta earthquake. According to the Association of Bay Area Governments, ABAG, the ratio of retrofitted houses to all single-family residential houses is 38%. The city was honored in 1999 by the Federal Emergency Management Agency (FEMA) with the "Model Community of the Year Award" for the Project Impact: Building Disaster Resistant Communities. Project Impact is a nationwide campaign for helping community members prepare for natural disasters.

More than 90% of the housing stock in the city is wood-frame buildings. Many of the single-family wood-frame houses constructed before 1945 are not bolted to their foundation or lack wall bracing. Multifamily wood-frame residential buildings, particularly with all or part of the first floor used for parking (structures called "soft-first story buildings") have a risk of collapse in case of intense shaking. These buildings need retrofitting.

The city has provided economic incentives for retrofitting these buildings since 1991. Its popular programs include the real estate transfer tax rebate, permit fee waiver and grant funds or loans to low-income house owners to retrofit their homes. Transfer tax is a local tax imposed by the city on the real estate exchange. Property transfer tax can be rebated up to 1/3 of the 1.5% tax for seismic retrofit work on residential structures or the structures which contain two or more dwelling units. Moreover, permit and inspection fees for retrofit work are waived by the city in case of residential buildings. The total reduction in the revenue for the city due to both programs amounts to 1 million dollar annually. These strategies are very innovative compared to those in Japan where retrofitting incentive programs mainly provide financial assistance and low interest loan for seismic evaluation or retrofitting work.

In addition to the above-mentioned measures, the city library maintains a tool-lending library where community members can borrow the tools needed to retrofit their houses. The city also provides building retrofit education programs assisted by non-profit organizations. These activities aim at promoting house owners to retrofit by themselves.

With slight changes due to administrative differences, I believe that there is a large benefit of adopting similar strategies in the Japanese system that have proven so successful in promoting private building retrofit in California.

Soft-first story building

Welcome to Dr. Amano, visiting Professor

ICUS welcomes its new staff Dr. Reiko Amano, who has joined ICUS as a Visiting Professor from February 2004. Dr. Amano is a Deputy General Manager of the Kajima Corporation, Tokyo. Here, we present a self introduction of Dr. Amano for our readers.

I have been working for Kajima Corporation since 1980. My specialization is in design of different types of bridges. I have been engaged in developments of various types of bridges using latest PC (Pre-stressed Concrete) technology as a designer, a researcher and a construction manager. In 1986, one of our main works, Birdie Bridge, a stressed-ribbon type bridge using the composite material with concrete and FRP, received Tanaka Award from the Japan Society of Civil Engineers (JSCE). Another of our works, "The Seismic Design Method for PC Bridges with High Pier", which was adopted to Washimi Bridge, received JCI Technical Award in 1989.

During my stay in Indonesia from 1997 to 1998, I concluded my doctoral dissertation based on my research experiences of developments of unique structures, and proceeded to obtain doctoral degree from the University of Tokyo in 1999. In recent years, my major concerns are environmental protection systems and fire prevention systems. Last year, we developed a unique fire prevention system called "Water Screen System", which can be adopted to subways, underground highways, underground shopping arcades and so on.

ICUS Activity Records

- *Prof. Yasuoka delivered a lecture at AIT and carried out a field survey at Sri Samrong, Thailand together with Dr. Endo (Feb 24-28).*
- *Prof. Meguro carried out a damage investigation survey of Bam earthquake together with Dr. Yoshimura (Feb 16-26).*
- *Prof. Ooka attended the annual meeting of AGS in Sweden (Mar 29-28).*
- *Prof. Dutta visited AIT for collaborative research at RNUS (Feb 10-Mar 31) and carried out GPS survey and field investigation for a research project in Sri Lanka (Feb 14-22).*
- *Dr. Kato, Dr. Endo and Dr. Yoshimura visited AIT for collaborative research at RNUS (Mar 11-13), and visited India for research investigation related to RNUS (Mar 14-17).*
- *Dr. Endo carried out a field survey related to eucalyptus in Chile (Mar 21-29).*

3rd International Symposiumon Urban Safety Engineering on Octorber 18-19, 2004

ICUS is going to organize the 3rd International Symposium on "New Technologies for Urban Safety of Mega Cities in Asia" jointly with the Indian Institute of Technology Kanpur (IITK), India. The symposium will be held in Agra, India during October 18-19, 2004. The symposium will focus on the following areas;

- Safety assessment of existing infrastructure
- Seismic rehabilitation and retrofitting of structures
- Planning and development of urban infrastructure
- Environmental impact of urbanization
- Advanced technologies for assessment of urban safety

The various deadlines for paper submission and registration are as follows:

- Submission of abstract: June 30, 2004
- Notification of acceptance: July 15, 2004
- Submission of full paper: August 15, 2004
- Last date of registration: September 15, 2004

Dr. Sudhir Misra, an Associate Professor of IITK, is the Secretary of the Organizing Committee. He can be contacted for further details in the following address:

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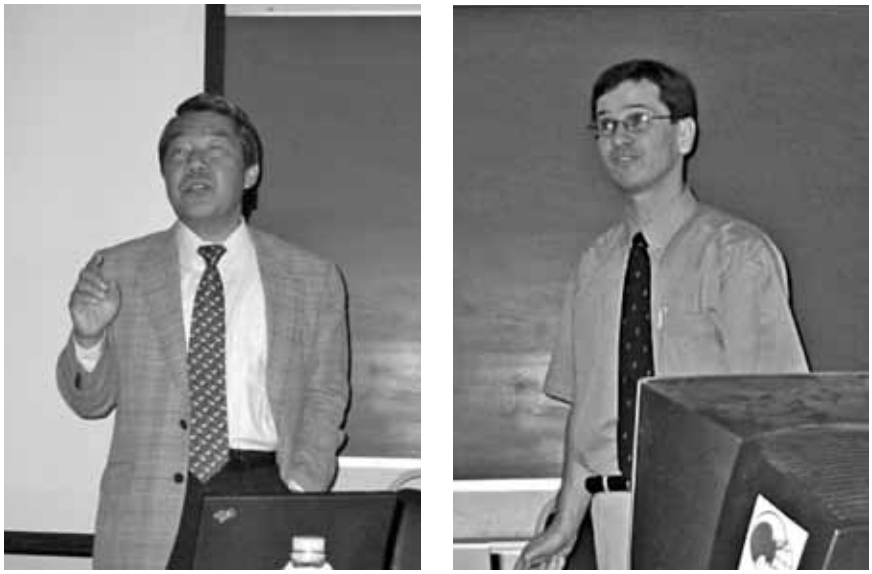
News from Regional Network Office of ICUS/AIT in Thailand

The Regional Network Office for Urban Safety (RNUS) has initiated a series of seminars at AIT from the beginning of 2004 on various issues emphasizing new technologies for urban safety and security by inviting researchers and experts working in these areas. A total of four seminars have been organized during the last three months.

The first seminar was delivered by Dr. Takahiro Endo on February 24, 2004 on applications of Hyperspectral Remote Sensing. Dr. Endo, a Lecturer of ICUS, University of Tokyo, Japan, spoke to a packed classroom about the basics of hyperspectral remote sensing and its usage. One of the main focuses of his presentation was application of hyperspectral remote sensing in estimation of damaged concrete for urban safety.

Then on 27 February 2004, RNUS facilitated the organization of the 2nd Seminar on "Remote Sensing from Local to Global Scale." The presentations were given by Prof. Yoshifumi Yasuoka who talked on "New Technical Trend in Remote Sensing – Its Application to Civil Engineering" and by Dr. Dennis Dye who discussed "Photosynthetically Active Radiation and the Terrestrial Carbon Cycle". In the seminar, the two scientists presented recent scientific developments in the field of remote sensing and its applications in civil and environmental engineering. Prof. Yasouka is the Deputy Director General of the Institute of Industrial Science under the University of Tokyo. Dr. Dye is the Group Leader of the Ecosystem Change Research Program, Frontier Research System for Global Change, Japan.



Prof. Y. Yasuoka and Dr. D. Dye during their talks at the Seminar on March 12, 2004 at AIT

On March 2, 2004, RNUS organized a seminar on "Numerical Models in Fluid and Their Applications" by Dr. Keisuke Nakayama, a Senior Researcher of the National Institute for Land and Infrastructure Management, Japan. In his presentation, Dr. Nakayama discussed the various types of numerical models which can be applicable for modeling of ecological system in bay areas of coastal cities. A case study of Tokyo bay was presented in his lecture. He applied various numerical methods and conducted laboratory tests to understand the flow field and stratification phenomenon in Tokyo bay, and predict the ecological system.

Dr. Yoshitaka Kato, an Assistant Professor and Ms. Miho Yoshimura, a Research Associate of ICUS, the University of Tokyo, delivered talks at the 4th seminar of the series organized by RNUS at SCE, AIT on March 12, 2004. Dr. Kato talked on recent problems and maintenance of concrete structures in Japan. He elaborated some of the major problems encountered by the Japanese civil engineers in evaluating the concrete structures using Non Destructive Inspection (NDI). He introduced a new NDI technique, which can be effectively used to deal with the current problems. Ms. Yoshimura introduced a new Retrofitting Promotion System (RPS) for low earthquake-resistant structures in earthquake prone countries that could serve as driving forces for the promotion of retrofitting of weaker structures. She mentioned that the effectiveness of the RPS was verified on the basis of the recovery activity data after the 1999 Kocaeli earthquake, Istanbul, Turkey and through this process, several advantages for both governmental and citizen sides were identified.

Editor's Note

Since 2002, ICUS has been holding international symposium on urban safety every year. The 2nd symposium was held in Japan in October 2003 and the upcoming 3rd symposium would be held in India in October 2004. I visited India with my colleagues Dr. Endo and Ms. Yoshimura for a preparatory meeting of this symposium in March. We arrived at Delhi around midnight and went to Agra, the city famous for the Taj Mahal, by car the following morning. The distance of just about 200km took around 5 hours to travel. During this journey, among many other things, I could feel the variety of differences between Japan and India. For instance, maintenance situations of infrastructure, traffic rules, and so on. I believe that the differences in these practices depend on the differences between the cultures and sense of value of each country and similarly infrastructure maintenance in a country is also closely related to its culture. So, we should never enforce our rules in a partner country as they are when we support infrastructure development in a developing country. It is extremely important to understand the culture and the sense of value of that country.

ICUS set up the regional network office at AIT (Asian Institute of Technology) in 2002. Since then, Dr. Dutta has been successfully working on collaborative projects in cooperation with researchers in Thailand. Dr. Dutta recieved a M.Eng. from AIT and a Ph. D. from the University of Tokyo. So, despite being an Indian, he is well versed with the cultures of Thailand and Japan. However, upon reaching here, I find that I do not know the culture of Thailand at all. I believe the level of my understanding of the Thai culture would ultimately affect the level of success of my research in Thailand. So, my first step in Thailand would be towards learning the Thai culture and to try and work and think like a Thai.

(by Kato)

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Institute of Industrial Science
The University of Tokyo

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WORKING AT INTERNATIONAL ORGANIZATIONS

By

Ken SUDO*

I worked at four international institutes for 27 years, including International Center for Disaster-Mitigation Engineering(INCEDE) which was a ten-year program, from 1991 to 2001, by the Institute of Industrial Science (IIS), University of Tokyo. All organizations are/were aiming to make our Earth safer from natural disaster and safer from nuclear weapon. In this short article, my observation and experiences at these organizations are mentioned.

IISEE

International Institute of Seismology and Earthquake Engineering (IISEE) was established in 1962 jointly by the Japanese Government and the United Nations. The establishment was based on a resolution of the General Assembly of the United Nations. This resolution was a follow-up of the initiative by International Association of Earthquake Engineering which took place in 1960 at the IIS. Prominent professors of IIS such as the late Professors Shunzo Okamoto and Keizaburo Kubo devoted themselves to this initiative as their contribution to earthquake disaster reduction in the world.

The objective of the IISEE is to foster engineers and seismologists in the field of earthquake disaster mitigation, in particular, in the developing world. Since its inception, more than 1,000 participants from 105 countries have reportedly finished courses which were programmed by international well-known experts. Nowadays large alumni of IISEE are playing the central role in earthquake disaster management in the respective countries. IISEE is still active in conducting its mission. I was involved in diversity programs of IISEE for 15 years.

Shaking test of actual 7-story apartment house at the Almaty city

One of the programs which I was in charge was for seismic risk reduction of the Almaty city in the Republic of Kazakhstan. Almaty is located in a high seismic region at the northern foot of the Tien-Shan Mountains. Kazakhstan was one of the developed republics among the former Soviet Union. Collapse of the Soviet regime led the Republic to serious economic disruption. Under the marketing economy, most investment has been addressed to business potentially producing more benefit quickly. Disaster management which the government should take responsibility has been put in less priority issues. Needless to say, Kazakhstan is not exceptional. There are many disaster prone countries in the world where even poor measures against disaster cannot be taken.

My activities focused on knowledge transfer to researchers in the Institute of Seismology at Almaty. They were enthusiastically keen to absorb any knowledge. Any lectures and colloquia were filled with many participants. These meetings were followed by hot discussion. I am very much satisfied with my activities at the Institute. A charming and very much talented secretary helped me with excellent faithfulness. She viewed my lecture notes before the classes to understand what I was going to talk. So that she spoke as if she herself was a teacher. I took opportunities to observe full scale shaking test of a 7-story building, while I was in the Institute. The test was sponsored by a general contractor (see the photo on the 1st page) which has its industrial base at Almaty. They said that such test has not been conducted since the beginning of 1990s. The successful test has encouraged researchers to develop further studies for earthquake disaster mitigation.

My staff at the office of IISEE, Republic of Kazakhstan

The lunch time was an opportunity to know what Kazakhstan people think in daily life. My secretary and driver are of mid thirty age. The first half of their lives were under the Soviet and the second under the marketing economy. They talked about summer holidays in forests while they were children. Their parents did not meet any costs for the camp, contrarily, they need much money for their children to spend long summer vacation in forests. Education in better school is also costly. When they were children, no education fee was charged from their parents. Bread and butter were certainly in hands, although they had to be in long queue. Nowadays, some poor people have difficulty in even getting bread. They talked that they realized that richer people could get more benefit in the current system. I learned that the name of Kazakhstan was taken after Khazar Kingdom which existed in the 8-10th century around the Caspian Sea and which is thought to be the home place of Ashekenazi people. The Ashkenazi people must be one of key-people to understand the modern world.

IDNDR

International Decade of Natural Disaster Reduction (IDNDR) was an initiative based on the unanimous resolution of the United Nations General Assembly in 1999. This 10-year program started with enthusiastic welcome by disaster prone countries in the world. It was thought that the 10-year, 1990-2000, would be enough to identify problems to be solved for the safer Earth in the 21st century and to establish institution/machinery for putting the issues into practice The IDNDR Secretariat at Geneva, however, could not help any initiatives and undertakings by

Программа «Радиус» – во бла

Первое интервью – «Вечерке»

Newspaper clip of 'Tashkent Evening News'.

scientific communities or engineering associations financially, as the Secretariat had no mechanism for regularly getting money. The funding was made on voluntary base at willingness of donor agencies. Actually the Japanese Government made the largest contribution. It reached almost 60 % of total operational expense.

I was at position to monitor scientific activities undertaken at various places by different organizations. I learned that many projects are stranded due to financial difficulties. Therefore the Secretariat itself had to launch projects to encourage the world. RADIUS project was one of these projects.

A Symposium about VAN by International Council of Scientific Union (ICSU) was another. In the beginning of 1990, most seismologists were very much pessimistic in earthquake prediction. Nevertheless, Greek physicists claimed that the VAN method needed to be paid more attention. Sir James Lighthill of ICSU thought that there was something in VAN as Professor Kanamori of California Institute Technology commented to the Science, a well-known scientific journal. All papers presented in this successful symposium were compiled into a book, titled as 'Critical Review of VAN' published by World Scientific

Press. I was involved in coordination of the Symposium. Dr. Sir James was of strongly scientific curiosity and He never had prejudices toward's any scientific view. He tried to see only facts. His manner moved him to dare hold the symposium. It is very much pity that he passed away soon after the Symposium by an accident in the sea.

INCEDE

After retiring from the job as director of IISEE, I was invited as Director of International Centre for Disaster–Mitigation Engineering (INCEDE) in the summer of 1996. It should be surprising to see that only four permanent staff members were conducting many international collaborative projects, holding 'Open Lecture', managing the INCEDE human network, and publishing INCEDE Newsletter, having help by a couple of beautiful and hard-working secretaries. Communication through the Network taught me that people struggling with diasters in the respective countries wanted to know what other people did, what technology or devices were available and many different things. The Newsletter responded to these wishes. Any INCEDE Newsletters were responded by voices from readers in the world. In an issue of the Newsletter, two articles on VAN were put. Two prominent researcher, Drs. Seiya Uyeda (Professors Emeritus of the University of Tokyo) for VAN and Robert Geller (Professor of the University of Tokyo) against VAN, kindly contributed articles. Since by some reasons any article for VAN had not appeared in the public at that time, this issue was welcome in the world and many copies of this issue were sent to many readers in addition to regular readers.

I had a visit by the director of natural disaster department in a country in the Caribbean Sea. She took an opportunity to observe monitoring systems and devices against disaster, while she was staying in Japan. At volcanic sites, she saw a monitoring system consisting of many high-technology sensors and automatic information process on real time. At other sites, she saw that more than 1000 GPS data were analyzed on real time base to reveal how Japan islands were deformed by the plate motion. Certainly it will be powerful tool for earthquake prediction. Right before her leaving for her country, she sighed, saying 'in principle human-being can know when a volcano will erupt and how a large earthquake will occur at where. But it is not our case'. I could not find my response to her words.

CTBTO

In 2002 autumn, I was invited as a unit head of Comprehensive Nuclear Test Ban Treaty Organization(CTBTO). The Organization needed my knowledge and experiences on seismological analysis. When a nuclear atomic bomb is exploded under the ground surface, elastic waves are generated within the Earth. The waves are very much similar to seismic waves. CTBTO has a verification system of nuclear explosion test. The central component of the system is detection of events which might be generated by explosion. For this purpose, CTBTO deploys global observation network comprising of around 300 sensors: two thirds are seismographs and the others for hydroacoustic, infrasound and radioactive nuclide observation. Analysis of signals from the network is my task. It is almost seismological work.

Readers of this Newsletter may think that the above observations, in particular, geophysical observations can benefit studies on earth science and natural disaster monitoring. I wish to suggest you to contact your Government, if you are interested in the data and if you wish to access the data.

There are difference between the United Nation office at Geneva and Vienna International Center where CTBTO, International Atomic Energy Agency(IAEA), and

CTBTO building

other United Nation Organizations. Security system at the Vienna is much more strict. No body can enter the inside of the building without certification. In order to reach my office, anybody has to pass through one more gate which is always locked. Some data might be related to nuclear weapons. This is the reason why so strict security is kept. Needless to say, data handling is also controlled under strict rule.

Another difference of CTBTO from IDNDR is in budgetary system. While IDNDR had no financial base, CTBTO is financed by member countries. The Japanese government meets 20% of the total budget. There are five Japanese staff members among total 250. Only 2% is too small, compared to financial contribution by the Japanese Government. The rate of Japanese staff is also very small in other organizations. The Permanent Mission of the Japanese Government to International Organization at Vienna is always to keen to increase the number of Japanese staff at the organizations.

Acknowledgement

I thank Prof. Uomoto and his staff of ICUS for providing me with the space for this article. Also I wish to have your permission to say my gratitude to Ms. Yasuko Fujitani who had helped me with the most faithfulness while I was in IIS. I do hope ICUS will achieve further works helpful to safer Japan, safer Asia and safer world.

Professor, CTBTO, Preparatory commission for the comprehensive nuclear-test-ban treaty organization, Vienna

Reports Published by the Research Committee RC-39 "Research on Sustainable Engineering for Urban Safety"(1)

The Research Committee on Sustainable Engineering for Urban Safety (Rc-39) established by the ICUS, has been working since April, 2002. Besides the members of the faculty of the Center, the committee comprises of 16 private companies and research organizations.

The reports written by the 5 working groups were published in March, 2004 in Japanese. The five 'working groups' were as follows and a brief explanation of each report is given here in after.

WG1: Methods to handle aging infrastructure (Secretary: Mr. Kenji SHIBA, Shimizu Corporation)
WG2: Global environment (Secretary: Mr. Hidenobu NAKAI, The Tokyo Electric Power Co., Inc.)
WG3: Study on heat islands in urban environments (Secretary: Mr.Haruhido TSUBAKI, Kajima Corporation)
WG4: Disaster prevention and response (Secretary: Mr. Seiichiro FUKUSHIMA, Tokyo Electric Power Services Co., Ltd.)
(Abstract To be published in vol.4-2)
WG5: Developments in sensing technology and its applications (Secretary: Mr. Yukio AKAMATSU, Kokusai Kogyo Co., Ltd.)
(Abstract To be published in vol.4-2)

WG1: Methods to handle aging infrastructure

Japan's dramatic economic growth was remarkable during the sixty years after the Second World War. Social infrastructure was also developed. Those constructed in the early phase are now aging and starting to require renewal. According to 2003 White Paper on Land, Infrastructure and Transport in Japan, the social capital stock was 405 trillion yen as of 2001. It led is the prospect that, as the maintenance/management and renewal cost for 2025 should be about 10 trillion yen, such cost needs to be increased by 150 billion yen every year for the next 10 years. Replacement was once preferred for the social capital infrastructures based on the strategy "Scrap and Build". However, the shift to "Stock and Renovation" is now prioritized in the eco-friendly and recycle oriented society of the modern world. Therefore, aging structures should be properly managed and renewed to sustain the function of urbanized areas.

From this viewpoint, Aging Structure Working Group studied aging structures from three aspects: Engineering (Physics), Function and Economy and identified issues that need to be addressed to carry out the effective asset management. Based on the case study of "BANKOKU-BASHI (BANKOKU Bridge)" the concrete road bridge built about 65 years ago in Yokohama, Maintenance and Management Guidelines of Social Capital Stock (for "System Design") was developed.

The study on BANKOKU-BASHI revealed that structures may sustain its semi-permanent material life with the minimum cost as far as they are properly designed, built, and undergone sufficient construction management unless it was uniquely designed or affected by unavoidable environmental actions. On the other hand, it also reminded the importance of establishing the framework to sufficiently maintain such social assets to accept the extension of functionality of the structures as they age in order to meet the needs of the society. Some issues remain unverified from the study which was conducted for less than 2 years. Thus, we are determined to further study this issue to develop an overall asset management policy.

WG2: Global environment

Keeping in mind that global warming due to greenhouse gases (GHGs) emissions by fossil fuels is one of the most critical issues that we need to cope with immediately, we have explored how to estimate the GHGs emissions from activities within cities by reviewing existing studies in order to figure out factors which influence most to GHG emission reduction.

Based on the recent study (Kiriyama et al "Urban and Land Structure for Lower Environmental Impacts", Journal of Policy Research for Land, Infrastructure and Transport, Vol. 12, 2002), the electricity consumption per capita has a tendency that is higher in city center and lower in suburbs. It is also noted that there is little difference among total consumption between city center and suburbs, despite the fact that the density of electric appliances tends to increase in a small size house of city center and the amount of automobile energy consumption from residence is lower in city center than in suburbs.

According to our findings, there are very few studies indicating the possible future scenarios covering energy demand increase, population trends, changes of economic situation in various regions, and urban life style changes in the future, even though some studies show that GHGs emissions can be roughly estimated by statistical analysis of existing available data.

For pursuit of the ultimate goal, which is the establishment of the effective and accurate tool to estimate and forecast GHG emissions by urban activities, it is exactly needed to cooperate with wisdom in various related field such

as engineering, geography, economics, science. Although, we believe that we have found the key issues to be solved, this study was only able to reach the door to the future goal. We are hoping to continue the study on the issues in any way.

WG3: Study on heat islands in urban environments

In order to develop a so-called sustainable city, it is necessary to study about a sustainability of urban infrastructures organizing the city and environmental influence of these infrastructures. There are many factors of the urban infrastructure development that affect the environment in cities, such as air the pollution, water pollution, noise problem, etc. This working group focused and investigated the heat island phenomenon which is rapidly increasing in Japan . The heat island phenomenon has a very complicated mechanism so that a numerical simulation based on a mathematical model is very useful for this investigation. So we carried out a numerical simulation of Hanshin district where the air temperature is getting remarkably high in recent years using remote sensing data. Specifically speaking, we shared the preparation of initial data with Nakanihon Air Service, the simulation of meso-scale atmosphere with University of Tokyo and the heat balance analyses at the ground surface with Kajima Cooperation. The subjects below were investigated.

(1) Development of numerical simulation method using data obtained from MSS fitted to an aircraft as a tool to predict an environment in cities.

(2) A difference from prediction accuracies depended on sets of land covering data for the purpose of establishing numerical simulation method.

Under restriction of two years period, this working group could obtain excellent results on these subjects because it has been organized from specialists of many fields, such as architecture and building, civil engineering, geographic information and so on, and could carry out an analysis of the heat island phenomenon from many technical views.

We hope these results can contribute to developing a sustainable city practically and make studies about sustainability and the influence on the environment of urban infrastructures progress.

The 6th ICUS Open Lecture

The 6th ICUS open lecture was performed at the first meeting room of IIS in the afternoon of April 9, 2004. The title of the open lecture was "World and Japan, Peace and Disaster Prevention". In the open lecture, three interesting lectures were given from the three famous professors, Prof. Fukuwa, Prof. Sudo and Prof. Okada. At the end of the lecture, special session was organized to discuss the importance of safety engineering with the three professors and the audience (90) from many different aspects. The lecture ended at 17:00 but the talks continued till the end of the cocktail party after the lecture.

The title, brief explanations and the lecturers were as follows:

1) Prof. N. Fukuwa, Nagoya University: "Disaster Mitigation Strategy for Local Area Based on Experience in Nagoya Area ",

- In the near future, within 50 years, one or more large earthquakes are expected to happen in Shizuoka and Nagoya area. To deal with the earthquake, lecture was given how the government and private sectors are planning and working hard to prevent and mitigate disasters in this area.

2) Prof. K. Sudo, CTBTO (Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization): "My Activities for Safer and More Peaceful Earth",

- Brief explanation of the lecture is given at the top of this Newsletter. The lecture was given by the former director of INCEDE.

3) Prof. H. Okada, Hokkaido University: "Successful Predication for Volcanic Eruption of Mt. Usu",

- The lecture was given how the prediction was made at the time of volcanic eruption of Mt. Usu in Hokkaido. Although the prediction was successful due to detailed inspection and monitoring of the movement of the volcano, disaster may happen when the inspectors visited the site.

Technical Delegation from France

A technical delegation from France visited ICUS on April 21, 2004. The mission of the French team visit to Japan was to survey the new technologies applied to large projects, newly developed construction materials, risk and management methodologies now being used in Japan.

The team consisted of 14 members including senior officers from French Embassy, Tokyo and it was led by Mr. Daniel TARDY of MEDEF (Mouvement des Entreprises de France). The delegates were mostly from industrial sectors.

French delegation with some ICUS staff members

Prof. Uomoto, Dr. Meguro and Dr. Ooka of ICUS presented recent works on their respective areas of research related to the interests of the visitors and showed the their on going research activities at the research laboratories. The delegates were impressed by the wide range of fundamental research and collaborative research activities performed at ICUS.

Prof. Uomoto explains various activities of ICUS to the visitors

IIS Open House

The Institute of Industrial Science opened the facilities to the public on June 6 and 7, 2004. Our ICUS (International Center for Urban Safety Engineering) also opened the facilities and explained our activities both in English and Japanese. The title of the open house of ICUS was "Towards Safer and Securer Built Environment in Mega Cities in Asia". Total number of participants for two days was 120.

Under the umbrella of the ICUS title, ICUS members' research titles were as follows:

1) Dr. Kimiro Meguro:
   - Development of Integrated Information System for Total Disaster Management -

2) Prof. Taketo Uomoto:
   - Methodology from Inspection and Diagnosis to Repair Method of Concrete Structures -
3) Dr. Ryuzo Ooka:
   - Sustainable Urban Design with CFD Simulation -
   - Wind Energy Use and Diffusion of Contaminants in Urban Area with Wind Tunnel Experiment -

4) Prof. Yoshifumi Yasuoka:
   - Environment Monitoring and Disaster Assessment Using Remote Sensing -
5) Dr. Yoshitaka Kato:
   - Development of Maintenance Management System for Existing Concrete Structures -

ICUS Activity Records

- *Prof. Uomoto visited Zurich (Switzerland), Munchen, Berlin and Koln of Germany for participating in research activities related to concrete engineering (June 12-20).*
- *Prof. Yasuoka and Dr. Endo participated at the 8th MODIS meeting at Bangkok, Thailand with GISTDA and AIT on management and utilization of MODIS data (June 23-26).*
- *Prof. Ooka participated in the conference on "Development of Urban and Building Models for Densely Populated Area with Minimized Environmental Load in Hot and Humid Climate" and attended the annual meeting of ASHRAE at Nashville, USA (June 26-July 2).*
- *Prof. Dutta visited AIT, Thailand for collaborative research at RNUS (June 15-Aug 31).*
- *Dr. Kato attended the 4th International Conference on Concrete under Severe Conditions at Seoul, Korea (June 28 – July 1) and visited AIT, Thailand for collaborative research at RNUS (July 2- 22).*

Awards

- *Mr. Kei OOYOSHI, a student of Prof. Yasuoka, won the best presentation award at a Conference of the Japan Society of Photogrammetry and Remote Sensing in June*
- *Mr.Pakawat SANCHAROEN, a student of Prof. Uomoto, won the excellent presentation award at the annual meeting of Japan Cement Association in May.*
- *Mr. Kazumichi SHIRASE, a student of Prof. Uomoto, won the excellent presentation award at the annual meeting of Japan Cement Association in May.*

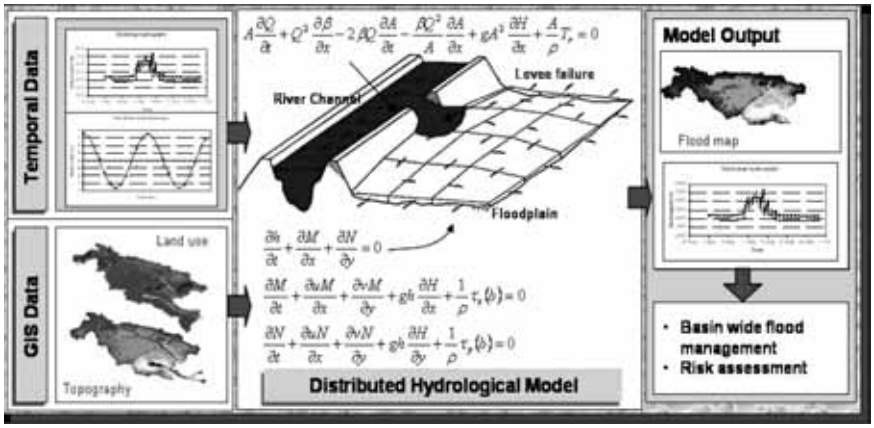
- RNUS Activities -

An Introduction to RNUS Project on Urban Flood Modeling in Mekong Basin

Since inception, the Regional Network Office for Urban Safety (RNUS) of ICUS/AIT has initiated several research projects in collaboration with other research institutes or private sectors. This is one of sponsored research projects of RNUS by private sector, which aims at developing a system for urban flood inundation simulation in the Lower Mekong river basin. The project mainly focuses on physically based surface-river modeling for flood inundation simulation.

The model is developed with the objective of integrating it with airborne and space borne resources and numerical weather prediction models for designing an integrated flood warning system. An existing distributed surface-river hydrological model developed at the Public Work Research Institute (PWRI) of Japan is modified and improved for Mekong river basin. Initially, the existing model is tested in a small river basin in Japan with historical data and then, it is modified to make it suitable for large basin for its application and verification in the Mekong River basin with data of some selected major flood events. The focused area in the Mekong basin is Cambodian floodplains of the Mekong, Tonle Sap and Bassac Rivers. After successful application, the model will be utilized as the flood simulation model of a proposed comprehensive flood warning system for the Mekong Basin.

For further information about this project, please contact RNUS by e-mail (rnus@ait.ac.th) or visit the RNUS website (http://www.sce.ait.ac.th/rnus/).



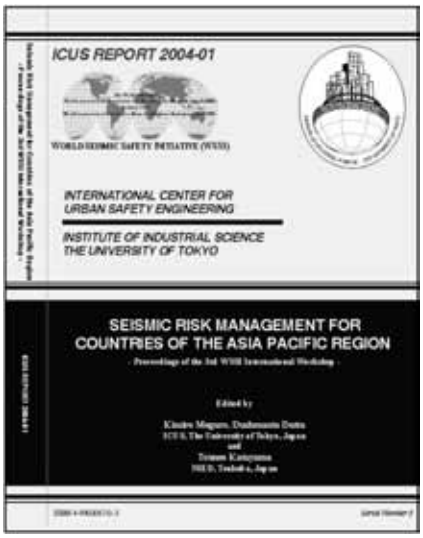
Schematic representation of the modeling concept

ICUS Report 5: Proceedings of 3rd WSSI International Workshop is published

RNUS spearheaded the editing activities of the ICUS Report 5, which was published recently. This volume of ICUS Report contains the proceedings of the Third International Workshop of the World Seismic Safety Initiative (WSSI) on Seismic Risk Management for countries of the Asia Pacific Region. WSSI is an undertaking of the International Association of Earthquake Engineering. The workshop was held in Bangkok, Thailand during December 7-8, 2003 and was attended by 52 participants from 19 countries. The organizing activities of the workshop were coordinated by RNUS.

The proceedings include country reports from 12 countries, reports on inter-national cooperation of JICA and reports from other International Organizations. The country reports emphasized on the earthquake risk mitigation efforts, strategies, responses and assessment measures initiated in their respective countries. Most of the country reports focused on seismic risk management activities in the last five years, scope for future collaborations in the region for varied resources and further networking and information-sharing with international organizations. Important roles played by WSSI as a catalyst in initiating several activities for earthquake disaster reduction in different countries are highlighted in the country reports. The four papers on JICA related activities introduce major projects and programs of JICA on international cooperation, which have been implemented in an attempt to reduce seismic risk in different countries of Asia. The last section of the proceedings includes reports from five international organizations.

For obtaining a copy of this Report, you may contact RNUS by e-mail (rnus@ait.ac.th).



Cover page of ICUS Report 5

Editor's Note

ICUS has been opening international symposiums, workshops, and open lectures to the public every year, addition to the activities required by IIS, such as "Open House of Komaba Campus" and "Open House of Chiba Campus". In this News letter, the lecture given to us in the open lecture by Prof. K. Sudo, the former director of INCEDE, is introduced. As given in the paper, it is not an easy work to start a new activity without any help from the public. Our ICUS was lucky enough to overtake the networks of former center "INCEDE", and succeeded in enlarging the relations with other organizations, universities and industries throughout the world.

Three years have passed since ICUS started its activities in April, 2001. Many projects have been performed among the staff members of ICUS related to urban safety engineering. Since April of 2001, 6 new staff members joined ICUS : Prof. S. Misra, Dr. T. Endo, Ms. M. Yoshimura, Prof. T. Takahashi, Prof. M. Setojima, and Prof. R. Amano. But after one to two years of stay, 4 members, Dr. S. Ochi, Prof. S. Misra, Prof. T. Takahashi and Prof. M. Setojima have already left ICUS, working hard during their stay in ICUS. The secretaries of ICUS have also changed: Ms. N. Shiuchi, Ms. C. Murakami, Ms. V. Aravinthan, Ms. Y. Ochi, Ms. S. Hazarika have left ICUS but Ms. E.Yoshimoto and Ms. T. Fujita are taking over their works.

On May 5, we have a celebration day for children in Japan. To celebrate, large carps made of cloth are hoisted in tall poles and let them swim in the air as shown in the photograph. The carps are believed to be live and strong fishes and people wish their children to grow up with high spirits like carps. Although members of ICUS are changing year by year, we wish all the members including former members to support our activities like the carps in the photograph. Although ICUS is becoming one of the top centers in Japan, we hope our center to be one of the most active international center for urban safety engineering throughout the world. ***(by Uomoto)***

Swimming carps and Mountain Fuji

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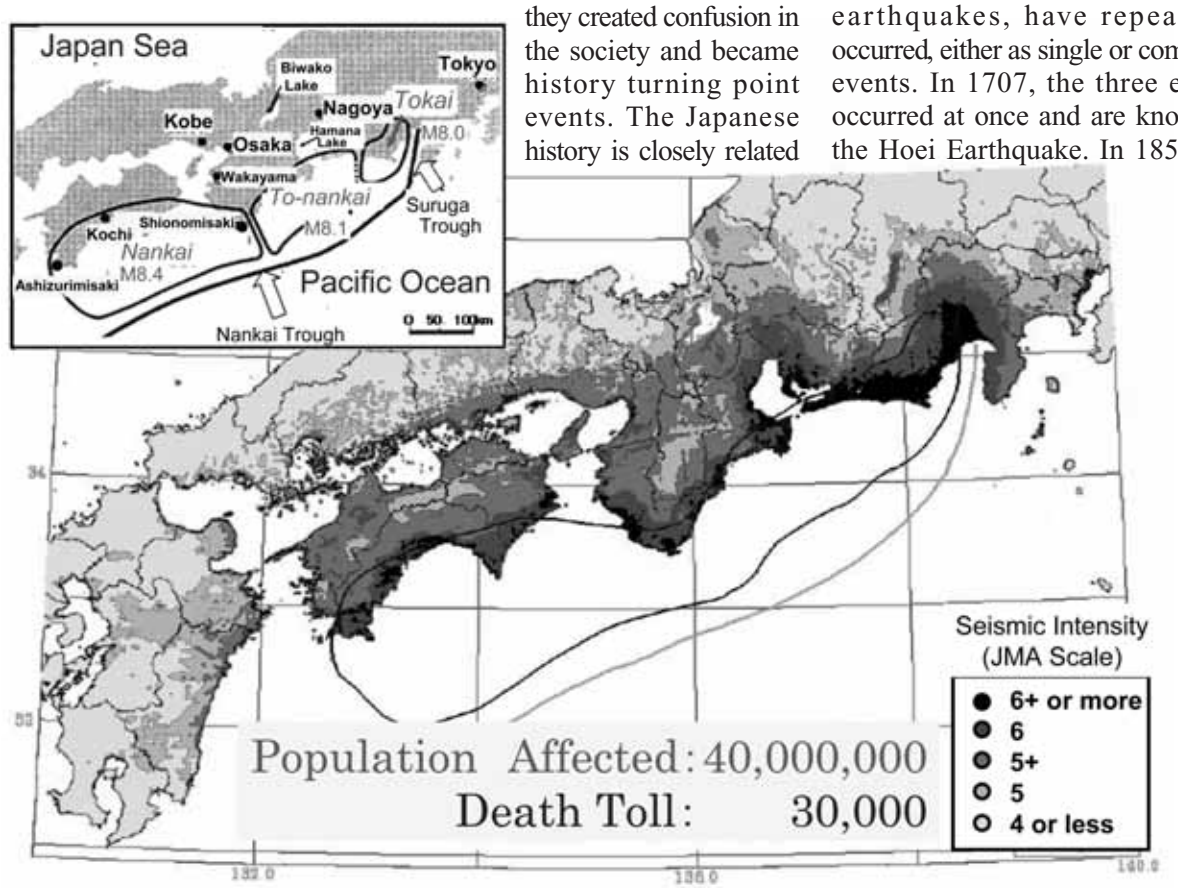
EARTHQUAKES DO NOT WAIT
LET'S CONSTRUCT A BRIDGE BETWEEN THE RESEARCH OFFICES AND THE REAL SOCIETY

By

Nobuo FUKUWA*

Earthquake engineering experts are greatly concerned about the occurrence of three huge earthquakes around the Nankai Trough, which is located along the western coast of Japan. These earthquakes are expected to shake vast regions with intensities over 6 in the Japanese Metrological Agency scale. When these earthquakes stroke in the past, they created confusion in the society and became history turning point events. The Japanese history is closely related with the occurrence of these events.

Along the Nankai Trough, three 100-year return period events, the Tokai, To-Nankai and Nankai earthquakes, have repeatedly occurred, either as single or combined events. In 1707, the three events occurred at once and are known as the Hoei Earthquake. In 1854, the



JMA Seismic Intensity Distribution due to Tokai+To-Nankai+Nankai Earthquakes
(by The Central Bureau of Earthquake Disaster Reduction, Japan)

Tokai and To-Nankai Earthquakes stroke simultaneously and the Nankai Earthquake followed after 32 hours. This event is known as the Ansei Earthquake. The last series of combined events occurred in 1944 and 1946 when the To-Nankai and Nankai Earthquakes occurred, respectively. Because at that time no Tokai Earthquake occurred, this event is highly expected and 25 years ago, a short term prediction system was started to be prepared.

The Japanese earthquake research committee of the National Government has reported on March 2004 that the probabilities of occurrence of the Tokai, To-Nankai, and Nankai earthquakes in the coming 30 years are 84%, 56%, and 46%, respectively. The Central Bureau of Earthquake Disaster Reduction estimated the damage expected in case these three earthquakes occurred and reported its results in 2003 as shown in the figure in the front page. In the worst case scenario, the estimated death toll was approximately 30,000, the number of collapsed and heavily damaged houses, 1,000,000 and the economic loss, 100 trillion yen. Compared with the damage caused by the 1995 Kobe Earthquake, the estimated death toll and the structural damage/economic loss are five and ten times larger, respectively. Japanese total tax revenue in 2004 is estimated as 41.7 trillion yen. Therefore, it can be said that Japan has a great probability of losing the equivalent of more than two-year tax revenue in the first half of this century. Japan should recognize this situation.

The main cause of earthquake damage is the existing low resistant structures. In Japan, when a new building design code is enacted, it is not retroactive, i.e. existing buildings do not need to comply with the new code. Because of this, there are approximately 13 million low earthquake resistant houses in Japan. Retrofitting these structures is the key issue to reduce the earthquake damage level. A huge damaging earthquake in Japan may have a worldwide impact.

It has been recognized that it is very important to promote earthquake disaster counter measures in the areas that will face the Tokai, To-Nankai and Nankai Earthquakes. These regions are wide and located in western Japan. Approximately 40 million people live there in 10 million houses. If a huge earthquake strikes, one third of the total Japanese population will be affected and self defense forces and firefighters are needed to cope with in this situation, however, the numbers of these two organizations are both 150,000. It is clear that there will be a shortage of human resources to respond well against such a disaster. In this situation, all the population should engage in activities of rescue, first aid, fire fighting, and life protection as well as on mutual assistance inside the community. There is no other possible way to deal with this disaster situation. In the case that three earthquakes strike at once, the damaged area will extend from Kanto to Kyushu. Against such a huge disaster, cooperation among prefectures is fundamental. In order to be able to help each other, the damage in each region should be minimized, thus increasing the capability of each of them to respond independently against the disaster.

What shall we, earthquake disaster field researchers responsible of human lives, do against this imminent situation? Of course, research on highly developed technologies such as base isolation systems, health monitoring, vibration control, and others are very important. I myself am convinced that it is much more important to spread the use of earthquake retrofitting methods which have the minimum requirements to safeguard the human life. Even if these methods are not perfect but manage to save lives, they are very meaningful. It is necessary to retrofit all structures by minimum requirement low cost methods which can be readily implemented. Earthquake disaster research has no meaning if it can not help protect human lives.

I know that it is not easy to promote retrofitting or to make the general public understand its importance. Therefore, the government should improve its system to promote retrofitting. In this sense, I believe that the most important point is to educate the people and show them the situation that they would be facing if an earthquake strikes and they have not retrofit their houses. I am convinced that it is necessary to increase the public awareness by organizing activities to let the people understand the importance of retrofitting. It is also important to bring up a generation of people who can carry out these activities. We, earthquake researchers, are the people called to reduce the earthquake damage in the region, and therefore should go from our research offices to the society by carrying out awareness campaigns for the general public, especially in the areas where the number of specialists is insufficient.

Because the number of earthquake experts is limited, we should collaborate and get support from the media to help us create a bridge between the specialists and the general public. The key issues are the education of elementary, junior and high school teachers, voluntaries in the disaster mitigation field, and mass media people. The author and other supporting members started establishing various cooperation systems among the public as shown in the figure below, as well as human resource education system, colleges for the training of disaster mitigation leaders, and development of disaster

Cooperative activities at a regional level

Educational activities using portable equipments to demonstrate the public the dynamic behavior of structures and the benefits of retrofitting.

mitigation education at elementary school. Useful tools for this purpose are education materials such as portable dynamic structure behavior simulators. The figure above shows three models produced by the author. These equipments are manually or electrically motored and have a great impact on the public.

The university, where earthquake disaster experts are working, may be regarded as a very important regional base for proper preparation and response in case of an earthquake. In a disaster situation, the university can gather information related to ground motion observations and building damage. An appropriate disaster information system is therefore required. The figure below shows the earthquake disaster information system recently developed at Nagoya University, where the author works. Cameras and seismometers are installed at various locations in the Nagoya University campus and national universities around it. Through this system, photographs and strong ground motion records can widely be sent in real time. This information is displayed in multiple screens and many researchers can analyze it. We have established satelite information networks and TV conference systems by which we can communicate with different municipalities. With this system, the university can play a key role as a regional disaster response organization. I am currently developing a very economic seismometer, with a cost of less than 100,000 yen/unit, and am aiming at installing it in all elementary school and business buildings in order to observe the vibration of these structures.

If the general public is given the opportunity to seriously consider an earthquake and a disaster situation, it may become possible to guide them to take proper disaster reduction countermeasures. We, earthquake disaster researchers, have many things to do now. We are expected to take initiatives beyond our conventional action boundaries.

**Professor, Environmental and Safety Management, Graduate School of Environmental Studies, Nagoya University*

Earthquake disaster information system at Nagoya University. This system combines cameras and seismometers to monitor the disaster situation in real-time at Nagoya University and surroundings.

Reports Published by the Research Committee RC-39 "Research on Sustainable Engineering for Urban Safety"(2)

The Research Committee on Sustainable Engineering for Urban Safety (RC-39) established by the ICUS, has been working since April, 2002. Besides the members of the faculty of the Center, the committee comprises of 16 private companies and research organizations.Reports written by the 5 working groups(WG) were published in March, 2004 in Japanese. Research topic and the name of secretary of each WG are listed below. Following the last volume, ICUS Newsletter vol.4-1, brief explanation of WG4 and WG5 are given in this volume.

WG1: Methods to handle aging infrastructure (Secretary: Mr. Kenji SHIBA, Shimizu Corporation)
WG2: Global environment (Secretary: Mr. Hidenobu NAKAI, The Tokyo Electric Power Co., Inc.)
WG3: Study on heat islands in urban environments (Secretary: Mr.Haruhido TSUBAKI, Kajima Corporation)
WG4: Disaster prevention and response (Secretary: Mr. Seiichiro FUKUSHIMA, Tokyo Electric Power Services Co., Ltd.)
WG5: Developments in sensing technology and its applications (Secretary: Mr. Yukio AKAMATSU, Kokusai Kogyo Co., Ltd.)

WG4: Disaster prevention and response

Among the various risks we are exposed to, those of the current concern are natural hazard disaster and terrorism. Since these two risks are categorized into pure risk and unavoidable risk, it is very important to accept these risks adequately and to construct countermeasures in the manner of disaster mitigation. In this research, two model risks; one is the terrorist attack to SHINKANSEN, the Japanese bullet train, and the other is the earthquake, were examined.

Before examining the terrorist attack, the differences in the mechanisms of terrorism risk and earthquake risk were identified, in order to make the characteristics of the former clear in some aspects, such as a definition of risk, background of occurrence, consequences, methodology for quantifying risk, countermeasures, and so on. It was found that the largest difference is the possibility to control the risk. Based on the knowledge obtained, the scenario of terrorist attack to SHINKANSEN was constructed. Through this examination, vulnerable area and parts were illustrated, followed by the concrete countermeasures for them.

For earthquake disaster reduction, although the most important and effective measure is the retrofitting of existing low earthquake-resistant buildings, the progress of retrofitting program is still very slow. In this study, the business model for promoting the retrofitting was proposed to overcome this situation. Employing the model case with realistic retrofitting cost, insurance fee, effect of retrofitting on seismic risk and so on, the effectiveness and feasibility of the proposed business model were demonstrated from the view point of total cost within the business period.

A forum for the terrorism risk was held and a technical paper titled "business model for promotion of retrofitting existing low earthquake-resistant structures" was published during the period of this research.

WG5: Developments in sensing technology and its applications

It is necessary to monitor the present status and change of urban infrastructure in order to maintain a sustainable urban development.

However, there is yet to have any systematic methodology for urban infrastructure has not been systematized enough yet, as the concept of monitoring methodology for a sustainable urban development is new and the monitoring methodologies are not well examined.

The WG5, consisted of specialists in the fields of monitoring and application, has made a set of guidelines of monitoring methodologies for sustainable urban development through examination and organization of materials in order of importance for sustainability.

The guidelines consist of six topics for monitoring methodology in four major application fields, such as, aged infrastructure, disaster, global environment, and urban environment. The themes of six topics are as follows;

- interior damage to an aged infrastructure
- reduction of man-made disaster
- assessment of low-seismic resistant building
- assessment of heat island
- extraction of 3D urban structures towards reduction of CO_2 emission
- dream-inspiring monitoring methodology for future

These guidelines consider not only practically methodologies for a sustainable urban development but also new techniques and concepts such as network with ultra small sensr devices, monitoring methodology from the sky and counterterrorism. It is a challenging task to develop useful guidelines for sustainable urban development that are multi-dimensional and multi-disciplinary in nature. Although, our exercise for the guideline development is yet to achieve the final goal, we believe the concept and the monitoring methodology that are proposed by this group will be useful for a sustainable urban development in the future.

Computational System for Evaluating the Oil Tank Sloshing Risk due to Earthquake

Dr. Naoto Ohbo, Kajima Corporation, was invited by Prof. Amano to give a lecture to ICUS members on computational system for evaluating the oil tank sloshing risk due to earthquake on September 21, 2004.

The natural period of a liquid retaining tank depends on the tank diameter and the liquid depth. Sloshing excitation is determined by the power of the seismic ground motion in this period.

The sloshing evaluation system, which is installed in the oil tank base, uses real-time earthquake information, such as the event location and magnitude determined using the ground motions recorded at stations close to the source, and the local site conditions at the tank site to quickly estimate the expected ground motion at the tank. With this information, the tank diameter and the liquid depth, the sloshing wave height is rapidly estimated. This initial estimation is recalculated and updated when the "real" earthquake motion reaches the tank base. The figure above shows one example of the system output for a particular earthquake ground motion and liquid level.

Sloshing wave height in all tanks estimated by the proposed system

In addition, the system evaluates the damage probability based on the relation between the heights of the sloshing wave and tank, and delivers this information to the manager.

The 7th ICUS Open Lecture

The 7th ICUS Open Lecture was performed at IIS in the afternoon of September 29,2004. The title of the open lecture was "Prediction and Countermeasures of Global Disaster in Asia". About 200 audiences attended the meeting and interacted with the presenters.

In the open lecture, very interesting and informative lectures were given from the four famous researchers, Profs. Kimoto, Takara, and Mrs. awatsu and Kawamura. The titles and lecturers were as follows:

1) Prof. Masahide Kimoto, Professor, Center for Climate System Research, University of Tokyo:
"Global Climate Variability and Its Prediction"

2) Prof. Kaoru Takara, Professor, Division of Fluvial and Marine Disasters, Disaster Prevention Research Institute, Kyoto University:
"Global Monitoring and Countermeasures Against Storms and Water-Related Disasters"

3) Mr. Takuyuki Kawazu, Senior Assistant for Disaster Prevention, Planning Division Administration Department, Japan Meteorological Agency:
"International Network for Monitoring the Seismic and Volcanic Activities"

4) Mr. Hiroshi Kawamura, Director, Department of Social Rehabilitation Research Institute, National Rehabilitation Center for Persons with Disabilities:
"Persons with Disabilities and Old People as Active Players of Disaster Preparedness"

Finally, Prof. Taketo Uomoto of ICUS made the concluding remarks on this Open Lecture and expresses gratitude to the participants. Details of this Open Lecture will be reported in the next ICUS News Letter.

Open Lecture lively discussion

Lecture by Prof. M. Kimoto

ICUS New Staff

During this Newsletter Volume period, ICUS welcomes two new staff, Mr.Shogo HAYASHI and Dr. Jun-ichi Susaki as a visiting Professor and an Assistant Professor, respectively. Mr.HAYASHI joined ICUS in July and Dr.Susaki did in August. Here we present their self-introduction for our network members and readers.

I joined the ICUS as a Visiting Professor on July 1, 2004. I graduated from the Faculty of Law, the University of Tokyo in 1970 and entered the Ministry of Internal Affairs and Communications, former Ministry of Home Affairs. Since then, I have been working as a specialist of law system for taxation and public finance. I am currently the Head of the Fire and Disaster Management Agency of the above mentioned ministry of the Japanese Government.

I believe that in both the academic and administrative fields, we have a strong specialization and work independently in each field. This causes a low efficiency and generates various problems. It is time to change our current style to integrate isolated fields of expertise in order to effectively contribute to achieve our final goal of "human happiness, safety and security".

Mr. Shogo HAYASHI

As an ICUS member, I would like to share experiences and exchange information with ICUS network members in the world. I am looking forward to getting new ideas and developing a human network.

I received the Dr. Eng. degree in civil engineering in 2000 from the University of Tokyo. I worked as an Assistant Professor at the Department of Environmental Information, Faculty of Informatics, Tokyo University of Information Science, till joining ICUS. My current major research interests include development of large-scale vegetation monitoring systems using satellite data based on data fusion techniques.

In recent years, there have been concentrated efforts towards conservation of global environment and importance of global monitoring has been widely recognized for that purpose. Meaningful global monitoring requires stability and continuity in order to analyze from the long-term view point. The Institute of Industrial Science (IIS) of the University of Tokyo, a leading institute of remote sensing in Japan, has been playing active role in receiving, processing and distributing remotely sensed data. On the other hand, urban safety is one of the most pressing issues in Japan, and the techniques and strategies to prevent and control disasters are highly expected. As a member of IIS and ICUS, I shall put efforts to contribute to such urban safety issues as an expert of remote sensing.

Dr. Jun-ichi SUSAKI

ICUS Activity Records

- *Prof. Uomoto attended the "4th International Conference on Advanced Composite Materials in Bridges and Structures", at Calgary, Canada (July20-24) and the "3rd Civil Engineering Conference in the Asian Region" at Seoul, Korea (Aug.16-20), and "the International Conference on ISO/TC71- Concrete, Reinforced Concrete and Pre-stressed Concrete" at Istanbul, Turkey (Sep. 19-24) .*
- *Prof. Yasuoka attended the "XXth International Society for Photogrammetry and Remote Sensing" at Turkey, Istanbul (July16-23).*
- *Prof. Meguro and Ms. Yoshimura attended the "13th World Conference on Earthquake Engineering" at Vancouver, Canada (Aug. 1-8).*
- *Prof. Ooka attended the "5th Conference on the Urban Environment" at Nashville, Vancouver, Canada (Aug. 21-28).*
- *Prof. Dutta visited AIT, Thailand for collaborative research at RNUS (June 15-Aug 31).*
- *Dr. Kato visited AIT, Thailand for collaborative research at RNUS (July 2- 23).*
- *Dr. Susaki participated in the "Meeting on Operation of MODIS Receiving Station and Research using MODIS data" at Bangkok, Thailand (Aug15-17).*

Awards

- *Mr. Atsushi ONEZAWA and Mr. Naoki TAKESHITA, students of Dr. Kato, won the excellent presentation awards at the Annual Conference of Japan Society of Civil Engineers in September.*
- *Mr. Shinya Kondo, student of Prof. Meguro, won the excellent presentation awards at the Annual Conference of Japan Society of Civil Engineers in September.*

- RNUS Activities -

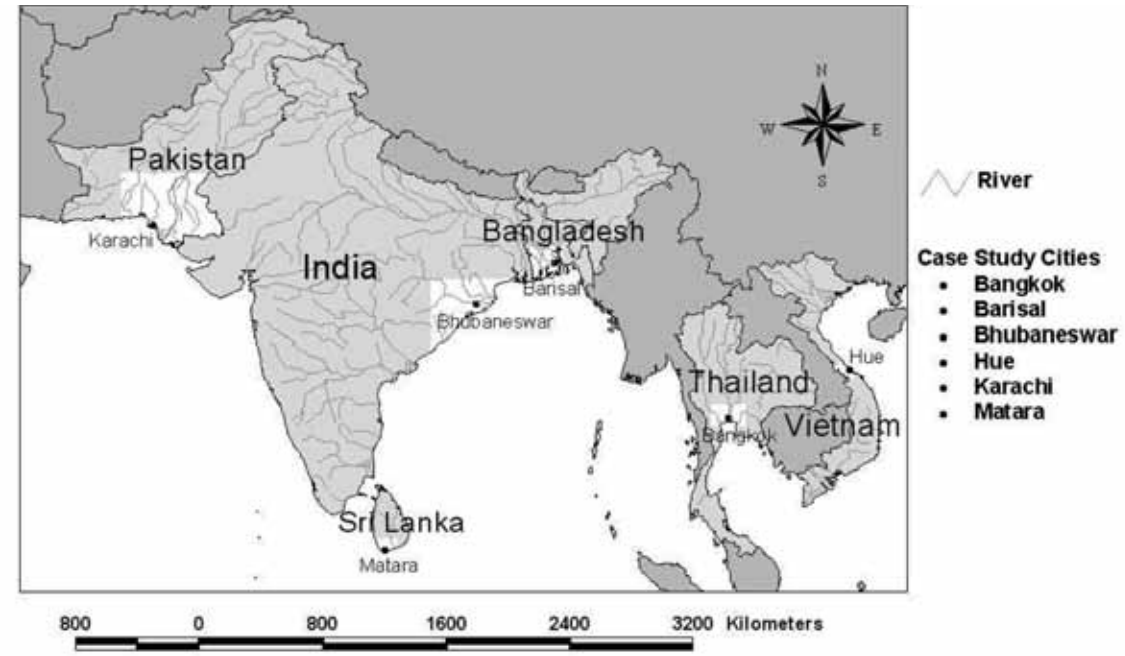
RNUS proposal was selected for APN funding

The Regional Network Office for Urban Safety (RNUS) of ICUS/AIT receives an award from the Asian Pacific Network on Global Change (APN) to conduct a research project titled "An Assessment of the Socio-economic Impacts of Floods under Climate Change Conditions in Large Coastal Cities in South and South-east Asia". The APN was established as a regional research network that would focus on broadening global change research, providing support for multi-disciplinary research and education and encouraging the development of sound science that underpins national and international policy-making needs in the Asia-Pacific region. The award received by RNUS is under the CAPaBLE programme of APN, which is a concrete initiative to realize parts 110 to 114 of the Johannesburg Plan of Implementation for the World Summit on Sustainable Development (WSSD) and has been registered as a WSSD Type II Partnership Initiative to develop and enhance scientific capacity in developing countries to improve their decision-making in climate change and water and food security.

The RNUS project focuses on understanding the flooding characteristics under projected climatic and socio-economic scenarios. It will integrate and analyze existing data, information and results and use existing tools for simulating the flood behavior and impacts. The project scope is limited to selected low-lying large cities of the participating countries: Bangladesh, India, Pakistan, Sri Lanka, Thailand and Vietnam. One city from each country is identified based on their representativeness for the study. The research also focuses on identifying critical gaps in information and policy and a set of recommendations will be made for better decision making to improve the livelihood of the local people. The figure shows the locations of the six cities of South and South-east Asia selected for conducting case studies in the project.

Participation of RNUS in GISIDEAS 2004 in Vietnam

RNUS joined the list of the supporters of the International Symposium on GeoInformatics for Spatial-Infrastructure Development in Earth & Allied Sciences (GISIDEAS 2004), which was held in Hanoi, Vietnam during 16-18 September 2004. The symposium was organized by the Japan-Vietnam Geoinformatics Consortium and the main theme was Geoinformatics applications for monitoring, predicting, managing and mitigation of natural disasters. RNUS Coordinator Dr. D. Dutta was a member of the Steering Committee of the Symposium and he participated in the symposium to present two technical papers titled "Development of Urban Building Inventory for Bangkok using Very High-Resolution Remote Sensing Data for Disaster Risk Analysis" and "Impact of Urbanization in Flow Characteristics in an Urban River Basin in Japan using a GIS Based Distributed Hydrological Model", which were the outcomes of research works conducted at RNUS. For further information about GISIDEAS 2004, please visit the following website; http://gisws.media.osaka-cu.ac.jp/gisideas04/.



The cities of South and South-east Asia selected for case studies

Editor's Note

Japan has been facing a very seismically active period. As presented by Prof. Fukuwa, in the main article of this volume, we will have the Tokai, To-nankai, and Nankai earthquakes with M8 or more, along the Nankai-Trough within 30 to 40 years. In northern Japan, a M7.5 to 8 event, the Miyagi-ken-Oki earthquake, will attack with very high probability, 85% and 99% within 20 and 30 years, respectively. Besides these huge earthquakes, the number of the events of M7 class, same as the 1995 Kobe earthquake, which will occur before and after huge earthquakes, is several times larger than that of M8 events. The total damage due to the 1923 Kanto earthquake was over 40% of total GDP of Japan at that time. The total damage due to above mentioned events will be larger than that. The number of collapsed/heavily damaged and moderately damaged structures will be over one million and approximately two million, respectively.

The most important issue for earthquake damage reduction is retrofitting the existing low earthquake resistant structures. There are three measures for total disaster management, Mitigation, Preparedness and Disaster Response, and Recovery and Reconstruction Strategy. Although we can improve our disaster reduction capacity by well balancing these three measures, the most important measure among them is Mitigation which makes an effort to prevent the Hazard, a physical phenomenon, to become a disaster, a negative impact to the society, by taking optimal measures beforehand. Even with a very good disaster response system and optimum recovery and reconstruction strategy, if your structures are not strong enough, you can reduce neither the number of damaged structures nor the casualties that their collapse will cause.

Based on this understanding point, we have been studying technical methods and social systems to increase the seismic capacity of existing low earthquake resistant structures in developed and developing countries. For developed countries, incentive systems for promotion of retrofitting and for developing countries, very low cost and efficient retrofitting methods, are proposed. By our proposed new incentive system, the total damage can be drastically decreased and thus, the cost burden to both government and citizens, reduced. By our economical and efficient retrofitting method, typical adobe and/or masonry houses can be retrofitted by approximately US$100. I hope that using these study results, an earthquake safer environment can be realized.

(K. Meguro)

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DISASTER PREPAREDNESS OF PERSONS WITH DISABILITIES

By

Hiroshi KAWAMURA*

The United Nations World Conference on Disaster Reduction (WCDR) held in Kobe in January 2005 gave me most important findings regarding disaster preparedness for persons with disabilities as follows:

a. Tsunami Disasters on 26th December 2004 could have been significantly reduced if an early warning system and Tsunami preparedness were well developed. As soon as the earthquake happened, experts knew the magnitude of the potential disaster caused by the Tsunami but there was no system to disseminate the critical information in time and in an accessible and understandable form.
b. Although detailed statistics on victims is not yet available, children and foreign travelers are believed to be among vulnerable killed by the Tsunami incident in addition to old people and persons with disabilities.
c. There are best practices on Tsunami preparedness developed by many coastal local governments in Japan. However, the Tsunami preparedness for persons with disabilities and those from foreign countries is still to be developed.
d. Japan Autism Society successfully held an international symposium on disaster preparedness of persons with Autism Spectrum Disorders (ASD) in association with the WCDR to identify the special needs of persons with ASD.
e. World Meteorological Organization (WMO) successfully held the Thematic Session on Disaster Reduction of the World Summit on the Information Society (WSIS) in the framework of WCDR to identify the key role of the Information and Communication Technologies (ICT) development.

Lecture delivered by Dr. Kawamura(ICUS Open Lecture, Sep. 29, 2004)

We recognize the critical importance of disaster preparedness of all levels including personal knowledge and training level. The outcome of WCDR was not just for immediate response or reconstruction but also for long term disaster reduction and preparedness. The lesson we

learned from the Tsunami incident must boost the development of international collaboration for early warning, response, disaster reduction and preparedness development.

The key lesson of the Tsunami incident was the development of understanding on disasters such as imagination of each disaster including evacuation routing.

Of course each individual has individual requirements. If we develop our imagination well, we will be able to identify some special needs such as;

a. If you are challenged by visual impairments and/or hearing impairments, how do you know the early warning and evacuation route?
b. If you are challenged by motor disability, how do you get assistance to evacuate?
c. If you have cognitive/intellectual disability to understand the warning, how do you develop your capacity of understanding and respond?
d. If you are on a beech in foreign country without knowledge of the local language, how do you cope with early warning?

The key role of ICT development is obvious when we identify special needs of individuals and try to meet those requirements. In this context, forthcoming WSIS Tunis Summit to be held in November 2005, in particular its 10 Years Plan of Action to be decided will be of critical importance to implement necessary accessibility built into the system for early warning and evacuation.

In conclusion, I believe that persons with disabilities and others so called vulnerable people in terms of disasters are potential active role models to identify individual requirement that needs to be met by disaster reduction activities including development of preparedness.

Presentation in Global Forum on Disabilities in the Information Society(Mr.YAMANE)

**Director,*
Department of Social Rehabilitation
National Rehabilitation Center for Persons with Disabilities(NRCD)

Suggestions for Accessible Disaster Preparedness Information

Delivery:
a. Internet
b. TV/Radio analog/ digital broadcasting
c. Mobile phone
d. Public information displays such as Kiosk and ad-board
e. Streaming mechanism with adaptable bit rates and formats
f. Portal service with distance learning support

Language:
a. Multilingual capability
b. Alternate text presentations in corresponding languages
c. in simplified languages; such as "easy to read"
d. in Braille/finger Braille
e. in sign language/tactile sign language
f. Pictograms

Visual expressions:
a. Visual signs and landmarks
b. Alternative visual expressions for text contents
c. Geo-spatial awareness on way finding support

Tactile expression/Vibration:
a. Vibration standards
b. Tactile indicator for exit, entrance, etc.

Audio expression:
a. 3D audio has potential to identify the way for evacuation
b. All textual presentation need to be associated with audio output
c. Alternative audio description
d. Ubiquitous system in association with audio guidance
e. Alarm sound and message construction

User interface for manipulation of devices:
a. Single key/simple switch action support
b. Voice command/recognition
c. Refreshable Braille support
d. Touch panel
e. Automatic turn on when alarming comes
f. Gesture recognition commands
g. Automatic optimization for individuals/locations

Interactivity:
a. Role playing game capability
b. Simulations and training

Easy straight forward media capturing/editing process:
a. Semi-automatic capturing support
b. Capacity to start with one shot project
c. Capacity to combine multiple projects
d. Templates support

Others:
a. Olfactory
b. Puppets
c. Avatar

ICUS & IITK Organized Third International Symposium on Urban Safety in Agra, India

The International Center for Urban-Safety Engineering, Institute of Industrial Science, University of Tokyo and the Department of Civil Engineering, Indian Institute of Technology, Kanpur, India, organized the Third International Symposium on New Technologies for Urban Safety of Mega Cities in Asia at Agra on October 18-19, 2004. Several national and international professional and government organizations also supported the symposium financially and otherwise.

The symposium sought to bring together experts in areas of design, construction and maintenance of urban infrastructure and those engaged in development of new tools that could be used for better asset management. It also provided a forum for decision makers, practicing professionals and researchers to share their expertise in diverse areas such as infrastructure planning and development, application of new technology, nondestructive evaluation of structures and rehabilitation methods.

Professor SG Dhande, Director, IIT Kanpur chaired the inaugural session along with Professor Yoshifumi Yasuoka, former Deputy Director-General of the Institute of Industrial Science, University of Tokyo. Prof Mahesh Tandon, President of the Indian Concrete Institute, and leading structural consultant of Delhi was the Chief Guest and Professor R N Iyengar of Indian Institute of Sciences, Bangalore and formerly Director, CBRI, Roorkee, delivered Keynote address in the inaugural session.

Speech given by Prof. Dhande, Director of IITKanpur

About 150 delegates from India and 36 delegates from other countries participated in the symposium, where about 60 technical papers were presented in the oral and poster sessions. The papers have been printed in the Proceedings of the symposium both in the form of a book and a CD-rom.

Based on the deliberations, a resolution calling for greater cooperation among the professionals and organizations in the region was adopted in the closing session. ICUS and IIT Kanpur also signed an Memorandum of Understanding for closer cooperation in research activities in areas of mutual interest.

by Dr. Sudhir MISRA
Associate Professor
Department of Civil Engineering
IITKanpur

Opening ceremony of the Symposium

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Plenary sessions

Parallel sessions

SCHEDCULE OF SESSIONS(*)

Date	Time	Session	
October 18	09:00 -10:30	**Inaugural session**	
	11:00 -13:15	**Plenary session I**	
	14:30 -16:15	**Plenary session II**	
	16:30 to 18:00	**Plenary session III**	
October 19	09:00 to 10:45	**Parallel session A** Rehabilitation of Structures	**Parallel session B** Remote Sensing and GIS
	11:00 to 12:45	**Parallel session C** Structural Engineering and Seismic Performance	**Parallel session D** Planning and Monitoring of Infrastructure
	14:00 to 16:00	**Plenary session IV**	
	16:00 to 16:30	**Closing session**	

* Papers in the poster session were on display throughout the duration of the symposium

Central Part of Niigata Prefecture was Striken by M 6.8 Earthquake on October 23, 2004

On October 23, 2004, at 17:56, a magnitude 6.8 earthquake, with a focal depth of 13 km, stroke the central part of Niigata Prefecture. This earthquake was the first event in which the derailment of a bullet train was observed since they entered service in 1964. Fortunately, this service line is not very congested and at the time of the earthquake only one of the lanes, the one bound for Niigata, was being used. As a result, no fatal victims were reported.

Due to this earthquake, strong ground motions with Japanese Meteorological Agency (JMA) Intensity 7, which corresponds to the highest intensity in this scale, were observed. This is the first time since the JMA changed its definition, from a human perception based definition to an instrumental observation based one. Peak ground accelerations up to 1.7 g and peak ground velocities up to 133 kines were observed. These values are much higher than those of the ground motion during the 1995 Kobe Earthquake. Based on earthquake response spectrum anaysis, in the short period range from 0 to 1.0 sec, the response acceleration was over 6,000 Gals.

Because of this earthquake, 40 people were killed, 9 of them due to structural collapse. The other victims died for other reasons such as shock, exhaustion, stress, and the economy class syndrome. The latter was caused by the long periods that the residents had to sleep in their cars, in uncomfortable positions, because of the insecurity of their houses and their fear due to the huge number of aftershocks. The number of people injured was 4,500, whereas the number of collapsed, moderately damaged, and slightly damage houses were 2,800, 10,600, and 88,500, respectively.

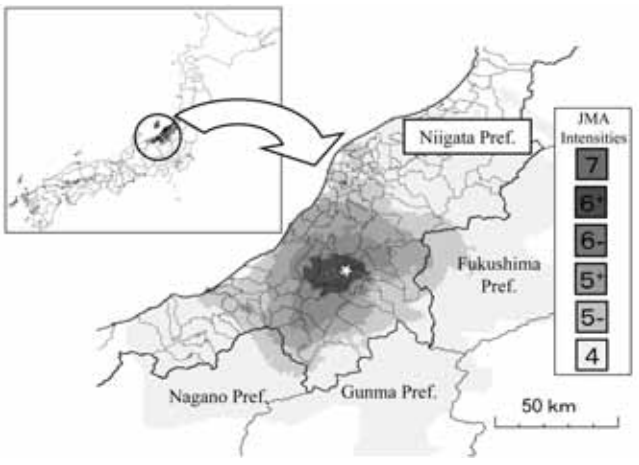
One of the most important characteristics of this earthquake is the huge number of large aftershocks. Another major characteristic is that it occurred in a mountainous area which was hit by heavy rainfalls and typhoons just prior to the earthquake occurrence. These previous events saturated and loosen the soil, and therefore when the earthquake stroke the mountain slopes where particularly vulnerable. For this reason, the geotechnical related damage was widespread and much more considerable than the structural damage.

Due to the severe winter and huge snow fall that is common in this area, houses are built with small openings, to keep them warm and robust foundations and structural elements to resist the snow weight. These features increase the overall structural strength and thus it is not surprise to observe that most of the collapse houses were either old or presented soft stories in the 1st floor were open space, such as parking or shop is allocated.

(by K. Meguro)

Typical buildings in the affected area, an old damaged (upper) and a new intact (bottom)

The bullet train derailed for the first time since it started operations in 1964



Distribution of JMA Intensities at the earthquake hit area during the main shock on October 23, 2004, 5:56PM

Bullet train viaduct pillars exhibited concrete spalling at the sections where longitudinal rebars were cut

ICUS Members Joined Regular Maintenance of The Disaster Mitigation Facilities at Metropolitan Expressway Tunnels

Following the tragic fire accident of the Nihonzaka Tunnel in 1979, great efforts to improve road tunnel safety have been made in Japan. During November 2004, Mr. Takafumi Takahashi, the executive director of The Metropolitan Expressway Public Corporation (MEPC) and ICUS former visiting Professor arranged two field trips to observe the disaster mitigation facilities of MEPC tunnels and to attend their regular examination. The MEPC has a total length of approximately 283.3 km and carries around 28% of the arterial vehicular traffic in the Tokyo Metropolitan area.

Several ICUS members joined the visits to Asukayama and Kasumigaseki Tunnels. The field visit started at the tunnel disaster management office, where all the facilities inside the tunnels are remotely monitored. A brief expansion of the disaster mitigation and emergency facilities was presented. Inside the tunnels, these facilities were observed as well as maintenance operation of fire-hydrant and sprinkler systems.

(by S. Elkholy)

Examination of performance of foam fire-hydrant by Prof. Meguro

Verification of water sprinkler system

Open Campus of IIS Chiba Experiment Station

Children looking at exhibition

The Institute of Industrial Science (IIS) of the University of Tokyo organized an open house at its Chiba Experiment Station on November 12, 2004. ICUS participated in this event and presented its research activities to the visiting students from the Yayoi elementary school. At the Uomoto laboratory section of the ICUS presentation, Mr. Hoshino and Mr. Nishimura, the technical assistants of the Uomoto laboratory, guided and explained the research works to the students. After the explanation, the students were given an opportunity to make models using their hands from cement paste cast in bread dough. Students were highly impressed by this experience and that were reflected in their letters written to the institute. We hope that the students gained good impressions and knowledge about concrete technology.

ICUS Signed MOU with IIT Kanpur

On October 22, 2004, ICUS signed a Memorandum of Understanding (MOU) with the Indian Institute of Technology, Kanpur (IITK) to collaborate in research and other academic activities, in the fields of Urban Safety Engineering. One of several categories of the academic exchange and cooperation is "Organizing academic meetings, symposia and workshops". ICUS held the Third International Symposium on "New Technologies for Urban Safety of Mega Cities in Asia" jointly with IITK at Agra, India (Oct. 18-19) as a part of that.

A team from the ICUS visited IIT Kanpur, India on Oct.22 after the symposium at Agra, and discussed possibilities of closer understanding and joint research between the two institutes.

ICUS Renewed Contract of RNUS with AIT

ICUS recently renewed its collaboration with the Asian Institute of Technology (AIT), Thailand on the operation of the Regional Network Office for Urban Safety (RNUS). RNUS was established at AIT in October 2002 towards strengthening its research collaboration in South and South-east Asia. With the successful progress of collaborative activities at RNUS in the last two years, ICUS signed an agreement with AIT in October 2004 to foster the collaboration for another three years. Signed on 22 October 2004 by Prof. Taketo Uomoto, ICUS Director and Prof. Jean-Louis Armand, AIT President and, through RNUS, SCE and ICUS cooperate in promoting urban safety engineering utilizing advanced engineering technologies. The signing ceremony was witnessed by ICUS faculty members, Prof. Reiko Amano, Dr. Kimiro Meguro, and Dr. Junichi Susaki.

RNUS' activities revolve around urban disaster mitigation, infrastructure maintenance and environmental monitoring. Since its inception in October 2002, RNUS has initiated several collaborative research projects in the areas of health monitoring of urban infrastructure, utilization of very high resolution remote sensing for urban inventory and catastrophic disaster risk management in Bangkok as well as the socio-economic impacts of coastal floods in South and South-east Asia under climate change conditions.

ICUS Activity Records

- *All ICUS members participated in the Third International Symposium on "New Technologies for Urban Safety of Mega Cities in Asia" at Agra, India (Oct15-20).*
- *Profs. Uomoto, Amano, and Meguro visited AIT, Thailand for collaborative research at RNUS, AIT (Oct.22-23).*
- *Prof. Uomoto attended the "First International Conference of Asian Concrete Federation" at Chiang Mai, Thailand (Oct.27-31) with Dr. Kato, and the "Event of International Activities, CICHE2004 (Selected for Joint-Seminar Speakers)" at Kaohsiung, Taiwan (Dec.1-3).*
- *Prof. Yasuoka attended the "SPIE Fourth International Asia-Pacific Environmental Remote Sensing Symposium" at Honolulu, Hawaii (Nov.8-13) and the "25th Asian Conference on Remote Sensing" at Chiang Mai, Thailand (Nov21-26) with Dr. Endo.*
- *Prof. Meguro attended WSSI meeting at Nanyang University, Singapore (Dec.5-8).*
- *Prof. Ooka visited RNUS, AIT to give a seminar (Nov. 21) and attended the "Celebration of the 60th Anniversary of the Department of Architecture of the National Cheng Kung University", Taiwan. (Nov. 22-25).*
- *Prof. Dutta visited AIT, Thailand for collaborative research at RNUS (Sep.7-Dec.31). During this period, he attended the "International Conference on Advances in Integrated Mekong River Management", Vientiane, Lao (Oct. 24-28) and the "International Conference on Sustainable Water Resources Management in Changing Environment of the Monsoon", Colombo, Sri Lanka (Nov. 17-19).*
- *Dr. Susaki participated in the "Meeting on Operation of MODIS Receiving Station and Research using MODIS data" at Bangkok, Thailand (Aug15-17), and the "25th Asian Conference on Remote Sensing" at Chiang Mai, Thailand (Nov.22-27).*

Visitors to ICUS

Some of the international visitors to ICUS during the period of October-zDecember 2004 are listed below.

- *Profs. Yuanxian Gu, Yang Haitian and Gengdong Cheng, Dalian University of Technology, China (Oct. 28).*
- *Prof. Chongrak Ploprasert, Asian Institute of Technology, Thailand (Nov. 5).*

- RNUS Activities -

Workshop on urban safety lessons from Japan

Over half of the world's population is concentrated in urban areas covering just 4% of the world's surface. Mega cities in particular are characterized by a high population density and tremendous pressure on supporting infrastructure. It is estimated that by 2015, Asia will be host to more than 50% of the mega cities in the world. A phenomenal growth in the number of high-rise buildings and other infrastructure in these cities is clearly foreseen, though a balance is often not ensured with measures for their maintenance. Safety of infrastructure is foremost important for sustainable urbanization and economic development in Asia. RNUS organized a workshop on "Urban Safety for Sustainable Urbanization: From Experiences of Japan" at AIT on 22 October 2004 by inviting three prominent academicians; Prof. Taketo Uomoto, Prof. Reiko Amano and Prof. Kimiro Meguro of ICUS, the University of Tokyo, Japan to talk on how urban safety issues are addressed in highly urbanized Japanese cities. Various issues related to durability of urban infrastructure with proper safety measures including measures against disasters like earthquake and fires with the conventional and new technologies were addressed by the speakers. Prof. Taketo Uomoto talked on Maintenance and management of urban infrastructure in Japan to decrease risk of injury to public. Prof. Reiko Amano talked on "Water Screen Fire Disaster Prevention System in Underground Space". Prof. Prof. Kimiro Meguro presented about the Universal Disaster Simulator towards earthquake disaster mitigation in Japanese cities. The workshop, coordinated by Dr. Pennung Warnitchai of RNUS, was well attended by over 65 participants from AIT and various government institutions and private organizations from Bangkok.

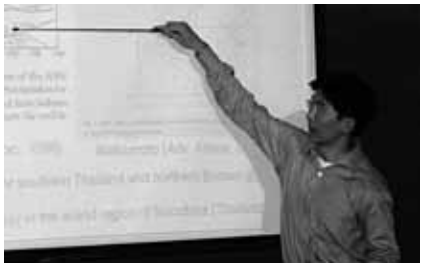
A snapshot from the workshop venue

RNUS receives research grant from UNU

In July 2004, RNUS received a research grant from the United Nations University, Tokyo, Japan to conduct research on "Risk Analysis due to Catastrophic Urban Floods using GIS, Remote Sensing and Surface-River Model". The research project is funded by UNU from its Multi-hazard Risk Assessment Core Research Budget. The main scope of the project includes a case study in Bangkok city for risk analysis due to catastrophic urban flooding. The work will cover simulation of catastrophic floods due to extreme rainfall events and assessment of its socio-economic impacts using an existing urban flood risk assessment model in a part of the Bangkok city, which is most vulnerable to floods. The one-year long project is scheduled to complete in July 2005.

Seminar Series on urban safety

The Regional Network Office for Urban Safety (RNUS) of ICUS/AIT initiated a seminar series on urban safety in 2003 by inviting experts from different countries to talk on various related issues. As a part of this series, two seminars were organized in November 2004. On 15 November 2004, RNUS invited Dr. Koji Dairaku, Researcher at the Disaster Prevention Research Group under the National Research Institute for Earth Science and Disaster Prevention in Tsukuba, Japan to give a seminar the "Role of Orography and Soil Moisture in Hydrological Transitions Associated with Monsoon Onset in Southeast Asia". In the seminar, Dr. Koji Dairaku presented his research on Asia monsoon region, particularly Thailand, to study the mechanism of atmospheric-landsurface interaction using regional climate models. Understanding of this mechanism is essential for accurate prediction of rainfall, which can be utilized for urban flood forecasting. On 22 November 2004, RNUS invited Dr. Ryozo Ooka, Associate Professor at the International Center for Urban Safety from the University of Tokyo, Japan to give a seminar on "Numerical Simulation of Atmospheric Environmental Problems", Dr. Ooka discussed turbulence modeling and explained its applications in understanding environmental problems such as wind environment around a building, pollutant dispersion in an urban street canyon, urban fire spreading and heat island phenomena.



Dr. Dairaku and Dr. Ooka during their seminars at AIT

Editor's Note

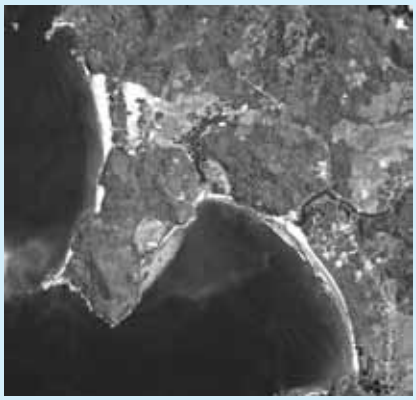
We theoretically understand that the earth is active and moving, however, we have never imagined that it would really move as much as on December 26, 2004. The images and movies on the earthquake and the tsunami were far more than we imagined.

The disaster this time demonstrated the difficulties in observing and predicting it. Before the event we need to deploy wide and general observation system linked with prediction system, and when it would unfortunately happen it should be switched to the site-focused, pinpointed and very frequent observation system linked with the counter measures including evacuation.

At the Third Earth Observation Summit held in February, 2005 at Belgium the ten-year's Implementation Plan for building a comprehensive, coordinated, and sustained earth observation systems was adopted. "Reducing loss of life and property from natural and technological disasters" was raised as the top item of 10 specific areas of socio-economic benefit in observing the earth system. In a series of Erath Observation Summit Japanese Government declared that Japan would contribute to the earth observation in three fields including global warming/carbon cycling, climate change/water cycle and disaster mitigation over Asian and Oceanic regions.

The mission of the ICUS covers from observation, modeling to countermeasures for the disaster prevention. "It surely happens when we forget it", the very famous remark by Dr. Torahiko Terada. We, the ICUS, will do our best for the next event which of course we would not like to have.

(by Y. Yasuoka)



Banda Aceh (before Tsunami)

Banda Aceh (After Tsunami)

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SUMATRA EARTHQUAKE AND TSUNAMI, 26 DECEMBER 2004

By

Teddy BOEN*

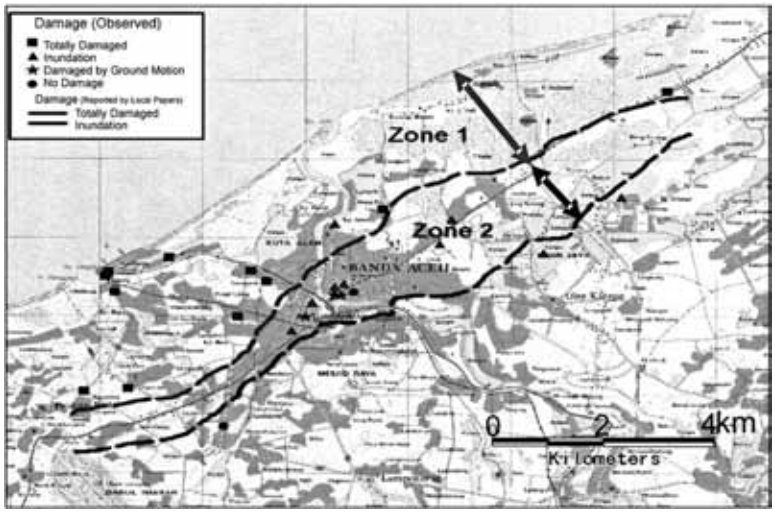
On December 26, 2004, a great earthquake of M9.0, followed by a devastating tsunami struck the Indian Ocean countries: Indonesia, India, Malaysia, Maldives, Myanmar, Sri Lanka, and Thailand killing more than 300 thousand people and leaving almost a million homeless. It was the 4th largest earthquake since 1900, sending a wave of shock, and drawing sympathy and assistance offers from across the world. In Indonesia, over 200 thousand people were killed and 700,000 were displaced. This was the worst natural disaster experienced in its history in which Banda Aceh and North Sumatra suffered the most. This article is a quick survey report giving the overall information on damages to the engineered and non-engineered buildings with a touch to infrastructure damages in Indonesia.

On Sunday morning Dec 26, 2004, Banda Aceh was holding a 10km marathon and some participants had already reached the finishing line. At 07:58:50 WIT (Western Indonesia Time), the earth was struck by a strong earthquake of M9.0. Almost everybody panicked and lay down on the ground. After the shaking stopped, people wandered watching some collapsed buildings in the city. A TV reporter even toured the city to check damaged and collapsed buildings. At around 08:42 WIT, the first tsunami wave reached the coastlines of Banda Aceh and some people started shouting: "water, water from the sea". Many people started running towards the city center. At around 08:53 WIT, a second wave, more

Area damaged by the tsunami disaster on December 26, 2004 (Meulaboh, Indonesia)

Source of map: OYO International

Sites surveyed



Damaged and inundation zones in Banda Aceh (enlarged map of small marked zone in the left side map)

powerful than the first one, swept the coastal area and caused significant catastrophe.

Approximately at 09:15 WIT, the third and most powerful wave hit the coastal area up to a distance of about 4km inland bringing destruction along its path. Most of the buildings that collapsed were non-engineered buildings and were subjected to tsunami forces such as battering, scouring impact and buoyancy. After the third wave, Banda Aceh was inundated up to a height of approximately 2m for about 30 to 40 minutes and subsequently, water started flowing back to the sea. At around 11:00 WIT, the water level was approximately 30-40 cm.

The tsunami curse throughout the coast

There were two zones affected by the tsunami: Zone 1 and Zone 2. The first includes the coastal areas which were destructed by tsunami forces such as battering, scouring, impact and buoyancy. In Banda Aceh, this zone goes up to 3km inland. Zone 2 was the inundated part, where the tsunami force was reduced but the wave caused flooding, dumping mud and debris. This area was approximately 0.5 to 1.5km further inland.

Disaster episodes along the tsunami waves

In areas where the beach is gently sloped, the tsunami waves were very powerful and this is evident in places like: Lhok Nga, Ulhue Lhe, Krueng Raya and Meulaboh. The damage was mostly by the battering and scouring forces of the tsunami. This was observed from the debris originating from frames of timber houses which were practically disintegrated into building components. In case of masonry construction, walls were shattered into pieces of almost equal size. Reinforced concrete columns were ripped off from the foundations, and beam and column connections were severely damaged.

In harbors with deep water, the tsunami wave strength was reduced and the dominant force was buoyancy. This was observed at Lhok Nga cement factory jetty at Ulhue Lhe harbor. The jetty was protected by breakwater walls.

The areas closer to the center of Banda Aceh were damaged by impact force. This impact force was exaggerated by the mud density which is larger than that of the water. It was observed that the tsunami traveled upstream rivers and lagoons and subsequently spilled over the landward areas. It was also seen that, in hilly areas, tsunami waves run up to much higher elevation along hill slopes and valleys than those in plain areas, although the strength was less.

The tsunami wave heights were

Inundation height measured from house wall (Banda Aceh, Indonesia)

Inundation height measured from trees (Banda Aceh, Indonesia)

estimated from measurements of water level traces on walls and trees. They were: (a) Meulaboh (Western Coast), about 4 m, (b) Lhok Nga (West of Banda Aceh), about 15 m (run-up height against hillside), (c) Banda Aceh, about 8m in coastal areas Zone 1 and about 2-3m in Zone 2, and (d) Krueng Raya (North coast), about 6m (watermark on coastal side wall of the Mosque).

"Water, water from the sea" .....An early warning

When people saw a huge wave approaching the coast, some people started shouting, warning that a flood was coming, and started running towards the center of the city. However, the people of coastal areas were not "trained" to evacuate immediately upon hearing this "early warning". Most of them did not have any idea that a tsunami wave could be dangerous to them. Due to this "early warning", approximately 30% of the coastal area population survived the tsunami while the other 70% were literally wiped out together with their houses. Similar "early warning" procedure was also practiced in Meulaboh.

People ran to higher ground after the first wave – Banda Aceh.

People ran to higher ground after the first wave – Meulaboh.

The fate of the city

Two building types can be identified: a) Engineered Buildings, and b) Non-Engineered Buildings.

Engineered buildings consisted mostly of reinforced concrete structures

Almost all "engineered" buildings in Banda Aceh were unaffected by tsunami but some collapsed due to the shaking of the Dec. 26, 2004 earthquake.

The typical cause of damage to reinforced concrete engineered buildings in Banda Aceh during the Sumatra Earthquake was the vertical irregularities which created abrupt changes in stiffness and strength that concentrated forces in an undesirable way. Poor quality of concrete and detailing also contributed to the collapse of those engineered buildings.

Non-Engineered buildings consisted of: i) burnt brick masonry with sand and cement mortar, and ii) timber buildings

The majority of the buildings that collapsed in Banda Aceh city and villages in Lhok Nga, Krueng Raya, and Meulaboh city were

Kuala Tripa Hotel

Office of the Department of Finance

Lhok Nga (Zone 1)

Debris and mud at Meulaboh (Zone 2)

non-engineered buildings consisting of two types. The first type was a one or two-storey building made of burnt brick confined masonry using sand and Portland cement mortar. The roof mostly consisted of galvanized iron sheets. All those buildings used RC "practical" columns and beams as confinement. The second type was timber construction consisting of a timber frame and also timber planks walls and usually used galvanized iron sheets as roof. The ratio of these two types of structures estimated is to be 30 % to 70 %.

Most of the one to two-storey buildings collapsed due to the tsunami and not due to the earthquake ground motion though it was responsible for the walls to crack in some places.

The ill fate of infrastructure facilities

Roads: Most of the main roads in Zone 1 were covered by huge amounts of tsunami debris. Several parts of the road from Banda Aceh to Meulaboh were washed away by the tsunami. ***Bridges:*** Several bridges in Banda Aceh were destroyed: the one at Iskandar Muda area and the other leading to Lhok Nga. Along the road from Banda Aceh to Meulaboh (distance approx. 270 km), several bridges were washed away. ***Ports:*** A part of the Meulaboh Port was washed away but the supports were still in tact. ***Power supply:*** The main power plant in Banda Aceh was not affected by the shaking or tsunami. However, many distribution poles and wires in the affected areas collapsed. ***Telecommunication and Water supply:*** Though these were not very much affected, some telephone junction boxes and underground water piping system were damaged.

Emergency responses and needs after the disaster

Right after any disaster, it is essential to restore telecommunications immediately. This makes emergency response easier and faster, and reduces panic among the community.

The challenge of the recovery is not to repeat mistakes from past disasters, among others, how to prevent NGOs, local as well as foreign, from bringing in "alien" materials and products such as knockdown houses which are not compatible with the local culture. All government officers, community leaders and donors are discussing recommendations to relocate the destructed villages and almost all of them are relying on NGOs/donors who have shown willingness to "adopt" certain villages. Appropriate planning and analysis shall be made prior to recommendation for implementing post earthquake disaster relocation.

Risk to the Indonesian economy

It is predicted that the Aceh tsunami will not have a significant effect towards the Indonesian economy and the 2005 national growth would be 5-6%. It is also estimated that the tsunami will not cause negative effects towards the expectation and risk perception on the Indonesian economy and will not disrupt either investment plans or the exchange rate performance.

The last drop

In spite of the fact that the tsunami most probably will not disrupt the Indonesian economy, the loss of jobs could be crippling at the local level. Even though the damage to agricultural land is only 10%, it will take many years to recover. Farmers lost their livestock and equipments. The aquaculture losses were quite significant. Apart from all those mentioned earlier, the tsunami also swept and destroyed many roads, bridges, drainage systems, water piping, electrical lines, and telecommunication towers. The repair and rebuilding of those all and the resettlement of displaced people will take many years and will need a considerable amount of fund, which may be a substantial percentage of the country gross domestic product.

**ICUS Network Member from Indonesia*

Note: A comprehensive report on the damage survey of the 2004 Sumatra Earthquake and Tsunami disaster in the Indian Ocean Rim countries will soon be published as ICUS REPORT 2005-01. It can also be obtained from the ICUS website (http://icus.iis.u-tokyo.ac.jp/wwwe/publications/index.htm).

A Report on UN World Conference on Disaster Reduction in Kobe, Japan

The World Conference on Disaster Reduction, organized by the United Nations International Strategy for Disaster Reduction (ISDR), was held in Kobe, Hyogo Prefecture, Japan during January 18-22, 2005. The organizational activities of the conference were carried out by the Hyogo Cooperation Committee, which was formed for organizing the conference to bring together academics, government officials, representatives of NGOs and other experts in the areas of disaster reduction. The Mega conference included a variety of events during the five-day period including intergovernmental meetings, thematic sessions, public fora, workshops, exhibition booths, poster sessions and study tours. It drew about 5,000 participants from around the world that included representatives of 168 countries and numerous international organizations.

The conference was composed of three main processes: an intergovernmental segment, a thematic segment for knowledge exchange, and a forum for public participation. The Intergovernmental segment provided the venue for delegates to make statements, discuss and negotiate on the outcomes of the conference for final adoption. The Thematic segment consisted of three high-level round tables; 1) Disaster Risk: The Next Development Challenge, 2) Learning to Live with Risk, 3) Emerging Risks: What will tomorrow hold? and a number of parallel sessions clustered under five themes as well as a regional session for exchange of experience and lessons learned from each region.

Mr. Toshizo Ido, the Governor of Hyogo Prefecture, addresses the conference participants

Prof. K. Meguro and Dr. D. Dutta during their keynote presentations at the UNU Public Forum

The Open forum included a number of thematic seminars, open house meetings, exhibitions and poster sessions organized by NGOs and the academia.

The conference took place less than a month after the catastrophic tsunami disaster of the Indian Ocean of December 26, 2004 that claimed over 300,000 lives. It was dominated by various events and discussions related to tsunami disasters and development of early warning systems.

The conference also marked ten years since the Yokohama conference organized by the United Nations International Decade for Disaster Reduction (IDNDR) in May 1994, where United Nations member states drew up an action plan for a safer world. The Kobe conference aimed to review the progress on the plan since the Yokohama conference. In the conference, it was deliberated that although much progress had taken place on the technical front in the last ten years, disaster losses and poverty-based vulnerability were still out of control. The "Review of the Yokohama Strategy and Plan of Action for A Safer World" summarized the accomplishments since the adoption of the 1994 document. It noted the gaps and challenges for the future, including the need for "more tangible commitments" for translating promises into action.

In the closing session, the delegates adopted the "Hyogo Declaration" and the "Hyogo Framework for Action 2005-2015," which are aimed at assessing ongoing efforts to lessen the effects of natural hazards and determining what further action is needed. In the declaration, they emphasize the importance of translating the Hyogo Framework for Action into concrete actions to lessen risks and vulnerabilities to natural hazards through integrated cooperation and information-sharing mechanisms. The action plan for the upcoming decade seeks to substantially reduce losses from natural disasters and to develop an international early warning system and a global information network for that purpose. It also points out the need to establish international schemes to respond to disasters across borders and notes that unplanned urbanization, environmental destruction and climate change may raise disaster risks.

Coordinating disaster mitigation activities around the world is a daunting task due to various issues, level of priorities, participations, commitments, actions and funds. Through the IDNDR, UN have been successful in raising awareness against natural disasters around the world and information dissemination through the established national committees or focal points for the decade. However, its limitations in taking leadership in reduction of disaster impacts towards "sustainable development" in most vulnerable communities around the world have been witnessed.

At the end of the Kobe conference, it appears that United Nations is up again in taking the leadership for disaster reduction worldwide, it is acting fast to see success in its efforts to setting up effective tsunami early warning systems around the world. But the task of coordinating and integrating efforts to enable all countries at risk to minimize losses from natural disasters is likely to be a complex and difficult one. The world will watch carefully how the words of "Hyogo Framework for Action 2005-2015" are translated into action in the coming decade to build resilience of nations and communities to disasters.

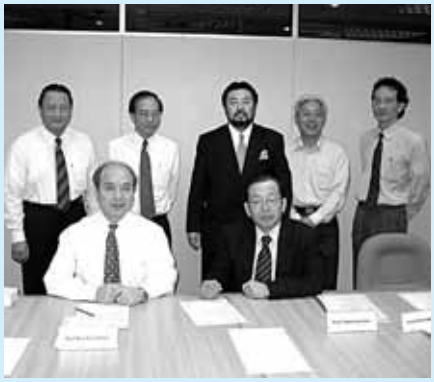
(by D. Dutta)

ICUS Signed MOU with NUS and NTU, Singapore

ICUS has signed a Memorandum of Understanding (MOU) with National University of Singapore (NUS) and Nanyang Technological University (NTU) to collaborate in research and other academic activities in the field of Urban and Safety Engineering on March 28 and 29, 2005, respectively.

These universities will be hosting the Fourth International Symposium on "New Technologies for Urban Safety of Mega Cities in Asia"

National University of Singapore



Nanyang Technological University

The 8th ICUS Open Lecture

The 8th ICUS Open Lecture was held at IIS in the afternoon of February 28th, 2005. The title of the lecture was "Messages from the Disaster Scene". About 100 people attended the lecture. There were four speakers, Mr. Shogo Hayashi, Dr. Takashi Tsuruda, Mr. Katsumi Seki and Prof. Masamitsu Tamura.

The TOPICS were as follows:

1. *Mr. Shogo Hayashi, Commissioner, Fire and Disaster Management Agency (FDMA): "FDMA's activities towards large-scale disasters in Japan during 2004 and it's future issues".*
2. *Dr. Takashi Tsuruda, Leader of Special Fire Research Group, National Research Institute of Fire and Disaster: "Investigation of Special Fire cases and lessons learnt".*
3. *Mr. Katsumi Seki, Director, Construction Planning Division, Policy Bureau, Ministry of Land Infra-structure and Transport: "Emergency Management for Disaster Reduction – A field perspective".*
4. *Prof. Masamitsu Tamura, Professor Emeritus, The University of Tokyo, Guest Professor of Yokohama National University: "Recent safety problems and potential issues in the 21st Century".*

Finally Professor Taketo Uomoto of ICUS made concluding remarks on this Open Lecture and expressed gratitude to the participants.

The 4th International Symposium on "New Technologies for Urban Safety of Mega Cities in Asia" on October 18-19, 2005

On October 18-19, 2005, the 4th International Symposium on New Technologies for Urban Safety of Mega Cities in Asia will be held at Nanyang Technological University in Singapore. Prof. Pan Tso-Chien, Professor of Nanyang Technological University will be hosting this symposium (TCPan@pmail.ntu.edu.sg). Application of registration and submission will start soon. Further details can be obtained from the Web sites listed below. http://icus.iis.u-tokyo.ac.jp/isus05/ and http://www.ntu.edu.sg/ptrc/USMCA2005.

ICUS Activity Records

- *Prof. Uomoto and Prof. Meguro visited Nanyang Technological University and National University of Singapore, Singapore to sign a Memorandum of Understanding (March 27-30).*
- *Prof. Meguro carried out Sumatra Earthquake and Tsunami disaster investigation in Sri Lanka (Feb. 17-25) and in Thailand (March 9-13).*
- *Prof. Ooka attended the "ASHRAE Winter Meeting" at Orland, USA. (Feb. 5-11), and "Geo Exchange meeting" at Vancouver, Canada (March 16-19), and the "Annual meeting on AGS" at Boston, USA. (March 20-24).*
- *Prof. Dutta visited AIT, Thailand for collaborative research at RNUS (Jan. 22-March 30), and attended the "Map India 2005 International Conference" at Delhi, India (Feb. 7-9). He also participated in field survey and meeting in Guwahati towards developing a project on urban flood risk management at Guwahati, India (Feb. 10-12).*
- *Dr. Susaki visited AIT, Thailand as a JICA expert of remote sensing (Feb. 1-Jan. 31, 2007).*
- *Dr. Endo visited Thailand for research on forest fire in Hauy Kha Khaeng Wildlife Sanctuary (March 13-17).*

RNUS hosted the Secretariat of the International Symposium on Transboundary River Basin Management organized by UNU, AIT and Thammasat University

In recent years, development activities and research surrounding Asian international rivers, especially the Mekong River has expanded. Yet, many efforts in the downstream are disconnected from those in the upstream and vice versa. These communications gaps seriously hamper improving the understanding of basin hydrology and forecasting its future status. To improve regional cooperation and facilitate discussion among scientific community in riparian countries who share interest and incentive to understand one another's views, United Nations University (UNU) organized the symposium on "Role of Water Sciences in Transboundary River Basin Management" together with the Asian Institute of Technology (AIT) and Thammasat University during March 10-12, 2005 in Ubon Ratchathani, Thailand.

The symposium was an academic meeting that served as a venue for information exchange among transboundary water stakeholders working on Asia's international rivers. The focal issues of the meeting were: 1) Modeling and Monitoring, 2) Stakeholder Participation, 3) Transboundary Cooperation and 4) Scientific Networking.

The symposium brought together over 50 water professionals and academicians from 12 countries to share their experience and knowledge in various case studies particular to their basins, emphasizing both risks and paths to cooperation.

The two-day technical program of the symposium included six technical sessions organized under the four focal issues of the meeting. A total of 31 papers were presented in these sessions. After the six technical sessions, a special session was held to discuss research cooperation on transboundary river basin management with special focus on Mekong River Basin.

On the finalday, a field trip was organized to visit the Khong Pha Peng waterfall, located in the Laos Part of the Mekong River and close to the Cambodian border, where the Mekong river slopes steep downwards over a 20km stretch to create a 30 m head and water passage is separated into narrow strips by numerous rocky islands.

The symposium was successful in establishing a network of researchers for future scientific cooperation on transboundary river basin management. The next event for follow-up acitivities is a brainstorming session going to be held at AIT in June 2005 to formulate an action plan for research and development.

The secretariat for organizational activities of the symposium was hosted by the Regional Network Office for Urban Safety (RNUS) of ICUS/AIT and Dr. D. Dutta, the Coordinator of RNUS, acted as the Secretary of the Organizing Committee. Those who are interested to obtain a set of the symposium proceedings can write to the Symposium Secretariat at rnus@ait.ac.th.

Participants of the symposium held at the Tohsaeng Khong Jiem Resort, Ubon Ratchathani, Thailand, March 10, 2005

Editor's Note

Four years have passed since I became a member of ICUS. Meanwhile, the lineup of ICUS had been established.

A large number of activities have been done. The results have been accumulated. However, the speed at which I am writing my manuscript is slow as usual. The reason though is not known.

The three main research subjects I am dealing with are

(1) Urban environmental problems that are related to atmospheric environment,

(2) Urban safety problems related to fire, and

(3) Urban energy problems related to environmental control

(1) and (2) have been conducted as an academic activity in ICUS.

Some students have graduated in these four years under my guidance.

As cooperation work with these students, a number of research results for the above-mentioned (1)-(3) have been achieved in these four years.

In the days to come, I will be informing these results through ICUS.

ICUS is able to offer a meeting venue for researchers coming from various countries around the world.

Personally speaking, I had opportunities to visit many countries through ICUS.

I am looking forward to meeting and working with people who are interested in my research.

(by R. Ooka)

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ICUS NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

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FIRE AND DISASTER MANAGEMENT AGENCY ACTIVITIES IN 2004 AND AN APPROACH TO THE FUTURE

By

Shogo HAYASHI*

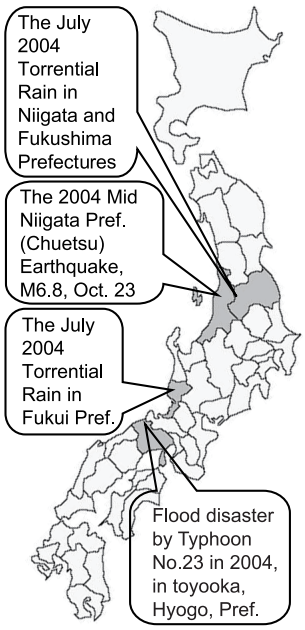
Large-scale disasters in 2004 and response activities by the Fire and Disaster Management Agency (FDMA) of the Ministry of Internal Affairs and Communications as well as FDMA future plans are reported in this article.

With regard to the existing fire defense situations in Japan, all cities, towns and villages (hereafter referred to as municipalities) take administrative responsibility for their own fire defense activities.

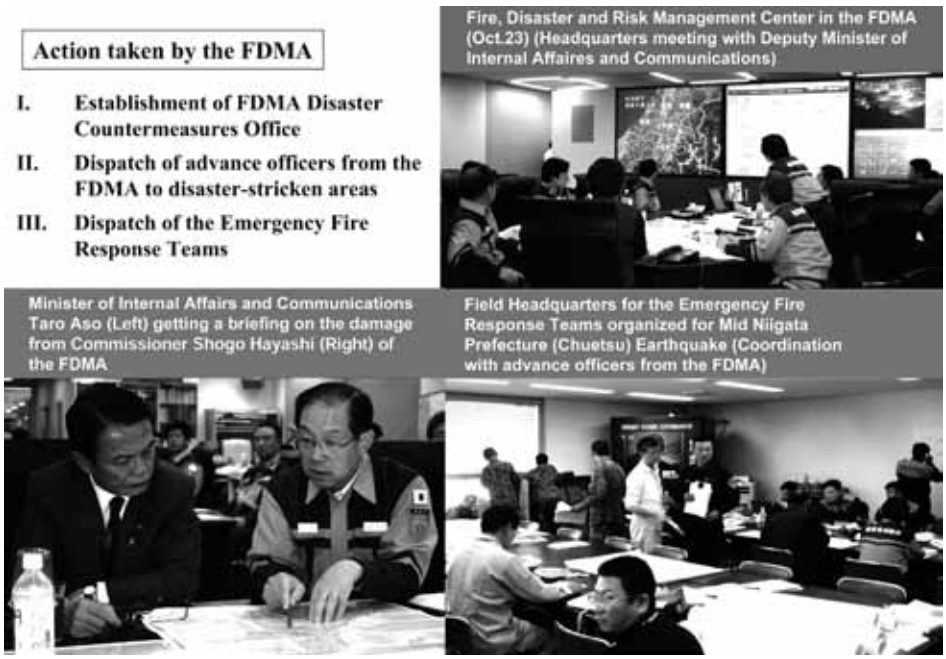
The FDMA is a government agency which manages fire defense organizations in all parts of the country. The FDMA, as a national organization, is in charge of fire fighting and emergency medical and rescue services as disaster preparedness and first response for emergency under the assumption of damage caused by severe earthquakes and floods.

DISASTERS – 2004

The year of 2004 was remarkable for a number of natural catastrophes like torrential rains



Large-scale disasters in 2004



A glimpse of the activities at Fire, Disaster and Risk Management Center

and frequent typhoons that had not struck in recent years. Earthquake also showed up its ugly face.

About three to six typhoons affect the Japanese landmass each year. However, the islands were affected by ten or more of them in 2004.

Typhoon number 23 in particular brought about severe damage killing 95 people in Toyooka, Hyogo Prefecture.

Japan is usually prepared for disasters which occur due to 40-50 mm of rain per hour. Severe torrential rains exceeding 100 mm per hour affected the Niigata, Fukushima and Fukui Prefectures in July 2004.

Many earthquakes have rocked Japan since last decade. The earthquake which rocked Chuetsu district in Niigata Prefecture on October 23rd left a strong impression in particular (see ICUS Newsletter, Special Issue 2005).

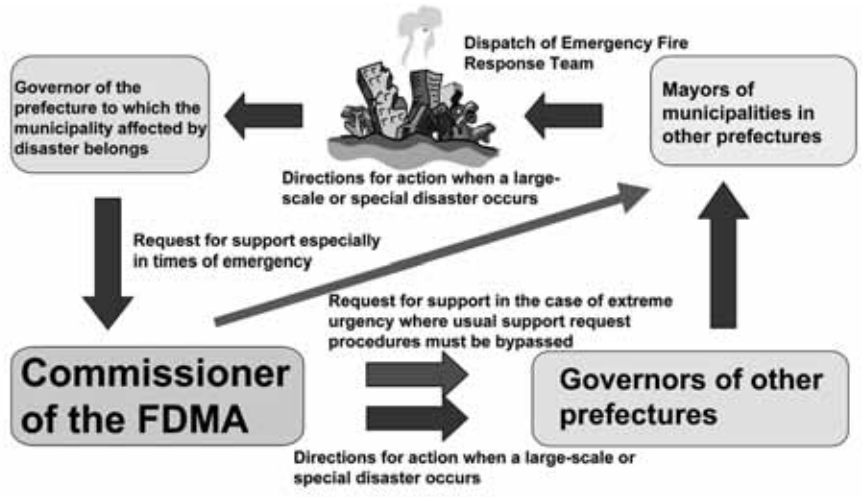
The occurrence of frequent earthquakes is not a phenomenon specific to the last year. Japan is now in an extended period when earthquakes will frequently occur.

COUNTERMEASURES BY THE FDMA

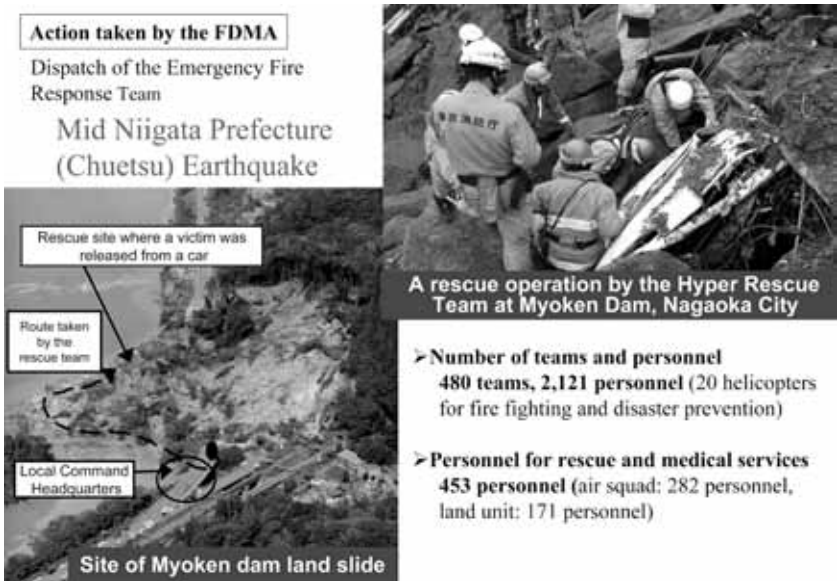
The Fire, Disaster and Risk Management Center, established within the FDMA, is equipped with systems for analyzing pictures transmitted from helicopters as well as for checking responses by the FDMA. This enables the advance units to be sent forward to specific locations damaged by hazards in any emergency.

Last year, the emergency fire response teams were dispatched to disaster-struck areas four times; namely to Niigata, Fukushima, Fukui and Hyogo Prefectures, and finally to Chuetsu, Niigata Prefecture.

The members sent from each prefectural fire defense headquarters to the areas damaged by the 1995 Kobe Earthquake met with various problems. By letting these problems be a lesson, Emergency Fire Response Teams were established in 1995 with a view to prepare for conditions requiring human aid in each prefecture. The Fire Organization Law was revised in June, 2003 and in the April 2004, this law was formally enforced.



Action plan of Emergency Fire Response Team



Rescue operation by Emergency Fire Response Team

The International Rescue Team (IRT) of Japan was one of the first teams to arrive at some of the areas struck by tsunami occurring in the Indian Ocean (see ICUS Newsletter, Vol.4, No.4, 2004) and carried out an invaluable number of first aid and rescue operations. On the 28th of December 2004, over 80 persons in all including fire and emergency services personnel medical staff and police personnel were dispatched. The relief work of the Japanese rescue team was highly appreciated and made headlines which were reported by the CNN and BBC at the end of the year. Japan is equipped with countermeasure systems against disasters and can contribute towards relief in case such a disaster occurs in Asia or surrounding areas.

CHANGING CONDITIONS

Conditions with regard to fire fighting and disaster preparedness are continuously changing.

First, the occurrence of large-scale disasters is indeed a matter of great concern.

Second, the law concerning the measures for protection of the people in armed attack situations etc. was enacted in the Diet last year. Two situations are assumed in this law; one in cases of emergency where missiles are shot into Japan by a hostile country or infiltrators enter Japan. The other one is for urgent countermeasures against acts of terrorism.

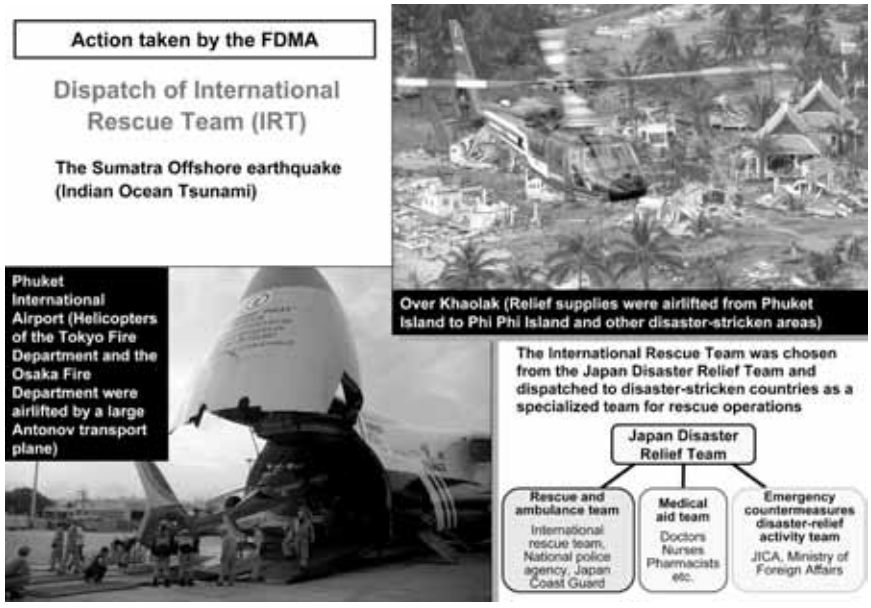
Third, recently, in particular, industrial disasters have occurred frequently. Therefore, companies are required to complete and strengthen their fire and disaster preparedness systems.

The preparation of fire defense systems in response to damage caused by the above mentioned matters must be forwarded from the national point of view with consideration to international cooperation. Based on this view, it is very important that the fire and disaster preparedness systems in municipalities need to be further improved.

COUNTERMEASURES BY THE FDMA FOR THE FUTURE

In order to strengthen the system for taking any initial action as a national duty in response to disasters, an overall revision of the system of the Fire, Disaster and Risk Management Center was made. The system was improved to be able to take any action required even in case of complete power failure or the destruction of facilities due to earthquakes and other hazards. The FDMA had poor results with regard to dispatching logistics and support units last year. The FDMA members lost no time in arriving at areas damaged by hazards. However, it could not be estimated how long teams would have to stay there. Hence, it is vital to improve the logistics and support systems.

In response to the convening of a World Fire Defense Agency Commissioners Conference for strengthening international cooperation, the first conference was held with representatives from ten countries. It was seen in this conference that there are few countries which have a national organization such as the FDMA in Japan. As can be recognized from the response to the great damage caused by the 2004 Sumatra earthquake and tsunami, the international network for fire fighting and disaster preparedness is urgently in need of strengthening.



Activity of International Rescue Team

The most important problem to be solved in the future is to strengthen the systems linking the municipalities. Firstly, it can be pointed out that systems for communicating satisfactorily with other cities, towns and villages of Japan have yet to be established. Secondly, there is a problem in the preparation of widespread administrative radio installations for disaster preparedness. Thirdly, a reconnaissance helicopter can be dispatched before taking command of emergency disaster response teams. Full command is taken after studying the images of the scene sent from the helicopter. If necessary, support units can be dispatched. We are planning to prepare a system, in which a portable earth station can receive images via satellite, in all parts of Japan. Fourthly, over 60% of disaster victims are elderly. Last year, we recognized that regional disaster prevention in a community is eventually most important for rescuing elderly persons living alone. Fifthly, municipalities are lagging behind badly in taking earthquake proofing measures for disaster prevention stations. Promotion activities with regard to this problem have been carried out in cooperation with the FDMA and ICUS, IIS, the University of Tokyo. Finally, with consideration to the importance of a regional disaster prevention system, a concept of relief and refuge stations has been proposed to regional bodies. At present, there are about 24,000 primary schools all over the country. Information with regard to fire fighting and crime prevention in ordinary times is to be collected at empty classrooms utilized as disaster management stations by considering a school district as one unit area. These classrooms can also be used to strengthen the disaster preparedness capacity in the school area while securing regional safety in ordinary times. These classrooms can be used as relief and refuge stations where information about safety can be relayed in the event of disasters. We hope this plan of utilizing unoccupied schools as disaster management stations will spread throughout the country in the light of the aforementioned projects.

The actions taken by the FDMA as well as issues to be dealt with in the future have been described above. We will take further positive actions with a view of securing the overall safety of our country.

**ICUS Visiting Professor, Commissioner of the FDMA, Ministry of Internal Affairs and Communications, Japan*

Guidelines for Promoting Seismic Retrofit of Critical Facilities for Disaster Management Published by the FDMA and ICUS Collaboration

In the Mid Niigata Prefecture Earthquake of M6.8, according to the Japan Meteorological Agency (JMA), occurred on October 23rd 2004, four towns and village offices suffered severe damage.

These were centered on the areas with seismic intensity of JMA scale 6 or more, and emergency response activities were seriously interrupted in operations by their severe damage. These buildings were constructed before 1981 when the Japanese seismic design code was revised and were designed based on the old code. This earthquake damage made us strongly feel the necessity and importance for seismic retrofitting of the critical facilities for disaster management.

In response to such lessons, Fire and Disaster Management Agency (FDMA) has just completed the guideline in collaboration with ICUS and many architect offices and construction companies. This effort has a significant meaning as the first collaboration made by industry, government and academic society.

Until now, many examples have been published related to the seismic retrofit of buildings, however, this guideline has specific features like providing information to people who are involved in the local governments to understand the importance of seismic retrofit of critical facilities such as city or town halls, school buildings, fire stations which are expected to play an important role in case of disaster. This guideline is designed to make local government people understand easily about key issues such as basic judgment of seismic capacity evaluation and effective retrofit procedures, necessary cost, working time by the introduction of actual examples of seismic retrofitting.

Following is a table of contents of this guideline.

Critical facilities for disaster management

Role of the facility

[CHAPTER-1]
Why is Seismic Retrofit Necessary for Critical Facilities?
1-1 What is the current earthquake risk in Japan?
1-2 What is a critical facility?
1-3 What level of retrofit is required?
1-4 What are the causes making the retrofitting difficult?
1-5 What are the types of damages to buildings?
1-6 What types of buildings are vulnerable to earthquake?

[CHAPTER-2]
Procedures for Seismic Retrofitting
2-1 What is seismic capacity evaluation?
2-2 Preliminary screening to retrofitting – A flowchart
2-3 What should be investigated?
2-4 What is the output of seismic capacity evaluation?
2-5 Cost and time for evaluation?

[CHAPTER-3]
Seismic Retrofitting Method and Examples:
3-1 What is seismic retrofit?
3-2 Which method of retrofit is better?
3-3 Which is the popular retrofit method?
3-4 Is there any external retrofit method?
3-5 What is vibration control?
3-6 What is base isolation?
3-7 Model examples of seismic retrofit.
3-8 List of practical examples of retrofitted buildings.

I sincerely wish this guideline will be widely used by many people who are involved in the local governments and enhance disaster mitigation and contribute to the safety of the country.

Prof. Y. Nakano, IIS provided his valuable advice for the above project.

(by Reiko Amano,
Visiting Professor, ICUS
General Manager of Kajima Corp.)

Seconded to Asian Institute of Technology

Several months have already passed since I have been seconded to Asian Institute of Technology (AIT), located in the suburb of Bangkok, Thailand. When I arrived, January semester had already started. I took over the class shared with another instructor, and finished final examination by early May. Because AIT has a semester system, the period from early May to early August is summer vacation for students. They seem to enjoy studying and staying at their home.

I'm seconded to Remote Sensing and GIS Field of Study, School of Advance Technology as an expert of Japan International Cooperation Agency (JICA). Dispatch of JICA experts to AIT by Japanese government started in 1969. Experts for long-term, i.e. more than six months, amount to 118 persons. Most of the experts have been seconded to departments related to civil engineering as they have expertise in the same field. At present, AIT has only two JICA experts. To date, Japan has contributed greatly to the improvement of AIT, especially in the fields of civil engineering. However, Japan started to withdraw support to AIT gradually as well as United States and Germany, which used to be important supporters for AIT. Other than JICA experts, there are other Japanese faculty members, four directly hired and three seconded by other institutes of Japan.

Regarding remote sensing, AIT has continued an outstanding position among the Southeast Asian countries. AIT has a "Geoinformatics Center" consisting of two divisions. One of them is "Asian Center for Researches of Remote Sensing", a research-oriented division. The other is "GIS Application Center (GAC)", a training-oriented division. Geoinformatics Center has two antennas for receiving satellite data, supported by Institute of Industrial Science (IIS), The University of Tokyo. The received data are processed and distributed to IIS under several joint projects between AIT and IIS. I am working at the Geo-informatics Center most of the times. As staffs are from many countries, e.g. Thailand, Vietnam, India or Sri Lanka, I enjoy talking and sharing a considerable amount of information with them.

From a research viewpoint, I've started fundamental researches related to disaster mitigation. This year, Thailand had severe drought in almost all of provinces. I cite some articles from Bangkok Post, an English newspaper published in Thailand.

Sugarcane plantations covering over 60,000 rai (1 rai=1600 square meters) in three districts of Suphan Buri are dying as water supply from the local Kra Seaw dam stopped for the first time yesterday due to severe drought. Agricultural areas in Doembang Nangbuat, Nong Yasai and Sam Chuk districts also depend on water from the earth dam, which is located in Dan Chang district and has a capacity for storing 240 million cubic metres of water. The 4.25-km-long dam blocks the Nam Seaw River which flows from Uthai Thani. Only 20 million cubic metres now remains in its reservoir so the dam must stop discharging water for cultivation and keep the water to maintain its own physical condition, according to Thongthos Nokchan, the dam's irrigation and maintenance chief (March 21).

The number of provinces suffering from drought has been reduced from 72 to 16 by rain-making operations, Agriculture and Cooperatives Minister Sudarat Keyuraphan said. Of these only four or five, including Chumphon and Surat Thani, are now badly affected as there is insufficient water for agricultural use. Cloud-seeding would now focus on these areas. A total of 1,070 seeding flights to relieve the dry spell were made from nine rain-making centres from March 15 to April 9. On April 9 alone, rain was reported in 30 provinces: eight in the North, six in the Central Plain, seven in the Northeast and nine in the South (April 11).

Remote sensing can be a powerful tool for drought monitoring because onset of drought is gradual and can be detected by long-term monitoring. In order to develop a drought monitoring system, I started with field measurements to model the phenomenon on the surface from remotely sensed data. Finally, I'd like to contribute to the mitigation of such severe disasters through remote sensing technique for two-year stay in Thailand.

(by Junichi Susaki)

Drying dam in Nakhon Ratchasima province
(Upper: April 23, Lower: June 11, 2005)

Seeding into dry paddy fields in Buri Ram province. Farmers are eager for rain. (June 12, 2005)

ICUS PARTICIPATION – IIS OPEN HOUSE

The Institute of Industrial Science conducted the OPEN HOUSE during June 2-3, 2005. The various Departments and their respective Laboratories are open for public viewing during this time. ICUS participated in the same by explaining its numerous activities in both Japanese and English. The topic of focus for ICUS was "Towards Safer and Securer Built Environment in Mega Cities in Asia." About 270 People visited ICUS this year.

Under the umbrella of the ICUS title, the research titles of ICUS members were as follows:

1) Prof. Taketo Uomoto:
-Development of Technologies for Increasing Durability of Concrete Structures

2) Prof. Kimiro Meguro:
-Today's Issues of Japanese Disaster Countermeasures: Ten Years after the Kobe Earthquake

3) Dr. Taikan Oki
- Re-Spotlight on Flood Disaster

4) Dr. Ryozo Ooka:
-Sustainable Urban Design with CFD Simulation
-Diffusion of Contaminants in Urban Area and Natural Ventilation

5) Dr. Yoshitaka Kato:
-Development of Maintenance Management System for Existing Concrete Structures

(by M. Yoshimura)

Mr. Chuko Hayakawa, a member of the House of Representatives, visiting ICUS

Lecture for high school students

ICUS New Staff

Dr. Taikan Oki has joined ICUS since April 1 2005 as Associate Professor. Trained in Civil Engineering at the University of Tokyo, Dr. Oki now runs the Laboratory for Hydrology and Water Resources Engineering at the Institute of Industrial Science, the University of Tokyo. He is assigned to the Council for Science and Technology Policy, Cabinet Office of Japan, to support policy making, prioritization and evaluation of measures for science and technology in Japan, particularly to support the development of the third master plan of national science and technology development from 2006 to 2010. He has served as a lead author for the IPCC Fourth Assessment Report as well as a contributing author for the UN - Millennium Ecosystem Assessment. Dr. Oki was a visiting scientist at the NASA/ Goddard Space Flight Center for 1995-1997, and he spent a few years at the Research Institute of Humanity and Nature in Kyoto. He was one of the associate editors of the JGR- Atmospheres of the American Geophysical Union. Dr. Oki is currently chairing the IAHS Hydrology

Dr. Taikan Oki

2020 Working Group, and he was the winner of the Tison Award of the IAHS in 2003. He is a science panel member of a few international research projects, such as GEWEX Asian Monsoon Experiment (GAME), Global Land Atmosphere System Studies (GLASS), Global Water System Project (GWSP), and Global Soil Wetness Project (GSWP). His research interests include: global water balance and hydrologic cycle; world water resources assessment and the virtual water trade, impacts of climate change on hydrological extremes and water resources managements, land-atmosphere interaction and its modeling; inter-annual variation of global climate and the Asian monsoon; application of remote sensing in hydrology.

(by T. Uomoto)

ICUS welcomes Dr. Rashmi Iyengar, who joined ICUS from April 2005 to assist in the preparation of ICUS publications. Prior to joining ICUS, she completed her training to be a medical doctor from India.

Dr. Rashmi

ICUS Activities

- *Prof. Uomoto and Dr. Kato visited AIT, Thailand for a meeting at RNUS (May 2-4).*
- *Prof. Meguro attended the "Earthquake Summit" at Lake Tahoe, USA. (April 24-27), and "International Symposium on Floods in Coastal Cities under Climate Change Conditions" at AIT, Bangkok, Thailand (June 24-26).*
- *Prof. Oki attended the "IAHS Hydro- logy 2020 Working Group Work- shop" at Iguassu Falls (April 1-11).*
- *Prof. Ooka attended the "Global Advances in Heat Pump Technology Applications and Markets" at Las Vegas, USA (May 30- June 4), and the "ASHRAE Annual Meeting" at Denver, USA (June 25-30).*
- *Prof. Dutta attended the "7th IAHS Scientific Assembly" at Iguassu Falls (April 5-12).*

Awards

Prof. Oki won the Environmental Award at the Annual Meeting of Japan Society of Civil Engineers in May.

Prof. Ooka won the Technology Promotion Award at the Society of Heating Air-Conditioning and Sanitary Engineers of Japan Standard in May.

INTERNATIONAL SYMPOSIUM ON FLOODS IN COASTAL CITIES UNDER CLIMATE CHANGE CONDITIONS

The Regional Network office for Urban Safety (RNUS) organized an international symposium on "Floods in Coastal Cities under Climate Change Conditions" during 23-25 June 2005 at the Asian Institute of Technology (AIT), Bangkok, Thailand. The symposium was sponsored by the Asia Pacific Network for Global Change Research (APN) under a year-long project. The symposium was attended by 45 participants mainly from South and South-east Asian countries and Japan including academicians, researchers, policy makers and practitioners.

After a brief opening ceremony, the symposium was started with a keynote speech on Flood Control Systems in Bangkok by the Director General of Bangkok Metropolitan Administration, Mr. Teeradej Tangpraprutgul. In his presentation, Mr. Tangpraprutgul discussed about the history of flood in Bangkok, the main causes behind it and demonstrated the existing systems for flood prevention and future plans.

The keynote speech was followed by three technical sessions on the 1st day. The first two sessions witnessed the different country case studies conducted by the key collaborators of the APN Project, followed by in-depth demonstration of the respective country policy issues and strategy. The country case-study reports were presented from Thailand, Bangladesh, India, Sri Lanka, Vietnam and Pakistan (in order of presentation). These sessions was chaired by Dr. Mukand S. Babel and Prof. Addala N Swamy respectively. Dr. Uditha Ratnayake and Dr. KS Rajan were the rapporteurs respectively. The day ended with a brainstorming session where the day's presentations were discussed and chalked out the composition of the policy guidelines.

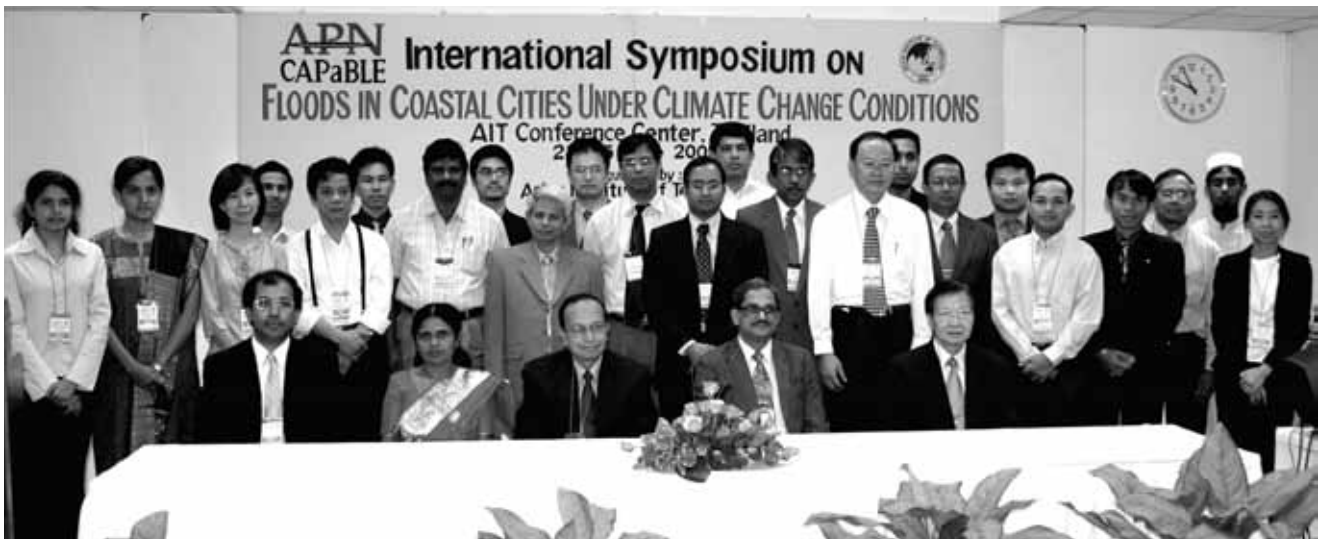
The second day started with the continuation of the previous day's brainstorming on policy issues. Prof. Ashim Das Gupta was the facilitator of brainstorming session. The next session of the day had the theme of Climate Change Impacts chaired by Prof. Tawatchai Tingsanchali. This session witnessed many different researches conducted at The University of Tokyo, AIT, Universiti Sains Malaysia and Thammasat University. The presenters revealed their simulation and possible risks due the climate change.

After lunch break, a technical tour was arranged to the Bangkok Metropolitan Administration (BMA). At BMA headquarter, the participants listened to a presentation on the Department of Drainage and Sewerage and then visited the Krung Kasem Pumpoing Station and Si Praya Treatment Plant.

The third day started with the session titled Tsunami and Coastal Flooding chaired by Dr. Junichi Susaki and rapporteur Dr. Yoshitaka Kato. This session had some attention-grabbing invited presentations by Prof. Kimiro Meguro of The University of Tokyo, Japan, Dr. Pennung Warnitchai, AIT, Dr. Srikantha Herath, UNU, Mr. David Hastings of UNESCAP and Mr. Ole Neilson from Geoscience Australia also.

The symposium concluded with the last brainstorming session chaired by Dr. Mukand S. Babel. This session outlined the policy issues of the discussed countries and developed a guideline for the policy maker to combat the climate change impacts and coastal flooding.

(by Dushmanta Dutta)



Some of the participants of the symposium on 23rd June before the Keynote speech

Editor's Note

The Sumatra earthquake occurred about 6 months ago. Although large natural disasters have not occurred in Japan this year, man made disasters such as terrorism, rail accidents have occurred at a global and local levels, respectively. Hundred or more people were killed when a train (Fukuchiyama line) of the West Japan Railway Company derailed on the 25th of April this year. ICUS sent its heartfelt condolences.

We should be ready to execute countermeasures for the disasters that may happen in future. This is one of the missions of ICUS and some of those activities are introduced in this volume.

There are two kinds of factors which cause severe damage to our social life. The first is a disaster that momentarily causes severe damage such as earthquake, tsunami, floods, etc. The other is a disaster that gradually effects. When the damage is gradual, it is difficult to address the same. For instance, environmental destruction, urban infrastructure ageing, etc. The former is "heel drop" as a killer shot, the latter is "low kick" that is sober though cumulative damage is large. An amateur (society) obviously pays attention to the killer shot. On the other hand, the expert concentrates on low kick. The editor's research is in the field of maintenance of urban infrastructures. It is classified from the above-mentioned classification into "Countermeasure for low kick"

I was seconded to AIT in the middle of May 2005. Weekdays are spent in AIT whereas the weekends are spent in a hotel in Bangkok. Many buildings are being constructed rapidly in Bangkok until midnight. It is very important to offer facilities at the right time from the economic point of view. However, it is a huge drawback that the quality of the facilities decreases as a result of the fast work. This was the situation that Japan experienced when the economic growth rate was high. To solve this issue, it will cost enormously. I sincerely wish Thailand and other Asian countries will not to be confronted with the same problem as Japan had.

(by Y. Kato)

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Institute of Industrial Science
The University of Tokyo

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WHY ARE YOU AFRAID OF ONLY EARTHQUAKES?

By

Taikan OKI

WHAT ARE PEOPLE IN JAPAN AFRAID OF?

More than 90% of people in Japan are afraid of big earthquakes, but percentage of the people who are afraid of extreme weather, such as typhoons, torrential rainfall, and droughts, is less than 60% — recent survey by Tokyu Agency Inc., an advertising agency, illuminated the people's consciousness on their fear. Even though these two natural disasters by seismic and atmospheric variations respectively are the top two issues that people in Japan are apprehensive about their safety, why are their perceptions quite different for these two? The number of people who are not afraid of wind storm and floods is 4 times that of those who are not afraid of earthquakes. The survey by Tokyu Agency Inc. was conducted in September 2005. Its results are consistent with the observation of the special public opinion poll conducted in February 2005 by the Cabinet Office of Japan which indicates that 34% of people in Japan do not think they have any risk from torrential rainfall or typhoons.

In 2004, two torrential rainfall events subsequently occurred in July associated with the seasonal rain front at Niigata and Fukushima, and Fukui Prefectures and there were 10 landfalls of typhoons during the season. As a result, over 200 lives were lost. If these surveys either by Tokyu Agency Inc. or by the Cabinet Office of Japan were done in 2003, before the prominent damage of 2004, awareness of the risk against floods would have been much less and people must have expressed their fear mostly against earthquakes.

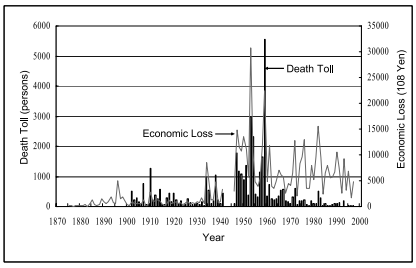
Actually, there was an earthquake of magnitude 6.8 on the Richter scale in Chuetsu region of Niigata Prefecture on October 23, 2004, and of course, this disaster reminded the risk of earthquakes for the people in Japan. This might have been reflected in to the results of the survey, as well.

Property damage due to flood caused by failure of embankment

Damage by Natural Disasters in FY2004

	Death toll	Injured	Collapsed	Half Damaged	Partially Damaged
Snow	**86**	**758**	**55**	**5**	**94**
Earthquake	**47**	**5,572**	**3,270**	**13,746**	**105,152**
Flood	**230**	**2,539**	**1,450**	**15,960**	**92,371**

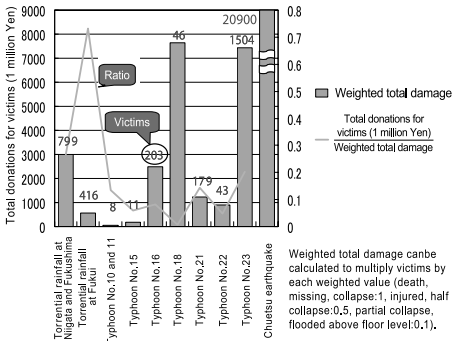
(Fire and Disaster Management Agency, Japan, by March 20, 2005.)



Victims and economic loss due to flood

Above table is a list of damages caused by natural disasters summarized by Fire and Disaster Management Agency, Japan for the Japanese fiscal year of 2004, namely from April 2004 through March 2005. The number of earthquake related death toll was increased till October 4, 2005. All the numbers include the indirect damage, for example, those who lost their lives during the evacuation or in the hospital, and the period of counting the damage is not set unlike the statistics of car accidents in Japan, which counts only the loss within 24 hours after accidents.

As is apparent from the table above, many lives were lost due to floods in 2004. The number is exceptional in recent Japan as shown in above figure. It was not rare a few decades ago for the death toll in a year due to floods to be more than a few hundreds. But since 1982, when severe floods in Nagasaki Prefecture resulted in 299 deaths or missings, human casualties have been decreasing even though the economic losses have not decreased significantly.

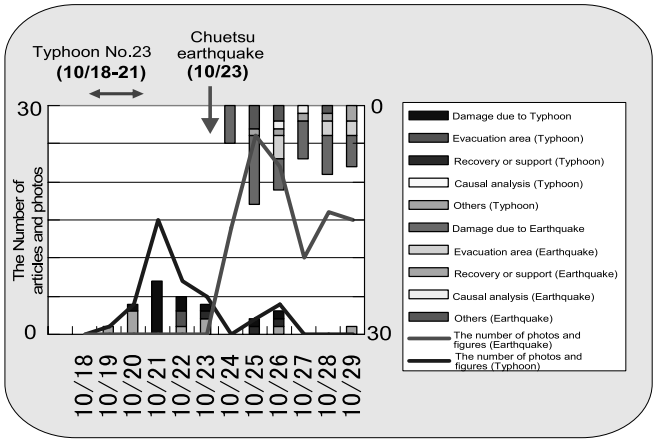


Weighted total damage canbe calculated to multiply victims by each weighted value (death, missing, collapse:1, injured, half collapse:0.5, partial collapse, flooded above floor level:0.1).

Ratio of the donation compared to the weighted total damage

The perception of higher interest in earthquake than flood can be observed in the number of articles on newspapers. Below figure shows typical example for the case of the Asahi Shimbun NewsPaper. The number of articles on the Typhoon No. 23 (TOKAGE) was the peak on October 21, the next day of the most serious damages were given and follow up articles were on the page space.However, after the big earthquake hit Chuetsu region, Niigata Prefecture, in the evening on October 23, most of the space were filled with the articles on the earthquake and articles on the floods were suppressed. Absolute number of articles, photos and figures on earthquake were much larger compared to those on floods, even though the total number of the death toll due to the Typhoon No.23 only was close to 100; it was less than 40 at that moment by the earthquake.

This difference of the attention by mass media made difference for the charity donation. Approximately 30 billion yen of charity donation were sent for the earthquake; however, it was only 3 billion yen for the Typhoon No.23. Left figure illustrates the ratio of the donation compared to the weighted total damage by each disaster. Apparently, people suffered by floods were not well treated and supported, and the situation is really unfair.



Transition of newspaper articles about Typhoon No.23 (Asahi Shimbun Newspaper)

FLOODS IN JAPAN IN 2004

Some characteristics are diagnosed in the floods of 2004. Although not surprising, disaster challenged people — either aged person over 65 years old or handicapped person— accounted for 64% of the deaths or missings due to floods and landslides in Japan in 2004. Percentage of persons aged over 65 years is approximately 20% in Japan now. It was a shock for experts of flood disaster mitigation to hear the news of aged person drowned in floods because recent casualties were mostly by landslides, and only a few were lost due to dropping into a flooded channel accidentally or being confined in a basement. This fact initiated the discussion on how to issue more efficient alert information introduced below.

Many cases were observed where people were isolated in their houses and could not evacuate from the inundated area. Because of the large area and the number of people affected, it took long time for helicopters to safely transfer all affected people to safe places. Fortunately no serious damage was reported but day nurseries and schools were isolated and some children had to spend over night there. It is surprising children were in day nurseries and schools when flood warning was issued. We should not put too much priority for efficiency in our daily activities but should accept idleness under emergency; we should stay at home with children and should not let them go outside under severe weather conditions.

Other common feature of the damage due to floods in the last year was that the levees of main stream of major rivers managed by the national river bureau were fine even though water level exceeded the dangerous level at some locations. However, levee crevasse occurred at the sections of tributaries of major river basins that are managed by prefectures.

Unfortunately, most of the hazard maps or the inundation hazardous areas were estimated for levee crevasse of main streams of major rivers, and inundated areas in the last year were not

foreseen. As bad luck would have it, flood forecasting systems were not generally installed and operated in these tributaries.

It was known before, but it was also made clear by the flood disasters in 2004 that higher levee can hold larger floods, however, once levee crevasse occurred, the damage particularly close to the levee becomes seriously severer. Practically it is impossible to secure the safety of levee for its all length, therefore, we should consider the risk of levee failure and their impacts in the design of river improvement measures.

WHAT LESSONS WERE LEARNT AND WHAT ARE THE MITIGATION MEASURES?

It was recognized that the delays in issuing flood alert to the local people by the local governments were one of the critical reasons that flood damages were intensified. According to the recent survey, it was suggested that disaster challenged persons need additional one hour, approximately, for their evacuation. There were only two categories of disaster related alert that local government issued in the past: evacuation instructions and evacuation directives. Reflecting on the disasters in 2004, evacuation preparation information was added and the reactions local people should take when they hear these three commands, were clearly defined, which may have been different in each local government. For the case of flood alert, the "evacuation preparation information" is issued when water table is expected to reach to the dangerous level within certain time, over which the safety of the levee cannot be guaranteed. The "certain time" here is defined as the time within the duration disaster challenged person can evacuate and the accuracy of the information can be assured. Disaster challenged person should evacuate immediately and ordinary people should start preparing for their evacuation if they touch with the "evacuation preparation information." Evacuation instructions are issued when the water table is expected to reach the dangerous level within certain time; "certain time" being the duration within which ordinary people can evacuate. All the people should evacuate immediately. An evacuation directive is issued when serious disaster has already happened, such as levee crevasse, finding of critical cracks in levees or a large quantity of leakage of water, failure of flood management facilities such as water gates or pumping stations, or the reach to the dangerous water level. People are suggested to evacuate immediately if they can but they should assure the safety of the evacuation route. These three levels of alerts are defined for storm surges, landslide disasters, and tsunamis, as well. The basic philosophy is the same as for the case of flood alerts.

Mayors are responsible for issuing flood alerts, but practically speaking, municipal governments are not used to flood disasters and are not equipped to carry out proper flood prediction. For these typically small rivers a new concept of "special warning water level" is recommended. Mayors are suggested to issue the "evacuation preparation information" when the water level reaches the "special warning water level."

WHAT KIND OF RESEARCH AND DEVELOPMENT ARE GOING ON AT IIS/UNIV. OF TOKYO?

Oki and Kanae Laboratory, the Hydrology and Water Resources Engineering Laboratory at the IIS, the University of Tokyo, has been working on the global water cycle within the context of earth system science and world water resources assessment including the virtual water trade. Corresponding to the recent floods disasters in Japan, they have started to develop a macro scale hydrological modeling system which covers whole land area all over Japan. Prototype model was developed in 0.1 degree horizontal resolution, and proved that the prediction by the Meso Scale Model of the Japan Meteorological Agency, which is delivered in real time through the internet, can be used for practical flood forecasting. The modeling system is now under revision and improvement of its accuracy. The merit of the modeling system is unlike the classical rainfall-runoff modeling in hydrology; soil moisture distribution can be obtained simultaneously, and is expected to be used for the risk assessment of land slides considering the historical record of soil moisture estimated by offline simulation.

Such a modeling system will also be developed in Thailand under the Japan EOS (Earth Observation System) Promotion Project (JEPP), which was initiated by the approval of the 10-year implementation plan of the GEOSS (Global Earth Observation System of Systems). Even though the demonstration project of the hydrological modeling system will be developed in Mae Waang river basin near Chiang Mai, Thailand in cooperation with Thai Universities, such as Kasetsart, Chulalongkorn, and King Mongkut, and Thai Operational Agencies such as Royal Irrigation Department, Thai Meteorological Department, and Royal Forestry Department, hydrometeorological and climatological studies should have a scope covering whole Indo-China Peninsula and neighboring oceans such as Andaman Sea and South China Sea. This scope fits to the planning of new project "Monsoon Asia Hydro-Atmospheric Science Research and Prediction Initiative" (MAHASRI) as a successive project of the GEWEX Asian Monsoon Experiment (GAME). Our project will have close relationship with GEOSS, MAHASRI, IAHS/PUB, GWSP, GE-WEX/GSWP, etc., and probably will have a name such as "GEOSS and MAHASRI Experiment in Tropics" (GaME-T). GaME-T aims to investigate the "Scientific Basis for Hydrometeorological Warning System" in short, medium, and long ranges for flood and drought management with the basic understanding of Asian Monsoon System and the latest technology of monitoring and modeling. All the interested researchers and stakeholders are welcome to join the new project.

REMARKS

There are also many issues to be discussed in this topic, such as the impact of climate change, global warming to the water resources management,the development of the robustness against flood disaster in community, integrated water resources management incorporated with the land use management, but they will be introduced in another occasion.

After ten years of my affiliation with INCEDE/ICUS

- Greetings from the Monash University, Australia -

After ten years of my association with this quarterly newsletter as a staff of INCEDE and then ICUS, for the first time I am writing as a network member of ICUS. It makes me nostalgic with flash back of so many interesting events and activities of INCEDE and ICUS that I participated in during the last 10 years of my stay at the University of Tokyo. Walking down the memory lane, I joined INCEDE in August 1995 as a Research Associate after obtaining my M. Eng. degree in civil and water resources engineering from the Asian Institute of Technology (AIT). Soon after joining INCEDE, I got many wonderful opportunities to participate in several international projects of INCEDE in areas of urban disaster mitigation. I was also assigned the editorial task of the INCEDE newsletters. Through these activities, I got to know and work with many enthusiastic INCEDE and ICUS Network members and in the course of time, I developed long lasting friendship with many of them. I shall cherish our friendship in the days and years to come and look forward to having opportunities again to work with from the Monash University.

I am grateful to the then INCEDE Directors Prof. T. Katayama, Prof. K. Sudo and colleagues Prof. S. Herath and Prof. K. Meguro for giving me the opportunity and support to complete my Ph.D. from the University of Tokyo in 1999 as a working staff of INCEDE. As INCEDE became ICUS in 2001, I became a research staff of ICUS. With the expansion of research areas at ICUS to urban safety, our team and activities were expanded. That expanded the horizon for me to work with some of the great researchers. In 2003, I was promoted to the position of Associate Professor. Promotion comes with additional loads; it was not exceptional for me. I was immediately assigned with the responsibility of coordinating the activities of the Regional Network Office of Urban Safety (RNUS) at AIT, which was newly established for regional collaboration of ICUS in areas of urban safety. For this task, I joined the School of Civil Engineering of AIT as a visiting Associate Professor. Coordinating a new office was challenging, but with the wonderful support of my colleagues from ICUS and AIT, I was successful in establishing and expanding the activities of RNUS and initiating several collaborative research projects. I thank Prof. Taketo Uomoto, the ICUS Director for rendering his unconditional support to me in my initiatives at RNUS.

The ten years of my career at the University of Tokyo is the most satisfactory and enriching experience of my professional life so far. I take this opportunity to thank all my past and present colleagues at the University of Tokyo for their kind support to me during my stay.

I moved to Australia in July 2005 to join the School of Applied Sciences and Engineering (SASE) of the Monash University as a faculty member. At SASE, I am involved with teaching and research in areas of water engineering and science. SASE is located in the modern and picturesque Gippsland campus of the Monash University in the township of Churchill, Victoria. The faculty of SASE consists of a team of scientists and engineers of various disciplines focusing on teaching and research in multi-disciplinary areas of science and engineering. SASE offers degrees and double-degrees in several fields of science by on-campus and off-campus modes. The school also offers a range of honours, postgraduate and research programs in science and engineering. One of the new programs at SASE is the Bachelor of Civil and Environmental Engineering established to meet the increasing demand of an integrated program of civil and environmental engineering for sustainable development in the 21st Century. The program provides broad-based capabilities for the design, implementation and management of civil engineering solutions in an environmental context. If you are more interested to know about SASE or the Monash University, please feel free to contact me any time by e-mail.

Finally, I extend my best wishes to all the colleagues at ICUS and RNUS for their continued research endeavor to enhance the safety and security of Asian cities. I am looking forward to collaborating with ICUS, RNUS and its network members from my new office in areas of water related urban disaster risk management.

(by Dushmanta Dutta, Lecturer, School of Applied Sciences Engineering, Monash University dushmanta.dutta@sci.monash.edu.au)

Gippsland campus, Monash University, Churchill, Victria, Austraria

Dr. Dushmanta Dutta

International Collaboration Between Asia-Pacific Space Agencies for Disaster Reduction

A technical workshop of Asia-Pacific Regional Space Agency Forum (APRSAF) titled "Disaster Reduction through Effective Space Technology Utilization in the Asia Pacific Region" was held at Malaysian Centre for Remote Sensing (MACRES), Kuala Lumpur from May 24 to May 26, 2005. APRSAF was established jointly by Japan Aerospace Exploration Agency (JAXA) and local space agencies of the region. APRSAF12 will be held in Kitakyushu-city, Japan in October, 2005.

The main themes of APRSAF can be divided into two categories: (1) activities of local space agencies, and (2) international cooperation for disaster reduction. As an example of local activities, the National Institute of Aeronautics and Space (LAPAN), Indonesia reported about the remote sensing applications in disaster management in Indonesia. It has been trying to improve the capability for early detection, warning and response to natural disasters, especially "Weather/climate anomalies", "Droughts", "Floods" and "Land/Forest fires". LAPAN has developed several systems such as "Potential flooded area monitoring system", "Fire danger rating system" and "Smoke dispersion modeling". Most of the systems combine satellite data such as MODIS (spatial resolution 250m, 500m and 1km) and NOAA (spatial resolution 1.1km) images, and meteorological data. LAPAN also pointed out current problems, e.g. lack of expertise for interpretation of the results, shortage of supporting field data for validation, and lack of models and algorithms for the disaster specific. LAPAN informed that it needs technical trainings on modeling and database creation for remote sensing/Geographic Information System (GIS), and regular update of database and national/international collaboration.

From the viewpoint of an international cooperation, capacity building and development of data sharing network were mainly discussed. JAXA has been supporting activities for capacity building of remote sensing and GIS through Geoinformatics Center, Asian Institute of Technology (AIT). From the current fiscal year, these activities are being implemented through "Mini-project" as per local needs. Trainees are expected to acquire the knowledge and skills through mini-projects conducted by themselves under the supervision of AIT. Data sharing is also one of the most important issues in terms of disaster reduction. "AIT/JAXA Digital Asia" project plans to develop a data network. It will require "nodes" in different countries to distribute the necessary data efficiently. The project plans to set up a data server at each node, and the server will be managed by local space agencies. Many countries expressed their willingness to participate, and installation of servers and training of personnel are in progress. Such international collaboration is regarded as an indispensable activity for the utilization of remote sensing data for disaster reduction.

Opening session of APRSAF

(by J. Susaki)

Current Status and Countermeasures for Asbestos Problem

Professor Motoyasu Kamata of The University of Tokyo, one of the best experts in asbestos removal techniques in Japan, was interviewed about the state of asbestos related problems in Japan and the measures being taken to deal with them.

Recently, the damage caused by asbestos has been in the news in Japan. Asbestos is the general term used for fibrous inorganic silicate minerals belonging to the serpentine and amphibole groups with a length over 5μm and a thickness less than 3μm. People tend to mistakenly believe that asbestos itself is a toxin, but the substance itself exists in nature and is not toxic. However, it is extremely fine and can get lodged in the lung alveoli and other organs, and it is said to be the cause of mesothelioma. Fibers over a certain size are naturally expelled from the body, but those as fine as asbestos accumulate within the body and lead to problems. Also, the latency period of asbestos is extremely long (sometimes over 30 years) so it is often difficult to prove a causal relationship with the illness. Asbestos is highly fire-resistant and has excellent heat insulating properties. Moreover, it is inexpensive. These have led to its extensive use; it has been used in construction materials such as fireproofing boards and roofing materials, ceiling spray, water pipes, and so on. In line with increasing awareness of the damage caused by asbestos, use of spraying asbestos was banned by amendments to the Industrial Safety and Health Law's Ordinance on the Prevention of the Hazards due to Specified Chemical Substances in 1975. It is said that if asbestos is solidified and is not dispersed, it is not harmful, but it is inevitable that a certain amount is released during repair works and demolition. Therefore, construction works must be conducted with full attention so that the asbestos is not dispersed into the air. At present, the Building Center of Japan is conducting inspection and certification (previously these inspections and certifications were conducted with approval from the Minister of Construction, but now they are done voluntarily by the Building Center) of methods that care about prevention of asbestos contamination and asbestos removal. However, there are presently no punitive provisions and application of these methods is still largely up to the goodwill of the developer and construction companies. A legal solution is required for this matter as soon as possible.

Spray asbestos (Asbestos center, Japan)

(by R. Ooka)

The 9th ICUS Open Lecture

The 9th ICUS Open Lecture was held at Convention Hall of IIS in the afternoon of September 29, 2005. The title of the lecture was "Safety Problems of Structures in Japan." About 100 people attended the lecture. There were three speakers, Dr. Tadayoshi Ishibashi, Dr. Makoto Kaneuji and Prof. Terunobu Fujimori.

The topics were as follows:

1. Dr. Tadayoshi Ishibashi, Associate Director, East Japan Railway Company (JR East): "Seismic Damage and Retrofitting of Railway Structures".
2. Dr. Makoto Kaneuji, Renewal Group Leader, Technology Development Department, Kajima Corporation: "Asset Management and Safety of Motorway Bridges".
3. Prof. Terunobu Fujimori, Professor, Institute of Industrial Science, The University of Tokyo: "Construction Safety in Japan from a Historical Viewpoint ".

Participants of the Open Lecture

All the three presentations were very new and impressive to all the participants. Dr. T. Ishibashi explained the details of the damage to railway concrete structures caused by Niigata-Chuetsu earthquake happened on October 23, 2004 (see Newsletter Special Issue, Jan. 2005). Dr. M. Kaneuji explained how the asset management of motorways are now being done in Japan. Prof. T. Fujimori explained the changes of design concept for buildings since 14th century till now. Finally, Professor K. Meguro of ICUS made concluding remarks on this Open Lecture and expressed gratitude to the participants.

(by T. Uomoto)

Dr. T. Ishibashi

Dr. M. Kaneuji

Prof. T. Fujimori

CHAIN OF SURVIVAL AND AED

Coordinating with Tokyo Emergency Association, Tokyo Fire Department, ICUS conducted a training seminar on Emergency procedures and the use of AED (Automated External Defibrillator). The tutors explained that during emergency response, the most important things to keep in mind are 'speed' and 'appropriateness' of the response. In these cases, Sudden cardiac arrest (SCA) has been found to be one of the leading causes of death, can kill up to 50% of the patients within the first 3 minutes (M. Cara, 1981). The cardiac 'Chain of Survival' is an important methodology for increasing the victim's chance of survival. It consists of 4 main steps as follows.

(i) Early access to care (Call 119 or other Emergency No.)

(ii) First Aid and Heart Massage (cardiopulmonary resuscitation, CPR)

(iii) Early Defibrillation – use of AED

(iv) Move quickly to Hospital. The tutors explained, demonstrated and got the participants to practice these procedures.

An AED is a device about the size of a laptop computer that analyzes the heart's rhythm for any abnormalities and, if necessary, directs the rescuer to deliver an electrical shock to the victim. This shock, called defibrillation, may help the heart to re-establish an effective rhythm of its own. AED is easy to operate as it uses voice prompts to instruct the rescuer on when to apply the shocks. It was really a good experience to have this training in CPR and AED skills. There were about 20 participants and we thank ICUS for organising it.

(by K. S. Rajan, Researcher, Shibasaki Lab. IIS)

Training of cardiac massage

Certification of Emergency procedure training

Receiving a Doctor's Degree from the University of Tokyo

The recent incidences of damaging earthquakes have clearly revealed that retrofitting of low earthquake-resistant houses is the key issue for earthquake disaster reduction. However, the homeowners possess various reasons not to retrofit their houses and retrofitting are not carried out widely especially for private houses. Ms. Miho YOSHIMURA was awarded Ph.D degree for her study on new strategies for providing incentives for retrofitting vulnerable houses. Based on the analysis on current problems through questionnaire survey for

homeowners, a new system for providing incentives for retrofitting was proposed. Its main concept is that the government guarantees a portion of the housing repair and reconstruction expenses if retrofitting is implemented by the owner following the guidelines before the earthquake and in spite of this, the structure is damaged. Its effectiveness was verified by simulation. In several earthquake prone countries.

(by K. Meguro)

ICUS New Staff

We are glad to introduce our new colleague Dr. Hisashi Kanada, who joined ICUS as Project Research Associate from August 1, 2005. He received D. Eng. Degree from the University of Tokyo in September 2004.

His research interests include non-destructive inspection using spectros-copy, and he received an incentive award of 2nd invention contest at Institute of Industrial Science, the University of Tokyo in 2004.

A remote non-destructive method that can detect deterioration factors such as carbonation, chloride content or sulfuric acid attack would be an out-standing innovation in inspection methodologies. In his research, remote non-destructive material detection of concrete was attempted using near-infrared spectroscopy. This enables us to obtain chemical information of concrete by just sensing reflected nearinfrared rays from the measuring plane.

Dr. Hisashi Kanada

In the case of civil infrastructures, the inspection area is large, and environmental condition or location may be tough; therefore, it often requires high labor and cost in order to inspect concrete structures. Near-infrared spectral imaging system was also introduced to scan distribution or concentration of deleterious substances two-dimensionally. This method would prove to be a very effective technique for inspectors.

Recently, he is involved in developing a new remote and non-destructive testing method for concrete structures. Results of research are expected to be applied for field inspection.

(by T. Uomoto)

ICUS Activities

- *First student seminar was held and 25 students in ICUS reported current research results (Jul 20).*
- *Prof. Uomoto attended ConMat'05 Third International Conference on Construction Materials: Performance, Innovations and Structural Implications, in Vancouver (Aug 21-26), Korea-Japan Joint Workshop on the Assessment of Infrastructures at Cheju (Sep 3-5) and 2nd ICI-Asian Conference on Ecstasy in Concrete in Mumbai.*
- *Prof. Meguro visited Columbo, Sri Lanka for a workshop on '2004 Tsunami Impact' (Sep 15-19).*
- *Dr. Ooka attended The Sixth Asia-Pacific Conference on Wind Engineering (APCWE-VI) in Seoul (Sep 11-14) and 8th International Symposium on Fire Safety Science (IAFSS) at Peking (Sep 18-23).*
- *Dr. Oki visited Visiting TMD, RID, Phitsanulok site in Thailand for meeting (Jul 24-27) and attended the Hydrology 2020 Meeting in Stockholm (Aug 20-25).*
- *Dr. Kato stayed at Asian Institute of Technology for his research work at RNUS and education (May 24 - Jul 21, Aug 1 - Sep 8).*

Awards

- *Prof. Uomoto received the Merit Award from Japan Concrete Institute.*
- *Dr. Ooka won the Excellent Presentation Award (Poster) for 'Development of a Three Dimensional Human Thermal Model Accounting for Direction of Blood Flow' at the 3rd International Conference on Human-Environment System.*
- *Mr. Masanori Ito, researcher of Prof. Uomoto's Laboratory, won the Incentive Award for the paper of Annual Conference of the Japan Concrete Institute.*
- *Dr. Elkholy Said Abd-elffatah Said, a researcher of Prof. Meguro's Laboratory, won the Excellence Presentation Award at the 7th International Sum-mer Symposium of Japan Society of Civil Engineering.*

Editor's Note

A giant earthquake hit Pakistan on October 8, 2005. An article of newspaper Bangkok Post on November 14, 2005 tells that more than 86,000 people are known to have died in the earthquake.

World Food Programme (WFP) requested rich nations for funds to deliver vital aid to the damaged areas. But delivery is facing severe logistic problems. Because roads to mountain villages are crumpled, covered with landslides or have already been swept away, helicopters cannot reach the destinations to deliver food and shelter. People are still carrying on their backs. A series of news remind us of severity caused by disasters.

After about a year of the Indian Ocean Tsunami of December 26, 2004, a five-day international workshop hosted by Asian Disaster Preparedness Centre (ADPC) was held in Bangkok from October 2. Most of the participants, about 30 participants from 10 Asian countries, were senior health professionals and people involved in policy formulation. The agenda focused on the lessons from tsunami, e.g. disaster preparedness and management procedures for dealing with the dead and missing.

As I have been in Bangkok and working at Asian Institute of Technology (AIT), located at a suburb of Bangkok, for these nine months, I had many chances to discuss tsunami with Thais including AIT staff as well as the public. The discussions showed that nowadays many Thais know what tsunami is and regard it as a terrible disaster.

A TV news program reported that there was a drill of an evacuation for tsunami in Phuket island, Thailand. Many people were running after an emergency notice was announced, and some of them were smiling while walking.

We Japanese have experienced such drills many times since childhood. The drill conducted in Thailand, however, may be recognized as a milestone from a viewpoint of disaster education. As Prof. Meguro has repeatedly insisted, disaster education is quite important to improve people's ability to imagine disasters' effects and make proper decisions after a disaster happens. As a result of tsunami aftermath, it seems that the public is ready to be proactive for disaster preparedness and mitigation. I strongly hope that the concept of "preparedness" for disasters will be recognized widely not only in Thailand but also in other Asian countries.

(by J. Susaki)

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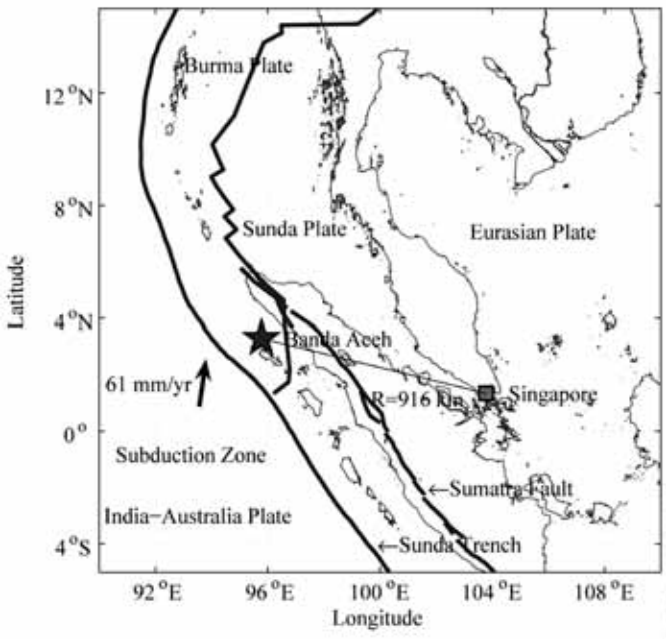
FROM GROUND SHOCKS TO AIR BLASTS: MULTIPLE-HAZARDS PROTECTION OF BUILDINGS

By

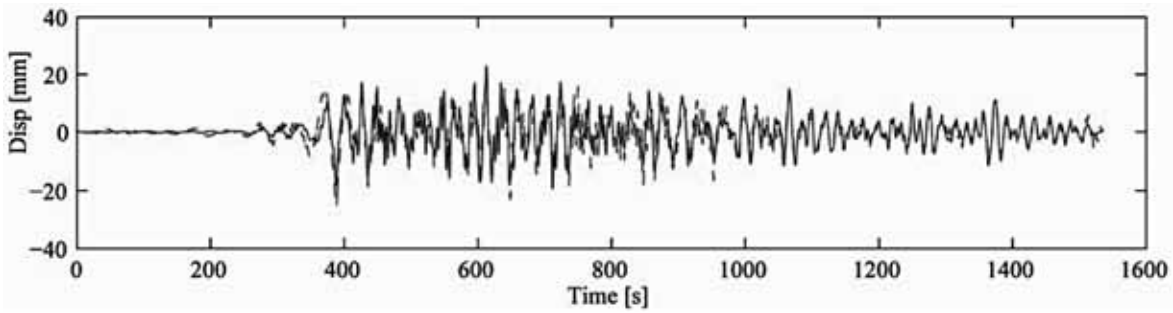
TSO-CHIEN PAN *

Reflecting the rapid economic growth and development, many high-rise buildings and complex infrastructure systems have been constructed in recent decades in almost all Mega Cities of Asia. Of concern is the high concentration of population and commercial activities taking place in these cities. Therefore, the consequences of even a moderate disaster may be enormous in these cities. Recent technological development has motivated the devising of new methodologies for sustainable development of Asian Mega Cities with adequate safety and security. The importance of using advanced tools in urban safety has been recognized by the International Center for Urban Safety Engineering (ICUS). This is the motivation for ICUS to organize a series of symposium in the Asian Region. These symposiums encourage trilateral communication among researchers, practitioners and policy- makers, whereby the epicenter of this is evidently human lives. Any improvement of urban safety serves to better protect the core of a community – human lives.



Map of epicenter

Republic Plaza



Numerically determined displacement compared with recorded displacement

The Fourth International Symposium on New Technologies for Urban Safety of Mega Cities in Asia (USMCA 2005) was held in Nanyang Technological University, Singapore, during October 18-19, 2005. It was co-organized by Protective Technology Research Center, Nanyang Technological University, Singapore, and ICUS, IIS, University of Tokyo, Japan. About 100 participants from various countries were present. The countries included Australia, Thailand, Bangladesh, China, Japan and Singapore. The participants included engineering researchers, defence scientists, design engineers and members of government organizations. The variation of the participant's background supports the philosophy of ICUS's intent for these symposiums. For this symposium, the areas discussed include safety assessment and monitoring of existing infrastructure, threat reduction and consequence management, structures subjected to seismic, shock and impact loads, environmental impact assessment of urbanization, tsunamis, flood and environmental risk assessments. During the symposium, the two co-chairmen of the symposium, Prof. Kimiro Meguro and Prof. Pan Tso-Chien, were interviewed by the Channel News Asia Television Station. During the interview, both the co-chairmen emphasized the need for the balance between engineering solutions and the enforcement of these solutions.

Within the Singapore community, the concerns about urban safety include: (a) the response of buildings subjected to far-field earthquake ground motions; (b) damage assessment of buildings subjected to ground shocks; and (c) blast response of buildings.

FAR-FIELD EARTHQUAKE MOTIONS

Singapore is located in a low seismicity region of Sunda plate. The Sumatran fault and the Sumatran subduction zone, are located more than 350 km away. While earthquakes have never posed any real problems for Singapore, previous large earthquakes have induced tremors felt in Singapore. Like other mega cities, the lack of free surface land has prompted the construction of taller buildings. These taller and flexible buildings may respond more significantly to long period, far-field earthquake ground motions.

On 26 December 2004, the Great Sumatra-Andaman Islands Earthquake (Mw = 9.0) occurred off the northwest coast of Sumatra, Indonesia. The epicenter of this earthquake is about 916 km west-northwest from Singapore (figure in previous page).

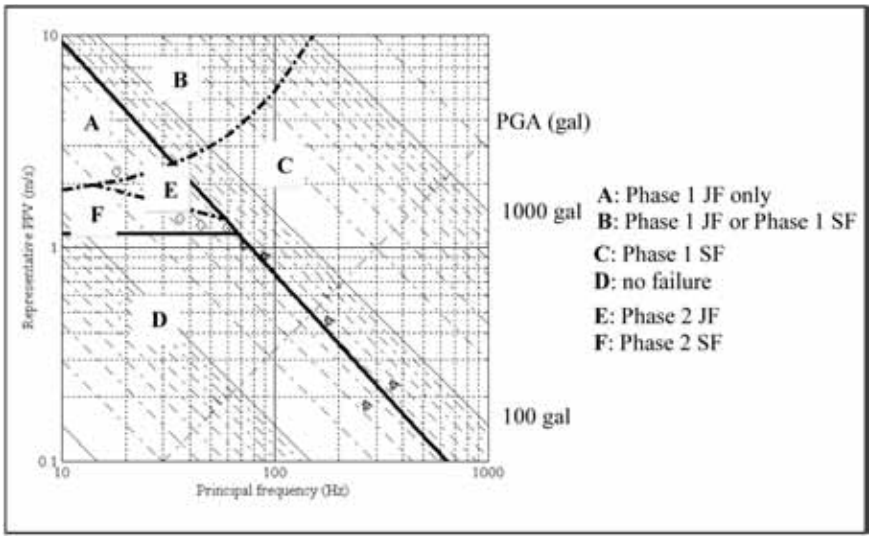
Since 1996, one of the tallest buildings in Singapore, the Republic Plaza shown in previous page has been instrumented to study buildings responses due to winds and far-field earthquakes. The Republic Plaza is a 66-storey, 280 m high tower consisting of a frame-tube structural system with a central core wall, in turn connected to a ring of external columns by a horizontal steel framing system at every floor. From ambient vibration tests, the predominant frequencies of the building are found to be 0.19 Hz and 0.20 Hz, in the two horizontal directions.

Accelerometers are installed at the basement level and the roof level, along the two principle directions of the building. The accelerometers recorded the building vibration during the Great Sumatra-Andaman Islands earthquake. The ground signals recorded at the basement were used as the input to the finite element model of the Republic Plaza. When subjected to this input ground motion, the response results obtained numerically were compared with the recorded responses shown in above figure. At the roof level, the displacement response obtained by the numerical method is reasonably similar to that of the recorded response.

GROUND SHOCKS

Most mega cities have limited free space. Singapore's national effort is to intensify its land use. This has prompted under-ground space development, leading to the housing of ammunition storages underground. As a result, ground shocks due to accidental underground explosions and their effects on surrounding buildings are investigated.

Ground shock characteristics can be segmented into two parts: the major shock duration (Phase 1) and the ensuing duration (Phase 2). It was shown that the high frequency nature of a ground shock leads to a large shear force with small deformation during Phase 1, followed by significant deformation during Phase 2. In Phase 2, the responses of global modes are significant, and this would possibly cause beam-column joint failure.



Damage characteristics of a 6-storey RC frame to ground shocks

For non-seismically designed beam-column sub-assemblies, it has been experimentally observed that the beam-column joints may fail at an inter-storey drift ratio of about 3 % of the storey height.

A non-seismically designed 6-storey reinforced concrete (RC) frame was subjected to a simulated ground shock. For the simulated ground shock, the peak ground acceleration (PGA) is 124 gal, the peak particle velocity (PPV) is 0.9 m/s and principal frequency is about 200 Hz. By considering the failure mechanisms of flexural failure (FF), diagonal shear failure (SF) and joint failure (JF), the damage for the 6-storey RC frame subjected to the simulate ground shock was assessed.

A parametric study was undertaken which involved the scaling of the PGA, PPV and principal frequency of the simulated ground shock. The characteristics of the scaled ground shock leading to the various failure mechanisms, are shown in the above Figure.

AIR BLASTS

Effects of an air blast explosion on a high-rise commercial RC building resulting from a vehicle bomb at the ground level area, were investigated. The objective was to investigate the effect of standoff distance on building damage. The high-rise commercial building selected for the study was a 30-storey RC structure with frames and a shear wall core.

For a long standoff distance case, the deformation was concentrated at the ground column and the beams of the second and the third storeys. The beam deformation was focused at its ends where local damages occurred like as the figure below.

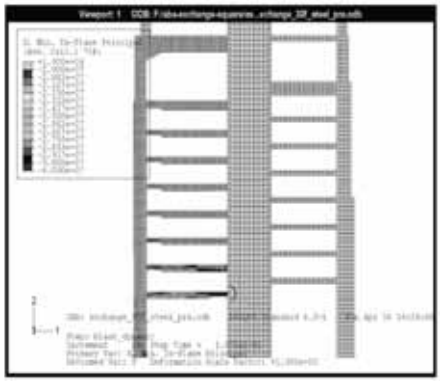
However, for a short standoff distance, the dynamic deformation was localized at the blastloaded columns spanning the first and the third storeys. The beams connected with these columns might thus be damaged. Large residual deformations were observed for the blast-loaded columns and the beams connected to them. Thus, the beams connected to these columns might be damaged as shown in the figure.

Compared with the case of long standoff distance, the global response hardly existed in the short standoff distance case. Furthermore, compared with the case of long standoff distance, the damage in the case of short stand-off distance was more localized.

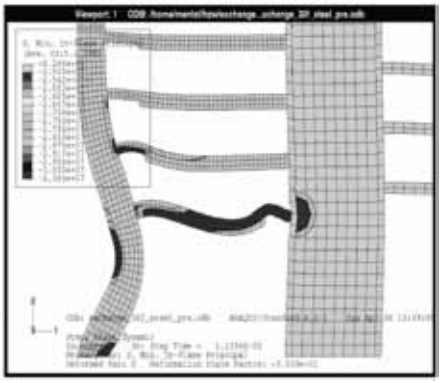
CONCLUSIONS

In summary, there is a need to investigate systematically the effects of multiple hazards which may include both natural and man-made events. In this article, the multiple hazards investigated comprised the effects of long-distance major Sumatra earth-quakes, ground shocks, and air blasts. The dynamic response of the non-seismically designed building structures in Singapore to these multiple hazards has shown varying characteristics.

This will pose a challenge to the engineering community who must strike a balance between safety and economy in designing and constructing a building structure to resist multiple hazards. The consequences from any extreme event of multiple hazards could be devastating to mega-cities due to the high concentration of population and also the high-value of commercial and financial activities. However, it is important to realize that the dynamic effects of these events have varying characteristics and frequency of occurrence.



Stresses and deformation for short standoff



Stresses and deformation for long standoff

** Director, Protective Technology Research Centre, Nanyang Technological University, Singapore*

4th International Symposium on New Technologies for Urban Safety of Mega Cities in Asia at NTU, Singapore

On October 18-19, 4th International Symposium on New Technologies for Urban Safety of Mega Cities in Asia was held at Nanyang Executive Centre, Nanyang Technological University, Singapore. The symposium was co-organized by ICUS and Protective Technology Research Centre, School of Civil and Environmental Engineering, Nanyang Technological University, Singapore, and sponsored by Center for Sustainable Urban Regeneration, The University of Tokyo, 21st Century Center of Excellence Program, Ministry of Home Affairs (Singapore), Shimizu Corporation, CPG Corporation Pte Ltd. and Surbana International Consultants Pte Ltd..

Seven keynote papers and 63 technical papers were presented. 97 delegates from 12 countries participated in the symposium.

This symposium provided a platform for sharing knowledge and forming a network among the Asian researchers. The number of participants are increasing and the quality of papers are improving at each new symposium. The next symposium will be held at Phuket, Thailand on December 16-17, 2006. Further details will be announced soon.

(by H.Kanada)

Number of participants per country

Country	Number of participants	Country	Number of participants
Singapore	43	Australia	2
Japan	31	Iran	2
China	5	Bangladesh	1
Thailand	4	Indonesia	1
Taiwan	3	Nigeria	1
India	3	Vietnam	1
		Total	97

Number of presentation

Session name	Number of presentation
Keynote	2
Plenary	3
Safety Assessment and Monitoring of Existing Infrastructure	11
Threat Reduction and Consequence Management	6
Maintenance, Retrofitting and Rehabilitation of Structures	6
Design and Assessment of Structures for Seismic, Shock and Impact Loads	15
Environment Impact Assessment of Urbanisation	6
Tsunamis, Floods and Environmental Risk Assessment	6
Advanced Technologies for Assessment of Urban Safety	8
Planning and Development of Urban Infrastructure	5
Total	70

Symposium participants pose for a group photo

RNUS Activities

RNUS Seminar

On October 20, RNUS organized another RNUS seminar on 'Advanced Technology for Urban Safety – Against Disaster and Hazardous Environment'. Four professors from the University of Tokyo were invited to give the presentation. The presenters were Prof. T. Uomoto, Prof. R. Amano, Prof. K. Meguro,and AssociateProf.R.Ooka.

The content of this seminar covers technologies applicable to prevent various types of disaster and to evaluate hazardous environmental condition. There were approximately 80 audiences in this seminar. Not only staffs and students of AIT but those from other institutes and engineers from construction companies also joined this event.

Field Trip to New Airport

RNUS held the field trip to the new international airport of Thailand on October19,2005.The name of this new airport were conferred by H.M. the King as Suvarnabhumi or "GoldenLand" on September 29, 2000 and a foundation stone laying ceremony was held on January19,2002.

Prof.W. Kanok-Nukulchai gave a present to Prof. T. Uomoto

Dr.Tokuda:Chief of Thai Obayashi Corp in Suvarnabhumi Airport

The field trip which was led by Dr. Tokuda began with a brief introduction about the airport construction and ended with a visit to the construction of runways and terminals.

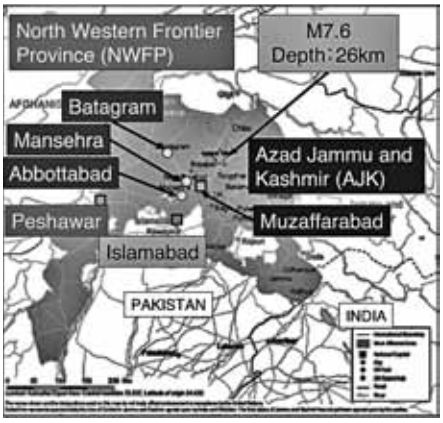
Suvarnabhumi airport has an approximate area of 8,000 acres and is located around 25 km to the east from the downtown Bangkok.

There are two 60-m wide parallel runways (4,000 and 3,700 m. respectively). Two parallel taxiways were designed to accommodate simultaneous departures and arrivals. The annual passenger capacity is expected to be 45 million at opening day and 100 million upon attaining the full capacity.

(by R. Sahamitmongkol)

Pakistan and India was Struck by a M 7.6 Earthquake on October 8, 2005

On October 8, 2005, at 3:50 (UTC), a magnitude 7.6 earthquake, with a focal depth of 26 km, struck the North of Pakistan and North West of India. Most damaged area is North Western Frontier Province (NWFP), and Azad Jammu and Kashmir (AJK) in Pakistan. Many cities, towns and villages were heavily damaged.



Map of Damaged Area (UN OCHA Relief Web)

The statistics of human casualties and structural damage are provided in the following tables. Due to this earthquake, approximately 75,000 people and 77,000 were killed and injured, respectively. Mainly all types of masonry structures were damaged during this earthquake.

This earthquake occurred in a mountainous area like the 2004 Mid-Niigata Prefecture Earthquake, Japan. So the geo-related damage was widespread. Many roads were broken and damaged. Therefore, many people living in mountainous area were isolated and could not evacuate and get foods and tents. Military carried affected people to refugee camps or medical centers by helicopters. They made temporary heliports at riverbeds and fields and used them.

One of the features of this earthquake damage was that public buildings, especially school buildings had heavy damage near the epicenter. So many students and teachers were affected (see upper right table). School buildings located not near the epicenter had also cracks in the walls. As the earthquake occurred during school time, students ran away from classrooms without their textbook, bags etc. After the earthquake, the students did not return to the schools due to three reasons: "Students do not want to come to school"; "Their parents do not send them to school"; and "Teachers do not want to go to school". So it is necessary to provide psychological support to both students and teachers and construct emergency building for schools.

(by Shinya Kondo, Researcher of Disaster Reduction and Human Renovation Institution)

Casualties in Pakistan and India (as of November 20, 2005 by UN OCHA Relief Web)

	Pakistan	India	Total
Injured	69,392	7,510	76,902
Dead	73,320	1,307	74,627

Damaged buildings in Pakistan (as of November 20, 2005 by UN OCHA Relief Web)

Pakistan	Total Units	Completely Damaged
AJK	244,980	204,940
NWFP	542,603	195,222

Casualties at schools in AJK, Pakistan (as of November 20, 2005 by UN OCHA Relief Web)

	Enrolled	Died
Students	204,023	24,491
Teachers	3,099	173

Damaged school buildings in AJK, Pakistan (as of November 20, 2005 by UN OCHA Relief Web)

	Total schools	Collapsed	Dangerous	Major repairs required	Minor repairs required
AJK	4,472	3,076	1,024	247	125

Many public buildings were collapsed (Muzaffarabad)

Many large land slides were observed (Muzaffarabad)

Temporary heliport set at dry riverbed (Alai)

Pancake collapse of building (Abbottabad)

Due to fear of earthquake, both students and teachers dislike attending school even if the structural damage were not so severe (Mansehra)

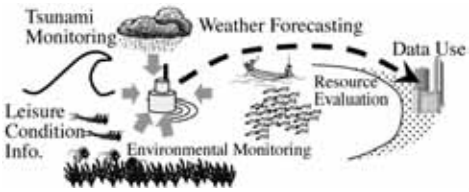
Potential of Coastal Industry in Tsunami Disaster Reduction

A year has passed since the huge tsunami generated by a M9.0 earthquake off Sumatra devastated Indian Ocean rim countries. The number of victims by this event was reported as over 300,000. However, the number is still unconfirmed even after one year due to lack of proper identity check and a large number of dead bodies being carried away by huge waves. Affected countries are seeking a reasonable approach to improve their preparedness against tsunami disaster to avoid the same consequence in the future.

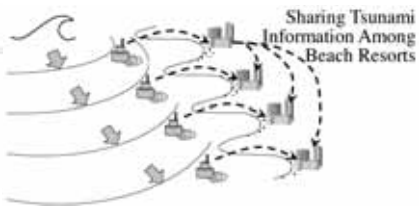
Most straightforward approach for tsunami disaster reduction would be setting back from the coast line. However, it is not always an acceptable solution for everyone.

As shown in photos, their livelihood is inseparably linked to ocean. Beach front location which allows guests good access to water pleasure, nice ocean view and comfortable sound of waves is an indispensable factor for resort hotels. Fishers tend to live just next to shore line. They use beach as a dock to maintain fishing boats and equipments, an yard to process the catch and meeting space with neighbors for fishers. With this reality, tsunami warning system (TWS) can be a most practical solution.

Meguro Lab., IIS, The University of Tokyo has proposed a sustainable



Concept of Sustainable Tsunami Warning System using Multi-Purpose Maritime Observation



Networked Multipurpose Buoy System

TWS concept using Multi-Purpose Observation Buoy Network. Important characteristics of this system are its simplicity, economical efficiency and daily-usability. Indian Ocean rim countries have less resource of technologies, researchers and experiences of tsunami disasters compared with Pacific Ocean rim countries. So, it is important for monitoring tsunami which occurs in around 100-year period continuously without any interruptions to develop a scheme to use and maintain the monitoring system on daily basis. Industries inherent in coastal area have strong need to collect various kinds of information as shown in middle figure above.Promotion of coastal industries and continuous tsunami monitoring can be accomplished by adding tsunami monitoring function on the system collecting daily use information.

Minimum unit of the system is one or two multi-purpose observation buoys operated by one beach society. The cost to maintain the system should be shared by the beach society, who will receive the most benefit from the system. When many beach societies install the system and join the multi-purpose observation buoy network beyond the administrative or international boundary, it must be possible to gather marine information needed on daily basis in much larger scale and to get more advantage before tsunami arrival even in case of transoceanic tsunami.

Understanding and cooperation of local leading industries and governments are essential to implement this kind of plan. We had opportunities to talk with resort hotel owners, managers and local government officers in our field surveys. It was found that hotel owners and managers who did not receive physical damage on their properties but suffered from decline of guests with harmful rumors tends to have a strong interests on our concept. We wish to implement our concept in cooperation with those local stakeholders and contribute to the tsunami disaster safety in their countries.

For further information: see ICUS Report, Report on the 2004 Sumatra Earthquake and Tsunami Disaster, 2005- 01.

(by Masasuke Takashima, Lecturer of FujiTokoha University)

left: resort beach in PhiphiIs., Thailand right: a fishing village in Trincomalee, Sri Lanka

INTER MAINTECH 2005

Inter Maintech 2005 was held from November 15 to 18 at Tokyo International Exhibition Center. This is the only trade show in Japan which focuses on diagnosis and repair as well as maintenance related management technology from industrial facilities to social-capital infrastructure related facilities such as concrete and steel structures.

ICUS set up booth and presented the following research topics;

1. *Diagnosis software for concrete structures (concrete bridges, piled piers, tunnels)*
2. *Development of new technique to detect deleterious substances of concrete using NIR spectral imaging system*
3. *Online monitoring system for aging concrete bridges*

Booth of ICUS

Over 400 specialists visited our booth and were interested in exhibits. Various publications from ICUS were also distributed there. Stock ran out due to heavy demand of ICUS publications.

ICUS will make a presentation at The 10 Earthquake Technology EXPO scheduled to take place at PACIFICO YOKOHAMA from February 2 to 3, 2006.Please come and visit our booth.

(by H. Kanada)

Open Campus of IIS Chiba Experiment Station

The Institute of Industrial Science (IIS) of the University of Tokyo organized an open house at its Chiba Experiment Station on November 11, 2005. There were 651 participants in this event.

ICUS also participated in this event and presented its research activities. The ICUS topic was "Towards Safety Improvement in Mega Cities." Research associate of ICUS, Dr. Endo guided and explained the research works to the participants.

Elementary school students from near the experiment station visited the facilities. They listened to Dr. Endo intently. They attended and drew picture on concrete block at the Uomoto laboratory.

Professor Uomoto, the head of Chiba Experiment Station gave a special lecture on "Urban Safety on Concrete."

(by R. Ooka)

Guidance by Dr. Endo

Special lecture by Prof. Uomoto

ICUS New Staff

ICUS is glad to welcome its new staff, Dr. Raktipong Sahamitmongkol who joined ICUS as Researcher from October 1st, 2005.

He received his Ph.D degree from the school of civil engineering, the University of Tokyo in September, 2005. During his doctoral study, he also got the outstanding presentation award at the annual meetings of Japan Concrete Institute (JCI) and Japan Society of Civil Engineering (JSCE). His research interests are the usage of expansive agent to prevent cracking or to control cracking condition in RC structure.

In his research, it was found that the expansive additive with suitable reinforcement not only induces beforehand the compressive stress in concrete, but it can also enhance the ductile behavior of concrete. As a result, the cracking of RC structure can be effectively prevented. This technique is proved advantageous to elongate the service life of important infrastructure.

Dr. Raktipong Sahamitmongkol

He has been assigned to station at the Regional Network for Urban Safety (RNUS) which locates in the Asian Institute of Technology (AIT), Thailand to activate more collaborative research with other Thai organizations.

Recently, he started more research program including the study about the application of ferrocement to protect the structural element in building from bomb blasting, bridge inspection in Bangkok Metropolitan Area, and the application of NDT to inspect the condition of concrete structure.

(by T. Uomoto)

ICUS Activities

- *Project team was formed to consider the role of The University of Tokyo Hospital in a time of disaster. The joint working group meetings are regularly convened.*
- *All ICUS members participated in the 4th International Symposium on New Technologies for Urban Safety of Mega Cities in Asia at NTU, Singapore (Oct 18-19).*
- *Second student seminar was held and 25 students in ICUS reported their current research results (Dec 9).*
- *Prof. Uomoto attended RNUS Seminar at AIT (Oct 20-21) and 13th general meeting and working of ISO/TC71 in Seoul (Nov 27-30).*
- *Prof. Amano attended RNUS Seminar at AIT (Oct 20-21).*
- *Prof. Meguro attended RNUS Seminar at AIT (Oct 20-21), World Seismic Safety Initiative board meeting in Singapore and visited Islamabad to investigate the damage due to northern Pakistan earthquake (Oct 22-Nov 1).*
- *Dr. Ooka attended RNUS Seminar at AIT (Oct 20-21), International Symposium on Sustainable Development of Asia City Environment 2005 in China (Nov 23-27).*
- *Dr. Oki attended The Second Post-GAME Planning Workshop in Thailand (Nov 4-7) and The Second Post-GAME Planning Meeting in Thailand (Nov 19- 24).*
- *Dr. Kato stayed at Asian Institute of Technology for his research work and teaching duties at RNUS (Sep 19-Dec 9) and attended a conference on Durability of Reinforced Concrete under Combined Mechanical and Climatic Loads in China (Oct 26-31) and visited Vietnam Institute for Building Science & Technology to exchange views (Nov 10-13).*
- *Dr. Yoshimura attended RNUS Seminar at AIT (Oct 20-21).*
- *Dr. Sahamitmongkol stayed at Asian Institute of Technology for his research work and teaching duties at RNUS (Oct 5- Dec 18).*

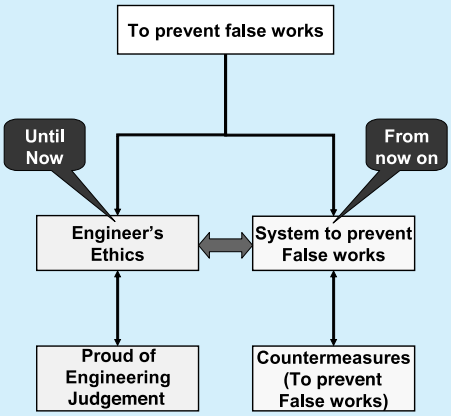
Awards

Three graduate students; D. Itoh, T. Nanjyo (Meguro lab.) and N. Takeshita (Kato lab.) won the excellent presentation award at 60th annual meeting of Japan Society of Civil Engineers (Dec 26).

Editor's Note

In November 2005, a big shock struck Japanese society through newspapers, radio and TV. Mr. Hidetsugu Aneha, a first-class certified architect confessed that he faked records to make substandard buildings look like they met Japan's anti-earthquake requirements. In the committee of Japanese parliament, he mentioned that he began faking earthquake safety data around 1998, when a developer asked him to reduce costs by decreasing the amount of steel reinforcements below the compulsory minimum in a Tokyo apartment project. He mentioned that he was under heavy pressure from the developer to reduce steel reinforcements. Initially he refused the request because of his pride as a first-class certified architect. But considering the reduction in construction cost and pressure from the developer, altimately he succumbed. The newspapers mentioned that at leat 88 structures (as of December 28, 2005) which he has designed may collapse in a moderate earthquake tremor.

Keio Presso Inn, Gotanda has been closed for demolition due to lack of adequate earthquake resistance



Such news were never reported in Japan until now. The person, who bought the houses paying a large amount of money, lost everything except the loan which was lent to him by the banks. If such a disaster is caused by the natural hazards (earthquake, tsunami, flood, fire, etc.), people and Japanese government may try to help the victims by all means. But in this faked design case, it may not be easy to request the people of our country to support the victims.

The systems now being used in our country are all based on Japanese culture and ethics that people will not try to do things bad, unless by accident. But this news gave us a big warning to our culture: Ethics is no longer efficient and "Learning makes a good man better and an ill man worse" (See the above figure). "Safety" is now becoming one of the most important requirements in urban area, and ICUS has been working to prevent and reduce the natural disasters for more than 5 years. May be we at ICUS have to widen our researches to man made disasters, not only natural hazards and terrorism but also to the faked works which have not been exposed yet.

(by T.Uomoto)

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RECENT EARTHQUAKE RELATED ACTIVITIES IN BANGLADESH

By

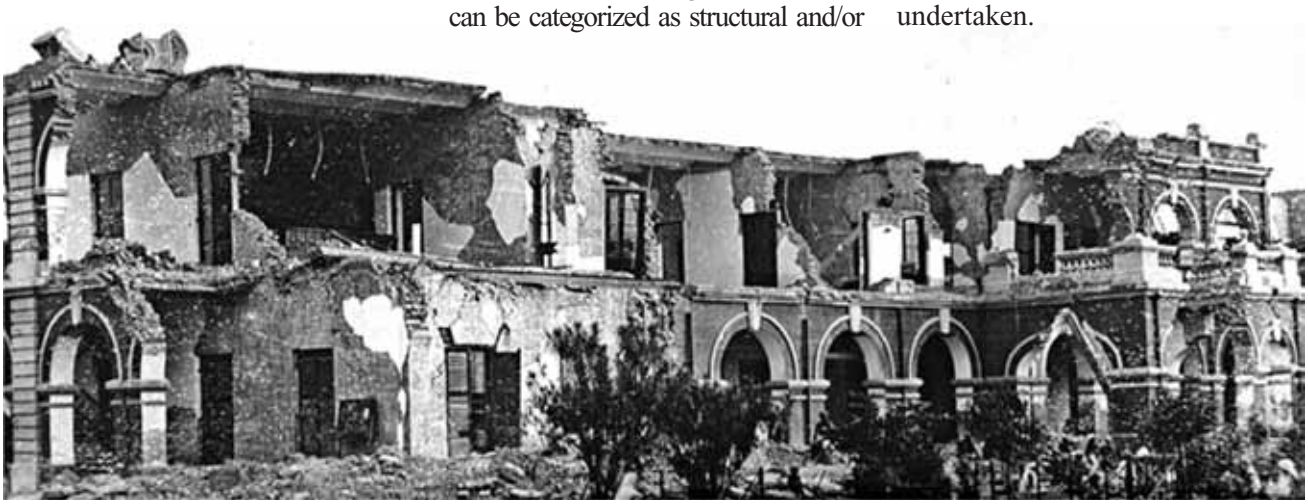
Mehedi Ahmed Ansary *

In the recent past, Bangladesh has not suffered any damaging large earthquakes, but in the past few hundred years, several large catastrophic earthquakes struck this area. So far, all the major recent earthquakes have occurred away from major cities, and have affected relatively sparsely populated areas. This has limited the human casualty and the economic losses. However, earthquakes in Gujurat (India, 2001), Bam (Iran, 2003), and Kashimir (Pakistan and India, 2005) have amply demonstrated that inappropriate construction technology may lead to high casualty levels even for moderate earthquakes.

In 1897, an earthquake of magnitude 8.7 caused serious damage to buildings in the northeastern part of India including Bangladesh and over 1,500 people were killed. The population around this region is at least 50 times larger than the population of 1897 and cities like Dhaka, Kathmandu and Guwahati have populations exceeding several millions. It is a cause for great concern that the next great earthquake may occur in this region at any time.

The extent of damage to structures and casualty level due to an earthquake in the future can be reduced by the introduction of suitable mitigation measures. These mitigation measures can be categorized as structural and/or non-structural. The structural measures are those that directly influence the performance of building stock through strengthening of code provisions and the prevalent construction practice.

The non-structural mitigation measures include improvement in the state of awareness and preparedness before a disaster, land-use control and other government policies, and the response following a disaster. The non-structural measures help to reduce the severity of casualty levels following an earthquake. In order to reduce the consequences of a major earthquake in the cities of Bangladesh, it is necessary that appropriate structural as well as non-structural measures are undertaken.



Damage to a brick masonry building during the 1897 Great Indian Earthquake

ACTIVITIES UNDERTAKEN IN BANGLADESH

In 2001, the World Seismic Safety Initiative (WSSI) sponsored the author to participate in an interdisciplinary reconnaissance team from developed and developing countries around the world to visit the earthquake affected Gujarat state. It was a unique experience for the author to visit and to get "live" learning experience from an earthquake devastated region with the presence of experienced people of different interests and professional background. This exposure motivated the author to work in the field of earthquake risk reduction.

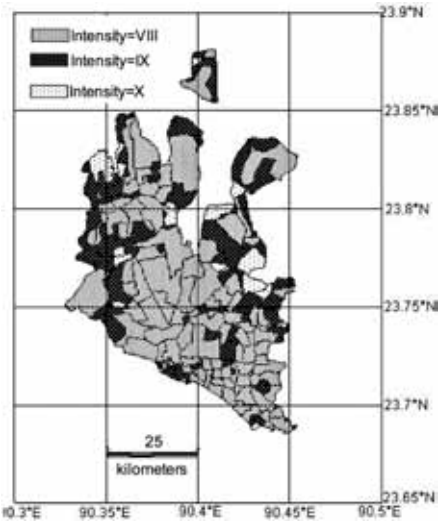
In 1996, the author together with a Bangladesh University of Engineering & Technology (BUET) team submitted a project proposal to the Jamuna Multipurpose Bridge Authority to install seismic devices on the bridge (a 4.8 km long RC bridge) and the surrounding area. The Panel of Experts approved the project on March 1997. The author also developed a course on Earthquake Engineering for postgraduate level at BUET and for the last few years has been offering the course at the postgraduate level. In the following paragraphs a brief summary of activities undertaken by different organizations of Bangladesh to mitigate earthquake disaster are presented.

BUET

The Department of Civil Engineering, BUET offers postgraduate courses on Earthquake Engineering, Soil Dynamics, Structural Dynamics and Vibration Analysis. So far 15 students completed their Master's thesis related to Earthquake Engineering field.

The Department of Civil Engineering, BUET is working as a consultant to monitor the seismic instruments installed at the Jamuna Multipurpose Bridge. In addition to the seismic instrumentation of the bridge, there are a borehole accelerograph at 57 m depth and seven free-field seismic instruments at Bogra, Natore, east and west bridge approaches, Mymensingh, Gazipur and Dhaka.

In January 2004, a linkage was established between the Virginia Polytechnic Institute, USA and the National Centre for Earthquake Engineering, BUET with USAID funding. Under this project several BUET faculties were trained in various



Integrated hazard map for Dhaka developed by a Master's student at BUET

earthquake related topics in India for one to two weeks.

Under the leadership of the author, several BUET teams performed field surveys after recent Bangladeshi earthquakes. The author also visited earthquake affected parts of Gujarat state of India as mentioned earlier with the Gujarat Earthquake Reconnaissance International Team under the joint sponsorship of Earthquakes and Megacities Initiative and WSSI. The author has also contributed two reports: one on unreinforced masonry and the other on mud houses to the World Housing Encyclopedia Project.

Recently, BUET acquired 60 analog SMA-I Type accelerographs from Strong-motion Accelerographs For Earthquake Loss Reduction Cities Project of Consortium of Organizations for Strong-Motion Observation Systems, a WSSI initiative. These accelerographs are already installed at the Public Works Department (PWD) offices all over the country to acquire earthquake data. These data will be used to develop attenuation laws for Bangladesh, which can be readily used for earthquake hazard analysis and updating of the existing seismic zonation map.

A workshop on earthquake curricula development was held at BUET on July 22, 2004. Thirty four faculties of different universities of Bangladesh attended and gave their feedback. A report was published.

The Directorate of Continuing Education, BUET, conducted the first short course on Earthquake Resistant Design and Retrofitting of Buildings in October 2004. In April and September 2005 similar short courses for Professional Engineers and Polytechnical Institute teachers of Bangladesh were offered. In July 2005, the Ministry of Science, Information and Communication Technology of Government of Bangladesh provided a fund to the author for a one-year project entitled Earthquake Vulnerability Assessment and Community Awareness. Under this project, activities for raising community awareness regarding earthquake effects and vulnerability analysis of a ward of old Dhaka will be conducted and remedial measures will be proposed.

Recently, with the help of Prof. Maksud Helali of the Mechanical Engineering Department of BUET, the author together with Dr. Noor has developed an indigenous shaking table (3m x 5.5m) for checking structural behavior under dynamic loading.

Indigenous shaking table

GOVERNMENT AGENCIES

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

The Ministry of Food & Disaster Management (MoFDM) is currently working as the government coordinator for all activities regarding earthquakes. Recently, they asked all the concerned ministries, departments and armed forces division to submit a Contingency Plan in case of an earthquake. The Ministry also compiled a list of available rescue and recovery equipment available in the country. The MoFDM held a mock drill on April 12, 2005.

The second phase (2003-2008) of the Program for Enhancement of Emergency Response (PEER), a USAID funded international project includes Bangladesh together with four other PEER affiliated countries – India, Indonesia, Nepal and Philippines. The program aims to strengthen and institutionalize capacities in emergency and disaster response of the member countries. A Memorandum of Understanding (MOU) in this regard was signed between PEER and MoFDM in June 2004.

In 2001, the Bangladesh Meteorological Department initiated a project to establish four broadband seismic stations at Rangpur, Sylhet, Dhaka and Chittagong cities. The installation of these seismic stations will be completed soon.

The PWD is responsible for constructing all the government buildings of the country. For the last few years, the PWD arranged several in-house workshops to train their engineers about earthquake resistant design. Also the engineers of this organization have started to use seismic codes for building design.

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

The Geological Survey of Bangladesh (GSB) is the oldest organization in the country involved with the development of seismic zonation maps. The organization was pivotal in developing the 1972 and 1979 seismic zonation maps. But unlike its predecessor, the Geological Survey of India (GSI) under the British rule, it did not initiate any research in earthquake field. Currently it depends on the US Geological Survey (USGS) and GSI for earthquake source information. In September 2004, GSB together with USGS and UNESCO conducted a four-day long workshop on seismic analysis for the South Asia region in Dhaka.

In January, 2006 DMB with the verbal instruction of Minister, MoFDM has started to develop a comprehensive Earthquake Risk Management Plan which comprised two plans namely, Earthquake Preparedness and Earthquake Response Plans. Also, the Comprehensive Disaster Management Programme under the MoFDM is proposing a Comprehensive Disaster Management framework for the South Asian Association for Regional Cooperation (SAARC) countries. This will be placed at the SAARC Expert Group meeting to be held in Dhaka in early February, 2006.

BANGLADESH EARTHQUAKE SOCIETY

Bangladesh Earthquake Society (BES), a non-government voluntary organization, was established on April 2002 and was registered on January 2003. The first election of the society was held on August 2003 and the second election was held on December 2005. The BES members consist of engineers, geologists, NGO activists and government administrators.

After the July 2003 Rangamati Earthquake, the author and other members of the Society visited the affected earthquake sites and provided the government with their technical advice. BES also organized two national level workshops and held several monthly seminars so far. The first workshop was jointly organized with RAJUK (Capital Development Authority) in August, 2003 to train the engineers of Bangladesh about earthquake resistant design. The second workshop was organized together with DMB, MoFDM in September, 2003 to sum up the findings of 2003 Rangamati Earthquake. BES also successfully organized the First Bangladesh Earthquake Symposium (BES-1) on December 14-15, 2005. BUET and BES jointly hosted the symposium. More than 100 participants joined the symposium, 40 papers were presented: 10 international and 30 local.

With the financial assistance of USAID and the Cooperative for Assistance Relief Everywhere (CARE), Bangladesh, BES translated and published the International Association for Earthquake Engineering's Guidelines for Earthquake Resistant Non-Engineered Construction in 2004. Recently the final draft of an Earthquake Resistant Design Manual was completed and will be jointly published by BES and the Canadian International Development Agency soon.

OTHER ORGANIZATIONS

Guidelines for non-engineered construction

Also many NGOs, private organizations, universities and mass media are playing an important role in earthquake risk mitigation in Bangladesh. CARE-Bangladesh, Bangladesh Red Crescent Society, Oxford Committee for Famine Relief, ActionAID, CARITAS, European Policies Research Centre, Franco-Bangladesh Association of Scholars and Trainees, Grameen Jonokallyan Sangsad, Safety Assistance for Emergencies, Bangladesh Insurance Academy, BRAC University, Chittagong University of Engineering & Technology, Institute of Engineers Bangladesh, Institute of Diploma Engineers Bangladesh, Military Institute of Science & Technology, Shahjalal University of Science & Technology, Real Estate and Housing Association of Bangladesh, Institute of Architects Bangladesh are some of those organizations.

**Professor, BUET, Dhaka, Bangladesh & Secretary General, Bangladesh Earthquake Society*

Comparative Studies on Urban Earthquake Disaster Management

The 6th Workshop on "Comparative Studies on Urban Earthquake Disaster Management" was held on January 18, 2006 at the Kobe International Conference Center. It was cosponsored by the Research Center for Disaster Reduction Systems at the Disaster Prevention Research Institute, Kyoto University and ICUS and was attended by approximately 100 people. This time the topic was: "Towards a drastic increase of retrofitting of existing low earthquake resistant structures — Comparative study of the environment surrounding seismic retrofitting activities in different countries."

Recently, Japanese society has been shocked by the scandal of faulty apartment buildings, mainly RC buildings, deliberately designed and constructed without following the Earthquake Resistant Design Code. When the next big earthquake comes, they will surely perform poorly. However, these will not be the only affected structures. If the number of the buildings related to this scandal is compared to the total number of existing low earthquake resistant buildings in Japan, the later is 15,000 times larger. The panorama is even darker if the wooden houses with low earthquake resistance, whose number is over 10 million, are included in the count. This situation is common to both developed and developing countries. In the symposium, Prof. K. Meguro, Dr. M. Yoshimura, Prof. H. Murakami (Yamaguchi University) and Mr. B. Fujimura (Waseda Shopping Street Association) discussed this issue from different viewpoints.

At first, Prof. Meguro made an overall explanation of the similarities and differences in developed and developing countries in their quest to protect their building stock. He made emphasis on the technological and social viewpoints of the problem. He then invited the other speakers to share their ideas. Dr. Yoshimura introduced the successful retrofitting experiences of California State, US, particularly the case of Berkeley City. She compared the system there and in Japan highlighting social, individual, and structural differences. Prof. Murakami pointed out that even old structures can perform well during earthquakes in spite of their age as long as they are well constructed — using good materials, at locations with good soil conditions — and have good maintenance. This was the situation observed during the 2000 Tottori Earthquake. She stressed that high quality houses represent a good social stock which is needed in countries like Japan characterized by low birth rate and aging population. Mr. Fujimura shared his believe that for solving the issue at hand, the business driving force is essential. He explained his own activities to promote retrofitting such as training of house builders and developing and obtaining approval for new retrofitting methods. The presentations were followed by a lively panel discussion in which there was an exchange of questions and answers.

(by K. Meguro)

Prof. Meguro pointed out key issues for protecting building stock

RNUS Activities

RNUS Seminar

RNUS Seminar on 'Advanced Technologies toward Sustainable Concrete Structures' was held on January 17th, 2006. The speakers were Prof. Toyoharu Nawa and Dr. Pipat Termkhajornkit from the Hokkaido University and Prof. Somnuk Tangtermsirikul from the Sirindhorn International Institute of Technology, Thammasat University.

Prof. Toyaharu Nawa presented the development of various types of superplasticizers and the production of high performance concrete. Prof. Somnuk gave a presentation about both theoretical background and practice of zero-slump concrete in Thailand, while, Dr. Pipat Termkhajornkit made a presentation entitled 'XRD and Its Application in Cement and Concrete Field'. The seminar was well received by AIT personnel.

RNUS Seminar Snapshot

Special Visit of Prof. H. Mutsuyoshi

It was a great honor for RNUS to welcome Professor Hiroshi Mutsuyoshi and Assistant Professor Takeshi Maki from Saitama University on March 15th, 2006.

On this occasion, Prof. Mutsuyoshi kindly gave the special lecture entitled 'Structural Damage due to 2004 Niigata-Ken-Chuetsu Earthquake' to AIT staff and students. The presentation delivered special characteristics of the Niigata-Ken-Chuetsu earthquake and promising technologies to prevent sudden failure and to minimize the residual deformation of structures under seismic loads.

ICUS Director Visited the AIT President

On March 21st, Prof. Uomoto visited AIT and held a meeting with Prof. Said Irandoust, the current President of AIT and Prof. Worsak Kanok-Nukulchai, the Acting Dean of the School of Engineering and Technology. The meeting was also attended by Dr. Pennung Warnitchai, Dr. Susaki and Dr. Kato. The director of ICUS and the president of AIT agreed to strengthen the collaboration between their institutions and to promote more activities in the region.

(by R. Sahamitmongkol)

Meeting participants

ICUS Signed MOU with LCM Research Center, PARI, Japan

On January 18, 2006, ICUS signed a Memorandum of Understanding (MOU) with The Life Cycle Management (LCM) Research Center, the Port and Airport Research Institute (PARI) in order to collaborate in research and other academic activities.

LCM Research Center was established on April 1, 2005 to respond to the demands of efficient operation and maintenance of infrastructures. The Sustainable Engineering Division of ICUS aims to develop new technologies for the evaluation of structural safety. The two centers will exchange personnel and will provide research cooperation in the field of maintenance and management of new technologies for structural safety and other fields of common interest.

(by H. Kanada)

Prof. T. Uomoto and Dr. H. Yokota, Director of LCM Research Center

Prof. Uomoto Visited BUET, Dhaka, Bangladesh

The Director of ICUS, Prof. T. Uomoto, visited Bangladesh University of Engineering & Technology (BUET), Dhaka, Bangladesh from February 17 to 19, 2006. He was accompanied by Dr. Mehedi Ahmed Ansary. During his visit, Prof. Uomoto met Prof. Md. Alee Murtuza, Vice-Chancellor (VC) of BUET and Prof. Md. Mazharul Hoque, Head of the Department of Civil Engineering, BUET. They discussed the establishment of an ICUS branch office at BUET (South Asian Network Office for Urban Safety Engineering: SAUS) and collaborative research activities between ICUS and BUET. Prof. Uomoto also met the President of the Institute of Engineers in Bangladesh, Mr. Akhter Hossain and discussed issues of mutual interest. Mr. Hossain also holds the post of Secretary of Ministry of Energy and Power, Government of Bangladesh. Prof. Uomoto met Mr. Abu Sadek and Dr. MA Noor, members of the Bangladesh Concrete Society, and the President of the Bangladesh Earthquake Society, Prof. JR Choudhury, at his office. At the end of his visit, Prof. Uomoto delivered a lecture on non-destructive testing at the BUET seminar room which was attended by about 100 people. The lecture was presided by the Head of the Department of Civil Engineering, BUET, Prof. Md. Mazharul Hoque and BUET VC Prof. Md. Alee Murtuza was the Chief Guest.

Prof. T. Uomoto presenting ICUS brochures to Prof. Md. Alee Murtuza VC, BUET

(by M. A. Ansary)

Contract for the Establishment of IIS Office at Chula Unisearch

On March 21, 2006, Prof. Uomoto visited to Chulalongkorn University as a representative of IIS. He and Prof. Ekasit Limsuwan, Director of Chula Unisearch signed the contract for the establishment of a collaborative research office.

Both parties agreed to establish a local office in Chula Unisearch in order to support the activities of IIS professors when they have research activities in Thailand.

Chula Unisearch was founded under Chulalongkorn University on Feb 14th, 1986. It was the first agency in higher education institution in Thailand created to put knowledge and expertise of its faculty members to the public service. Chula Unisearch is determined to create for faculty members and researchers the environment to help solving the country problems by studying, analyzing and solving issues in collaboration with concerned agencies.

(by R. Sahamitmongkol)

Ceremony participants

Professor Meguro Appeared in NHK TV Program

On January 16, 2006, Professor Meguro appeared in the TV program "Close Up Gendai." This is NHK's current affairs program, broadcasted from Monday to Thursday at 19:30.

The TV program was concerned with the lack of earthquake resistance of old wooden houses. Lessons from the 1995 Kobe earthquake have not been learned and many wooden houses are not reinforced against great earthquakes yet.

He suggested promotion systems such as renovation grant, tax cut and preferential treatment based on the house hold's current situation.

(by T. Uomoto)

Prof. K. Meguro and Ms. H. Kuniya, Anchorperson of Close Up Gendai

Workshop on Disaster Management at The University of Tokyo Hospital

The first collaborative workshop on disaster management between ICUS and The University of Tokyo Hospital was held on February 1, 2006 at the hospital auditorium.

It was held for doctors, nurses and administrative staff in order to give them a better understanding of the current problems, and to raise their disaster awareness.

A project team was formed to consider the role of The University of Tokyo Hospital in a time of disaster. ICUS members are investigating the social demands of a disaster base hospital during a disaster situation and based on these findings propose an adequate disaster management manual.

Prof. Meguro delivered a presentation on the importance of an efficient disaster management manual while Prof. Amano outlined the background and future plans of the project. Dr. Yoshimura introduced countermeasures against great earthquakes and the role of a disaster base hospital and Dr. Kanada presented the necessity of reviewing the current disaster management manual. The workshop was attended by more than 100 participants who were impressed with the presentations.

(by H. Kanada)

Prof. Amano outlined the project

10th ICUS Open Lecture Was Held

The 10th ICUS Open Lecture was held at the Convention Hall of the Institute of Industrial Science (IIS), The University of Tokyo (UT) in the afternoon of March 16, 2006. The title of the lecture was "Communication of Scientific Technologies and Risk Management Technologies to the Public." About 80 people attended the lecture.

Prof. Marie Oshima (IIS, UT), Dr. Toshiko Kikkawa (Associate Professor, Faculty of Business and Commerce, Keio University), and Dr. Yayoi Tanaka (Associate Professor, Department of Civil Engineering, UT) delivered the following speeches:

1. Prof. Marie Oshima: "Importance of communicating scientific technology to the public."
2. Dr. Toshiko Kikkawa: "How to communicate risk information to the public."
3. Dr. Yayoi Tanaka; "Drawbacks of communication by engineers."

Prof. M. Oshima emphasized that scientists and engineers should pay more attention to increase public understanding of their research and introduced some activities for communicating research results to young generations such as junior and senior high school students. Dr. T. Kikkawa explained how understanding of risk information is different between engineers and the general public. Finally, Dr. Y. Tanaka showed examples of poor communication between engineers and the general public in the process of public involvement in city planning.

Prof. T. Uomoto delivered concluding remarks on this Open Lecture and expressed gratitude to the presenters and participants.

(by M. Yoshimura)

Prof. M. Oshima

Dr. T. Kikkawa

Dr. Y. Tanaka

Announcement of USMCA 2006

The 5th International Symposium on New Technologies for Urban Safety of Mega Cities in Asia (USMCA) will be organized by the School of Engineering and Technology, AIT, Thailand and ICUS.

The symposium will be held at Cape Panwa Hotel, Phuket in Thailand on November 16-17, 2006. The scope of the symposium covers the following areas.

- *Safety Assessment of Existing Infrastructure and Buildings*
- *Planning for Development and Maintenance of Urban Infrastructure*
- *Environmental Impact Assessment of Urbanization*
- *Advanced Technologies for Monitoring and Assessment for Urban Safety*
- *Disaster Management Engineering*
- *Application of Remote Sensing to Enhance the Safety of Society*
- *Rehabilitation and Retrofitting of Urban Structure against Disasters*

Your participation is crucial for the meaningful discussion and success of the symposium. For more information, please access the symposium website at http://www.sce.ait.ac.th/rmus/usmca2006

(by R. Sahamitmongkol)

THE 10TH EARTHQUAKE TECHNOLOGY EXPO

The 10th Earthquake Technology Expo/Natural Disaster Recovery Expo was held on February 1-2, 2006 at Pacifico Yokohama. This is the biggest exhibition of advanced technologies for reducing disasters. It has been held every year after the 1995 Kobe Earthquake. This year more than 9,000 people including risk managers in private companies, local government officials and structural engineers visited the exhibition.

Hundred thirty booths were displayed and ICUS prepared a booth for presenting the Integrated Information System for Total Disaster Management. This is a leaning tool developed by Prof. Meguro research group in ICUS to increase the people's disaster awareness and to effectively reduce disasters. Over 400 visitors enjoyed the experience of operating it.

ICUS is willing to join the Earthquake Technology Expo again in the next year.

(by M. Yoshimura)

ICUS Booth

Integrated Information System for Total Disaster Management

ICUS New Staff

Dr. Mehedi Ahmed Ansary joined ICUS as a Project Associate Professor on January 16, 2006. He graduated from the Department of Civil Engineering, BUET in 1991 and joined at the same Department as Lecturer in June 1991. He obtained his PhD in Civil Engineering from the University of Tokyo in 1996. He was promoted to Professor in the Department of Civil Engineering, BUET in 2006.

His research interest is urban disaster mitigation which includes development of microzonation maps for cities of Bangladesh, assessment of building and lifeline vulnerabilities, characterization of strong ground motion from free-field and bridge monitoring data, raising awareness among citizens of Bangladesh through simplified experimental techniques and easily understandable guidelines for earthquake resistant construction, study of other urban disasters such as floods, fires and tornadoes, etc.

Dr. Mehedi Ahmed Ansary

He is currently working as the Secretary-General of Bangladesh Earthquake Society which is affiliated with the International Association of Earthquake Engineering. He is also the Project Director of the Virginia Polytechnic Institute, USA and the National Centre for Earthquake Engineering - BUET Linkage project funded by USAID, Bangladesh from January, 2004. He is a member of consultative panels of several Government agencies of Bangladesh.

(by T. Uomoto)

ICUS Activities

- *Prof. Uomoto visited BUET to discuss the establishment of an ICUS branch office there (Feb 17-21) and Chulalongkorn University to sign the contract for the establishment of an IIS collaborative research office (Mar 20-22).*
- *Prof. Meguro attended an Earthquake Summit in Beijing (Feb 19-23). He also visited Algeria and Pakistan (Mar 17-26) to conduct microzonation studies and shaking table demonstrations of his proposal local acceptable, simple and economical masonry retrofitting method.*
- *Dr. Oki attended IPCC AR4 WG 2 Conference in Merida, Mexico (Jan 14-21), AGS Annual Meeting 2006 in Bangkok (Mar 18-23), and Global Water System Project/Scientific Steering Committee in Oaxaca, Mexico (Mar 22-26).*
- *Dr. Ooka attended 2006 ASHRAE Winter Meeting in Chicago, 86th AMS Annual Meeting in Atlanta (Jan 21-Feb 2), and AGS Annual Meeting 2006 in Bangkok (Mar 18-23).*
- *Dr. Ansary visited BUET to discuss the establishment of an ICUS branch office there (Feb 17-21).*
- *Dr. Kato stayed at AIT for his research work and teaching duties at RNUS (Jan 10-18, Feb 27-Mar 22, Mar 26-31).*
- *Dr. Susaki attended the ASEAN Subcommittee on Space Technology and Applications in Hanoi (Feb 15-17) and the Forum on Monitoring of Global Environment from Space at IIS (Mar 12-19).*
- *Dr. Endo visited Bangkok to carry out data processing of ANHRR and MODIS (Mar 4-14).*
- *Dr. Yoshimura visited Istanbul to arrange the workshop with Istanbul Technical University and to investigate the urban structures of Garata area (Mar 17-26).*
- *Dr. Sahamitmongkol stayed at AIT for his research work and teaching duties at RNUS (Dec 29-Mar 29).*

Awards

Dr. Oki, Dr. Sinjiro Kanae (IIS) and Dr. Yukiko Hirabayashi (Research Associate of University of Yamanashi) won the Annual Prize of the Journal of Hydraulic Engineering, Japan Society of Civil Engineers (Mar 7).

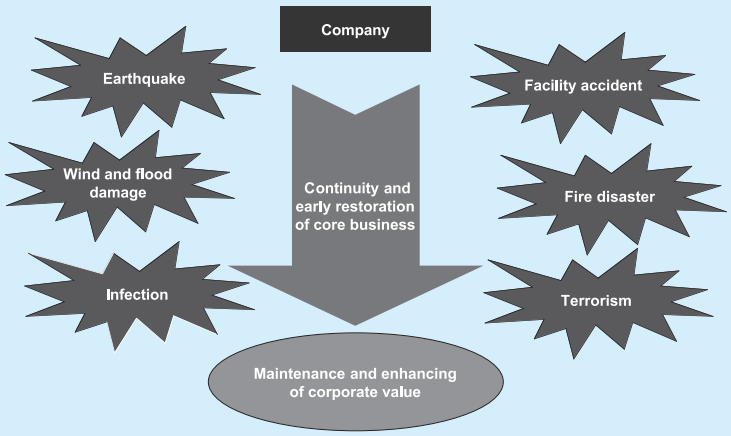
Editor's Note

The importance of the Business Continuity Plan (hereafter referred to as BCP) that takes into account the experience gained from the series of coordinated terrorist attacks in the United States and the Niigata Chuetsu Earthquake is being increasingly recognized in Japan. For example, advanced enterprises in the United States specify the Recovery Time Objectives (RTO: the target time required for the recovery of core businesses or basic services in cases when enterprises face emergencies such as natural disasters, fires and terrorist attacks) and make positive use of experts on data-back-up. Furthermore, a system for PDCA (plan-do-check-act) with regard to the BCP is set in place. In this respect, the BCP plays an important role in business activities at large and this plan has been carried out at management levels.

The ratio of Japanese enterprises applying the BCP is limited to about 8%. It will be indispensable to fully promote its implementation as well as to put it into practice at management levels. The concept of the BCP originated from dealing with the IT industry. In its earlier stage, it was applied mainly to infrastructural enterprises or financial firms. At present, it is being widely applied to other business areas. Moreover, the standardization of the BCP has begun to be discussed at the International Organization for Standardization. Enterprises will inevitably be required to adopt the BCP within 1~2 years. The BCP will become one of the most important company assets and will represent a competitive advantage for those companies who adopt it.

At present, ICUS and The University of Tokyo Hospital are studying how the latter should function as a disaster base hospital during large-scale emergencies, such as in the case of severe earthquakes. Taking the role of a disaster base hospital during earthquake disaster is very important and that is why it is necessary to investigate the BCP for The University of Tokyo Hospital.

(by R. Amano)



The role of BCP (Guideline of The Small and Medium Enterprise Agency)

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