



# ICUS Newsletter

Volume **13** Number **1** Apr. to Jun. 2013

**International Center for Urban Safety Engineering  
Institute of Industrial Science, The University of Tokyo**

## **Savar Building Tragedy in Bangladesh: Way forward**

By Mehedi Ahmed Ansary

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On 24<sup>th</sup> April at 9:00 A. M., a 9-storey building, Rana Plaza collapsed in Savar, 25 kilometers north of the Bangladesh capital, Dhaka (refer Figures 1 & 2). The building housed several garment

factories, a bank and several shops. As of August, 1,132 people died, 2,428 people were rescued and provided with immediate basic first aid or transferred to nearby hospitals for medical attention. According to

BGMEA (Bangladesh Garments Manufacturers and Exporters Association), 2,800 workers of the 6 garment factories were in the building during the accident. But the actual number is around 3,900



**Figure 1 Aerial view of the building after collapse**

(CPD, 2013). This article presents the search and rescue efforts undertaken by different agencies in Bangladesh to rescue people from underneath the collapsed building and tries to explain the reasons behind the building collapse.

### Search and Rescue Operations

Local volunteers, volunteers of the Bangladesh Red Crescent Society (BRCS), personnel from the Bangladesh Fire Service and Civil Defense, Bangladesh Armed Forces personnel, Border Guard Bangladesh and local police were involved in search, rescue and evacuation operation of trapped garment workers at Savar Building collapse site.

The BRCS was among the first responders on the scene. 100 trained volunteers were on the ground on a rotation providing search and rescue, basic first aid and safe drinking water. The organization also established a mobile medical team to assist the wounded. The BRCS ambulance service transported wounded people to various hospitals, and also helped to manage dead bodies. Restoration of Family Link (RFL) volunteers provided mobile phone services for the injured (see Figures 3 & 4) to connect with their families and relatives, and also compiled a list of the missing, injured and dead.

### Reasons behind the Building Collapse

Rana Plaza was a 9-storey industrial building with a single basement. The local municipality gave the owner permission to construct a 5-storey commercial building with one basement in 2005 and later allowed the owner to extend it up to 9-storey, without considering the consequence of such action. The



Figure 2 Location of collapsed building

owner is a potentially influential person in Savar area and probably he used his political muscle power to obtain the permission to extend the building up to 9 storeys from local (Savar) municipality. The width of the building was around 25 m and length around 80 m. A typical grid of the building is 5.2 m by 8.2

m. The column sizes vary from 35 cm by 35 cm to 45 cm by 45 cm. The building was supported by pile foundation having 45 cm diameter and length of 18.3 m.

The three main reasons can be attributed to the collapse of the structure: (i) Addition of four extra floors; (ii) Conversion of



Figure 3 Some critically injured garment workers





**Figure 4 Rescue operation**

the building from commercial to industrial use and (iii) Placement of Power Generator at the higher floors. The steel grade used was 60 grade deformed bar and concrete strength was found around 3,000 psi [see Figure 5].

### Way Forward

Bangladesh faced its worst human tragedy through Rana Plaza building collapse at Savar, Dhaka. In 1996 at Kalabagan, in 1997 at Khilgaon, in 2004 at Sakaribazar, in 2005 at Savar, in 2006 at Mahakhali, in 2010 at Hatirjheel and at Kathalbagan similar incidences occurred where altogether several hundred people were killed. Enforcement

of Bangladesh National Building Code (BNBC) has become the top priority.

Immediately, we need to set up a Building Regulatory Authority (BRA) as prescribed in BNBC. BRA will aim to deliver: Better safeguards for consumers; Building industry transformation and Legislative reform. The Building Authority will work closely with four statutory bodies to provide industry leadership and will regulate building quality. The associated bodies will be the Building Advisory Council, Building Appeals Board, Building Practitioners Board and the Building Regulations Advisory Committee. The Authority and four

bodies will

- Regulate Bangladesh's building industry
- Administer the registration of a country's building practitioners and monitor their conduct
- Advise the relevant Minister and the Government on building regulatory development
- Administer building legislation, the Building Act 1952 and Building Regulations 2008
- Resolve disputes and appeals arising from the Building Act
- Inform consumers about building and renovating
- Communicate changes that occur in building legislation
- Promote improved building standards nationally and internationally
- Provide comprehensive information on building activity
- Inform industry decision making through data and analysis
- Facilitate industry research
- Support the uptake of information technology and e-commerce
- Encourage sustainable and accessible building design, construction and use

The BRA will carry out these functions in consultation with a wide variety of stakeholders.



**Figure 5 (a) Broken samples collected from the building site**



**Figure 5 (b) Concrete cores collected from beams, columns and slabs of the collapsed building**

Source of few pictures:

<http://www.bing.com/images/search?q=Ranaplaza+photos&qpv=Ranaplaza+photos>

## Quake of M6.3 in Awaji Island

By Dr. Takashi Kiyota, IIS, The University of Tokyo

On 13<sup>th</sup> April, 2013, an earthquake of Magnitude 6.3 hit Awaji Island, Hyogo Prefecture. Since the noticeably large seismic intensity of 6 minus on the JMA scale was recorded at Gunge and Shizuki in Awaji city, this earthquake memorized us the 1995 Hyogo-ken Nambu (Kobe) earthquake that caused extensive damage to this area. Fortunately, however, no one was killed, and major damages to total 6 houses and minor damages to total about 8,000 houses were reported.

The major damages from this earthquake were in the estuary regions in Awaji city and Sumoto city which are located on the east coast of Awaji Island. This is due to the amplification effect of the

strong ground motion in the soft soil deposit. We visited in the Awaji city on 15<sup>th</sup> April, two days after the earthquake for damage survey on the geotechnical aspect.

The occurrence of moderate liquefaction was observed at the reclaimed lands in Awaji city. Although the liquefaction-induced damage to the roads and buried lifelines were observed, the extent of damage was not as much as that of the 2011 of the Pacific coast of Tohoku earthquake, and the rehabilitation works in Awaji city seemed to be done in an expeditious way. There are more than 20,000 agricultural water reservoirs in Awaji Island, and some damages were reported in the 1995 Hyogo-ken Nambu earthquake. We therefore visited some water

reservoirs in the epicentral area in Awaji city so far as time permits. There were no reservoirs that needed an emergency response, but only minor cracking at the dam crest was observed.

As outlined above, the damage to the social infrastructures by this earthquake was insignificant as compared to the recent large earthquakes. However, Awaji Island is thought to be one of the affected regions of the Tonankai and Nankai earthquakes envisaged by the government's Earthquake Research Committee. Therefore, it is important to enhance more effective earthquake disaster preparedness by learning the damage aspects caused by this earthquake.



Typical damage to tiled roof in Sumoto city (courtesy Prof. Mikami, Tokushima Univ.)



Boiled sand on the side walk and rehabilitation work in Awaji city

## Magnitude 7.8 Earthquake Hit Eastern Iran on 16<sup>th</sup> April 2013

By Mr. Mehrdad Sadeghzadeh, Meguro Lab

On 16<sup>th</sup> April, 2013 at 10:44:20 UTC (15:14:20 local time), an earthquake with Mw7.8 (BHRC: Building and Housing Research Center, Iran), struck Sistan-vabaluchestan, Hormozgan, Kerman, Southern Khorasan and Yazd Provinces in Iran as shown in Figure 1. The peak acceleration was recorded at Sabz-Gazz station ( $196 \text{ cm/S}^2$ ). The epicenter of

the event was located 28.24N, 62.14E (BHRC). It was the largest earthquake in Iran within the last 40 years. This earthquake occurred as a result of normal faulting at an intermediate depth in the Arabian plate lithosphere, approximately 80 km beneath the Earth's surface. Regional tectonics are dominated by the collisions of the Arabian and India plates with Eurasia;

at the longitude of this event, the Arabian plate is converging towards the north-northeast at a rate of approximately 37 mm/yr with respect to the Eurasian plate. Arabian plate lithosphere is subducted beneath the Eurasian plate at the Makran coast of Pakistan and Iran, and becomes progressively deeper into the north.



The sub-ducted Arabian plate is known to be seismically active to depths of about 160 km. The frequency of moderate and large earthquakes within the sub-ducted Arabian plate is not high compared with similar events in some other sub-ducted plates worldwide, but several earthquakes have occurred within this slab in the region of today's event over the past 40 years, including a Mw 6.7 shock 50 km to the south in 1983. In January of 2011, Mw 7.2 earthquake occurred approximately 200 km to the east, in a similar tectonic environment to the April 16 earthquake.

Figure 2 shows some damages in affected areas. Since the area was not very densely populated and the predominating building construction was relatively light materials such as mud and wood, 35 people were killed and 117 were injured, including 1 dead, 12 injured in Iran and 34 dead, 105 injured in Pakistan. All communications in the area were cut and rescue teams were dispatched to

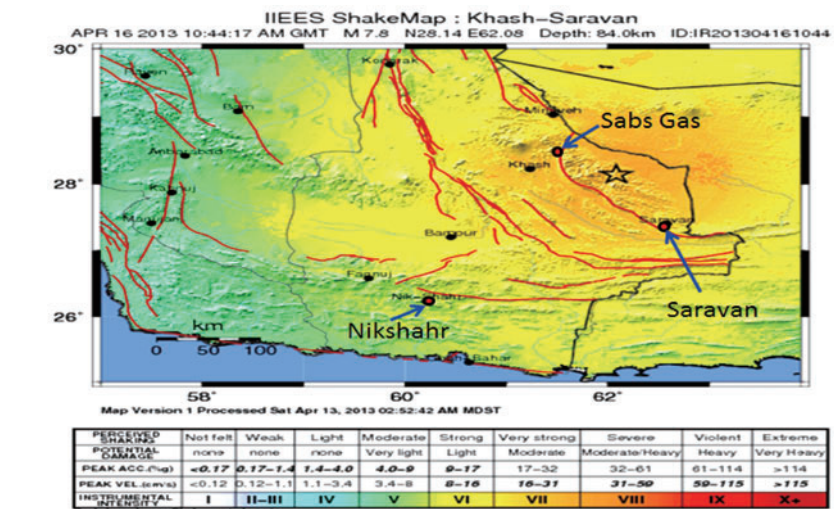


Figure 1 Seismic intensity distribution map by IIEES



Figure 2 Damages in Nikshahr (left) and in Saravan (right)

the affected area according to the Iranian Red Crescent's. There were reports of tremors felt in Qatar, Bahrain, Kuwait, Abu Dhabi, in the Gulf, in Afghanistan, in Pakistan and

India. In Delhi, more than 1,500 km from the epicenter, office workers evacuated buildings as fittings shook and windows rattled.

## ICUS Open House 2013

By Dr. Kohei Nagai

On May 31 and June 1, ICUS participated on celebrating IIS Open House 2013. In this occasion, IIS (Institute of Industrial Science) was open to all people including experts. Overall 5,000 people visited this year. ICUS is mainly focusing on its research activities toward the establishment of safety and sustainable urban systems. All member laboratories participated and showed their research activities through panels. Several ICUS's activities; such as open symposium, international conference: USMCA, RNUS and BNUS's activities were disseminated through the panels and annual reports.

Pre-open of the Open House was organized on May 30, and

registered 5 guests joined the special tour to know the ICUS activities. After the brief introduction of the ICUS by Dr. Nagai, they visited the laboratories of Prof. Koshihara on wood structures, Dr. Kuwano on geotechnical engineering and Dr. Ohara on disaster management. Guests could learn discuss with

ICUS members intensively. During the Open House, an ICUS Quiz was prepared following the success of previous years. About 80 people participated in the quiz and got prizes such as photo stands, picture books, ICUS special calendars, small bags, and key holders.



Activities on ICUS exhibition room, Bw601 during IIS Open House 2013

# Promotion of the Poly Propylene Band Mesh Technology in Indonesia

By Prof. Kimiro Meguro

I visited Indonesia during 10 to 14, April with Mr. M. Watanabe, Senior Researcher of Meguro Lab. to meet important persons and explain them about Poly Propylene Band Mesh (PPBM) Technology for seismic retrofit of weaker masonry houses.

The major cause of massive casualties due to recent earthquakes is, beyond all dispute, collapse of masonry structures as we saw in, among many others, Izmit in Turkey in 1999, Gujarat in India in 2001, Bam in Iran in 2003, Aceh in Indonesia in 2004, Kashmir in Pakistan in 2005, Central Java in Indonesia in 2006, Padang in Indonesia in 2007, Wenchuan in China in 2008 and Port au Prince in Haiti in 2010.

Although casualties were not so many, the earthquake which hit the town of cultural heritage in northern Italy in 2012 attracted world-wide attention to the high risks of masonry structures such as churches, castles and storages for wine and cheese to earthquake.

In view of growing vulnerabilities of masonry structures to earthquake and high risks of another big one in the areas of Padang, West Sumatra, Indonesia, we applied to the JICA sponsored Grass-Root Technology Cooperation Scheme for a grant. The Japan International Cooperation



Mayor's residence in Padang

Agency, JICA, had decided that a project entitled "Project for Earthquake Safer Built Environment employing PP-Band Mesh Seismic Retrofit Technology for Masonry Housing" was accepted. We are in the process of making a contract with JICA for successful implementation of the project.

The project will be implemented in partnership with the Royal Silk Foundation in Yogyakarta and State University of Padang of West Sumatra Province. The Royal Silk Foundation is famous for emergency relief as well as multi-spectral approaches to poverty alleviation in rural areas and had established strong ties with Japanese organizations. We got acquainted with the people of the State University of Padang through the JICA-JST project "Multi disciplinary Hazard Reduction from Earthquakes and Volcanoes in Indonesia" and agreed to the

project.

The PPBM Technology is featured by its unique natures; low-cost, easy to employ, high performance and high durability so that it must be referred to as a Columbus's egg technology. Unfortunately however people at risk are not aware of an easy approach to simple technology and its high availability.

We met the Mayor of Padang city and Deputy Governor of the West Sumatra Province and explained about the effects of PPBM by showing the filmed experiments. We met, in Bandung and Jakarta, the D.G. of the R&D Division of Public Works Department, the Deputy Minister of the Coordination Ministry for Economic Affairs and the Director of the ASEAN Secretariat. All of them appreciated for our efforts for an earthquake resilient society in Indonesia, as the first step, and throughout the world.



Coordination Ministry of Economic Affairs



ASEAN Secretary



# U-Tokyo President's IIS Bangkok Office Visitation and Thai Alumni Gathering

By Dr. Akiyuki Kawasaki

On May 30, 2013, U-Tokyo's 10th President's Council meeting was held in Bangkok, Thailand. This council was established to explore the University's future direction through discussion between the President and distinguished council members from various fields. The meeting is being held annually around the world.

The welcome reception hosted by Her Royal Highness Princess Chulabhorn of Thailand was held and about 150 guests were invited, including the university alumni, VIPs of international and Thai governmental organizations, and executives of Japanese companies in Thailand. Besides, a dialog meeting for discussing overseas

alumni activities was held among the representatives from three alumni groups in Thailand, including IIS Alumni Chapter in Thailand, and U-Tokyo's executives, such as President Hamada, Prof. Egawa, Director of Alumni Office (Executive Vice President, VP), and Prof. Haneda, Director General of International Affairs Division

(VP). On the day before the council, President and executives visited IIS Bangkok Branch Office at Chulalongkorn University, located in central Bangkok. During this visitation, Prof. Meguro introduced ICUS's research and education activities in Thailand and surrounding Asian countries to President Hamada and executives.



President and executives at IIS Bangkok office

## ICUS Activities April - June

### Travel

Date	Name	Country	City	Category	Purpose
Apr. 4- May 31	Dr. Kawasaki	Thailand	Bangkok		Operation of BNUS & lecture
Apr. 9-11	Dr. Kawasaki	Myanmar	Yangon	Meeting	Visit to Yangon Technology University, JICA and Japanese Embassy
Apr. 11-14	Prof. Meguro	Indonesia	Jakarta, Padang	Meeting	To meet regarding TTB
Apr. 12-28	Prof. Sawada	Brasil	Manaus	Project	Research and meeting of carbon dynamics of amazonian forest
Apr. 17-19	Prof. Meguro	China	Beijing	Meeting	International advisory board meeting
May 26-31	Dr. Mumada	Macedonia	Skopje	Symposium	To attend the SE-SCEE
May 27-Jun. 1	Prof. Sawada	France	Paris	Workshop	Japan & France workshop, Japanese & France technology adjustment meeting
May 29-31	Prof. Meguro	Thailand	Bangkok	Meeting	10 <sup>th</sup> President's council meeting, IIS alumni chapter in Thailand
Jun. 5-Aug. 23	Dr. Kawasaki	Thailand	Bangkok		Operation of BNUS & lecture
Jun. 15-21	Dr. Mumada	U.S.A	New York	Conference	To attend the ICOSAR2013
Jun. 17-20	Dr. Kawasaki	Myanmar	Yangon	Meeting	Visit to Yangon Technological University

## ICUS Welcomes Prof. Taikan OKI

By Prof. Kimiro Meguro

We are pleased to welcome Prof. Taikan OKI on the return of the ICUS member in the Environment Informatics Division. He has been heading Hydrology and Water Resource Engineering Laboratory, IIS. Beside the University of Tokyo, he had worked at several places such as; NASA, USA, the Research Institute for Humanity and Nature in Kyoto, the Council for Science and



Technology Policy, Cabinet Office of Japan. His contributions were honored many times; the Biwako Prize for Ecology in 2011, the Japan Academy Medal from the Japan

Academy, and JSPS Prize from Japan Society for the Promotion of Science in 2008. He is one of the coordinating lead authors for the chapter "Freshwater Resources" of the 5th assessment report of IPCC Working Group II.

We again welcome him and looking forward to his numerous contributions to create safer and sustainable urban systems.

### **Editor's note...**

On the articles of this volume of the Newsletter, two points are introduced from the editor. One is about the main article that is the collapse of an RC building in Dhaka, Bangladesh reported by Professor Mehedi Ahmed Ansary from BUET. This event teaches us a lot of important points, such as design of structures, quality control of construction and selection of materials, compliance with structural design criteria, maintenance, information release of structure to

users, etc. According to a series of accidents repeatedly happened, this event can be considered the tip of the iceberg of numerous poor quality structures. Considering the fact that the RC building was totally collapsed without any external force, such as seismic ground motion, damage will be very serious in case of earthquake even when shaking is relatively small. As these are common issues in all over the world, especially in developing countries, we should try to find solutions by sharing experiences and related information.

The second one is a good news that Professor Taikan OKI, well known to the world as leading researcher in the field of hydrology and water resources engineering, has returned ICUS in April 2013. This is a great reinforcement of ICUS in Environment Informatics Division and flood disaster management. We hope that with the help of Professor OKI, ICUS can contribute for improving safety of urban areas against extraordinary metrological events in the world as well as Asian countries

**By K. Meguro**

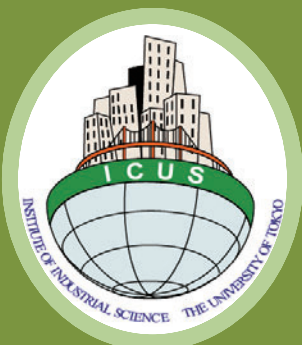
### **USMCA2013: Oct 9-11, Hanoi, Vietnam**

The 12<sup>th</sup> International Symposium on New Technologies For Urban Safety of Mega Cities in Asia (USMCA2013) going to be held in Hanoi, Vietnam on October 9-11, 2013.

Further information is available at the USMCA2013 official website: <http://www.usmca2013.vn/>

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*The International Center for Urban Safety Engineering (ICUS) is a research center located at the Institute of Industrial Science, The University of Tokyo.*

*The purpose of ICUS is to identify, investigate, and resolve issues towards the realization of sustainable urban systems for the prosperity and safety of society considering challenging socio-economic problems.*