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

Important lessons to be learned from the 1923 Great Kanto Earthquake Disaster

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September 1st is a national disaster day in Japan, commemorating the 1923 Great Kanto Earthquake that occurred on September 1st in 1923. This year marks the 90th anniversary of the earthquake, that caused the severest natural disaster in Japan. Damage due to this earthquake spread over the Kanto region and the total number of fatalities and missing were as high as 105,000. Tokyo recorded the highest number of fatalities, followed by Kanagawa, Chiba, Shizuoka, Saitama, Yamanashi, and Ibaraki. In cities, such as Odawara and Yokohama in the Kanagawa Prefecture, which is close to the epicenter, severe structural damage, fire, landslides, debris flow and liquefaction due to strong ground motions and tsunami damage in the coastal areas were observed. Over 40% of Tokyo's downtown was completely burned down by fires, which lasted over 40 hours, resulting in the highest number of fatalities. More than 65,000

Damage in Yokohama City (Left) and Tokyo Down Town area (Right) due to the 1923 Great Kanto Earthquake
Strong ground motion was the main cause of damage in Yokohama while in Tokyo,
spread of fire was the main cause the besides strong ground motion.
[Source: National Museum of Nature and Science, Japan]

people were killed or went missing due to fires, which accounts for 95% of the total fatalities in Tokyo. Because of this fact that the fire was the major cause of death, preventing a fire from spreading has become the main focus of urban earthquake disaster countermeasures.

Figure 1 Burned-out areas by fire broken out at a different seismic intensity calculated by the wooden house collapse ratio

However, based on the research carried out by the author's group, it was found that, structural damage was the major cause of widespread of fires in both the 1923 Great Kanto earthquake and the 1995 Kobe earthquake disasters. Although various countermeasures that were taken after the kanto earthquake were valuable as symptomatic treatments or post-event measures, it is very important to retrofit structures of low earthquake resistance immediatedly for tackling fire following a big earthquake, often, the firefighting demand greatly exceeds the capacity of existing public firefighters, as a number of fires are broken out simultaneously at various locations.

But the scale of fire at an early stage immediately after the earthquake is apperently not large, thus firefighting can be carried out by the citizen themselves, which proves to be the most efficient way towards tackling fires. However, when the structural damage is severe with many collapsed houses and buildings, firefighting by the citizens becomes difficult due to the following reasons: 1) the citizens expected to firefight are trapped under the damaged structures, 2) the citizens proioritize the rescue of other trapped victims to firefighting, 3) it is very difficult for citizens or non-professionals to manage a fire that breakes out under a collapsed structure, 4) collapsed structures may block narrow streets, restricting both citizens and firefighters to access the fire site. Figure 3 shows the evidence of this mechanism.

Learning from there lessons, and understanding the importance of seismic capacity of structures, facilitates are better preparation towards a future earthquake disaster.

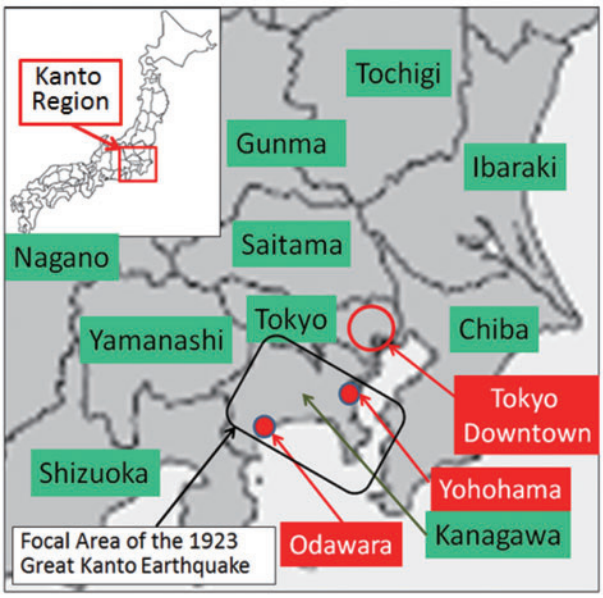


Figure 2 Location of prefectures and focal area of the 1923 Great Kanto Earthquake

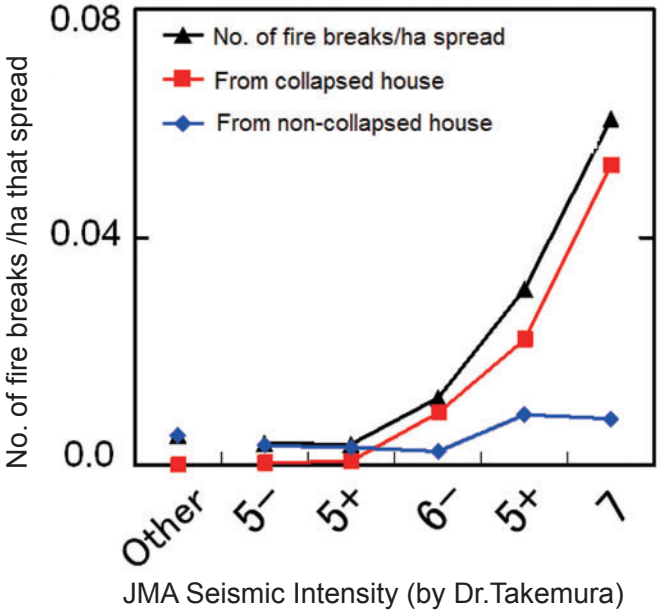


Figure 3 Relationship between the ratio of firebreaks that spread and JMA seismic intensity calculated by collapse ratio of wooden houses by Dr. Takemura (Fires broken out from non-collapsed houses could be extinguished by the general public.)

Heavy Rain in Tokyo Metropolitan Area on July 23, 2013

By Dr. Miho Ohara

During this summer, Japan experienced frequent heavy rains, causing casualties and housing damages in several areas as listed in Figure1. Among these events, this article focuses on the heavy rain, that occurred in eastern Japan due to the seasonal rain front on 23, July 2013.

Date	Area	Event	Death Toll	Collapsed Houses
July 9-26	East Japan	Seasonal rain front	0	1
July 26- Aug 2	All Japan	Heavy rain	3	28
Aug 9	Akita, Iwate	Heavy rain	8	8
Aug 23-28	All Japan	Heavy rain	2	8
Aug 29-Sep 5	All Japan	Typhoon 15, 17	2	2
Sep 16	All Japan	Typhoon 18	6	48

Figure 1 Events during July-September, 2013 in Japan

In the afternoon of 23, July 2013, sudden heavy rainfall attacked the Tokyo Metropolitan Area. In the area near Meguro city, where IIS is located, the hourly reported rainfall reported exceeded 100mm at 16:30. Figure2 shows the rainfall distribution observed by the radar at 16:30. The Japan Meteorological Agency (JMA) announced "Information of record short-time heavy rain" to inform that the recorded rainfall is torrential with the possibility of causing a disaster in that area. The last information was provided three years ago in Tokyo; this implies that the heavy rain on 23 July 2013 was an unusual event for the people living in the Tokyo Metropolitan Area.

This rainfall had caused social obstructions such as inundation of houses, stoppage or delay of trains, traffic restriction, power outage, etc. According to Setagaya ward next to Meguro ward, more than 100 houses were inundated below floor level. Tokyu-Toyoko-line stopped its train service for three hours due to the cable troubles, affecting about 160,000 passengers. the Bullet Train "Shinkansen" also stopped for 40 minutes, since the rainfall exceeded its operational standard level. According to the Tokyo Electric Power Company (TEPCO), about 14,000 houses suffered a power outage until the total restoration at 20:30.

Due to this heavy rain, the water level of the Meguro river running in the Meguro city increased. Figure 3 shows the observed rainfall in 10 minutes at Kamimeguro station near the river and the water level at Aobadai Station along the Meguro river. At 16:22, the water level was recorded to be 106 higher than the flood alert level. This figure shows that the intense local rainfall within one and a half hours drastically increased the water level of the river. The Tokyo Metropolitan Government and JMA jointly announced the Flood forecast of the Meguro river running near the Meguro station at 16:30. However the flood forecast was called off at 17:20.

Recently, the local governments started using various medias to deliver disaster information. At 16:22, the siren was sounded along the Meguro

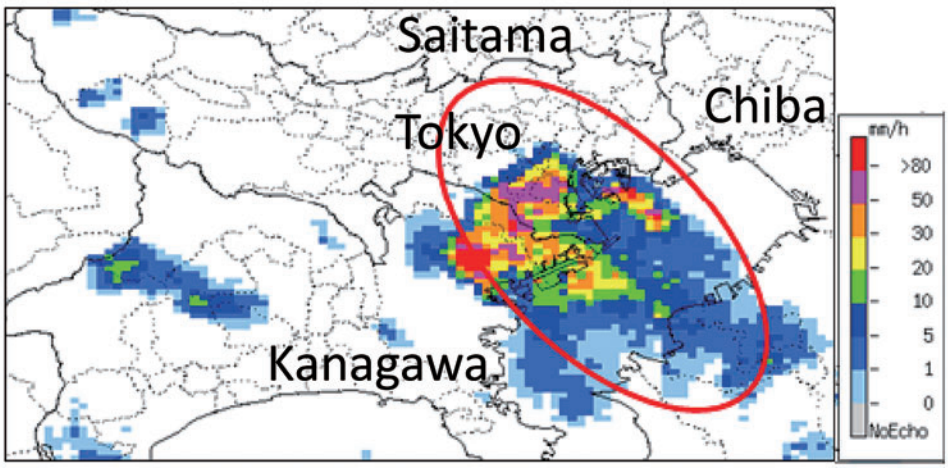


Figure 2 Rainfall distribution observed by radar (from Tokyo Metropolitan Government)

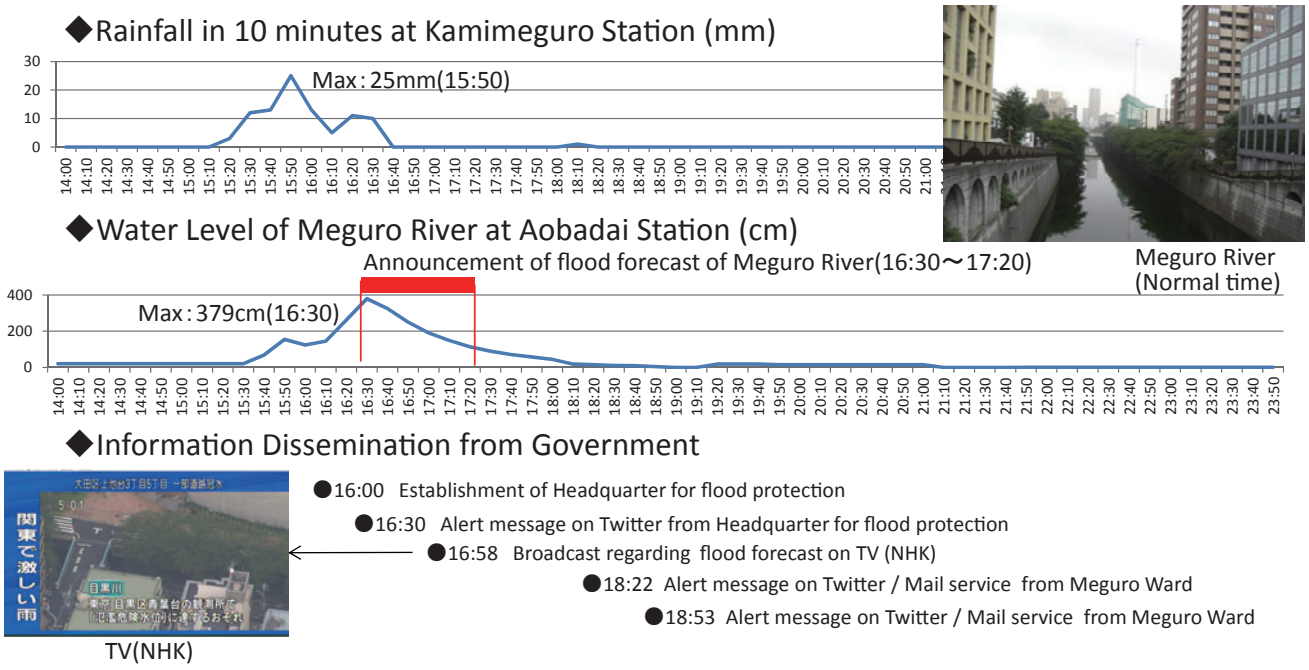


Figure 3 Flow of flood risk and information dissemination from government

river to alert people near the river. In addition to it, Headquarter for flood protection in the Tokyo Metropolitan Government established at 16:00 provided a message on the Twitter by its account (@tokyo_suibo) at 16:30 as shown in Figure 4. The message informed the flood forecast of the Meguro river, specially mentioning that the underground facilities need special attention to inundation risk.

After the 2011 Great East Japan Earthquake, many local governments started information dissemination by the Social Network Service (SNS) in order to expand their channels to deliver disaster information. These local governments usually give messages on Twitter or Facebook such as disaster warning, evacuation advisory, announcement of disaster drill, etc. Some wards in the Tokyo Metropolitan Area also have their own Twitter account. Regarding the event on 23, July, Meguro ward also gave messages on Twitter. However, the messages were given only after 18:22 when the forecast had been already called off.

Meguro ward also provides the mail service to the people's e-mail addresses or cell phone mail addresses in case of a disaster, provided people have registered their addresses. The messages sent from this mail service was also delayed. The experience on July 23 suggests the importance of disseminating disaster information with proper timing to the people, for future disaster reduction.

Figure 4 Twitter messages from the government

BNUS: Inspection of Ready-made Garment Factories after the April 2013 Rana Plaza Incidence in Bangladesh

By Prof. M.A. Ansary

Bangladesh is one of the densely populated countries in the world. Due to shortage of land, construction of multi-storey buildings for residential, commercial and industrial purposes has become very popular in the urban/suburban areas. A dramatic growth of garment industries has occurred during the last three decades. The industry has contributed to export earnings, foreign exchange earnings, employment creation, poverty alleviation, and the empowerment of women. During the 80's and 90's, garment factories grew at a very rapid pace and have been established mostly in Dhaka city and in greater Dhaka area. Within the city they have grown mostly in existing buildings through changing the building occupancy from residential or commercial to an industrial building. During the past decade, however, industries have developed at specific locations outside city area e.g., at Savar, Ashulia, Tongi, Gazipur of the greater Dhaka area and in several export processing zones (EPZs) in Dhaka, Chittagong, Mongla, Rajshahi and Adamjee in Narayanganj.

There are more than 3500 active garment factories in Bangladesh. However, in some cases a number of garment factories are housed in a single building. The total number of factory buildings may vary from 2000 to 2500 all over Bangladesh. Several building disasters have occurred recently, such as the collapse of Spectrum Garments Building in 2005, fire in Tajreen Garments Building in 2012 and very recently (April 2013) Rana Plaza in Savar. Following the tragic incidence in Savar, all concerned people including the labour community, the owners of RMG industries, building owners, local authorities and different government agencies were panic stricken and immediately has undertaken the program of inspecting the RMG factory buildings in order to identify the vulnerable ones.

Building safety assessment is being performed in two stages: Preliminary Assessment through Visual Inspection and Detailed Engineering Assessment.

Preliminary Assessment

Through visual inspection, the existence of any distress in the structure of a building will be identified. Structural design drawings and soil investigation reports, if available, will be reviewed to assess the current use and loading pattern. Most importantly, it will be assessed whether the building is having any immediate threat of collapse from current building use. From the visual inspection, if it is found that the building is carrying risk in continuing its current use, the team of expert visiting the building will suggest in the preliminary assessment report of immediate measures to be implemented by the building owner and user. It will also be recommended in the preliminary report, for immediate detailed engineering assessment of the building that would involve soil investigation, other non-destructive tests and 3D building modeling.

Detailed Engineering Assessment

The safety assessment of a building will not be completed without detailed engineering analysis of the structure of the building. To perform this detailed analysis, several important documents and information are needed that include approved building plan, complete structural design drawings, soil investigation report, and construction material test reports. The team of experts will also perform several non-destructive tests on the building using standard equipment to assess the strength of construction materials used which will then be used for the detailed analysis.

Figure 1 RMG Finishing Floor

Figure 2 RMG Sewing Floor

GIS and RS lectures in Yangon, Myanmar

By Akiyuki Kawasaki

Four faculties of Institute of Industrial Science, University of Tokyo, provided a lecture course on "Remote Sensing and Geographic Information System (GIS)" at Yangon Technological University (YTU), Myanmar in August and September, 2013. This is a part of ICUS's continuous support towards YTU's research and education since December 2012. About 40 graduate students and staff from departments of Civil engineering, Architecture, and Engineering geology took this course, and succeeded to master the fundamental of GIS and remote sensing through practical hands-on exercises. The lecture titles and lecturers are summarized in the given table. Based on the request from YTU, we prepared practical exercises using Myanmar as a study area. During the lecture by Prof. Sawada, satellite data of Bago River basin was used for image processing exercise and he brought students to the field for verifying processed images on ground. Dr. Takeuchi taught how to make drought map in central Myanmar. Through these practical lectures, YTU's students and staff were able to learn how to use GIS and remote sensing for environmental problem solving.

We hope our lectures would contribute to promoting advanced environmental and disaster research at YTU.

No.	Date	Course title	Lecturer
1	13–15 Aug.	Introduction to GIS	Dr. A. Kawasaki
2	20–22 Aug.	Introduction to remote sensing	Prof. H. Sawada
3	3– 5 Sep.	Advanced geospatial analysis	Dr. Y. Sekimoto
4	10–12 Sep.	Synthesis exercise	Dr. W. Takeuchi

GIS and remote sensing hands-on training (left) and group photo with YTU students and staff (right)

6th Joint Student Seminar on Civil Infrastructure : Bangkok, Thailand

By Niwat Apichartbutra, Tsubasa Sasaki and Fei Jiang

The 6th Joint Student Seminar on Civil Infrastructure was a combined programme of a seminar and a field trip. This year, the seminar was held on August 6th, 2013 at Chulalongkorn University. Two invited speakers and twenty students from universities in Thailand, Japan, and Korea gave presentations on their research in different fields. Two of the three students who were awarded "Excellent Presenters" were from the University of Tokyo.

Participants of the 6th Joint Student Seminar on Civil Infrastructure

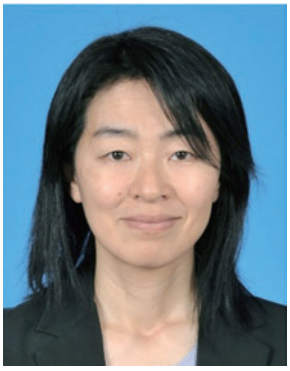
On the following day, August 7th, 2013, the participants went on a field trip of visiting places of cultural and engineering significance. The trip's highlight was Hua Lamphong's construction site where a tunnel of the new MRT Blue Line was being excavated.

After attending the seminar, we, as the seminar participants, agreed that not only did the seminar give us an opportunity to share research perspectives with other students but also, most importantly, a platform to develop a network of friendship that is invaluable as an informal platform to exchange ideas and information in the future.

Congratulation to Prof. Reiko Kuwano

By Prof.Kimiro Meguro

Dr. Reiko Kuwano, an active member in the social infrastructure management division of ICUS, has become a Professor at Institute of Industrial Science (IIS), the University of Tokyo in July 2013. On this auspicious occasion, we are very pleased and would like to give her our heartfelt congratulation on her promotion. She joined the IIS as an Associate Professor in April 2006 then established her own laboratory, Geotechnical and



Geo-Environmental Laboratory, and has been heading it. Prior to joining the IIS, she had worked as a lecturer at the Department of Civil Engineering, the University of Tokyo, as well as a senior researcher at the Public Works Research Institute. She has been participating in the ICUS activities as a member from her initial tenure, that has aided to achieve ICUS's goal.

We again congratulate her and we are looking forward to the uppermost contributions to create safer and sustainable urban systems.

ICUS Activities July - September

Award

Date	Name		Title	Organaizer
Aug. 06	Ms. Fei Jiang	Best Presentation	Study on efffect of street blockades to transportation of seriously-injured victims to hopitals –Case study of expected Tokyo inland earthquake-	6th Joint Student Seminar on Civil Infrastructure: Banjkok
Aug. 06	Mr. Tsubasa Sasaki	Best Presentation	The impact of flow rate on the microbial cementation of sandy specimens	6th Joint Student Seminar on Civil Infrastructure: Banjkok
Aug. 30	Dr. Akiyuki Kawasaki	2013 Excellent Research Prize	Cooperative development strategy of water resources in international river basins	The Kurita Water and Environment Foundation

Travel

Date	Name	Country	City	Category	Purpose
Jul.14-Aug.01	Prof. Sawada	Brasil	Sao Paulo &Manaus	Research	Project of carbon dynamics of amazonian forest
Aug. 12- 15	Dr. Kawasaki	Myanmar	Yangon	Meeting	Visit to Yangon Technology University
Aug. 31-Sep. 7	Prof. Kuwano	France	Paris	Conference	Attend the 18th International Conference on Soil Mechanics and Geotechnical Engineering
Sep. 02 - 24	Dr. Kawasaki	Thailand	Bangkok		Operation of RNUS & lecture
Sep. 27- Oct. 01	Prof. Sawada	China	Shenzhen	Conference	Attend DEHRS2013

USMCA2014: Nov 3-5, Yangon, Myanmar

The 13th International Symposium on New Technologies for Urban Safely of Mega Cities in Asia (USMCA2014) will be held in Yangon, Myanmar on November 3- 5, 2014, collaborating with Yangon Technological University (YTU) and Myanmar Engineering Society (MES).

University of Tokyo Alumni party and seminar in Thailand and Myanmar in January 2014

Alumni party and half-day seminar will be held: at Aetas Lumpini Hotel in Bangkok, Thailand on January 4th, 2014, and at Yangon University Boat Club in Yangon, Myanmar on January 5th, 2014.

For further information about alumni party and seminar,
please contact Dr. Kawasaki <akiyuki@iis.u-tokyo.ac.jp>

Editor's note...

Recently, the disasters are apparently getting bigger, and we can say that the world has entered the period of mega hazard. All countries over the world are facing some natural hazard risk regardless of their level of development.

Three kinds of disasters were introduced in this new volume: earthquake, flood and structure collapse. All disasters had close relation to urbanization. The major cause of post-earthquake urban fire spreading in the 1923 Great Kanto Earthquake Disaster was over-crowded urban environment with poor wooden houses. Regarding the flood in Tokyo this year, obviously the main reason was heavy rain, and moreover densely populated wide urban area with insufficient storm sewer was the indirect reason of magnifying the damages of houses and casualties.

I can say that the incident in Bangladesh was a result of urbanization in which only rapid economic progress had been kept in priority. The fact compels us to reconsider how urbanization should be. Japan, which already passed the period of development, got many kinds of lessons based on abundant experiences. Therefore, we have an obligation to disseminate our experiences to the world.

There is diversity in the world, and each country has its own specific characteristics such as culture and tradition, which can urbanize in its own way. However, human, family and community are universal, so, the precious lessons learnt through experiences should be applicable to tackle with several disasters in the world. Therefore, a deeper understanding of diversity and capacity building of penetrating insight focused on human and communities are necessary. Not only technology, mutual understanding and support in social aspects are rather more important. ICUS has been required to expand its field to contribute risk reduction of natural hazard from various aspects.

By Dr. Takaaki KATO

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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.