

# One Year after the 2011 Great East Japan Earthquake

- International Symposium on Engineering Lessons  
Learned from the Giant Earthquake -

March 1-4, 2012

Kenchiku-kaikan, Tokyo, Japan



## Program and Abstract Volume

### Organizing Societies

Japan Association for Earthquake Engineering  
Architectural Institute of Japan  
Japan Society of Civil Engineers  
The Japanese Geotechnical Society  
The Japan Society of Mechanical Engineers  
Seismological Society of Japan

### Supporting Organizations

Ministry of Education, Culture, Sports, Science and Technology / Ministry of Land, Infrastructure, Transport and Tourism / Ministry of the Environment / Science Council of Japan / WFEO Disaster Risk Management Committee / National Research Institute for Earth Science and Disaster Prevention / National Institute for Land and Infrastructure Management / Public Works Research Institute / Building Research Institute / Port and Airport Research Institute / Central Research Institute of Electric Power Industry

## **WELCOME TO THE SYMPOSIUM**

Welcome to the International Symposium on Engineering Lessons Learned from the 2011 Great East Japan Earthquake.

The damage due to tsunami, ground motions and liquefaction was destructive over an extensive area during the March 11, 2011 event. Fire also resulted in extensive damage. The Great East Japan earthquake revealed the fact that an infrequent and high consequence event can cause unforeseeable damage once it happened. We have to learn as many lessons as possible from this larger than expected earthquake. Furthermore, destructive damage occurred in recent earthquakes not only in Japan but also in Chile, China, Indonesia, Italy, New Zealand, Taiwan, Thailand and Turkey.

This Symposium was organized to offer a platform to bring together experts and relevant engineers who are interested in earthquake disaster mitigation worldwide (1) to identify and exchange views on damage and risk in light of the recent earthquakes, and (2) to identify future need and opportunities for joint research, cooperation among specialists, and exchange of data, information and research resources.

The Symposium was jointly organized by the Japan Association for Earthquake Engineering (JAEE), Architectural Institute of Japan (AIJ), Japan Society of Civil Engineers (JSCE), the Japanese Geotechnical Society (JGS), the Japan Society of Mechanical Engineers (JSME) and Seismological Society of Japan (SSJ) on March 1-4, 2012 in Tokyo, Japan. It is expected that the Symposium would help the advancement of short and long term objectives in earthquake disaster mitigation.

On behalf of the six organizing societies and the organizing committee, I express my profound gratitude and sincere appreciation to all participants of the Symposium for the active presentations and discussions.

March 2012

Kazuhiko Kawashima  
Chairman of the Symposium

## **ORGANIZING SOCIETIES**

Japan Association for Earthquake Engineering  
Architectural Institute of Japan  
Japan Society of Civil Engineers  
The Japanese Geotechnical Society  
The Japan Society of Mechanical Engineers  
Seismological Society of Japan

## **SUPPORTING ORGANIZATIONS**

Ministry of Education, Culture, Sports, Science and Technology  
Ministry of Land, Infrastructure, Transport and Tourism  
Ministry of the Environment  
Science Council of Japan  
WFEO Disaster Risk Management Committee  
National Research Institute for Earth Science and Disaster Prevention  
National Institute for Land and Infrastructure Management  
Public Works Research Institute  
Building Research Institute  
Port and Airport Research Institute  
Central Research Institute of Electric Power Industry

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Kenji Kosa, Japan  
Mikio Koshihara, Japan  
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Yingmin Li, China  
Zhenbao Li, China  
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Hideo Matsutomi, Japan  
Mitsumasa Midorikawa, Japan  
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Jack P. Moehle, USA  
Masaki Morishita, Japan  
Masato Motosaka, Japan  
Shoichi Nakai, Japan  
Yoshiaki Nakano, Japan  
Masayoshi Nakashima, Japan  
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Aydan Omer, Japan  
Andreas Oreta, Philippines  
Shunsuke Otani, Japan  
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Nigel Priestley, New Zealand  
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Hitoshi Shiohara, Japan  
Masaki Shiratori, Japan  
Akira Sone, Japan

Takahiro Sugano, Japan  
Yuping Sun, China  
Kohei Suzuki, Japan  
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Reiji Tanaka, Japan  
Jyunichi Tohma, Japan  
Koji Tokimatsu, Japan  
Takashi Tomita, Japan  
Ikuo Towhata, Japan  
Keh Chyuan Tsai, Taiwan  
Yoshimichi Tsukamoto, Japan

Shigeki Unjoh, Japan  
Ramon Verdugo, Chile  
Kazue Wakamatsu, Japan  
John Wallace, USA  
Lanmin Wang, China  
Fumio Yamazaki, Japan  
Mark Yashinsky, USA  
Susumu Yasuda, Japan  
Lieping Ye, China  
W. Phillip Yen, USA  
Solomon Yim, USA  
Fulin Zhou, China  
Askar Zhusbekov, Kazakhstan

## **SYMPOSIUM CHAIRMAN**

Kazuhiko Kawashima  
President, Japan Association for Earthquake Engineering  
Professor, Department of Civil Engineering  
Tokyo Institute of Technology  
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## **ORGANIZING COMMITTEE MEMBERS**

Kazuhiko Kawashima (Chairman)  
Hitoshi Shiohara (Secretary)  
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Hisahiro Hiraishi  
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Yoshikazu Takahashi  
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Ikuo Towhata  
Yoshimichi Tsukamoto  
Shigeki Unjoh  
Susumu Yasuda  
Kazue Wakamatsu

## VENUE

### **Kenchiku-Kaikan** (Architectural Institute of Japan Building)

Address: 26-20 Shiba 5, Minato-ku, Tokyo, Japan, Zip code: 108-8414

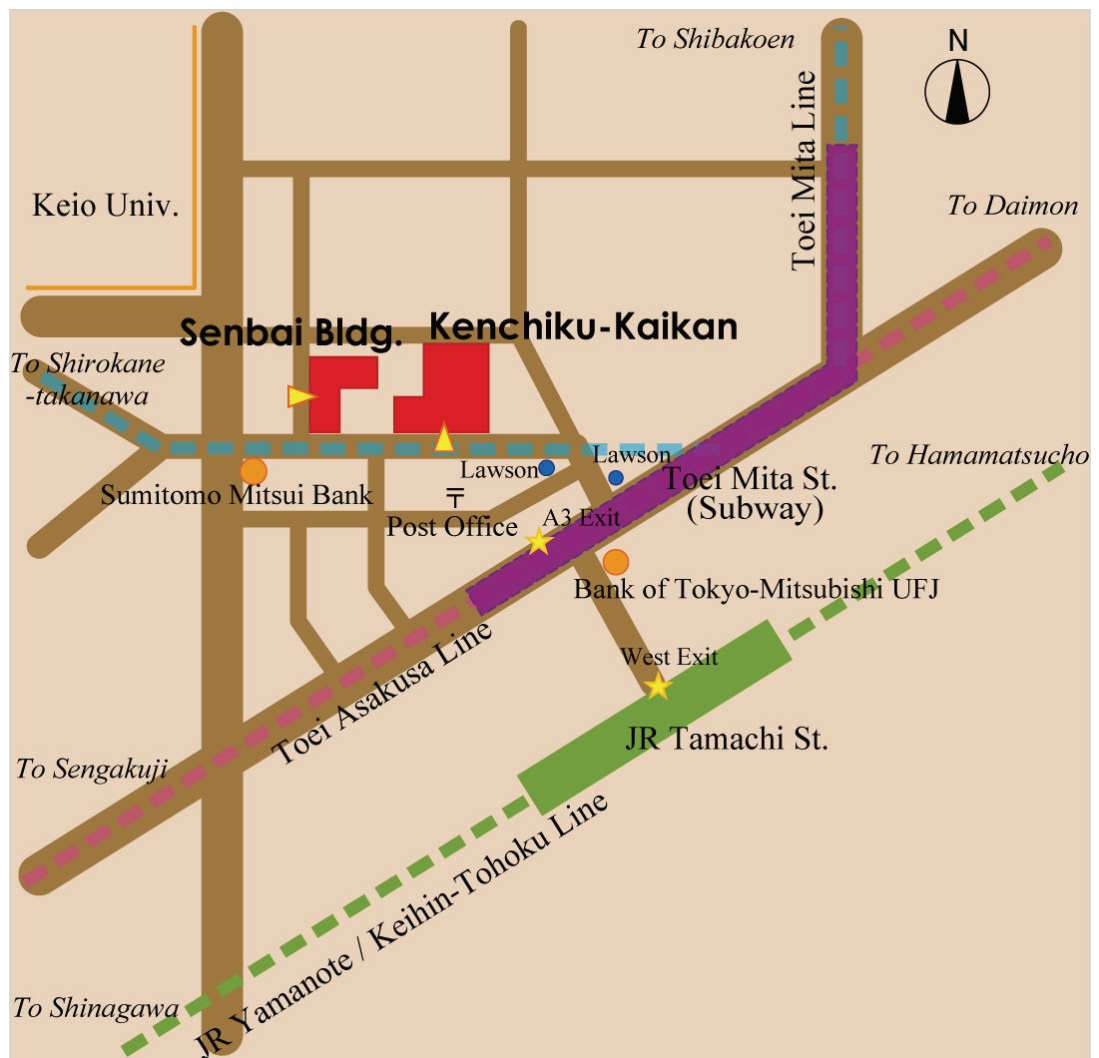
and

### **Senbai Building**

Address: 26-30 Shiba 5, Minato-ku, Tokyo, Japan, Zip code: 108-8414

### **Access**

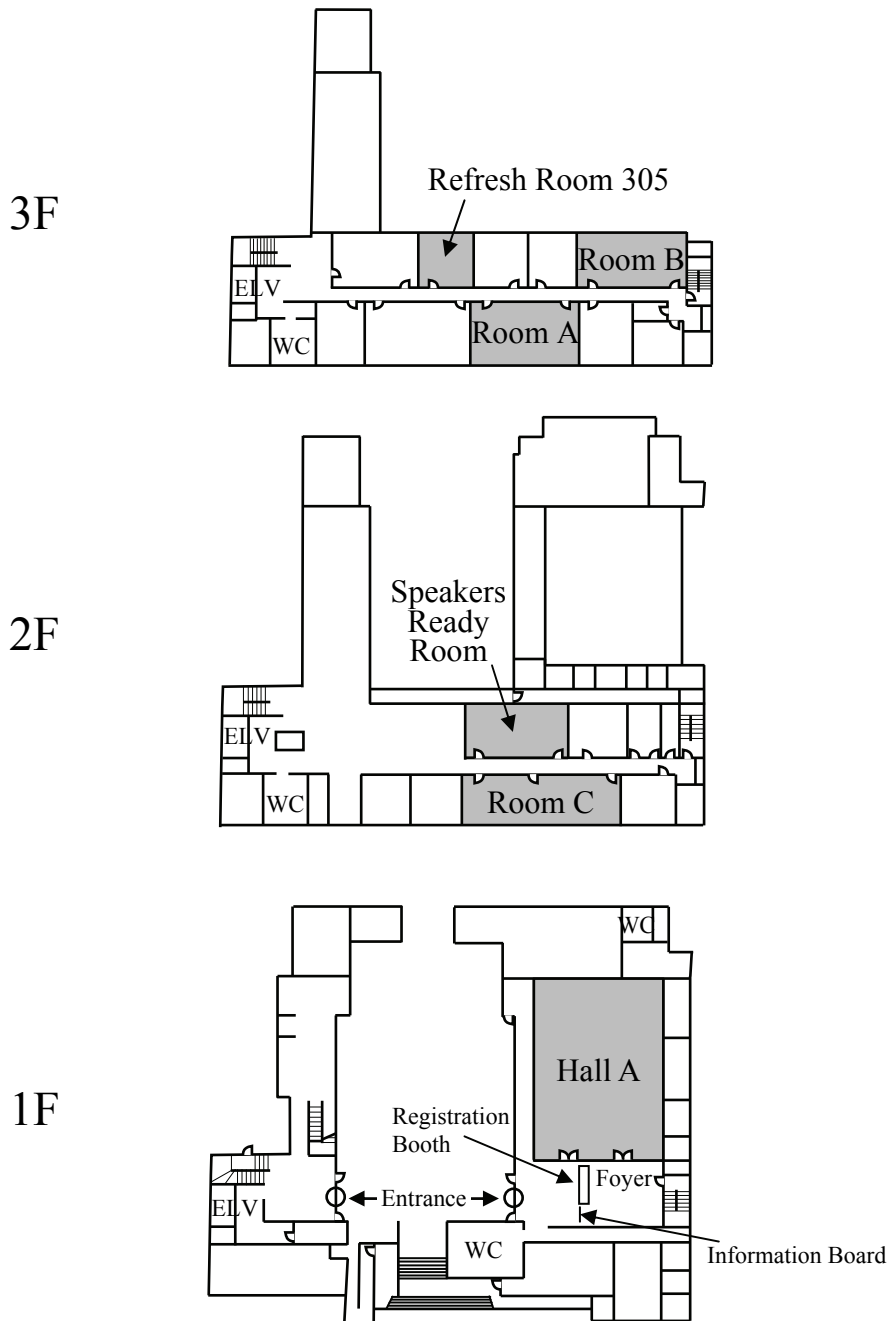
4 minute walk from JR Tamachi Station, and Mita Station of Metro of Mita Line or Asakusa Line



# HALLS AND ROOMS FOR PRESENTATIONS

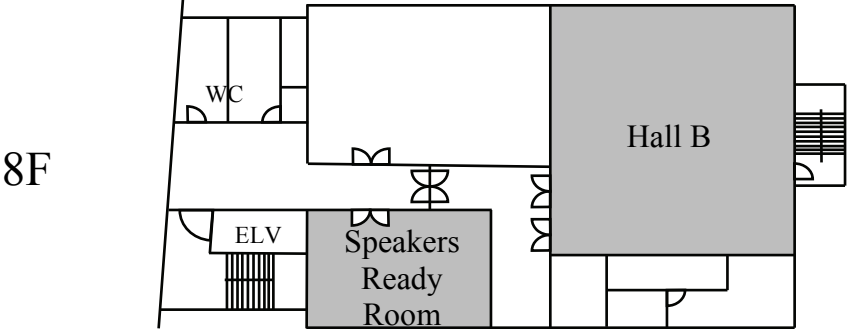
## Hall A, Room A, Room B and Room C

Kenchiku-kaikan Building.



**Hall B**

8th floor of Senbai Building.





## **GENERAL INFORMATION**

### **OFFICIAL LANGUAGE**

The official language of the Symposium is English. All presentations and discussions must be conducted in English.

### **REGISTRATION**

Registration is required for all speakers and participants. Registration booth is open at the Main Hall Foyer during the following hours:

March 3, Saturday	8:30-20:00
March 4, Sunday	8:30-19:50

### **FOR SPEAKERS**

- Nineteen minutes is allocated for a regular presentation. Discussions follow after all presentations are completed.
- Forty minutes is allocated for a key note presentation followed by approximately five minutes discussions.
- A PC (Windows) is provided at each session room. It is suggested to bring a memory so that speakers use this PC for saving time for connection. However speakers can use your own PC if needed.

### **INFORMATION BOARD**

Any change of the Symposium will be posted on an Information Board at the Registration Booth

### **SPEAKER READY ROOM**

A speaker ready room (a room in front of Room C, second floor) is available to speakers.

### **WELCOME RECEPTION WITH LIGHT BUFFET**

19:00-20:00, March 3, Saturday  
Hall-A Foyer, 1st Floor, Kenchiku-kaikan Building

### **NO SMOKING, NO FOOD AND NO DRINKS**

Smoking is prohibited at the entire space in Kenchiku-kaikan and Senbai building. Food and drinks are also prohibited at the entire space of Kenchiku-kaikan and Senbai Building except Hall-A Foyer.

## TECHNICAL SITE VISITS

Pre-registration is required for the technical site visits by February 1, 2012 for Groups A, B and C, and January 18, 2012 for Group D. For entry to the nuclear power station (Group D), participants must submit personal information including age, address, ID and the size of boots and working wear in advance of the tour.

### **Tour A: Geotechnical Group (Maximum 50 persons)**

Earth dam failure (Fujinuma Reservoir), failure of earthfills reclaimed for residential area developments (Shiroishi & Sendai), tsunami (Ishinomaki and Onagawa), failure of river dykes (Eaigawa River), soil liquefaction (Urayasu)

### **Tour B: Building Group (Maximum 50 persons)**

Damage of Tohoku University (Sendai), damage of buildings (Miyagi-ken and Iwate-ken) and tsunami damage of buildings (Shizugawa and Rikuzen-Takada)

### **Tour C: Civil Infrastructure Group (Maximum 50 persons)**

Ground motion- and tsunami-induced damage of roads, railways and ports in north Miyagi-ken and south Iwate-ken along the Pacific coast, damage of lifeline facilities in Sendai and Ishinomaki

### **Tour D: Nuclear Power Station Group (maximum 30 persons)**

Damage in Sendai city, tsunami-induced damage in Ishinomaki and Onagawa. Visit to Onagawa Nuclear Power Station.

## KEYNOTE SPEAKERS

Ian M. Arbon, Institution of Mechanical Engineers, UK  
Akihiko Hokugo, Professor, Kobe University, Japan  
Fumihiko Imamura, Professor, Tohoku University, Japan  
Kojiro Irikura, Professor, Aichi Institute of Technology, Japan  
Kenji Ishihara, Professor, Chuo University, Japan  
Toshimi Kabeyasawa, University of Tokyo, Japan  
Hiroyuki Kameda, Professor Emeritus, Kyoto University, Japan  
Kazuhiko Kawashima, Professor, Tokyo Institute of Technology, Japan  
Kazuki Koketsu, Professor, University of Tokyo, Japan  
Mikio Koshihara, Professor, University of Tokyo, Japan  
Stephen A. Mahin, Professor, University of California, Berkeley, USA  
Masato Motosaka, Professor, Tohoku University, Japan  
Hideki Nariai, Professor Emeritus, Tsukuba University, Japan  
Masaki Shiratori, Professor, Yokohama National University, Japan

## PROGRAM OVERVIEW

### March 3, Saturday

Time	Hall A	Room A	Room B	Room C	Hall B
9:00-12:00	HA0: Keynote (1)				
12:00-12:50	Break				
12:50-15:05	HA1: Keynote (2)	A1: Recent Earthquakes (1)	B1: Damage of Geotechnical Structures	C1: Damage of Buildings (1)	HB1: Tsunami (1)
15:05-15:20	Break				
15:20-17:10	HA2: Damage of Buildings (2)	A2: Damage of Machineries and Power Generation Facilities	B2: Soil Liquefaction (1)	C2: Evacuation, Repair and Restoration (1)	HB2: Tsunami (2)
17:10-17:25	Break				
17:25-18:55	HA3: Damage of Buildings (3)	A3: Recent Earthquakes (2)	B3: Soil Liquefaction (2)	C3: Evacuation, Repair and Restoration (2)	HB3: Tsunami (3)
19:00-20:00	Welcome Reception with Light Buffet				

### March 4, Sunday

Time	Hall A	Room A	Room B	Room C	Hall B
9:00-10:30	HA4: Keynote (3)	A4: Recent Earthquakes (3)	B4: Fault Mechanism (1)	C4: Damage of Lifeline Facilities (1)	HB4: Tsunami (4)
10:30-10:45	Break				
10:45-12:15	HA5: Damage of Buildings (4)	A5: Damage of Nuclear Power Stations	B5: Fault Mechanism (2)	C5: Damage of Lifeline Facilities (2)	HB5: Tsunami (5)
12:15-13:05	Break				
13:05-14:35	HA6: Keynote (4)	A6: Recommendations for Future Earthquake Risk Mitigation	B6: Fire	C6: Damage of Buildings (5)	HB6: Ground Motions (1)
14:35-14:50	Break				
14:50-17:05	HA7: Keynote (5)	A7: Recent Earthquakes (4)	B7: Soil Liquefaction (3)	C7: Damage of Transportation Facilities (1)	HB7: Ground Motions (2)
17:05-17:20	Break				
17:20-19:50	HA8: Damage of Buildings (6)	A8: Evacuation, Repair and Restoration (3)	B8: Soil Liquefaction (4)	C8: Damage of Transportation Facilities (2)	HB8: Ground Motions (3)

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Lee Marsh	C7	Isao Nishiyama	HA2, HB2
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Fumiaki Nagashima	HB7	Mario E. Rodriguez	HA8
Shigeto Nagashima	HA2	Anat Ruangrassamee	HB2
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Atsushi Nagaya	HA8	Kenji Saito	HA2
Shoichi Nakai	B8, HA5, HB7	Taiki Saito	HA8
Hiroataka Nakajima	B2	Junichi Sakai	C7
Kosuke Nakajima	C1	Noriaki Sakamoto	B6
Miyoko Nakajima	B7	Toshiaki Sakurai	B1
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Takao Nakamura	A5	Francisco J. Sanchez-Sesma	HB7
Takeshi Nakamura	HB7	Katsunori Sasaki	B6
Tomoharu Nakamura	A8, B1	Takahiro Sasaki	C6
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Yoshiaki Nakano	HB2	Toshimi Satoh	HB7
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Haruki Nishi	B6	Ai Sekizawa	B6
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Akihiro Shibayama	HB8	Takehiko Terada	HA2
Kenichi Shibuya	B8	Masaomi Teshigawara	C6
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Jun Shindo	HA2	Kohji Tokimatsu	B2
Kiyoshi Shingu	HB1	Shinji Tokita	C6
Hitoshi Shiohara	HA3	Satoshi Tokue	HB6
Shigeaki Shiotani	HB1	Takashi Tomita	HB1
Masaki Shiratori	HA6	Takashi Torigoe	B7
Gaku Shoji	A2, A8, B1, C4	Ikuo Towhata	A6, B8
Jonathan Siu	HA8	Kozo Toyota	HA2
Akira Sone	A2	Peter S. Tsai	B1
Bo Song	A7	Shin-ichi Tsuburaya	A8
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Karl Telleen	A1	Guangren Yu	HB2



Nam-Yi Yun  
Guangfeng Zhang  
Hua Zhang

C3  
C7  
C8

Xin-Rui Zhang  
Dapeng Zhao

HB6  
B5

# DAILY TECHNICAL PROGRAMS

**March 3, Saturday**

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**Kazuki Koketsu** (University of Tokyo)

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Moderator: Saburoh Midorikawa

**Kojiro Irikura** (Aichi Institute of Technology) and Susumu Kurahashi

Strong Ground Motions during the 2011 Pacific Coast Off Tohoku, Japan Earthquake ..... 2

Moderator: Takashi Tomita

**Fumihiko Imamura** (Tohoku University) and Suppasr Anawat

Damage due to the 2011 Tohoku Earthquake Tsunami and Its Lessons for Future Mitigation ..... 3

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**Stephen Mahin** (University of California, Berkeley)

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**Kazuhiko Kawashima** (Tokyo Institute of Technology)

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Moderators: Mitsumasa Midorikawa and Andrew W. Taylor

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### **Welcome Reception with Light Buffet**

**19:00-20:00**

**Foyer of Main Hall  
1st Floor, Kenchikukaikan**



## March 4, Sunday

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Moderators: Hiroyuki Kameda and Tsuyoshi Takada

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Moderator: Kazuhiko Kawashima

- Ikuo Towhata** (University of Tokyo)  
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