

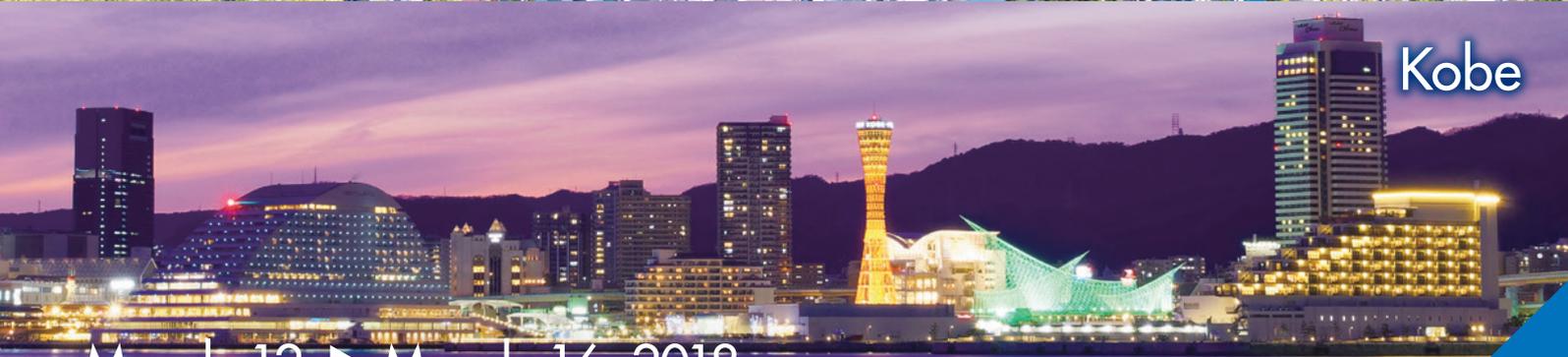
Tokyo



Sendai



Kobe



March 12 ▶ March 16, 2018

Tokyo, Sendai, and Kobe

Program

Technical Deep Dive on Seismic Risk and Resilience



Tokyo
Development
Learning
Center

Technical Deep Dive: Seismic Risk and Resilience

March 12-16, 2018

World Bank Tokyo Development Learning Center (TDLC)

World Bank Disaster Risk Management (DRM) Hub, Tokyo

Building Regulation for Resilience, Climate Change Mitigation and Development Knowledge Silo Breaker (KSB)

Overview

The Tokyo Development Learning Center (TDLC) and the World Bank Disaster Risk Management (DRM) Hub are organizing a Technical Deep Dive (TDD) on Seismic Risk and Resilience, in collaboration with the Building Regulation for Resilience, Climate Change Mitigation and Development KSB, in March 2018.

Earthquakes push more than 4 million people into extreme poverty on average every year, and building the quality of development investments coupled with increasing the preparedness of local authorities and residents can help address these challenges.¹

The TDD will provide a platform for knowledge exchange and structured learning on seismic risk management. It will also inform the design and preparation of participating client countries' ongoing or planned investments. Good practice, knowledge, and experience from Japan and other countries will be highlighted. A core component of this TDD will include country delegations sharing their own experiences and lessons learned related to strengthening seismic resilience. Japan's exposure to earthquakes is extremely high². Japan has proven that – even against the powerful destructive force of earthquakes – effective disaster risk management is possible through:

1. *Seismic Risk Identification*

Understanding risks is the first step to planning measures to reduce the effects of natural hazards. This focus area will provide an overview of the purpose and key methodologies for conducting seismic risk assessments. Discussion will focus on how to select, conduct, interpret, and operationalize risk assessments for policy making and development planning, such as cases of seismic risk assessments for (i) zoning and urban planning and (ii) design and construction of buildings.

2. *Seismic Risk Monitoring and Alert for Preparedness*

A chain of systems is required in order to detect and monitor earthquakes and then provide warning to the public in real time. Developing and managing seismic monitoring and disaster alert systems requires a focused coordination effort of stakeholders led by government and including local governments, research institutions, technical agencies, communities, and the private sector including media. This focus area will detail Japan's experience developing robust seismic monitoring and disaster alert systems.

3. *Seismic Risk Communication for Preparedness*

A public that is well-informed about the risk of earthquakes can prepare accordingly. Unfortunately, authorities face a variety of challenges in communicating earthquake risk to the public, including low public awareness and misinformation. This focus area will include the case study of [Seismic](#)

¹ "Unbreakable" (2016): <https://openknowledge.worldbank.org/handle/10986/25335>

² In Japan, Southern Pacific coastal regions are at the greatest risk of earthquakes. Some city centers in the Pacific coastal regions of Kanto, Tokai, Kinki and Shikoku have probabilities exceeding 80% for earthquakes with an intensity of 6 (on the Japanese seismic scale of 7) in the next three decades. Hazard map available here: <http://www.jshis.bosai.go.jp/map/>

[Preparedness Maps in Japan](#), which have been distributed to every household and include key information, such as the location of evacuations sites.

4. *Seismic Risk Management Applications in Infrastructure Management*

Earthquakes damage infrastructure, often leaving communities without safe and reliable services, such as water, electricity, and transportation. For example, damaged water pipelines and roads due to an earthquake adversely affect fire and emergency medical services and a cascade of other effects. This focus area will review: (i) options for integrating early warning and other risk reduction measures into risk-informed investment and asset management for infrastructure; (ii) cascading effects of earthquakes; and (iii) coordination models for DRM agencies, city management, and infrastructure operators on emergency preparedness & response, including business continuity planning (BCP) for infrastructure.

5. *Seismic Risk Reduction in the Built Environment*

[Building and land use regulation](#) can reduce vulnerability through the development and implementation of adequate standards for construction or retrofit and manage exposure by guiding development away from hazard-prone areas. This focus area will take a holistic approach to building regulatory systems, and their 3 critical components: legal & administrative frameworks, building code development & maintenance, and implementation & compliance. It will integrate [Japan's experience](#) of using an incremental approach to advance the safety in the built environment through building regulation and taking advantage of post-disaster reconstruction to “build back better”.

Objectives

This TDD will provide an opportunity for World Bank client country delegations to develop a deeper understanding of seismic risk, and the holistic approach required to reduce risk effectively:

- Build capacity for seismic risk identification, communication, and management;
- Inform client's ongoing or planned investments in seismic risk management;
- Follow-up operational support to support application of knowledge gained through the TDD;
- To facilitate peer to peer knowledge exchange amongst client countries;
- Cutting edge policy thinking and technical knowledge through engaging learning sessions;
- Tacit knowledge exchanges through applicable site visits;
- Opportunity to engage directly with Japanese academia, municipalities, ministries and the private sector to learn of innovative solutions and to identify areas of further collaboration and knowledge exchange.

Specifically, for this TDD on Seismic Risk and Resilience, participating World Bank client country delegations will aim to recognize:

- (1) the importance, economic arguments, and feasibility of investing in seismic resilience;
- (2) the range of potential interventions and investments available for this purpose; and
- (3) the potential expertise, solutions, and technical and policy details that can support and enhance such interventions and investments.

Participant Selection

- Based on nominations by GSURR management in coordination with the DRM Hub – priority will be given to countries supported through relevant TA from the Japan-World Bank DRM Program.
- Delegations will consist of 2 government officials and 1 World Bank TTL. To promote awareness of seismic risk management approaches across sectors and levels of government, it is recommended that the government officials should be of one of the following profiles. [This TDD](#)

will focus on ex-ante seismic risk reduction and management, and doesn't cover emergency response.

- Official responsible for urban or territorial development (including the built environment) at the sub-national or national level;
- Official from the national or sub-national DRM or emergency management authority;
or
- Official from the national authority responsible for identifying or monitoring seismic risk

Budget

TDLC and the DRM Hub will cover the following expenses (following World Bank policies):

- Airfares, hotel and actual expenses for all participants not based in Japan
- Simultaneous translation services (to/from English-Japanese)
- Venue for training, including required technology facilities
- Local Transportation
- Most meals, including breakfast, lunch and dinner. Participants will receive reimbursement (actual expense) for meals that are not provided by TDLC.

DAY 1 MONDAY, MARCH 12 -TOKYO-	
SCHEDULE	
8:30-9:00	Breakfast and Registration Venue: Tokyo Development Learning Centre (TDLC), Tokyo, Japan
9:00-9:40	<p><u>Welcome and technical deep dive objectives</u></p> <p>Agenda Setting: Introduce the TDD, key objectives, overview of the activities for the week</p> <ul style="list-style-type: none"> ▪ Dan LEVINE, Senior Officer, TDLC, WBG <p>Welcoming Remarks</p> <ul style="list-style-type: none"> ▪ Mr. Go MUKAI, Senior Deputy Director, Multilateral Development Banks Division, International Bureau, Ministry of Finance, Government of Japan <p>Framing Presentation: A Framework for Tackling Seismic Risk and Resilience</p> <ul style="list-style-type: none"> ▪ James NEWMAN, DRM Specialist, Coordinator, Tokyo DRM Hub, GFDRR, WBG <p>Icebreaker - Cultural bingo</p> <ul style="list-style-type: none"> ▪ Haruka IMOTO, Knowledge Management Analyst, TDLC, WBG
9:45-11:00	<p><u>Focus Area 1: Seismic Risk Identification</u></p> <p>Overview of types and methodologies for conducting and applying risk assessments. What are the objectives of seismic risk assessments? How do decide different levels of risk assessments to pursue? Practical use of seismic risk assessment?</p> <p>This session will introduce the national level risk assessment and policy framework that GoJ undertakes. The presentations will demonstrate how the outputs from the risk assessments underpin the subsequent planning of risk reduction activities.</p> <p>Seismic Risk Identification and risk reduction planning at the local government level</p> <p>How do local governments obtain and use risk information to plan and implement risk reduction activities?</p> <p>Introduction of Seismic Risk from the Government and Policymaker Perspective</p> <ul style="list-style-type: none"> ▪ Ms. Setsuko SAYA, Director, International Cooperation Division, Disaster Management Bureau, Cabinet Office, Government of Japan <p>Risk identification activities across the World Bank Disaster Risk Management projects</p> <ul style="list-style-type: none"> ▪ Rashmin GUNASEKERA, DRM Specialist, Urban DRM LAC, WBG ▪ Facilitator: James NEWMAN, DRM Specialist, Tokyo DRM Hub, GFDRR, WBG
11:00-11:15	Coffee Break
11:15-12:45	<p>Shift and Share (1): Presentations on challenges/approaches to managing disaster risks from participating delegations – 4 Countries</p> <p>Each participating delegation will make a brief presentation on efforts undertaken and major projects under implementation. The intention is to get to know the challenges faced and actions taken by each participating team.</p>
12:45-13:30	<p>Lunch</p> <p>Day 5 Optional Dinner - Please confirm RSVP with Ms. Haruko NAKAMATSU during Lunch.</p> <p>LOGISTICS REVIEW for DAY 2 – TDLC to brief on Hotel Check-Out and Day 2 Travel</p>
13:30-13:45	<p>Introduction to Technical Deep Dive Action Plan</p> <ul style="list-style-type: none"> ▪ Dan LEVINE, Senior Officer, TDLC, WBG
13:45-15:00	<p><u>Focus Area 2: Seismic Risk Monitoring and Alert for Preparedness</u></p> <p>This session will detail Japan’s experience developing robust seismic monitoring and disaster alert systems.</p> <ul style="list-style-type: none"> ▪ Speaker: Satoshi HARADA, Senior Coordinator for International Earthquake and Tsunami Information, Earthquake and Tsunami Observation Division, Seismology and Volcanology Department, Japan Meteorological Agency (JMA) ▪ Facilitator: Naohisa KOIDE, Senior Scientific Officer, Office of International Affairs, JMA ▪ Moderator: James NEWMAN, DRM Specialist, Coordinator, Tokyo DRM Hub, GFDRR, WBG

15:00-16:00	<p>Shift and Share (2): Presentations on challenges/approaches to managing disaster risks from participating delegations – 4 Countries</p> <p>Each participating delegation will make a brief presentation on efforts undertaken and major projects under implementation. The intention is to get to know the challenges faced and actions taken by each participating team.</p>
16:00-17:10	Supper / Reception Venue: “Rossini” (1F, Fukoku Seimei Building)
17:10-17:15	Proceed to 10 th floor for Public Seminar
17:30-19:00	<p><i>Public Seminar: “Converting Disaster Experience into a Safer Built Environment”</i></p> <p>Learning from Japan’s century long journey to improve the seismic resilience in the built environment. It was not a linear path, and continue to be evolving steps learning from each earthquake. How did it start? How highly technical engineering studies informed policy making and regulations? What approaches were taken to build enforcement capacity? What role financing can play? What are lessons we can learn?</p> <ul style="list-style-type: none"> ▪ Opening Remarks: Masato MIYAZAKI, Special Representative, Japan, World Bank (TBC) ▪ Speaker: Thomas MOULLIER, Senior Urban Specialist, GSURR, WBG ▪ Speaker: Hideaki SATO, Director for Building Technology Policy Analysis, Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) ▪ Speaker: Karen JIMENO, Undersecretary, Department of Public Works, Philippines ▪ Moderator: Keiko SAKODA, DRM Specialist, GSURR, WBG
	Stay in Tokyo

DAY 2 TUESDAY, MARCH 13 -TOKYO/SENDAI-	
SCHEDULE	
7:00-7:45	Breakfast at Hotel and Check-out Luggage Drop by 7:15 am sharp Lobby by 7:45 am sharp
7:45-8:30	Bus to Tokyo Station
8:56-11:00	Tohoku Shinkansen from Tokyo to Sendai (Tohoku Shinkansen-Yamabiko 129)
11:00-11:20	Walk to TKP Sendai Conference Room
11:30-12:30	<p><u>Focus Area 3: Seismic Risk Communication for Preparedness</u></p> <p>How to communicate risks to the community (including the case of Seismic Preparedness Maps in Japan)? What role you expect from citizen preparedness? What information will promote responsibility /self-help? How to manage sensitivity and incentivize opening hazard /exposure /vulnerability data?</p> <ul style="list-style-type: none"> ▪ Welcome Remarks: Akira TAKAHASHI, Senior Director, Disaster-Resilient and Environmentally-Friendly City Promotion Office, Sendai City ▪ Speaker: Tomoki SUZUKI, Director, Disaster Prevention Planning Section, Crisis Management Department, City of Sendai ▪ Panelist: Shoichi TAWAKI, Director, Disaster Risk Management Department, City of Sendai ▪ Discussant: Satoru MIMURA, Deputy Director General, JICA TOHOKU, Executive Senior Research Fellow, JICA Research Institute ▪ Moderator: World Bank
12:30-13:15	Lunch BRIEF LOGISTICS REVIEW for DAY 3 – TDLC to brief on Hotel Check-Out and Day 3 Travel
13:15-14:15	<p>Shift and Share (3): Presentations on challenges/approaches to managing disaster risks from participating delegations – 2 Countries & Report Back</p> <p>Each participating delegation will make a brief presentation on efforts undertaken and major projects under implementation. The intention is to get to know the challenges faced and actions taken by each participating team.</p>
14:15-15:30	<p><u>Focus Area 4: Seismic Risk Management Applications in Infrastructure Management</u></p> <p>Earthquakes damage infrastructure, often leaving communities without safe and reliable services, such as water, electricity, and transportation. For example, damaged water pipelines and roads due to an earthquake adversely affect fire and emergency medical services and lead to a cascade of other effects. This session will describe efforts to tackle the risks to infrastructure management.</p> <ul style="list-style-type: none"> ▪ Keynote: Fumihiko IMAMURA, Professor of Tsunami Engineering and Director of the International Research Institute of Disaster Science (IRIDeS), Tohoku University ▪ Panelist Presentation: Keisuke INOUE, Deputy Director, Planning Department, MLIT Tohoku and Mr. Junji KIMURA, Regional Planning Chief, Planning Division (Regional Planning Promotion Office for Greater Tohoku Areas), Planning Department, MLIT Tohoku ▪ Panelist Presentation: Tetsuya MIZUTANI, Ph D., Director of Sewerage Pipeline Construction Section, City of Sendai and Akihiko OTSUBO, Director of Management Strategy Office, Business Planning Section (Sewage management), City of Sendai ▪ Moderator: World Bank
15:30-16:00	Bus to Site Visit

16:00-17:45	<p><u>Site Visit:</u> Applications of Seismic Risk Identification and Awareness in Sendai, including Sendai Arahama Elementary School (with elevated road along the relocation site), and Tsunami Evacuation Nakano 5-Chome Tower.</p> <p>16:00-16:50 - Arahama Elementary School visit</p> <p>16:50-17:05 - Travel to Evacuation Tower</p> <p>17:05-17:30 - Evacuation Tower visit</p>
17:45-18:15	<p>Bus to HOTEL (JAL CITY SENDAI)</p> <p>LOGISTICS REVIEW for DAY 3 – TDLC to brief on Hotel Check-Out and Day 3 Travel</p>
18:15- 18:45	CHECK IN
18:45	Dinner to be confirmed

DAY 3 WEDNESDAY, MARCH 14 -SENDAI/KOBE-	
SCHEDULE	
6:00-6:30	Breakfast at Hotel and Check- out
6:30-7:15	Bus to Sendai Airport See Site Description in this Program regarding Seismic and Tsunami effects from GEJE in 2011 and new efforts to ensure its resilience to future risk using the PPP model
7:15-7:55	Flight Check-in
7:55-9:20	Flight from Sendai to Itami (NH732)
10:00-11:00	Bus to E-defense
11:00-12:30	Focus Area 5: Seismic Risk Reduction in the Built Environment (1) Building regulation can play a pivotal role to reduce seismic risk in the built environment, as Japan demonstrated . What comprises effective and efficient regulatory system? How to “nudge” compliance at scale? How to build robust enforcement capacity? <ul style="list-style-type: none"> ▪ Speaker and Facilitator: Thomas MOULLIER, Senior Urban Specialist, GSURR and World Bank BRR Team ▪ Discussant and Wrap-Up: Christoph PUSCH, DRM and Climate Change Practice Manager, South Asia Region, WBG
12:30-13:30	Lunch
13:30-15:00	Site Visit: 3D Full-Scale Earthquake Testing Facility (E-defense , National Research Institute for Earth Science and Disaster Resilience (NIED)), Hyogo Earthquake Engineering Research Center) Speaker: Koji SUZUKI, Executive Director, NIED 13:30-13:35 (1) Welcome Remarks Speaker: Kentaro TABATA, PhD., Chief Researcher, Earthquake Disaster Mitigation Research Division, NIED 13:35-13:55 (2) Introduction of NIED and E-defense 13:55-14:50 (3) Tour of the facilities of E-defense 14:50-15:00 (4) Questions and Answers
15:00-15:45	Bus to Great Hanshin-Awaji Earthquake Memorial Center (30-45 mins by bus)
15:45-17:30	Site Visit: The Great Hanshin-Awaji Earthquake Memorial Center 15:50-16:30 Lecture by storyteller (West 1F) 16:40-17:00 Theater (West 3F) 17:00-17:30 Guided Tour
17:40-18:00	Bus to Dinner Venue
18:00-19:00	DINNER at Japanese Restaurant (Saketo Meshino Hirai, Iikutazaka Branch)
19:00-	CHECK-IN Hotel
	Stay in Kobe

DAY 4 THURSDAY, MARCH 15 -KOBE/TOKYO-	
SCHEDULE	
8:00-9:00	Breakfast at Hotel and Check-out Hotel Registration at Day 4 venue
9:00-10:00	Discussion and Review of Days 1-3 and Introduction to Day 4 <ul style="list-style-type: none"> ▪ Key Remarks: Christoph PUSCH, DRM and Climate Change Practice Manager, South Asia Region, WBG
10:00-12:00	Focus Area 5: Roadmap for Seismic Risk Reduction in the Built Environment (2) “Roadmap for a Resilient Built Environment”, a new tool to support governments in the effective planning and implementation of building regulatory reform, and capacity building to foster professional resources that support the regulatory framework. What are the critical activities? Can your country’s experience help inform the roadmap? What are the key challenges your country faces in building regulatory reform and implementation? <ul style="list-style-type: none"> ▪ Speakers and Facilitators: Thomas MOULLIER and Keiko Sakoda, GSURR ▪ Speaker: Yukio TANAKA, Manager, Examination Guidance, Building Safety Division, Building Guidance Department, Housing and Urban Planning Bureau, Kobe City ▪ Speaker: Kazuya NAKAJIMA, Manager, Earthquake-Proof Construction Promotion Division, Building Guidance Department, Housing and Urban Planning Bureau, Kobe City ▪ Discussant: Christoph PUSCH, DRM and Climate Change Practice Manager, South Asia Region, WBG
12:00-13:00	Lunch
13:00-14:30	Focus Area 2-3: City of Kobe Training Session for Seismic Risk Preparedness for Government Officials <ul style="list-style-type: none"> ▪ Speaker and Facilitator: Taisuke MATSUZAKI, Director, ICT Promotion Department, Planning & Coordination Bureau, City of Kobe ▪ Moderator: James NEWMAN, DRM Specialist, Coordinator, Tokyo DRM Hub, GFDRR, WBG
14:30-14:45	Coffee Break
14:45-16:00	Action Planning Session Teams to continue preparing their Action Plans for the Action Plan Presentations on Friday. Resource people and facilitators will be available.
16:00-17:00	City Hall Site Visit: (i) Base Isolation & Damper, (ii) Emergency Operations Center (EOC), (iii) Bosai/DRM Public Outreach Office Visit to Kobe City’s Crisis Management Center in Kobe City Hall Annex 4
17:00-17:30	Bus to Shin-Kobe station
18:06-20:53	Shinkansen to Tokyo/ NOZOMI 46. Shin-Kobe 18:06 – Tokyo 20:53
21:00-21:30	Bus to HOTEL Check-in Hotel
	Stay in Tokyo

DAY 5 FRIDAY, MARCH 16 -TOKYO-	
SCHEDULE	
8:00-8:30	Breakfast at Hotel
8:30-9:00	Coffee at TDLC
9:00-9:30	<p>Video-Link with 100 Resilient Cities (100RC) Chief Resilience Officer (CRO) Exchange in Mexico City</p> <p>Brief exchange between Rockefeller Foundation’s 100RC Network Exchange in Mexico and the World Bank TDD in Japan: What is the idea/concept/solution for seismic resilience that has most resonated during the Exchange/TDD? Why? How can it be implemented at home?</p> <ul style="list-style-type: none"> ▪ Remarks: Christoph PUSCH, DRM and Climate Change Practice Manager, South Asia Region, WBG ▪ Speaker (via Video Conference): Dr. Arnoldo MATUS KRAMER, Mexico City, Chief Resilience Officer
9:30-10:30	<p>Action Plan Presentations (1)</p> <p>Each delegation presents their action plan; comments from expert panel:</p> <ul style="list-style-type: none"> ▪ Hideaki SATO, Director for Building Technology Policy Analysis, Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) ▪ Christoph PUSCH, DRM and Climate Change Practice Manager, South Asia Region, WBG ▪ Daniel LEVINE, Senior Officer, TDLC, WBG ▪ Moderator: James NEWMAN, DRM Specialist, Tokyo DRM Hub, GFDRR, WBG
10:30-10:40	COFFEE BREAK
10:40-12:00	<p>Action Plan Presentations (2)</p> <p>Each delegation presents their action plan; comments from expert panel:</p> <ul style="list-style-type: none"> ▪ Mikio ISHIWATARI, PhD, Senior Advisor on Disaster Management and Water Resource Management, JICA ▪ Keiko SAKODA, DRM Specialist, GSURR, WBG or Thomas Moullier, Senior Urban Specialist, GSURR, WBG ▪ Rashmin GUNASEKERA, DRM Specialist, Urban DRM LAC, WBG ▪ Moderator: James NEWMAN, DRM Specialist, Tokyo DRM Hub, GFDRR, WBG
12:00-13:00	Lunch
13:00-14:30	<p>Action Plan Presentations (3)</p> <p>Each delegation presents their action plan; comments from expert panel, including:</p> <ul style="list-style-type: none"> ▪ Thomas MOULLIER, Senior Urban Specialist, GSURR, WBG ▪ Moderator: James NEWMAN, DRM Specialist, Tokyo DRM Hub, GFDRR, WBG
14:30-15:00	Bus to site visit
15:00-16:30	<p>Site Visit: Tokyo Rinkai Disaster Prevention Park</p> <p>The Tokyo Rinkai Disaster Prevention Park acts as a central base of operations for disaster prevention in the Tokyo Metropolitan Area and houses emergency response facilities including local disaster management headquarters, as well as institutions that compile disaster-related information and coordinate emergency disaster measures.</p>
16:30-17:00	Bus to HOTEL
	<p>Optional Dinner at Gonpachi, Ginza</p> <p>Please confirm on Monday, March 12 with Haruko Nakamatsu, DRM Hub.</p>
	Stay in Tokyo

Site Visits

Sendai

Arahama Elementary School

This is one of the ruins of the Great East Japan Earthquakes still open to public. It is Sendai city's goal to never again fall victim to a tsunami, to pass on the lessons learned to future generations. After the earthquake struck, the four stories reinforced concrete school building became the evacuation area for 320 residents, students, and school personnel. The tsunami surged up to the 2nd floor, and everyone who had evacuated to the school building managed to escape safely to the rooftop. It is operated by the City of Sendai.

http://www.city.sendai.jp/kankyo/shisetsu/documents/mitsuori_arahamasyo_2.pdf



(Top left: Visit by WBG President Jim Yong Kim and IMF Managing Director in 2012, right and bottom: City of Sendai website)

Nakano 5-chome Tsunami Evacuation Tower

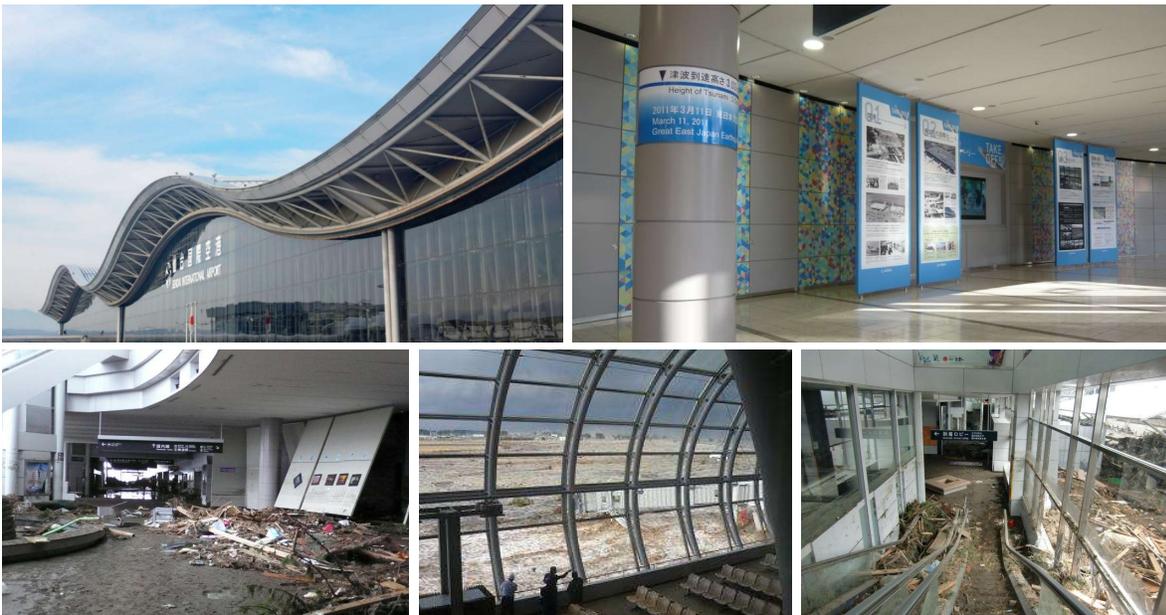
Based on the lessons learned from the Great East Japan Earthquake, the City of Sendai has invested in the construction of Tsunami Evacuation Towers. The first Tsunami Evacuation Tower was launched in February 2016 in Nakano 5-Chome area. It accommodates 300 people with 398 m² and 9.9 m from ground level, and provides emergency food and water, radio connected to municipal disaster risk management, toilet facility, slope for wheelchair evacuees, solar-powered LED light for night evacuation, portable generator, among other features, depending on the earthquake and tsunami conditions. Evacuation towers were designed and located based on seismic review of where a tsunami would arrive in approximately 45 minutes. Sendai City has 13 towers, which also are used for evacuation drills.



Reference: City of Sendai Official Website

Sendai Airport

The Sendai airport is the first and the only one airport in Japan hit by tsunamis in 2011. The exhibition panels are displayed on the ground floor to see what happened to this airport in the Great East Japan Earthquake. Refer to new efforts to ensure its resilience to future risk using the PPP model in the link below. <http://pubdocs.worldbank.org/en/221901515466795175/ppp-contracts-and-procurement-japan-case-study-final.pdf> (please see more WGB knowledge products in Bibliography of the Program) <https://www.sendai-airport.co.jp/en/>



Reference: (Top left) WBG, (right and bottom) Sendai Airport Corporate Division

Kobe

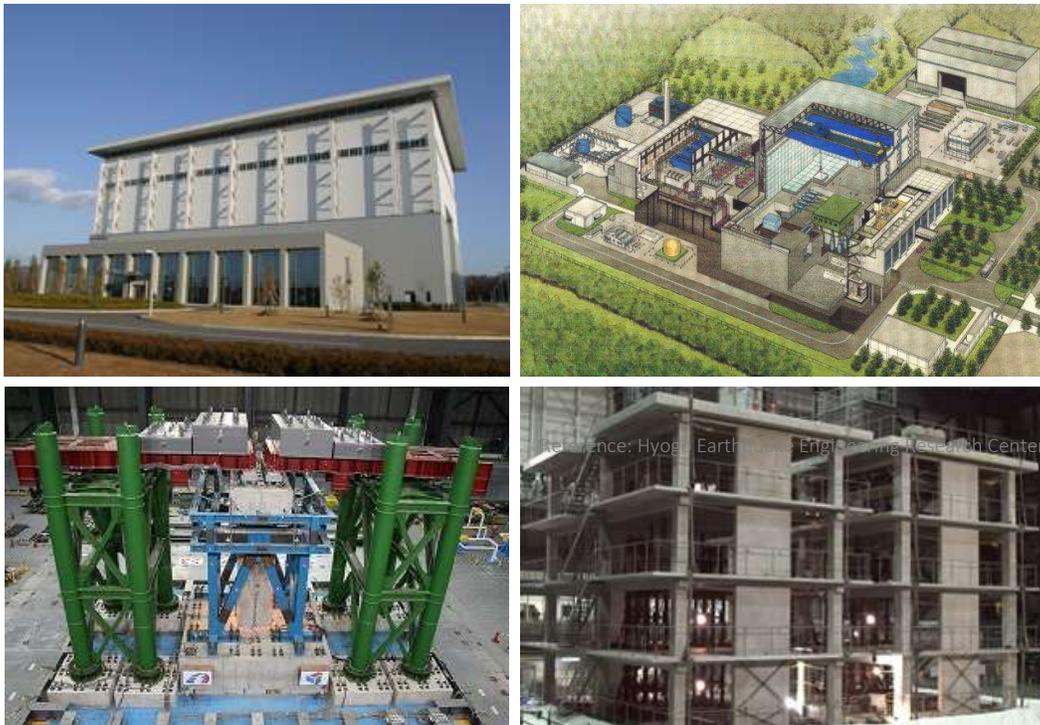
E-Defense

Hyogo Earthquake Engineering Research Center, National Research Institute of Earth Science and Disaster Resilience (NIED)

The 3-D Full-Scale Earthquake Testing Facility, E-Defense, is operated by the Hyogo Earthquake Engineering Research Center since 2005. The world's largest shaking table can simulate high level ground motions up to 1,200 tons (1t=1,000kg) with the same level of magnitude as the 1995 Hanshin-Awaji Great Earthquake. Videos of shaking experiments can be seen in this link below:

<http://www.bosai.go.jp/hyogo/research/movie/movie.html>

<http://www.bosai.go.jp/hyogo/ehyogo/index.html>



The Great Hanshin-Awaji Earthquake Memorial Museum

Disaster Reduction and Human Renovation institution (DRI)

The Disaster Reduction and Human Renovation Institution (DRI) was established in Kobe in 2002 to raise disaster awareness, enhance local capacity for disaster management, support the development of disaster management policies, and contribute to civic collaboration on safety and security. The Memorial capture the effects, overs, efforts and lessons learned from the 1995 Great Hanshin-Awaji Earthquake.

<http://www.dri.ne.jp/en>



Reference: Disaster Reduction and Human Renovation Institution

Tokyo

The Tokyo Rinkai Disaster Prevention Park

In the event of a large-scale disaster, such as an earthquake centered below Tokyo, the Tokyo Rinkai Disaster Prevention Park acts as a central base of operations for disaster prevention in the Tokyo Metropolitan Area that houses emergency response facilities including local disaster management headquarters, as well as institutions that compile disaster-related information and coordinate emergency disaster measures. The park is also a disaster prevention facility that acts as a core base camp for regional assistance units and a base of support for disaster medical care that functions in an integrated manner with the Higashi Ogishima region (Kawasaki City) distribution control center.

With respect to park operations, the City of Tokyo divides responsibilities with the Ministry of Land, Infrastructure, Transport and Tourism through the Urban Park Program taking into account activities during standard hours as well as times of disaster. (1) During standard operating hours, relevant organizations collaborate and perform exchanges of disaster-related information as well as a variety of simulations, training, and other activities in order to prepare for future disasters. (2) The park is also provided as a place to encourage interest among the citizens of Japan and instill within them the intelligence, knowledge, techniques, as well as values of self-help and mutual assistance, that will make it possible for them to handle an actual disaster through a wide variety of experience, studying, and training. (3) The park is also an attractive area that takes advantage of urban concentration and ability to attract visitors to the Tokyo waterfront subcenter.

<http://www.ktr.mlit.go.jp/showa/tokyorinkai/english/index.htm>

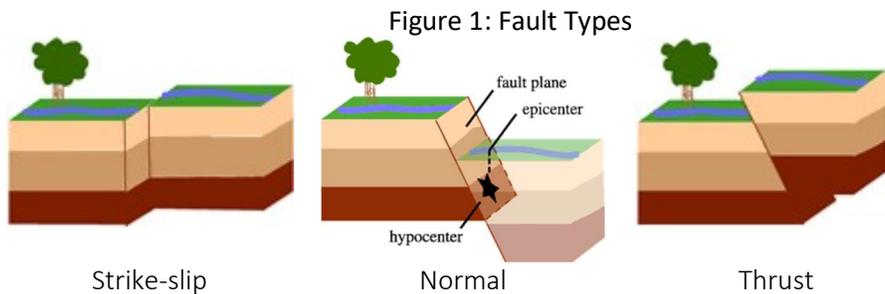


Reference: Tokyo Rinkai Disaster Prevention Park Website

Key Information on Earthquakes and Tsunamis

Definition

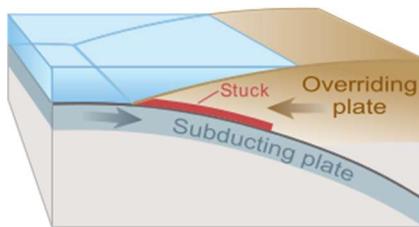
- **Earthquake:** a sudden violent shaking of the ground, which occurs as the result of movements within the earth's crust or volcanic activity.



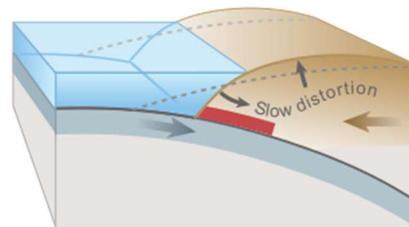
Reference: U.S. Geological Survey

- **Tsunami:** a long, high sea wave caused by an earthquake or other disturbance.

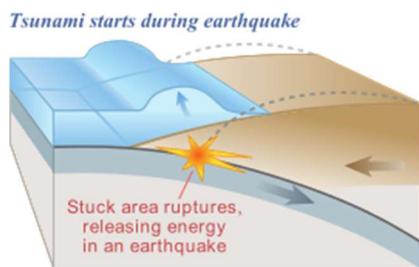
Figure 2: Tsunami Triggered by an Earthquake



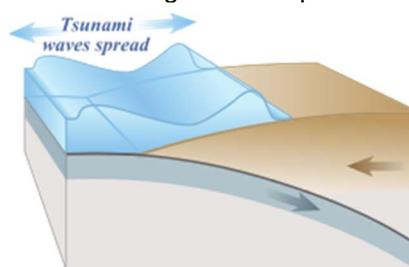
1. Tectonic plate boundary before earthquake



2. Overriding plate bulges under strain, causing tectonic uplift



3. Plate slips, causing subsidence and releasing energy into water



4. The energy released produces tsunami waves

Reference: U.S. Geological Survey

Measuring Earthquakes

There are several ways of measuring the magnitude and intensity of earthquakes, including magnitude (M_s), Modified Mercalli Intensity (MMI) Scale, and the JMA Seismic Intensity Scale.

Magnitude (M_s)

M_s	Approximate Incidence of Earthquakes of this Magnitude per year
8.5 - 8.9	0.3
8.0 - 8.4	1.1
7.5 - 7.9	3.1
7.0 - 7.4	15
6.5 - 6.9	56
6.0 - 6.4	210

Source: <https://earthquake.usgs.gov/learn/topics/measure.php>

Modified Mercalli Intensity (MMI) Scale

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Source: <https://earthquake.usgs.gov/learn/topics/mercalli.php>

JMA Seismic Intensity Scale

Magnitude-Shindo Number (Shindo Number in Japanese) / Meter reading	Effects on people	Peak ground acceleration ^[12]	Approximate Equivalent Rating on Mercalli Scale
0 (0) / 0–0.4	Not felt by all or most people.	Less than 0.008 m/s ²	I
1 (1) / 0.5–1.4	Felt by only some people indoors.	0.008–0.025 m/s ²	I-II
2 (2) / 1.5–2.4	Felt by many to most people indoors. Some people awake.	0.025–0.08 m/s ²	II-IV
	Felt by most to all people indoors. Some people are frightened.	0.08–0.25 m/s ²	III-IV
4 (4) / 3.5–4.4	Many people are frightened. Some people try to escape from danger. Most sleeping people awake.	0.25–0.80 m/s ²	V-VII
5-lower (5 弱) / 4.5–4.9	Most people try to escape from danger by running outside. Some people find it difficult to move.	0.80–1.40 m/s ²	V-VIII
5-upper (5 強) / 5.0–5.4	Many people are considerably frightened and find it difficult to move.	1.40–2.50 m/s ²	VI-IX
6-lower (6 弱) / 5.5–5.9	Difficult to keep standing.	2.50–3.15 m/s ²	VIII-X
	Impossible to keep standing and to move without crawling.	3.15–4.00 m/s ²	IX-X
	Thrown by the shaking and impossible to move at will.	Greater than 4 m/s ²	X-XII

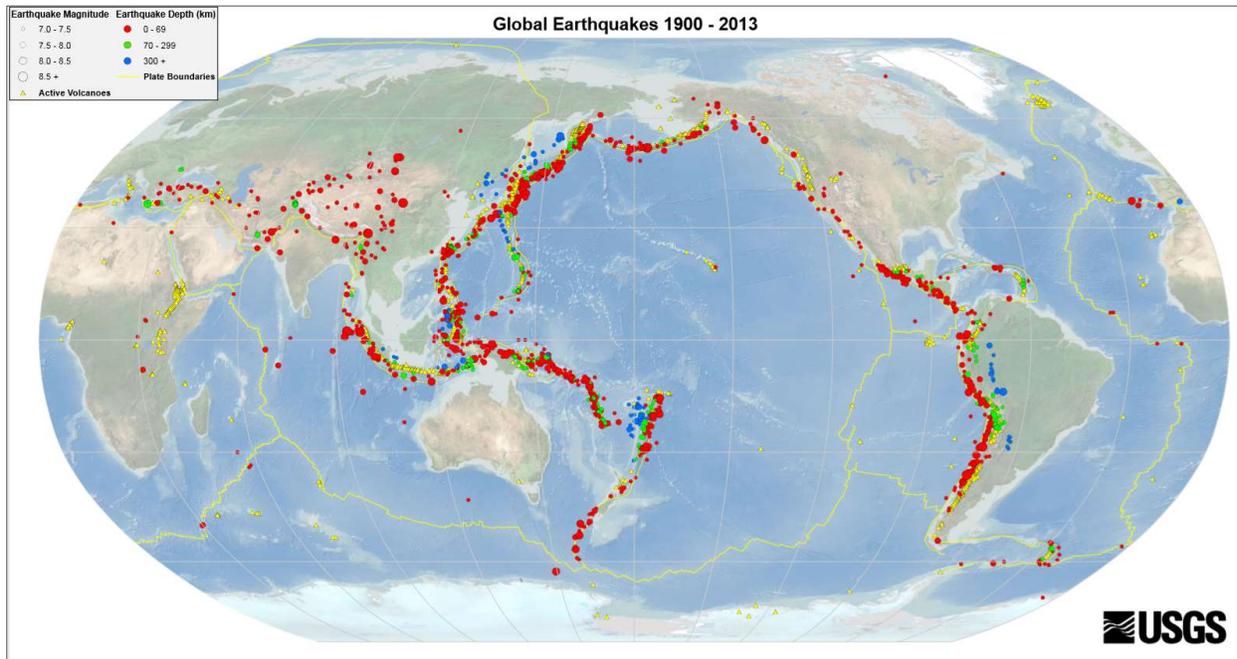
Source: https://en.wikipedia.org/wiki/Japan_Meteorological_Agency_seismic_intensity_scale

Measures of Earthquake and Tsunami Annual Average Exposure by Country

Region	Country	Earthquake (Scale of 0-10)	Tsunami (Scale of 0-10)	Physical exposure to earthquake MMI VI	Physical exposure to earthquake MMI VIII	Annual Expected Exposed People to Tsunamis
AFR	Kenya	4.2	5.6	29,409	-	33
AFR	Malawi	4.0	-	15,143	-	-
EAP	Indonesia	8.4	9.6	428,042	7,304	10,468
EAP	Japan	9.4	10.0	207,695	113,310	36,837
EAP	Myanmar	9.3	8.5	105,139	27,385	1,125
EAP	Philippines	9.4	9.1	155,287	90,565	3,150
LCR	Ecuador	9.4	9.0	33,015	12,481	931
LCR	Peru	9.2	9.1	52,408	25,386	1,599
MNA	Lebanon	6.5	6.0	12,122	-	17
SAR	Bangladesh	8.7	8.5	266,067	25,242	2,110
SAR	India	7.9	8.3	819,762	84,880	4,018
SAR	Nepal	9.9	-	59,595	41,262	-
Total	Total	8.0	7.0	2,183,683	427,815	60,289

Source: INFORM Index (<http://www.inform-index.org/>)

Map of Global Earthquakes 1900-2013



Reference: U.S. Geological Survey

Major Earthquakes and Tsunamis in Japan

Name of Earthquake	Date	Event type	Magnitude	Effects on people
2016 Kumamoto Earthquake	April 14/ April 16	Earthquake	M6.5/M7.3	120
2011 Great East Japan Earthquake	March 11	Earthquake and tsunami	M9.0	21,839
2007/2004 Chuetsu Earthquake	July 16, 2007 /October 23, 2004	Earthquake /Earthquake	M6.8/M6.8	68/15
1995 Hanshin-Awaji Great Earthquake	January 17	Earthquake	M7.3	6,437
1946 Nankai Earthquake	December 21	Earthquake and tsunami	M8.0	1,443
1933 Showa Sanriku Earthquake	March 3	Earthquake and tsunami	M8.1	3,064
1923 Great Kanto Earthquake	September 1	Earthquake and tsunami	M7.9	105,000

Reference: Cabinet Office / Japan Meteorological Agency

List of Relevant Materials

No.	Title of Publication	Source	Year	Key Pages (if applicable)	Link
1	Preparedness Map for Community Resilience: Earthquakes, Experience of Japan	World Bank (DRM Hub)	2016	ALL (29 pages, no Annex)	https://www.gfdrr.org/sites/default/files/publication/121516_drnhubtokyo_Preparedness_Map_for_Community_Resilience_Earthquakes.pdf
2	Modernization of Japan's Meteorological Services: A Report on Lessons Learned for Disaster Risk Management	World Bank (DRM Hub)	2016	Pg. 141-146	http://pubdocs.worldbank.org/en/855021475119724095/DRMHubTokyo-Modernization-of-Meteorological-Services-in-Japan.pdf
3	Resilient Water Supply and Sanitation Services The case of Japan-Solutions Brief 2017	World Bank (DRM Hub)	2017	4-pager	http://pubdocs.worldbank.org/en/728691516233426227/Resilient-WSS-Japan-Solutions-Brief-FINAL.pdf
4	Building Regulation for Resilience: Managing Risks for Safer Cities	World Bank (DRM Hub)	2015		https://www.gfdrr.org/sites/default/files/publication/BRR%20report.pdf
5	Building Regulation for Resilience - Program Profiles	World Bank (DRM Hub)	2016	2 pages	https://www.gfdrr.org/sites/default/files/publication/program-profile-building-regulation-for-resilience.pdf
6	Built Environment - Transforming Disaster Experience into a Safer Built Environment: The Case of Japan -, Solutions Brief	World Bank (DRM Hub)	2016	4-pager	http://pubdocs.worldbank.org/en/969091497345407955/DRMHubTokyo-201706-Built-Environment.pdf
7	Learning from Mega-Disasters: Lessons from the Great East Japan Earthquake	World Bank	2014	Overview - P1-21	https://www.gfdrr.org/sites/default/files/publication/Learning%20from%20Megadisasters%20Lessons%20from%20the%20Great%20East%20Japan%20Earthquake.pdf
8	Istanbul Seismic Risk Mitigation & Emergency Preparedness - Success Stories	World Bank	2015		https://www.gfdrr.org/en/publication/istanbul-seismic-risk-mitigation-and-emergency-preparedness-project-ismep

No.	Title of Publication	Source	Year	Key Pages (if applicable)	Link
9	Cabinet Office White Paper - Disaster Management in Japan	Government of Japan	2017	Page 1 - special feature entitled "Revising Disaster Management Policies in Light of the Kumamoto Earthquake."	http://www.bousai.go.jp/kyoiku/panf/pdf/WP2017_DM_Full_Version.pdf
10	Disaster Management in Japan (Brochure)	Government of Japan	2011	52 pages with Japanese and English on the same page	http://www.bousai.go.jp/1info/pdf/saigaipanfe.pdf
11	Meteorological Service Act, Act No. 165 of June 2, 1952	Government of Japan	1952	Available in English	http://www.japaneselawtranslation.go.jp/law/detail_main?re=&vm=02&id=1968
12	Tsunami Evacuation Guide/Map of Tsunami Evacuation Facilities, Shelters, and Areas	City of Sendai	-	1-page A3 map	Hard copy
13	Display Guide: Ruins of the Great East Japan Earthquake: Sendai Arahama Elementary School, Disaster-Resilient and Environmentally-Friendly City Promotion Office, City of Sendai, 2017	City of Sendai	-	8-page A4 pamphlet	Hard copy
14	Development of Tsunami Evacuation Facilities in Sendai City-Nakano 5-chome Tsunami Evacuation Tower-, Planning Section, Disaster Prevention Planning, Crisis Management Department, City of Sendai	City of Sendai	-	1-page A3 guide	Hard copy
15	Guidebook of Sendai 3/11 Memorial Community Center	City of Sendai	-	Pamphlet	Hard copy
16	(in Japanese) Recovery Construction of Minami-Gamo Wastewater Treatment Plant, City of Sendai	City of Sendai	-	24-page A4 pamphlet	Hard copy
17	Sendai DRR Newsletter Vol.1, November 2016, City of Sendai	City of Sendai	2016	2-pager	Hard copy
18	Sendai DRR Newsletter Vol.3, September 2017, City of Sendai	City of Sendai	2017	2-pager	Hard copy
19	SENDAI -Toward a Disaster-Resilient and Environmentally-Friendly City-	City of Sendai	2017	15-pager A4 booklet	Hard copy
20	Road to Recovery SENDAI	Post-Disaster Reconstruction Department City Planning, Policy Bureau, City of Sendai	2017	31-pager A4 booklet	Hard copy

No.	Title of Publication	Source	Year	Key Pages (if applicable)	Link
21	NEVER FORGET: Memories of the Great East Japan Earthquake	Tohoku Regional Bureau, MLIT)	2015	30-page booklet	Hard copy Ref: Earthquake Memorial Museum (MLIT Tohoku Bureau) http://infra-archive311.jp/en/ It has rich information including photos, videos, chronology of 3.11.
22	Leading the First Response to Large-scale Natural Disasters -Lessons from the MLIT's Experience of the Great Eastern Japan Earthquake-	Tohoku Regional Bureau, MLIT	2014	A book of 208 pages.	Hard copy
23	New report highlights risks of fire and building collapse in central Tokyo following predicted megaquake	Japan Times	Feb 15, 2018	Article	https://www.japantimes.co.jp/news/2018/02/15/national/new-report-highlights-risks-fire-building-collapse-central-tokyo-following-predicted-megaquake/#.WoaB5ujFKhM



Tokyo, Sendai, and Kobe

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