The Master Builders

For more than half a century, Japan's Building Research Institute has served as a global center of excellence in earthquake and tsunami disaster mitigation.

On Saturday, February 27, 2010, at 3:34 a.m. local time (3:34 p.m. in Japan), a major earthquake measuring M 8.8 on the Richter scale of magnitude occurred along the Pacific coast region of Chile in South America. The tremor and a subsequent tsunami devastated a large part of the country, and left 432 people dead and 98 missing. More than 1.8 million people and 810,000 residential buildings were afflicted. Japan's Building Research Institute provided support in the assessment of damaged buildings undertaken by the Department of Housing Affairs in Chile's Ministry of Housing and Urban Affairs, in collaboration with the University Catolica, the University of Chile and others.

Among other buildings, many high- and medium-rise reinforced concrete buildings and masonry structures were badly damaged. Reinforced concrete buildings mainly have shear walls as seismic elements and many masonry structures make up most of the low-rise buildings. In Concepción, a high-rise reinforced concrete building toppled and collapsed (photo 1) and a collapse at the middle level of another building was seen. More serious damage was observed in this city than in any other area.

The Building Research Institute had previously accepted a total of forty-two trainees from Chile. Some former trainees provided dedicated cooperation in the damage survey, to ensure efficient operation. This demonstrates how human exchange is beneficial to damage-related activities. The following section outlines the training program.

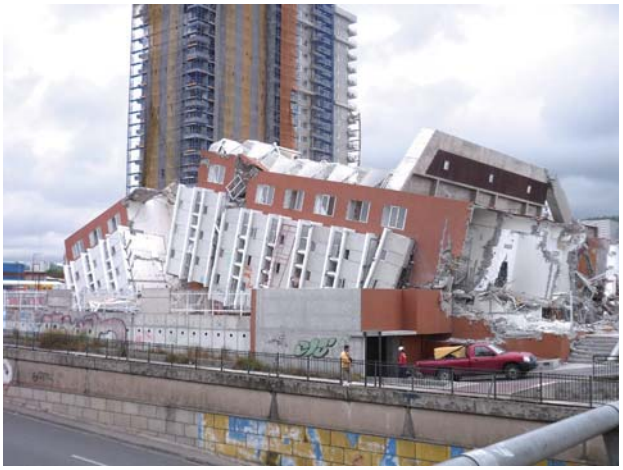

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Photo 1: The high-rise multi-family residential building in Concepción which toppled and collapsed

International Training in Seismology and Earthquake Engineering

In 1960, half a century ago, a strong earthquake with a magnitude of M 9.5 hit Chile. It was the most powerful earthquake ever recorded. In the same year, the second World Conference on Earthquake Engineering took place in Tokyo to discuss and recognize the need for training in earthquake engineering for young seismologists and earthquake engineers from developing countries. After that, the first international training in seismology and earthquake engineering was carried out at the University of Tokyo. It comprised a seismology course and an earthquake engineering course. The results of this training program earned such high praise from the international community that the Japanese government set up the International Institute of Seismology and Earthquake Engineering (IISEE), in the Building Research Institute in January 1962, to continue providing the training. In the following year, the first half of the second training session took place at Waseda University. Later, the IISEE took over the program to organize the second half of the training. Since then, the IISEE has been in charge of the training.

Under this scheme, run in cooperation with the Japan International Cooperation Agency (JICA), four different types of training are currently provided, namely: Annual Training in Seismology and Earthquake Engineering, Global Seismological Observation Course, China Seismic Building Course and Individual Course.

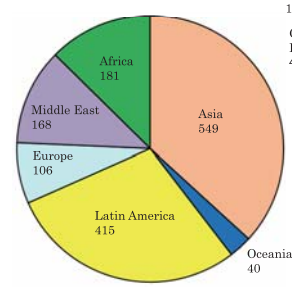
As of August 2010, a cumulative total of 1,459 trainees from ninety-six countries and areas have participated in the training courses (figure 1). These training courses are highly regarded in Japan and beyond.

The Seismology Course

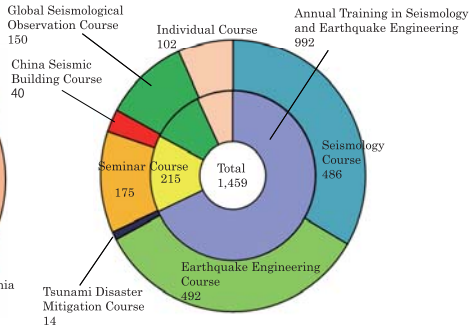
The Seismology Course is provided as part of the Annual Training in Seismology and Earthquake Engineering. It is attended by researchers, engineers and government officials from developing countries, centered on young personnel working in public bodies responsible for seismological observation and earthquake and tsunami countermeasures, universities and other institutions, who are expected to act as key players in their home countries in the future. The course covers information science and technology, including mathematics and computer sciences, disciplines concerning the earthquake source process, determination of earthquake parameters, seismological observation, seismic activities and the propagation of seismic waves, earthquake risk assessment jointly provided with the earthquake engineering course, as well as earthquake disaster countermeasures and policies. It includes not only classroom lectures and training but also visits to key facilities, and participation in international academic conferences held in Japan. Some lectures may involve outdoor training and laboratory experiments (**photo 2**).

Figure 1: International Training in Seismology and Earthquake Engineering

Number and Nationalities of Trainees
– Achievement of 50 years –



Number of ex-participants by region



Number of ex-participants by course

Participants in this course come mainly from earthquake-prone countries. Since the 2004 Indian Ocean Tsunami subsequent to the Sumatra-Andaman Earthquake, the course has been attended by personnel from countries where earthquakes do not occur or are unlikely, such as Sri Lanka and Bangladesh. The 2009–2010 course accepted a total of nine trainees, two coming from Malaysia and one each from China, Columbia, Myanmar, Nepal, Pakistan, Peru and the Philippines.

The Earthquake Engineering Course

The other course in the Annual Training in Seismology and Earthquake Engineering focuses on earthquake engineering. Like the Seismology Course, it is designed for researchers, engineers and government officials, centered on young personnel working in government organizations, universities and other institutions. The training is provided with a view toward mitigating damage caused by earthquakes to structures and resulting damage to humans in developing countries.

The course covers structural analysis and structural dynamics fundamental to earthquake engineering, different earthquake-resistant structures such as reinforced concrete and steel structures, the latest in seismic isolation and response control techniques and the seismic limit state design approach. After studying these subjects through lectures, practical training and tours, trainees continue pursuing specific subjects, based on their own interests or challenges, under the supervision of their advisors. The course will thus help them solve the problems facing their home nations. The 2009–2010 course accepted a total of eight earthquake engineers and researchers, three of whom are from El Salvador with one each from Algeria, China, Indonesia, Nicaragua and Peru.

Photo 2: Trainees visit the Nojima Fault Preservation Museum in Awaji-shima island, Hyogo Prefecture.

Sumatra-Andaman Earthquake

On December 26, 2004, at 00:58:53 UTC, a massive earthquake with a magnitude of M 9.1 struck, its epicenter off the northwestern coast of Sumatra near the Andaman Islands. It triggered a series of tsunamis that traveled over the Indian Ocean to claim more than 220,000 lives in coastal countries. It was the worst tsunami disaster in history. Experts commented that the lack of development of the tsunami warning systems in the Indian Ocean coast region and a lack of public knowledge about tsunamis were among the reasons for the extensive damage. Data demonstrate the estimated times required from occurrence of the earthquake to the arrival of the waves at different locations. The data are based on a numerical simulation. This reveals that there were a couple of hours until the tsunami hit some countries remote from the epicenter zone, especially in Thailand, India and

Sri Lanka, where the damage was tremendous. An appropriate measure for evacuation and disaster control with a tsunami alert immediately after the earthquake could have massively reduced the damage.

Tsunami Disaster Mitigation Course

The damage from tsunamis cannot be mitigated without disaster control countermeasures based on the latest findings on earthquakes and tsunamis. The Tsunami Disaster Mitigation Course was launched in the 2006–2007 season, as a third annual training course on seismology and earthquake engineering.

The objectives of the course are to help the trainees acquire advanced knowledge and skills relating to earthquakes and tsunamis through training in the field of tsunami disaster mitigation policies and to develop people capable of using their knowledge and skills for tsunami disaster mitigation such as tsunami hazard assessment and tsunami early-warning systems, and introducing them in their own countries. The 2009–2010 course trained a total of five participants, two from Indonesia and one each from Fiji, Malaysia and Peru (**photo 3**).

Photo 3: Trainees visit facilities for tsunami disaster prevention in Miyako City, Iwate Prefecture

Photo 4: Dr. Murakami Shuzo, chief executive of Japan's Building Research Institute, awards master's degrees in disaster mitigation to trainees at the National Graduate Institute for Policy Studies.

Master's Degree in Disaster Management

From October 2005, some of the lectures delivered at the annual training in an alliance with the National Graduate Institute for Policy Studies (GRIPS) are recognized as GRIPS lectures. This allows trainees to obtain a master's degree in disaster management accredited by GRIPS and the Building Research Institute, by taking a master's degree program run by GRIPS and by obtaining the required credits. All nineteen trainees who completed the training in September 2006 became the first to receive the master's degree under the program. This academic qualification helps ensure and enrich the foundations for the trainees' activities as specialists in seismology and earthquake engineering after they return to their countries. Set up in 2006, the Tsunami Disaster Mitigation Course is also run as a course under the master's degree program (**photo 4**).

Sichuan, China Earthquake

On May 12, 2008, at 2:28 p.m. local time, a strong earthquake with a magnitude of M 7.9 occurred, its epicenter in Wenchuan county in the Chinese province of Sichuan. The quake killed 69,185 people, with 374,171 injured and 18,404 missing. Among the 23,143,000 residential houses hit by the quake, 6,525,000 collapsed (**photo 5**). Masonry buildings were particularly hard hit. The Building Research Institute took swift action, accepting seven Chinese trainees for the Seismology Course and the Earthquake Engineering Course under the annual international training in seismology and earthquake as part of its assistance in post-earthquake reconstruction (**photo 6**).

Photo 5: The Sichuan Earthquake of May 2008 left millions homeless.

Photo 6: Trainees on the China Seismic Building Course following the first lecture of the 2009 term at the Building Research Institute

In addition, the China Seismic Building Course was launched in October 2009 as part of JICA's Human Resource Development Project for Seismic Buildings. This course is set to be offered for three years, with approximately twenty trainees each year. After completing the training, engineers are expected to return home and introduce the technologies in their own countries. The aim of the course is to train around 5,000 structural engineers.

Global Seismological Observation Course

Actions for putting into effect the Comprehensive Nuclear Test Ban Treaty (CTBT) are underway inside and outside Japan. In connection with these

initiatives, the IISEE has been offering a two-month Global Seismological Observation Course in cooperation with the Japan Meteorological Agency and JICA since 1995. As requested by the Ministry of Foreign Affairs, the IISEE engages in this course to make an international contribution for pushing ahead with nuclear arms reductions (**photo 7**).

Photo 7: Participants on the Global Seismological Observation Course receive practical training in the use of seismometers.

Ex-Trainees' Activities

Trainees are dispatched from government organizations, state-run research institutions and universities. After returning home, some work as leaders in the fields of seismology and earthquake engineering as ministers, heads of research institutions and university professors. The following gives some examples.

Dr. Harsh Gupta from India took the 1966–67 course and later served as secretary to the Government of India for the Department of Oceanic Development, the director of the Indian National Geophysical Research Institute and the first chairman of the Asian Seismological Society. At the end of 2008, he was awarded a Waldo E. Smith Medal from the American Geophysical Union for his scientific contribution in seismology and for the outstanding role he has played in geosciences.

The training has been received by many personnel from the National Research Institute of Astronomy and Geophysics (NRIAG) in Egypt. Dr. Rashad Kebeasy was a trainee in the 1965–66 course. He is a former president of the NRIAG and a former director of the International Data Center in the Preparatory Commission for the Comprehensive Nuclear-test-ban Treaty Organization (CTBTO). Dr. Salah Mohamed took part in the 1982–83 course and is the current president of the NRIAG.

As of 2008, Peru had sent the largest number of trainees, specifically 105. Taking the 1961–62 course, Dr. Julio Kuroiwa is an influential figure in the world of earthquake engineering in Peru. After the Pisco Earthquake in 2007, he provided daily explanations on Peruvian television. Dr. Roberto Morales took part in the 1970–71 course and later served as principal of the National University of Engineering in Peru. Sadly, he passed away in office. The knowledge and technologies he learned from the international training on seismology and earthquake engineering were passed down by him to Peruvian researchers and engineers and now help mitigate natural disasters in that country.

Working in the Institute of Engineering Mechanics under the China Earthquake Administration, Yu Shizhou was a trainee in the 2006–07 course. Just after the Sichuan Earthquake in 2008, he started a long-term field survey on the damage. His activities were reported in the Japanese press. Many former trainees, including Shizhou, took part in the damage survey after the major earthquake and cooperated with the emergency rescue mission from Japan.

IISEE Net

The Internet-based Information Network of Earthquake Disaster Prevention Technologies (hereinafter referred to as "the IISEE Net" [http://iisee.kenken.go.jp/]) has been established. It offers Web access to a wide range of technical information on earthquake disaster mitigation for buildings to the public. At present, it has technical information for ninety-one countries, most of which are developing nations. The information covers the earthquake observation network, the strong motion observation network, the seismic damage history, the quake-resistant building standards and examples of microzoning. The information available on IISEE Net is updated each year on the basis of data received from trainees. The IISEE Net has been equipped with the Earthquake Damage Estimation System for Buildings (EDES-B), which proposes the methodologies and steps required for estimating earthquake damage in the form of a list on the website, from which developing countries can select a method. It also seeks to offer information to developing countries in multifarious ways, for instance, by preparing lecture notes for training in the form of electronic data, providing special lectures with the use of the video conferencing system and introducing an e-learning system.

The UNESCO Project

The training program has been run continuously for half a century. More than 1,400 engineers and researchers from around 100 countries have completed the international training in seismology and earthquake engineering. They must work to minimize the damage caused by earthquakes not merely in their home countries but in neighboring countries as well. The Ministry of Land, Infrastructure, Transport and Tourism of Japan, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the IISEE have formed a cooperative relationship with the aim of building an international network for research and training on the subject of earthquake disaster mitigation in the building and housing sector, and to create the International Platform for Reducing Earthquake Disasters, as a mechanism for providing international support in the event of a huge earthquake or tsunami. This project enjoys the cooperation of research and other institutions in eight countries where JICA projects relating to earthquake disaster mitigation took place, namely Chile, Egypt, Indonesia, Kazakhstan, Mexico, Peru, Romania and Turkey. Viewing this as a first step, the IISEE will continue its commitment to reducing earthquake damage across the globe while increasing the countries and organizations it supports in the future.