TRAINING SYSTEM AND INFORMATION NETWORK FOR EARTHQUAKE DISASTER MITIGATION

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ABSTRACT :

The International Institute of Seismology and Earthquake Engineering (IISEE) at the Building Research Institute (BRI) was established in 1962 for the purpose of training young seismologists and earthquake engineers from earthquake-prone countries. As of March 2008, 1,332 participants from 95 countries have been trained. Now IISEE has three training courses; the Regular Course (Annual Training), the Individual Course and the Global Seismological Observation Course. Since the 2005-2006 Regular Course, IISEE has started to provide Master Degree; Master of Disaster Mitigation", to the participants through the cooperation among BRI, the Japan International Cooperation Agency (JICA) and the National Graduate Institute for Policy Studies (GRIPS). Associating with the training program, IISEE launched the Web site; IISEE-net, as an internet-based system designed to disseminate a variety of technical information regarding seismology and earthquake engineering in order to contribute to developing countries' efforts for earthquake disaster mitigation.

KEYWORDS: training system, information network, earthquake disaster mitigation

1. INTRODUCTION

The 2nd World Conference of Earthquake Engineering in 1960 raised the importance of training programs for seismologists and earthquake engineers in developing countries. A proposal was instituted at the Institute of Industrial Science of the Tokyo University with the cooperation of JICA. In an effort to place the training project on a permanent basis, the IISEE was newly established and took over the administration of the program in 1962. After the training program took off, its organizing framework changed from a joint project of the Japanese Government and UNESCO to a governmental technical cooperation program of Japan. After years, the courses provided by the program were reviewed and enhanced to respond to the demands of the times. More than 45 years after its establishment, the training project is now cosponsored by JICA under the support of relevant government ministries and agencies and academic organizations. Since the 2005-2006 regular course, by achieving required credits during the training, the participants will be awarded a Master's degree, "Master of Disaster Mitigation" by GRIPS and BRI. Figure 1 shows countries of ex-participants. The size of the circle indicates the number of participants. As of March 2008, 1,332 participants from 95 countries have been trained.

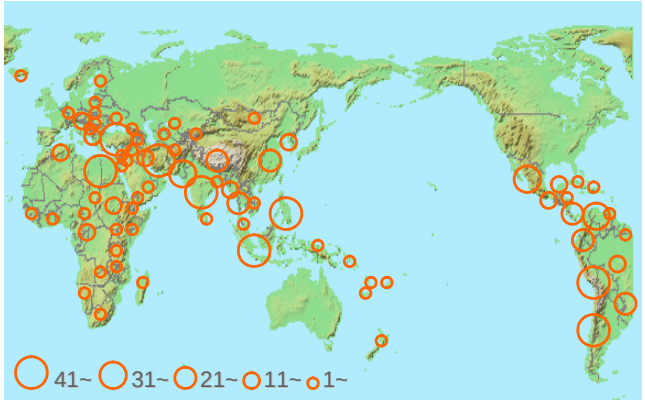


Figure 1 Distribution of ex-participants of IISEE training course

Lack of technical information related to seismology and earthquake engineering is thought to be one of the major reasons for the catastrophic loss of lives and properties. In addition to the training program, IISEE conducts various activities for contributing worldwide earthquake disaster mitigation. IISEE has developed and operates an internet website named IISEE-net since June 2002; where IISEE-net is a system whereby kinds of technical information necessary for protecting building structures against earthquakes are collected, compiled and analyzed. Researchers in developing countries can access this free Web site for technical references on seismic networks, strong motion observatory networks, seismic damage archives, seismic design code, and microzonation data on a county-by-country basis. Figure 2 illustrates an image how the IISEE-net can be utilized in developing countries.

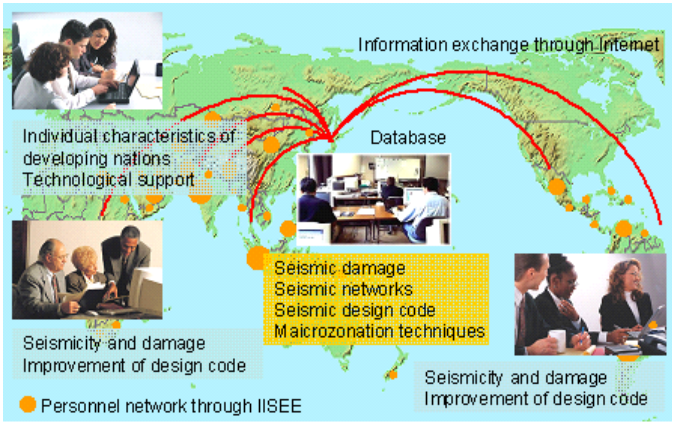


Figure 2 Information Network on Earthquake Disaster Prevention Technologies (IISEE-net)

2. INTERNATIONAL TRAINING PROGRAM

IISEE offers three courses: a regular course to study basic and applied technologies of seismology, earthquake engineering and tsunami disaster mitigation (for approximately 12 months with around 25 participants per year), a global seismological observation course to study seismic observatory technologies for nuclear test deterrence (for approximately 2 months with around 10 participants per year), and an individual course to address a specific issue (for an arbitrary term with several participants) as shown in Table 1.

Table 1 Training courses offered by IISEE

Regular Course on Seismology, Earthquake Engineering and Tsunami Disaster Mitigation	1960 Seismology Course (10)* 1960 Earthquake Engineering Course (10) Tsunami Disaster Mitigation Course 2006 (5)
Global Seismological Observation Course	1995 (10)
Individual Course	1968

*( ) indicates the capacity of the course

In most cases, participants of the regular course are nominated in each country through JICA and JICA supports all expenses necessary for the training. JICA offers the limited number of group training courses for each of the developing countries according to the need survey. Therefore, to attend the regular course, first of all, the group training course, "Seismology, Earthquake Engineering and Disaster Mitigation", must be selected from the

menu of the JICA group training courses with high priority by the Government of each country.
The duration of the regular course is 12 months; it starts at the end of September and finishes in the middle of September of the next year. The course consists of lectures, practical training, field trips and individual study. During the individual study period, participants select their original themes for Master reports and study under the supervision of a specific expert in Japan. The regular course has three sub-courses; Seismology (S), Earthquake Engineering (E) and Tsunami (T) sub-courses. The curriculum of each sub-course is described in Table 2. Figures 3 and 4 show Photos of a lecture and a study trip.

Table 2 Curriculum of regular course

Seismology sub-course	Earthquake Engineering sub-course	Tsunami sub-course
+ Computer	+ Computer	+ Computer
+ Mathematics	+ Structural Analysis & Dynamics	+ Mathematics
+ Theory of Seismic Wave	+ RC & S Structures	+ Theory of Seismic Wave
+ Earthquake Observation	+ Foundation Engineering	+ Source Mechanics
+ Analyses of Teleseismic Records	+ Structural Testing	+ Plate Tectonics
+ Source Mechanics	+ Limit Analysis	+ Hydrodynamics
+ Plate Tectonics	+ Seismic Design Code	+ Tsunami Propagation
+ Geophysical Exploration	+ Seismic Retrofit Techniques	+ Tsunami Simulation
+ Seismic Micro Zonation	+ Seismic Micro Zonation	+ Tsunami Early Warning System
+ Earthquake Disaster Mitigation Policy	+ Earthquake Disaster Mitigation Policy	+ Tsunami Disaster Mitigation Policy
+ etc.	+ etc.	+ etc.

Figure 3 Lecture in IISEE

Figure 4 Study trip

3. INFORMATION NETWORK : IISEE-net

To mitigate earthquake disaster in developing countries, it is essential to transfer advanced technologies in the fields of seismology, earthquake engineering and tsunami. Researchers in developing countries can use IISEE-net for free any time to find technical information about seismic networks, the strong motion observatory network, seismic damage archives, seismic design codes, and microzonation data in and around their countries. In addition, organizations engaged in assisting developing countries can look up the characteristics of earthquakes and building properties in each country to obtain information useful to technological development in each country. IISEE-net is free to access from the following URL:

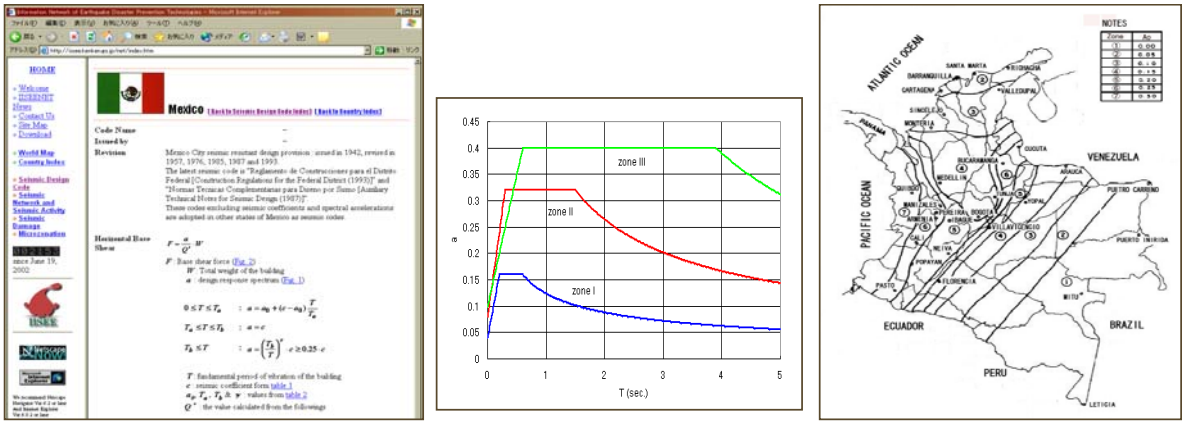
http://iisee.kenken.go.jp/net/index.htm

The technical information for IISEE-net was obtained mainly through the international training program on Seismology, Earthquake Engineering and Tsunami Disaster Mitigation and its ex-participants. In this sense, IISEE-net works not only as a system to disseminate technical information, but also as a forum for interactive information exchange among research institutes and researchers in developing countries. Supply of up-to-date

data from the developing countries allows the Web site to avoid outdating of the information, and to expand the information volume continuously. This close personnel network of the ex-participants plays a significant role in gathering information in developing countries and in promoting use of IISEE-net.

3.1. Seismic Design Code

IISEE-net offers information on the seismic design code of approximately 45 developing countries describing the procedure to determine the design earthquake. In addition, in the same manner, the brief introduction of the Building Standard Law in Japan, the International Building Code (IBC) in the United States, Eurocode 8 and ISO 3010 are also presented. Figure 5 shows the view images of the seismic code of Mexico.

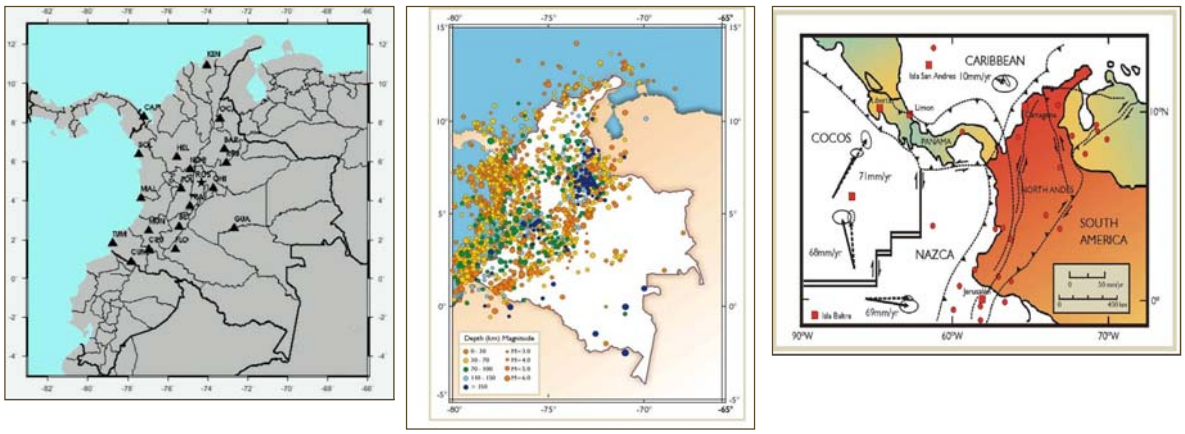


(a) code description (b) design spectrum (c) zone map

Figure 5 Seismic design code in Mexico from IISEE-net

3.2. Seismic Networks and Seismic Activity

Based on country reports by the ex-participants, the Web site provides information on approximately 50 earthquake-prone countries about their seismic networks, seismic activity, tectonics, etc. Figure 6 shows the seismic network and seismic activity in Colombia.

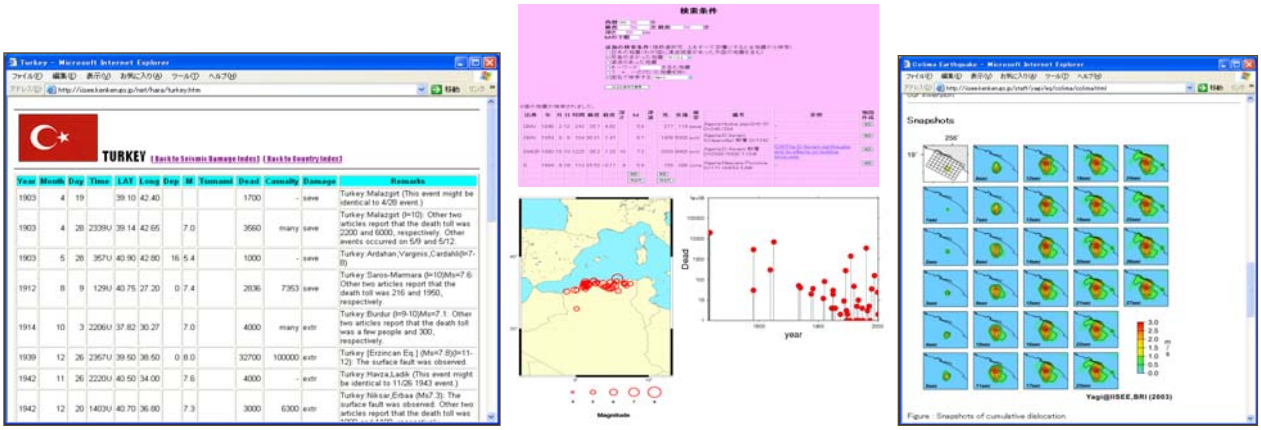


(a) seismic network (b) seismic activity (c) tectonics

Figure 6 Seismic network and seismic activity in Colombia from IISEE-net

3.3. Seismic Damage

IISEE-net offers an archive of earthquake damage in approximately 120 developing countries based on the "Catalog of Damaging Earthquakes in the World" made by the Earthquake Research Institute of the Tokyo University. This original database was compiled by Dr. Tokuji Utsu, Professor Emeritus of the Tokyo University. Accepting the kind offer by Prof. Utsu to hand over the database, the IISEE maintains and updates the data continuously. IISEE-net also prepares a search engine to find out the earthquakes which match the search conditions from the archive and draw the graphs of their epicenters and occurrence years. Furthermore, the distribution of after shocks, the fault mechanism and the wave propagation process are also presented for the representative earthquakes. Figure 7 shows an example.



(a) earthquake list of Turkey (b) search results of Algeria (c) source rupture process

Figure 7 Seismic damage archive in IISEE-net

3.4. Microzonation

Seismic microzonation project reports from several countries focusing on their metropolitan areas are presented in IISEE-net. Main sources of information are the reports of JICA development studies of seismic microzonation and country reports of ex-participants. So far, the microzonation reports of six countries; Algeria, Iran, Colombia, Fiji, Mexico and Moldova are available in IISEE-net. Figure 8 shows an example for the city of Teheran, Iran.

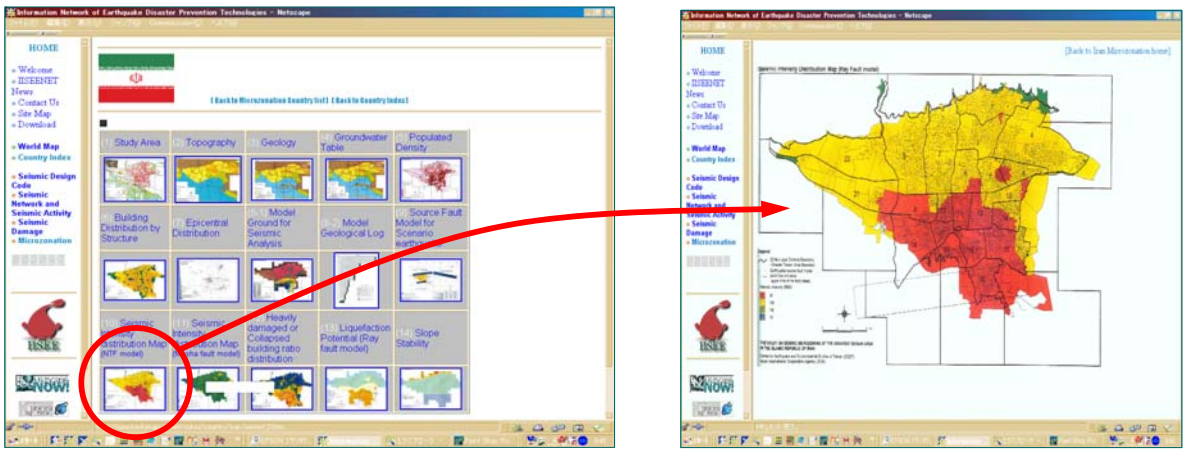


Figure 8 Seismic microzonation of the city of Teheran, Iran from IISEE-net

4. EARTHQUAKE DAMAGE ESTIMATION SYSTEM

IISEE would like to promote the use of technical information and encourage developing countries to establish their own disaster prevention strategies. In order to do this, the institute is focusing on the creation of an Earthquake Damage Estimation System for Buildings (EDES_B) in IISEE-net that can take each country's technological conditions into account. Our goal is to create a system to provide methodologies of seismic damage estimation which can be used when an earthquake occurs or in preparation for ones. The methodologies are categorized according to the flow of earthquake damage estimation procedures as shown in Figure 9. In order to consider the difference of technical background of each country, the methodologies are classified into several grades according to their technical levels.

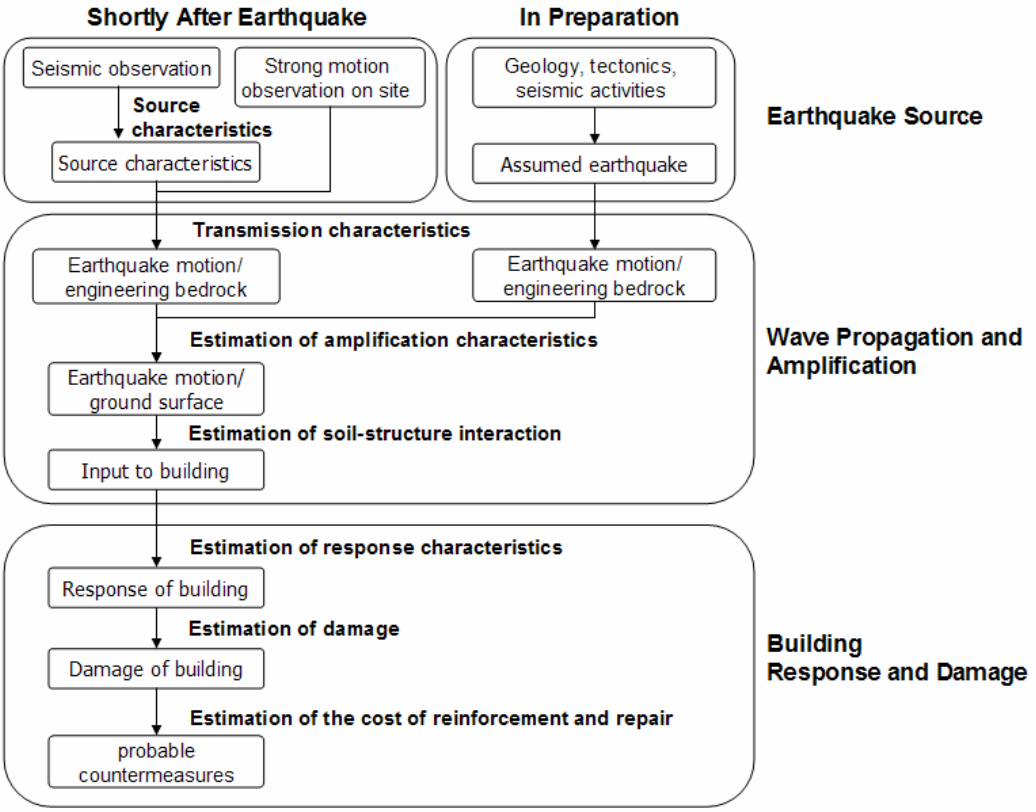


Figure 9 Earthquake damage estimation flow

Figure 10 shows the Web interface of EDES_B which guides a user to find out appropriate methodologies for earthquake damage estimation. The right side of the figure shows the list of methodologies in three categories;

- Earthquake Source (estimation of source characteristics)
- Propagation and Amplification (estimation of the transmission and amplification of seismic waves)
- Building Response and Damage (estimation of building response and damage)

The left side in the figure shows the simplified flow graph of damage estimation. In each category, methodologies are classified into three grades according to their technical levels:

- Low (simple method relatively easy to use)
- Medium (general method for the common use)
- High (sophisticated method using up-to-date knowledge)

A user selects methodologies by mouse-clicks on the box in the Flow. Figure 11 shows an example, where methodologies are selected in the order; E-2 (Grade 1 + fault plane) → P-2 (Empirical Attenuation Relation based on the Rectangular and Homogeneous Seismic Fault Model) → B-2 (PGA, PGV). The detail description of the methodology and the related software are also available so that the user can find out the appropriate information.

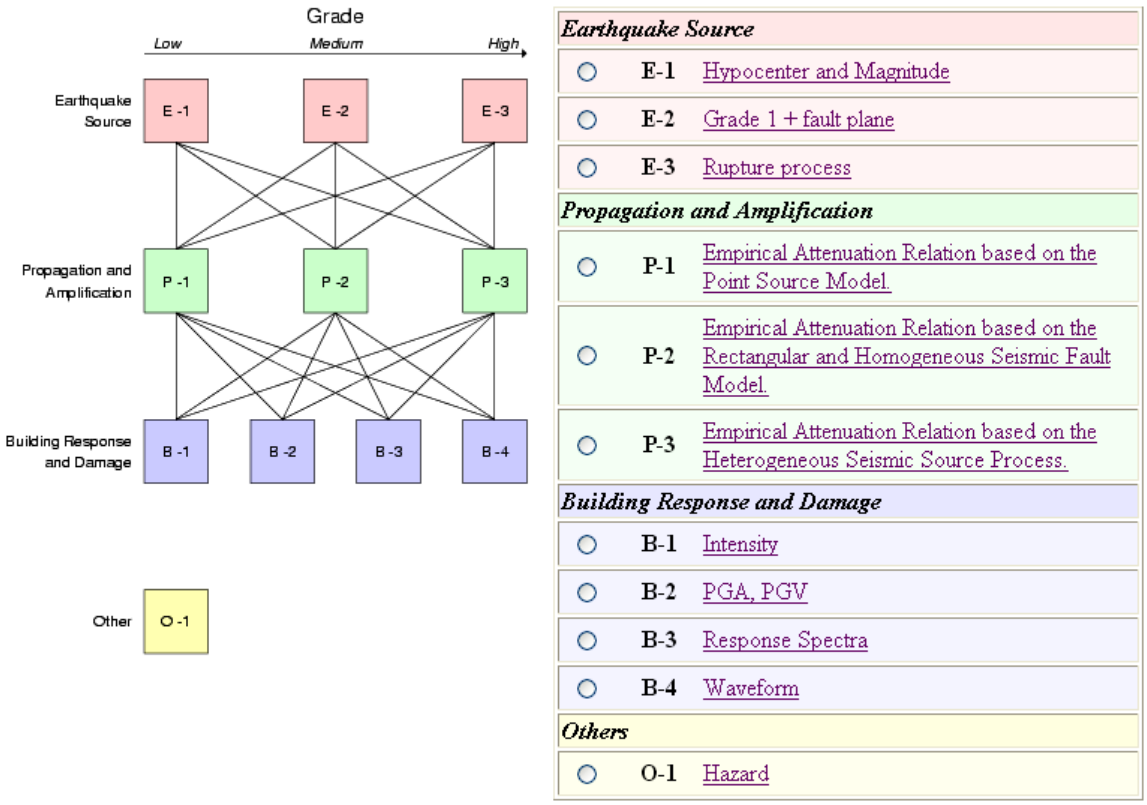
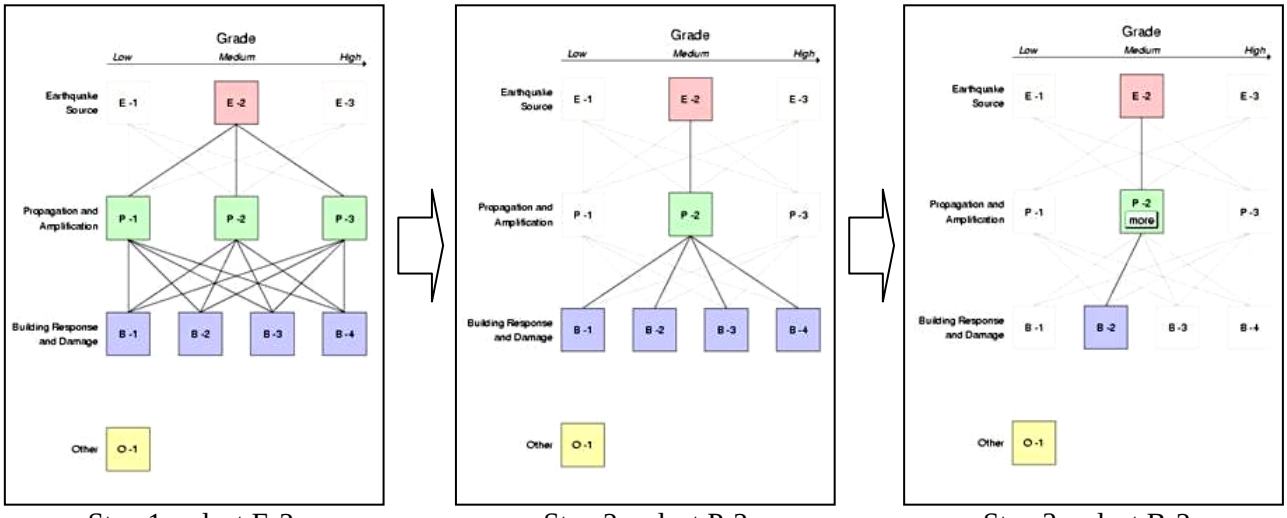


Figure 10 EDES_B Flow



Step 1: select E-2 Step 2: select P-2 Step 3: select B-2

Figure 11 Example of the procedure to select methodologies

4. CONCLUSIONS

Human resource is the key of the success of earthquake disaster mitigation. It is quite delightful to know that many ex-participants of the IISEE training course now play important roles in their home countries for earthquake disaster mitigation. To enhance real-time communication with organizations and individuals and

supplement IISEE training course program, IISEE installed a video-conference facility in 2006. So far, IISEE has conducted several video conferences jointly with the international organizations which already have world-wide networks of video conference such as World Bank's Global Development Learning Center and JICA-Net. Figure 12 shows a photo of the video conference on seismic safety of adobe houses between Japan and Peru on February 24, 2006. IISEE also plans to provide lectures and technical suggestions regarding seismology and earthquake engineering matters through the video-conference and the e-learning system which is now under construction in IISEE-net for the ex-participants as well as the people who can not attend our training course.

Figure 12 Video conference on seismic safety of adobe houses between Japan and Peru

IISEE send Newsletters periodically to ex-participants by e-mail to activate information exchange between the IISEE staff and ex-participants. Also, every time after a destructive earthquake happens, IISEE immediately publish the special page of the earthquake on IISEE-net including information on earthquake source mechanism, Tsunami simulation results, etc.

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