Interim evaluation report:
Seismic Disaster Prevention Research Group

1. Objectives

To enhance a city's disaster prevention capabilities during earthquakes, the behaviors and responses of the entire city during such events have to be grasped accurately and effectively. Therefore, the Seismic Disaster Prevention Research Group aims, first of all, at constructing a system that can provide reliable information about what happens to us during an earthquake.

Conventional seismic simulation technology, which until now has been applied to individual buildings and structures, must be used to analyze the behaviors and responses of the entire city. It is also necessary to present a framework that enables such technology to be used not only by engineers but also by decision-makers who are concerned with establishing the necessary systems, and carrying out business/economy and other social activities.

Existing Pre-Code-Revision houses will cause numerous human injuries and other damages in future earthquakes. Our research will therefore design a new system/setup, for changing citizens' awareness of the need for retrofitting promotion .

Seismic retrofit of houses and the ownership of earthquake insurance policies have not increased as expected. The reason for this, in addition to insufficient motivation and inadequate social structures, is the fact that the decision-making analysis for individuals—the potential disaster victims—has not been properly done. To carry out such an analysis, we need to integrate economic models with psychological knowledge, as well as with the characteristics of an individual's psychological reactions to catastrophic risks. Therefore, to measure the socio-economic damage suffered by seismic disasters, we will establish the necessary knowledge and information and build an integrated risk management technique/method pertaining to catastrophic risks.

Moreover, to make such seismic disaster prevention information truly useful, we need to take an educational approach to draw the people who are not only interested in but also uninterested in our field.

To implement seismic disaster prevention strategy in a useful and practical manner, the researches conducted within the existing frameworks of earthquake resistance and/or disaster prevention are not enough. We need to carry out our researches under a cooperative system crossing various other sectors. To actualize this type of research, therefore, we take an expansive approach incorporating economic, business/management, legal, and administrative perspectives.

2. Members

Besides 9 core members specialized in different academic/research fields, the group developed a structure for cross-sectional study, working with research cooperators specialized in science, law, economics and education, as well as with experts who provide advice on the direction of the research.

- Core members

Name	Affiliations
Junji Kiyono	Assistant Professor, Kyoto University
Masato Abe	Assistant Professor, the University of Tokyo
Muneo Hori	Professor, the University of Tokyo
Kimiro Meguro	Assistant Professor, the University of Tokyo
Hirokazu Tatano	Professor, Kyoto University
Kenjiro Terada	Assistant Professor, Tohoku University
Naotsugu Sato	Professor, Chuo University
Atsuomi Obayashi	Assistant Professor, Keio University
Zhu P.	Research Institute of Science and Technology for Society

- Research cooperators

Name	Affiliations
Tsuyoshi Ichimura	Tohoku University
Takashi Akamatsu	Tohoku University
Manabu Shoji	Tsukuba University
Masayuki Kohiyama	the University of Tokyo
Nodoka Ujita	the University of Tokyo
Ayako Hatanaka	Research Institute of Science and Technology for Society
Naoya Yamaguchi	the University of Tokyo
Kenji Oguni	the University of Tokyo
Morito Tsutsumi	the University of Tokyo
Riki Honda	Kyoto University
Jiro Yoshida	Development Bank of Japan
Taketoshi Toyoda	Research Institute of Science and Technology for Society
Kentaro Yamaguchi	Mitsubishi Research Institute
Akio Murayama	Mitsubishi Research Institute

Masayuki Yoshimi	National Institute of Industrial Safety
Koichi Takimoto	Yamaguchi University
Yusuke Ono	Kyoto University

- Advisors

Name	Affiliations
Hideyuki Horii	the University of Tokyo
Hiromichi Higashihara	the University of Tokyo
Yozo Fujino	the University of Tokyo

3. Target achievements

The goals of this research are as follows.

(1) Development of science and technology for society: Develop and integrate the technology for identifying and describing an issue concerned.

(2) Manifestation of science and technology for society: Clarify disaster prevention scenarios and risks associated with earthquakes.

(3) Presentation of strategies to reduce seismic damages as well as the effects of such strategies: Analyze decision-making process for promoting seismic retrofit of houses and for promoting earthquake insurance ownership, and establish a comprehensive risk management method/technique for catastrophic risks.

(4) Publication and implementation of the science and technology for society that has been developed: Promote social recognition and incorporate such knowledge in disaster prevention education.

4. Status and self-evaluation

So far, we were able to show the feasibility of visualizing the behavior of urban models during an earthquakes. Specifically, we used a 3D CAD model of urban structures and embedded it into a GIS as map data. We converted it into an analytical model for earthquake simulations and conducted analyses. We reloaded our analytical findings into visualization software and were able to re-create the tremors that the entire city would experience during earthquakes. It appears that a survey of existing simulation technology was insufficient. However, we used a method of individually tracking each building's behavior/action and simultaneously visualizing it. We are also in the process of introducing an evaluation axis for identifying detailed responses of individual buildings. As a consequence, we are counting on the visualization process—a means of clearly demonstrating a fact during an earthquake—to effectively prevent and

deter seismic disasters. However, we believe that the achievements of this research have also given us the opportunity to reexamine the psychological effects that are brought about by Computer Aided Engineering (CAE) technologies.

Regarding our proposals for a system that promotes seismic retrofit of existing pre-code-revision houses, we have developed a system for quantitatively explaining the benefits/effects of such repair both to the public administration and citizens. We have been actively providing explanations to a wide range of targets, from a central government to regional municipalities. Since the characteristics and advantages of this system have been evaluated highly by numerous mass media and experts, we have begun studying the establishment of specific systems that incorporate this proposal tool as their basis. The Seismic Disaster Prevention Research combines engineering knowledge with that related to social sciences, in order to propose solutions to important social problems. In this respect, it may be considered an ideal form of research related to the science and technology for society missions.

We also made dramatic strides in theoretical aspects, including the influence of catastrophic risks on economic growth and the regional economy. Regarding a practical model, moreover, we have already analyzed the economic repercussive effects of damages to the functionality of wide-area traffic networks, using (1) an optimally designed model of the earthquake insurance system that incorporates seismic damage simulations and (2) CGE model. As can be seen, we have more or less finished sorting out the framework for evaluating comprehensive risk management measures.

Generally speaking, our research has been progressing at a pace that exceeds our initial plan. Our achievements themselves have received high acclaim through presentations at domestic and overseas academic meetings. We also published numerous papers that had been reviewed and screened, and conducted vigorous publicity-related activities through the mass media and websites. We are convinced that we have so far obtained substantial results vis-à-vis our goals. From here on, we plan to make use of the achievements of other mission groups and obtain their cooperation to actualize, on the web, science and technology for society that combines the “manifestation of facts during an earthquake” with “seismic retrofit subsidy programs and to promote earthquake insurance ownership.” At the same time, we will aim at distributing disaster prevention educational software based on the science and technology for society that has been developed (i.e., earthquake simulator).

The following shows a list of the specific contents of research that are currently being compiled.

(1) Development of elemental technologies/gathering of basic information

- Development of simulators for strong ground motion
- Development of a program for analyzing the dynamic responses of structures and interior space
- Development of an analytical program capable of tracking the collapse of structures
- Examination of measures that promote seismic retrofit of existing pre-code-revision houses
- Identification of problems of densely inhabited area during earthquakes and examination of countermeasures

(2) Development of comprehensive technologies

- Development of interface technology for promoting elemental technology collaborations
- Development of quake simulators that integrate ground motion, structural responses, people's evacuation behaviors, etc.
- Development of a relevant visualization system

(3) Manifestation of development technology as a science and technology for society

- Building of a prototype for a pseudo-experience system (earthquake simulator) that can handle everything in a universal manner, from simulating seismic ground motion to emergency evacuations

(4) Presentation of strategies to reduce earthquake damages as well as the effects of such strategies

- Proposal of drafts of systems/policies that promote seismic retrofit of existing pre-code-revision houses, and evaluation of the effects of such systems/policies

The Seismic Disaster Prevention Research Group has taken a new approach to upgrade seismic disaster information, namely, constructing a virtual site on a computer and clearly showing the facts by comprehensively accumulating high-precision numerical calculations. Although various problems exist, we believe that we were able to solve them through productive discussions with members of other missions who are experts in other sectors, and were able to build a prototype much more quickly than we had originally anticipated. From here on, we hope to examine the method and system for providing seismic disaster information to the public in the easy-to-understand form.