



AN EARTHQUAKE DISASTER ACTION PROGRAM OF A PRIVATE JAPANESE CONSTRUCTION COMPANY - THE CONCEPT OF THE PROGRAM AND A DAMAGE ESTIMATION SYSTEM

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ABSTRACT

A research & Development project has been set up by a private Japanese construction company to counter the effects of severe earthquakes which may occur in the Tokyo metropolitan area. The main aims of this emergency management system are voluntary contribution to society and rapid business recovery plans for clients. This computerized system is composed of various data bases updated frequently, and an Emergency Operation Center with a damage estimation system and a reliable communication system.

KEYWORD

Corporate earthquake program; Emergency management; G.I.S.; Seismic hazard; Seismic damage estimation; Risk analysis

INTRODUCTION

The Great Hanshin Earthquake in 1995 has been a spur to corporate earthquake programs as well as governmental earthquake programs in Japan. In general, the basic purposes of a corporate earthquake program are to safeguard employees' lives and to prevent facility damage. If a major earthquake occurs, however, private construction companies will be in a unique situation where they are obliged to assume restoration and reconstruction for other companies and public facilities in the affected areas. Therefore, private construction companies have social responsibilities to provide measures against various and complicated forms of earthquake damage anticipated in heavily industrialized and populated regions, namely, an Earthquake Disaster Action Program.

This paper outlines the concept of the Earthquake Disaster Action Program based on the supposition that a major earthquake hits the Tokyo metropolitan area, and the damage estimation system.

CORPORATE EARTHQUAKE PROGRAM OF CONSTRUCTION COMPANY

A concrete example, based on the experience of a certain private construction company after the Kanto earthquake, is shown in Table 1 to explain characteristics of the corporate earthquake program of construction companies. At noon on September 1, 1923, the Kanto earthquake, of magnitude 7.9 on the Richter scale, struck the Tokyo metropolitan and Yokohama areas. The earthquake caused serious structural damage, extensive fires, landslides and tsunamis. As a consequence, 142,000 people died.

The construction company devoted its whole energy to rescue, restoration and reconstruction, originally begun on humanitarian grounds. As a result, the company established a reputation for trust and reliability, and expanded its business to the Tokyo metropolitan area. This example reveals that society relies on the immediate action of construction companies when such a serious disaster occurs. It also suggests that construction companies have to rapidly obtain accurate information and cooperate fully with governments to adequately execute their corporate earthquake programs.

Table1 Action of Obayashi Corporation after the Kanto Earthquake

DATE	ACTION
Sept. 1	Received Information from Osaka Prefecture
Sept. 2	Reconnaissance Team Departed by the Osaka Prefecture Ship <div style="border: 1px solid black; padding: 2px; margin: 5px 0;">Two Employees and Some Bags of Rice</div> 1st Relief Party Departed by Train (Incomplete by Rail Road Accident) <div style="border: 1px solid black; padding: 2px; margin: 5px 0;">Dozens of Employees and Subcontractors as well as 8 Doctors and Nurses Food, Medical Supplies, Candles, Daily Necessities and Cars</div>
Sept. 3	1st Relief Party Departed again by a Charter ship
Sept. 5	1st Relief Party Arrived at Yokohama Port Planning Reconstruction Works, and Starting Volunteer Work for Victims
Sept. 6	2rd Relief Party Departed by a Charter Ship <div style="border: 1px solid black; padding: 2px; margin: 5px 0;">President and Dozens of Employees, as well as Food, Construction Materials</div>
Sept. 7	Assigned Construction Works by the Osaka and Kyoto Districts for Tokyo Disaster Relief <div style="border: 1px solid black; padding: 2px; margin: 5px 0;">Wooden Dwelling Facilities (200m² × 500 Houses) Temporary Emergency Hospitals (13 Buildings – 1000 Inpatients) Prefabricated in Osaka and Transported to Tokyo</div>
Sept. 10	Started Repair Works <div style="border: 1px solid black; padding: 2px; margin: 5px 0;">300 Employees, Subcontractors and Carpenters</div>
Sept. 13	Transported Prefabricated Components NOTE: Dwelling Facilities and Temporary Hospitals Completed in One month

CONCEPT OF THE EARTHQUAKE DISASTER ACTION PROGRAM

Figure 1 shows a flow chart which explains the Earthquake Disaster Action Program. The key of this system is the Emergency Operation Center which controls the damage estimation system using a geographic information system (G.I.S.), and the communication system. The damage estimation system suggests actions in every phase - the normal, emergency and recovery phases. It contains various data bases which include disaster scenarios, in-house data, clients data, etc. These data bases are updated frequently, data being obtained from every office through computer networks.

In the normal phase, the damage estimation system and data bases are utilized for consultation business: e.g. earthquake hazard mitigation, earthquake-proof design and structural inspection. In the emergency phases, the damage estimation system and databases are utilized by the Emergency Operation Center to check the safety of employees, construction site and clients facilities, to cooperate with governments, and to contribute to society voluntarily. Figure 2 shows an information network for use in the emergency phase. In order to decide the appropriate actions, various data are sent from each Local Hub of the company and other sources via reliable communication systems to the Emergency Operation Center. These data are analyzed by the damage estimation system, and subsequent decisions concerning what action should be taken are sent to each Local Hub of the company. In the recovery phase, the damage estimation system and data bases are utilized not only for restoration, but also for quick business recovery plans of clients.

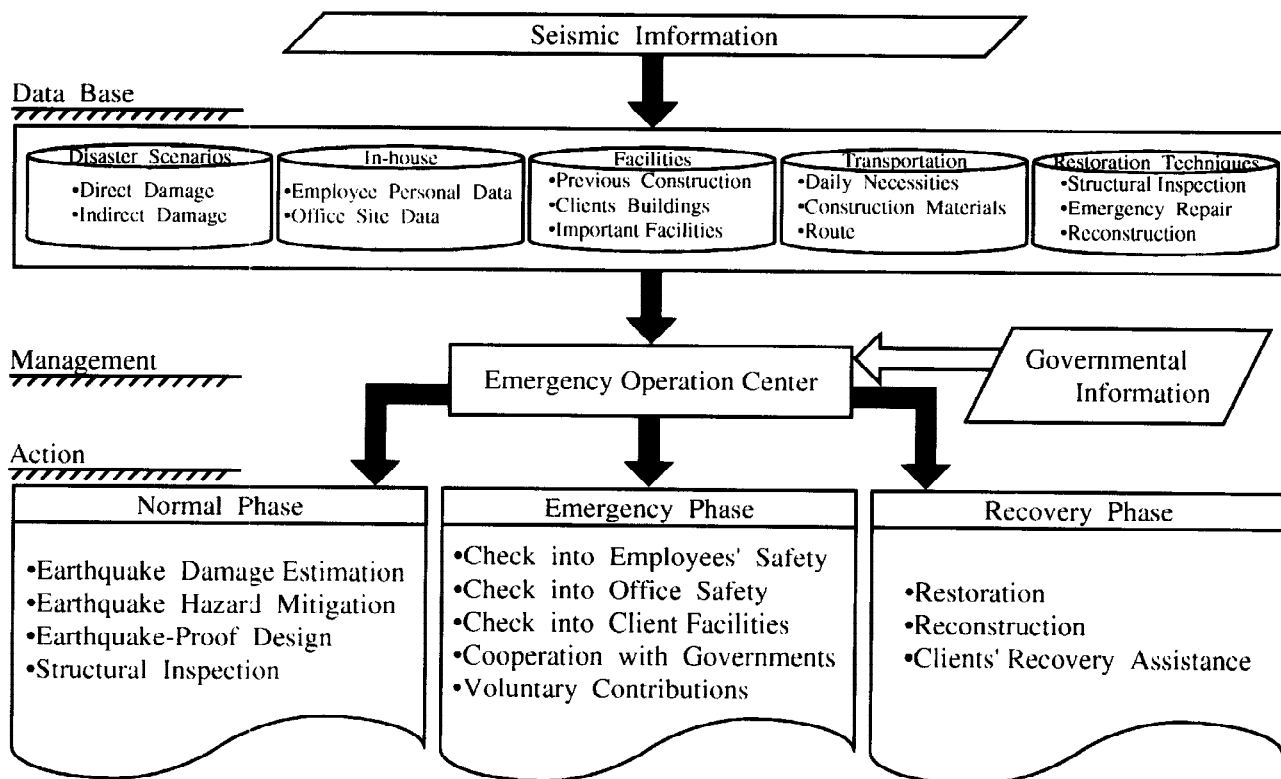


Fig.1 Flowchart of Earthquake Disaster Action Program

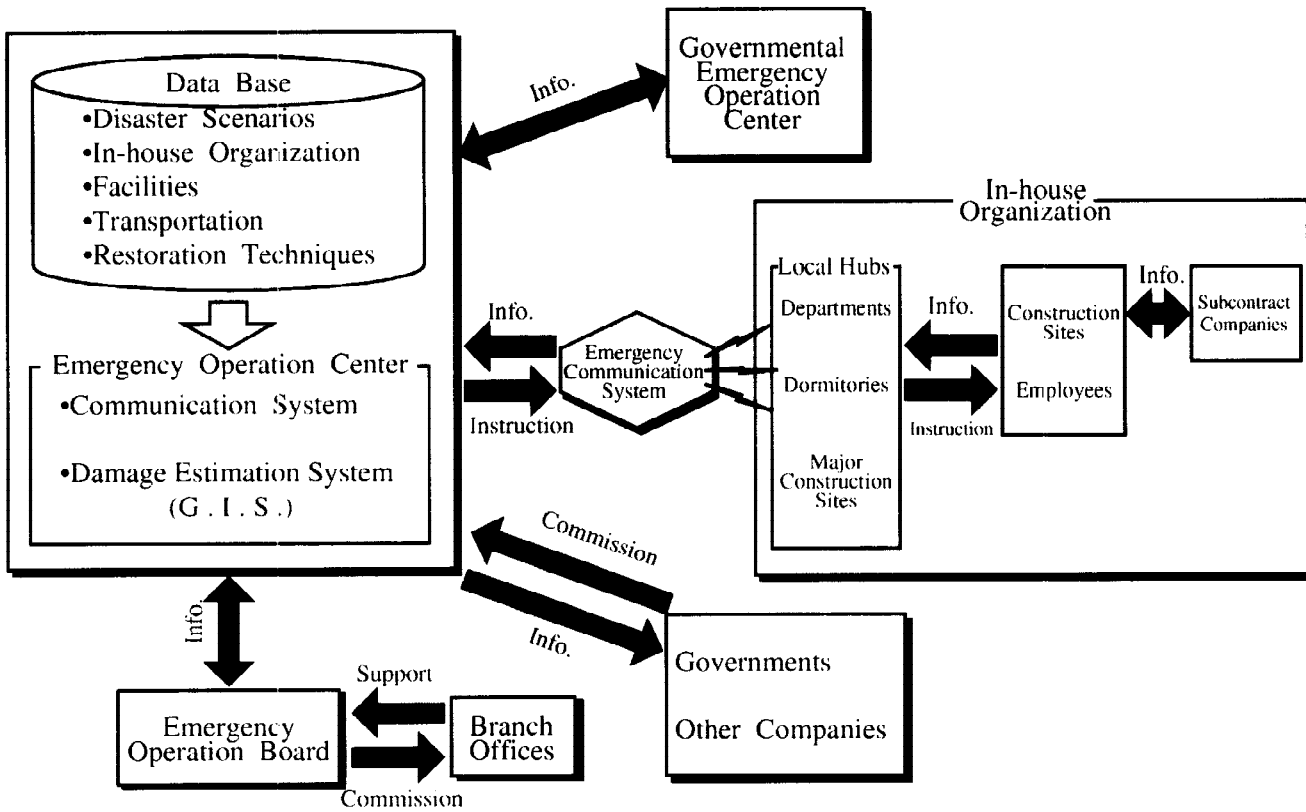


Fig2. Information Network for Emergency Phase

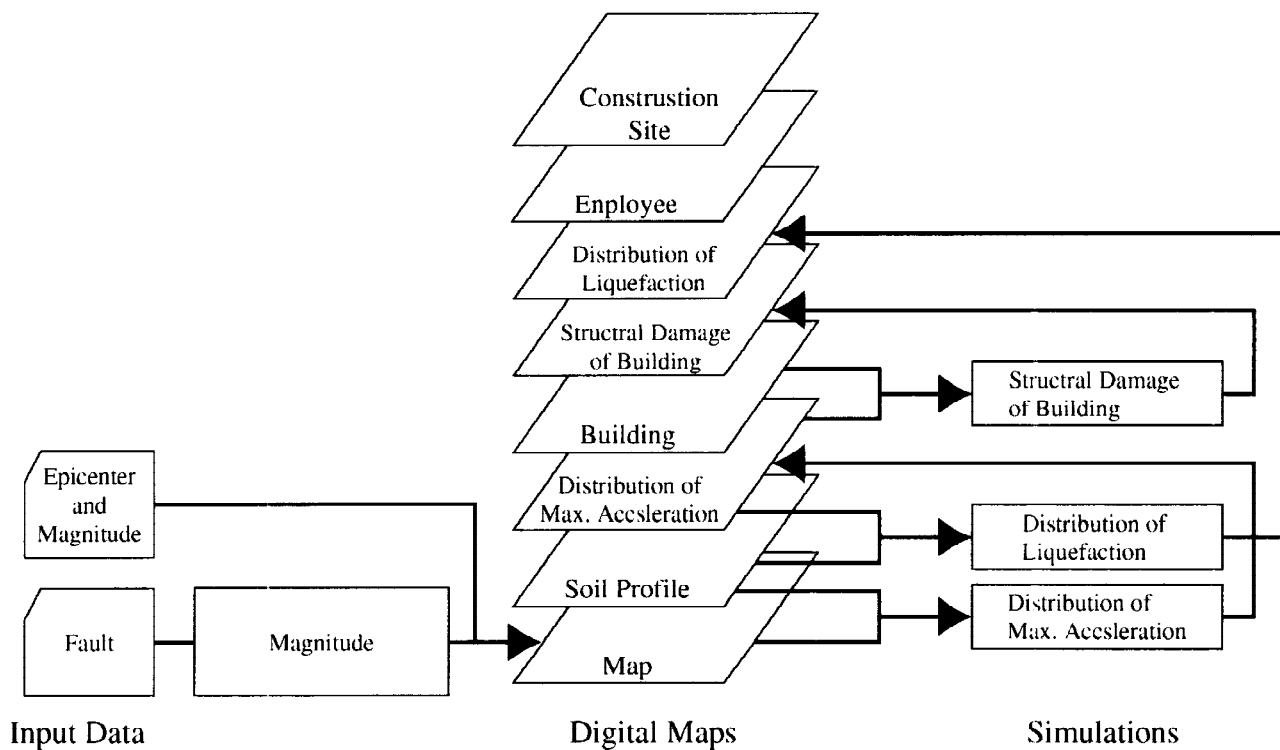


Fig3 Flowchart of Damage Estimation System

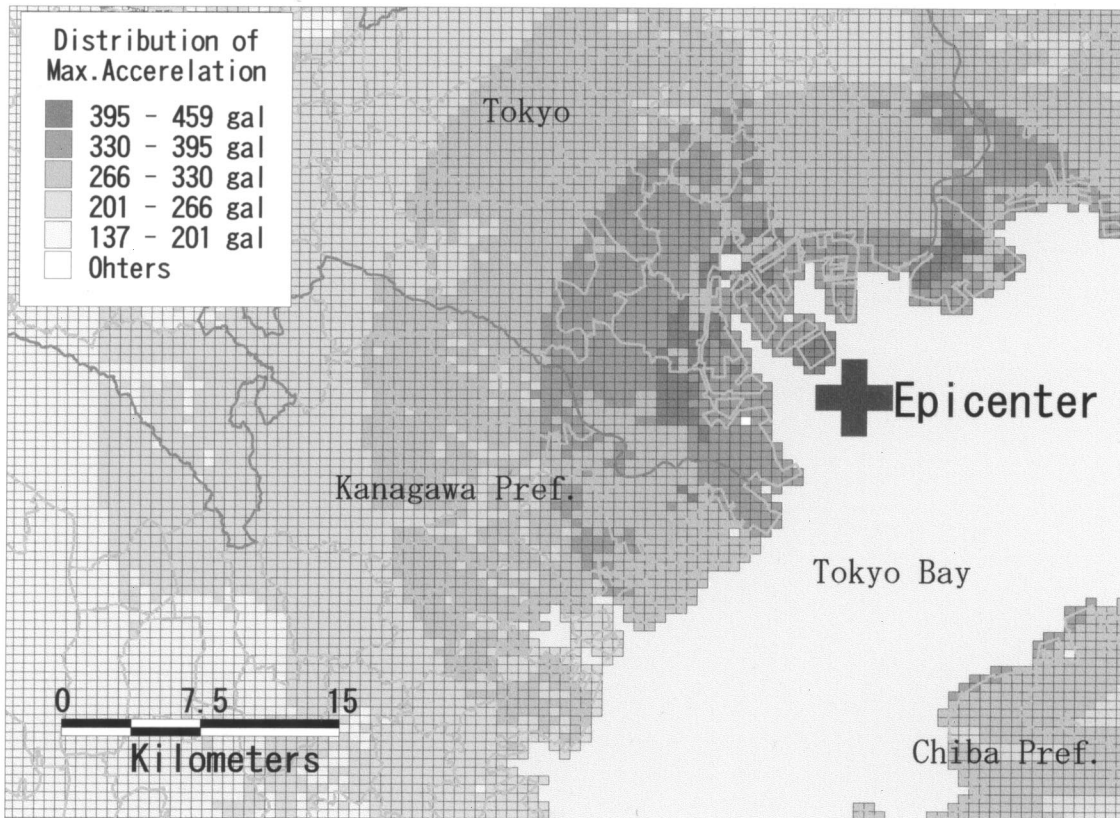


Fig.4 Distribution of Max. Acceleration

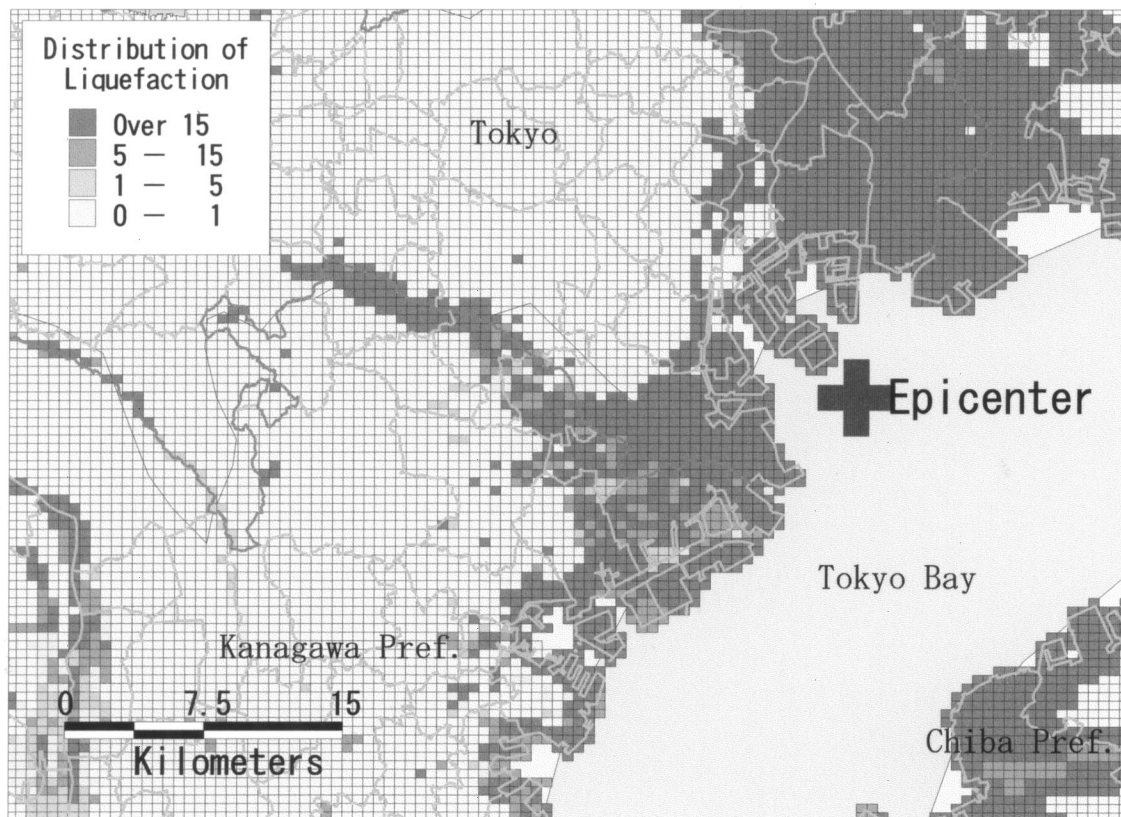


Fig.5 Distribution of Liquefaction

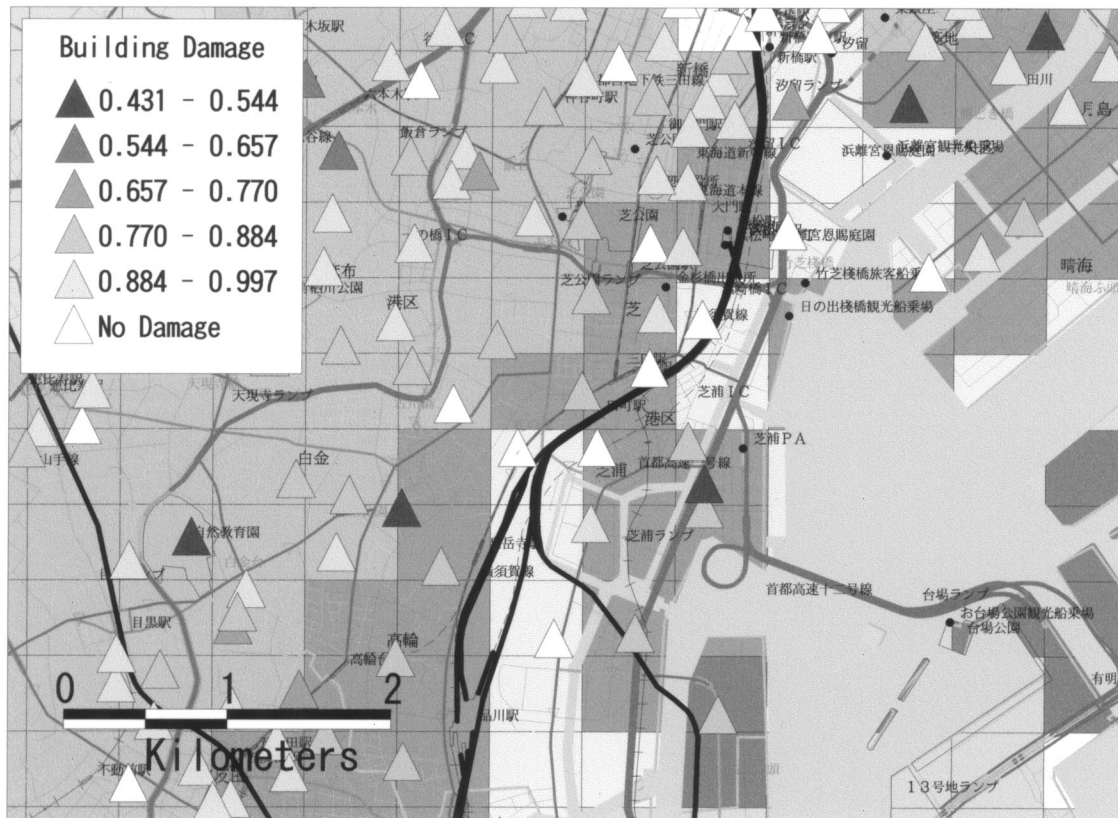


Fig.6 Structural Damage of Clients' Buildings

THE DAMAGE ESTIMATION SYSTEM

The damage estimation system is an analytical tool using G.I.S. for assessing and monitoring earthquake hazards. Figure 3 shows a flow chart of the system. This system can estimate distribution of Max. acceleration, distribution of liquefaction and damage of each clients' building. Figure 4-6 show examples of estimation calculated by this system. The distribution of Max. acceleration and the distribution of liquefaction are calculated on each 500m square mesh which has soil profile data on digital maps. The building damage is calculated on each clients building individually. These estimation results suggests the area damaged heavily by the earthquake. It is also effective that these estimation results are overlaid with various data, e.g.; employees' addresses and location of construction sites, etc.

CONCLUDING REMARKS

Construction company have an important role in every phase of any earthquake disaster. Unfortunately, there is no standard for corporate earthquake programs among construction companies in Japan to date. Close cooperation with other construction companies would be required to execute this action program effectively. It is imperative that governments offer useful information, which would encourage construction companies to design some original and significant earthquake disaster action program.