**5. Committee of Technical Survey and the Study of Measures for the Protection of Sewage Systems against Earthquake**

The Ministry of Construction, which is the national authority responsible for sewage systems, established the committee on February 6 in order to analyze the characteristics of damage to wastewater systems by this quake and in order
to revise the standards for earthquake-proofing if it is deemed necessary.

The Committee published their initial findings on technical matters based on studies, to that time, of the damage situation and its causes in the Hyogo Nanbu Earthquake and other earthquakes in the past. The findings are intended to be taken into consideration during on-going reconstruction and for future sewage projects.

The Committee shall continue to collect related information and find the mechanisms of damage and their effects on wastewater treatment plants and other facilities during an earthquake. Furthermore, the Committee will from time to time present further suggestions on measures to be taken for the protection of sewage systems against earthquakes including earthquake -proof designs for sewage facilities.

# DAMAGE TO URBAN INFRASTRUCTURE AND RECONSTRUCTION IN THE EARTHQUAKE-STRICKEN AREA

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## 1. Introduction

The Hyogo Nanbu Earthquake which occurred on January 17 1995, hit one of the most urbanized areas in Japan, and caused damage comparable to the great Kanto earthquake of 1923. About four months have passed since the tragic disaster, but there are many problems yet to be solved, some of which are the management of shelter accommodating a total of about 40 thousand evacuees, supplying temporary houses, mental care of sufferers, planning disposal of debris, and planning an action program for rehabilitation. This disaster brought out many weak points of urban systems in Japan and offered many lessons to engineers and city planners.

In this article, I will discuss the situation of the damaged area and examine what we should learn and how we should improve present urban systems, from the perspective of urban planning for disaster prevention.

## 2. Summary of Damage

The epicenter of the earthquake was located close to a densely inhabited area, just over a fault which thoroughly ruptured the Hanshin district. The most heavily damaged (JMA Seismic intensity scale 7) areas are distributed along a 1-2km wide strip approximately 30km long in an E-NE direction (Fig. 1).

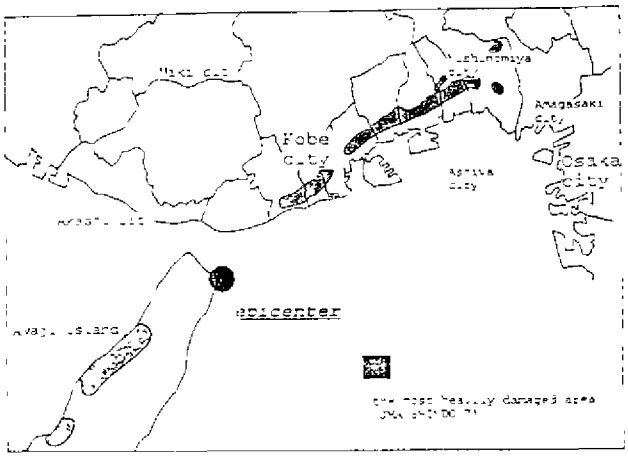


Fig. 1 Location of Epicenter and the Most Heavily Damaged Area

Mr T. Kato

Main damage may be summarized as follows.

(i) Building damage

As far as building damage is concerned, a total of 100,062 buildings collapsed and 86,933 buildings were severely damaged (report date: April 9 1995). All structural types, regardless of whether they were built of wood, concrete or steel, were damaged. It is of interest to note that very old wooden houses and concrete structural buildings built according to 1971 code (old seismic code) completely collapsed. Most of the concrete structural buildings built based on the new seismic code (1981) were hardly damaged (Photo 1-2).

(ii) Loss of lives

5,501 people were killed and 36,938 injured (report date: April 7 1995). The main cause of death was crushing due to the collapse of buildings. Analysing the age of the dead, the number over 60 years old was considerable with a distribution ratio of more than 50%.

(iii) Fire and fire spread

The ratio of wood houses is very high in every city in Japan, so the volume of physical damage is determined by whether fire spreads or not. In this disaster, a total of 292 fires broke out, and as a result 7,123 buildings were burnt down. Damage was concentrated in Kobe city. The main cause of fire was judged to be electricity or gas leak. It is said that its ratio was more than 50%.

Photo 1 Typical Building Damage (Wood Structures)

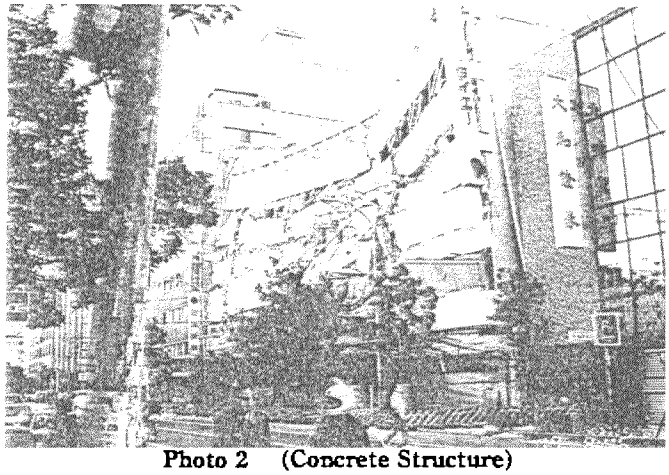

Photo 2 (Concrete Structure)

(iv) Lifelines damage

Electricity, gas and water supply lines were all damaged. Table 1 shows the maximum amount of functional damage and the date of restoration.

**Table 1 Lifeline Damage**

| lifeline | maximum est. damage (household) | restoration |
|---|---|---|
| electricity | about 916,000 | after 10days |
| city gas | about 834,000 | after 3months |
| city water | about 1,070,000 | after 3months |

(v) Railway, road and harbor facilities

One of the most outstanding characteristics of this disaster is that many large artificial structures were destroyed, which were believed to be completely safe. Overhead highways and railways collapsed in many places. Harbor facilities were completely damaged. It will take approximately 3 years for them to be restored to their original state.

(vi) Evacuees

House collapse and fire caused many people to evacuate to public shelters. The number of evacuees rose to 316,678 during the peak period. As lifelines were restored and temporary houses were supplied, the number of refugees has gradually decreased. According to the latest estimate (the first week of May), approximately 40 thousand people cannot find an alternative so they continue to live in temporary shelters. Schools in affected neighborhoods have functioned as shelters. Shelters have been managed by officers and volunteers who were residents or came from unaffected regions.

## 3. Lessons to Learn

It is too early to generalize the precepts to be learned, but I considered them within as wide a limit as possible.

(i) Improve housing stock

The factor which caused the most casualties was the collapse of many houses. It also directly caused many injuries and created many evacuees. In Japan, high quality houses have barely been provided especially since the country experienced rapid development(1960−70). This is considered to be one of the main causes. Damage is closely related to the housing problem.

(ii) Improve earthquake-proofing of civil engineering structure

It is the damage to civil engineering structures that has inhibited many activities for recovery. Damage to highway, railway and harbor facilities make transportation of essential materials very difficult, bringing support and recovery to almost a standstill. The seismic code for civil engineering structures is uniform. Its damage suggested that improvement of the seismic code should be decided taking into account the experience of this earthquake.

(iii) Consider connection between disaster factors

Lifeline damage is closely related to fire damage. The main cause of fire was gas or electricity. Since the water system also got damaged, it totally prevented fire fighters from extinguishing the fire and thus accelerated the spreading of fire. Hence it could be seen that the damage to water supply lines further aggravated the situation. Disaster factors are not independent but inter-related as mentioned above. We have to take measures to meet every disaster considering these factors.

(iv) Have space to spare in developed areas

To have space to spare in developed areas is one of the most important requirements for reducing the level of damage. For example, wide roads and parks are effective in stopping the spread of fire and useful as space for evacuation from heat. Open space in developed areas is needed to provide shelters and temporary houses, and also to store the debris until disposed of.

(v) Have man power to spare in local government

Local government is organized to execute routine work, so it was difficult to cope with an emergency situation. In the stricken area, many volunteers have taken an active role in compensating for the shortcomings of the local government system. Their activities were considered to be enough, but all the members could not work to their maximum ability. The

reason is that the disaster prevention systems of local governments cannot accommodate the volunteers necessary to implement the countermeasures.

### 4. New Direction of Measures against Earthquake Disaster

There are some new measures which have to be discussed based on some of these lessons.

Some local governments have started talking about local disaster prevention plans. The main point of discussion has been about the appropriate emergency system organization for the first stage just after an earthquake and the appropriate placement of volunteers for practical activities.

Japan Society of Civil Engineers (JSCE) has discussed the seismic code for civil engineering structures. Until recently all the structures were designed based on the same seismic code but past experience suggests that different structures which are subjected to the same magnitude of earthquake are affected in different degrees. Furthermore, there are some structures which are very essential for the resumption of activities once rehabilitation has started. For example, a harbor is the most important facility for receiving relief supplies. These facilities have to be built stronger to withstand an intensive earthquake such as this one regardless of the cost. Hence JSCE decided to propose different codes for different types of structures depending on their importance in the event of major earthquakes.

In Japan, drastic measures like the reconstruction of city infrastructure has not been carried out. This is because the characteristics that are used for planning for daily life and for emergencies differ radically.

To insure complete safety in an emergency, enormous costs, which are be practical when considering only normal economic principles, may be needed. Completely safe surroundings in an emergency doesn't guarantee convenience in daily life. For example, the design of structures built to withstand more intensive earthquakes may not suit the individual's likings.

Which logic should we use when choosing between the needs of daily life and emergencies? It depends on the economic and social circumstances of each country. In conclusion, I would like to state that researchers specializing in the disciplines related to disaster prevention should try to pinpoint the most suitable measures and create plans that will satisfy all concerned.

## INDIVIDUAL VOLUNTEERS IN THE STRICKEN AREA OF KOBE

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### 1. Volunteers' Contribution to Water Supply and Sanitation

I stayed in Kobe from the last week of February (about 40 days after the earthquake) to mid-March. I was a graduate student in the Department of Urban Engineering of the University of Tokyo. I participated in one of the temporary groups which were composed of individual volunteers. The group made its headquarters in the Chuo-ward office at Sannomiya, the center of Kobe city, and had a close relationship with the local government. Accommodations and food were provided by the ward office (the accommodations were a public library). The ward officer who was in charge of volunteers and two organizations frequently exchanged information. About 30−40 new people joined the group every day and most of them participated for a few days. There were many weekend volunteers. The number of people who were always active in the group was approximately 100. Sometimes the leaders also changed. However, the representative of the group and a few leaders were fixed by local members, who had been working for months. Volunteers were mainly students who were around 20 years old, including 30−40 % who were female students.

Our group collected information about victims' needs, published a newspaper, talked and played with the elderly and children in shelters, supplied warm meals, helped with moving, and so on. I helped Chuo-ward with office work, which was very busy.

In relation to water supply and sanitation, we carried out the following projects.

− Construction of makeshift toilets

All lifelines were severely damaged right after the earthquake. Because of water cut-off, people couldn't use flush toilets. Volunteers made pit latrines in schoolyards.

− Fetching water

The bureau of waterworks of Kobe announced nearly 100 % recovery during my stay in Kobe. However, this figure didn't necessarily mean the full revival of water service, because the bureau's jurisdiction was limited as far as distribution pipes under public roads. Service pipes inside buildings were another problem. For example, in the ward office where I stayed, I could use water from taps only below the second floor. The upper floors had one makeshift faucet for each floor and water for rest rooms was stocked in bottles and buckets. Because pipes and tanks inside buildings need to be repaired at the victims' own expense, this point seems to be critical for water service

restoration.

To fetch water from stand pipes or water-wagons to victims was one of the volunteers' important jobs. But as the water distribution rate rose, demand for water carriage got scattered and became unnoticed. Our ability to fulfill demand was not satisfactory.

– Installation and operation of temporary public baths

Gas service was not available in a wide area, so public baths were always very crowded. Volunteers from our group were dispatched to control the entrances. Some other volunteer groups installed and operated public baths by themselves at shelters. Public baths seemed very effective for maintaining good hygiene and relaxation of the victims.

– Drying blankets

Health problems like an epidemic didn't occur. However, some evacuees developed skin diseases caused by blankets which had been used for two months without cleaning. As countermeasure, volunteers cleaned the blankets with the help of dry cleaners.

Thus the volunteers' role was limited to work which didn't need skill. On the other hand, the staff of bureaus dealing with water supply and sanitation, the staff of health centers and plumbers, who required special knowledge and experience, seemed to suffer from a labour shortage. Sanitary engineers might be able to take a more active role in this field.

**2. Volunteers for Domestic Disaster on the Basis of International Cooperation**

Most of the group leaders had experience helping people in developing countries. In the rescue operation, many NGOs whose main purpose is international cooperation played an important role. At the same time, we should give attention to the fact that volunteer activity knowhow was accumulated in each individual as well through grass-roots cooperation.

The leaders showed great skill in organizing their groups. They estimated each volunteer's own will and tried to produce an organization without any obligations or restraints.

Problems with the volunteer groups in Kobe seemed to be similar to those in an international project. For instance;

– Does the presence of volunteers prevent the victims from supporting themselves?
– How do local volunteers take over the work, especially long-term needs such as mental care of the victims?
– How to understand victims' feelings and talk frankly with each other?
– How to communicate among NGOs and individual volunteers in order to make the rescue operation more effective?

Most of the participants were short-stay students who made use of the vacation between school years and were first-time volunteers. Whether they continue to volunteer elsewhere after they leave Kobe will be interesting. At the same time, people who didn't go to Kobe this time also had a favorable image of volunteers and knew that to participate in volunteer activity was not so strange. Although experienced volunteers from international projects were a great boon to the earthquake rescue operation, after this it is expected that volunteer activities by Japanese in developing countries will accelerate.

## TWO BOOKS ON JAPAN'S EXPERIENCES IN ENVIRONMENTAL MANAGEMENT

Japan has changed its status from an agrarian society into the world's leading industrial and economic power in a short period; experiencing rapid industrialization and urbanization accompanied by various environmental problems. As such Japan has great potential to serve as a rich source of experiences in environmental management for the developing world.

Its experiences include both positive and negative ones which can provide a number of useful lessons for policy makers in the developing world. Some of them are highly worthy of being emulated while some others definitely should be avoided in order to achieve prosperous societies without pollution. Nevertheless, Japan's experiences have been reported very little to the rest of the world, mainly because of the language barrier. Given such conditions it is a great pleasure for the staff of INTEP to introduce the following two books which have recently been published. They will certainly fill a big part of this information gap.

The first book is "Industrial Pollution in Japan" edited by Prof. Jun Ui of Okinawa University and published by the United Nations University Press in 1992.

This book shows the darker side of Japan's technological and industrial achievements-namely, the

widespread enviromental damage that has ocurred in the process of Japan's modernization. It begins with a look at the well-known Ashio Copper Mine pollution case, one of modern Japan's first and most devastating environmental disasters. The country's worst pollution incident in the post-war period, the mercury poisoning in Minamata, whose victims are still on the increase today, is also covered in depth. Two other major incidents of the post-war period are detailed, and in addition to these specific cases, an overall analysis of the social, economic, political, and technological factors relevant to industrial pollution is provided.

The second book is "Japan's Experience in Urban Environmental Management" published as a Metropolitan Environment Improvement Program (MEIP) report by The World Bank in 1994. MEIP is a UNDP-assisted and World Bank-executed program to assist Asian urban areas in tackling their rapidly growing environmental problems. MEIP considers that it is highly effective for developing countries to learn from countries and cities that have experienced similar problems and that as a developed country in Asia, Japan´s urban environmental management history affords an excellent opportunity to derive lessons and case studies.

In contrast to the first book, this book reviews mainly the brighter side of post-war Japan's experience in urban environmental management. It consists of an overview of Japan's experiences, and draws general conclusions about the relevance of these experiences for developing countries.

*People who want to get these books are advised to contact the respective publishers directly.*

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*53-70, Jingumae 5-chome, Shibuya-ku, Tokyo 150, JAPAN*
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## INTEP MOVES TO NEW OFFICES

Following the construction of a new building at the University of Tokyo, INTEP moved into new offices on May 18 1995. The new INTEP offices are located on the 7th floor of the 14th building of the Faculty of Engineering. Telephone numbers and occupants of the new offices are as follows;

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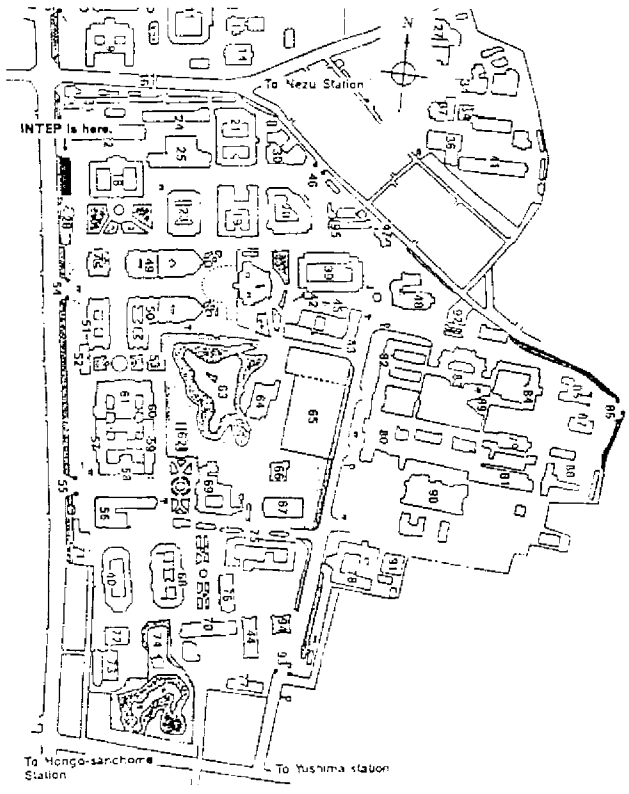


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