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SOCIAL WELFARE FACILITIES' DAMAGE AND THEIR CORRESPONDENCE ON 1995 GREAT HANSHIN-AWAJI EARTHQUAKE

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SUMMARY

During a period of several months following the Hanshin-Awaji Earthquake of 1995, several hundred elderly people died from illness in the disaster region. It is reported that a major factor contributing to their occurrence was the poor environment in evacuation facilities. We must take advantage of lessons taught by this tragic experience to quickly establish a crisis management system that can guarantee a living environment of a tolerable quality in order that the emergency living conditions experienced by elderly people following an earthquake are not significantly inferior to their normal living conditions.
As part of efforts to realize such a crisis management system, we conducted a questionnaire survey of social welfare facilities operating in the region where damage was severe and in the surrounding regions immediately after the Hanshin-Awaji Earthquake. We reached the following conclusions based on the results.

1) It is necessary to provide base isolated buildings in order to improve the safety of elderly people during shaking caused by earthquake motion with a seismic intensity of 6 or more. 2) Assuming that an earthquake will disrupt pipelines, roads, and other so-called lifelines that supply needed services, social welfare facilities must introduce measures to deal with this problem: the installation of systems to use well, river, and pond water or to generate non-utility electric power, preparation to switch-over to propane gas, and the stock-piling of emergency stores of necessary materials. 3) If an earthquake inflicts damage over a wide area and it takes a long time to restore the lifelines, many residents of the region will require nursing care. Groups of social welfare facilities must form networks in order to prepare for this eventuality.

INTRODUCTION

Surveys of earthquake disasters occurring in recent years in Japan have indicated that elderly people are more likely to suffer injuries and to die than younger people [1]. This tendency was conspicuous following the Hanshin-Awaji Earthquake of January 17, 1995, with elderly people accounting for about half of the more than 5,500 fatalities that were initially announced. Documents concerning the earthquake disaster in Takarazuka City suggest that elderly people are more likely to be killed or injured not only because they are physically weaker than younger people, but because they tend to live in houses that are not very resistant to earthquake motion. By the end of 1995, the number of fatalities caused by the earthquake had risen to more than 6,300. The additional fatalities include those who passed away as an effect of diseases caused by the earthquake, and many of these were elderly people. It is reported that an important cause of these fatalities was the poor conditions in evacuation areas.

The aging of the Japanese population is accelerating and the transformation of Japan from an aging society to an aged society is now in progress. This means that the number of people prone to the effects of disasters will increase. Consequently, Japan and other nations with aged societies have to quickly establish crisis management systems to guarantee the safety during earthquakes of elderly people and others who are susceptible to the effects of disasters and to minimize the decline in the quality of their lives during the period of emergency following an earthquake. In order to construct a crisis management system needed to deal with disasters occurring in an aged

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society, the authors have studied the actual state of damage inflicted at social welfare facilities in the region where the Hanshin-Awaji Earthquake inflicted severe damage and in other social welfare facilities in the surrounding regions and the response of these facilities to the damage to clarify the challenges that must be faced to establish such a crisis management system.

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THE SURVEY

Positioning of Social Welfare Facilities During a Disaster:

Because social welfare facilities are widely distributed throughout every region and are normally closely linked to regional society through their day service activities, they can serve as the core of activities to assist disaster prone people in their homes during an earthquake, and are therefore, counted on to serve as activity centers in crisis management systems established for the benefit of people susceptible to the effects of a disaster. Specifically, social welfare facilities must fill two roles: 1) the prevention of the death and injury of facility residents and the maintenance of their living conditions after the disaster and 2) providing emergency assistance to elderly and disabled persons who have suffered from the disaster at their own homes. To successfully fulfill the first role, social welfare facilities have to guarantee the safety of their buildings etc. against earthquake motion and provide personnel and substitutes for services cut off by damage to lifelines needed to maintain the living conditions of their residents. Needless to say, their second role is premised on their ability to successfully fill the first role.

Survey Method:

In May 1995, the authors mailed questionnaires to 463 social welfare facilities (welfare facilities for the elderly, protective facilities, children’s welfare facilities, facilities for the rehabilitation and care of the physically disabled, facilities for the care of the cognitively handicapped, facilities for the treatment of the mentally ill) in Hyogo Prefecture and Osaka Prefecture in order to clarify the actual state of welfare facilities under the effects of the disaster, and obtained replies from 308 of these facilities. The questionnaire concerned the category of facility, its operation, building damage and personal injury etc. caused by the earthquake, failure of lifelines and response to this failure, assistance activities, and disaster protection measures prepared before the disaster. The authors also carried out supplementary direct interviews with personnel at welfare facilities for the elderly in the cities of Kobe and Ashiya where the damage was particularly severe.

ANALYSIS

Outline of the Facility Based on the Face Sheet:

The categories and numbers (percentage of all responding social welfare facilities) of social welfare facilities that responded, were 204 (66.2%) welfare facilities for the elderly, 40 (13.0%) facilities for the care of the cognitively handicapped, 29 (9.4%) facilities for the rehabilitation and care of the physically disabled, 16 (5,2%) children's welfare facilities, 14 (4.5%) protective facilities, and 5 (1.6%) facilities for the treatment of the mentally ill for a total of 308 facilities. Of these, 89 (28.9%) are out-patient facilities that offer day services.

The number of people residing in these facilities ranges from 6 to 850 (average of 69.8), and the ability of these people to move is, as shown in Figure 1, quite low. For example, only 176 (51.8%) of the facilities reported that at least 50% of their residents can walk unaided. Responses regarding the care provision situation defined as the number of facility users (number of residents plus the number of users living outside the facility) per employee revealed a rate of 4.5 during the day (weekday immediately before the earthquake) and 25.7 at night (for the number of residents the day of the earthquake), indicating a big difference in the care provision situation. The key to preventing an increase in the scale of a disaster occurring at night is the way that the facilities respond to nighttime disasters.

Damage to the Facilities and Effects on Residents Immediately after the Earthquake:

Direct Earthquake Damage to the Facilities:

Figure 2 shows the distribution of the social welfare facilities (including damage to the building). The earthquake inflicted overall building damage at 8 facilities and damaged the building or rooms at 38 facilities. By room use, baths were unusable at 9 facilities, toilets unusable at 5 facilities, and bedrooms unusable at 5 facilities. A look at equipment earthquake protection measures introduced at these facilities prior to the earthquake reveals that lockers, bookshelves, etc. were anchored at only 27 facilities (8.6%) and large televisions were anchored at only 65 facilities (21.1%). Window glass was either wired or coated with film sheets at 83 facilities (26.9%). These results demonstrate that overall, measures to prevent equipment from overturning and measures to protect it from damage were inadequate at social welfare facilities. As a consequence, the earthquake overturned steel lockers at 47 facilities (overturning rate of 16.8%) and large television sets at 41 facilities (overturning rate of 16.9%) and broke window glass at 35 facilities (breaking rate of 15.6%). The overturning rates or breakage rates of each of these categories of equipment are around 16%, revealing the same degree of susceptibility to earthquake motion at these facilities. Other equipment damage included overturning of bureaus in bedrooms at 33 facilities and the overturning of dish cupboards in kitchens at 25 facilities.

Effects of Facility Damage on Residents:

At all facilities, 1 resident was seriously injured and 16 residents suffered moderate injuries and the highest injury rate at a single facility was 7.5%. But the rate of personal injuries among residents of social welfare facilities was generally less severe than that among ordinary citizens. Even the person who was seriously injured at a social welfare facility was an elderly person who, happening to be out of bed at the time of the earthquake, was injured because the earthquake threw the person to the floor. It is however, important to note that only a small number of people were injured because the earthquake occurred before the residents woke up. It is likely that if this earthquake had occurred during the daytime, the earthquake motion would have directly injured many residents inside the buildings. The only way to protect physically weak people from strong earthquake motion is to improve the earthquake resistance of the buildings so the possibility of providing these buildings with base isolation systems must be studied.

Turning to examples of problems hampering immediate post-earthquake evacuation, one welfare facility for the elderly in Kobe suffered severe damage to its building, forcing the emergency evacuation of its residents. Located on a hillside, cracks spread through its building under the effects of the failure of a retaining wall on the valley side of its site. Its 61 residents were evacuated to a nearby building under the guidance of the facility staff over a period of 2 hours and 20 minutes late on the night of January 18th while the power was cut off. Although there are usually more than 50 people on duty at this facility during the day, only 8 were working there on the night of January 18th. It took 18 minutes for each employee to evacuate one resident.

This shows that because of this sharp decline in the number of employees at night, it takes a long time to safely evacuate a large number of people with impaired mobility. This means that the assistance of residents of the neighborhood of a social welfare facility is indispensable for emergency evacuation following a disaster. But only 65 (21.1%) of facilities had, as part of its disaster protection measures, consulted with residents of the neighborhood regarding assistance during a disaster prior to the earthquake. And only 6 facilities (1.9%) had carried out evacuation training with the support of residents of the neighborhood. Most of the facilities had not considered large-scale disaster evacuation measures.

Preparations for Daily Life During a Disaster:

The daily life of residents of a social welfare facility depend upon electricity, gas, and water supplies and telephone connections and other lifelines and upon the activities of its employees. An earthquake instantly cuts off these functions, making it difficult to maintain the normal living conditions inside the facility. The time required for the lifelines to be restored is defined as the emergency living period, and the authors studied measures taken at 150 facilities in Hyogo Prefecture where the damage was concentrated.

Lifeline Restoration Process and Return of the Employees to Work:

Figure 3 shows the lifeline (electricity, gas, water) restoration process and the time required for the employees to return to work. In response to a question regarding what difficult problems were caused by the earthquake (free answers), most of the respondents referred to the cutting off of services. The earthquake cut off the electricity, city gas, and water at between 50% and 60% of the facilities. The period of time required for these services to be restored varied depending on the difficulty of the restoration work. The electricity was restored quickly with electric service to 90% of the facilities restored on the same day as the earthquake. City gas and water supplies were not restored for three or more months, and because of the danger of city gas, its restoration took a particularly long time.

In order to study the employees' work situation, the questionnaire requested the date that most of the employees were back on the job. The same tendency seen in the city gas and water supply restoration appears in the results concerning the employee's return to work. Only 63 facilities (42.0%) reported that, "most of the employees live within a 1 hour bicycle ride of the facility." And 58 (38.7%) of the facilities reported the collapse or destruction by fire of their employee's homes with 19 facilities (12.7%) reporting the death or injury of employees. It is easy to imagine that the operation of facilities in the disaster region was severely impeded by delays in the return of their employees.

Actual State of Emergency Living Conditions:

The activities of social welfare facilities can be categorized as the basic activities that are food service, heating, bathing, laundry, and medical treatment, and also includes recreational activities such as walks etc. At some facilities, these activities also include the day service etc. for users living outside the facility.

Figure 4 shows which of these activities were suspended and the time required for them to be restored. But the questionnaire asked how long it took for food service to return to the same level as before the earthquake. Their restoration process closely resembles the lifeline restoration trends (Figure 3), revealing that many of these activities depend upon the lifeline services. It took about 3 months for all activities to return to their level before the earthquake. The level of medical treatment declined the least and it recovered quickly. It is assumed that this is a result of the fact that at facilities whose residents include many infirm people and those whose health is fragile, top priority was placed on the restoration of medical treatment functions and assistance to medical staff was provided quickly. Other basic activities (food service, heating, bathing, laundry) declined between 50% and 60% from the pre-earthquake levels and were seriously effected by the cutting of the lifelines. The ripple effects on food services and bathing, both of which depend on city gas and water supplies, were serious. The service most seriously effected was the provision of services to users living outside the facilities. Services to outsiders appear to have been restored about 1 month after the levels of daily life services for residents returned to normal.

Introduction of Substitute Equipment in Response to the Cut-off of Lifelines:

The electric power was cut off at 78 facilities. Seventy-five of these used electric power for lighting purposes, 52 for heating, and 41 for cooking. After the earthquake, flashlights were used as substitute lighting at 52 facilities

(53% of facilities) and in-house emergency generators were used for this purpose at 33 facilities (44% of facilities). Because these are absolutely essential for nighttime evacuation, they must be provided at all facilities in the future. Kerosene stoves were used as substitutes for electrically powered heating systems at 13 facilities (25% of facilities). Propane gas was used for cooking in place of electricity at 18 facilities (44% of facilities). Portable gas-powered hot plates were substituted for cooking use at 12 facilities (29% of facilities).

City gas was cut off at 37 facilities and until it was restored, substitute heat sources were introduced at these facilities as shown in Table 1. Substitutes used for heating were kerosene and, after it was restored, electricity. Almost all facilities that normally used city gas to prepare food replaced it with propane gas. Few facilities turned to substitute sources of heat for preparing bath water. Its restoration was probably postponed because bathtubs require large volumes of water and it was wintertime. The installation of equipment capable of being powered by propane gas is recommended as a way to prepare in advance for the loss of supplies of electricity and city gas.

Table 1: Substitute heat sources due to city gas cut off.

Substitute heat sources	Number of facilities cut off city gas		
	Heating	Cooking	Heating a bath
	22(1.00)	37(1.00)	29(1.00)
Kerosene	12(0.55)	1(0.03)	5(0.17)
Propane gas	2(0.09)	24(0.65)	6(0.21)
Electricity	16(0.73)	13(0.35)	4(0.14)
Fire wood	1(0.05)	9(0.24)	1(0.03)
Charcoal	0(0.00)	3(0.08)	0(0.00)
Total	31(1.41)	50(1.35)	16(0.55)

The water to 67 facilities was cut off. Table 2 categorizes the water use or the method of obtaining water while the normal water supply was cut off. A simplified aggregation by use reveals that the quantity of water used for various purposes declined in the sequence: cooking, toilet, laundry, and bath use. This appears to reflect the degree that each type of use is necessary for the conduct of daily life, and as stated in the discussion of substitutes for city gas, bathing was given the lowest priority. Responses to questions regarding the type of water used and the method of obtaining it revealed that most facilities obtained it from water supply trucks, a method that was twice as widespread as other methods. Water delivered in this way was used in large quantities for cooking, toilets, laundry, and bathing. This result indicates that the availability of water supply trucks is the most important form of support for facilities. But considering the actual state of the daily life of the residents during the emergency period, they are not capable of providing the total quantity of water that is needed.

Table 2: Method of obtaining water due to normal water supply cut off.

Method of obtaining water	Number of facilities cut off water				
	Cooking	Toilet	Laundry	Bathing	Total
	67(1.00)	66(1.00)	66(1.00)	66(1.00)	67(1.00)
Water supply trucks	36(0.54)	20(0.30)	21(0.32)	12(0.18)	89(1.32)
Water presented by persons	26(0.39)	11(0.17)	7(0.11)	3(0.05)	47(0.70)
Water left in high-level water tank	20(0.30)	10(0.15)	8(0.12)	1(0.02)	39(0.58)
Water from a well	5(0.07)	11(0.17)	8(0.12)	6(0.09)	30(0.45)
Water in pond & river	2(0.03)	19(0.29)	7(0.11)	1(0.02)	29(0.43)
Total	89(1.41)	71(1.08)	51(0.77)	23(0.35)	234(3.49)

Support and Assistance:

Table 3 presents the details of the support the facilities received from outside and the assistance they provided to other facilities and to victims of the disaster. The support they enjoyed was in the form of supplies of materials that the facilities required. They were particularly short of food, clothing, drinking water, and personnel. Shortages of food and clothing indicate that companies supplying these products were forced to close down and traffic was unable to move during the period. It is difficult for a single facility to stockpile enough of these materials to last a long time. It is vital for individual facilities to keep enough of these materials on hand to last a short period, about 1 week for example, and to strengthen their links with other facilities to establish systems of transporting goods to facilities in disaster regions. Such systems must also be applied to personnel resource support.

Table 3: Support from outside and assistance to outside .

Contents	Number of facilities	
	Support from outside	Assistance to outside
Clothing	65(0.21)	26(0.08)
Food	79(0.26)	49(0.16)
Medicine	35(0.11)	27(0.09)
Drinking water	64(0.21)	59(0.19)
Taking a bath	24(0.08)	50(0.16)
Personnel resource support	46(0.15)	140(0.45)
Cash	32(0.10)	168(0.55)

Acceptance and Transfer of People Requiring Care:

Even after people susceptible to the effects of disasters living in their own homes had come through the earthquake uninjured, the cutting of lifelines faced them with serious difficulties in leading healthy daily lives. In sum, as a consequence of the deterioration of their living environment, elderly people etc. are more likely to require special care than people in normal condition. It is, therefore, necessary to clarify the living conditions of people prone to the effects of disasters as quickly as possible in order to take appropriate action to assist them by, for example, placing them in welfare facilities. But admitting new residents is the second dilemma that welfare facilities face during a disaster, and the 167 facilities (54.2%) that accepted new residents were distributed throughout Hyogo Prefecture and Osaka Prefecture. Only 11 facilities (3.6%) transferred residents to other facilities.

Table 4 shows the relationship of the degree of damage in various regions with the state of acceptances of new residents by facilities and of the transfer of residents (including transfers to locations other than other facilities). The degree of damage in a region is represented by the percentage of buildings totally destroyed in each city, ward, town, and village where the various social welfare facilities are located. The greater the degree of damage in a district, the lower the percentage of facilities that only accepted new residents, and when the degree of damage in a district exceeded 10%, the percentage of facilities reporting both acceptances and transfers rises. There is a close relationship between the degree of damage in a district and the length of time its lifelines were cut off (Table 5). In other words, it is possible to conclude that this result indicates that in regions where damage to homes was particularly severe, the prolongation of the period when the lifelines were cut off gradually produced more and more people requiring care in their homes.

Table 4:Relationship of the degree of damage in various regions with the state of acceptances of new residents by facilities and of the transfer of residents.

Degree of damage	Number of facilities				
	Transfer	Acceptance	Acceptance only	No acceptance	Total
0-1	0(0.00)	1(0.01)	67(0.84)	12(0.15)	80(1.00)
1-3	0(0.00)	2(0.08)	20(0.83)	2(0.08)	24(1.00)
3-10	0(0.00)	1(0.06)	11(0.69)	4(0.25)	16(1.00)
10-	2(0.07)	9(0.30)	16(0.53)	3(0.10)	30(1.00)
Total	2(0.01)	13(0.09)	114(0.76)	21(0.14)	150(1.00)

Table 5:Relationship between the degree of damage in a region and the period of city gas' stop.

Periods of city gas cut off	Degree of damage in a region (%)			
	0-1	1-3	3-10	10-
Within 1 week	1(0.25)	6(1.00)	0(0.00)	1(0.05)
Within 1 month	3(0.75)	0(0.00)	3(0.50)	5(0.25)
Within 2 months	0(0.00)	0(0.00)	1(0.17)	11(0.55)
Within 3 months	0(0.00)	0(0.00)	2(0.33)	3(0.15)
Total	4(1.00)	6(1.00)	6(1.00)	20(1.00)

What were the maximum numbers of people requiring care that the facilities could accept? The authors calculated the maximum new resident acceptance ratio: the ratio of the maximum number of new residents accepted after the earthquake to the standard capacity of the facility. Figure 5 shows the relationship of the maximum number of new residents accepted ratio with the extent of the damage in a region. A line falling to the right was obtained by plotting an envelope linking the upper limits of these maximum number of new residents accepted ratios. In other words, it indicates that in a region that suffered severe damage, there is a limit on the number of people requiring care that were accepted. The maximum new residents accepted ratio at a regional

extent of damage of 10% reached 0.6. In sum, in preparation for an urban earthquake with an intensity of 6 or 7, it is necessary to set a target that will permit the accommodation of 1.5 times the normal number of residents and implement various related measures.

Let's look at an actual example of the way a facility obtained staff. A social welfare facility for the elderly located in Ashiya City normally accepted an average of 6 people/day for short stays. But with its staff down sharply and its lifelines disrupted, immediately after the earthquake, it accepted new residents equal to 60% of its normal capacity (approx. 30 people). Although a drop in the quality of its services caused problems, it survived the crisis thanks to the help of volunteers experienced in providing care. It was able to take care of its residents thanks to the assistance of an average of 8.8 volunteers per day in addition to its normal facility staff of 50.

CONCLUSIONS

1. Overall, measures to prevent equipment from overturning and protect it from damage at social welfare facilities are inadequate, requiring the early introduction of safety measures. It is also necessary to provide their buildings with base isolation systems in order to protect the elderly etc. from the powerful shaking generated by earthquakes with an intensity of 6 or more.
2. At social welfare facilities, far fewer staff members are on duty at night than during the daytime. This means that when measures to be implemented in the event of a nighttime disaster are planned, relations with nearby residents should be expanded to construct a cooperative disaster response system in order to supplement for the shortage of nighttime staff.
3. The Hanshin-Awaji Earthquake cut off supplies of water and city gas for three months and caused shortages of both materials and personnel at the facilities. Their operators introduced or obtained substitutes for the lost services, but could not obtain these in adequate quantities. This was the cause of a decline in the living standards of the residents followed by a gradual return to normal levels as the lifelines were restored. It is, therefore, essential for such facilities to prepare for the disruption of services provided through these lifelines by planning for the use of well, river, or pond water, installing in-house electric power generators, planning a switch-over to propane gas, and by stockpiling materials.
4. Damage over wide areas and delays in the restoration of lifelines result in the appearance of many people requiring care in the region. But there are limits to the capacity of a region's facilities to accommodate these people.
5. The above conclusions indicate that to create an effective crisis management system for social welfare facilities, multiple social welfare facilities must form a network. Future studies must be undertaken to plan material stockpiling sub-systems, personnel resources assistance sub-systems, and sub-systems for the acceptance of people in need of care that will be part of such a network.

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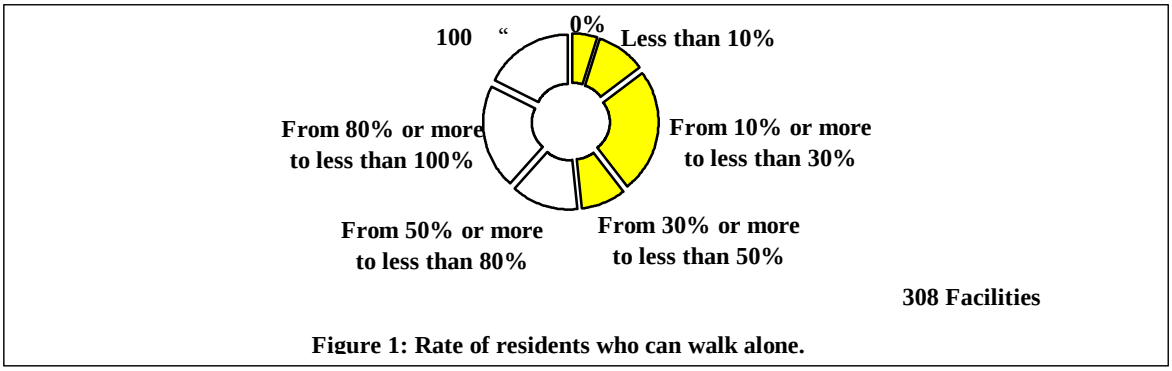

Figure 1: Rate of residents who can walk alone.

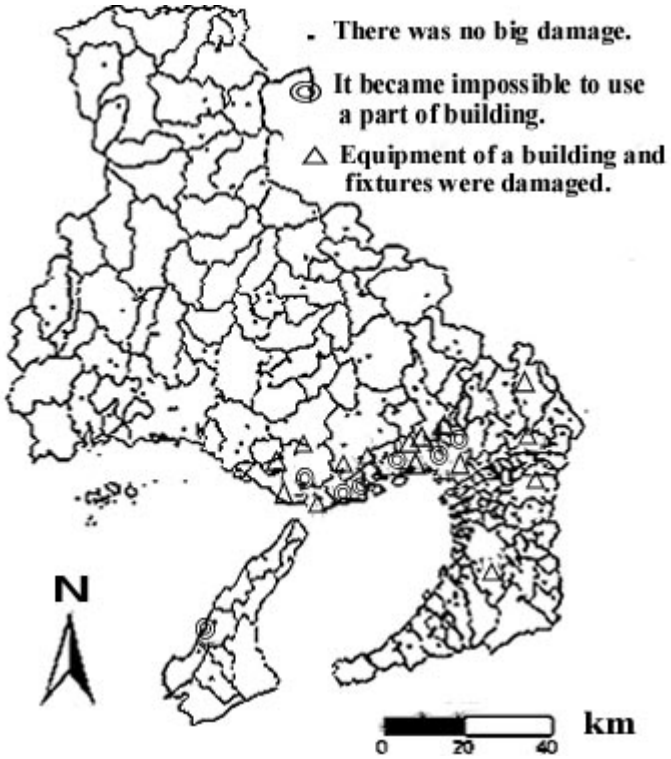

Figure2 Distribution of the social welfare facilities.

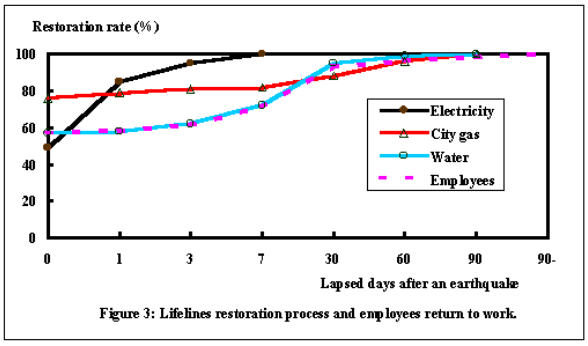

Figure 3: Lifelines restoration process and employees return to work.

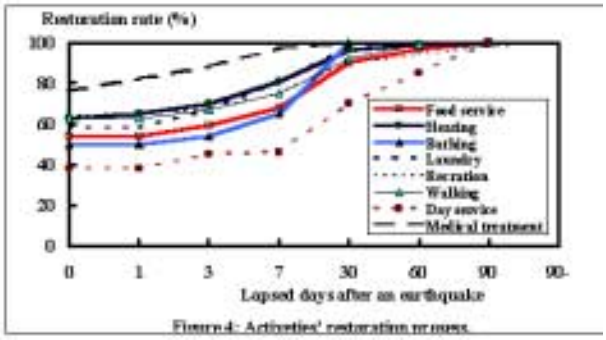

Figure 4: Activities' restoration process

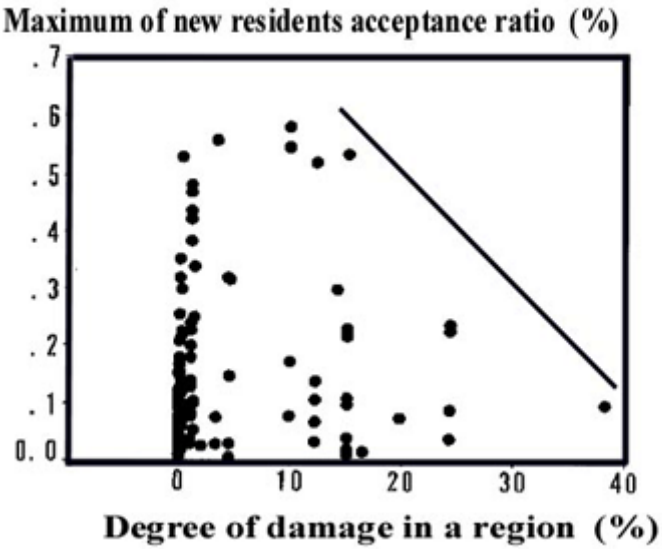

Figure 5:Relationship of the maximum number of new residentsaccepted ratio with the extent of the damage in a region.