

# Evaluation of evacuation environment of disabled persons in designated shelters

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## Abstract

*Introduction:* Japan is known as a country frequently hit by earthquakes, floods, volcanoes, and various other natural disasters. We evaluated the evacuation environment of people with disabilities in urban areas and conducted research to clarify the evacuation environment of people with disabilities from the viewpoint of rehabilitation.

*Methods:* Five designated evacuation shelters, excluding elementary, junior-high, and senior-high schools, were selected, and the interview survey was conducted.

*Results:* High average marks exceeding 4.0 points were obtained for all evacuation sites. There were evacuation sites that had universal design lavatories installed, but the number of those lavatories was insufficient to accommodate the number of people for the site.

*Discussion:* The results indicated that all of the evacuation sites overwhelmingly lack in the number of universal design lavatories, and that there are differences in the presence of universal design showers according to evacuation sites. Consequently, as an emergency measure, portable toilets can be used. Adoption of simplified universal design for lavatories for people without disabilities could achieve great cost reduction and provide a quick solution.

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## 1. Introduction

### 1-1 Japan Earthquake

Japan is known as a country frequently hit by earthquakes, floods, volcanoes, and various other natural disasters. Japan's history includes a large number of natural disasters that caused tremendous damage. The 2011 Great East Japan Earthquake, together with the accompanying tsunami, resulted in about 20,000 casualties<sup>(1)</sup>. Thereafter, massive earthquakes occurred also in Tottori Prefecture and Kumamoto Prefecture, and the earthquakes in Kumamoto Prefecture caused casualties.

Many studies have been conducted on the evacuation methods for the disabled, but only a

few studies have been conducted on specific methods<sup>(2-3)</sup>.

The authors interviewed the disabled about evacuating during disasters<sup>(4-5)</sup>. We evaluated the evacuation environment of people with disabilities in urban areas and conducted research to clarify the evacuation environment of people with disabilities from the viewpoint of rehabilitation.

### 1-2 Purpose

This survey was conducted to assess the presence of universal design features in the evacuation environment of the disabled. The purpose of the survey was to determine whether welfare equipment is necessary to create accessible environments at emergency shelters.

## 2 Method

Lists of Temporary Gathering Sites announced by Osaka Prefecture as of April 2016 were classified according to secondary medical care region. Based on data containing the number of the disabled in municipalities in every secondary medical care region (2015 Version), municipalities with a large number of the disabled were identified, and disaster shelters that were intended to accommodate 1,000 people or more were listed. Five designated evacuation shelters, excluding elementary, junior-high, and senior-high schools, were selected, and the interview survey was conducted.

The size of the area and facilities of elementary, junior-high, and senior-high schools are standardized by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and their architectural design is standardized by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). Thus, elementary, junior-high, and senior-high schools have many facilities in common and are designated as temporary gathering sites. Therefore, they were excluded from the evaluation targets.

Evaluation of the shelters was conducted using the items contained on MLIT's Building Accessibility and Mobility Standards' checklist and additional items formulated by two members of our evaluation team (level differences at the building entrance, level differences at the lavatory entrance, presence or absence of universal design lavatory, number of universal design lavatories, presence or absence of handrails at main evacuation sites inside the building, presence or absence of bath (shower), adoption of universal design for bath (shower), presence or absence of elevator, elevator capacity, and presence or absence of benches around the shelter). A five-point scale was used for the main subjective evaluation method. (Approval number for the research:

2016-205)

## 3 Results

Table 1 shows the results of each item using the five-point scale. High average marks exceeding 4.0 points were obtained for all evacuation sites. When viewed item by item, all of the requirements of the Building Accessibility and Mobility Standards' checklist were satisfied, but for buildings that were older than 20 years, no measures were included to accommodate ostomates. There were evacuation sites that had universal design lavatories installed, but the number of those lavatories was insufficient to accommodate the number of people for the site.

Although gymnasiums, etc. that are used for shelters have showers installed, some buildings do not have universal design for the showers as shown in Fig. 1. With respect to elevators in evacuation shelters, all of the evacuation shelters were equipped with elevators, but the elevator car of some shelters was able to accommodate only one wheelchair at a time (Fig. 2). In some evacuation shelters located in hilly zones, etc., evacuation spaces were installed in the basement, where the use of elevators was mandatory. In these facilities, it is necessary to determine whether the elevator can be operated by the emergency power system.

## 4 Discussion

Evacuation sites were classified by each secondary medical care region, and using the Building Accessibility and Mobility Standards' checklist and the additional evaluation items formulated by our evaluation team, each evacuation shelter was evaluated. The results indicated that all of the evacuation sites overwhelmingly lack in the number of universal design lavatories, and that there are differences in the presence of universal design showers according to evacuation sites.

Table 1. An itemized list of the contents

|        | The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) | Bump at building entrance | Bump of each space | Bump of rest room | Presence of barrier-free rest room | Number of barrier-free rest rooms | Presence of handrail in evacuation site | Presence of bathroom | Bathroom of barrier-free | Presence of elevator | Capacity in elevator | Presence of bench in evacuation site |
|--------|--------------------------------------------------------------------|---------------------------|--------------------|-------------------|------------------------------------|-----------------------------------|-----------------------------------------|----------------------|--------------------------|----------------------|----------------------|--------------------------------------|
| Area 1 | 5                                                                  | 5                         | 5                  | 5                 | 5                                  | 5                                 | 5                                       | 5                    | 3                        | 5                    | 3                    | 4                                    |
| Area 2 | 5                                                                  | 5                         | 5                  | 5                 | 5                                  | 3                                 | 5                                       | 5                    | 4                        | 5                    | 3                    | 4                                    |
| Area 3 | 5                                                                  | 5                         | 5                  | 5                 | 5                                  | 4                                 | 5                                       | 5                    | 4                        | 5                    | 5                    | 5                                    |
| Area 4 | 5                                                                  | 5                         | 5                  | 5                 | 5                                  | 4                                 | 5                                       | 5                    | 5                        | 5                    | 5                    | 4                                    |
| Area 5 | 4                                                                  | 5                         | 4                  | 5                 | 5                                  | 4                                 | 5                                       | 5                    | 3                        | 5                    | 5                    | 5                                    |
| Mean   | 4.8                                                                | 5                         | 4.8                | 5                 | 5                                  | 4                                 | 5                                       | 5                    | 4                        | 5                    | 4.2                  | 4.4                                  |

5: Excellent, 4: Good, 3: Average, 2: Fair, 1: Poor

First, with respect to the universal design lavatory, the level difference, width of the doorway, etc. met the MLIT's Building Accessibility and Mobility Standards. It is clear that a universal design lavatory provides a desirable environment for wheelchair users in non-disaster times(Fig.3).

When these buildings are used as evacuation shelters at the time of disasters, they must accommodate a large number of people. It becomes essential to install the required number of universal design lavatories given the population aging rate and number of the disabled.

For example, assuming that the population aging rate of a 1,000-capacity evacuation shelter is 20%, about 200 elderly people require shelter. Assuming that 50% of these elderly people require long-term care, 100 people are in care-requiring condition. Suppose 50% of the elderly people in need of care have a care need of 3 or higher; accordingly, about 50 people need wheelchairs. Many elderly people need assistance for movement. If 50 people use wheelchairs in a shelter, one universal design lavatory is insufficient. Potential issues of dehydration caused by fluid restriction or physical deconditioning caused by decreased movement are predicted to occur with limited lavatories.

Our previous study<sup>(4-5)</sup> reported that an auditorium, administered and operated by a university with four universal design lavatories was used as a secondary evacuation shelter. The auditorium was built on the supposition that the disabled come to use the lavatories even in non-disaster times and many of the disabled are able to use the lavatories at the time of disasters. The evacuees of the previous study<sup>(4-5)</sup> included a maximum of 60 people, with half of those people in wheelchairs. This study indicated that the presence of one universal design lavatory for every 6-7.5 people could achieve a comparatively favorable shelter operating environment.

In typical gymnasiums, showers for people without disabilities are available; however, the presence of showers that can accommodate wheelchair users varies as shown in Fig. 4.

A shower is equipped with drainage facilities and can be used as a private room or place for hygiene measures, such as changing diapers or bodily cleansing. Showers must be installed in evacuation shelters because of their high versatility not only by people who need support, but also by women and infants.

The number of universal design lavatories and showers at evacuation shelters were investigated. The results indicate that universal design environmental measures must



Fig.1 Showers were not universal design.



Fig.2 The elevator car of some shelters was able to accommodate only one wheelchair at a time.



Fig. 3 A universal design lavatory.

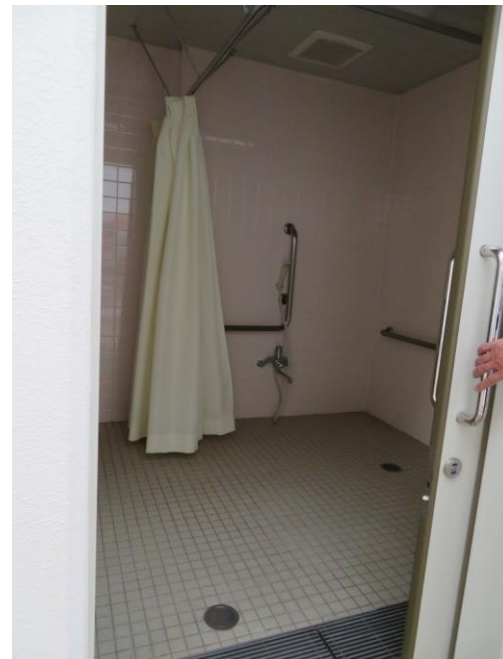


Fig.4 Universal design showers.

be enhanced at evacuation shelters for the disabled.

However, remodeling existing buildings is a large task, and the time and costs associated with remodeling are extensive. Remodeling on a scale of tens of millions of yen is foreseen,

which would put a heavy strain on the municipalities that are responsible for the management of these facilities.

Consequently, as an emergency measure, portable toilets can be used. Adoption of simplified universal design for lavatories for

people without disabilities could achieve great cost reduction and provide a quick solution.

To implement this project, specialists of bodily functions for the disabled and of universal design (welfare service workers and rehabilitation specialists) must be consulted and the cooperation of builders, etc. who have experience in universal design remodeling must be gained.

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