

Development of technologies to improve facilities to secure the health and safety of evacuees in evacuation shelters

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1. Introduction

(PhD Engineering)

Millions of people are expected to seek evacuation shelters in major earthquakes, such as an earthquake that would directly hit Tokyo. In addition, when they have to remain in shelters for a long period of time, the living environment of the shelters needs to be improved to prevent adverse health effects, including effects on mental health, and to ensure the safety of evacuees. Specific situations, such as regional characteristics, need to be taken into consideration when preparing evacuation shelters. Current evacuation shelter guidelines often fail to provide enough information concerning specific equipment and methods of improvement.

The authors started research and development to improve such situations and overcome problems in FY 2017. This paper introduces the outline of the study, findings of the investigations of evacuation shelters damaged in earthquakes, and findings of literature searches concerning relevant problems.

2. Outline of the study

2.1 Image of the research and development

The objective of this study is to present specific methods and improvement technologies to provide the adequate living environment of evacuation shelters that include toilets, the sanitary environment, privacy, and sound, heat, and lighting environment and functions. Figure 1 shows the image of the research and development.

2.2 Investigation concerning demands in evacuation shelters such as demand for electricity

The authors conducted interviews with people who operated evacuation shelters in three locations around the Sanriku Coast that was significantly damaged in tsunamis in the Great East Japan earthquake. Table 1 shows extracts from the hearing investigation. The investigation revealed that situations varied depending on the size of an evacuation shelter and management body of the shelter, as well as that challenges and problems differed depending on the conditions of lifeline restoration.

2.3 Literature search concerning the acoustic environment in evacuation shelters

The authors searched the literature on past studies concerning the acoustic environment in evacuation shelters. The weight of problems specifically associated with lifelines was heavy in the initial phase of a stay in

evacuation shelters. When the stay in evacuation shelters becomes long, however, the problem of noise, such as sound and the voices of children, surfaces as people seek the protection of privacy and improvement of comfort.

3. Future perspectives

To solve these problems, the authors are going to explore current facility plans by focusing on school facilities that are used as evacuation shelters, examine methods to operate and manage shelters after the onset of a disaster, and develop partitions with sound absorption functions to protect privacy.

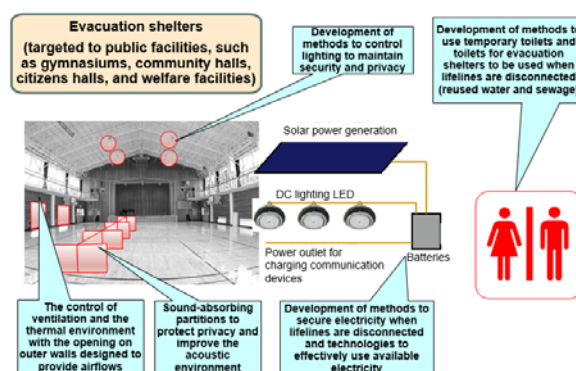


Figure 1: Image of the development of technologies to protect health in evacuation shelters

Table 1: Outline of the findings of hearing investigation (extracted)

	Evacuation shelter A	Evacuation shelter B	Evacuation shelter C
Building outline	Junior high school	Elementary school	Former convenience store
Maximum capacity	About 1,600 people	About 300 people	Dozens of people
Operation system	A headquarter system of principals and volunteers is organized.	Voluntary operation by evacuating local residents	Voluntary operation by evacuating local residents
Electricity restoration period	Three days after a natural disaster	About one month after a natural disaster	About two weeks after a natural disaster
Water supply restoration period	About three months after a natural disaster	About four months after a natural disaster	About four months after a natural disaster
Measures to protect privacy	Cardboard partitions were installed in early May.	A manufacturer provided 100 table tennis fences.	None
Problems and challenges	Whiteboards and large pieces of papers become useful. Toilets need to be provided, etc.	Importance of autonomous operation Disparity in supports available at different evacuation shelters, etc.	Septic tanks are useless unless water is available. Power generators are needed, etc.