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Jiro Sagara is a product designer with a strong interest in Universal Design and accessible design. From 1977 to 1998, he worked at the Hyogo Rehabilitation Center and the Hyogo Institute of Assistive Technology, where he dedicated himself to improving the quality of life and independence of people with physical disabilities across a wide range of fields. In 1995, he participated in support activities and reconstruction planning for refugees of the Great Hanshin-Awaji Earthquake, focusing on individuals with disabilities and elderly citizens.

In 2000, Sagara became an associate professor in the Department

of Product Design at the School of Design, Kobe Design University, and was promoted to professor in 2004. He served as chief director of the Rehabilitation Engineering Society of Japan (RESJA) from 2011 to 2014. In 2011, he contributed to the development of proposals for emergency temporary housing and led on-site services with RESJA volunteers and university students to improve living conditions in temporary housing in Natori City. He took initiative in Gensai Design and Planning Competition as one of the boards of the Society of Arts and Design Fusing with Science and Technology from 2012 to 2022.

Sagara has also researched and developed systems to support the independent life for early stages of dementia, working with occupational therapists to create cues for managing home equipment, environments, and schedules since 2012.

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Inclusive Emergency Temporary Housing Design with GENSAI Principles

Creating a Temporary Community for All Refugees in the Event of a Major Disaster

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Abstract

Japan is frequently struck by earthquakes and faces annual typhoons. In recent years, the country has also experienced severe regional heavy rains and flooding. In such major disasters, victims lose their lives, properties, and homes. All victims, particularly vulnerable groups such as people with disabilities, children, and the elderly, require habitable emergency temporary housing provided by the government, where they can live for a certain period during the recovery process.

The author has two key experiences in improving the habitability of emergency temporary housing: during the Great Hanshin-Awaji Earthquake in 1995 and the Great East Japan Earthquake and Tsunami in 2011. Based on these experiences, he proposes better emergency temporary housing designed with Universal Design principles. Disasters, whether natural or man-made, such as war or civil unrest, can happen anywhere in the world. It is crucial to

adopt a spiral-up approach through continuous practice and experience, guided by Universal Design principles.

Keywords: ***Emergency Temporary Housing, disaster, earthquake, Universal Design,***

Background

Japan is well known for its frequent earthquakes because the islands are located on the edges of four continental plates. As a result, there are many active volcanoes which provide hot natural water called onsen (spa). Earthquakes under the sea can cause tsunamis, such as the Great East Japan Earthquake in 2011.

Recently, we have also experienced heavy rains concentrated in limited areas where multiple cumulonimbus clouds rapidly form in a line. This phenomenon is called a linear heavy precipitation band.

During the summer season, several typhoons strike Japan, especially the islands of Okinawa, Kyushu, and Shikoku. These heavy rains can cause landslides, river floods, and the collapse of bridges.

Weather-related disasters can be partially predicted, but most disasters strike suddenly, impacting our lives and properties. In such events, the most affected are often people with

disabilities, children, and elderly citizens, collectively referred to as vulnerable people.

Not only Japan, but many countries and regions around the world, may be struck by natural disasters such as earthquakes, tsunamis, typhoons, cyclones or hurricanes, heavy rainfalls, and volcanic eruptions. Additionally, man-made disasters can disrupt the ordinary lives of citizens.

In the event of a major disaster, many families lose their homes. Therefore, emergency temporary housing should be provided to refugees until they can recover their lives and rebuild their homes. How can we make temporary housing more comfortable? This proposal suggests building and operating them according to Universal Design principles, based on experiences from the Great Hanshin-Awaji Earthquake in 1995 and the Great East Japan Earthquake in 2011.

The “GENSAI” Design

"GENSAI" is a Japanese word composed of two characters: GEN (減), meaning to reduce or scale down, and SAI (災), meaning disaster, trouble, difficulty, or cataclysm. Another related term, which is more commonly known, is "BOUSAI," composed of BOU (防), meaning to prevent, protect, or guard against, and SAI.

Examples of earthquake disaster prevention measures include

building reinforcement, damping systems, and seismic base isolation. Similarly, huge tide embankments serve as disaster prevention for tsunamis. These measures are designed based on estimated scales of disasters, but if the actual scale exceeds the estimation, they may not be effective.

Many families in Japan keep emergency supplies (e.g., bottled water, batteries, dried or instant foods, a whistle, aluminum-coated thin film, hygienic goods, a generator, a radio, a rope, etc.) stored in a bag out of sight. However, disasters often occur when interest and awareness have waned, rendering some supplies useless. People may also forget the existence or proper use of these emergency supplies. The disaster happens suddenly and then destroys a person's daily life, however, people must keep daily activities in extraordinary circumstances.

"GENSAI" refers to the mitigation of damage or casualties caused by disasters, and the "GENSAI Design" involves creative activities aimed at addressing four stages of disaster countermeasures: first, gathering information and evacuating or rescuing family and neighbors; second, improving convenience in shelters or emergency temporary housing; third, developing better reconstruction plans; and fourth, sharing experiences and preparing for future disasters (Sagara, 2017). Consequently, both BOUSAI (disaster prevention) and GENSAI (victims or damage reduction) measures must be considered to effectively prepare for disasters.

The emergency temporary housing in 1995

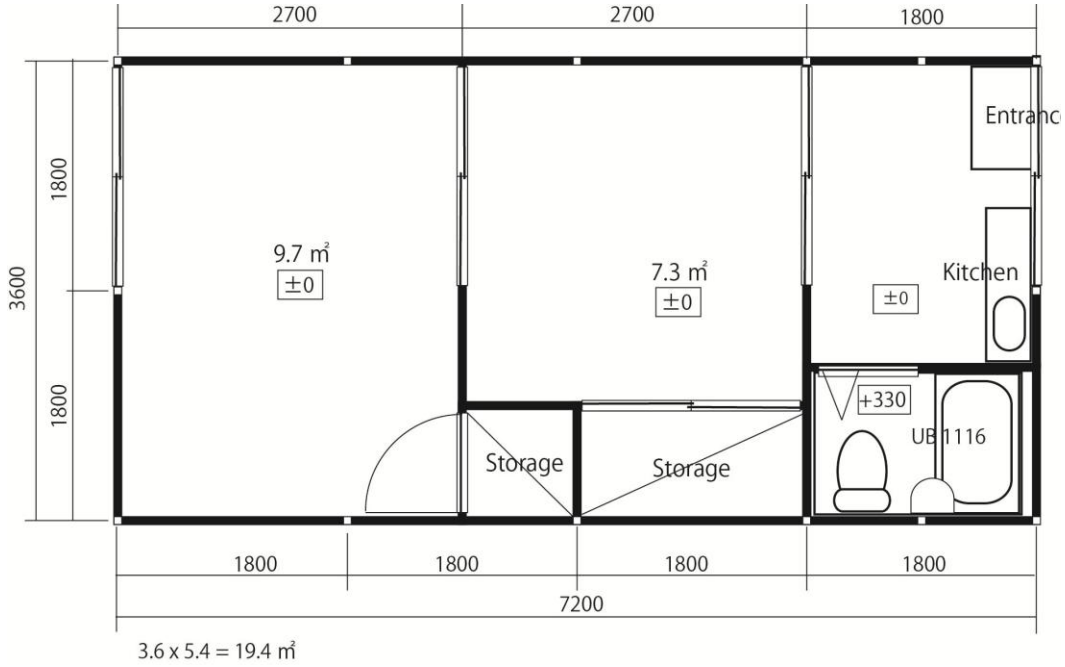

Figure 1. Emergency temporary house in the Great Hanshin-Awaji Earthquake in 1995

Under the Disaster Relief Law of Japan, the prefecture of the affected area can provide free emergency temporary housing to refugees (Cabinet office of Japan, 2020). This includes free rental houses in undamaged areas, including outside the prefecture, or prefabricated houses in open areas. The basic prefabricated temporary houses come in three sizes: 19.8m² for singles or couples, 29.7m² for standard families, and 39.6m² for large families. The standard size includes two bedrooms, a kitchen and dining area, a toilet, and a bathroom, as shown in Figure 1. A total of 48,300 emergency temporary houses were provided in the damaged area and around, including imported prefabricated houses (Cabinet office of Japan, 2018). The average cost for a standard house is capped at 2.4 million JPY. As these are temporary houses, the duration of residence is limited to two years by law,

although some, such as those used after the Hanshin-Awaji earthquake, were occupied for over four years.

Figure 2. Inverted U- shaped gutter placed at the entrance of emergency temporarily house (upper photo from Kobe city website of archives). Easy steps made by volunteers, and resident tried up and down frequently (below)

These houses are typically built as flat row houses in open fields. By law, the floor level must be at least 450 mm above the ground, so each house is equipped with steps at the entrance. If the site is sloped, the floor level increases progressively from one house to the next. In 1995, some temporary houses had floor heights over 700 mm and featured inverted U-shaped gutters at the entrances. One resident with Parkinson's disease stayed indoors all day after moving in. Volunteers built gentle stairs for him, and he repeatedly walked up and down them with a smile, as shown in Figure 2. Additionally, the bathroom, including the toilet and washstand, had a step of more than 300 mm to accommodate the drain trap and piping of the factory-made unit bathroom. This step was a significant problem, especially for the elderly. The Hyogo Institute of Assistive Technology designed a simple wooden stool to ease the step, and they published a booklet on how to make it and other useful ideas (Hyogo Institute of Assistive Technology, 1995). During the summer holidays in 1995, some high school students made these stools and delivered them to elderly residents in temporary houses. After the Niigata Earthquake in 2004, ready-made wooden stools were provided to every temporary house.

As emergency temporary houses were supplied gradually, families with elderly members or persons with disabilities were given priority. This often-disrupted community ties and led to isolation (Hyogo Institute for Traumatic Stress, 2004). In response, a group home type of temporary housing for single elderly individuals was proposed and built in several locations in Kobe. This new concept proved successful and was later adopted in public apartment houses for restoration as corrective housing.

The emergency temporary housing in 2011

After the Great East Japan Earthquake and Tsunami, around 53,000 emergency temporary houses were built. Most refugees had lost their homes to the tsunami, so the sites for these temporary houses needed to be away from coastal areas. Typically, temporary houses are prefabricated, but the demand exceeds the providers' capacity. Given the area's rich wood industry, traditional wooden construction was also used. Additionally, new ideas, such as using cargo containers for structures, were adopted.

Figure 3. Ramp and flat deck type entrance and gentle stairs type entrance (Upper two). Flat access toilet and step to bathroom (below two)

FOR EXAMPLE, ONE EMERGENCY TEMPORARY VILLAGE IN NATORI CITY, MIYAGI, HOUSED REFUGEES FROM THE YURIAGE COMMUNITY, AS SHOWN IN FIGURE 3. THE AUTHOR AND COLLEAGUES FROM THE REHABILITATION ENGINEERING SOCIETY OF JAPAN (RESJA) VISITED IN LATE MAY TO INTERVIEW RESIDENTS WHO HAD MOVED

THERE A FEW WEEKS EARLIER. THE TOILET ROOM WAS SEPARATE FROM THE BATHROOM WITH FLAT ACCESS FROM THE DINING ROOM. THERE WAS A 300 MM LEVEL DIFFERENCE BETWEEN THE BATHROOM AND DINING ROOM, BUT A STEP EASED THE GAP. THE VILLAGE HAD SEVENTEEN BUILDINGS, EACH WITH SIX DWELLINGS IN A ROW, AND ONE MEETING FACILITY. TWO BUILDINGS FEATURED FLAT DECKS WITH RAMPS AT THE END. THE STAIRS FOR EACH DWELLING WERE GENTLE AND DESIGNED WITH CONSIDERATION FOR WINTER SNOW. GRAB BARS WERE INSTALLED AT THE ENTRANCES, TOILET ROOMS, AND BATHROOMS OF ALL DWELLINGS.

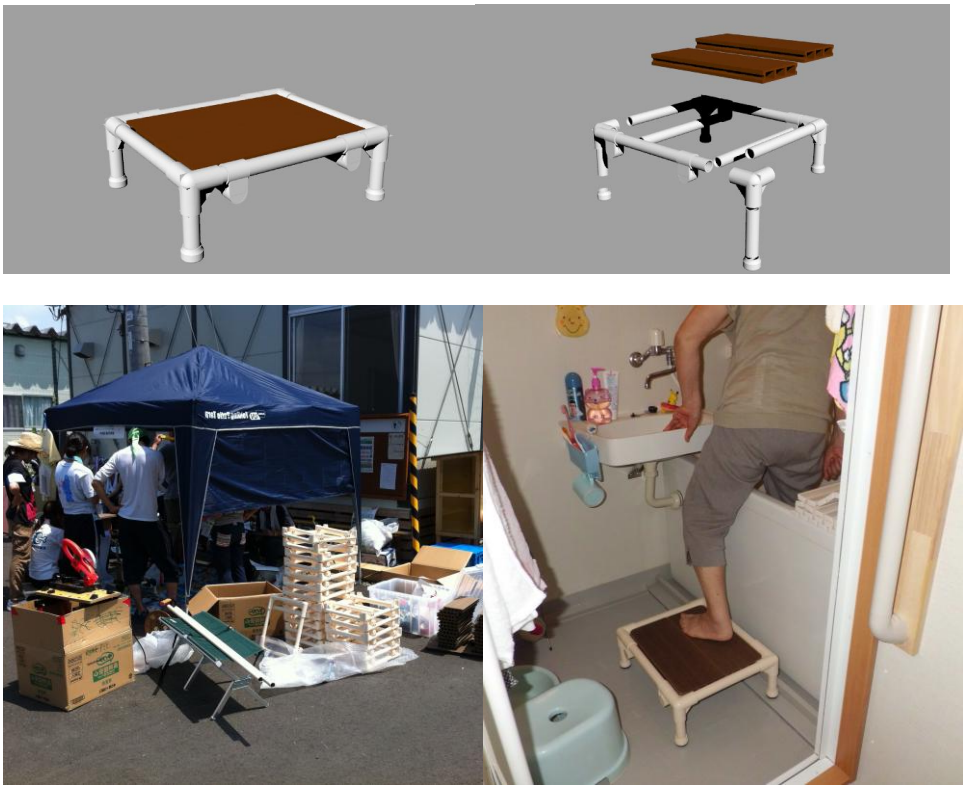

Figure 4. CG of Designed step (upper Left), and its construction (upper Right), on -site service (lower left and one trying step for Bathtub (lower right)

STRANGELY, A WHEELCHAIR USER WHO NEEDED A RAMP LIVED IN A BUILDING WITHOUT ONE, LIKELY DUE TO MISCOMMUNICATION BETWEEN THE CONSTRUCTION AND WELFARE DEPARTMENTS.

Overall, the quality of these houses was an improvement over those built-in 1995. However, refugees faced daily life challenges. Many had previously lived in large detached houses and used low bathtubs, making the bathing process difficult, especially for the elderly. Japanese people traditionally love bathing in tubs filled with hot water and washing their bodies outside the tub. The RESJA addressed this need by designing stools for the bathroom floor. The author designed the stools and estimated the materials required. The Yazaki Kako Corporation contributed most of the materials. In August, students from several universities and RESJA volunteers visited again, making stools and other devices according to residents' needs (Sagara et. al, 2012), as shown in Figure 4. While this was a small-scale support effort, it is important to accumulate and share each experience and piece of know-how.

Prospects and Conclusion

Tohoku district where the Great East Japan Earthquake happened, experiences extremely cold winters with heavy snowfall. To address this, additional features were installed in temporary housing, such as heat insulation, dual-pane windows, windbreak rooms at entrances, paved pathways, gutters, and second air conditioners. As a result, the average cost of these temporary houses reached 6 to 7 million JPY (Cabinet office of Japan and Ministry of Land, Infrastructure and Tourism, 2024). Many of these homes were used for over ten years, highlighting the difficulty of rebuilding one's home after a major disaster, not just for the elderly but also for younger generations.

Given the high costs and extended use, more durable solutions, such as compact residences that can be expanded later, should be considered. Japan has a long history of public baths, and onsens are a popular retreat. While it is desirable for each temporary house to have a bathroom, this may be impractical for smaller units. The author suggests constructing public baths within community halls in temporary villages and equipping each house with showers. This arrangement would serve not only for bathing but also as a communal space for residents to interact and monitor each other's well-being. Figure 5 presents a prototype design for a universally accessible public bath, suitable for wheelchair users and individuals with hemiplegia who can walk. While basing in a tub is common in Japan, Nordics love sauna, and Germans enjoy spas. Some Asian countries also have public baths.

Following the 2011 disaster, the national government reformed the rules for emergency temporary housing. Alongside standard prefabricated houses, traditional wooden construction and cargo container homes became official alternatives. More durable housing options were also introduced, including wooden flat-type houses

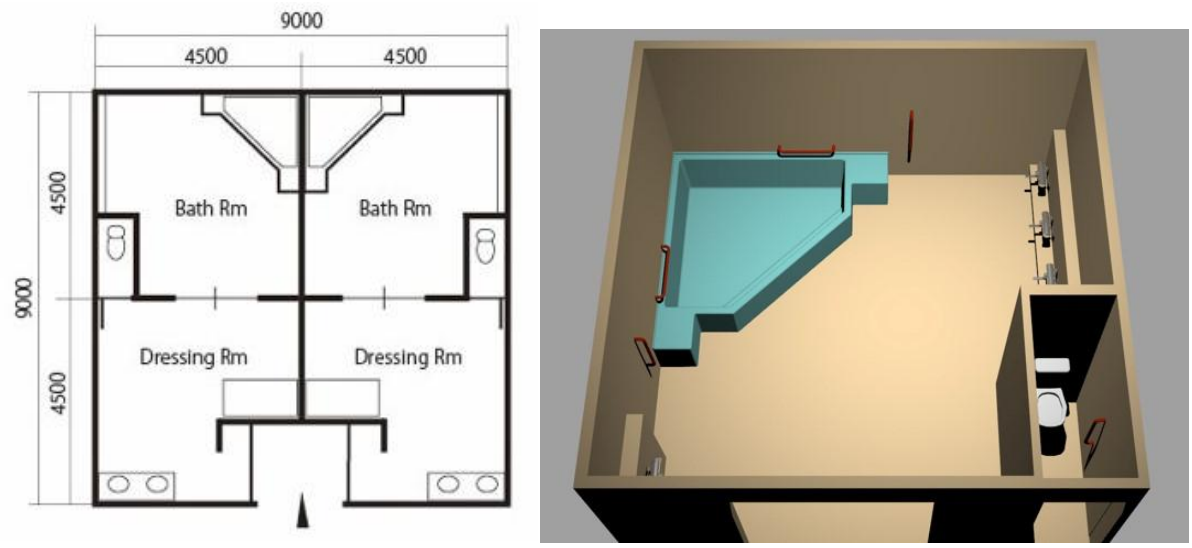

Figure 5. Prototype Drawing and CG of proposal of Public Bath in the Emergency Temporally Community

intended to create new villages and detachable wooden houses for families wishing to return home (Cabinet office of Japan and Ministry of Land, Infrastructure and Tourisms, 2024). These homes were built on new sites with stable concrete foundations, while others were constructed on pine piles.

Emergency temporary houses were subsequently provided in Kumamoto (2016), Fukuoka (2017), Okayama, Hiroshima, Ehime (2018), and Hokkaido (2018) after the 2011 disaster. On January 1, 2024, the Noto Peninsula was struck by an earthquake, and emergency temporary houses are currently being provided. In this case, 5% of the units will be specially designed for wheelchair users, and a quarter of the emergency temporary houses will be detached wooden houses that can expand later (Ishikawa prefecture, 2024). Despite these unfortunate events, Japan continues to learn from them, gradually strengthening its society through the spiraling-up strategy of Universal Design.

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