

# An Examination of housing designs to address post-earthquake shelter needs

## Deprem sonrası barınma ihtiyacını karşılamaya yönelik konut tasarımlarının incelenmesi

Aylin Aras<sup>\*1</sup> , Zeynep Seymen<sup>2</sup> 

<sup>1</sup>Bursa Technical University, Department of Architecture, Bursa, Türkiye

<sup>2</sup>Architect, İstanbul, Türkiye

**Abstract:** Examining the economic and socio-cultural impacts of earthquakes, which are natural disasters with human-induced effects, in the post-earthquake period is crucial in emphasizing the societal effects of earthquakes and the importance of constructing earthquake-resistant buildings. In the scope of the study, the construction stages and designs of temporary housing projects aimed at meeting the basic need for shelter after an earthquake have been examined and evaluated. The first stage of the study involved conducting a literature review to examine earthquake-related definitions, the causes of disasters, and preventive measures. In the subsequent stage, the research consisted of examples previously examined by experts that did not overlook the socio-cultural dimension of earthquakes. Two countries located in earthquake-prone zones, Türkiye and Japan, were selected as examples and studied. One of the examples evaluated the potential of an existing structure to meet the needs of its users after an earthquake, while the other example encompassed container settlements established after an earthquake. In addition to being fast and practical, temporary housing design should prepare the ground for permanent housing after an earthquake. It should accurately address the needs by making the right site selection, be user-oriented, and offer different plan solutions to different users, enabling them to return to their pre-earthquake lives as quickly as possible. Because post-disaster community health also suffers significant damages, and when a sense of belonging is not established in the post-earthquake living areas, psychological and sociological problems can arise. This can negatively impact the transition from temporary housing to permanent housing, affecting the speed of the recovery process. Within the scope of the study, an evaluation was conducted by examining examples of post-earthquake housing needs and assessing their potential to meet user requirements.

**Keywords:** Earthquake, Temporary shelter, Housing, Reconstruction, Process management.

**Özet:** İnsan kaynaklı etkileri olan doğal afetlerden depremlerin, deprem sonrası dönemde ekonomik ve sosyo-kültürel etkilerinin incelenmesi, depremlerin toplumsal etkilerinin ve depreme dayanıklı yapıların inşa edilmesinin önemini vurgulanması açısından büyük önem taşımaktadır. Çalışma kapsamında, deprem sonrası temel barınma ihtiyacını karşılamaya yönelik geçici konut projelerinin yapım aşamaları ve tasarımları incelenmiş ve değerlendirilmiştir. Çalışmanın ilk aşamasında literatür taraması yapılarak depreme ilişkin tanımlar, afetlerin nedenleri ve önleyici tedbirler incelenmiştir. Sonraki aşamada ise, daha önce uzmanlar tarafından incelenmiş ve depremin sosyo-kültürel boyutunu göz ardı etmeyen örnekler değerlendirilmiştir. Deprem kuşağında yer alan iki ülke, Türkiye ve Japonya örnek olarak seçilmiş ve incelenmiştir. Örneklerden biri mevcut bir yapının deprem sonrasında kullanıcılarının ihtiyaçlarını karşılama potansiyelini değerlendirirken, diğer örnek deprem sonrasında kurulan konteyner yerleşimlerini kapsamaktadır. Geçici konut tasarımı hızlı ve pratik olmasının yanı sıra deprem sonrası kalıcı konutlara zemin hazırlamalıdır. Doğru yer seçimi yaparak ihtiyaçları doğru bir şekilde karşılamalı, kullanıcı odaklı olmalı ve farklı kullanıcılara farklı plan çözümleri sunarak onların deprem öncesi yaşamlarına mümkün olan en kısa sürede dönmelerini sağlamalıdır. Çünkü afet sonrası toplum sağlığı da önemli zararlar görmekte, deprem sonrası yaşam alanlarında aidiyet duygusu oluşmadığında psikolojik ve sosyolojik sorunlar ortaya çıkabilmektedir. Bu durum geçici konutlardan kalıcı konutlara geçişi olumsuz etkileyerek iyileşme sürecinin hızını düşürebilmektedir. Çalışma kapsamında deprem sonrası konut ihtiyaçlarına yönelik örnekler incelenerek kullanıcı gereksinimlerini karşılama potansiyelleri değerlendirilmiştir.

**Anahtar kelimeler:** Deprem, Geçici barınma, Konut, Yeniden yapılanma, Süreç yönetimi.

\*İletişim Yazarı / Corresponding author. Eposta/Email : aylin.aras@btu.edu.tr

Geliş / Received: 05.03.2024, Revizyon / Revised: 14.04.2024

Kabul / Accepted: 16.04.2024



## 1. Introduction

An earthquake is an event that occurs when energy generated by the fracture of the Earth's crust due to tectonic or volcanic movements causes the environment and the Earth to shake in the form of seismic waves (Disaster and Emergency Management Authority Report, AD: 18 February 2023).

To minimize the damage caused by earthquakes, it is important to conduct ground surveys in the region beforehand, use appropriate materials in building construction, and raise public awareness. Although these measures cannot prevent earthquakes, they play a crucial role in mitigating their effects and consequences (Uzuner and Akıncıtürk, 2020).

Conducting a ground survey in the region where the building is to be constructed can provide valuable information on the suitability of the area for building, the appropriate materials to be used, and the correct ground design. Construction on structurally unsuitable grounds can be prevented by carrying out a correct ground survey in accordance with the rules. To reduce the occurrence of earthquakes, it is essential to use high-quality materials, columns that are suitable for the load they will carry, and appropriate foundation designs. Decisions must also be made in accordance with regulations.

Raising public awareness is crucial in mitigating the destructive effects of earthquakes. Individuals who are knowledgeable about earthquakes are better equipped to take appropriate action during and after an earthquake, thereby reducing the loss of life and property damage. It is important to take these precautions to avoid the significant material and moral losses that can result from earthquakes (Yılmaz, 2012).

Shelter is a fundamental human need and right, as stated in Article 25.1 of the Universal Declaration of Human Rights. In cases where individuals are deprived of this right due to uncontrollable events, such as natural disasters, their country of citizenship is obligated to provide for this need and right. According to the Universal Declaration of Human Rights (AD: 12 February 2023), individuals who are deprived of their right to shelter due to natural disasters, such as earthquakes, should be provided for by the authorities. It is important to note that earthquakes are natural events beyond human control.

Article 32 of the Regulation on Emergency Aid Organisation and Planning Principles Regarding Disasters stipulates that the 'Directorate of Public Works and Settlement', 'Directorate of National Education, Youth and Sports', 'Provincial Directorate of Rural Services', 'DSİ local organisation', 'TCK local organisation', 'Municipality', 'Special Provincial Administration' and 'Red Crescent' are responsible for providing shelter to survivors in Türkiye, where earthquakes are frequently experienced (Regulation on Emergency Aid Organisation and Planning Principles for

Disasters, AD: 18 February 2023). These solutions provide temporary tents and prefabricated housing units made from various materials for short and long-term use. The post-earthquake temporary construction process can last up to two years in some cases. When constructing permanent settlements in earthquake-prone regions, it is important to consider the structural characteristics of the area. Settlements should be built away from fault lines and earthquake zones, taking into account ground surveys, morphology, climate, hydrography, and infrastructure features (Özdemir, 2004). For instance, following the 2003 earthquake in Bam, Iran, the government implemented an 'earthquake risk reduction strategy'. This is achieved through the use of advanced technology, compliance with regulations, increased security of public buildings and infrastructure, public awareness campaigns, and the establishment of a competent earthquake response team (Ash-tiany and Hosseini, 2007). The strategy aims to minimise losses after a possible earthquake by creating national security awareness.

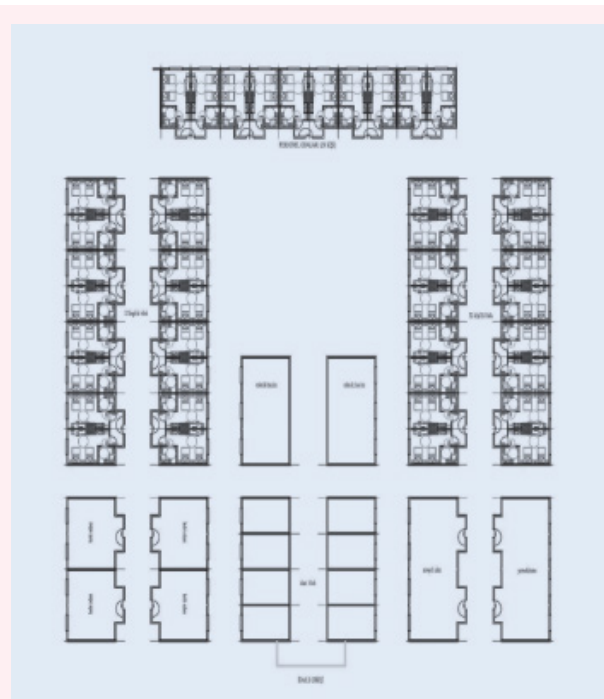
The study provides information on the causes of earthquakes and the necessary precautions to be taken beforehand. Additionally, it analyses the post-earthquake recovery and reconstruction process from a socio-cultural perspective by comparing two examples from Turkey and Japan. The examples prioritise improving society by reconstructing regions to their former state. Alexander (2014) emphasises the importance of bringing the parts together.

The study focuses on two of the most seismically active countries in the world, Turkey and Japan, as samples (Yılmaz, 2021). One example evaluates the potential of an existing building to meet the needs of its users after an earthquake, while the other discusses container settlements established after the earthquake. The selected example in Turkey focuses on evaluating the potential of Kahramanmaraş Elbistan Nursing Home to meet the needs of its users after an earthquake. The designs of Onagawa Temporary Container Housing in Japan were evaluated based on user needs in the given example.

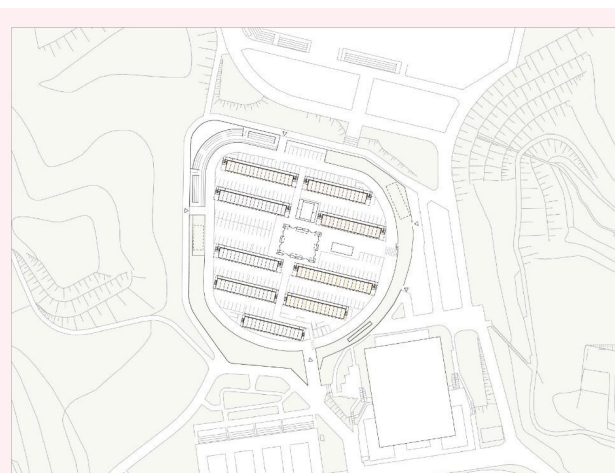
## 2. Material and Method

This study examines the construction stages and designs of temporary houses built to meet the need for shelter after an earthquake, using national and international examples. Firstly, a literature review was conducted on the effects of earthquakes and the need for post-earthquake shelter. This text discusses the criteria for constructing living spaces for earthquake victims. The criteria include site selection, shelter unit and shelter centre as explained in Disaster And Emergency Management Authority's Directive on the Establishment, Management and Operation of Temporary Shelter Centres. Additionally, the criteria related to ecology, technology, cost, building physics, spatial organisation, sociology and aesthetics as explained by various authors are also considered. Based on these criteria, the examples are analysed in terms of individual, public, architectural elements, and urban context.

In the second stage, the samples were selected and evaluated. Two sample buildings were chosen from Turkey and Japan, two of the most seismically active countries (Yılmaz, 2021). The selected example is the Kahramanmaraş-Elbistan Prefabricated Nursing Home Complex, which is proposed as a new living space for people who have no relatives in the event of a devastating earthquake. This is a pilot study. The selected example is the Kahramanmaraş-Elbistan Prefabricated Nursing Home Complex, which is proposed as a new living space for people who have no relatives in the event of a devastating earthquake. The Onagawa Temporary Container Dwellings were chosen as an example because they are multi-storied, created by overlapping the units, unlike previously built containers (URL-1, AD: 24 May 2023).



**Figure 1.** Proposal for 60-person Kahramanmaraş Elbistan Nursing Home for the elderly (Akyıldız et al., 2018)



**Figure 2.** Onagawa Container Temporary Housing (URL-1; AD: 24 May 2023)

## 2.1. Scope of The Study

The study examines the post-earthquake reconstruction process through two examples. It covers the scientific explanation of earthquakes, precautions that authorities and individuals should take before earthquakes, and the importance of creating social awareness over a wide time period. The examination is done in the context of individual, social, architectural, and urban environment elements.

## 2.2. Sample Selection

This section analyses the post-earthquake process through two examples from Turkey and Japan. The Elbistan Nursing Home in Kahramanmaraş, Turkey, was selected as a pilot example to evaluate its potential to meet the needs of users left behind in the event of an earthquake. The evaluation was conducted from an individual perspective, taking into account its psychological and sociological dimensions (URL-2, AD: 13 September 2023). The scenario created was analyzed from both architectural and urban contexts, and recommendations were made regarding the plan layout. They provided suggestions at the plan level. This example aims to restore the mental and physical health of disadvantaged elderly members of society by considering their wishes and needs. It addresses the social, psychological, and economic effects of the earthquake (Akyıldız et al., 2018).

The Onagawa Temporary Container Complex is a series of multi-storey containers designed by Shigeru Ban after the 2011 Onagawa earthquake disaster. It includes units such as a community centre, market area, and workshop to meet the social and shelter needs of the users. This example is unique compared to other container examples in Japan. The source (URL-3, AD: 21 May 2023) provides further information.

## 3. Findings

### 3.1. Post-earthquake Processes

Earthquakes occur in the world, leaving deep wounds in the society, sometimes destroying the whole city, sometimes destroying other cities around it. In addition, the living space of many living things is destroyed. Earthquakes destroy places, structures, equipments and areas in the city, while destroying a society together. Therefore, the society has psychological and social destruction as well as economic and historical destruction. Restoring the destruction area to its former state as soon as possible will be possible with the improvement of the society. Because, the sooner the society affected by the earthquake can return to its former state, the built environment will recover with it and begin to regain its former state.

Sociologist Enrico Quarantelli analysed the post-earthquake process under 4 headings:

1. Emergency Shelter: It is the type of shelter that covers the first 24 hours after the earthquake occurs. It is real-

ised in such ways as taking shelter in a public building, taking shelter in the house of someone familiar, taking shelter in a tent, etc. The aim of the disaster officials during this period is to reach the people trapped under the rubble in a short time, to help those who need first aid, to deliver emergency shelter, water, clothes, food, first aid material to the people in need. At this stage, the shelter system that can be provided by the officials will be in the form of emergency shelter. In developed countries, these shelter systems are public buildings such as hospitals, sports grounds, schools, while in undeveloped or underdeveloped countries, these emergency shelters are usually tents or less developed systems since these structures are also damaged.

2. Temporary Shelter: It follows days and weeks after the earthquake. During this period, people whose houses were destroyed meet their accommodation needs in tents, with relatives or friends, in their own cars, in public buildings, rental houses, hotels or hostels. Due to the climate in which the earthquake occurred, epidemics, hypothermia, security problems, etc., people will not be able to stay in such areas for a long time. Therefore, it would be better to move from tents to areas that are more secure, away from the unfavourable climatic conditions outside, where privacy can be ensured and where people can stay for a longer period of time. Authorities should provide these accommodation units quickly and practically. In addition to the need for shelter, officials should provide food, clean water, first aid supplies and undertake the necessary assistance for the elderly, children, special individuals and animals in need of help as soon as possible.

3. Temporary Settlement: In cases where the conditions are not favourable to move to a regular permanent settlement, it is the process lasting from a few months to a few years in which shelter is provided by providing tents, prefabricated, container etc. systems. In conditions where there are not enough rental housing, hotels, public buildings in the region or when the existing economy cannot provide enough facilities to accommodate the people in these places, the process of moving to permanent settlement is prolonged and users are placed in prefabricated containers that offer fast and practical solutions. A complex is designed where not only shelter, but also common spaces for socialisation and areas where needs can be met, and people affected by the earthquake are placed there. Therefore, this phase is also called “semi-permanent settlement area”.

4. Permanent Settlement: It is the process of settling the earthquake victims in their own reconstructed, reinforced houses or new buildings (Quarantelli, 2000).

### 3.2. The Role of the Architect in Earthquake

Before the earthquake, architects should use qualified materials, use columns suitable for the load to be carried, make appropriate foundation designs, and make decisions in accordance with the regulations while performing their profession as described in the introduction. In

addition, courses such as “earthquake awareness” should be taught compulsorily in universities in order to create awareness and consciousness about earthquakes. In the process after the earthquake, architects, in cooperation with the government, can take on roles such as building damage assessment, site selection in the reconstruction process, planning stages, material selection and usage rates, cost and practical solutions in the process of creating design ideas and providing training to earthquake victims (Idemen and Şener, 2023).

### 3.3. Post-earthquake Temporary Construction Process, Issues to Be Considered in Site Selection

There are some site selection criteria for temporary construction centres after the earthquake. According to Disaster and Emergency Management Authority and some authors, these criteria are explained as follows:

- a) According to the Directive on the Establishment, Management and Operation of Temporary Accommodation Centres published by Disaster and Emergency Management Authority in 2015, the criteria for site selection are as follows (URL-4, AD: 17 September 2023):
  - The temporary settlement is sheltered against external dangers and easy to access to control points,
  - Availability of temporary settlement, electricity, water and sewerage networks,
  - Planning the location of the temporary settlement according to the capacity and service scale of the centre for the establishment of facilities such as schools, kindergartens, markets, places of worship, health centres, psycho-social support service centres, sports facilities, laundry, drinking water waste water treatment facilities, playgrounds, course areas,
  - The temporary settlement should allow for the settlement of new units in line with population growth (it should be flexible),
  - A ground survey should be carried out in the temporary settlement,
  - When selecting the area to be established in the temporary settlement, it is necessary to select areas that are not suitable for agriculture and to have a slope of 2% to 6% at least 3 metres higher than the rainwater basin, which is expected to accumulate during the rainy season,
  - Attention should be paid to the prevailing wind direction.
- b) According to Özdemir:
  - The ground of the settlement area should not allow



liquefaction, should not be permeable and cracked (ground property).

- The slope of the ground should be maximum 4% against possible disasters such as floods, landslides and erosion (morphological feature).
- Site selection should be made in accordance with the climatic characteristics of the region and the prevailing wind direction (climatic feature).
- The soil should be suitable for excavation for easy installation of tents and prefabricated systems. At the same time, it should be permeable in order to drain rainwater (soil property) (Özdemir, 2004).

c) According to Akgün et al:

- Temporary settlement centres should be away from external threats, easily controlled by the government and easily accessible to settlements.
- Ground survey should be done.
- Damage to the environment during settlement should be minimal.
- Access to clean water should be easy.
- The selected locations should be state land and an agricultural area should not be selected as much as possible.
- Under all circumstances, there should be a road that can be accessed. If there is not, a suitable road design should be made.
- There should be no stagnant water, swamps, volcanoes that may cause epidemics in the vicinity.
- Market, school, kindergarten, health structure, worship areas, sports facility, social support centres, children's playgrounds etc. Structures should also be included in this facility.
- Planning should be made to allow for a possible population increase (Akgün et al., 2018).

### 3.4. Design Objectives and Criteria of Post-Earthquake Temporary Housing Units

The purpose of designing temporary housing units after an earthquake is to provide shelter for the affected individuals until permanent housing is ready. However, this process may take several months or several years depending on the destructive effect of the earthquake. Therefore, while designing these housing units to provide shelter, other social and psychological needs of the users should also be considered and additional units should be designed to meet these needs. At the same time, it is also important that these temporary units can be easily dis-

mantled and stored so that they can be reused when necessary after the permanent housing units are designed (Arslan, 2009). Therefore, many criteria were determined while designing these units. According to the Directive on the Establishment, Management and Operation of Temporary Accommodation Centres published by Disaster and Emergency Management Authority in 2015, the criteria are divided into two categories except for the site selection criteria (URL-4, 17 September 2023):

#### 1. Criteria for the shelter centre

- There is a distance of at least 8 metres between the entrance door of the containers and tents in the temporary settlement.
- The width of the main roads in the temporary settlement is at least 15 metres and the width of the side roads is at least 10 metres.
- The main streets of the neighbourhoods in the temporary settlement may be paved with asphalt or cobblestone.
- Neighbourhoods are established from the appropriate number of containers and tents to be determined in the temporary settlement, and it is essential to accommodate a single family in containers and tents other than collective tents.
- Dining halls, dormitories and similar common areas in the temporary settlement can be built in prefabricated structures.
- Semi-closed areas are created for garbage containers in the temporary settlement.
- Containers and tents in the temporary settlement are set up under the supervision of an urban planner.
- A guard post is set up at the entrance of the temporary settlement for security control. X-ray doors and a sufficient number of body search detectors are provided at this guard post for the purpose of controlling the entrances and exits to and from the centre.

#### 2. Criteria for the units

- For tents or containers, the covered area per person should be 3.5-4.5 m<sup>2</sup>,
- The height of the containers from the ground should be 30 cm,
- Use of materials suitable for climatic conditions,
- Tent or container, electricity can be delivered to all units,
- Containers and tents should be made of fire-resistant materials (Disaster and Emergency Management, 2015).

In addition to Disaster and Emergency Management's directive, there are some other criteria that should be considered when making settlements in order to ensure that the users who are aimed within the scope of this study regain their individual and social selves. The opinions of different authors on this subject are compiled below.

### 1. According to Forouzandeh et al:

- Providing comfort and well-being,
- Providing mental support,
- To provide multiple functions to the spaces as much as possible,
- Paying attention to local and environmental factors,
- To make sure that it is sustainable,
- Designing the units according to the number of users,
- Easy access,
- Providing places suitable for various cultures,
- Providing recreational and socialising areas (Forouzandeh et al., 2008).

### 2. According to Şener and Altun:

- a) Criteria related to ecology,
  - Ground layout and environmental impact
- b) Technology related criteria,
  - Structural performance
  - Storage
  - Assembly
  - Resistance to destruction
- c) Cost related criteria,
- d) Criteria related to building physics,
  - Indoor climate comfort
  - Indoor air quality
  - Heat, light, sound and waterproofing
  - Fire insulation
  - Floor insulation
- e) Criteria related to spatial organisation,

- User-friendly design
- Flexibility

### f) Criteria related to sociology,

- Visual communication
- Security
- Psychological effects after disaster

### g) Criteria related to aesthetics (Şener and Altun, 2009).

### 3. According to Avlar:

- Suitable for geographical region and climate conditions,
- Being healthy and hygienic,
- Made of qualified and durable products
- Can be protected from various external influences
- Environmentally friendly,
- Renewable and sustainable,
- To meet the personal, social and community needs of earthquake victims,
- Providing spaces shaped according to the number of different users,
- Ensuring privacy,
- Providing visual and auditory comfort,
- Security,
- Fast and easy transport, installation, dismantling and storage (Avlar et al., 2023).

While designing shelter units, attention should also be paid to the design of these units. Especially after disasters with large-scale destruction, the temporary sheltering process can be prolonged. Therefore, these units should include common areas (market area, square, children's playgrounds, etc.) that provide environments where individuals can be together when we consider public health. In this way, individuals will get out of the negative conditions they are in more easily with the social support of being together. At the same time, schools, workshops and courses should be opened in order to ensure that individuals can continue their education from where they left off in order to ensure that they return to the routines of the society outside of the places that allow these natural gatherings, and individuals should be able to continue their lives in a healthy way from where they left off (Vural Arslan & Gülay, 2023).

Earthquakes affect individuals psychologically and sociologically as well as economically. In the aftermath of an earthquake, remedies are generally sought only for the economic dimension of the earthquake, ignoring this situation. In the continuation of this situation, although instant solutions are produced, deep traces may remain in the psychological health of the society. Individuals who fulfill their wants and needs according to certain routines before the earthquake become completely unable to meet these habits, wants and needs after the earthquake. As a result, people may first start to fight a psychological war individually, and then, if a solution is not produced, a social collapse may begin to occur. Rebuilding societies with strong ties to the past after a disaster can be more challenging than rebuilding from scratch. Therefore, the priority in the post-earthquake reconstruction process is to be fast and practical, but it is important to examine the community in that region and determine their culture, routines, wants and needs.

There are practices where institutions/organizations/volunteers meet with the people in the region in the post-disaster construction process. After a flood disaster in India, shelters were designed to be used temporarily by individuals. Before the design of this shelter, an interview was held with the people living here and their wishes were determined. Following the design process, it is evident that the needs of individuals have been met in accordance with their wishes. As a result, they can more easily overcome the negative psychological effects of the flood disaster by being together. It has been concluded that individuals who are together feel safe and at home (Dev & Das, 2020). This research shows that the way in which the basic needs of individuals are met, the involvement of the individual in the design process, and the consideration of their wishes and needs play a major role in post-disaster reconstruction.

A study was conducted on the reconstruction of buildings in Indonesia after a tsunami. People were interviewed for this research. According to the interview, it was concluded that the reconstructed buildings did not have the same atmosphere as the buildings they lived in before the tsunami, that their food was tastier even with the dirty coal residues in the old kitchens, and that they had difficulty living in them because they were not designed in special sizes for individuals. Residents of this region expressed their dissatisfaction with their lives in the new buildings after the tsunami. This shows that when reconstruction is carried out, specific designs should be made for the location and user group, taking into account the socio-cultural structure (Rahmayati, 2016a; Rahmayati, 2016b).

Since the reconstruction process may be prolonged due to adverse conditions, needs will increase, differentiate and change day by day. In many cultures, people tend to live together after disasters such as earthquakes, etc., either out of necessity or because of the negative situation experienced. In order to respond to this, the units to be

built should be able to be combined, separated, added on top of each other, disassembled and reassembled, stored and reused when needed. This change and transformation process will both provide flexibility to the design by providing different solutions for different user profiles and respond to the needs in an easy way (Efe & Dostoglu, 2022; Avlar et al., 2023). New construction generally needs to be fast and practical. Therefore, the use of materials produced on site or existing materials will give faster results. This has been found to be positive in terms of sustainability and it will be more difficult to bring materials from elsewhere as transportation will be a problem due to the earthquake. However, fully prefabricated fabricated containers are usually repetitive units trapped in a mold. They are therefore inflexible and respond to the need to a certain extent. However, semi-prefabricated products, such as those brought in pieces and assembled in the earthquake zone;

- Provide flexibility because they can be combined in desired shapes and move easily,
- Less costly,
- The fact that it merges in that region creates a positive socio-cultural impact by enabling individuals to participate in the design (Abulnour, 2014).

In connection with the strategy of developing new functional solutions, it is known that producing flexible solutions is an effective method in residential use. In this process, flexible space production and construction techniques are thought to facilitate the development of spatial solutions and spatial transformations depending on the socio-cultural structures of the building and its users.

### 3.5. Kahramanmaraş-Elbistan Prefabricated Nursing Home Complex

Surrounded by water on 3 sides and connected to land on one side, Türkiye is an earthquake zone with a location that includes three major fault lines. Therefore, many major earthquakes have been experienced from past to present (İşçi, 2008). One of these three major fault lines is the Eastern Anatolian Fault Line, which passes through the province of Kahramanmaraş. In this section, Akyıldız et al. report "A Case Study on Meeting the Temporary Accommodation Needs of Elderly Disaster Victims: Kahramanmaraş-Elbistan The Elbistan Nursing Home in the region was chosen as a pilot home to analyze the Kahramanmaraş-Elbistan Prefabricated Nursing Home Complex, which was designed in preparation for a potential earthquake in Kahramanmaraş (Akyıldız et al., 2018).

Earthquake creates many material and moral negative effects on all groups of the society. According to the researches conducted after the major earthquakes that occurred worldwide in the past (for example, in Japan, China and Italy), the groups most affected by the earthquake are the elderly, children and special individuals. Because these groups in the society are individuals who

cannot easily adapt to the changes in their environment. In 2004 Canada 13th Earthquake Conference, a ranking was made according to people's ability to adapt to a possible earthquake. The elderly are at the top of the list, followed by individuals with special needs, those who are financially disadvantaged, and those who lack sufficient knowledge (Akyıldız et al., 2018).

In his book *Developmental Psychology* written by Onur in 1995, in his chapter on the elderly, he discussed the psychology of the elderly after the earthquake. Onur mentioned that after a possible earthquake, the elderly, who are disadvantaged individuals of the society, receive psychological blows, cannot easily adapt to change and have problems in returning to their daily lives. According to some scientific researches and statistics conducted after the earthquake, some groups of elderly individuals under different conditions were examined and then their capacity to adapt to the environment was measured. As a result, it was concluded that the mental and physical health of the elderly who tried to maintain their old habits and started to live in the old buildings repaired or reconstructed in the area where they lived before the earthquake was better than the elderly who tried to live in a completely different environment by gaining new and different habits (Onur, 1995, p.124). These statistics and researches show that; in order to prevent an increase in losses after a possible earthquake and for elderly individuals to continue their lives in a healthy way, they should continue their routines in living conditions similar to their pre-earthquake lives. Within the scope of this example, it is aimed to ensure that elderly individuals can return to their lives with minimal damage after a possible earthquake. For this reason, it is aimed to ensure that elderly individuals are away from the fear and loneliness psychology caused by the earthquake by designing spaces where they can be together. In this section, site selection, design objectives, design criteria, conclusions and recommendations for the nursing home complex are presented.

### 3.5.1. Site Selection Criteria for Kahramanmaraş-Elbistan Prefabricated Nursing Home Complex

In the implemented projects, site selection is made in line with the criteria decided by Disaster and Emergency Management Authority. Kahramanmaraş Nursing Home example is an unimplemented study. Therefore, in this example, only the design issue is considered and it is stated that the necessary site selection (if it is desired to be implemented) should be decided by Disaster and Emergency Management Authority. Although the exact location for this pilot study has not been determined, there are general and basic criteria stated by various authors. These are:

- Accessibility,
- Suitable size,
- Proximity to the homes of affected users,

- Infrastructure conditions,
- Land drainage,
- Soil permeability,
- Physical layout and environmental configuration,
- Prevailing wind direction,
- Cultural heritage issues,
- Proximity to road networks,
- Suitable distance from polluting industries,
- Culture, tradition and composition of population groups,
- Vegetation,
- Security and protection,
- Communication service,
- Proximity to assistance services,
- Convenient distance for easy water supply,
- Convenient distance to medical centres,
- Appropriate distance to hazardous areas (Bologna, 2006; Soltani et al., 2015).

### 3.5.2. Design Objectives and Design Criteria of Kahramanmaraş-Elbistan Prefabricated Nursing Home Complex

Prefabricated system was chosen as the construction system in the nursing home complex. Because, apart from the known features of the prefabricated system (modularity, easy installation, low cost, short construction period, utilisation of wastes, etc.), the fact that the prefabricated system is generally single-storey and local plays a positive role in the adaptation process of elderly individuals. At the same time, since accessibility is an important issue for these individuals, the prefabricated system can easily provide this (Amani and Niyazi, 2018).

While designing the prefabricated modules, the primary aim is not to isolate the users from the social environment of the existing 60-person nursing home in Elbistan. Because many of the elderly people who were relocated to other provinces after the Marmara and Van earthquakes had difficulties in adapting to their environment. Therefore, the priority is to keep the routines as similar as possible and to avoid trying to place them in an unfamiliar environment (Akyıldız et al., 2018).

The units to be built should respond to the routines of the elderly and ensure that their needs are easily accessible.



Since the primary goal is to help them overcome the psychological negativities brought about by the earthquake, to continue their lives as before, and to return to the social life they are used to, it is important that the spaces can be adapted to their previous state. This can be easily achieved thanks to the flexibility and openness to change and transformation provided by the prefabricated system (Akyıldız et al., 2018). Considering the user comfort and sense of belonging mentioned in the criteria, shelter design to create a friendly and familiar environment will also facilitate the healing process of users through settlement (Dev and Das, 2020).

Nursing homes usually have single rooms. However, since this complex was designed after an earthquake, it was designed for two people in order to prevent the elderly from feeling lonely due to psychological problems that may occur. There are three main spaces in the module: living area, WC-bathroom and windbreak. The living modules are accessed through a common windbreak serving 4 elderly people and two separate rooms are accessed through separate doors. The rooms are designed to allow wheelchair access in accordance with the accessibility regulations. There is a kitchen sink, mini bench and refrigerator, wardrobe, desk, chair and TV in the room to meet daily needs. Thus, elderly individuals can easily meet their daily needs without leaving their living spaces (Akyıldız et al., 2018).

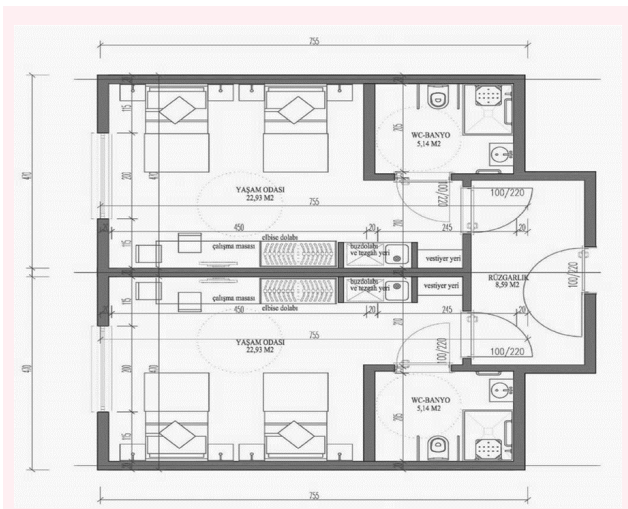


Figure 3. Prefabricated House Plan (Akyıldız et al., 2018)

Except for the living modules for elderly people, other administrative, social and technical modules were designed based on the m<sup>2</sup>s of the pre-existing Elbistan Nursing Home. These modules are,

- 8 module administrative staff room
- 4 module cafeteria
- 10 module staff room
- 4 module social area

- 6 module technical volume
- 8 module hobby areas
- 32 module is a living space (Akyıldız et al., 2018).

Living modules consist of 2 rooms for 2 persons (Figure 3). It contains basic living spaces for a possible post-earthquake settlement. The dimensions and m<sup>2</sup> of the modules are designed in accordance with the “accessibility regulation” for elderly use. According to this regulation, the important items for the Nursing Home Complex are as follows:

- Entrance doors should be made of lightweight materials so that elderly people do not have difficulty pushing.
- Toilets should be dimensioned to allow wheelchair maneuvering (Q=at least 150 cm) and should have grab bars.
- The corridor and transition areas should be 120 cm clear for wheelchair maneuvering (Republic of Türkiye Ministry of Family and Social Services Accessibility guide, AD: 20 May2023).

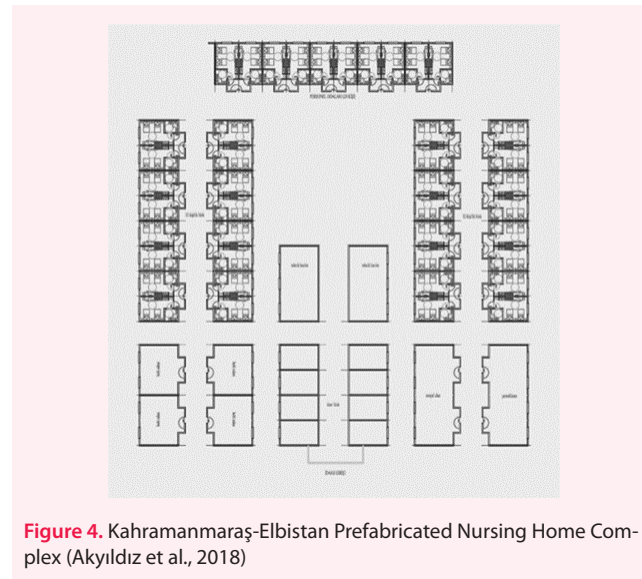


Figure 4. Kahramanmaraş-Elbistan Prefabricated Nursing Home Complex (Akyıldız et al., 2018)

Apart from the living modules, the living and administrative units of the institution staff are also located near these living spaces. In addition, spaces that contribute to socialisation such as dining hall and hobby rooms are also located in this complex. An inner courtyard was created while placing the modules. This enabled individual to be together and intertwined with nature. The presence of these spaces in this nursing home complex helps to improve the psychology of the user by enabling elderly individuals to continue their routines from where they left off.

### 3.6. Onagawa Temporary Containerised Housing

In Japan, which consists of 4 islands surrounded by the

ocean and where most of the active volcanoes in the world are located, approximately 1500 earthquakes occur annually. When these earthquakes occur on or under the ocean shore, they generate giant waves called tsunamis (URL-3, AD: 21 May 2023). One of these earthquakes was the earthquake that occurred on 11 March 2011 in Onagawa town of Miyagi Prefecture, Japan. This region was severely damaged after the tsunami generated by the earthquake. Although many emergency shelters were provided immediately after the earthquake, the shelters provided were not sufficient because the town of Onagawa was completely flooded. Therefore, architect Shigeru Ban designed a different temporary housing complex for the users whose houses were damaged by the earthquake. The reason for this difference is that it is the first multi-storey temporary container complex designed in Japan (URL-1, AD: 24 May 2023).

In this section, the progress of the temporary housing process, site selection decisions, design objectives, design criteria, conclusions and recommendations will be discussed.

### 3.6.1. Site Selection Criteria for Onagawa Temporary Container Houses

Immediately after the earthquake, the authorities provided containers, which are emergency shelters, to the region. These ready-made containers require a flat ground. However, since the town was flooded and there was no solid, flat land of sufficient size, the containers provided were not enough for the earthquake victims. Therefore, a different solution was needed. Architect Shigeru Ban proposed a complex where the containers are stacked on top of each other for 3 floors (Figure 5). In this way, he thought that it would require less space on the ground and rise upwards to provide living space for a larger number of users. As a result of these decisions, the containers were stacked 3 storeys on top of each other and positioned on an intact flat area of Onagawa (Figure 6). Processes such as site selection and container supply are carried out by the governor's office. However, since approximately 189 families were left homeless in Onagawa after the earthquake, these processes were managed together with the governorship and the mayor in order to accelerate the process (URL-1, AD: 24 May 2023).

### 3.6.2. Design Objectives and Design Criteria of Onagawa Temporary Container Houses

After the earthquake, many people became homeless due to the fact that the standard containers provided by the government could not meet the needs of the users and there were not enough of them, which revealed the need for a new temporary shelter complex. Since many people were left on the streets, the installation of this complex should be fast and practical. Therefore, ready-made containers were brought to the region. Thus, the construction period will be shortened and the cost will be low. As mentioned in the previous sections, these containers need to serve a large number of people and there is no space on the ground (flat land) to accommodate the num-

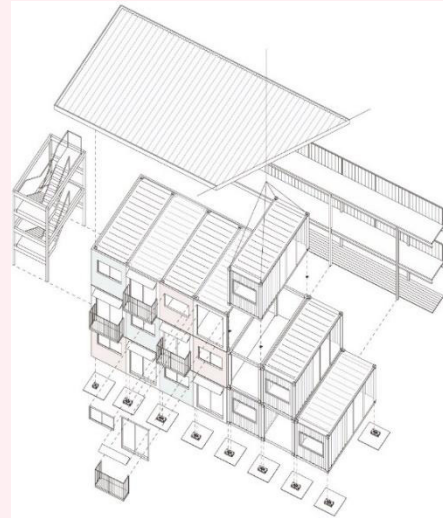


Figure 5. Onagawa Temporary Container Housing Complex (URL-1, AD: 24 May 2023)

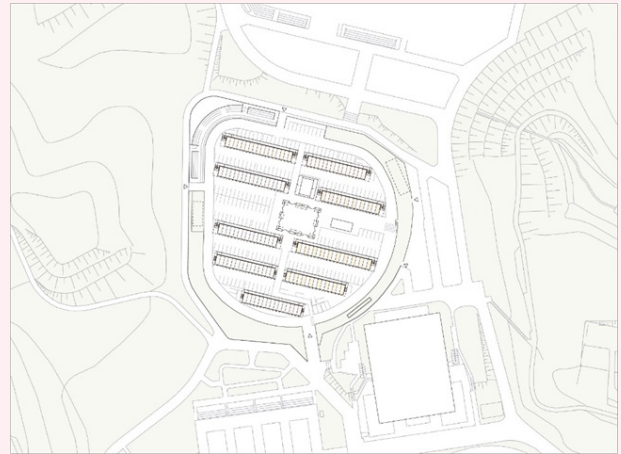


Figure 6. Onagawa Temporary Container Complex Positioned on Flat Land (URL-1, AD: 24 May 2023)

ber of users. Therefore, Shigeru Ban designed a 3-storey complex by overlapping the containers. Thus, the open spaces formed between the containers will provide light to the living units on the one hand and social areas on the other (URL-5, 24 May 2023).

While time, space and budget are normally the main considerations in the design of temporary housing, Ban's priority has been to ensure that the design meets the needs and desires of the users. For this reason, he did not consider all users in the same category, but went for different plan solutions to serve different family types. Plans of 19.8 m<sup>2</sup> were designed for singles or couples, 29.7 m<sup>2</sup> for families of 4 people and 39.6 m<sup>2</sup> for families with more than 4 people. Ban realised that there was a storage space problem in the emergency shelters provided by the government. Therefore, in the containers he designed, he aimed to eliminate this clutter and make people feel like they are at home rather than staying as guests in a temporary place by installing many wall-mounted cabinets and shelves as a precaution against a possible earthquake.





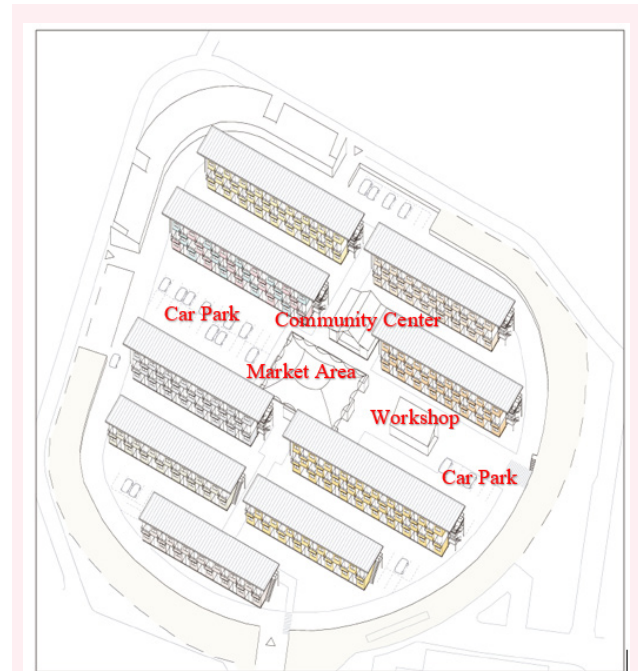
**Figure 7.** Delivery of Ready Containers to the Region (URL-6, AD: 24 May 2023)

Another issue that Ban cares about is to ensure that the users affected by the earthquake come together and heal the wounds of the earthquake and to ensure that the users can continue their lives from where they left off as quickly as possible psychologically. For this reason, he designed a community centre-workshop, market, market area that will enable people to meet among the containers and meet all kinds of needs (education, clothing, food, etc.) such as market-school located in remote parts of the city. As mentioned in the example of Kahramanmaraş Nursing Home, the more people start to live together and socialise, the easier they will be able to return to their old lives. Thus, the wounds of the earthquake can be healed together (URL-6, AD: 24 May 2023).

#### 4. Discussion and Conclusions

The aim was to redesign the living spaces of Elbistan Nursing Home users in Kahramanmaraş in preparation for a possible earthquake scenario. The province has a fault that has not produced an earthquake for 500 years, making it highly susceptible to earthquakes. A major earthquake is expected (URL-8, AD: 20 May 2023). While designing, the main priority is to restore the physical and mental health of elderly individuals after an earthquake with minimal damage and to mitigate its effects. Therefore, the design aims to maintain the comforts and routines of the previous nursing home for the elderly as much as possible without altering them (Akyıldız et al., 2018).

The study found that not only functionality but also user emotions and habits were given importance, which is a positive outcome. In designs created after sudden events such as earthquakes, the priority has traditionally been to quickly meet the necessary functions. Unfortunately, the psychological dimension of earthquakes is often



**Figure 8.** Social Space (community centre, market area, workshop) Complex Providing Parking (URL-1, AD: 24 May 2023)

overlooked. However, this study found that prioritising the psychological dimension of earthquakes had a positive impact on evaluations.

It is considered positive that the needs of individuals who are unable to leave their homes due to certain restrictions, such as being bedridden or elderly, can be met in a single area. This can be achieved by separating the areas of movement such as eating, drinking, working, and dressing from the areas of immobility such as lying and sleeping within the same living space. The toilets should also be located in these living modules. This approach ensures a logical and efficient use of space for those with restricted mobility. A complex with living modules has been designed to meet the needs of elderly people without requiring them to leave the module. This design allows for staff and elderly people to be together, and for all users to gather in common social areas. The aim is to provide an environment where elderly individuals can continue their lives, apply their old habits, and avoid the fear of death and loneliness caused by earthquakes.

The site plan intended to create an inner courtyard, but the social and hobby areas were located far from the living units. Figure 10 shows that the inner courtyard can be expanded to accommodate social and hobby areas in a semi-open and spacious manner. By relocating the living units to face the inner courtyard and maintaining the position of the administrative and personnel units, it is possible to create spaces that promote togetherness and avoid turning away from the inner courtyard.

The Onagawa Temporary Container Housing example demonstrates that an architectural approach that prioritizes aesthetics can be achieved with low cost and few

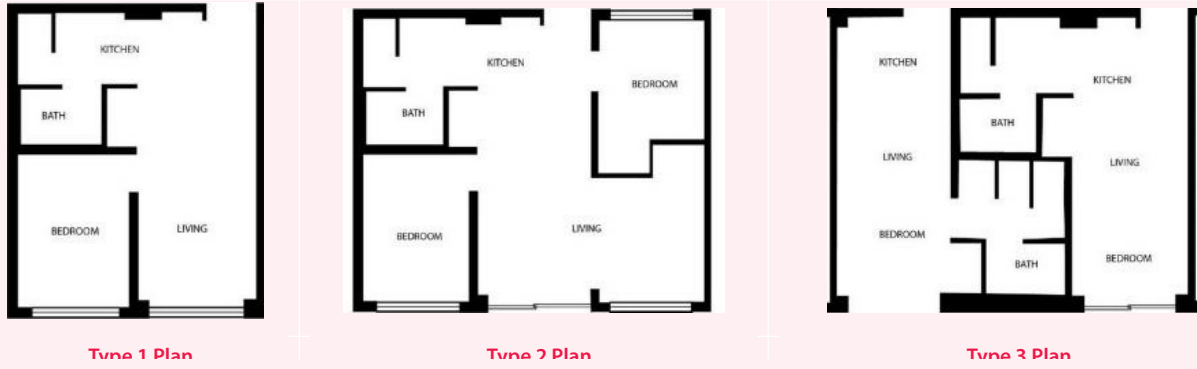


Figure 9. Different Plan Solutions (URL-6, AD: 24 May 2023; URL-7, AD: 22 May 2023)

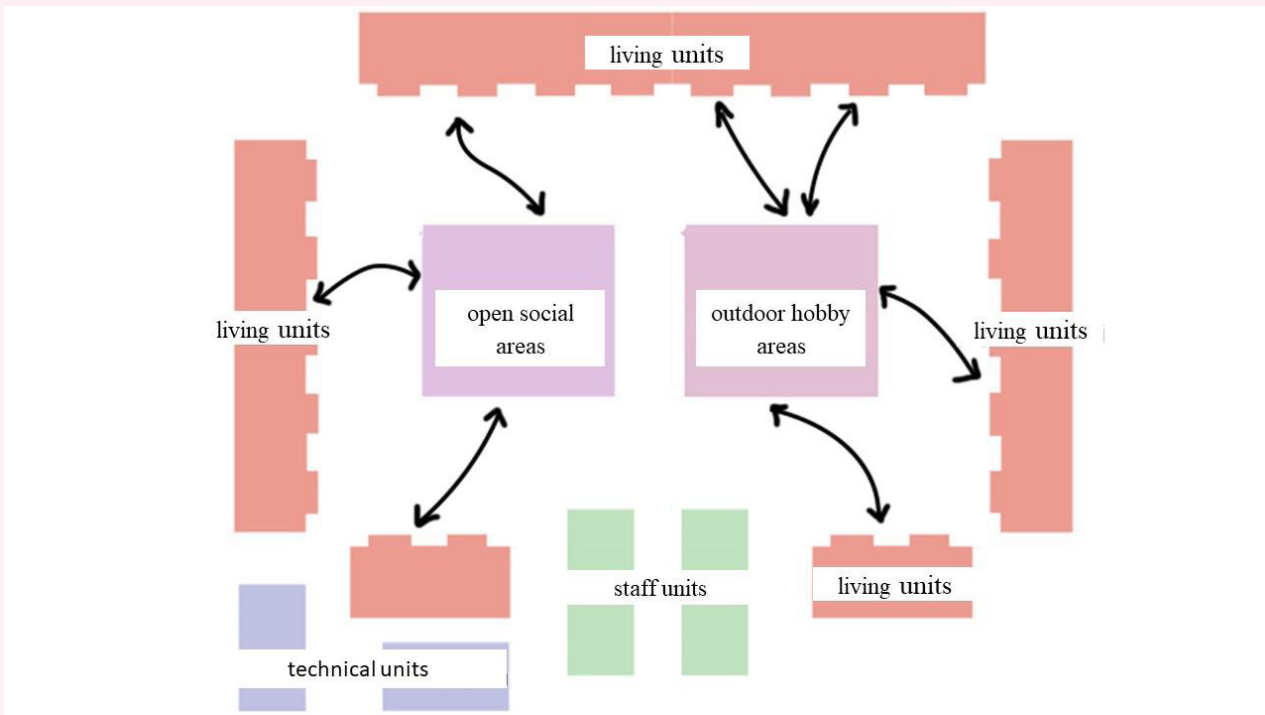


Figure 10. Proposed Site Plan (Prepared by the authors)



materials. Government-provided shelters are often focused on process and cost rather than user needs and desires, which fails to adequately support disaster survivors. Ban has designed a low-cost, user-oriented solution that maximizes capacity and allows for socialization. He offers various plan solutions tailored to different users. The fact that private spaces such as the bedroom and master bathroom are hidden in the plan solutions was positively received. While urgent solutions are necessary, it is important to note that the architect has prioritized privacy concerns. This highlights the importance of considering all relevant factors during the design process. Additionally, the inclusion of socialization areas in the complex should be carefully considered, as function-oriented solutions are typically developed during emergencies such as earthquakes. Additionally, the inclusion of socialization areas in the complex should be carefully considered, as function-oriented solutions are typically developed during emergencies such as earthquakes. However, it is important that individuals are able to resume their previous routines and lifestyles as soon as possible after an earthquake. This is because earthquakes can have a psychological impact on society, which can affect overall health. In the case of Onagawa, the consideration of psychological factors and the design of social spaces to improve the well-being of the community were viewed positively. In the case of Onagawa, the consideration of psychological factors and the design of social spaces to improve the well-being of the community were viewed positively. Although it was originally designed as a temporary solution, this example has served as a basis for permanent neighbourhoods due to its resemblance to modern communities, fulfilment of basic and social needs, and consideration of user requests (URL-9, AD: 22 May 2023).

## 5. Recommendations

Although earthquakes are natural disasters, their destructiveness is largely determined by the quality of buildings. Therefore, during the construction of buildings, it is important to conduct a thorough ground survey and select suitable land that is appropriate for the climate of the region. Additionally, making the right structural decisions is crucial. In addition to structural considerations, losses during earthquakes can also be exacerbated by human factors. For instance, in a building with residential units on the upper level and commercial units on the lower level, even if all regulations are followed in the residential area, the commercial units may cause damage to the load-bearing elements for their own benefit. It is essential to implement control measures to avoid such issues.

Although it is not possible to prevent earthquakes, taking precautions beforehand can mitigate their effects and prepare for the post-earthquake process. Following these precautions, the issue of shelter for users will arise after the earthquake and debris removal. Processes to address this problem begin after the earthquake. It is important

**Table 1.** Comparison of Kahramanmaraş Elbistan Nursing Home Complex and Onagawa Temporary Container Complex.

Features	Kahramanmaraş Elbistan nursing home complex	Onagawa Temporary Container Complex
site	unclear	plain
implementation	-	+
temporariness/permanence	persistent	temporal
capacity	64 person+ staff	189 unit
construction time	unclear	14 weeks
building system	prefabricated	prefabricated
number of floors	1	3
different plan analysis	-	+
common use areas	+	-
social house-dwelling	+	+
additional units to the dwelling	+	+
pedestrian way	+	+
parking space/surface street	-	+
user psychology taken into account	+	+

to consider this problem from various perspectives, not just economic. As demonstrated in the case studies of Kahramanmaraş-Elbistan Nursing Home and Onagawa Temporary Housing Complex, it is important to approach earthquake design from a sociological and psychological perspective. The design should consider the needs of the users and aim to create spaces that facilitate a return to their previous routines and promote adaptation. As correct and effective temporary housing design is crucial for the success of permanent housing, it should be both fast and practical, while also meeting the needs of different users by offering various plan solutions. The ultimate goal is to enable people to return to their pre-earthquake lives as soon as possible. Disasters such as earthquakes can have a severe impact on public health, and the healing process can be hindered when people do not feel a sense of belonging in their temporary living spaces. This negatively affects the recovery process and slows down the transition from temporary to permanent housing.

Designers and authorities should take into consideration the socio-cultural needs of the users as well as the technical criteria for construction and physical requirements in the post-disaster reconstruction process. These criteria are

- Belonging (providing spatial requirements to reflect the pre-disaster cultural background),
- Accessibility (providing spatial requirements that can respond to different user characteristics before and after the disaster),
- Flexibility (Providing spatial adjustments after moving to permanent housing or as a result of changing needs)

- Designing spaces with different functions (providing spatial requirements that will help ensure the continuity of users' living standards)
- Social communication and interaction (providing spatial requirements that will enable users to reach pre-disaster living standards),
- Spatial comfort and user requirements (providing spatial requirements that can ensure the achievement of pre-disaster space standards) in the form of a basic need.

As the individual should meet his/her basic needs, the way of meeting them should also be decisive in this process. Disaster survivors should play an active role in this process. For example, it is thought that it will be facilitating to take positive steps if the institutions/organizations/volunteers related to the construction process make necessary meetings with the people in the region.

## Orcid

Aylin Aras <https://orcid.org/0000-0003-3315-3655>

Zeynep Seymen <https://orcid.org/0009-0007-3127-8178>

## References

- Akgün, Y., Çınar, A.K. and Maral, H. (2018). Afet sonrası acil toplanma ve geçici barınma alanlarının planlanmasındaki faktörlerin incelenmesi: İzmir-Karşıyaka örneği. *Planlama Dergisi*, 28(2), 181,182.
- Akyıldız, N.A., Gürboğa, Ş. and Gürboğa, C. (2018). Yaşlı afetzedelerin geçici barınma ihtiyaçlarının karşılanması üzerine örnek bir çalışma: Kahramanmaraş-Elbistan prefabrik huzurevi kompleksi. *Sosyal Politika Çalışmaları Dergisi*, 18 (41), 325-338.
- Abulnour A. H. (2014). The post-disaster temporary dwelling: Fundamentals of provision, design and construction. *HBRC Journal*. 10(1), (10-24).
- Alexander, D. (2014) The role of temporary accommodation buildings for post-disaster housing reconstruction. *Journal of Housing and the Built Environment* 30(4).
- Amani A. and Niyazi A.Q. (2018). Türkiye'de prefabrik yapı sektörünün hızlı gelişimi. *Mühendislik Bilimleri ve Tasarım Dergisi*, 6(3), 491,492.
- Arslan H. (2009). Afet sonrası yeniden yapılanma sürecinin yere bağlılık, yer değiştirme ve bilişsel haritalama olguları açısından irdelenmesi. [PhD Thesis, Istanbul Technical University Graduate School of Natural and Applied Sciences].
- Ashtiany M.G., and Hosseini M. (2007). Post-Bam earthquake: recovery and reconstruction, *Natural Hazards Journal*, 44, 229–241.
- Avlar E., Limoncu S. and Tızman D. (2023). Post-earthquake temporary housing unit: CLT E-BOX. *Journal of the Faculty of Engineering and Architecture of Gazi University*. 38(1), 471-482.
- Bologna R. (2006). Strategic Planning of Emergency Areas for Transitional Settlement. International Conference and Student Competition on post-disaster reconstruction "Meeting stakeholder interests" Florence, Italy.
- Dev K. N. and Das A. K. (2020). Sheltering Emergencies: Design development process of temporary housing in post-disaster settlement by community participation. *NordDesign 2020*. Lyngby, Denmark.
- Disaster and Emergency Management Authority Report, Access date: 18 February 2023.
- Disaster and Emergency Manegment Presidency, (2015). Geçici Barınma Merkezlerinin Kurulması, Yönetimi ve İşletilmesi Hakkında Yönerge. <<https://www.aile.gov.tr/uploads/athgm/uploads/pages/goc-afet-ve-acil-durumlarda-psikososyal-destek/gecici-barinma-merkezlerinin-kurulmasi-yonetimi-ve-isletilmesi-hakkinda-yonerge.pdf>> Access date: 12 September 2023.
- Efe, B., and Dostoglu, N., (2022). Geçici Barınma Mekanlarını Oluşturmak Üzere Tasarım Parametrelerinin Belirlenmesi, *Yapı Dergisi*, 46-51.
- Forouzandeh A.J., Hosseini M. and Sadeghzadeh M. (2008). Guidelines for Design of Temporary Shelters After Earthquakes Based On Community Participation. The 14th World Conference on Earthquake Engineering, Beijing, China.
- İdemem A.E. and Şener S.M. (2023). Afet Sonrası Barınma: Geçici Toplu Barınma Merkezleri Olarak Mevcut Binaların İşlevsel Dönüşümü. <https://yapidergisi.com/afet-sonrasi-barinma-gecici-toplu-barinma-merkezleri-olarak-mevcut-binalarin-islevsel-donusumu>, Access date: 10 April 2023.
- İşçi, C. (2008). Deprem nedir ve nasıl korunuruz. *Journal of Yasar University*, 3(9), 959-983.
- Onur, B. (1995). Gelişim Psikolojisi. Ankara: İmge Yayınları. (s.124)
- Özdemir, H. (2004). Afetlere hazırlık çalışmalarında geçici iskan alanlarının belirlenmesi. *Doğu Coğrafya Dergisi*, 9(12), 246-249.
- Quarantelli, E. L. (2000). Emergencies, Disasters and Catastrophes Are Different Phenomena, Disaster Research Center Preliminary Paper # 304, Disaster Research Center, University of Delaware.
- Rahmayati, Y. (2016a). Post-disaster housing: translating socio-cultural findings into usable design technical inputs. *International Journal of Disaster Risk Reduction*. 17, (173-184).
- Rahmayati, Y. (2016b). Reframing "building back better" for post-disaster housing design: a community perspective. *International Journal of Disaster Resilience in the Built Environment*. 60, (344-58).
- Regulation on Emergency Aid Organisation and Planning Principles for Disasters, <https://www.saglik.gov.tr/TR,10439/afetlere-iliskin-acil-yardim-teskilati-ve-planlama-esaslarina-dair-yonetmelik.html>, Afetlere İlişkin Acil Yardım Teşkilatı ve Planlama Esaslarına Dair Yönetmelik, Access date: 18 February 2023.
- Republic of Türkiye Ministry of Family and Social Services Accessibility guide, [https://www.aile.gov.tr/media/65613/erisilebilirlik\\_kilavuzu\\_2021.pdf](https://www.aile.gov.tr/media/65613/erisilebilirlik_kilavuzu_2021.pdf), Access date: 20 May2023.
- Şener S. M. and Altun M. C. (2009). Design of a post disaster temporary shelter unit. *ITU A|Z journal*. 6(2). 58-74.
- Soltani A., Ardalan A., Boloorani A. D., Haghdoost A. A. and Hosseinzadeh M. J. (2015). Criteria for Site Selection of Temporary Shelters after Earthquakes: a Delphi Panel. *PLoS currents*, 7.
- Universal Declaration of Human Rights, <https://www.hsk.gov.tr/Eklentiler/Dosyalar/9a3bfe74-cdc4-4ae4-b876-8cb1d7eeae05.pdf>, Access date: 12 February 2023.
- URL-1, (2023, May 23). <https://www.world-architects.com/en/architecture-news/reviews/onagawa-container-temporary-housing>.
- URL-2, (2023, September 13). <https://www.asahi.com/articles/AS->

- R267FTNR26ULBH00F.html?iref=pc\_rellink\_02>.
- URL-3, (2023, May 21). <https://arquitecturaviva.com/works/vivien-das-temporales-container-3>>.
- URL-4, (2023, September 17). <https://www.aile.gov.tr/uploads/athgm/uploads/pages/goc-afet-ve-acil-durumlarda-psikososyal-destek/gecici-barinma-merkezlerinin-kurulmasi-yoneti-mi-ve-isletilmesi-hakkinda-yonerge.pdf>>.
- URL-5, (2023, May 24). [http://www.shigerubanarchitects.com/works/2011\\_onagawa-container-temporary-housing/index.html](http://www.shigerubanarchitects.com/works/2011_onagawa-container-temporary-housing/index.html)>.
- URL-6, (2023, May 24). <https://www.re-thinkingthefuture.com/2021/08/01/a4743-onagawa-container-by-shigeru-ban-temporary-structures-with-impactful-design/>>.
- URL-7, (2023, May 23). <https://www.dezeen.com/2011/07/21/multi-storey-temporary-housing-by-shigeru-ban-architects/>.
- URL-8, (2023, May 20). <https://www.ksu.edu.tr/default.aspx?Did=64516>>.
- URL-9, (2023, May 22). <https://www.bbc.com/turkce/articles/c51pr37xnd0o>>.
- Uzuner, E. and Akıncıtürk, N. (2020). Deprem sonrası kentsel yayılma sürecine dair bir değerlendirme: Kocaeli/ Gölcük örneği. *Dirençlilik Dergisi*, 4(1), 65-75.
- Vural Arslan T. and Gülay T. (2023). Afet Sonrası Geçici Barınma Alanları Tasarımı. *Kentli Dergisi*, 49, (78-85).
- Yılmaz, A. (2012). Türkiye’de afetlerde karşılaşılan sorunlar. *Manas Sosyal Araştırmalar Dergisi*, 1(1), 62.
- Yılmaz, Z. (2021), Emergency Architecture: Van and Onagawa Example. 4 th International Conference of Contemporary Affairs in Architecture and Urbanism (ICCAUA-2021). p:657.