JOURNAL OF DESIGN FOR RESILIENCE
IN ARCHITECTURE & PLANNING

Research Article
Online: www.drarch.org
Volume 5, Issue 3, (497-509), 2024
DOI: 10.47818/DRArch.2024.v5i3145

Flexible model proposals for post-disaster temporary housing in architectural design

Mazlum Kalak*
Özge Zenter**
Emine Fulya Özmen***

Abstract

Shelter is one of the most basic needs that emerged with the existence of humanity and is necessary for people to continue their lives. In addition to meeting physical needs, it also has social and cultural functions. Especially in the post-disaster process, it is essential to create temporary shelter units in the face of emerging problems. Since societies can be affected simultaneously in this process, needs must be met as quickly as possible. "Flexible container designs" are seen as a solution to this problem. Flexible container designs can provide significant advantages in meeting basic needs after a disaster and in terms of rapid intervention. The study aims to present flexible model suggestions that can be used to produce temporary shelter units. Because the production of temporary shelter units is essential in terms of flexibility due to reasons such as reusability, portability, limited design periods, etc. The study discusses the designs made by the students within the scope of the Structural System Information course of the Architecture Department of Gazi University Faculty of Architecture. The students were asked to produce solutions to problems such as the emergence of shelter needs for people after disasters, bringing containers to the need area, and serving different functions. The study reveals the value of the concepts of flexibility, portability, and modularity in the design of temporary shelter units through student designs; it emphasizes the importance of these concepts in design processes in both architectural education and architectural practices. The study will contribute to the development of innovative, flexible, and portable solutions.

Keywords: architectural education, container, earthquake, flexible designs, portable designs

1. Introduction

Since the early periods of history, people have needed shelter, a place to take refuge from the effects of nature. Along with changing and developing living conditions, shelters have also developed; social functions such as being comfortable, healthy, livable, sustainable, etc. have been assigned to spaces. A shelter should always protect the physical and mental health of its users and be able to meet the needs of its users (Tamer Uçar, 2015).

When people lose their homes and living spaces where they feel safe due to natural disasters, it both increases the impact of the adversities they experience and prolongs the time to return to their normal lives after the natural disaster (Abanoz & Vural, 2023). When the post-disaster needs are examined, it is of great importance in terms of disaster management to provide safe shelter spaces in order for disaster victims to reconstruct their living arrangements and routines. The need for shelter is one of the most critical problems to be met in the emergency phase after natural disasters.

Temporary shelter units are needed until permanent housing is completed (Ayanoğlu & Erbaş, 2023). Temporary shelter units are defined as units that meet the shelter needs in disasters,

*Res. Assist., Gazi University, Türkiye mazlumkalak@gazi.edu.tr
**(Corresponding author), Res. Assist., Gazi University, Türkiye, ozgezenter@gazi.edu.tr
***Lect., Gazi University, Türkiye efozcan@gazi.edu.tr
Article history: Received 11 October 2024, Accepted 24 December 2024, Published 29 December 2024

epidemics, earthquakes, etc., and are unsuitable for long-term use (Beyatlı, 2010). These units must be produced in a short time, be quickly installed, not require high costs, and be able to meet people's physical and social needs.

In the world and in our country, in the post-disaster sheltering process, Tent type, Mevlana houses, and prefabricated houses are used as temporary shelter units. Although they are cheap and easy-to-install systems at first glance, the traditional methods used today need to be revised in terms of allowing disaster-affected communities to stay in healthier and more comfortable places, to adapt to climatic conditions, and to meet user needs more quickly. Therefore, these systems need to be replaced by more advanced, innovative systems (Beyatlı, 2010).

When the words "container", "shelter", "temporary shelter" are searched in Web of Science, there are 1310 publications in the field of architecture and civil engineering in 2020 and after. The concepts that draw attention in the publications are as follows: adaptability, flexibility, foldability, kinematic compatibility, modularity, portability, sensitivity, sustainability, energy efficient, resilience. It is seen that these concepts support the same view (Clarivate, 2024).

At this point, the need for flexible, sustainable systems that can replace traditional structures and that can be quickly installed and dismantled clearly emerges. Flexible housing units play an important role in modern construction; they are supported in the face of a rapidly changing world. The increase in natural disasters and the decrease in environmental resources cause the need for flexible housing units that can be adapted to different needs. Temporary housing units are considered necessary for groups such as immigrants, refugees, homeless, etc., as well as natural disasters. The requirements for the units can be listed as durability, flexibility, mobility, sustainability, and comfort (Erdoğan Biter, 2023).

This study discusses the designs made by the students within the scope of the Structural System Information course of the Architecture Department of Gazi University Faculty of Architecture. The study focuses on the problems that lead people to seek new solutions in terms of meeting their basic needs and security as well as shelter needs. Students are expected to create durable, portable, sustainable, and innovative designs that consider the concepts of flexibility, portability, and modularity. The designed temporary shelter units undertake a critical mission with these concepts. This study will improve students' design skills through student designs and contribute to being more prepared for disaster risk. The study aims to reveal the value of flexibility, portability, and modularity in the design of temporary shelter units and to emphasize the importance of these concepts in the design processes in both architectural education and architectural practices. It is also thought to be a guide for newly designed shelter units.

2. Post-Disaster Temporary Housing Units: Container Design

Temporary shelter areas are basic shelter areas where the best possible living conditions are provided, which are pre-planned in order for the disaster victims to shelter for a temporary period of time after overcoming the initial chaos after the disaster, to be protected from climatic conditions and to live comfortably (Maral, 2016). There are many temporary shelter units: disaster units, prefabricated units, caravans, containers, trailers, etc. Within the scope of this study, container systems are focused on.

The container can be defined as a building element or unit positioned at a sufficient height from the ground level, has a simple and lightweight structure, is easy to transport and install, and has many different areas of use. Due to these features, container units are preferred in many areas (Kumaş, 2022). The use of containers in architecture is divided into two parts: the first is the use of a single cell (temporary shelter after a disaster), and the second is the use of mass (exhibition hall, fairground, etc.).

- Use in Emergency Situations: They can be used quickly in disaster situations such as earthquakes and floods. They can be used as emergency shelters to provide temporary accommodation for disaster victims or as emergency health centers.

- Transportation: The most common use of containers is maritime transportation. Standard containers are used to transport goods around the world on large ships. They are also used in land transportation, such as trains and trucks, allowing goods to be transported quickly and safely.
- Storage: Containers are also used to meet storage needs. Containers are preferred especially for temporary or long-term storage of products such as construction materials, furniture, clothing.
- Construction: In the construction industry, containers are used for purposes such as temporary offices, worker accommodation units, engineering offices and worker rest areas. When the nature of the work requires constant relocation, containers can be quickly moved and rearranged.
- Events and Fairs: Containers are used as temporary shops, food and beverage areas, toilets, ticket offices, etc. in events such as concerts, festivals, fairs, etc. It offers solutions to the needs of event areas with its portable and quickly installed structure.
- Housing and Hotels: In recent years, containers have become popular as environmentally friendly and sustainable housing alternatives. By bringing containers together, structures such as housing, hotels, and holiday villages can be built. Their fast installation and cost advantages make them preferred in this area.
- Agriculture: Containers are ideal for vertical farming applications. Especially in urban farming projects, containers can be used to create space-saving, efficient and sustainable farming areas.

Containers generally consist of a steel frame skeleton with wall panels, roof panels, and floor panels as carriers. They are of standard dimensions and are designed for transportation and storage purposes. Container design includes structural design (external dimensions of the container, internal volume), material selection, internal layout and functions, air conditioning and insulation, security and ease of use, and rapid assembly and disassembly (Niu, 2010).

Containers, which have many areas of use, are aimed to be used quickly, effectively and reliably within the scope of the study, especially in situations requiring emergency intervention after a disaster. Containers offer a solution to quickly resolve the sheltering problem that occurs after a disaster. Therefore, the fact that many countries, including Turkey, are under earthquake risk and the need to quickly resolve the sheltering problem that occurs after an earthquake also reveals the necessity of the containers' potential to provide urgent and effective assistance to earthquake victims.

Many different parameters should be taken into consideration in the design of post-disaster shelter units. In addition to providing the need for shelter, many other parameters such as the removal, storage and reuse of these units should be an important part of the design process (Vural Arslan & Gülay, 2023). International/national standards and guidelines provide guidance on shelter principles in particular. On a national level, "AFAD-Directive on the Establishment, Management and Operation of Temporary Accommodation Centers" (2015) and on an international level, "The Sphere Handbook-Humanitarian Charter and Minimum Standards" (2018) provided an important reference point for the study.

AFAD's Directive on the Establishment, Management and Operation of Temporary Accommodation Centers (2015) defines the principles for the location of accommodation centers, infrastructure requirements, security measures and provision of basic services (water, electricity, health, education, etc.). It aims to support rapid and effective response after a disaster. According to the Directive, it is important that temporary shelters are located in areas where they can be protected against hazards, taking into account the prevailing winds and water basins that may accumulate during the rainy season, and in a position suitable for capacity expansion in case the population increases. In addition, the standards for shelter units are as follows:

- The indoor area per person in shelter units should be 3.5-4.5 m^2.
- Containers should be 30 cm above the ground height.
- In hot and humid climates, air flow should be ensured and protected from direct sunlight.
- Optimum insulation should be provided in cold climates.
- Electricity should be available to all units and fire resistant materials should be used (AFAD, 2015).

The Sphere Handbook: Humanitarian Charter and Minimum Standards (2018) defines minimum standards in humanitarian processes. According to the Sphere project, shelter is more than four walls and a roof. The charter defines what people affected by disasters have a right to expect from humanitarian assistance and consists of four main chapters: water supply, santitation and hygiene promation, food security and nutrition, shelter and settlement, health services. All chapters are important in designing units that are equitable, fair, accessible, livable, culturally acceptable, accessible, healthy, flexible and safe for all. In particular, the standards for shelter units are as follows:

- Shelter units should be designed by considering climatic data. In warm, humid climates, they should not receive direct sunlight; in hot, dry climates, they should be shaded and ventilated; in cold climates, they should be designed to provide solutions to the heating problem.
- Necessary and appropriate areas for storage, nutrition and water supply should be allocated within the shelter unit.
- There should be a minimum of 3.5 m^2 of living space per person.
- Temporary shelter areas should be flexible enough for expansion. In case the population increases, new temporary shelters should be planned to be placed in the area (The Sphere Handbook, 2018).

The issues emphasized in these standards are to comply with minimum living space standards per person and to allow for flexibility. At this point, it is important that the units are capable of providing shelter for up to 4-6 people and are in alignment with international standards. The use of standard dimensions can facilitate the modification process in cases such as increasing the number of users, meeting different functions, etc.

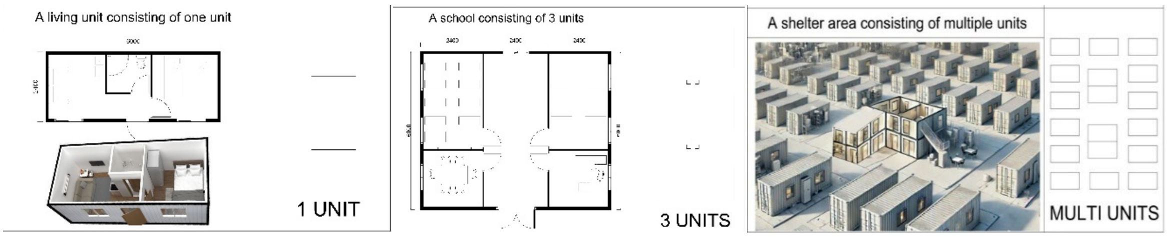
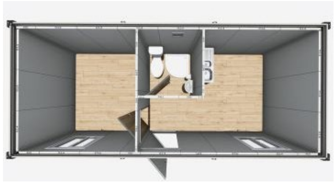
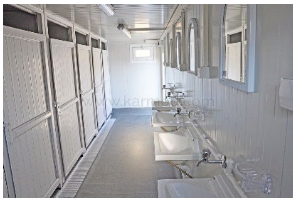
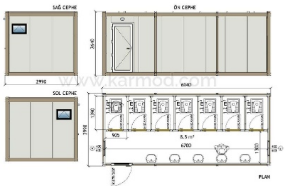


Figure 1 The use of temporary shelter units in different functions by integrating them with each other

Prefabricated containers used in our country are generally produced in accordance with specific standards. The most common dimensions are 3 m in width, 7 m in length, and 2.65 m in height. However, designs can be made in special cases and needs, and production can be carried out dimensions. Some container types are given as examples in Table 1.

Table 1 Container Types and Sizes Used in Our Country (AFAD Deprem Konteyneri-Konteyner Kent, 2024)

		
Standart Konteyner: 300x700x265cm		
		
Deprem Afet Barınma Konteyneri: 300x700x265cm		
		
WC Duş Konteyner: 300x700x265cm		
		
Özel Konteyner: 400x1200x265cm		

Most of the container cities established after earthquakes in our country are established as seen in Figure 2.

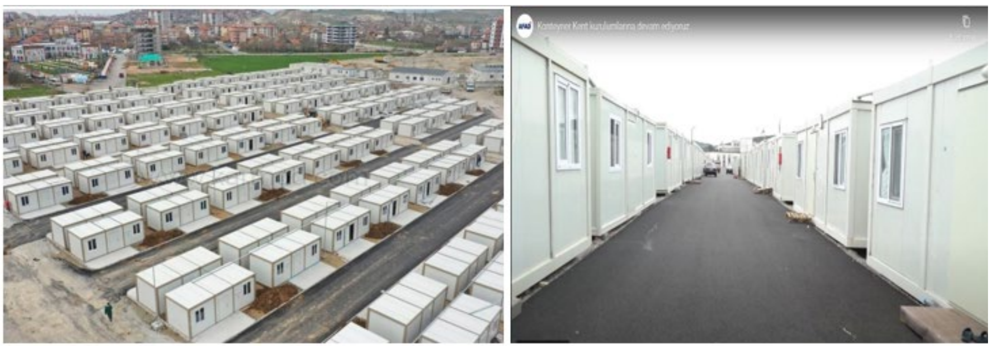


Figure 2 Kahramanmaraş container city

Temporary shelters after disasters are essential in the lives of communities affected by disasters in terms of creating a sense of normality, increasing hygiene conditions, and providing protection against climatic effects. To provide comfort consistent with the standard of living after a disaster, temporary shelters must be provided quickly. The design of these units is necessary to encourage a return to normal in a chaotic and uncertain situation. Temporary shelters may be unsustainable and inadequate in some cases due to the strategies used, misunderstandings about user needs, local conditions, etc. These units should be related to sustainability in terms of cost and environmental aspects (Félix et al., 2013).

Security, privacy, comfort, thermal and sound performance, ventilation, durability, etc., issues need to be considered. In addition to these concepts, planning for the future in producing solutions, contributing to possible future uses, and designing systems that can be adapted for reuse is essential. Therefore, temporary shelter units should be flexible, easy to install, dismantle, and use, and allow for simple and quick transformations (Avlar et al., 2023).

After a disaster, due to damage or destruction of structures, shelter areas need to be provided quickly. In reconstructing structures, a solution should be found for the shelter problem for the people living there. In addition to the shelter needs, alternative projects should be produced to meet other basic needs of people (Beyatlı, 2010).

The ready-made units used are solutions that are entirely built in the factory and need to be transported to where they will be placed. These solutions usually involve complex transportation systems, which can cause difficulties. Heavy transportation systems are needed, especially in regions with difficult access, since transportation will be even more challenging (Félix et al., 2013). Since only two containers can fit on a truck during the transportation of traditional containers, major transportation problems can be experienced. In addition, a severe storage problem arises when these containers are stored after they have completed their function after an earthquake. In addition, although standardly designed containers are universal, difficulties can also arise because they ignore the real needs of users, climatic differences, cultural values, and differences in daily life. When solutions cannot be adapted to user needs, they must make changes and additions. This makes containers unstable and unsustainable in the face of future problems (Félix et al., 2013).

Therefore, container designs that are more flexible and portable and based on modularity should be developed. Projects should be developed through kit solutions. While using the advantages of prefabrication, the kit concept means producing the elements that make up the unit instead of producing finished units. Transportation and local assembly can be facilitated by assembling the elements on-site (Félix et al., 2013). Thanks to these new designs, containers can be combined into more units, and more can be fitted into vehicles during transportation. Thus, transportation problems can be reduced, and more accommodation space can be provided. It also minimizes the storage problem and increases the reuse and sustainability of containers.

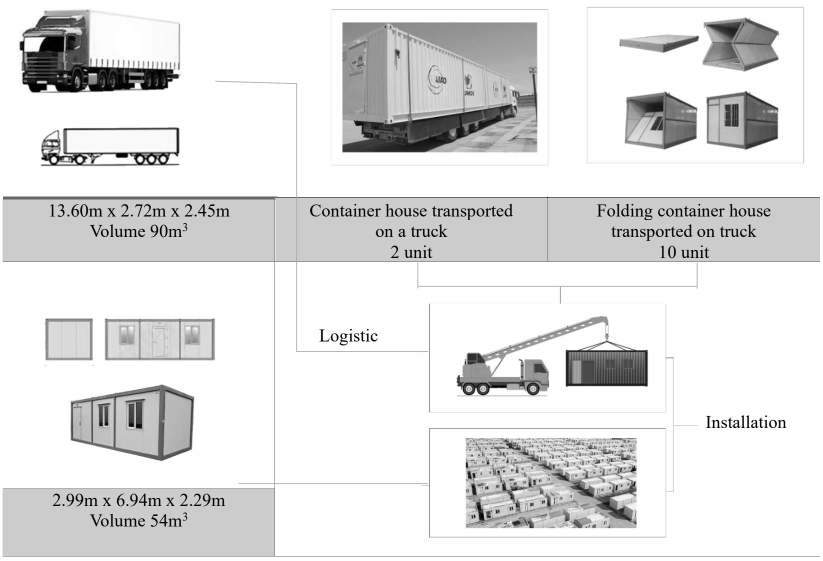


Figure 3 Container transportation and installation stages

3. Student Works Produced within the Scope of the Course

Within the scope of the study, the problem of shelter, which is one of the most important needs after a disaster, was addressed, the difficulties brought by traditional containers were analyzed and alternative design proposals were aimed to be developed. Alternative design proposals were prepared within the scope of an educational study.

Architectural education requires lifelong learning. Being able to respond to social relations and the needs of society, thinking critically on issues concerning society, and examining the relationship between architecture and society should be taught to students during the architectural education process (Yücel & Aydınlı, 2015). The design process in architectural education is a problem-solving action. Both international practices and social problems determine the requirements of education. Architecture and architectural education should be questioned, especially with the earthquake disaster experienced in our country.

Therefore, within the scope of the "Supporting System Information" course in the Department of Architecture of Gazi University Faculty of Architecture, students were asked to solve problems such as the need for shelter after disasters, bringing containers to the required area, and serving different functions. Within the scope of the course, the process started with the transfer of theoretical and technical information about the concept of the supporting system to the students. In the transfer of theoretical information stage, students are taught the basic principles of supporting system information; the technical information stage is carried out through modeling. This course aims to provide students with supporting system information and to provide them with experience in designing safe, durable, qualified structures that contribute to society. For this purpose, students were expected to design a "flexible container".

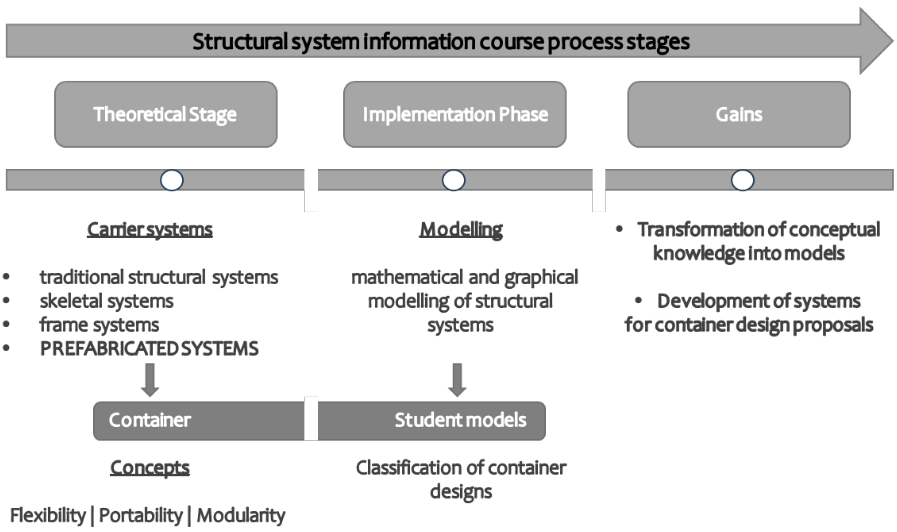


Figure 4 Structural system information course process stages (Created by the authors)

3.1. Theoretical Stage

In the transfer of theoretical knowledge stage: Carrier systems; traditional carrier systems, skeletal systems, frame systems and prefabricated systems were classified. It was decided to design containers from prefabricated systems. The concepts of flexibility, portability and modularity were emphasized; the possibilities provided by these concepts and how they are reflected in practice in container design were discussed. In architectural design, the concepts of flexibility, portability and modularity express the design's ability to adapt to changing needs and changing conditions and its capacity to overcome difficulties.

Flexibility is defined as the ability of a design to respond to the needs of different users and to be used for different functions (Tapan, 1972). Flexible design is a design that is adaptable rather than stagnant, that responds to change rather than rejecting it, and that is mobile rather than static.

The benefits of the concept of flexibility in design can be listed as follows; buildings can remain in use for a long time, can meet user experience and intervention, and can remain relevant to cultural and social needs in economic and ecological terms (Zenter, 2018).

Portability means that a structure can be easily transported and quickly assembled. It is a flexible approach where the structure is transported in a limited number of parts and assembled on-site. This approach allows for many different forms and follows the concept of a kit of parts during the assembly process (Wagemann, 2017). Portable designs provide ease of storage by being placed side by side or on each other when in a closed position. In addition, it is seen as efficient in terms of transportation in that many units can be transferred at once during shipment (Erdoğan Biter, 2023). Systems that can be disassembled, assembled with portable parts, and used repeatedly can offer an easy and modern lifestyle. Ease of transportation, not taking up much space, and not requiring tools during assembly are essential design features (Beyatlı, 2010).

Modularity is the ability to separate and recombine units in a system in line with functional needs. The design has a modular structure, and the modules are developed from a single prototype. The structure is formed by combining different modules within the framework of specific rules, and when these modules come together, larger and more complex structures can be created. Modularity allows easy rearrangement and expansion according to needs (Radev, 2017; Altunkaya, 2020). In this way, a constantly evolving and changing system emerges. Modular systems can be designed as semi-open, open, and closed according to the users' wishes. It can provide solutions for flexibility and mass production by creating various plan alternatives (Erdoğan Biter, 2023).

The relationship between flexibility, portability, and modularity in container production is based on the principle that components can be arranged in potentially infinite numbers and shapes. The primary purpose of such systems is to minimize damages and loss of time while producing rapid solutions to needs with an efficient organization, including the installation of modules and foldable panels, considering user needs. Systems can also include flexible, combined, and modular techniques that can change their shape and size with strategies that can open, close, and expand/contract thanks to their geometric and mechanical features (Wagemann, 2017). These concepts are of great importance, especially in container designs required for post-disasters, as they have high adaptability and capacity to produce solutions to problems.

Figure 5 Examples of foldable and demountable containers

3.2. Implementation Phase

In the transfer of technical knowledge phase: the gains obtained in the theoretical phase are tested with application and modeling methods. In this phase, students were asked to design a "flexible container"; the focus was on the concepts determined in the theoretical phase. In order to make the system more understandable, the carrier systems were expected to be modeled mathematically and graphically and their models were made.

What is expected from students;

• A flexible module design that can be attached, detached, and expanded is requested.

• Focus should be on the concepts of flexibility, modularity, and portability.

• Vertical and horizontal carriers should be arranged to form a frame.

• Insulation and materials should be considered in ready-made panel walls.

• Door-window gaps should be taken into account in the design.

• In the floor design, it is necessary to understand and apply the grid system, not the flat plate.

Expectations are planned to understand the skeletal and cladding systems of prefabricated containers and to raise awareness about flexible, portable and modular concepts that can be quickly and easily installed, fulfill vital functions in the design of temporary shelters.

As a result of the study, 16 different container designs were developed through group work; these designs were presented in the form of 1/10 scale models and 3D models. During the evaluation process, projects that comply with international standards, include conceptual approaches and structural system details were included in the scope of the study. The main reason for this selection is the aim of providing practically applicable solutions in accordance with the purpose and focus of the study. In student studies, container designs are examined in three groups in the transformation of concepts into models: Detachable systems, sliding systems and modular systems.

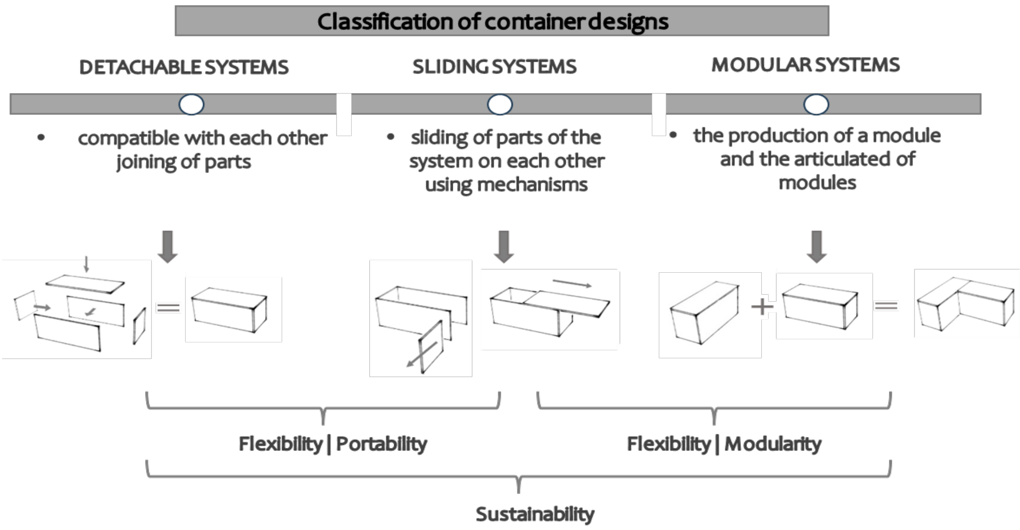


Figure 6 Classification of container designs (Created by the authors)

Recommendation 1-Detachable systems;

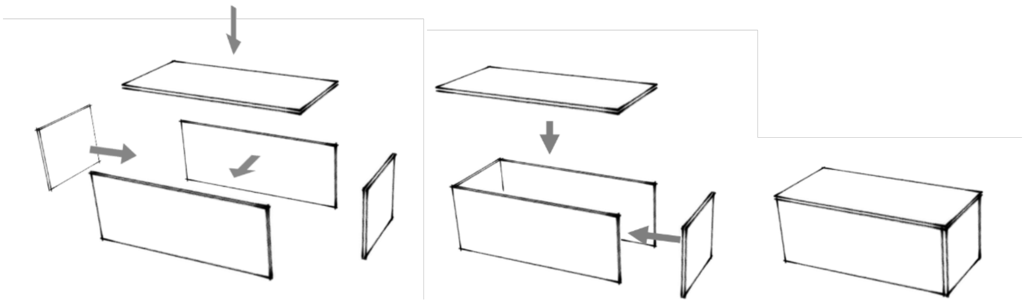


Figure 7 Detachable systems

In the first proposal, a removable/portable system model was created. Removable systems are formed by combining prefabricated panels that are compatible with each other. These systems can be preferred especially for post-disaster situations or when a removable structure is needed due to their features such as easy and fast production, low cost, and fast installation. Since prefabricated panels take up very little space while being transported, they provide both space saving and convenience in terms of carrying more systems at once. Unwanted panels can be removed during installation; panels that need to be changed can be easily replaced (İnan, 2014).

Figure 8 Detachable system-student model study

The detachable and attachable proposed design consists of 6 sandwich panels. It contains the shelter and bathroom/WC area. Since the volumetric reduction occurs when the unit is disassembled, it will provide ease of transportation and storage. When needed, it can be delivered to the desired location in larger numbers compared to traditional containers and easily installed.

Recommendation 2-Sliding systems;

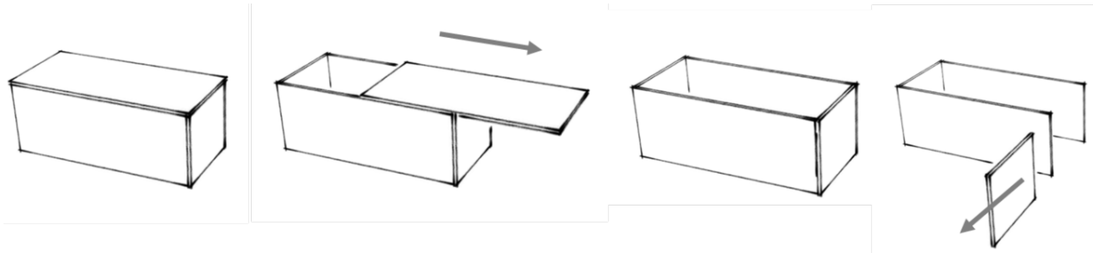


Figure 9 Sliding systems

In the second proposal, a sliding system model was created. Sliding systems are formed by sliding some or all of the panels on a special mechanism. Sliding panels are mechanisms that allow functional flexibility (Zenter, 2018).

Figure 10 Sliding system proposal-student model study

The proposed design consisting of sliding sandwich panels provides ease of both transportation and installation. With the interior panel mobility in the proposed system; interior layout and functions can be easily changed and adapted according to the needs of disaster victims. Open-closed space interaction is also possible with the sliding of the exterior panels on each other.

Recommendation 3- Modular systems;

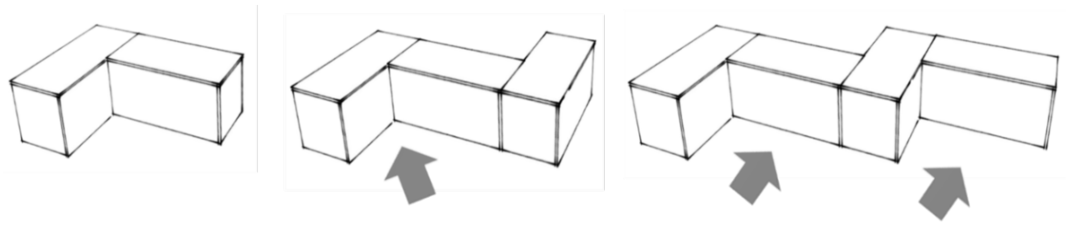


Figure 11 Modular systems

The third proposal focuses on modular and compact units. Modular systems are formed by a standard module produced and the appropriate combination of these modules. Parts can be disassembled and combined when necessary. Since modular systems provide growth flexibility, they can also respond to possible scenarios (İnan, 2014).

Figure 12 Modular systems-student model study

Unlike other suggestions, in this proposed design, modules can be articulated side by side or on each other. This way, volumetric growth occurs; different functions requiring different volumetric capacities can be served. Modular units can also be a solution in the face of changes in the number of users. They can also be arranged in a way that creates courtyards between them; thus, users can connect and socialize. Creating transition areas such as gardens between modules can provide privacy between neighbors and allow open areas for common work, rest, etc.

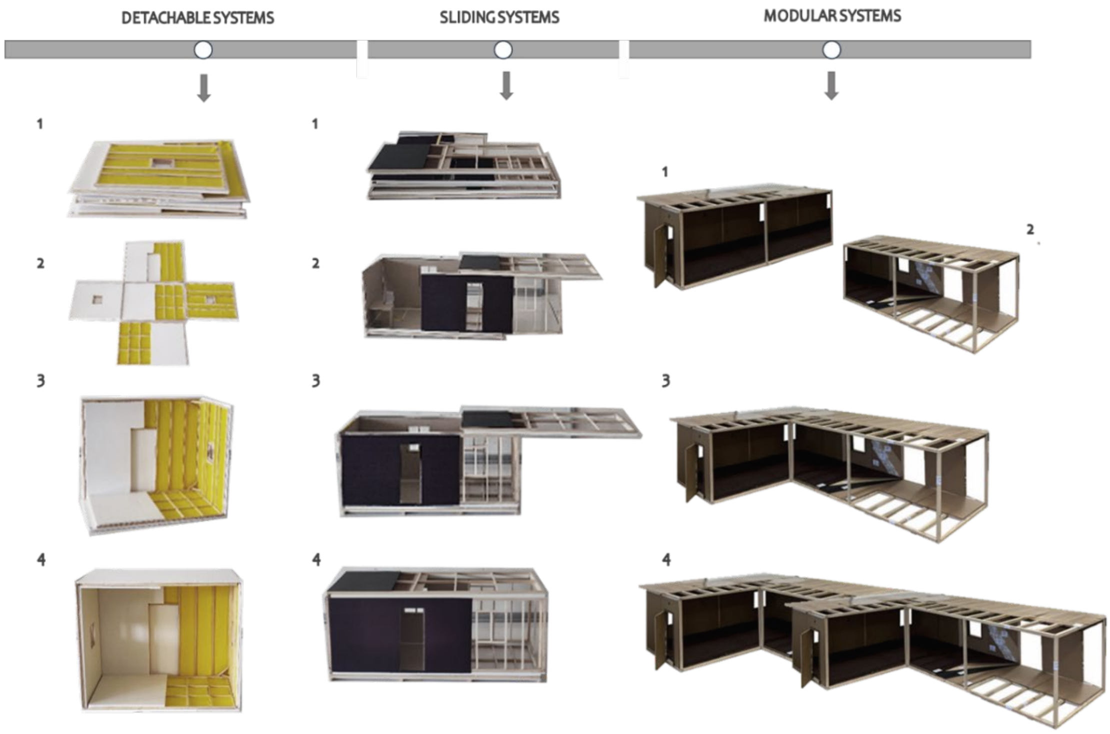


Figure 13 Flexible model suggestions and stages for temporary shelter after disaster

3.3. Evaluation

The models are designed in a rectangular form, with a width of 270 cm, length of 650 cm, and height of 270 cm, considering fixed dimensions. The models are elevated with 30 cm high feet on the four lower corners for protection against cold conditions and insects.

- In the 1st proposed system, thanks to the detachable and attachable panels, the model can be opened and closed when necessary—especially in the pre-emergency preparation phase; stocking shelters and moving them from warehouses to usage areas after disasters are essential. Portable systems provide great convenience in storage and transportation/transportation from warehouses since they will take up less space.
- In the 2nd proposed system, thanks to the sliding movable panels, both portability and flexibility can be provided. In sliding systems, opening a section of the structure by sliding can define the open area-closed area relationship in addition to the flexibility of expandability/reduction and flexibility of use.
- In the 3rd proposed system, combining modules that can accommodate a family of four makes it possible to create larger living spaces for larger families. In addition to adapting to

the number of users, thanks to volumetric change, different functions can be served (health, education, etc.).

The models have a kit concept; instead of producing finished units, they produce the elements that make up the unit. They are packaged so that more than one piece can fit on a truck. They can be lowered and installed in the area of use with the help of a portable crane. Manpower is sufficient to install the models; there is no need for a comprehensive mechanical system or electrical energy. They can be placed, repaired, or stored by anyone in a short time.

The suitability of the developed container model proposals as temporary shelter units after a disaster was evaluated based on the criteria in the literature. This evaluation was made within the scope of usage features (assembly, storage, transportation, privacy, permanent housing opportunity) and performance features (endurance, adaptation to different functions, adaptation to different climates, reuse). The results are expressed in a table in comparison with traditional containers.

| Flexibility | Portability | Modularity |

			Traditional Container	Detachable Systems	Sliding Systems	Modular Systems
Usage features	Assembly	Expertise is not required. Easy to assemble.		○	○	○
	Storage	It does not require large areas. It does not take up much space..		○	○	
	Transportation	Easy to transport.		○	○	
	Privacy	It is sufficiently isolated from the external environment.	●	○	∘	○
	Permanent housing opportunity	Suitable for long-term use.			∘	○
Performance features	Endurance	There is no negative situation regarding durability.	●	○	○	○
	Adapt to different functions	It can adapt to different functions.			∘	○
	Adapt to different climates	It enables control of the physical environment.			○	
	Reuse	Suitable for reuse.	•	○	○	∘

Figure 14 Comparative analysis of flexible model proposals for temporary shelter after disaster (Created by the authors)

4. Conclusion

This study discusses the work carried out by students under the "Flexible Container Design" title. It emphasizes the importance of flexible and easily transportable and installed systems, especially for rapid post-disaster intervention. In the design of temporary shelter units, meeting users' personal, social, and community needs and producing durable and comfortable space that is easy to install and dismantle and has fast-transportable solutions should be a priority. Flexible, portable, and modular designs can be made with the systems used in the proposed shelter units.

- Flexibility: Adaptability to different scenarios and ability to adapt to different geographical and climatic conditions.
- Portability: Portability, detachability, easy installation.
- Modularity: Expandable, reducible, capacity to respond to different needs.

With flexible, portable, and modular designs, adaptability can be achieved according to the number of users and their needs; with the kit concept, more containers can be transported to the disaster area, containers can be collected and reused after the disaster, and storage costs can be significantly reduced.

In addition to these advantages, the proposed designs bring a humane design as they can provide effective and rapid response in emergencies. They can save cost and time. They can be environmentally friendly when produced with recyclable materials; they can support sustainability.

As a result, this study has emphasized the essential features of post-disaster container designs, such as flexibility, modularity, and portability through student designs. The importance of the use of new and innovative design approaches in post-disaster intervention and recovery processes has been emphasized. This study reveals the necessity of flexible, portable and modular designs as an alternative to traditional container systems that do not accommodate the number of users, climatic conditions, portability, easy installation, etc. The systems proposed in the study are designed as prototypes at the theoretical stage, but it is possible to increase their applicability in practice and make them usable in the site. It is hoped that the technical details of the proposed systems will be optimized and used in practice by architects, designers and aid organizations. The development of successful solutions for temporary shelter units will only be possible when the concepts of flexibility, portability, and modularity are considered.

References

Abanoz, F. B., & Vural, N. (2023). Dünyada ve Türkiye'de kullanılan geçici afet konutlarının karşılaştırmalı analizi ve model önerisi, *Eksen Dokuz Eylül Üniversitesi Mimarlık Fakültesi Dergisi*, *4*(1), 132-153.

AFAD, (2015). *Geçici barınma merkezlerinin kurulması, yönetimi ve işletilmesi hakkında yönerge*. https://www.afad.gov.tr/yonerge

AFAD Deprem Konteyneri - Konteyner Kent. (2024). *Prefabrik karmod prefabrik*. https://www.karmod.com/konteyner/afet-sonrasi-acil-barinma-unitesi/

Avlar, E., Limoncu, S., & Tızman, D. (2023). Deprem sonrası geçici barınma birimi: CLT E-BOX. *Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi*, *38*(1), 471-482. https://doi.org/10.17341/gazimmfd.1027894

Beyatlı, C. (2010). *Acil durum barınakları ve bir barınak olarak acil durum konteynır öneri modeli*. Yüksek Lisans Tezi, Trakya Üniversitesi Fen Bilimleri Enstitüsü, Edirne.

Clarivate. (2024). *Clarivate*. https://www.webofknowledge.com/

Erdoğan Biter, Y. (2023). *Afet yönetiminde kullanılabilir acil durum modülü için hızlı-kolay-tekrarlanabilir bir kurulum modeli geliştirilmesi ve hizmet alt yapısının kurgulanması*. Doktora Tezi, Mimar Sinan Güzel Sanatlar Üniversitesi Fen Bilimleri Enstitüsü, İstanbul.

Félix, D., Branco, J. M., & Feio, A. (2013). Temporary housing after disasters: A state of the art survey. *Habitat International*, *40*, 136-141. https://doi.org/10.1016/j.habitatint.2013.03.006

İnan, N. (2014). *Kinetik yapı tasarımında işlevsel esneklik ve entegre sistemlerin kullanım önerisi*. Doktora Tezi, Gazi Üniversitesi Fen Bilimleri Enstitüsü, Ankara.

Kumaş, B. (2022). *Konteynerların geçici konut olarak kullanımı ve mekansal çözüm önerileri geliştirilmesi*. Yüksek Lisans Tezi İstanbul Üniversitesi Lisansüstü Eğitim Enstitüsü, İstanbul.

Maral, H. (2016). *Afet sonrası geçici yerleşim yerlerinin planlanmasında üst ölçekli planlama: Karşıyaka örneği*. Yüksek Lisans Tezi, Gediz Üniversitesi, Fen Bilimleri Enstitüsü, İzmir.

Niu, G. (2010). *New container architecture: Design and sustainability*. Laurence King Publishing.

Radev, S. (2017). *Flexible architecture: Modularity, portability and prefabrication*. Routledge.

Tapan, M. (1972). *Prefabrike elemanlarla yapımda esneklik veya değişkenlik sorunu*. YAK Bülteni, İTÜ Mimarlık Fakültesi, İstanbul.

The Sphere Handbook. (2018). *Humanitarian charter and minimum standards in humanitarian response*. https://spherestandards.org/

Vural Arslan, T. & Gülay, M. (2023). Afet sonrası geçici barınma alanları tasarımı. *Kentli Dergisi*, *49*, 78-85.

Wagemann, E. (2017). *From shelter to home: Flexibility in post-disaster accommodation*. Doctoral Thesis, University of Cambridge, USA.

Yücel, S., & Aydınlı, S. (2015). 'Mimarın eğitimi' üzerine spekülatif bir deneme. *Erciyes Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *31*(1), 17-23.

Zenter, Ö. (2018). *Kinetik biyomimetik yaklaşımların mimari tasarımda işlevsel esneklik amaçlı kullanılması*. Yüksek Lisans Tezi, Gazi Üniversitesi Fen Bilimleri Enstitüsü, Ankara.

Resume

Mazlum Kalak is an assistant at the Faculty of Architecture at Gazi University, specializing in conservation and restoration. He is actively involved in both academic research and practical applications within the fields of architectural conservation, restoration, and related architectural activities.

Özge Zenter has been a research assistant at Gazi University Department of Architecture since 2015. She received her BArch at Karabük University in 2014; her MArch at Gazi University in 2018. Her research fields include architectural design, current developments in design, sustainable architecture, biomimesis and kinetic architecture.

Fulya Özmen graduated from Galatasaray Hihgschool (1980), holds a Professional degree in architecture from Mimar Sinan University (1985) and a Ph.D. from Gazi University (2003). She is an academic member of Gazi University Faculty of Architecture since 1988, focusing on building technologies, building and construction management systems, building and environmental qualities, mass-housing techniques and problems, hotel buildings and architectural education.