

Chapter 2

Mobility and Flexibility in Architecture

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Introduction

Since the beginning of their existence, humanity has had to survive defencelessly in the natural environment. Therefore, they have produced various solutions to meet their survival needs. Especially in the early periods of human history, it was more difficult to meet basic needs such as food, protection, privacy and shelter while living in the natural environment. To protect themselves against the dangers of the natural environment, they have created a special place and have developed different shelters over time. Environmental factors, geographical conditions, climatic effects and living conditions in the region have been decisive factors in forming these places. Over time, there have been transitions from these places to different areas due to resource depletion, destruction, or environmental problems. These transitions led to the displacement of people and the development of mobile lifestyles.

Until today, spaces have been the concept most affected by social developments and socio-economic conditions (Demirel, 2004). Technological developments in the century we live in have closely affected human life. Thanks to technologies such as mobile phones and computers, people no longer have to be tied to a place (Hacıalibeyoğlu, 2005). Thanks to the living conditions brought about by globalization and technological developments, people have preserved the desire to move and be mobile in their structures with the desire to be independent (Yalçınkaya & Karadeniz, 2022).

Recent events such as pandemics and natural disasters have also distanced people from being tied to a settled place. Mobile spaces or using them in response to their needs, such as a continuous lifestyle or holiday, are becoming increasingly popular. In this study, the concept of mobility, the historical development processes of mobile spaces, the reasons for their emergence, the purposes of use from past to present, and their relationship with the concept of flexibility are discussed in detail.

The main research question of this study is;

- What are the effects of flexibility on the design process in mobile spaces?

The research aims to find design approaches in mobile spaces. The study aims to reveal the integration of the concept of mobile life into the life of human beings, to show the contribution of the concepts of flexibility and changeability to this lifestyle and spaces, and finally to determine the design approaches in mobile spaces. As a method in the study, domestic and foreign articles, thesis and doctoral studies related to the sub-headings and components of the subject will be examined as a source and the design criteria of mobile spaces will be determined and transferred under three headings as Inputs-Process-Outputs.

Material and Methods

In this study, the design approaches of mobile life are questioned through flexibility. In this context, the study's methodology is based on the main headings of "Inputs, Process and Outputs" (Figure 1). Under the title of inputs, a literature review was conducted on the definitions of mobility-flexibility-mobile life, the history of the development of mobile life and the reasons for the preference of mobile spaces. Under the process heading, the classification of mobile spaces and flexibility principles are included. Under the title of Outcomes, the results of the information gathered until this section are given. In the discussion section, the design criteria of mobile spaces are tabulated due to the comparison. Finally, the article ends with a conclusion section where the study is interpreted in the context of the existing literature, suggestions for future studies and the importance of the findings are emphasized. The

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documents used in this study were obtained from research books, local and foreign journals, websites, university publications and digital records.

DETERMINATION OF MOBILE SPACE DESIGN CRITERIA

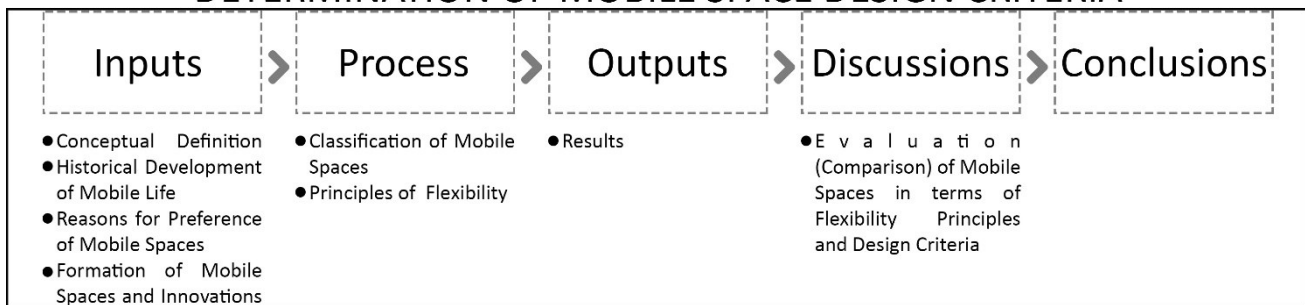


Figure 1. Structure of the study (Developed by Author).

Mobility, Flexibility, Mobile Life

This chapter aims to discuss different aspects of the concept of mobility in detail and explain the titles related to this concept. In this context, the phenomenon of 'mobility and flexibility' will be examined based on the scientific foundations of mobility. The way movement is realized and expressed is essential for understanding the concept of mobility. Mobility is not concerned with the time spent in a non-moving space but describes a sequence of continuous and dynamic spaces (Hoete, 2003). The change associated with the position of a subject in a moving wagon, a vehicle traveling on a motorway or a ship sailing on the sea over time constitutes the concept of mobility. After explaining mobility and the concepts related to this concept, the development of mobile life and mobile spaces in the historical process will be examined and the design criteria and reasons for the preference of mobile spaces will be explained.

Conceptual Definitions

Mobility is a multifaceted concept that describes a physical state and mental and technological development. This is because factors as crucial as the physical movement itself influence mobility. The environmental factors that cause movement and the technological developments that shape how movement occurs make mobility an action based on physical relocation and a social phenomenon encountered in every field today. For example, rapidly developing information and communication technologies have led to the emergence of more flexible working and living styles. How the places where people live will be affected by these social changes is very important (Clews & Henry, 1997). People can attend a meeting and carry out their work many kilometers away thanks to communication and video systems controlled by remote control. Information technologies have made the concept of distance almost irrelevant. This has enabled places such as homes, offices, and schools to be managed from a single center in an integrated manner. With the rapid spread of the Internet, the concept of working from home has developed in the last decade, allowing people to carry out their work without leaving their physical space. This situation causes the houses to be re-evaluated by the users' needs. Throughout history, people have searched for suitable places with the need for shelter. Social changes, wars, disasters, and technological developments have led us to question our sense of belonging, and many people do not feel they belong anywhere. For this reason, in some cases, people move voluntarily, while in others, they become mobilized compulsorily. These situations give rise to problems such as homelessness, migration, refugeeism, and disaster victimization.

The concept of flexibility is closely related to mobility as it is related to many spaces. In the literature, there are many discourses on flexibility in architectural design. This section of the study includes these discourses in theory and practice. The concept of flexibility, a product of the Modern Movement in Architecture, gained importance after the 1950s, adding the elements of 'time' and 'unknown' to the design and giving a new breath to functional architecture (Forty, 2000). In parallel with the emergence of socialist thought and public interest in the field of architecture, urban design and planning, which became increasingly widespread in the West in these years, the concept of communication in design, the role of the user and accessibility were discussed in a broad framework (Incedayı, 2008).

Mobile means to be able to move, to be able to move on its own or with an auxiliary vehicle, and to be disassembled when necessary. For this reason, housing spaces that are mobile and disassemblable are generally called 'mobile spaces'. Mobile architecture is constructing a building by efficiently combining the structure's parts (Küçükerman, 1995). It considers the modular placement of parts on a permanent foundation as a mobility criterion. On the other hand, mobile life is a multifaceted concept covering a physical situation and mental and technological development. The phenomena that constitute physical movement transform mobile life, i.e., mobility, from a physical action based on displacement into a social phenomenon we encounter in every field today. Thanks to the continuous and rapidly developing information and communication technologies, more flexible working and living styles are emerging (Clews & Henry, 1997). In today's understanding of mobile life, how movement takes place is essential. The roads traveled, changing landscapes, and geography are observed, felt, and perceived by the passive subject. Mobility, a part of modern society, is a situation that needs to be monitored, including housing, work, and

recreation problems. Millions of people traveling on motorways and railways daily follow the changes in the city and its surroundings from a room with a view(Houben, 2003). People's search for place and mobility has become essential to today's complex social and technological dynamics.

Historical Development of Mobile Life

In order to survive in the early ages, human beings first used natural shelters such as tree barks and caves and then simple huts and tents that they built themselves(Arı, 2019). The first mobile spaces are tents and portable shelters that can be quickly erected and transported. The tent is the first example within the scope of mobile space. Tents that can be installed and removed anywhere are suitable for the definition of mobility. In this process, since the primary source of livelihood for human beings was hunting and gathering, they built temporary shelters. In the following period, with the discovery of agriculture, settled life began and the importance of mobile life decreased. However, certain groups, such as nomadic tribes and traders traveling along trade routes and military camps, still maintained mobile lifestyles. In the Middle Ages, with trade development through trade routes and caravans, caravans and traveling merchants continued mobile living. In the 18th century, horse-drawn carriages were used as mobile structures. As time passed, many areas of use of horse-drawn carriages pulled by animals emerged, and their types diversified. In these vehicles, people can both travel and sleep. With the Industrial Revolution and the developments in transportation and communication, people's ability to change places and travel has increased. In this period, transport vehicles such as trains, ferries and cars further facilitated people's mobile lifestyle. In the 20th and early 21st centuries, technological advances and globalization have made people's mobile lifestyles more and more common. Portable housing such as caravans, campers and mobile homes have increased people's freedom to travel and live in different places. Today, technology, industry and science offer unlimited possibilities, which has led to mobile living becoming a popular choice. In short, the development of technology and communication has led to the modern revival of mobile living(Figure 2).

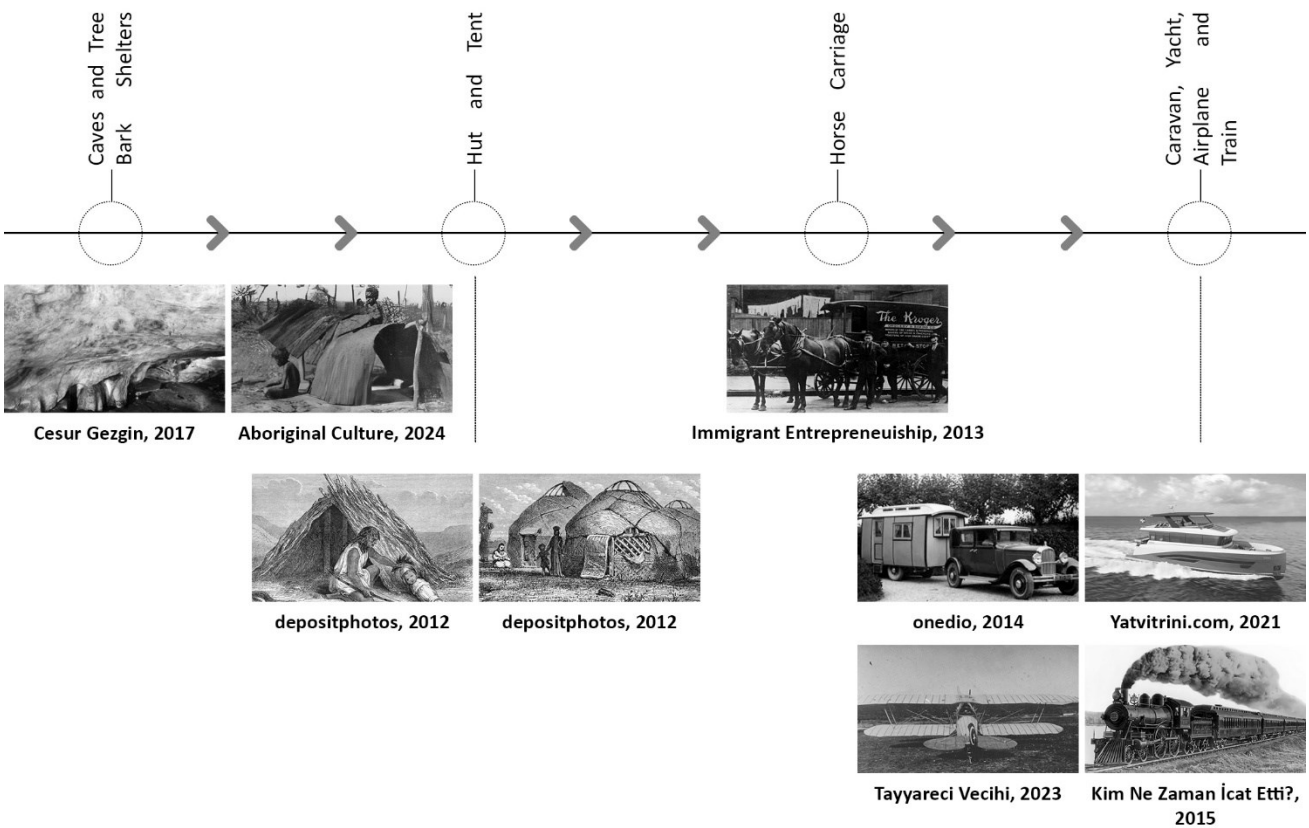


Figure 2. Historical development of mobile life (Prepared by Author)

Reasons for Preference of Mobile Spaces

Mobile spaces may be preferred due to economic, social, environmental and psychological factors. They are also preferred because they are economical, easy to clean, have a lightweight structure and have minimal and efficient interior arrangements in limited spaces. Causes such as wars and natural disasters force migration and some occupational groups that require mobility lead people to mobile living(Altan, 2007). The broad scope of cultural values reveals the reasons for the variability of societies lifestyles. Nowadays, there are environmental problems that lead people to mobile life, and this leads to global migration. The following table illustrates these problems(Taşkesen, 2019)(Table 1).

Table 1. Environmental issues (Taşkesen, 2019), (Edit by Author)

Environmental Developments			
	Issues	Solution Approaches	Solution Oriented Products
Energy Challenge	Oil Crisis	Effective Use of Energy	PV Panels Solar Collectors
	Depletion of Non-Renewable Energy Sources	Renewable Energy Use	Smart Housing Equipment
	Depletion of Water Resources	Environmentally Sensitive Space Approach	Passive Solar Systems
Global Warming and Climate Change	Melting Glaciers	Artificial Air Conditioning	Smart Housing Equipment
	Global Sea Surface Rise	Adaptation to Different Environmental and Terrain Conditions	Movable and Flexible Structures
	Global Migration as a Result of Natural Disasters	Mobile Architecture Flexibility	
Environmental Pollution	Air Pollution Greenhouse Effect in the Atmosphere	Using Technology as a Means of Integration with Nature	Recycled Building Materials
	Water Pollution Degradation of Water Resources	Sustainability	Building Systems Created from Waste Materials
	Waste	Recycling	

Formation of Mobile Spaces and Innovations in Mobile Spaces

The formation of mobile spaces can be divided in three ways. The first one is portable structures. Portable structures can be easily pulled or pushed to the desired location thanks to the mobile elements they contain. The parts that enable the transportation of these mobile structures are usually inseparable from the structure. While such structures are sometimes moved by external forces (pushing, pulling or carrying), sometimes they can move with their own motor power. For example, caravans are an example of this category (Tuncel, 2007). Another example is the N55 structure. The N55 structure is an example inspired by the concept of a mobile caravan. It was founded in 1994 in Copenhagen as a non-commercial exhibition space and laboratory under the leadership of Norre Farimagsgade (55). The N55 structure emerged from this collaboration. In 1996, people gathered in an apartment building in the center of Copenhagen and tried to build a new structure. They envisioned it as a platform for collaboration and a public platform for their daily lives. The three-dimensional triangulation system called N55 spaceframe was built in the harbor area in 2000. Until 2004, it served as a starting point for local initiatives and interventions, a group workspace and a living space, and is currently only used as a living space. N55 provides a platform for people who want to work together and share their living space, economy and means of production. The design is adaptable to the characteristics and behavior of its users, so that it can adapt to the diverse conditions of the world (Siegal, 2008). The Snail Shell System is a prominent example of a portable structure. This system is a low-cost structure that can be used both on land and on water, giving people freedom of movement in different environments. Offering a space for one person, the Snail Shell System can be rolled like a wheel. On the water, it can be moved with the help of a kite or rowed like a ship or ferry. It can be anchored in lakes, rivers, harbor areas and seas, while on land it can be easily positioned in forests, parks and suitable areas in the city. The Snail Shell System can be placed in a suitable arrangement in a small footprint; it can even be buried in the ground, leaving only the entrance section outside. It can also be easily placed inside existing buildings and provide a functional space (Siegal, 2008).

Another type, replaceable structures, are also known as modular structures. These mobile structures can usually be transported in sections and assembled according to the location where they will be placed. Practically all parts are portable, but in some cases the structure can be divided into parts and made portable. The most distinctive feature of such structures is the ability to create larger areas according to different settlement conditions (Tuncel, 2007). The Micro - Compact Village, as the name suggests, looks like a small village in concept and placement. Designed with advanced technology and low energy use, it consists of seven micro-compact pieces that are portable and lightweight. The design was developed by British architect Richard Horden and realized in collaboration with six selected students at the Technical University of Munich. A four-year research process by Richard Horden and German researcher architects Lydia Haack + Hoepfner resulted in significant progress on the structure. The layout is inspired by traditional Japanese tea house architecture. Within each building there are wet areas such as toilets, showers and kitchens. The central axis is used as both an entrance and kitchen circulation area. There is also a dining area on the lower floor and a sleeping area for two people on the mezzanine. The building makes use of lightweight alloy technology with portability as a material; timber, galvanized aluminum sections and insulated vacuum aluminum panels are used as the building foundation. The Micro - Compact Home structure is ideal for business travel, vacation homes or short-term housing and can be quickly ready for use by providing energy and communication systems. They can be lifted off the ground and transported, keeping environmental interference to a minimum (Siegal, 2008).

Another type is removable structures. Such structures are designed to be transported piece by piece and assembled on site. Thanks to their flexible size, they can be shaped according to requirements, and are usually transported with all parts together but not assembled. The main distinguishing feature of this type of structure is that it can be adapted to different configurations without complexity issues (Tuncel, 2007). For example, the Strain Residence is a three thousand square meter building made using traditional commercial and industrial materials. Located in the Brewery District in Los Angeles, it was designed by the Office of Mobile Design to blend into the industrial landscape of the city, even creating an oasis inspired by it. Strain Residence is a building that can easily let in daylight thanks to its large and expansive glass panels. In collaboration with Richard Carlson and the fabricators, the project was developed with environmental harmony and aesthetic values in mind. The sections inside the building are created by dividing large containers and have different functions. For example, one container is organized as an entertainment and library area, while another is used as a bathroom and laundry room. Other spaces, such as the dining room, office area and master bedroom, are also shaped in different containers. The materials used include recycled storage containers, grain trailers, steel and high glass panels. The combination of these materials gives the building an open, modern and sculptural look. Strain Residence is not only practical and cost-effective, but also a unique and impressive example of architecture (Siegal, 2008).

In conclusion, the development and diversification of mobile spaces has provided many examples of structures that have emerged from the examination of the elements underlying the concept of movement. With the influence of technology, these structures have become portable, relocatable or removable and have played a role in facilitating human life. These developments have enabled more functional and aesthetically appealing structures to replace conventional designs. Advances in material diversity have enabled buildings to bring together materials selected according to needs. These materials play an important role in the development of mobile structures with their production techniques, resistance to climatic conditions and versatile usage possibilities. In the next section on mobile space types, the effects of mobile spaces on office environments will be discussed by examining the formation of the office concept and working styles.

Classification and Principles

This section consists of two subheadings. The first subheading describes the classification of mobile spaces. Although this classification can be done in many different ways, the study classifies mobile spaces according to environments (land, air, water). The second subheading aims to give the principles of flexibility. These principles are reorganized according to mobile spaces, and the study's discussion section is based on them.

Classification of Mobile Spaces

Different cultures have used mobile spaces in the past for relocation purposes. These spaces have changed over time due to many factors such as social life, personal preferences and economic factors, and have become inhabited while moving (Doğan, 2020). Today, mobile spaces, unlike dismountable and fixed spaces, can move on their own or be pushed and pulled to relocate. Caravans, boats and airplanes are examples of these spaces. Spaces such as caravans, boats or airplanes move people from one location to another and are used for various actions such as traveling and sheltering. Thus, the individual can continue their vital activities while moving.

Mobile spaces, which can be classified in many ways (portability, usage purposes, design features, etc.), are classified according to the environment (land, water, air) in this section. Different mobile spaces that are shaped and adapted according to the needs of these environments have emerged. When we examine the individual features of these environments,

- Mobile places on land include various vehicles and structures used for traveling or accommodation. Examples of these are caravans and campervans. These places stand out with their large interior spaces and portability.
- Mobile spaces on the water provide the opportunity to travel and stay by providing interaction with water. Examples of these spaces are boats and yachts. The size or smallness of these spaces used for various purposes (traveling, home, sports, etc.) are sized according to the purpose.
- Airborne mobile venues provide a fast and efficient means of transport, enabling aerial travel and offering various options for different needs. Examples of these spaces are airplanes and helicopters. Used for multiple purposes (transport, cargo, emergency, etc.), these places' size, smallness or luxury are shaped according to the purpose.

Apart from the two examples given for the above environments (Table 2), mobile spaces have been observed to have these characteristics.

Table 2. Classification of mobile spaces (Prepared by Author)

CLASSIFICATION OF MOBILE SPACES ACCORDING TO ENVIRONMENTS		
ON LAND	ABOVE AIR	ON THE WATER
<ul style="list-style-type: none"> • Caravan • Campervan • Automobile • Truck • Bus • Tent • Train 	<ul style="list-style-type: none"> • Airplane • Helicopter • Jet 	<ul style="list-style-type: none"> • Yacht • Boat • Ship

Principles of Flexibility

The literal meaning of the concept of flexibility is the ability to take its former form after undergoing changes in form such as lengthening, shortening, bending, etc. under the influence of an external force. The concept of flexibility in architecture focuses on how spaces can evolve over time, how they can adapt to changing needs and how they can be made suitable for users. These concepts encourage architects to use various strategies and methods in the design process to ensure that spaces adapt to changing needs rather than serving a single purpose. Regarding the flexible design approaches to be developed to meet these changing needs, there are different flexible approaches and practices of famous architects in this direction (Islamoglu & Usta, 2018). It is seen that the approaches to provide flexibility with the developing technologies and requirements in the process are handled in different ways according to the designer. As we can see in the figure below (Figure 3), some of the studies are structural, some are spatial, and some are both structural and spatial evaluations.

DIFFERENT APPROACHES TO FLEXIBILITY THAT MARKED THE PERIOD

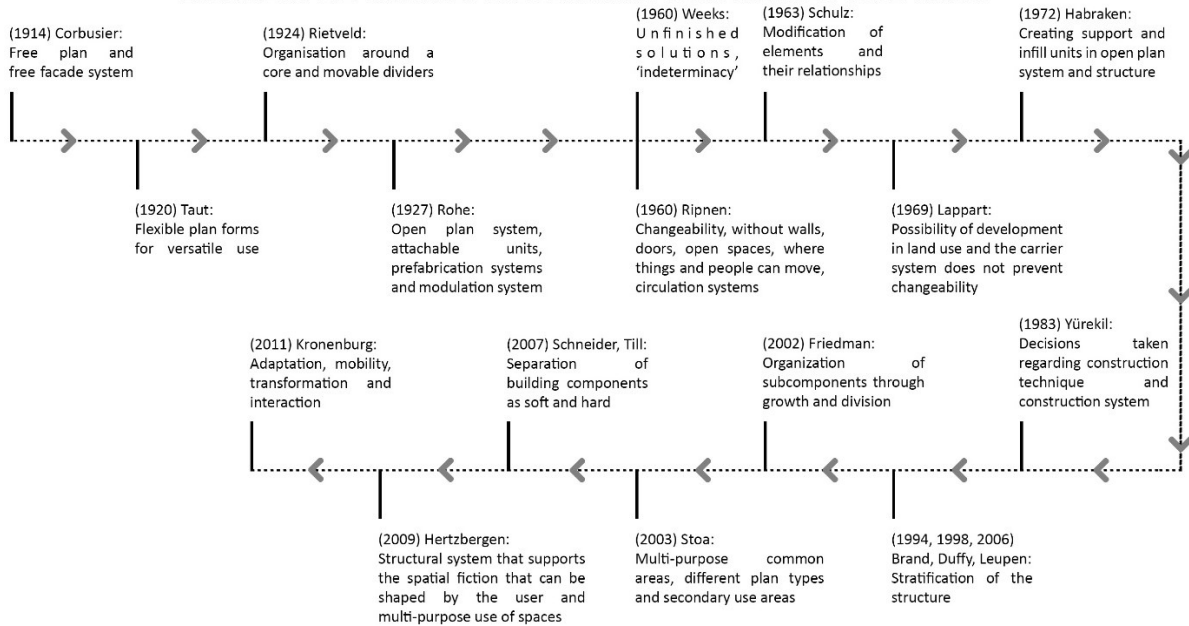


Figure 3. Different approaches to flexibility (Prepared by Author)

Flexibility in architecture is to make it possible to meet needs and to allow for changes in layout by maintaining integrity and adding or removing elements. In order to ensure this situation, general principles of flexibility have been established. These seven principles are; Addition-Subtraction, Mobility, Modularity, Neutral Spaces, Combining-Splitting, Multi-Purpose Use and Different Plan Types. These principles are formed under the headings of design and flexibility of use. When we look at the generally accepted principles (Islamoglu & Usta, 2018) (Figure 4);

1. The principle of modularity ensures the gridal organization of the design and creates a structure suitable for changes.
2. The strategy of neutral spaces envisages that an indefinite or undefined part of the space can later be organized for different purposes.
3. The strategy of different plan types provides flexibility with various plan layouts.

4. The addition/subtraction strategy refers to the ability of buildings, spaces and equipment to adapt to changing requirements.
5. The mobility strategy enables the interchangeability of space and equipment and different arrangements.
6. The combinability/divisibility strategy refers to the fact that two or more units can be combined or divided.
7. The multi-purpose use strategy enables a space to be used for more than one function.

We see seven principles necessary for the space to be flexible (it should comply with at least one). These principles increase the capacity of the design to provide flexibility, enabling the formation of a structure that can respond to the changing needs of users.

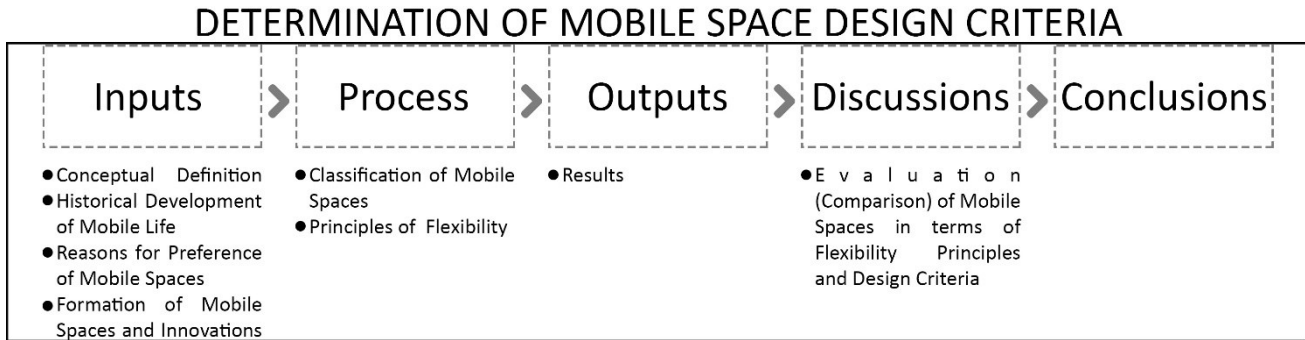


Figure 4. Principles of Flexibility (İslamoğlu & Usta, 2018), (Edit by Author)

Results

This chapter is the part where the written part of the study so far is presented collectively, the limitations are given and at the same time the information to be conveyed in the following chapters is included. The study aims to examine the effects of flexibility in mobile spaces on the design process and to reveal the design criteria of mobile spaces. The part of the study so far is aimed to examine the concepts of mobility and flexibility in depth and to emphasize their importance. Mobility is a fundamental concept to understand how people move and perceive spaces in a changing world. By changing the traditional perception of space, it allows people to carry out their work, communication and lifestyle in different spaces. In particular, rapid developments in information and communication technologies have increased mobility by supporting flexible working and communication styles. The widespread use of the Internet and the increase in remote working opportunities have reduced people's dependence on physical spaces and encouraged mobile lifestyles. The concept of flexibility emphasizes how spaces can adapt to changing needs and evolve over time. Principles such as modularity, neutral spaces and different plan types are strategies used to make spaces flexible. These strategies enable the creation of structures and lifestyles that can respond to the changing needs of users. Mobile spaces are one of the preferred lifestyles today. Under the influence of economic, social, environmental and psychological factors, people prefer mobile lifestyles. Mobile spaces such as caravans, boats and camping offer people different experiences and question the traditional understanding of housing. Such spaces give people freedom and adventure, allowing them to live and travel in other places.

In conclusion, the concepts of mobility and flexibility are critical for adapting to the requirements of modern life. These concepts contribute to the formation of structures and lifestyles that can respond to the changing needs of people in many areas from architectural design to social life. Mobility and flexibility play an important role in determining the designs and lifestyles of the future. The narration so far has not contributed to the understanding of the concepts of mobility and flexibility and the formation of further chapters. The discussion section gives the evaluation (comparison) of mobile spaces in terms of flexibility principles and design criteria. The limitation of the discussion section is that a comparison is made by taking one example from the classification of the mobile space according to the environments of the mobile space given in section 4.1. on land, in air and water. Finally, in the conclusion section, general findings are presented and suggestions for future research are provided.

Evaluation(Comparison)of Mobile Spaces in terms of Flexibility Principles and Design Criteria

In this section, a comparison of mobile spaces in terms of flexibility principles and design criteria is given. This comparison is formed by selecting and evaluating one example from each of the mobile spaces on land, in the air and in the water, which are valid in the classification of mobile spaces according to the environments as mentioned before. The selected mobile spaces were caravans on land, yachts in water, and airplanes in the air. The reason why these spaces were selected for comparison is that they are the first environments that come to mind as mobile spaces on land, in air and in water. The purpose of making these comparisons is to reveal the importance of the concept of flexibility in mobile space designs and to determine the design criteria of mobile spaces(Figure 5).



onedio, 2014



Yatvitrini, 2021



Tayyareci Vecihi, 2023

Figure 5. Mobile spaces compared in the study (Prepared by Author)

Evaluation(Comparison)of Mobile Spaces in terms of Flexibility Principles

After The principle of modularity, the principle of neutral areas, the principle of different plan types, the principle of addition/subtraction, the principle of mobility, the principle of combining/dividing and the principle of multi-purpose use have been followed.

Firstly, when we compare in terms of the principle of modularity;

Caravans generally stand out with their highly flexible and customizable structures in terms of modularity. They provide modularity in many areas such as interior layout, exterior equipment, ceiling and wall structure, sleeping arrangements and storage areas. Interiors can usually be organized or changed according to the needs of the user. Adding or removing external equipment is also quite common, providing options such as adding solar panels or fitting a bicycle rack. In some modern caravan models the ceiling and wall panels can be replaced or separated by movable partitions, thus enabling the interior to be customized to suit different needs. Sleeping arrangements are often modular; bed areas can be folded or converted so users can make different sleeping arrangements. Also, storage spaces are often modular; shelves, cabinets and drawers can be arranged or modified according to the user's storage needs. Yachts offer considerable flexibility in terms of modularity; although they do not offer as wide a range of modularity as caravans, cabin arrangements are often modular; cabins can be customized to different needs by removing or rearranging walls. Deck areas are also modular; deck furniture and equipment can be added, removed, or rearranged. Some yacht models may have a modular structure and can be enlarged or reduced in size as required. Yachts can often be fitted with modular equipment for water sports; for example, it is possible to add a water ski ramp or install a diving platform. Aircraft do not offer as much flexibility in terms of modularity as caravans and yachts, but they do have some modular features. Seat arrangements are modular on some aircraft models; seats can be removed or replaced so that they can be organized according to different needs. Cargo areas are often of a modular nature; cargo racks and compartments can be organised or modified according to different types of cargo. Interior decoration on private jets can be modular; interior decoration elements such as seat upholstery and floor coverings can be customized according to the customer's wishes. On some large aircraft, cabin compartments are modular; for example, first-class and economy-class compartments can be changed or rearranged as required.

When we compare in terms of the principle of neutral fields;

Caravans often have neutral spaces that are suitable for multipurpose use. Their interiors can be converted into living spaces; for example, the bedroom area can be used as a sitting area during the day, or the kitchen counter can serve as a dining table. In addition, storage areas can also be multipurpose; cupboards, drawers and shelves can be used for storing food, clothes, equipment and other supplies. Some caravan models can have outdoor spaces; for example, outside the caravan can be used to pitch a tent or organize outdoor meals. Also, some caravan models have expandable interior and exterior spaces; for example, a drop roof or sliding side walls can be used to expand the interior space or increase the use of the exterior space. Yachts usually have large neutral areas and can be used for various purposes. Deck areas can be used for various purposes such as resting, sunbathing, eating, drinking and entertainment. Deck furniture and equipment can be arranged according to users' preferences. Lounges and cabins are designed for multi-purpose use in the yachts' interior; they can be used for various activities such as sitting, eating, sleeping and entertainment. Some yacht models have particular areas for water sports; for example, diving platforms, water ski ramps, or jet ski storage areas are available for water sports enthusiasts. In addition, yachts often have areas suitable for outdoor activities; deck areas can be used for organizing outdoor meals or enjoying the view. Aircraft do not offer as much flexibility regarding neutral spaces as caravans and yachts, but there are some possibilities. Cabin space is usually limited and serves a specific purpose; however, neutral areas such as rest areas or work desks can be provided for the convenience of passengers. The cargo compartment is usually equipped with neutral areas and can store different equipment or cargo. Some private aircraft models may have rest areas for passengers or dedicated catering areas, which can be used to improve passenger comfort on long flights. Also, some business jets may have dedicated areas for passengers to work while traveling, which can be used for laptop computers or other office equipment.

When compared in terms of the principle of different plan types;

Caravans offer a variety of plan types, often designed to suit different needs. Some smaller caravans are ideal for single travelers or couples and usually have basic living areas and sleeping arrangements. Larger caravans are usually designed for couples or small families and offer larger living areas, a separate bedroom and more storage

space. Large caravans are often designed to meet the needs of families and can include multiple bedrooms, large living areas and fully equipped kitchens. Some caravan models feature a semi-modular construction; these plans allow certain sections to be removable or rearrangeable so users can customize the interior to suit their needs. In addition, some modern caravans are characterized by their open-plan design, which makes the interior feel larger and more spacious, as well as encourages multi-purpose use. Yachts also offer a variety of plan types but are usually characterized by more luxurious and spacious plans. Small boat plans are usually designed for day or weekend cruising and have basic living and sleeping arrangements. Mid-size yachts are usually designed for couples or small groups and include one or two cabins, a spacious living area and a fully equipped galley. Luxury mega yachts are usually designed specifically for wealthy clients or corporations and feature luxurious features such as multiple cabins, multiple living areas, a cinema room, a gym and even a pool. Some yacht models are catamarans, which generally have larger interior and exterior spaces and provide a more stable cruise. Aircraft usually offer standard plans according to certain classifications. However, some private aircraft models may have different plan types. Economy class plans usually have a standard seat arrangement, with seats usually arranged side by side and in rows. Business class plans offer wider seats, more legroom and greater comfort; on some aircraft models, business class seats can be converted into beds. First-class plans generally have the most luxurious and spacious seating arrangements; seats can often be converted into full beds, offering extras such as private catering and personal entertainment systems. Some private aircraft offer customized plans tailored to the needs of private clients; these plans can often include luxury features such as multiple cabins, office spaces, meeting rooms and even spa areas.

When compared in terms of the principle of addition/subtraction;

Caravans can often be customized to the needs of the user and allow extra equipment to be added or removed. Exterior equipment caravans can often have extra equipment added or removed; for example, options such as adding solar panels, fitting a bicycle carrier or adding a storage box at the rear are available. The internal arrangement is also essential in terms of the customisability of caravans; internal arrangements are often modular, allowing some parts to be added or removed. For example, in some models bed areas or kitchen worktops can be removed or replaced. Storage areas can also be removed or rearranged in caravans; shelves, cupboards and drawers can be added, removed or replaced according to need. The exterior tracks of caravans are often designed to accommodate adding extra equipment; various mounting points allow users to add or remove different equipment. Yachts also allow adding or removing extra equipment, but usually on a more restricted scale and in a more specific way. Deck equipment often allows extra equipment to be added or removed; for example, it is possible to add a deck bar or remove a deck shower. Some yacht models are equipped with specialized equipment for water sports, and this equipment can often be added or removed; for example, it is possible to add a water ski ramp or remove a diving platform. The cabin furniture of yachts is usually fixedly installed, but some models may have removable or interchangeable seats or tables. Storage areas of yachts are also often removable or reorganizable; shelves, cabinets, and drawers can be added, removed, or replaced as required. Aircraft do not offer as much flexibility as caravans and yachts regarding additions/removals, but there are some possibilities. For example, on some aircraft models, seat arrangements can be removed or changed, allowing airlines to adjust the inflight arrangements to different demands. Cargo compartments can often be added or removed, increasing the aircraft's carrying capacity and cargo handling flexibility. On private jets, interior decoration can often be customized according to the customer's wishes; interior decoration elements such as seat upholstery and floor coverings can be removed or replaced. Some private aircraft models are designed to allow extra equipment to be added or removed; for example, an ambulance aircraft allows emergency medical equipment to be added or removed.

When compared in terms of the principle of mobility;

Caravans provide great mobility flexibility, especially when camping and traveling. Firstly, they are generally portable structures that can move independently and travel without depending on their vehicles. This provides flexibility for camping or traveling. Also, they can meet the need for accommodation while traveling, which is a great advantage, especially for long journeys or camping trips. Caravans are often designed to suit various terrain conditions, facilitating access to more remote or isolated locations. Finally, they are designed in sizes that can fit in various parking spaces and offer accommodation in various locations and landscapes. Yachts provide the flexibility to travel across the seas and often offer a luxurious and comfortable accommodation experience. Firstly, yachts can often sail on their own and can easily travel between different ports and routes. This is an ideal option for long-term travelers at sea. Also, yachts usually offer luxurious and comfortable accommodations, which makes passengers' time at sea enjoyable. They facilitate access to different routes and destinations and offer accommodation close to harbors. Finally, some yachts may have private beach access, offering a private area where passengers can enjoy the sea or practice water sports. Aircraft are ideal for fast and long-distance travel and are often used for commercial or private travel. Firstly, airplanes offer fast travel and can cover long distances quickly, making them an ideal option for those with time constraints. They also facilitate access to different destinations worldwide and provide fast and efficient transport between different countries. However, airplanes usually operate based on airports and must take off and land at a specific airport. Finally, aircraft offer a wide choice of routes and allow travel on different routes, facilitating access to many airports.

When compared in terms of the principle of combinability/divisibility;

Caravans generally have the ability to be combined or divided, and in certain situations they can be broken down into smaller parts or multiple caravans can be put together. Firstly, some caravan models are sold as a set of

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multiple parts and can be combined and used as needed. This feature can be an ideal option for large groups. Also, some caravan models allow certain sections to be removed or replaced. For example, the bedroom section at the rear can be removed or replaced. In addition, some caravan models have expandable construction and can be used to extend the interior space further when required. For example, a sunroof or side walls can provide extra living space. Finally, large groups or families can come together to form caravan convoys, which can be a fun option for traveling with friends or family members. Yachts can also be assembled or disassembled, but usually in a more limited way and under certain conditions. For example, some yacht models can be broken down into smaller parts or transported in certain circumstances. As an example of this, some catamaran yachts can be split into two parts and transported. Also, some custom yachts may have a modular structure and certain sections can be removed or replaced. For example, a deck area or cabin section can be modified modularly. Yachts can also come together to form yacht convoys, which is an enjoyable way to be with friends or family members while traveling at sea. Last but not least, some yachts can be joined or combined in certain circumstances. For example, in a particular harbor, yachts can come together to form a larger accommodation area. Aircraft generally do not have the ability to be combined or divided, but in certain situations they can be configured in different ways. For example, private jets may have a modular structure of their interiors and certain sections may be removed or replaced. A business jet may offer a modular interior arrangement, such as a meeting room or a relaxation area. Furthermore, in certain situations an aircraft can be used as if it were of a combinable structure. For example, interior arrangements can be changed for a specific group or organization on a charter flight, or different configurations can be created on board. Private aircraft can have interior arrangements specially designed for VIP customers and certain sections can be removed or replaced. Furthermore, aircraft can be disassembled for repair or maintenance after a certain period of time. This ensures the longevity of the aircraft and ensures their safe operation.

When compared in terms of the principle of multipurpose use;

Caravans are flexible regarding multi-purpose use and can be used according to different needs. Firstly, they can be used primarily for camping, offering portable accommodation and living space for those who want to spend time in nature. They are also ideal for traveling, offering accommodation inside, making them an ideal option for taking a break or spending the night on long journeys. Some caravan models can be used to transport goods or equipment, they are handy for transporting supplies for outdoor activities or sports activities. Today, many people use their caravans as mobile offices, providing internet access and workspace, making them an ideal option for working remotely. Finally, some caravan models can be used as additional accommodation for guests, offering more privacy and independence to hosts and guests by providing accommodation outside the home. Yachts are flexible regarding multi-purpose use and offer an ideal environment for different activities. Primarily, they are preferred for a luxurious holiday experience and offer an ideal option for traveling on sea routes, often with beautiful scenery. They are also suitable for spending fun time with friends or family members. They provide a pleasant environment by offering many facilities such as sun decks, water sports equipment and entertainment systems. Some yachts are specially designed for fishing activities and offer an ideal option for fishing enthusiasts. There are also yachts that offer a suitable environment for diving activities. Equipped with unique diving platforms and equipment, these yachts are perfect for exploring the world under the sea. Finally, yachts can be chartered for special events and parties. They provide a spacious and comfortable venue and offer an unforgettable experience with sea views. Aircraft can be used for various purposes, although they have certain limitations regarding multipurpose use. Firstly, they are often preferred for long-distance travel. Commercial or private flights are used to reach different destinations around the world quickly and efficiently. Business jets are ideal for business travel, enabling business meetings or client visits with special interior arrangements and comfortable seats. In emergencies, ambulance aircraft are used to provide emergency medical assistance and play a life-saving role by quickly transporting patients from one place to another. Cargo aircraft enable the rapid transport of large quantities of cargo and are ideal for transporting commercial supplies or emergency medical equipment. Finally, some particular aircraft can be used for tourist flights. They offer tourists the opportunity to see a city or region from the air and provide an unforgettable experience.

Table 3. Comparison of selected mobile spaces according to flexibility principles (Prepared by Author)

CLASSIFICATION OF MOBILE SPACES ACCORDING TO THEIR ENVIRONMENT				
ENVIRONMENTS AND SELECTED MOBILE SPACES		ON LAND	ON THE WATER	ABOVE AIR
		Caravan	Yacht	Airplane
FLEXIBILITY PRINCIPLES	Modularity Principle	<ul style="list-style-type: none"> • Interior Layout • External Equipment • Ceiling and Wall Structure • Sleep Regulations • Storage Areas 	<ul style="list-style-type: none"> • Cabin Arrangements • Deck Areas • Boat Dimensions • Water Sports Equipment 	<ul style="list-style-type: none"> • Seat Arrangements • Cargo Areas • Interior Decoration • Cabin Sections
	Neutral Spaces Principle	<ul style="list-style-type: none"> • Living Spaces • Storage Areas • Outdoor Spaces • Expandable Spaces 	<ul style="list-style-type: none"> • Deck Areas • Hall and Cabins • Water Sports Areas • Outdoor Activities 	<ul style="list-style-type: none"> • Cabin Space • Cargo Department • Rest and Food and Beverage • Working Areas
	Different Plan Types Principle	<ul style="list-style-type: none"> • Single Plans • Double Plans • Family Plans • Semi-Modular Plans • Open Plans 	<ul style="list-style-type: none"> • Small Boat Plans • Medium Yacht Plans • Luxury Mega Yacht Plans • Katamaran Plans 	<ul style="list-style-type: none"> • Economy Class Plans • Work Class Plans • First Class Plans • Private Plane Plans
	The Addition /Subtraction Principle	<ul style="list-style-type: none"> • External Equipment • Internal Regulation • Storage Areas • External Traces 	<ul style="list-style-type: none"> • Deck Equipment • Water Sports Equipment • Cabin Furniture • Storage Areas 	<ul style="list-style-type: none"> • Seat Arrangements • Cargo Sections • Interior Decoration • Extra Equipment
	The Mobility Principle	<ul style="list-style-type: none"> • Ability to Move on Your Own • Accommodation during the journey • Access to Various Locations • Flexible Parking Lot Selection 	<ul style="list-style-type: none"> • Ability to Travel the Seas • Luxury Accommodation • Access to Different Routes • Private Beach Access 	<ul style="list-style-type: none"> • Fast Transportation • Access to Long Distances • Connectivity to Airports • Wide Route Selection
	The Combinability /Divisibility Principle	<ul style="list-style-type: none"> • Caravan Sets • Removable Partitions • Expandable Caravans • Caravan Convoys 	<ul style="list-style-type: none"> • Divisible Yachts • Modular Yachts • Yacht Convoys • Combinable Yachts 	<ul style="list-style-type: none"> • Modular Interior Organization • Charter Flights • VIP Configurations • Repair and Maintenance
	The Multi-Purpose Use Principle	<ul style="list-style-type: none"> • Camping • Journey • Transportation • Mobile Office • Guest House 	<ul style="list-style-type: none"> • Holiday • Fishing • Diving • Events and Parties 	<ul style="list-style-type: none"> • Travel • Emergency Situations • Cargo Transportation • Touristic Flights

As a result; caravans, yachts and airplanes differ in terms of different levels of modularity, neutral spaces, add/remove features, mobility and versatility. Caravans generally have the highest levels of modularity and versatility, while yachts offer moderate modularity and neutral spaces. Airplanes, on the other hand, come with a more limited modularity and their neutral areas are less flexible. Each means of transport can be customized according to users' needs and preferences, thus providing a personalized experience. However, each means of transportation is designed for different purposes and responds to different usage scenarios. Caravans are generally preferred for travel and accommodation on land, while yachts are ideal for luxury vacation and leisure at sea. Airplanes, on the other hand, are used for fast and long-distance travel and serve different purposes such as business trips, emergencies and tourist flights (Table 3).

Evaluation(Comparison)of Mobile Spaces in terms of Design Principles

Mobile spaces are becoming increasingly popular and versatile structures that can be used for different purposes. They are preferred for their portability, flexibility and adaptability to various usage scenarios. The design of mobile spaces is shaped by taking into account a number of principles. These principles are given in the table below (Table 4).

Table 4. Design criteria of mobile spaces (Prepared by Author)

DESIGN PRINCIPLES	EXPLANATIONS
Mobility	Mobile spaces should be portable from one specific location to another. This includes using lightweight materials, foldable structures and ease of transportation.
Durability	Mobile venues must be durable as they are subject to frequent transportation and use. Sturdy structures, impact-resistant materials and reinforced connection points ensure long-lasting use.
Usability	The interior layout and arrangement of the space should suit the needs of the users. Easily accessible storage areas, comfortable seating arrangements and functional kitchen and bathroom areas are essential for usability.
Flexibility	Mobile spaces should be flexible to adapt to different needs and usage scenarios. Modular furniture, foldable equipment and convertible spaces allow the space to be used for different purposes.
Security	Mobile spaces should be designed for the safety of users. Elements such as fire safety, theft prevention, emergency exits and safe electrical and gas installations ensure a safe use.
Comfort	It is essential that users have a cozy and comfortable experience. Well-insulated interiors, climate control systems and ergonomic furniture ensure a comfortable living space.
Environmental Sensitivity	It is important to minimize environmental impacts during the design of mobile spaces. The use of sustainable materials, energy efficiency and waste management are important for environmental sensitivity.

These criteria form the basis for designing mobile spaces effectively and meeting the needs of users. Each principle ensures that the space is user-friendly, safe and functional. The principle of flexibility is fundamental because mobility and diversity of use are the primary purpose of these spaces. In order to respond to people's changing needs, flexibility expands the usefulness and range of uses of mobile spaces. Therefore, ensuring flexibility at the design stage allows users to make the most of the space and adapt to their changing needs. For example, a living room can be instantly transformed into a bedroom thanks to modular furniture, or the function of the space can be easily changed thanks to folding equipment. Flexibility is therefore critical in the design of mobile spaces and is a crucial focus of the design. When we consider these design criteria for caravans, yachts and airplanes determined within the scope of the study;

1. **Portability:** Caravans are often characterized by their portability when traveling overland. Small and medium-sized caravans can be towed by most standard vehicles and can be used in various terrain conditions. Yachts usually travel on water and are dependent on a specific water environment. Large yachts can be moved from port to port, but this is more difficult and costly. Airplanes travel in the air and have the highest level of mobility, are fast and can cover long distances quickly.
2. **Durability:** Caravans are usually built from durable materials and can withstand various weather conditions. Yachts are designed to withstand seawater and salt air and are built with materials suitable for long-term use. Airplanes are subjected to high engineering standards and strict safety controls, so they are usually durable.
3. **Usability:** Caravans usually have a user-friendly design and offer the comforts of a home. However, some models may have handling difficulties due to limited space. Yachts are easy to operate if operated by experienced staff, but the learning curve can be steeper for those without maritime experience. Airplanes have complex systems and are operated by professional pilots, so they are more difficult for ordinary users to operate.
4. **Flexibility:** Caravans are usually modular and can be easily configured according to different needs. Yachts are also flexible in terms of modularity, but not as modular as caravans. Airplanes typically have a fixed structure and are less flexible than caravans and yachts.
5. **Security:** Caravans generally offer a safe living space, but are less protected against external threats while traveling. Yachts provide a safe environment at sea, but can be more vulnerable to external factors such as bad weather. Airplanes are equipped with strict security protocols and provide high safety during flight.
6. **Comfort:** Motorhomes generally offer comfortable living spaces, but comfort levels can vary depending on space and equipment. Yachts provide luxurious and comfortable accommodations, huge yachts. Airplanes offer comfortable travel in a limited space, but higher levels of comfort can be provided in first- and business-class cabins.
7. **Environmental Sensitivity:** Caravans are generally environmentally friendly because they can use self-sufficient energy sources and have a lower carbon footprint. Yachts can also be environmentally friendly, but some large yachts and luxury yachts use fossil fuels, which damage the environment.

As a result, caravans, yachts and airplanes offer different advantages and features in terms of design criteria of mobile spaces such as portability, durability, usability, flexibility, safety, comfort and environmental sensitivity.

Conclusions

The In this study, we see that even though people have shifted to a sedentary lifestyle over time, the need for mobility to meet personal needs has continued. This has found expression in the concept of mobile living and has led to the emergence of various mobile spaces. These spaces have provided a wide range of benefits from shelter to travel. Various factors have played a role in the positioning of mobile spaces and design criteria have included elements such as portability, durability and flexibility. In addition, flexibility in the design of mobile spaces has been critical to adapt to user needs and changing lifestyles. As a result, the importance of flexibility in the design process of mobile spaces has been emphasized and it has been revealed that it can play an important role in determining future designs and lifestyles. The development of future mobile spaces may provide a more comfortable, eco-friendly, functional and personalized experience through a combination of factors such as technological integration, sustainability and environmental friendliness, modular design and personalization, community and sharing economy, health and well-being-oriented design, space utilization and efficiency. The use of advanced technology and smart systems can enhance the user experience, while environmentally friendly practices and a shift to sustainable energy sources can reduce the ecological impact of mobile spaces. Modular design and personalization allow users to adapt and customize spaces according to their needs, while community and sharing economy can provide economic benefits. Health and wellbeing-oriented design can better respond to users' health needs, while space utilization and efficiency can optimize the interior design of mobile spaces and increase their usable area. These developments could lead to significant changes in the travel and hospitality industry and increase the social and economic impact of mobile places, providing a foundation for future research.

Figure 5. Simulation across 100 iterations (Developed by Author).

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Conflict of Interests

The author declares no conflict of interest.

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