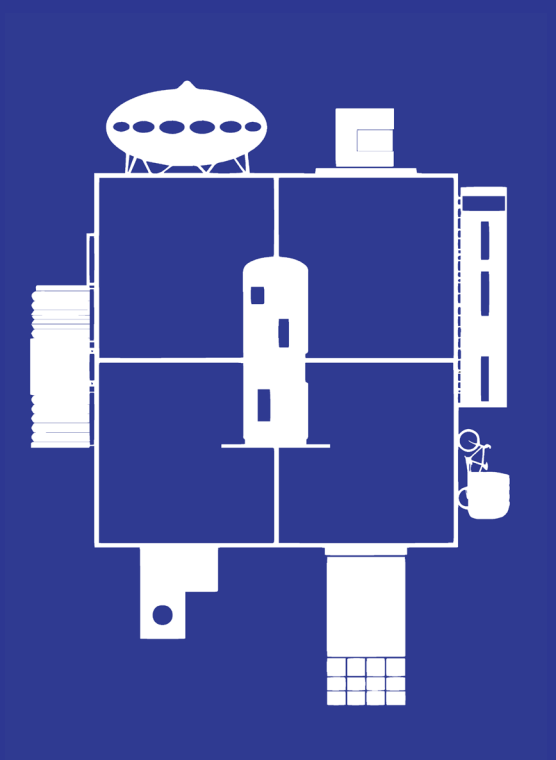
MEF University
Graduate School of Science and Engineering
Master of Science in Architectural Design
Alternative Architectural Practices

Changing Ideals Continuing Visions: Prefabricated Micro Living Unit Experiments from 1960s-1970s and 2000s-2010s



Sare Sena Hut
2023

GCRIS

I would like to thank my thesis advisor, Prof. Dr Şebnem Yücel for her precious support, guidance and criticism during the research process. Additionally, I would like to express my gratitude to Oral Göktaş, the AAP project coordinator, for his support and guidance, and to the AAP student team for their valuable contribution to the development of Volu-te and for working together as a stronger team.

Also, I would like to thank my family regarding their unconditional love: my mom Meliha Hut, my father Faysal İbrahim Hut and my Sister Seher Naz Hut. Furthermore, I would like to thank my closest friends for their moral support: Ayça Topaloğlu, Ece Gün, İrem Cerrahoğlu, Burak Dinç and Berk Özdemir.

GCRIS

Abstract

In this research, prefabricated micro living unit experiments are examined over two historical periods, 1960s-1970s and 2000s-2010s. The aim of the study is to reveal the different motivations that resulted with a common production on the same housing typology in the context of socio-economic, technological developments and popular culture. In addition to questioning whether the productions in the 1960s-1970s did turn into a common housing typology in their period or not, questioning the successful and unsuccessful aspects of these projects as well as identifying continuities and changes in the 2000s-2010s form the basis of this research. One of the aims is to reveal what role 1960s-1970s productions played in the 2000s-2010s. In order to achieve this aim, first of all, the historical development of prefabricated and micro living units was examined separately and the emergence of prefabricated micro living units as a housing typology was examined. Later, in chapter two the dynamics of the two historical periods are addressed separately through socio-economic, technological developments and popular culture and case studies of each period are introduced. Continuing visions and changing ideals between two historical periods spanning 1960s-1970s and 2000s-2010s are examined in chapters three and four. And finally, Volu-te, a prefabricated micro living unit developed under the Alternative Architectural Practices master's program, is located within the context of prefabricated micro living units in the 2000s-2010s.

Key Words: Micro Living, Prefabrication, Radical, Capsule, Compact, Small-Scale, Future

Science Code: 80107

GCRIS

Özet

Bu araştırmada prefabrike mikro yaşam üniteleri deneyleri 1960-1970'ler ve 2000-2010'lar olmak üzere iki tarihsel periyot üzerinden irdelenmektedir. Çalışmanın amacı aynı konut tipolojisi üzerinden ortak bir üretim yapılmasına neden olan farklı motivasyonları: sosyo-ekonomik, teknolojik gelişmeler ve popüler kültür bağlamında neler olduğunu ortaya çıkarmaktır. 1960'lı-1970'li yıllardaki üretimlerin kendi dönemlerinde ortak bir konut tipolojisine dönüşüp dönüşmediğinin sorgulanmasının yanı sıra, bu projelerin başarılı ve başarısız yönlerinin sorgulanması, 2000'li-2010'lu yıllardaki sürekliliklerin ve değişimlerin tespit edilmesi araştırmaların temelini oluşturmaktadır. Amaçlardan biri de 1960-1970'lerdeki yapımların 2000'li-2010'lu yıllarda nasıl bir rol oynadığını ortaya koymaktır. Bu amacı gerçekleştirmek adına öncelikle prefabrikasyon ve mikro yaşam ünitelerinin tarihsel gelişimi ayrı ayrı incelenmiş ve konut tipolojisi olarak prefabrike mikro yaşam ünitelerinin ortaya çıkışı mercek altına alınmıştır. İkinci kısımda iki tarihsel periyodun ayrı ayrı sosyo-ekonomik, teknolojik gelişmeler ve popüler kültür üzerinden dinamikleri açığa çıkarılmıştır ve her döneme ait vaka çalışmaları tanıtılmıştır. 1960-1970'ler ve 2000-2010'ları kapsayan iki tarihsel periyot arasında devam eden vizyonlar ve değişen idealler olarak üçüncü ve dördüncü kısımlarda mercek altına alınmıştır. Ve son olarak Alternatif Mimarlık Pratikleri yüksek lisansı altında geliştirilmiş olan prefabrike mikro yaşam ünitesi olan Volu-te'ün 2000'ler-2010'larda konumu üçüncü ve dördüncü kısımlarda incelenmiş olan, değişen idealler ve devam eden vizyonlar üzerinden irdelenmiştir.

Anahtar Kelimeler: Mikro Yaşam, Prefabrike, Radikal, Kapsül, Kompakt, Küçük Ölçek, Gelecek

Table of Contents

LIST OF TABLES.....V
LIST OF FIGURES.....XI
INTRODUCTION.....1
CHAPTER 1: BACKGROUND STUDY OF PREFABRICATED AND MICRO LIVING UNTS.....7
1.1 Evolution of Prefabrication.....7
1.1.a. Historical Evolution of Singular Prefabricated Living Units.....9
1.1.b. Evolution of Prefabrication in Turkey.....15
1.2. Evolution of Micro Living Unit.....19
1.2.a. CIAM II and Existenzminimum.....19
1.2.b. Capsule Living Units.....21
1.2.b. Micro Living Units.....22
CHAPTER:2 CONTEXTUAL BACKGROUND AND CASE STUDIES.....25
2.1. Contextual Background of 1960's-1970s.....25
2.1.a. Socio-Economic Dynamics.....26
2.1.b. Technological Developments.....26
2.1.c. Popular Culture.....27
2.2. Case Studies of 1960's-1970s.....28
2.2.a. Futuro House by Matti Suuronen.....28
2.2.b. Mobile House by Alberto Roselli.....30

2.2.c. Nakagin Capsule Tower by Kisho Kurokawa....32
2.3. Contextual Background of 2000s-2010s....34
2.3.a. Socio-Economic Dynamics....34
2.3.b. Technological Developments....35
2.3.c. Popular Culture....35
2.4. Case Studies of 2000s-2010s....36
2.4.a. Tricycle House by People's Architecture Ofice and People's Industrial Design Office....36
2.4.b. Tikku House by Marco Casagrande..38
2.4.c. Micro Compact Home by Richard Horden....40
2.4.d. Mobile Dwelling Unit by Lot-Ek....41
CHAPTER 3: CHANGING IDEALS....45
3.1. 1960s-1970s: Will to Produce to Future....45
3.1.a Technology Driven Productions and Space Race....46
3.1.b. New Life Order For the Future....47
3.2. 2000s-2010s: Saving the Day....51
3.2.a. Megacities and Demographic Shifts....51
3.2.b. New Life Order for the Present....54
CHAPTER 4: CONTINUING VISIONS....59
4.1. Interplay Between Mobility and Prefabricated Micro Living Units....59

4.2. Relationship Between
Spatial Configuration and Envisaged Lifestyle.....61
4.2.a. Common Features of the Spatial Configuration in the Prefabricated Micro Living Units.....61
4.2.b. Function Distribution in Spatial Configuration.....67
4.2.b.1. Cooking Zone.....68
4.2.b.2. Cleaning Zone.....69
4.2.b.3. Sleeping Zone.....70
4.2.b.4. Working and Eating Zone....72
4.2.b.5. Storage Zone.....73
CHAPTER 5: LOCATING VOLU-TE WITHIN THE CONTEXT OF PREFABRICATED MICRO LIVING UNIT EXPERIMENTS.....75
5.1. Locating Volu-te within the 2000s Case Studies.....76
5.2. Spatial Configuration of the Volu-te.....85
5.2.a. Common Features with 2000s-2010s Prefabricated Micro Living Units.....85
5.2.b. Function Distribution in the Volute.....88
5.2.b.1. Cooking Zone.....89
5.2.b.2. Cleaning Zone.....89
5.2.b.3. Storage Zone.....90
5.2.b.4. Sleeping Zone.....90
5.2.b.5. Working and Eating Zone....90
CONCLUSION.....93

REFERENCES 97

GCRIS

List of Figures

Figure 1 - Emergence of the Prefabricated Micro Living Units in 1960s-1970s and in the 2000s-2010s.....1
Figure 2 - One of the Pages from Aladdin Homes Catalog.....9
Figure 3 - One of the Pages from Sears Modern Homes Fall 1914 - Spring 1915 Catalog.....10
Figure 4 - 3D Model of the Dymaxion House.....12
Figure 5 - Dymaxion House issued in Fortune Magazine.....13
Figure 6 - Wichita House 13
Figure 7 - Case Study House No:8.....14
Figure 8 - Monsanto House of the Future.....14
Figure 9 - 6x6 Demountable House.....15
Figure 10 - Ereğli Iron and Steel Factory Lodgements.....16
Figure 11 - Portable Camp Houses.....17
Figure 12 - Dome Shelters.....17
Figure 13 - Different Mooble House Modules.....18
Figure 14 - Employment of Plastic.....27
Figure 15 - Djinn Chair by Olivier Mourgue and Saarinen Coffee Tables by Eero Saarinen.....27
Figure 16 - Futuro House.....28
Figure 17 - Plan and Section Drawings of Futuro House.....28

Figure 18 - Futuro House Transported with Helicopter.....29
Figure 19 - Transportation scenarios of the Futuro House.....29
Figure 20 - Mobile House.....30
Figure 21 - Plan and Section Drawings of Mobile House.....31
Figure 22 - Transportation scenarios of Mobil House.....31
Figure 23 - Nakagin Capsule Tower.....32
Figure 24 - Plan and Section Drawings of Nakagin Capsule Tower.....33
Figure 25 - Transportation scenarios of Nakagin Capsule Tower's Living Units.....33
Figure 26- Tricycle House.....36
Figure 27 - Plan and Section Drawings of Tricycle House.....37
Figure 28 - Transportation scenarios of Tricycle House.....38
Figure 29 - Tikku House.....38
Figure 30 - Plan and Section Drawings of the Tikku House.....39
Figure 31 - Transportation scenarios of Tikku House.....40
Figure 32 - Micro Compact Home.....40
Figure 33 - Plan and Section Drawings of Micro Compact Home.....40
Figure 34 - Transportation scenarios of Micro Compact Home.....41

Figure 35 - Mobile Dwelling Unit.....41
Figure 36 -Plan and Section Drawings of Mobile Dwelling Unit.....42
Figure 37 - MDU Harbors.....43
Figure 38 - Transportation scenarios of Mobile Dwelling Unit.....43
Figure 39 -Flying Saucer resemblance of the Futuro House within the Doors and Form.....46
Figure 40 - Tricycle House on the move.....53
Figure 41 - Crane depiction in the MDU Harbors.....60
Figure 42 - Common Features of the Spatial Configuration in the Prefabricated Micro Living Units.....62
Figure 43 - Utilization of different levels in Micro Compact Home.....62
Figure 44 - Inner Shell and Spatial Configuration Relationship in the Futuro House.....63
Figure 45 -Interior of the Tikku House with Conventional Furnishings.....64
Figure 46 - Convertible Furnishings according to Functions in the Tricycle House.....65
Figure 47 - Movement and Repose in Mobile House.....65
Figure 48 - Customizable Red Interior Color Scheme of the Futuro House.....66
Figure 49 - Customizable Blue Interior Color Scheme of the Futuro House.....66
Figure 50 - Customizable Violet Interior Color Scheme of the Futuro House.....66

Figure 51 - Representation of Customization Option for Mobile Dwelling Unit.....66
Figure 52 - Utilization of Technological Equipments in Nakagin Capsule Tower.....67
Figure 53 - Utilization of Technological Equipments in Mobile Dwelling Unit.....67
Figure 54 - Function Distribution in the 1960s Case Studies.....67
Figure 55 - Function Distribution in the 2000s Case Studies.....68
Figure 56 - Cooking Zone in the Futuro House.....69
Figure 57 - Cooking Zone in the Mobile House.....69
Figure 58 - Cooking Zone in the Mobile House.....69
Figure 59 - Cooking Zone in the Micro Compact Home.....69
Figure 60 - Tricycle House Cleaning Zone.....69
Figure 61 - Nakagin Capsule Tower Cleaning Zone.....70
Figure 62 - Openable Bunk bed in Micro Compact Home.....70
Figure 63 - Convertible Sleeping Zone in Tricycle House.....71
Figure 64 - Sleeping area in Nakagin Capsule Tower.....71
Figure 65 - Re-positioned sitting elements in the Futuro House.....72
Figure 66 - Foldable Sofa with stacked Mattresses in Mobile House.....72

Figure 67 - Working and Eating Zone in Micro Compact Home....73
Figure 68 - Working and Eating Zone in Micro Compact Home....73
Figure 69 - Working and Eating Zone in Tricycle House....73
Figure 70 - Working and Eating Zone in Nakagin Capsule Tower....73
Figure 71 - Storage Space that convertible to Table/ Bed Unit in Tricycle House....73
Figure 72 - AAP-Small Scale Decent Change Research Book and AAP-Volu-te Design Guidebook....75
Figure 73 - Volu-te....76
Figure 74 - Volu-te Plan....77
Figure 75 - Built Prototype of the Volu-te....80
Figure 76 - Transportation Scenarios of the Volu-te....81
Figure 77 - Volu-te Application....82
Figure 78 - Cycles of Volu-te....83
Figure 79 - Mobility Scnerios of Volu-te....85
Figure 80 - Conceptual Diagrams.... 86
Figure 81 - Volu-te usage scenarios....87
Figure 82 - Spatial Configuration of the Volu-te....88
Figure 83 - Cooking Zone....88
Figure 84 - Cleaning Zone....88
Figure 85 - Storage Zone....89
Figure 86 - Sleeping Zone....89
Figure 87 - Working and Eating Zones....90

Figure 88 - Function Distribution in the Volu-te.....90

Introduction

Volu-te was a prefabricated micro living unit experiment that was designed and built during the Alternative Architectural Practices (AAP) master program at MEF University. The program consisted of four parts: research, prototype, make and write. The research process of the Volu-te has sparked numerous questions in my mind regarding prefabrication and micro living units, as well as gave me an aspiration to gain deeper understanding of the historical evolution of prefabricated micro living units.

Throughout the design process, it became evident that prefabricated micro living units had already emerged as an alternative living unit typology in the 1960s-1970s, despite the differences in their circumstances and ideals from the 2000s-2010s. Yet, experimental prefabricated micro living unit experiments from the 1960s-1970s frequently faced criticism for their failure to be popularized and for their overly idealistic, utopian and futuristic aspirations. However, despite the 20 year gap, we witnessed a revival of a similar housing typology in the 2000's, characterized by similar features. [Figure 1]

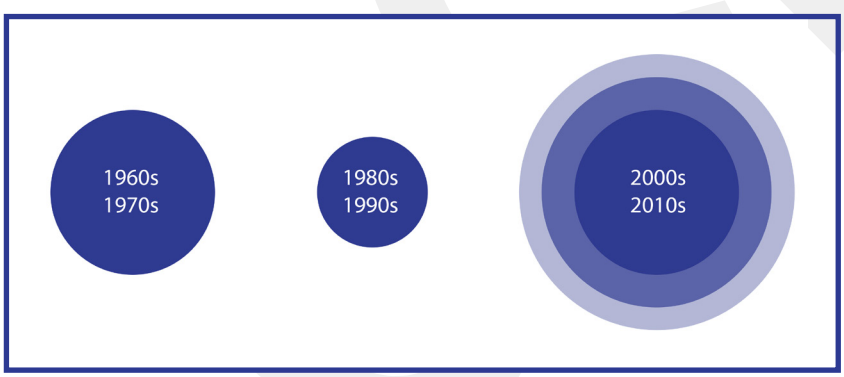


Figure 1: Emergence of the Prefabricated Micro Living Units in 1960s-1970s and in the 2000s-2010s(Drawn by Author)

Thus, while the socio-economic conditions, the reception of technological developments and adopted life scenarios of the two periods differed greatly, similar living unit typologies emerged in parallel with each other. For example, while in the sixties Neil Armstrong's quote regarding his first steps on the moon, "that's one small step for man, one giant leap for mankind"[1] highlighted how space studies and technological advances have been received and elevated expectations for the future, in the 2000s-2010s

1. Olivia B. Waxman, "Lots of People Have Theories About Neil Armstrong's 'One Small Step for Man' Quote. Here's What We Really Know," Time Magazine, July 15, 2019,https://time.com/5621999/neil-armstrong-quote/

technological developments became rather mundane as people have struggled with diverse issues including economic crises, environmental concerns, urban density and more.

This realization led me to question: “Despite the frequent criticism of the prefabricated micro living experiments of the 1960s-1970s, are there any influences from this period evident in today’s revivals?” In this context, the main research question of this thesis originated from this realization: “What are the changing ideals and continuing visions observed during the 1960s-1970s and the 2000s-2010s?”

To map changing ideals and continuing visions, the discussion was supported by sub-questions. These sub-questions can be listed as follows:

- How did different historical contexts lead to similar productions in prefabricated micro living units?
- Which keywords were prominent in corresponding periods?
- Which keywords have gone through changes in meaning or disappeared over time?
- What new keywords have emerged since the 2000s-2010s?
- How does Volu-te fit within the context of prefabricated micro living units?

To gain a deeper understanding of the contextual background of each of the two distinct periods, data were collected from history books, period movies, novels, and blog sites. These mediums allowed for the comprehension and identification of the socio-economic dynamics and popular culture specific to each period, as reflected in daily life and the current environment up to the present day. Furthermore, these collected data assisted in tracing prominent keywords and their contextual background, especially in cases where they were used repetitively.

To understand the changing ideals and continuing visions, case studies were selected belonging to each period, 1960s-1970s and 2000s 2010s. The selection of each case study is based on its ability to represent the period to which it belongs. To achieve this goal, case studies from different geographic locations and historical contexts were chosen. Furthermore, priority was given to selecting case studies that were documented by their designers throughout the books, articles etc., as well as those that have been subject to academic analyses and productions about them by diverse scholars. Thus, in addition to the documentation provided by the designers of the case studies, the discussions surrounding these case studies were also examined

and elaborated upon throughout this dissertation. Data belonging to case studies were collected from architectural office websites, books, interviews, videos, academic journals, master's theses, exhibition catalogs, and architectural periodicals. One of the priorities was to access sources that included the designers of the case studies' academic documentation, books, and interviews. This approach also assisted in understanding the direct motivations and agendas of the designers that catalyzed the period's prefabricated micro-living unit experiments.The selected case studies for the 1960s include Futuro House by Matti Suuronen, Mobile House by Alberto Roselli, and Nakagin Capsule Tower by Kisho Kurokawa. The second period covers four case studies between 2000s-2010s, listed as: Micro Compact Home (m-ch) by Richard Horden, Tikku House by Marco Casagrande and Casagrande Laboratory, Mobile Dwelling Unit (MDU) and MDU Harbor by Lot-Ek, and finally Tricycle House by People's Architecture Office and People's Industrial Design Office.

Collected data were analyzed through juxtaposition and comparison, to identify patterns as well as display the differences between two distinct periods: the 1960s-1970s and the 2000s-2010s. Keywords and phrases belonging to each period were identified, including prefabrication, micro, radical, capsule, future, compact, etc. Furthermore, to visualize collected data to assist in the analysis process; additional illustrations, tables and plan, section drawings of the selected case studies were drawn. These visuals provided a visual representation to the main discussion.

In the "Background Study of Prefabricated and Micro Living Units" chapter, there was an investigation of individual evolution of the prefabrication and micro living units to understand the timeline and define the crucial moments that later led to the emergence of prefabricated micro living units. This study focused on two periods of prefabricated micro living unit experiments spanning from the 1960s-1970s to the 2000s-2010s.

The "Contextual Background and Case Studies" Chapter review each period based on their socio-economic, technological backgrounds as well as the popular culture during this period. Following these discussions case studies are introduced. The discussion of the contextual background was focused on introducing the changing ideals and continuing visions throughout the two periods. The "Changing Ideals" chapter examined and compared the case studies in their historical and sociological contexts, analyzing the motives behind the emergence of prefabricated micro-living units. The "Continuing

Visions" chapter, on the other hand, examined the shared characteristics of prefabricated micro living units, despite the diverse motives behind their emergence in each historical period. In addition to common features such as their small scale and production methods, this chapter investigated mobility-oriented features and spatial configuration arrangements of prefabricated micro living units in both historical periods. The final chapter, "Locating Volu-te Within the Context of Prefabricated Micro Dwelling Experiments," situates Volu-te among the case studies of the 2000s-2010s based on the continuing visions and changing ideals discussed in chapters three and four.

Therefore, the primary objective of this thesis was to provide a deeper understanding of prefabricated micro living unit experiments through a comparative analysis of two distinct historical periods. To accomplish this aim, in addition to the background studies, the thesis was structured in two main parts. The first part was focused on identifying persistent and sustained characteristics of the prefabricated micro living units while the second one discussed the differences between two historical periods regarding the prefabricated micro living unit experiments. Finally, in addition to the aim of gaining a comprehensive understanding of prefabricated micro living units, this research was directed towards positioning Volu-te, a prefabricated micro living experiment from MEF University, where I took an active role in the research, design and production processes of it.

GCRIS

Background Study of Prefabricated and Micro Living Units

01

In this chapter, the evolution of prefabrication and small-scale living units as distinct subjects is addressed. It aims to establish foundational insights to emergence of prefabricated micro living units as a housing typology.

1.1. Evolution of Prefabrication

Within this section, technical aspects of prefabrication are introduced. According to Ryan E. Smith's definition of prefabrication, it means "the parts that have been produced and then are assembled onsite." [2] Prefabrication employs various pros, including reducing total construction time and money, increasing precision of the end product and construction process due to the usage of digital tools. Furthermore, prefabrication provides less waste production while preventing inefficiencies in labor. The production method provides the advantage of disassembly and assembly, allowing living units to be relocated to the preferred site. Dismantled components can be transported via railroad, seaway, and airway. As another relocation technique, prefabricated components which are lightweight and flexible can be moved as a whole through diverse transportation mediums including trucks, and helicopters. The ease of relocation and intertwined mobility of prefabricated living units is one of the key advantages of prefabrication. There are constraints as well as advantages of prefabrication. In the context of transportation, there are restrictions and limitations such as maximum widths, heights, load capacities etc. There are extra expenses such as temporary bracing for transportation and lifting the product for locating to the site.

On the other hand, there was a strong connection between historical context and the technical improvements in the context of development of prefabrication. For instance, the position of prefabrication through modernist movement, explained by professor Colin Davies of London Metropolitan

2. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada: Wiley, 2010), xi

University in his book titled The Prefabricated Home as follows:

> Modernists rejected the élitism, historicism and anti-industrialism that had characterized their profession in the nineteenth century. They wanted to bring architecture to the masses and to face up to the realities of an industrial society. What better way to achieve this goal than to design houses that would be mass-produced in factories, just like Model T Fords?[3]

Thus, in the development of prefabricated living units at an industrial level, Henry Ford's Model T assembly line became a starter point. Henry Ford's Model T assembly line innovation enabled producing automobiles with lower cost and higher quality and precision with decreasing labor force and time spent in the production process.[4] Since the late 1910s, the assembly line has been widely adopted in the building industry through various initiatives.[5] Within these developments, material advancements have progressed with the parallel development of prefabrication. New materials have been introduced, and existing materials have been utilized with advanced techniques. For instance, despite plastic's invention dating back to the 19th century, large-scale production and implementation of the housing industry was widespread at the beginning of the 20th Century.[6] In her book "Transparent Plastics: Design and Technology" Simone Jeska, explained that plastic was perceived as "a symbol of a better, promising future" that would do justice to the needs of modern society in every respect."[7] Thus, the internalization of the industrial techniques led to advancements in material adaptation and production methods.

In the 2000s-2010s, prefabrication continued to be used as an alternative production method, including digital technologies, CAD/CAM and BIM manufacturing methods, in the design and fabrication processes within the scope of the introduction of new materials, along with technological developments. For instance, cross laminated timber (CLT) emerged as a material used in prefabrication in the early 90's.[8] It is made bylaminating layers of softwood timber at right angles to each other, creating a strong and stable panel that can be used for floors, walls, and roofs. CLT is a sustainable, durable, and versatile building material that is gaining popularity in the construction industry as an alternative to traditional materials. construction industry as an alternative to traditional materials. Cross laminated timber (CLT) is appealing

3. Colin Davies, The Prefabricated Home, (London: Reaktion Books, 2005), 11

4. The definition of an assembly line by the Cambridge Dictionary is "a line of machines and workers in a factory that a product moves along while it is being built or produced. Each machine or worker performs a particular job that must be finished before the product moves to the next position in the line" "Definition of Assembly Line," Cambridge Dictionary, accessed June 2023, https://dictionary.cambridge.org/dictionary/english/assembly-line

5. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002), 13

6. Simone Jeska, Transparent Plastics: Design and Technology, (Berlin: Birkhäuser, 2007), 8

7. Ibid.

8. Jelly, "A Brief History of Cross Laminated Timber Construction," Seagate Mass Timber, August 27, 2019, https://seagatemasstimber.com/a-brief-history-of-cross-laminated-timber-construction/

materials. Cross laminated timber (CLT) is appealing material with the features of fire resistance, seismic durability, faster installation and environmental consciousness.[9]

On the other hand, a new type of plastic was invented which does not require any use of fossil fuels.[10] In these newly developed materials and techniques, there was a search for sustainable approaches and their implementation.

1.1.a. Historical Evolution of Singular Prafabricated Living Units

It is possible to start a review of singular prefabricated living units with kit homes. At the beginning of the 20th century, kit home developments became prevalent as a part of the internalization of the industrial revolution.[11] A kit home is a type of prefabricated house that can be chosen from a catalog, allowing customers to select their preferred living unit and have its components delivered to the site within the instructions.[12] Pioneer companies of kit homes were Aladdin Homes and Sears Roebucks Homes in the United States. Aladdin Homes were founded in 1906 by two brothers who were motivated by the idea of implementing mass production in the housing industry.[13] Brothers believed that the housing industry can be developed like mass produced clothing with standardized sizes.[14] As seen in the catalog in Figure 2, they developed the concept of the Readi-Cut system which represents delivering pre-cut components of the housing unit. The company sold around 65.000 Readi-Cut system housing until they withdrew in 1981.[15]

Another pioneer company in creating kit homes was Sears Homes, founded in 1908 by Sears Roebucks Co. As seen in Figure 3, Sears's home stood out through the production of a variety of house types. The pricingrange was between $650 and $2500 while the listed Mail Kit pricing covered "lumber, nails, shingles, windows, doors, hardware house paint, and also instructions."[16] Sears Roebuck and Co. of Chicago sold about 100.000 homes between 1908 to 1940.[17]

Besides, in both of these examples, priority was given to creating more affordable, easily assembled systems that run with powerful marketing approaches rather than introducing a new architectural stance.[18] In

9. Andrew Moore, "5 Benefits of Building with Cross-Laminated Timber," NC State University, Collage of Natural Resources, August 1, 2022, https://cnr.ncsu.edu/news/2022/08/5-benefits-cross-laminated-timber/

10. "Koreans make plastics without fossil fuel chemicals," CNN, accessed October 2023, http://edition.cnn.com/2009/TECH/science/11/23/eco.korea.plastic/index.html

11. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada: Wiley, 2010), 9

12. Brian Potter, "The Rise and Fall of the Mail-Order Home," 11 June 2023, Construction Physics, https://www.construction-physics.com/p/the-rise-and-fall-of-the-mail-order

13. Ibid.

14. Ibid.

15. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002),14

16. Ibid.13

17. Ibid.14

18. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada,: Wiley, 2010), 10

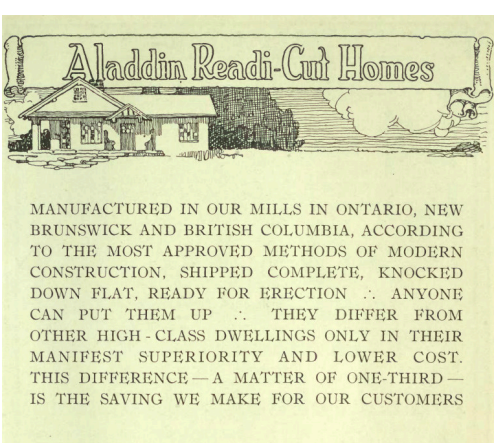


Figure 2: One of the Pages from Aladdin Homes Catalog (Source: Archdaily via https://openlibrary.org/)

their architectural style both Aladdin Homes and Sears Home did not adopt industrial aesthetics while embracing traditional housing features. As a result of the Great Depression and housing crisis in the 20's and 30's, both Aladdin Homes and Sears Home withdrew from the market.



Figure 3: One of the Pages from Sears Modern Homes Fall 1914- Spring 1915 Catalog (Source: https://archive.org/)

Howard T. Fisher founded General Houses Corporation to develop housing in the post-war housing shortage while focusing on Fordist production in 1932. The production method employed by the General Houses Corporation involved assembling "literally as an automobile."[19] Prices of the houses differed between $3000 to $4500.[20] The distinguishing feature of this initiative from Aladdin Homes and Sears Home was leaving traditional architectural forms behind while embracing the industrial aesthetics of prefabrication.[21] General Houses Corporation did not succeed in business, maybe since "Fisher's predictions about public taaste would be ultimately prove to be off the mark -Americans just weren't ready for houses straight off the assembly line" as Allison Arieff claimed in her book Prefab.[22]

A specific feature of the housing industry after World War II was about turning prefabricated housing initiatives into business models rather than producing technical developments.[23] In order to cover the urgent housing need due to destruction of the cities after World War II, there emerged private initiatives as well as government incentives. Destruction of the cities and soldiers that returned to their countries revealed the urgent need for housing in the U.S. The U.S. government has proposed many

19. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada: Wiley, 2010), 12

20. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002), 15

21. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada: Wiley, 2010), 12

22. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002), 16

23. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada: Wiley, 2010), 13

implementations that encouraged housing production. In 1946 the Veteran Emergency Housing Act (VEHA) demanded 850 000 prefabricated houses to be introduced to the market in a specified period.[24] This request led to numerous prefabricated house productions in the post-war era. Although this demand and its results were described as not reaching their full potential, it has led to the emergence of many initiatives. such as Lustron Corporation, Levittown, and Eichler Homes.[25]

Different approaches to answer the urgent need for housing have been witnessed in the post war period. For example, Lustron Corporation used the factories that were unused after the second world war to produce their steel housing units in 1948. Lustron Corporation embraced traditional features of American Housing yet the application of homes consisted of enamel steel both in exterior and interior.[26] However, due to the creation of too much waste compared to the production scale and the rise of the high-priced final housing units for the middle-income profile, only 2500 homes were built.[27]

Another project, Levittown, became prominent with successful marketing strategies in selling the American Dream in 1947. Owning a house with a private garden and parking space represented a happy and peaceful life after a period of coming out of many difficulties including World War II and the Great Depression.[28] In terms of appearance, they had very generic American suburban housing features with "small, one-and-a-half-story rectangular boxes with a pitched-tent roof, wood-sided exteriors, and classic window shutters as the only form of ornamentation."[29] Levittown provided housing for more than 80,000 people.[30] Owners of these houses were mostly soldiers who came back from WWII and their families.[31]

As an alternative solution to the need for low-cost housing, very quickly assembled living units, mobile houses took the stance. Mobile houses provided a suitable option for people who worked in diverse locations and needed temporary living spaces. The user profile of these living units included workers who constantly changed their location due to temporary jobs in various locations. These houses were assembled in the factory as a total unit and then transported to the site with the truck. The main idea was to keep wheels to maintain the mobility of the unit. However, this intention often remained in theory.[32] During World War II these homes were used as temporary living units. After World War II, these temporary units became permanent with improvements that made them bigger.[33] However, according

24. Ibid.

25. Ibid.

26. Ibid.

27. Ibid.

28. "Developing the American Dream: A Comparison of Levittown, New York and Celebration, Florida," 3, accessed June 2023, https://ats.emory.edu/_includes/documents/ARTHIST_InDesign%20Final%20Paper_example%204.pdf

29. Ibid.2

30. Ibid.

31. In the 1950's half of the residents who lived in Levittown were white (or caucasian) Catholics. Afro-Americans were not granted permission to own property in Levittown, and during the first few years, there were no Jewish residents in the community. These practices reflected the discriminatory social and cultural climate of the time. Ibid.2

32. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada: Wiley, 2010), 15

33. Ibid. 15-16

to Allisson Arieff, "mobile homes were promoted as the answer America' dire post war housing shortages but failed to deliver the domestic bliss its proponents promised."[34]

During the post war period, there were also novel productions that represented the innovative thinking and exploration of different approaches to housing rather than adapting prefabricated methods to produce rather conventional living units. As a trained architect and self-called inventor, Buckminster Fuller had many patented experiments such as the Geodesic Dome, Dymaxion House [Figure 4] and Wichita House. The main aim of the Buckminister Fuller was experimenting with mass production to develop housing units that presented "efficiency in living".[35] Dymaxion House by Buckminster Fuller which was developed for Marshall Field's Department store to exhibit furniture inside while attracting customers through spatial experience in the 1920.[36] Dymaxion was a made-up word bringing together Fuller's favorite words of dynamic, maximum and tension.[37]

Allison Arieff describes Dymaxion House in her book as "Hexagon in shape and held together using tension suspension from a central mast, the structure was a far cry from a conventional home and handily demonstrated Fuller's exhortation to "do more with less."[38] Features such as providing efficiency through transportation and assembly/disassembly processes, represented Fuller's aim to create "efficiency in living"[39] Although Dymaxion received a lot of attention from the press, including Fortune Magazine's April 1949 issue [Figure 5], it did not have many buyers.[40]

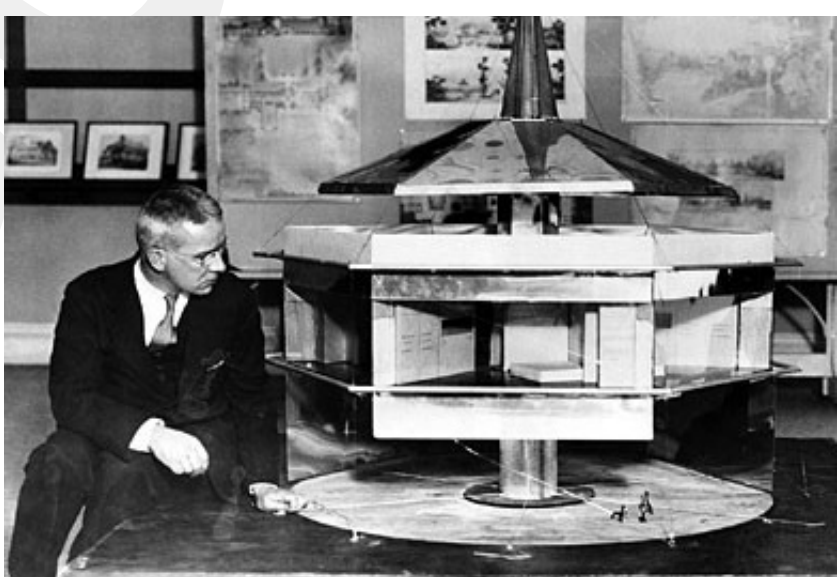


Figure 4: 3D Model of the Dymaxion House (Source: ArchDaily)

34. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002), 28
35. Ibid. 17
36. Ibid.18
37. Ibid.
38. Ibid.
39. Ibid.
40. Ibid.

Later in 1946, Fuller developed the Wichita House [Figure 6]. In his book Ryan E. Smith refers to Wichita House as a "technical marvel" due to its technical specifications with its aluminum body and within the inspiration drawn from airplane production and the rivets that provide static and structural stability. [41] One of the highlights of this design was lightness, weighing approximately 2700 kg. It could be transported by truck and assembled in 24 hours. However, although Wichita House was a prosperous work regarding the environment at a time Fuller did not allow Wichita House to become mass produced regarding that it was not ready for the long period of time.[42]

Emergence of the Case Study Houses Program shows similar patterns with other post-war experiments as a result of an urgent need for affordable housing. However, one of the distinguishing features of the Case Study Houses program was conducted by John Entanza, editor of the Arts and Architecture magazine to "pursue unprecedented experiment in modern domestic architecture."[43] Total thirty-six prototype houses were designed to be mass produced in the future by architects like Edward Killingsworth, Charles and Ray Eames, Richard Neutra for diverse customers.[44]

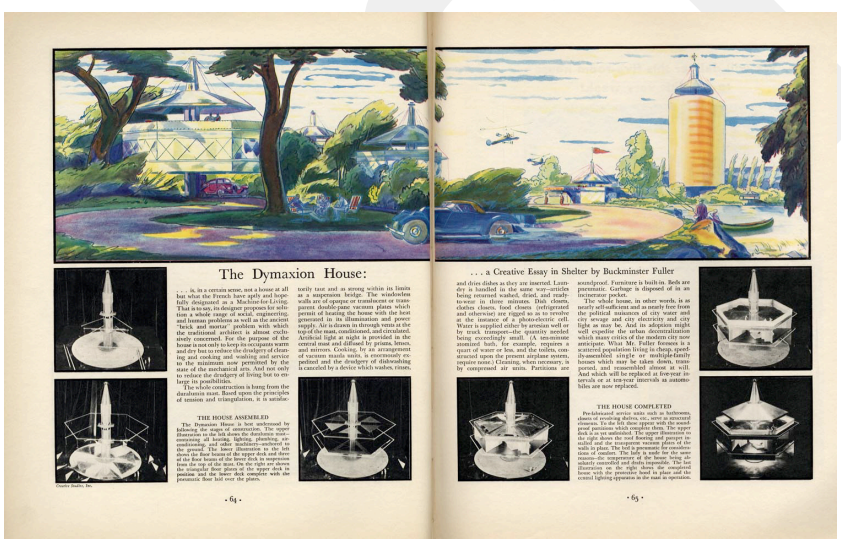


Figure 5: Dymaxion House issued in Fortune Magazine (Source: https://www.fulltable.com/)

Moreover, Allison Arieff stated that in her book Prefab, "Case Study Houses Program became the standard by which all other attempts at well-designed, affordable single-family homes were measured."[45] Also, regarding the Case Study House's success and their position in the historical trajectory, Fabian Dejtiar, an editor in Arch Daily, stated that Case Study Houses "also



Figure 6: Wichita House (Source: ArchDaily)

41. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, (Canada: Wiley, 2010), 32

42. Ibid.

43. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002), 27

44. Ibid.

45. Ibid.

46. Fabian Dejtiar, "Modern, Low-Budget and Easy to Build Living Spaces: the Case Study House Program," ArchDaily, March 29, 2021, https://www.archdaily.com/913748/case-study-houses-lessons-on-modern-low-budget-and-easy-to-build-living-spaces?ad_campaign=normal-tag

47. Ibid.

48. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002), 28

49. Lisa Scanlon, "The House of the Future That Wasn't," MIT Technology Review, January 1, 2005, https://www.technologyreview.com/2005/01/01/231834/the-house-of-the-future-that-wasnt/

50. Allison Arieff, Prefab, (Utah: Gibbs Smith, 2002), 25

51. Chlo Vadot, "Video: Explore the House of Jean Prouvé, the Pioneer of Prefabrication," Architizer, accessed June 2023, https://architizer.com/blog/inspiration/stories/video-jean-prouves-house/

52. Chlo Vadot, "Collecting Architecture: Jean Prouvé's Prefabricated Homes Around the World" Architizer, accessed June 2023, https://architizer.com/blog/practice/materials/jean-prouve-at-galerie-patrick-seguin/



Figure 7: Case Study House No:8 (Source: ArcDaily)



Figure 8: Monsanto House of the Future (Source: Docomomo US)

pioneered new construction materials and methods in residential development that continue to influence international architecture to this day."[46] Charles and Ray Eames designed Case Study House No:8 [Figure 7] for themselves. In the design process there has been research into defining a new way of living regarding the contemporary house. For instance, there is usage of open floor plan, rooms that are able to perform several rituals, and defined public and private spaces which have become pillar features of modern housing.[47] Case Study House No:8 also represents California Modernist lifestyle with an exposed steel frame construction.[48]

The Monsanto House of the Future [Figure 8] was situated in Disneyland, Anaheim, California, from 1957 to 1967. Its design resembled that of a space station, showcasing futuristic elements. The development of the Monsanto House of the Future was driven by Monsanto Chemical's exploration of plastic products for alternative markets. To achieve this goal, the company sponsored a research team from MIT to create an affordable and prefabricated house utilizing plastic as the primary material. The design process took two years and involved Marvin Goody and Richard Hamilton, both faculty members of MIT's Architecture department. Walt Disney offered to exhibit a prototype of the Monsanto House of the Future in Disneyland, where visitors were captivated by its futuristic features, including interior furnishings, fixtures, and representative colorful nylon clothing that depicted the envisioned lifestyle in the future within the house.[49] The structure comprised a central concrete space with a kitchen and bathroom, along with four glass-reinforced plastic arms where rooms were inserted, resulting in a total area of 1280 square feet.

In the meanwhile, in France, Jean Prouve, who was not a trained architect, created easily assembled projects through furniture to living units. Prouve created a system that constituted "a jointed steel structure that could be erected without scaffolding"[50] Prouve explained his approach as follows: "[The house] has been a bit thrown together, but all the different elements were fixed together without any problem because they were all part of an integrated production plan,"[51] Prouve focused on developing construction systems that can be easily assembled with a small group of people.[52] To solve the urgent need of housing after World War II, regarding the state's demand, Prouve created temporary living units in Lorraine and Franche-Comté, France. The 6x6 Demountable House [Figure 9] was sized 6 meters to 6 meters in 1944. Living units could be easily disassembled and relocated. It consists of

metal and wood prefabricated elements.[53] However, despite his aim to produce the living units on a mass scale, it was never realized.[54]

1.1.b.Evolution of Prefabrication in Turkey

The documentation of the experimentation of prefabricated housing units is dominated by initiatives from the U.S..[55] However after World War I, European countries focused on developing housing units through prefabrication due to the urgent need for housing both affordable and efficient.

Although the practice of prefabrication and the production of prefabricated housing were extensively experimented with in the U.S. and Europe since the beginning of the 20th century, it started at a later time in Turkey. As a result, there are very limited examples of prefabricated single-family housing in Turkey. Therefore, a more general prefabrication reading can be made.

Practices in prefabrication started around the 1940s with centrifugal concrete pole production in Turkey and intensified in the 1960s within industrial building productions.[56] One of the reasons why there are not many examples of the implementation of prefabrication in Turkey was the 5-year development plan designed between 1968 and 1972. In the development plan strategically crafted restrictions were introduced with the thought that it would prevent employment. Thus, in this period traditional construction techniques were encouraged. The construction of prefabricated housing, which will be shaped by technology and standardization, was prohibited unless it was considered obligatory.[57] The structures that would require the use of prefabricated construction methods were considered as educational buildings and rural sites without roads and building materials.[58] As a result, Turkey remained in the background in the context of experimentation in prefabrication in this time period, which was one of the most productive periods around the world.

The first experimentation of prefabricated living units through the prefabrication of concrete and the Large Panel System (LPS) emerged with the Ereğli Iron and Steel Factory Lodgements in 1964. Ereğli is an industrialized region with coal deposits processing, iron and steel factories, power plants

53. "Jean Prouve Architecture, 6x6 demountable House, 1944," Patrick Seguin, accessed June 2023, https://www.patrickseguin.com/en/designers/architect-jean-prouve/available-houses-jean-prouve/6x6-demountable-house-1944/

54. Chlo Vadot, "Collecting Architecture: Jean Prouvé's Prefabricated Homes Around the World" Architizer, accessed June 2023, https://architizer.com/blog/practice/materials/jean-prouve-at-galerie-patrick-seguin/

55. Burnham Kelly, The Prefabrication of Houses (New York: The Technology Press of Massachusetts Institute of Technology, John Wiley and Sons, Inc, 1951), 18

56. Melih Kurnalı, "İç Mekanda Prefabrikasyon ve Günümüz Prefabrik İç Mekan Ürünlerine Yönelik İnceleme" (Master Thesis, Hacettepe University, Ankara, 2015), 62

57. T.C. Başbakanlık D.P.T., "Kalkınma Planı – İkinci Beş yıl 1968-1972,", 286, http://www.sp.gov.tr/upload/xSPTemelBelge/files/D2PxI+plan2.pdf

58. Ibid.177



Figure 9: 6x6 Demountable House (Source: https://www.patrickseguin.com/en/)

and port activities. Due to these economic activities, the region experienced an increase in population as job opportunities arose, leading to a demand for housing.[59] In order to provide housing for people who work in Ereğli Iron and Steel Factory, a national competition was opened in 1962. The selected project belonged to Vedat Özsan, Yılmaz Tuncer, Güner Acar, Yılmaz Sanlı and the project featured the first prefabricated urban-scale living units in Turkey.[60] Moreover, in the competition entries, there were other projects that experimented with prefabricated techniques as an alternative production method. However, the Ereğli Iron and Steel Factory Lodgments [Figure 10] stands out as a unique example that successfully represents the adaptation of Fordist production principles into the realm of housing design in Turkey.[61]

Concrete has been adapted within prefabricated techniques in Turkey since 1923, aligning with the modernization agenda.[62] However, it is not possible to talk about a common usage of concrete in prefabrication in Turkey. According to Büyükyıldırım, who is an architect and researcher, these particular examples represented contemporary and innovative approaches resulting from material and production method experimentations parallel to a modern identity construction.[63]

In 1965, Portable Camping Houses were designed by Şemsi Didman. As seen in Figure 11, these houses were advertised as "prefabricated as in the U.S. and Europe" in the Hürriyet newspaper on 5th May 1965.[64] There were two size options with a single room and kitchen, and two rooms and kitchen. A total of 41 of these houses have been sold. Şemsi Didman explained this portable camping house as follows:

> For the first time in Turkey, we tend to make these kinds of living units. Users can use these living units wherever they want, including villages or landscapes. These portable houses can be easily assembled and disassembled, and we can assemble them on the required site.[65]

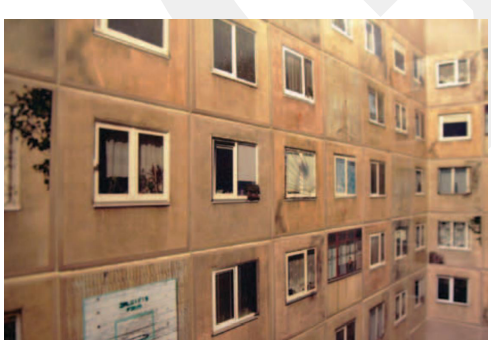


Figure 10: Ereğli Iron and Steel Factory Lodgments (Source: Nilüfer Karanfil Büyükyıldırım, "Türkiye'de Lojman Modeli: LPS* ile Konut Üretimi ve Ereğli Demir Çelik Lojmanları Örneği)

59. Nilüfer Karanfil Büyükyıldırım, "Türkiye'de Lojman Modeli: LPS* ile Konut Üretimi ve Ereğli Demir Çelik Lojmanları Örneği," Betonart, no.60, (2019): 48

60. Ibid. 49

61. Ibid

62. Ibid. 47

63. Ibid. 50

64. Abdullah Kutalmış Mızrak, "1965 yılında Türkiye'de ilk defa portatif kamp evleri satışa çıkarılmış!," Emlak Kulisi, November 28, 2014, https://emlakkulisi.com/1965-yilinda-turkiyede-ilk-defa-portatif-kamp-evleri-satisa-cikarilmis/315463

65. Ibid.



Figure 11: Portable Camp Houses (Source: https://emlak-kulisi.com/ via Hürriyet)

An exceptional example, Dome Homes [Figure 12] represented the implementation of semi-prefabricated living units. In 1970, following the Gediz Earthquake, a German chemical company donated 405 domes to those who lost their homes due to the earthquake. The company sent components, materials and technicians to the site by just a single plane.[66] The living units consisted of a simple structure and a "hemispherical inflatable formwork" for molding with polyurethane and isostynath sprayed over the "inflated PVC surface" using a single gun, outer skin is constructed, later, the "inflated PVC surface" was removed.[67] It took one hour to build one dome structure, and within a month, 405 dome structures were completed. Initially, the structures were not used, but over time, their usage increased. Furthermore, it became apparent how users adapted these structures to their own life cycles, changing their locations, and configuring village spaces during the usage process.[68]

Today, in Turkey, prefabricated practices primarily focus on the production of infrastructure components, sport complexes, and industrial buildings. According to the Turkish Construction Industry Report 2014, prefabrication has not become a common production method due to inadequate internal demand and a lack of control.[69] Despite the wide product range regarding prefabricated component productions in Turkey, there is an unfruitful environment in the context of prefabricated micro living unit productions compared to Europe and the U.S. In Turkey, prefabricated living units are often associated with post-earthquake shelters and temporary living units for immigrants.

Regardless of the listed conditions, the last decade has seen the

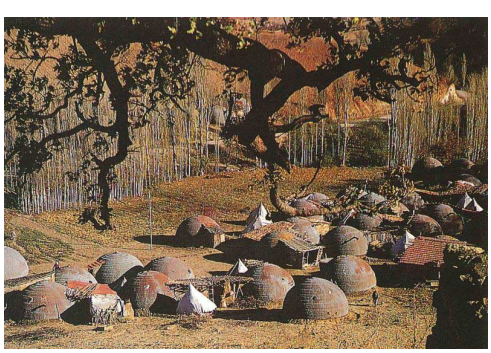


Figure 12: Dome Shelters (Source: Süha Özkan, "Turkey: Foam Domes," Mimar: Architecture in Development 8)

66. Süha Özkan, "Turkey: Foam Domes," Mimar: Architecture in Development 8, ed.Hasan-Uddin Khan., 1983, 59

67. Ibid.

68. Ömer Faruk Tekin, "Poliüretan Kubbeyi Yerelleştirmek," Arkitera, January 29, 2020 https://www.arkitera.com/gorus/poliuretan-kubbeyi-yerellestirmek/

69. Türk Yapı Sektörü Raporu, 2014, 176 quoted in "İç Mekanda Prefabrikasyon ve Günümüz Prefabrik İç Mekan Ürünlerine Yönelik İnceleme" by Melih Kurnalı, 2015, 62

emergence of prefabricated living units in Turkey. Yet, these examples have emerged as business initiatives rather than singular and experimental projects. Prominent initiatives representing prefabricated micro living in Turkey include Mooble House, Hane House, and Modsis Tiny House. These initiatives are business models designed for mass production with certain customization options. Many of them fall under the category of tiny houses, influenced by global popularization trends. Prefabricated living units are now associated with a certain lifestyle that combines minimalism, escape from city life, and the subtext of a safe haven, both in Turkey and around the globe.

For example, Mooble House products are designed as vehicles with licenses, making them suitable for transport on highways with a width of 2.55 meters. The length of the units can differ between 3.5 meters to 8.5 meters, while the maximum height is 4 meters. There are 5 types of Mooble House modules that utilize different features including mobility, size, roof types, material selection, and mezzanine options, catering to different accommodation capacities [Figure 13].[70]

In conclusion, in the experimentation with prefabricated living units the US was ahead, leading the world. Turkey, on the other hand, was lagging behind, except for a few experiments. Recently the popularity of the tiny house movement led to certain business initiatives in the country, whose sustaining popularity is yet to be seen.



Figure 13: Different Mooble House Modules (Source: https://www.mooblehouse.com)

70. Mooble House, "Mooble House Tiny House Doğadaki Eviniz," accessed September 2023, https://mooblehouse.com/uploads/sayfa-resimleri/e-katalog_501_.pdf

1.2. Evolution of Micro Living Units

This section presents a comprehensive background study of micro living units within a historical context, spanning three distinguishing time periods: the early 20th century and the concept of "Existenzminimum", the 1960s and capsule architecture, and the 2000s and micro-living units.

1.2.a. CIAM II and Existenzminimum

The Existenzminimum is critical for understanding the historical development of prefabricated micro living units, especially in relation to the development of capsule architecture. As Peter Senk stated in his book, Capsules: Typology of Other Architecture:

> In the legacy of the functionalism of the Modern Movement and the Congrès Internationaux d'Architecture Moderne (CIAM) congresses, subsistence minimum, together with and in relation to the subject of prefabrication, should be highlighted as one of the key topics, being an important basis for the formation of radical minimal environments and the development of the typology of the capsule.[71]

Therefore, to understand capsule living units in the 1960s and prefabricated micro living units in the 2000s-2020s, it is necessary to address the situations that catalyzed the Existenzminimum and its emergence.

After the 1850's there was a significant population growth in Berlin. It has risen from 170,000 residents to 1,950,000 in the latter part of the 19th century, regardless of the losses caused by World War I, Berlin became one of the densest cities in the West by 1920.[72] To control the density of the population and spread of the residential districts, regulations were conducted by the government. As a result of a set of regulations, rent was not affordable in the neighborhoods where the working class was residing.[73] Due to a lack of affordable housing, families started to live in shared housing units as an alternative. Moreover, post World War I conditions in Germany also caused housing shortages.[74] These conditions led to the examination of the

71. Peter Senk, Capsules: Typology of Other Architecture, (Slovenia, Taylor & Francis Ltd, 2017), 11

72. Marco Giorgio Bevilacqua, "Alexander, Klein and the Existenzminimum: A 'Scientific' Approach to Design Techniques," Nexus Network Journal, Vol 13, No.2 (2011): 298, https://doi.org/10.1007/s00004-011-0080-6

73. Ibid

74. Ibid.

new standards and spatial configurations to provide housing for the working class. Also, In France and England, defining the living unit that corresponds to minimum needs for the proletariat has been a common debate since the 19th century.[75] However, as stated by Sara Brysch in her article "Reinterpreting Existenzminimum in Contemporary Affordable Housing Solutions", the CIAM's second congress was the place, where "the first worldwide comparative study of minimum dwelling was conducted."[76] In this congress, the term Existenzminimum was introduced. Existenzminimum has no exact translation from German to English yet the closest terminology to define is 'minimum subsistence' or 'subsistence level'.[77] There was research and experimentation through producing dwelling units that were space-efficient and affordable in case of minimum quality standards. In brief, the main idea of Existenzminimum was to develop an optimum living environment and hygiene.[78] At the CIAM, the architects who were working to achieve this output were Ernst May, Alexander Klein, Le Corbusier, Margarete Schütte-Lihotzky and Walter Gropius etc.

In CIAM II, 207 minimum dwelling layouts from various US and European countries were examined. Peter Senk summarized the main issues that were discussed in CIAM II as follows:

> Standardization, industrialization, and Taylorization, sociological findings, economic requirements, requirements to ensure basic natural elements, and the biological nature of living were the topics discussed at lectures at the congress, or the basis of projects for a comparative exhibition of layouts of 207 minimum dwellings from twenty-six European and US cities, the sizes of which ranged from 29.5 to 76.5 m^2 for single-family houses, 24.7 to 52.7m^2 for individual units in two-family houses, 23 to 91.2m^2 for multi-family houses.[79]

On the other hand, there were those who did not fully support the outputs presented in CIAM II regarding the Existenzminimum. For instance, Karel Teige who was an artist, writer and critic, criticized common opinions on CIAM II's search for minimum dwelling in his book named Minimum Dwelling published in 1932.[80] According to Karel Teige there was a need for clarification in understanding the minimum dwelling:

75. Eric Paul Mumford, The CIAM Discourse on Urbanism, 1928-1960, (Cambridge: The MIT Press, 2002), 31

76. Sara Brysch, "Reinterpreting Existenzminimum in Contemporary Affordable Housing Solutions," Urban Planning 4, no. 3 (2019): 2, https://doi.org/10.17645/up.v4i3.2121

77. Ibid.1

78. Bruno Marchand, "Moving on: Is Existenzminimum Still Relevant?," Urban Planning 4, no.3 (2019): 186, https://doi.org/10.17645/up.v4i3.2451

79. Peter Senk, Capsules: Typology of Other Architecture (Slovenia, Taylor & Francis Ltd, 2017), 12

80. Ibid.

> We wish to point out from the start that in this book the term "minimum dwelling'" is not to be understood as a tiny dwelling for a little man! That is not the idea. Besides, the term "little man" is really a petit bourgeois invention and an architectural fiction, used by social science to put a label on a nonexistent creature. As an architectural slogan, the minimum dwelling should not be envisioned as a reduced or restricted version of a small bourgeois apartment; and it has nothing in common with so-called minimum apartments in rental tenement houses, built at the end of the last century, or with a kind of popular version of conventional apartments of reduced quality, with rooms so small as to render them uninhabitable. Moreover, it certainly does not represent a miniaturized version of a bourgeois villa.[81]

Teige's proposal of minimum dwelling constituted shared living areas and the single living units to each individual "for enjoying private intellectual and emotional life, a place for sleep, rest, and study."[82]

Another representative of the counter view regarding Existenzminimum was Nikolay Alexandrovich Milyutin, a Bolshevik activist and urban planner from the Soviet Union. He interpreted CIAM's approach as traditional in the context of minimum dwelling. He offered a dwelling complex with specified collective functions and separate living units of 8,4 square meter-sized. According to him, these living units provided minimum comfort while accommodating sleeping, working and storage areas.[83]

1.2.b. Capsule Living Units

Group of Architects from 1960s like Archigram and Metabolists, whose works were later categorized as the Radical Architecture, focused on plugged in structures and integrated capsule living units towards "individuality, collective identity and self-realization of the society."[84] Capsule living units are a type of prefabricated micro living units. Common features of capsule living units were downsizing the living space and using the aesthetics of the futuristic appearance. The word capsule itself was indicative of its aspirations:

81. Karel Teige, The Minimum Dwelling, trans. Eric Dluhosch, (Cambridge: MIT Press, 2002), 32

82. Peter Senk, Capsules: Typology of Other Architecture (Slovenia, Taylor & Francis Ltd, 2017), 13

83. Ibid. 12

84. Peter,Senk, "The Concept of Capsule Architecture as Experiment Origins and Manifestations with Selected Examples from Slovenia and Croatia," Prostor 21, no.2. (2013): 352, https://hrcak.srce.hr/file/167344

The word capsule comes from the Latin capsa, which means box or container, and capsa is derived from capere, which means to grasp, to hold or, in other words, to keep in captivity. In general sense, a capsule is a holder, a container. In more specific sense (with the space capsule as a paradigm), a capsule can be defined as a tool or extension of the body which, having become an artificial environment, shuts out the outer, hostile environment.[85]

The origin and definition of terminology may result from space-age inspirations. Thus, the derivation of the word "capsule" as a common term may be related to the belief in technology, developments in space studies, and the possibilities that people residing beyond Earth will be a forthcoming development in the near future.

Capsule living units can be defined as fully equipped living units that provide compact minimal furnished environments. In the 1960s-1970s, there was no specific size limitation for capsule living units. Yet, the motive was to create individual space to provide minimum living space to users. This was influenced by space capsules, with spatial implementation such as minimizing living space and using fully-equipped interior furnishings that provided ultimate protection from outside hazards.[86]

1.2.c. Micro Living Units

In the 2000s, economic crisis, environmental concerns, densely populated cities and demographic changes prompted designers producing prefabricated micro living units to create alternative solutions to develop quality housing units to mitigate contemporary problems.[87] Downsizing has been perceived as a common solution to the variety of problems for its contribution to an environmentally conscious lifestyle, as well as its cost efficiency and mobility. However, there is no exact definitive size reference describing micro living units in general. The size of the micro-units can differ from city to city.

Micro living units are commonly located in urban areas, especially in densely populated megacities. Urban Land Institute defines a micro-apartment, which can also be read as micro living unit, as:

85. Lieven De Cauter and Véronique Patteeuw, The Capsular Civilization: On the City in the Age of Fear, (Rotterdam: nai010 publishers, 2005), 77

86. Thomas Leslie, "Just What Is It That Makes Capsule Homes So Different, So Appealing? Domesticity and the Technological Sublime, 1945 to 1975," Space and Culture 9, no.2 (2006):182, http://dx.doi.org/10.1177/1206331205275009

87. Micro is a word originated from ancient Greek and defined by Oxford Dictionary as "Small-scale; very small." "Micro Etymology," OED Online, accessed June 2023, https://www-oed-com.ezproxy.mef.edu.tr/view/Entry/117905#eid37170117

> a purpose-built, typically urban, small studio or one-bedroom using efficient design to appear larger than it is and ranging in size from as little as 280 square feet up to as much as 450 square feet (which roughly equates to 20 percent to 30 percent smaller than conventional studios in a given market).[88]

However, micro living units or micro apartments are also referred to as tiny, compact, nano, etc. The choice of words depends on the scale and the conceptual framework of the living units. For instance, one of these words, compact, was defined by Oxford English Dictionary as "having the parts so arranged that the whole lies within a relatively small compass, without straggling portions or members; nearly and tightly packed or arranged; not sprawling, scattered, or diffuse."[89] Thus, the word compact illustrates the downsizing of the space within the efficient solutions including transformable furnishings, light dividers etc. Another word, tiny, is described by the same dictionary as "very small, little, or slight; wee, minute."[90] However, in the context of prefabricated living units it also refers to defined life style and even to a movement besides its scale. The tiny house movement represents a lifestyle centered around a rural environment with simple living, personal freedom, and a sense of community, all while addressing environmental and sustainability concerns.[91] More discussion on micro living units will be presented in chapter three and chapter four.

88. The Urban Land Institute, "The Macro View in Micro Units," 2014, 6, http://uli.org/wp-content/uploads/ULI-Documents/MicroUnit_full_rev_2015.pdf

89. "Compact Meaning," OED Online, accessed June 2023, https://www-oed-com.ezproxy.mef.edu.tr/view

90. "Tiny Meaning," OED Online, accessed June 2023, https://www-oed-com.ezproxy.mef.edu.tr/view/Entry/202346?redirectedFrom=tiny#eid

91. Tiny House Kickstart, "The Tiny House philosophy," Medium, December 7, 2020, https://tinyhousekickstart.medium.com/the-tiny-house-philosophy-65d0abdc1bd3

Contextual Background and Case Studies

02

In this chapter, there is a review of the contextual background of the two historical periods and the case studies that belong to these periods. Each historical period is investigated in two parts. The first part investigates the contextual background within the socio-economic dynamics, technological developments, and popular culture. In the second part, there is an introduction to case studies. To represent the selected historical periods' production in the context of prefabricated micro living experiments, three case studies from the 1960s-1970s and four case studies from the 2000s-2010s were selected. The case studies were chosen based on their architects' and their motive to produce within the intellectual background during the design process, as well as their documentation by diverse scholars. These studies also highlight different geographic locations and serve as notable examples of their time periods.

2.1. Contextual Background of 1960's-1970s

The 1960s-1970s were marked by widespread enthusiasm towards science and technology due to technological developments and a prosperous economy. People started to believe that through science and technology, humankind could reach the ability to exceed the limits of Earth in order to reach brand new horizons. The post-war period, The Cold War, Space Race, Vietnam War, and countless revolts can be referred to as the primary thresholds that encouraged society to produce alternative futures in the context of intellectual, socio-economic cases, and technological developments.

2.1.a. Socio-Economic Dynamics

The 1960s was a decade of intense political, social and cultural rebellions with anti-war protests and civil rights movements. Moreover, in The 1960s was a decade of intense political, social and cultural rebellions with anti-war protests and civil rights movements. Moreover, in this decade, academic associations have transformed into environments for students to act and raise their voices within the context of intellectual, political and pedagogical transformations.[92] These debates have also spread to various architecture schools in Europe. Consequently, during the 1960s, these factors prompted a questioning of both traditional architectural education and the role of architecture within the realms of politics, economics, and sociology. There was a climate of counterculture advocacy. The reflections of these uprisings and pedagogical changes are also evident in architectural production and group of architects including Archigram in England, Superstudio and Archizoom in Italy, Utopie in France, Haus-Rucker-Co and Coop Himmelblau in Austria, and Metabolists from Japan. Later, these experiments were coined as representatives of Radical Architecture by Italian critic Germano Celant in 1972.[93]

2.1.b. Technological Developments

In addition to political, economic, and social changes in society, another primary factor shaping prefabricated micro-living unit productions and experimental pursuits has been technological developments. Space exploration was catalyzed by the cold war between the Soviet Union and the USA which was referred to as the Space Race. Space explorations became a war field for the Cold War. After the placement of Sputnik 1 by the Soviet Union in orbit of the earth in 1957, the Space Age was officially started.[94] Then in 1969, Apollo 11's landing on the moon fostered the people towards possibilities of extraterrestrial life scenarios which led to space age influenced design language including fashion, graphics and architecture.

Moreover, computer aided design (CAD) was introduced in 1963 which later became the tool to "focus on efficient and fast integration and/or automation of various elements of design and manufacturing along with the development of new algorithms."[95] These developments, which also changed

92. Beatriz Colomina, Evangelos Kotsioris, Ignacio González Galán, Anna Maria-Meiste, The Radical Pedagogies Project (Massachusetts: MIT Press, 2022) 12

93. "Radical Architecture," FRAC Centre-Val de Loire, accessed March 2021, https://www.frac-centre.fr/_en/resources/thematic-exploration/radical-architecture/radical-architecture-362.html

94. Michelle Cadoree Bradley, "Sputnik and the Space Race: 1957 and Beyond," Library of Congress, 2007, https://guides.loc.gov/sputnik-and-the-space-race

95. Ihuhwa Marta Tau, "Brief History of CAD," Scribd, accessed March 2023, https://www.scribd.com/document/369186131/Brief-History-of-CAD

architectural production and processes, also played an important role.

2.1.c. Popular Culture

The Space Race, NASA, and associated military organizations, along with the appearance of gantry towers in space stations, significantly influenced the media from the very beginning, including scientific and architectural publications and magazines.[96] Moreover, these developments and the ongoing debates of the 1960s found a place in the cinema industry with productions like "Barbarella," "The Jetsons," and "2001: A Space Odyssey."

One of the notable examples of how space developments and architecture find its place in cinema is the movie titled "2001: A Space Odyssey". The movie was about a secret mission to uncover the origins of an unidentified artefact found in an excavation on the lunar surface with the crew and highly developed supercomputer H.A.L 9000.[97] In 2001: A Space Odyssey, Kubrick gave priority to technological accuracy.[98] They hired a specialist crew consisting of "astronomical artists, aeronautics specialists, and aerospace engineers to design the spacecraft interiors"[99] to achieve a realistic set design. Kubrick explained that he wanted to create a visual experience, "one that bypasses verbalized pigeonholing and directly penetrates the subconscious with an emotional and philosophic content."[100] This visual experience aimed to represent the future and how technological advancements will shape the living environment in addition to creating realistic set design.[101] In 2001: A Space Odyssey, the main features of the spatial configuration were stationary units to fulfill personal needs of the spaceship crew and perform daily routines. Screens were illustrated throughout the film with the expectation that technologies like screens and smart intelligence would be widespread in future spatial configurations. As seen in Figure 14, plastic was employed as the main material in interior spaces from floor to ceiling.

Also, the team prioritized to request commercial product suppliers such as IBM, and Honeywell, kitchens from Whirlpool, fabrics from Macy's, Dupont, Hilton Hotels, Parker Pens, cameras from Nikon and Kodak, watches from Hamilton and the designers and products including Djinn Chair by Olivier Mourgue, Saarinen Coffee Tables by Eero Saarinen [Figure 15].[102] As a result of these efforts, the movie turned into an analogy that represents avant-

96. Thomas Leslie, "Just What Is It That Makes Capsule Homes So Different, So Appealing? Domesticity and the Technological Sublime, 1945 to 1975," Space and Culture 9, no.2 (2006):182, http://dx.doi.org/10.1177/1206331205275009

97. "2001:A Space Odyssey," IMDB, accessed June 2023, https://www.imdb.com/title/tt0062622/ .org/10.1177/1206331205275009

98. Allie Hutchison, "2001: A Space Odyssey is Still the Most Scientifically Accurate Space Film Ever," Inverse, April 8, 2023, https://www.inverse.com/culture/2001-a-space-odyssey-55-year-anniversary-nasa-science-accuracy

99. Billie Muraben, "Stanley Kubrick's Meticulous Set Designs Made His Films Strikingly Eerie," Artsy, April 30, 2019, https://www.artsy.net/article/artsy-editorial-stanley-kubricks-meticulous-set-designs-made-films-strikingly-eerie

100. Allie Hutchison, "2001: A Space Odyssey is Still the Most Scientifically Accurate Space Film Ever," Inverse, April 8, 2023, https://www.inverse.com/culture/2001-a-space-odyssey-55-year-anniversary-nasa-science-accuracy

101. "An Architectural review of 2001: A Space Odyssey," Rethinking the Future, accessed September 2023, https://www.re-thinkingthefuture.com/rtf-architectural-reviews/a8893-an-architectural-review-of-2001-a-space-odyssey/

102. Paula Benson, "2001 A Space Odyssey – a Close Look at those Fabulously Futuristic Djinn Chairs and How Kubrick's Vision of the Future wasBrought to Life Through 'Product Placement'," Film and Furniture, 30 April, 2014, https://filmandfurniture.com/2014/04/kubricks-vision-of-the-future-brought-to-life-through-product-placement-in-2001-a-space-odyssey/



Figure 14: Employment of Plastic (Source: https://www.denofgeek.com/)



Figure 15: Djinn Chair by Olivier Mourgue and Saarinen Coffee Tables by Eero Saarinen (Source: https://www.stirworld.com/#)

garde contemporary design.[103]

2.2. Case Studies of 1960s-1970s

2.2.a. Futuro House by Matti Suuronen

With successive space studies, people began to develop an interest in potential life scenarios that incorporate habits from extraterrestrial environments.[104] In 1968 Matti Suuronen designed Futuro House [Figure 16] with these motives. Futuro House was a leisure time living unit yet it was also suitable to answer various functions.[105] Total area of the unit was 50 square meters within 8 meters diameter and 4 meters height.[106] Up to 6 people can be accommodated in the unit.



Figure 16: Futuro House (Source:ArchDaily)

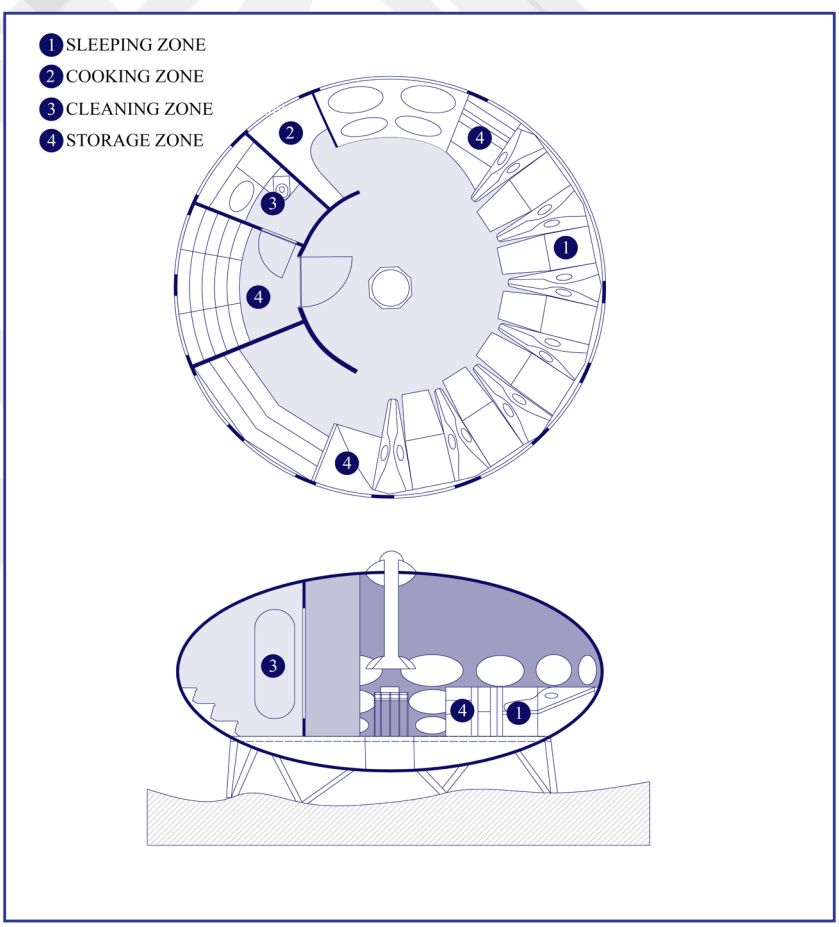


Figure 17: Plan and Section Drawings of Futuro House House (Drawn by Author)

103. Ibid.

104. Anna-Maija Kuitunen, "Futuro no. 001 – Documentation and Evaluation of Preservation Needs" (Conservation Historical Interiors Bachelor's Thesis, Metropolia University of Applied Sciences), 2010, 3

105. Ibid.19

106. "The Futuro House-Concept, Design & Manufacturing," The Futuro House, accessed September 2023, https://thefuturohouse.com/futuro_house_concept_and_design.html

In Finland, Futuro House was used as a ski chalet, where it was perceived as disrespectful for the environment with its plastic spaceship appearance.[107] However, around the word Futuro House got people's attention.[108] Futuro Houses reached a total of 24 countries.[109]

Futuro House consisted of:

> ...sixteen prefabricated elements which are bolted together through their bent edges inside the house. It stands on four V-shaped steel tube legs attached to a tubular steel ring. There are steel plates added to the end of the legs, which enables the bolting to the other steel plate 'shoes' set in concrete footings.[110]

This allowed Futuro House to be positioned in diverse terrains. Futuro could be assembled in five people in three days.[111] The lightweight building material was polyurethane insulation foam (PUR) laminated with glass-reinforced polyester (GRP) which is a type of plastic.[112] However, with the oil crisis in 1972, the main material of Futuro became over-priced. Even people started to refer to Futuro as "Mercedes Benz of the prefab housing."[113]

As seen in Figure 18, the illustration of the Futuro House being transported via helicopter was documented at a time.[114] Furthermore, Futuro House could both be transported as a whole unit within a helicopter and assembling and disassembling in a preferred site and in exceptional situations living unit could be moved within a truck [Figure 19].

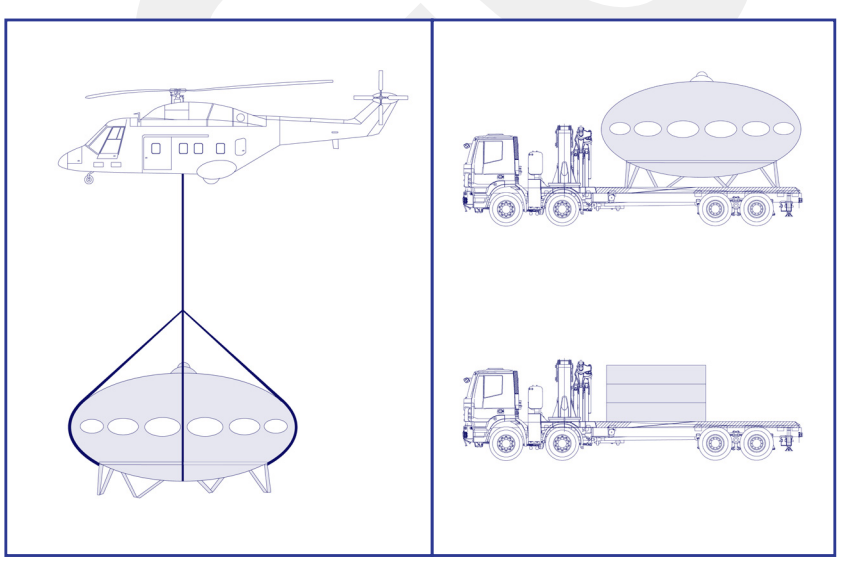




Figure 18: Futuro House Transported with Helicopter

Figure 19: Transportation scenarios of the Futuro House (Drawn by Author)

107. CNN Business,"The Flying-saucer Shaped Futuro Home was Doomed to Fail," Interview with Futuro Owner, 3:03, accessed March 2023, ttps://www.youtube.com/watch?v=EZ8jnR09eLE

108. Ibid.

109. Susanna Pettersson, "The Nostalgia of the Future. The Architect Matti Suuronen's Plastic House Was to be the Trademark of the New Space Age and of Trendy Neo-Nomads." Nomadic Art Review, (January, 1999), 11, https://mikataanila.com/wp-content/uploads/2014/02/futuro.pdf

110. Anna-Maija Kuitunen, "Futuro no. 001 – Documentation and Evaluation of Preservation Needs" (Conservation Historical Interiors Bachelor's Thesis, Metropolia University of Applied Sciences), 2010, 3

111. ABC News in Depth, "Decades Before the Tiny House, There was Futuro I Retro Focus," March 1, 2020, Old Footages, 3:13, accessed March 2023, https://www.youtube.com/watch?v=Yy-oxyphwWs

112. Anna-Maija Kuitunen, "Futuro no. 001 – Documentation and Evaluation of Preservation Needs" (Conservation Historical Interiors Bachelor's Thesis, Metropolia University of Applied Sciences), 2010, 7

113. CNN Business,"The Flying-saucer Shaped Futuro Home was Doomed to Fail," Interview with Futuro Owner, 3:03, accessed March 2023, ttps://www.youtube.com/watch?v=EZ8jnR09eLE

114. "So Just How Did They Get To Where They Were Going?," The Futuro House, accessed June 2023, https://thefuturohouse.com/futuro_house_transporting_and_moving.html

2.2.b. Mobile House by Alberto Roselli

Mobile House [Figure 20] was designed by Alberto Roselli as a part of the exhibition in the Museum of Modern Art called Italy: New Domestic Landscapes in 1972. This exhibition was curated by Emilio Ambasz who was the curator of Design in the Museum of Modern Art at the time. It was put together to highlight the accomplishments of the Italian designers while investigating certain problems which influenced the current design and then producing solutions to these problems.[115]

The exhibition included two different approaches to the role of the design in the society. The first one involved using design as an instrument to resolve conflicts, while the second approach, called counterdesign, aimed to create "structural changes"[116] in society. Design program were shaped within the general considerations.

The exhibition brought together both invited architects and those who were selected after an open call. The invited architects were well-known and accomplished names while those who were selected after the open call were young designers, all younger than the age of thirty-five.[117] Those who participated were asked to develop "prototypical solutions" after questioning long-term definitions of habits and ceremonies that are performed through a 24 hours daily period and were expected to follow technical limitations including cost and manufacturing processes. Sponsors invited designers to use synthetic materials and fibers while also demanding the design proposal's suitability for mass production. In terms of the proposals, prototypes "should be envisioned as industrial prototypes."[118] Sponsors of the exhibition invited designers to use synthetic materials and fibers while also demanding the design proposal's suitability for mass production.

Exhibition selection contained 180 objects and 11 environments which represented ongoing design advancements in Italy.[119] All environments took up a 16-foot x 16-foot area which is nearly 25 sqm and they were named as "microenvironments" and "microevents' ' in the exhibition catalog.[120]

Throughout this demand, Alberto Roselli, a designer who was focused on creating mass production through furniture and sanitary units at a time, designed Mobile House.[121] The unit contained contemporary amenities and furnishings. In Mobile House up to 5-6, people could be accommodated.



Figure 20: Mobile House (Source: http://ihd.it/)

115. The Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design (Greenwich: New York Graphic Society, 1972), 11

116. Ibid.

117. Ibid.37

118. Ibid.141

119. The Museum of Modern Art Department of Communication, Italy: New Domestic Landscapes, Press Release," 1972, 1

120. The Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design (Greenwich: New York Graphic Society, 1972), 137

121. Ibid.180



122. The Museum of Modern Art, "Mobile House, Release No 42," 1972, (Graphic Society, 1972), 11

Figure 21: Plan and Section Drawings of Mobile House (Drawn by Author)

In Mobile House, Roselli focused on creating a living unit that could be adapted to diverse usage scenarios and suitable to relocation through transportation. Main theme of the design was to "movement and repose" in the context of both interior and module mobility.[122] When the expandable volumes were closed, the Mobile House could be transported via highways [Figure 22].

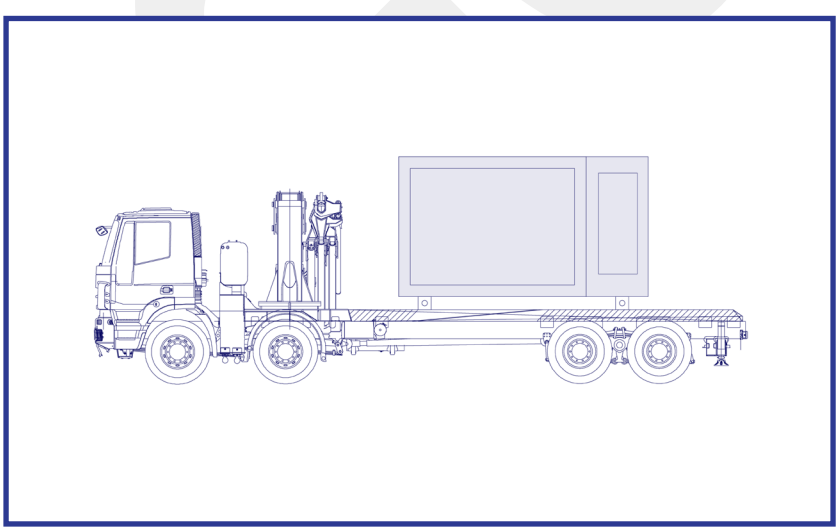


Figure 22: Transportation scenarios of Mobile House (Drawn by Author)

2.2.c. Nakagin Capsule Tower by Kisho Kurokawa

After World War II, the atomic bomb and following natural disasters, such as earthquakes and tsunamis, Japan needed to improve its economic, social, political and infrastructural conditions. Thus, according to Meike Schalk, associate professor in urban design and urban theory, Metabolism emerged "with architecture envisioning the complete transformation of Japan as a system of political, social, and physical structures into resilient spatial and organizational patterns adaptable to change."[123]

Their approach involved the removal of outdated elements and the introduction of new components based on the changing needs of the socio-economic environment.[124] Nakagin Capsule Tower [Figure 23] was one of the built examples of the Metabolist movement and as such it represented the main notions of Metabolist movement such as impermanence and moveability.[125]

Torizo Watanabe wanted to hire Kisho Kurokawa of the Metabolists to design a building that constituted capsules after his visit to the Osaka Expo '70 and after particularly being captivated by Kisho Kurokawa's Takara Beautilion.[126] In 1972 Kurokawa built Nakagin Capsule Tower. The Nakagin Capsule Tower's defined target users were business owners or individuals in need of temporary accommodation within central Tokyo, those who already owned residences outside the city.[127] Price range of the capsule living units differed between $12,300 to $14,600 which was the price of a luxury car at a time.[128]

The building constituted three parts: First were the two ferroconcrete shafts, which formed the main structure and they were cast-in-place. Second were 144 prefabricated capsules that could be plugged into this main core. Third were the utility facilities. The attached capsules were lightweight box-shaped structures covered with reinforced steel panels. The interior spaces were also prefabricated and interior surfaces were finished with kenitex spray to achieve a glossy appearance and coated with asbestos for fire protection.[129]



Figure 23: Nakagin Capsule Tower (Source: ArchDaily)

123. Meike Schalk, "The Architecture of Metabolism. Inventing a Culture of Resilience", Arts 3, no.2 (2014): 279, https://doi.org/10.3390/arts3020279

124. Raffaele Pernice, "Metabolism Reconsidered Its Role in the Architectural Context of the World," Journal of Asian Architecture and Building Engineering 3, no.2 (2004): 359, https://doi.org/10.3130/jaabe.3.357

125. Ibid.

126. Zhongjie Lin, "Nakagin Capsule Tower and the Metabolist Movement Revisited," Journal of Architectural Education 65, no.1 (2011): 517, https://www.acsa-arch.org/proceedings/Annual%20Meeting%20Proceedings/ACSA.AM.98/ACSA.AM.98.62.pdf

127. Kisho Kurokawa, Metabolism in Architecture, (Studio Vista, 1977), 105

128. Zhongjie Lin, "Nakagin Capsule Tower and the Metabolist Movement Revisited," Journal of Architectural Education 65, no.1 (2011): 518, https://www.acsa-arch.org/proceedings/Annual%20Meeting%20Proceedings/ACSA.AM.98/ACSA.AM.98.62.pdf

129. Kisho Kurokawa, Metabolism in Architecture, (Studio Vista, 1977), 107

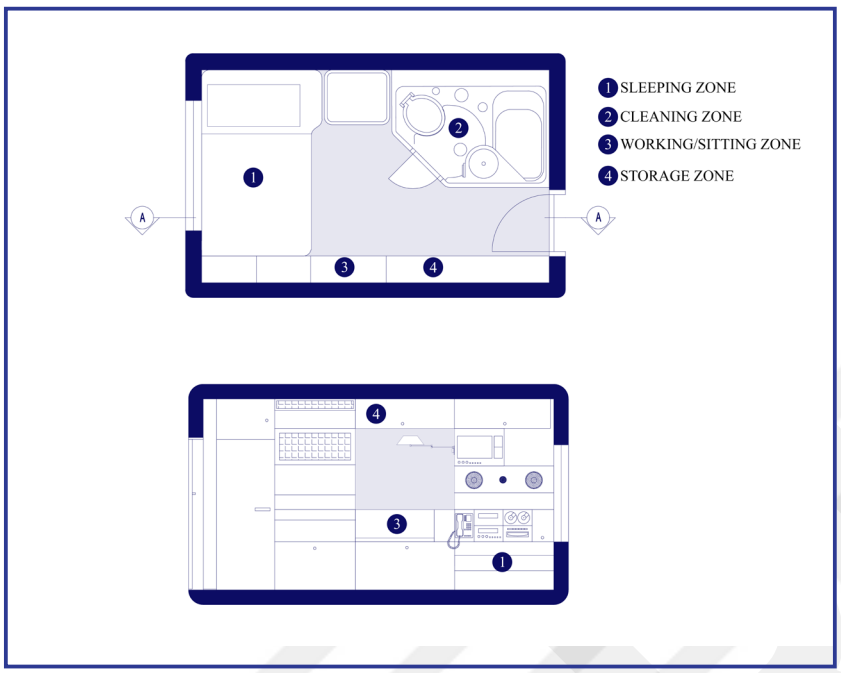


Figure 24: Plan and Section Drawings of Nakagin Capsule Tower (Drawn by Author)

Units were carried to the site with trucks [Figure 25] and assembled the concrete shafts within the cranes. In the design scenarios capsule units were aimed to be relocated in various concrete shafts located in different locations, but this aim was never realized.

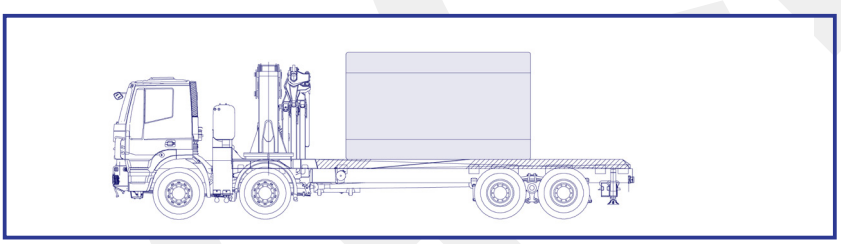


Figure 25: Transportation scenarios of Nakagin Capsule Tower's Living Units (Drawn by Author)

Kurokawa emphasized that the ferroconcrete shafts have a lifespan of at least sixty years, while the capsules were designed for replacement every twenty-five to thirty-five years. He further emphasized that the durability of the capsule unit itself was not the primary concern, but rather the focus was on accommodating changing human habits and social dynamics.[130] However, Nakagin Capsule Tower was demolished in 2022 due to their low maintenance, health risks of asbestos usages and not complying with the existing earthquake regulations.

130. Ibid.

2.3. Contextual Background of 2000s-2010s

"It was the best of times, it was the worst of times"[131] encapsulates the spirit of the environment in the 2000s. As the capabilities of the human race have grown through technological and scientific advancements, daily life scenarios have reached a point where they enriched people's lives. Nevertheless, although the 2000s were marked by numerous advancements, they brought about certain outcomes.

2.3.a. Socio-Economic Dynamics

The 2000s-2010s were the years of economic struggles and rising environmental concerns. "The global recession, the collapse of Wall Street, sub-prime housing crisis and the bursting of the housing bubble in the U.S. were major situations that resulted in an unstable economic environment. The 2008 financial crisis caused the masses to struggle to find affordable housing. There was an increase in family homelessness and adults that shared houses or lived in family houses in their late 30's.[132]

In the meanwhile, increased mobility around the globe can be attributed to various conditions including the need for relocation to access high paying job opportunities, daily commuting between work and home, the ability to work remotely from any location and travel for educational or leisure purposes.[133] Thus, to cater to the mobile lifestyle of the individuals, there is an emergence of alternative housing typologies like prefabricated micro living units. Individuals who compose the mobile population can be listed as; job seekers, students, travelers, soldiers, entertainers, celebrities, and businessmen. With the proliferation of virtual mediums and accessible transportation to long distances, there has been an emergence of a mobile population which is named as neo-nomads. Neo-nomads are defined as those "who would rather outfit a truck or trailer than a house, and whose movements are governed as much by work obligations as by the desire to change their relationship to the world."[134] Thus, over 35 million people were experiencing the digital nomad lifestyle in 2022.[135] Furthermore 33.8 billion flights were performed by the global airline industry in 2022.[136] According to UNWTO World Tourism 2019 rates, there are 1.5 billion international tourist

131. Charles Dickens, A Tale of Two Cities (Great Britain: Biddles Ltd, Guildford, Surrey for J. M. Dente Sons ltd, 1906), 1

132. Alan Travis, "More Young Adults in 20s and 30s Living with Parents than in Past 20 Years," The Guardian, December 8, 2009, https://www.theguardian.com/society/2009/dec/08/young-adults-living-parental-home-ons

133. "National Research Council, Division on Earth and Life Studies, Board on Earth Sciences and Resources, Committee on Strategic Directions for the Geographical Sciences in the Next Decade, Understanding the Changing Planet: Strategic Directions for the Geographical (Washington: National Academies Press, 2010), 78

134. Guillaume Logé, About the Exhibition, Artistic Lab, accessed June 2023, http://artisticlab.forumviesmobiles.org/en/oeuvre/neo-nomads-a-lifestyle-of-the-future

135. "Digital Nomad Statistics: How Big is the Nomad Movement In 2023?" Two Tickets Anywhere, accessed August 25, 2023, https://www.twoticketsanywhere.com/digital-nomad-statistics/

136. "Number of Flights Performed by the Global Airline Industry from 2004 to2021, with Forecasts until," Statista, December, 2022, https://www.statista.com/statistics/564769/airline-industry-number-of-flights/

arrivals.[137] These listed data shown, certain people are preferred to be constantly on the move.

In the 2000s, there were rising environmental concerns which were connected with climate change, global water crisis, endangered species, etc. Diverse acts were put in place trying to deal with these issues, like the Paris Agreement, which was put in effect to "set out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C"[138] With these situations coming to the fore, sustainable approaches have begun to be taken into account in the building industry through both production processes and the life scenarios envisaged in the designed product.

137. "International Tourism Growth Continues to Outpace the Economy," UNWTO, accessed February 2023, https://www.unwto.org/international-tourism-growth-continues-to-outpace-the-economy

138. "Paris Agreement," European Commission, accessed June 2023, https://climate.ec.europa.eu/eu-action/international-action-climate-change/climate-negotiations/paris-agreement_en#:~:text=The%20Paris%20Agreement%20sets%20out,support%20them%20in%20their%20efforts.

139. Angelo Young and Michael B. Sauter, "3D printing, E-cigarettes among the most important inventions of the 21st century," USA Today, January 9, 2020, https://www.usatoday.com/story/money/2020/01/09/21-most-important-inventions-of-the-21st-century/40934825/agreement_en#:~:text=The%20Paris%20Agreement%20sets%20out,support%20them%20in%20their%20efforts.

2.3.b. Technological Developments

In 2003 starting with the Android Inc.'s development of the mobile operating system following the acquisition of it by Google in 2005, the use of mobile phones and mobile devices reached another point.[139] Daily routines and habits have been updated with the introduction of such devices and their integration into daily life. The way information is processed and perception of wealth through material objects have been questioned. Consequently, with these developments, which reduced the need for physical space, downsizing in the living space has become a very viable alternative.

2.3.c. Popular Culture

As a result of rising production and demand regarding prefabricated micro living units took their places in the popular culture. They are documented through diverse mediums including books, magazines, social media platforms, games etc. In the case of the introduction and popularization process of micro living units, online platforms become useful. For instance, Youtube has been seized by micro living-related contents including channels like Living Big in a Tiny House and Never too Small. Online streaming platform Netflix produced a reality series about tiny houses named Tiny House Nation. Furthermore,

even in games, there is an appearance of tiny houses as highlighting a specific lifestyle choice. For instance, in 2020 EA Games launched additional plug-ins like Tiny Living Stuff Pack plug-in to The Sims 4.[140]

As a result of concerns through sustainability, urban density and economic issues there has been rising interest in prefabricated micro living units. Moreover, exhibitions were curated to highlight the history of prefabrication such as Home Delivery: Fabricating the Modern Dwelling in the U.S. in 2008 and Flying Panels – How Concrete Panels Changed the World held in Sweden in 2019. Home Delivery: Fabricating the Modern Dwelling was a documentation of prefabrication through the years and it was also a representation of current debates and contemporary approaches in the context of prefabrication. Barry Bergdoll, the curator of the exhibition explained:

> In architecture, the history of prefabrication is, in some senses, the history of modernism. The prefabricated house continues to be one of architecture's most radical pursuits. Prefabrication is a reflection of the house as a critical agent in the discourse.[141]

The exhibition consisted of two parts. The first part examined the historical process through individual architects including Frank Lloyd Wright, Jean Prouvé, Konrad Wachsmann, Marcel Breuer, Kisho Kurokawa, and Richard Rogers. In addition to individual architects, corporations such as Lustron, Sears Roebuck & Co were also included in this part. Then the second part featured contemporary housing experiments that included parametric design and digital production as well as sustainable approaches.



Figure 26: Tricycle House (Source: ArchDaily)

2.4. Case Studies of 2000s-2010s

2.4.a. Tricycle House by People's Architecture Ofice and People's Industrial Design Office

To advertise young artists and designers the Get it Louder Biennial has been held in China since 2005. The People's Architecture Office and People's Industrial Design Office were responsible for the curation of the

140. Melanie Olsson, "Living Tiny- An exploratory study of the tiny house movement in Sweden" (Master Thesis in Sustainable Urban Planning, KTH Royal Institute of Technology, Stockholm, 2020), 14

141. The Museum of Modern Art Department of Communication, Home Delivery:Fabricating the Modern Dwelling Presents the Most Thorough Examination to Date of Historical and Contemporary Prefabricated Architecture, Press Release, 2008, 2

sections “Architecture, Product Design, and Urbanism” in 2012. The curator team determined the theme of the year for the biennial as The People’s Future that reserves sustainable features.[142] In this biennial Tricycle House [Figure 26] was showcased. The unit comprised a bike and a living unit attached to each other, with the unit transporting the bike within itself [Figure 28]. The size of the living unit was 1.44m x 2.20m. The design invited people to question land ownership due to regulation related with the land ownership in China, mobility and sustainability.

142. “2012 Get It Louder Exhibition Design,” accessed June 2023, http://www.peoples-architecture.com/pao/en/project-detail/20

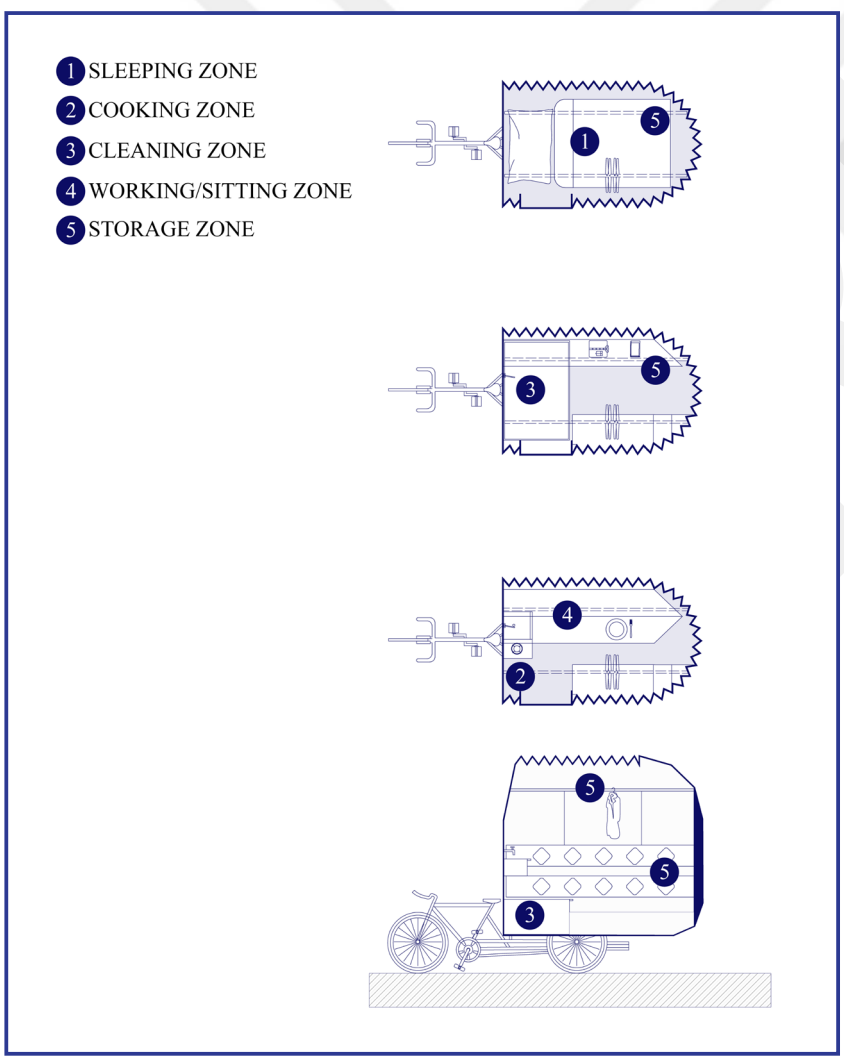


Figure 27: Plan and Section Drawings of Tricycle House (Drawn by Author)

Tricycle House was an experimentation on the employment of folded plastic towards prefabricated micro living units. With the utilization of a CNC Router, each component of the living unit was precisely cut and

creased, bent and joined together to reach the aimed form.[143] Polypropylene is the type of plastic that retains its durability even after being folded. This folded form allowed Tricycle House expansion and merger with other Tricycle Houses. With the plastic's translucency feature, Tricycle House also let the sunshine in at the daytime while night-time it could work like a street light.[144]

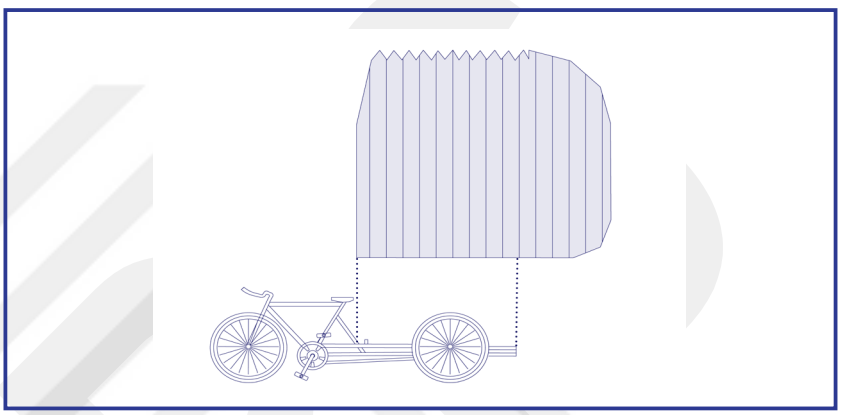


Figure 28: Transportation scenarios of Tricycle House (Drawn by Author)

2.4.b. Tikku House by Marco Casagrande

There is an ongoing debate about how to produce low-cost, sustainable housing around Europe.[145] This aim led to the emergence of alternative solutions to existing housing problems in the current context. Tikku House [Figure 29] was one of the alternative solutions regarding this issue. Tikku House was designed by Finnish Architect Marco Casagrande from Casagrande Laboratory in 2017. First prototype was showcased as a part of Helsinki Design Week 2017 in front of the Ateneum Art Museum.[146] Tikku House's base area was 2.5m x 5m which is equal to a parking lot. The total area was 37 m² which contained three stories whose function of each storeys was defined by the user preference while the prototyped version combines sleeping, working, and greenhouse area in each storey [Figure 30].



Figure 29: Tikku House (Source: ArchDaily)

143. Alison Furuto, "Tricycle House and Tricycle Garden / People's Architecture Office (PAO) + People's Industrial Design Office (PIDO)," ArchDaily, December 27, 2017, https://www.archdaily.com/312651/tricycle-house-and-tricycle-garden-peoples-architecture-office-pao-peoples-industrial-design-office-pido

144. Ibid.

145. Tim Nelson, "Helsinki Architecture Firm Launches Prefab, Solar-Powered Homes That Fit in a Parking Spot," Architectural Digest, October 12, 2017 https://www.architecturaldigest.com/story/helsinkHelsinki Architecture Firm Launches Prefab, Solar-Powered Homes That Fit in a Parking Spoti-tikku-prefab-solar-powered-homes-that-fit-in-a-parking-spot

146. Ali Morris, "Casagrande Laboratory Designs Wooden Micro House for City Dwellers," Dezeen, 23 October, 2017, https://www.dezeen.com/2017/10/23/casagrande-laboratory-designs-tikku-micro-house-cross-laminated-timber-installation-helsinki-design-week/
Powered Homes That Fit in a Parking Spoti-tikku-prefab-solar-powered-homes-that-fit-in-a-parking-spot

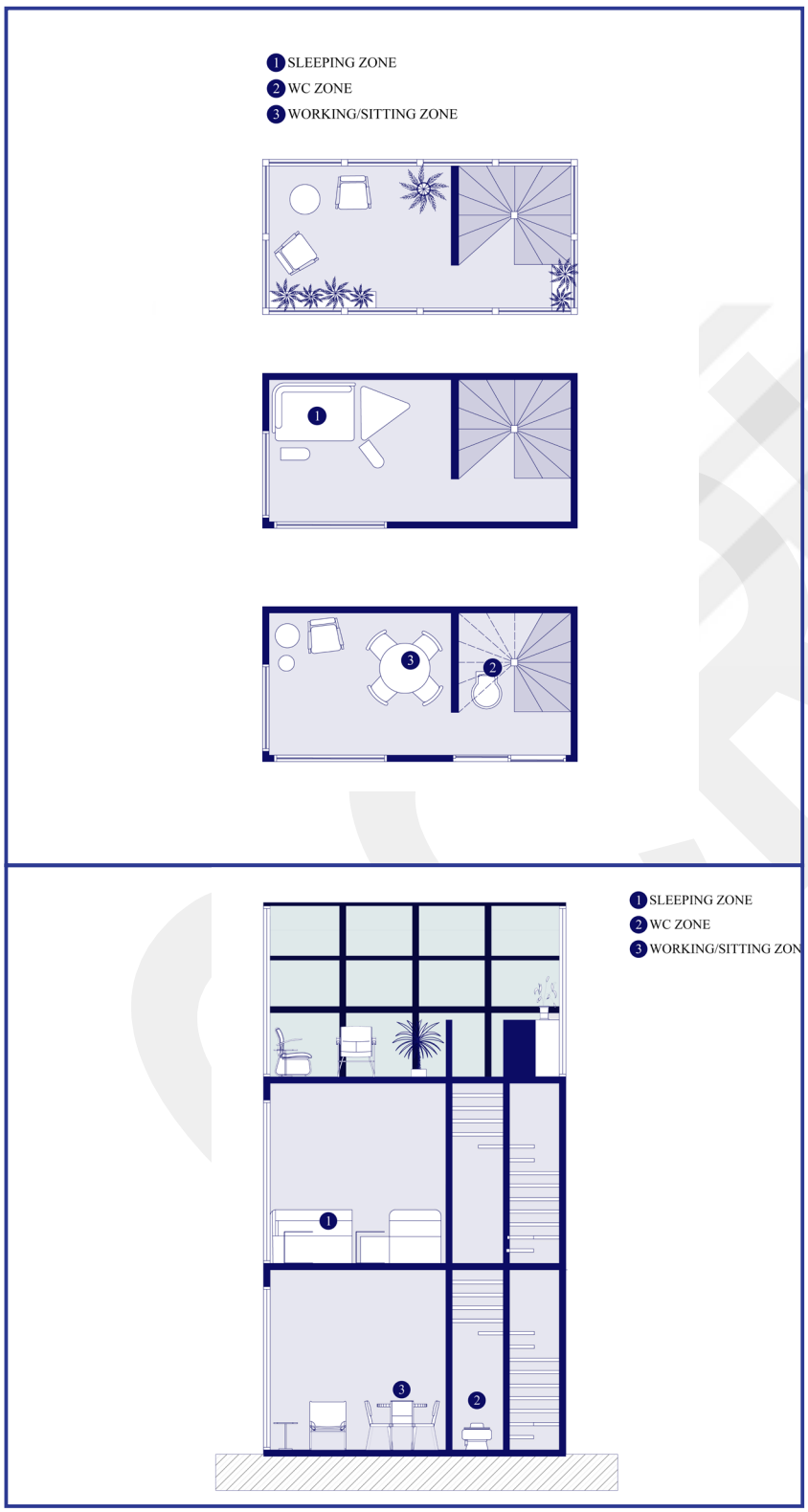


Figure 30: Plan and Section Drawings of the Tikku House (Drawn by Author)

147. Ibid.

148. Nial Burke, "The Micro Compact Home by Richard Horden," Humble Homes, April 2, 2014, https://www.humble-homes.com/micro-compact-home-richard-horden/

149. Mc-h," Micro Compact Home, accessed June 2023, http://www.microcompacthome.at/index.php?con=projects&l=e

With the components made out of CLT, Tikku House could be assembled in one night as a singular unit. According to the design team "Ten-centimeter-thick CLT is plenty for the structure and 20-centimeter-thick CLT is sufficient even for cold winters. No added insulation is needed".[147] Tikku House was designed to be transported via highways [Figure 31].

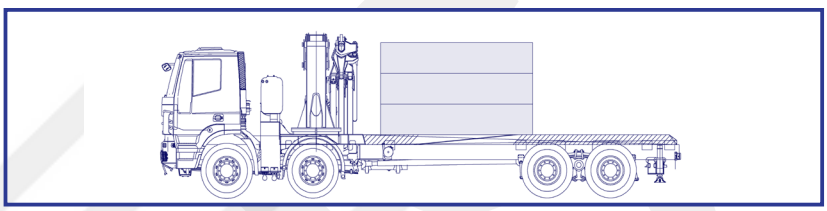


Figure 31: Transportation scenarios of Tikku House (Drawn by Author)

2.4.c. Micro Compact Home by Richard Horden



Figure 32: Micro Compact Home (Source: http://www.microcompacthome.at/index.php)

Micro Compact Home (m-ch) [Figure 32] was a research project that was run by Technical University Munich, which was conducted by Prof. Richard Horden and a team of students and assistants. 2001 to 2012, more than 15 of Micro Compact Homes were installed and used.[148] The Micro-Compact Home has emerged as an alternative to short-term accommodation needs regarding "social or student accommodation, short stay business or leisure."[149]

Micro Compact Home was a 2.60mx2.60mx2.60m cubical shape which was inspired by Japanese tea houses through scaling and size arrangements. It involved features of the conventional housing units including bed, dining space, air conditioning and fully equipped domestic appliances.

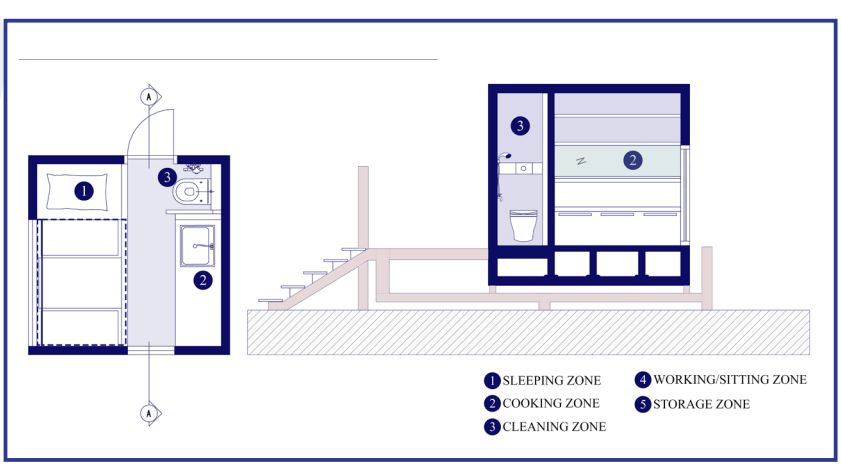


Figure 33: Plan and Section Drawings of Micro Compact Home (Drawn by Author)

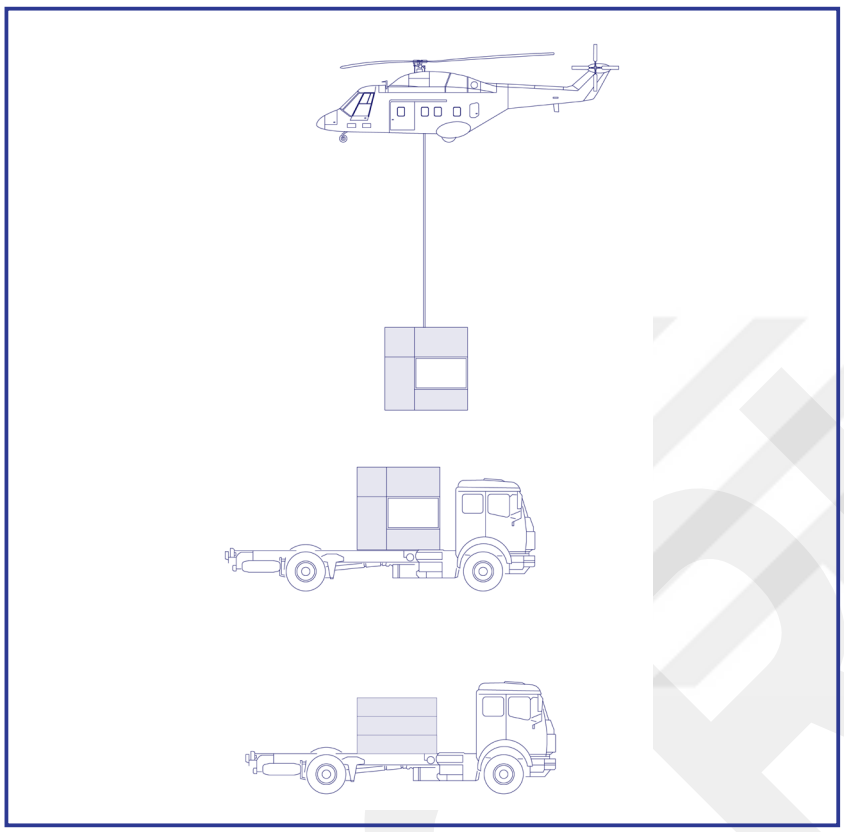


Figure 34: Transportation scenarios of Micro Compact Home (Drawn by Author)

However, all of these functions were configured using compact solutions such as convertible furnishings. In order to configure optimum arrangements in the limited area, high-tech approaches which combined the automobile and marine industry were employed.

Usage scenarios of the Micro Compact Home were suitable for vertical clustering and also for its placement as a single unit. Micro Compact Home can be easily transported via helicopter, trailer or truck [Figure 34].

2.4.d Mobile Dwelling Unit by Lot-Ek

Lot-Ek is an architectural firm founded in New York that specializes in up-cycling existing standardized industrial objects such as shipping containers, cement mixers, airplane fuselages etc. This approach is explained in the book titled Lot-Ek: Mobile Dwelling Unit as follows:



Figure 35: Mobile Dwelling Unit (Source: https://lot-ek.com/)

Lot- Ek's ambition is the search for a new vernacular based on the products of industrial technology. These products are all around us, almost invisible, yet they form the interconnected machine that enables our urban society to operate. The idea that by making better use of the industrial infrastructure of the world can change our lives for the better has been a recurring theme in design history.[150]

Lot-ek's approach in the Mobile Dwelling Unit (Figure 34) was closely connected with the logic of shipping containers and the context of how they were used and distributed. Around the world, there are seven million shipping containers in circulation.[151] Standardization of the containers had a significant impact in the transportation vehicles and the roads, railroads and trucks. As a result, shipping containers become a significant part of the worldwide distribution of goods which take up space in both the economical and physical agendas.[152] Within the utilization of the shipping container, living units itself can be part of the worldwide distribution. Throughout this agenda Mobile Dwelling Unit is an upcycling project that constitutes standardized shipping containers and expandable volumes to create the micro-living unit. As a material selection, in contrast to the industrial material on the facade, plywood is used in the interior. Extendable volumes are prefabricated with plastic-coated panels.

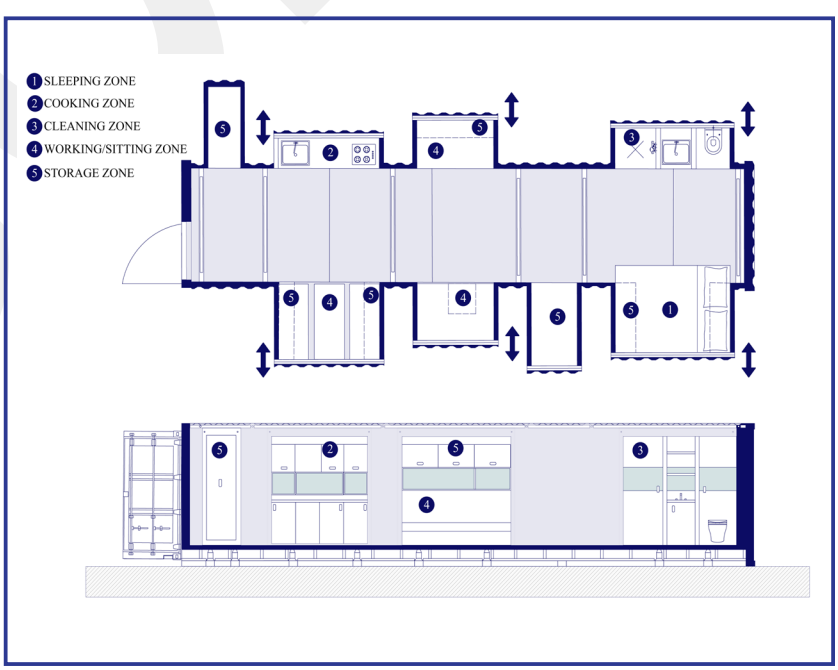


Figure 36: Plan and Section Drawings of Mobile Dwelling Unit (Drawn by Author)

150. Robert Kroenberg, Christopher Scoates, Aaron Betsky, Henry Urbach, Lot-Ek: Mobile Dwelling Unit (California: D.A.P./University Art Museum, 2003), 84

151. Ibid.88

152. Ibid.

MDU can be used as a singular unit or to be plugged into a megastructure called MDU Harbors [Figure 37] which is designed as a part of the MDU concept. MDU harbors presumes transportation of the MDU's through seaways and as a result MDU's can be plugged into structures that are located in diverse harbors.

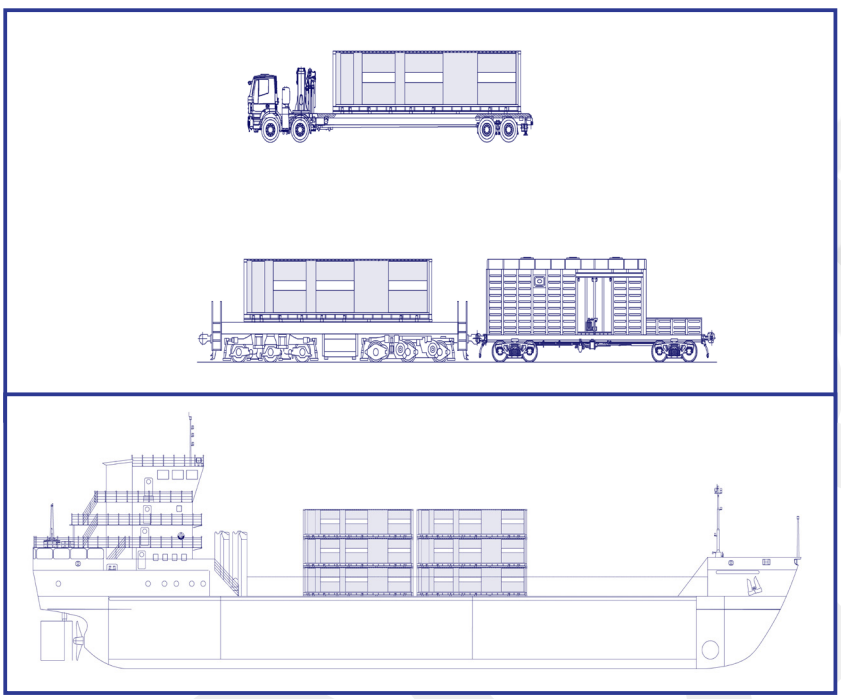




Figure 37: MDU Harbors (Source: Robert Kroenberg, Christopher Scoates, Aaron Betsky, Henry Urbach, Lot-Ek: Mobile Dwelling Unit)

Figure 38: Transportation scenarios of Mobile Dwelling Unit (Design by Author)

When it is employed as a singular unit independent from MDU Harbors, expandable volumes can be completely closed in order to turn the MDU to its standard size. With this feature, MDU becomes suitable to transport with any medium that typical containers can be transported with, such as ships, trucks, trains [Figure 38].

Changing Ideals

03

This chapter investigates the changing ideals that contributed to the development of prefabricated micro living units, while also examining the socio-economic conditions that catalyzed their emergence. This investigation will be conducted in two parts. The first part will investigate the production of prefabricated micro living units during the 1960s-1970s, highlighting the architects' aspirations to create futuristic living spaces driven by advancements in technology and successful space exploration, as well as their predictions about the future. The second part will focus on the production of prefabricated micro living units in the 2000s-2010s, where architects endeavored to address contemporary challenges such as demographic shifts, environmental concerns, and economic crises in order to provide viable solutions. The ideals with which architects and designers were motivated to design prefabricated micro living units differed significantly between these two periods. In the latter a will to produce the future was dominant, where else in the latter saving the day was the motto.

3.1. 1960s-1970s: Will to Produce to Future

In the 1960s, following the end of World War II, people were extremely optimistic about the future and the capabilities of humankind in creating advancement in various fields.[153] At the beginning of the 1960s, the economy started to expand consistently.[154] Both Japan and Western Europe reached more than a 5% growth rate in the economy during the first five years of the 1960s.[155] People firmly believed that through science and technology, humankind could reach the ability to exceed the limits of Earth and reach brand new horizons. As a result, architects designed and experimented based on their predictions for the future. The thriving economy and advancement in technology, enabled the emergence of will to produce a new life order for the future towards speculative projections.

153. Anna-Maija Kuitunen, "Futuro no. 001 – Documentation and Evaluation of Preservation Needs" (Conservation Historical Interiors Bachelor's Thesis, Metropolia University of Applied Sciences), 2010, 16

154. Council of Economic Advisers, Economic Report of the President, 1967: Chapter 5, Growth and Balance in the World Economy, (Washington: Biblio Gov, 2012), 170

155. Ibid.171

3.1.a Technology Driven Productions and Space Race

These optimistic approaches towards the future found their reflections through architecture about how people reside and inhabit the future on Earth or even outside of the Earth. As a result of successive space studies and developments, people predicted that soon space would become a new habitat for the human species. Consequently, architects began to design future cities that were significantly different from the conventional notions of urbanism and living unit production.[156] Moreover, following achievements including launch of Sputnik 1 in 1957, cosmonaut Yuri Gagarin's orbit of the Earth in 1961, the US moon landing in 1969, the ground was prepared for the emergencea of living units which were influenced by the space age. Architects began designing living units that served as references for living in extraterrestrial conditions. They developed their concepts by drawing parallels with predicted life forms in space, considering daily rituals, materials, production methods, and even form and colors. During this period words like avant-garde, radical, futuristic and space age started to be used frequently in architectural publications.

Futuro House was one of the productions that emerged as a result of the current environment at the time.[157] In the article published in "Nomadic Art Review", Susanna Pettersson stated regarding the futuristic features and the space age influence of the Futuro House: "The round plastic house was to be the trademark of the new space age and of trendy neo-nomads."[158] As seen in Figure 39, an example of this can be observed in the striking resemblance of the Futuro House to flying saucers in terms of its features and appearance. For instance, the entrance door and the structural leg resembling a landed flying saucer, contribute to its distinct design. Moreover, the color range employed in both the interior and exterior of the Futuro House further reinforced the association with the imagery associated with space age influence.

On the other hand, parallel with the rapid economic growth in Japan, Metabolism emerged within the agenda of "advocating the creation of a new relationship between humanity and technology."[159] The Metabolists, who thought that technology would dominate human life, aimed to produce a life scenario where the control would be on humans. Furthermore, in his preface

156. Anna-Maija Kuitunen, "Futuro no. 001 – Documentation and Evaluation of Preservation Needs" (Conservation Historical Interiors Bachelor's Thesis, Metropolia University of Applied Sciences), 2010, 3

157. Ibid.

158. Susanna Pettersson, "The Nostalgia of the Future. The Architect Matti Suuronen's Plastic House Was to be the Trademark of the New Space Age and of Trendy Neo-Nomads." Nomadic Art Review, (January, 1999), 11, https://mikataanila.com/wp-content/uploads/2014/02/futuro.pdf

159. Kisho Kurokawa, Metabolism in Architecture, (Studio Vista, 1977), 31



Figure 39: Flying Saucer resemblance of the Futuro House within the Doors and Form (Source: https://www.elledecoration.co.uk/)

to Metabolism in Architecture, Kurokawa stated that all of the countries, despite their belonging to different cultures, will be united in the belief of technology in order to build future architecture.[160] Thus, Kurokawa believed that technology would become a unifying force for people and soon become the center of life.

According to him, since the industrial revolution, diverse technologies have adapted daily life through tools to make life easier like automobiles as a replacement for horses, electricity to enlighten the dark.[161] However, according to him, the capsule living unit and the users themselves created a new kind of existence in which the capsule maintains a meaningful presence within the user. He explained his argument as follows:

> Instead, they will equip themselves with various devices with which to perform complicated roles which are beyond their capabilities as living creatures. But without those devices they will be unable to perform their roles in society. A device which has become a living space itself in the sense that a man cannot hope to live elsewhere is a capsule. And signs of such a development are beginning to appear around us.[162]

These sets of ideas and their implementation can be observed in the Nakagin Capsule Tower, where a fixed built-in interior became an extension of envisaged lifestyle through technological appliances, futuristic environment, and within the way daily routines perform. Thus, the capsule unit itself is presented as an experience that became an integral part of the user.

3.1.b. New Life Order For the Future

Kurokawa was one of the architects who designed with the agenda of constructing the future through envisaged life scenarios.[163] He focused on experimentation of prefabricated micro living unit's production. His book Metabolism in Architecture and his Nakagin Capsule Tower highlighted technology-driven approach towards architecture and the will to produce future life through architecture. In his article "Capsule Declaration" he stated that, "I took an iconoclastic position in order to penetrate the existing order,

160. Ibid. 76

161. Ibid. 75

162. Ibid. 76

163. Furthermore, Kurokawa's interest in the future of architecture was apparent since his college years. He studied at Kyoto University because they had Uzo Nishiyama on their academic staff who was specifically working on the future of the housing crisis and was investigating social aspects of architecture. Kisho Kurokawa, Metabolism in Architecture, (Studio Vista, 1977), 19.

break down architecture into units for individuals and then seek to establish a new order."[164]

Besides the technology-centered predictions, Kurokawa's projections also incorporated demographic shifts and future urban life scenarios which contributed to shaping the concept of the Nakagin Capsule Tower. For instance, Kurokawa mentioned that, at the time, the rate of people who moved their homes was about 25% in the US, in Japan, this rate was expected to rise 20% in the near future.[165] Furthermore, he claimed that to detect Tokyo's population, focusing on the night-time population was not an accurate method regarding the changing daytime population due to mobility of the population.[166] Throughout these sets of datas and predictions, he stated that "the disintegration of a community and the unusual upsurge in migration indicate the advent of capsule space as the new form of dwelling, in the shape, for example, of the mobile home."[167] Thus, The Nakagin Capsule Tower addressed mobility-oriented life scenarios within its concept by incorporating the ability to relocate through the attachment of capsule living units to the main structure of another capsule tower located at different sites. According to Kurokawa, capsule living units would eventually become a vital part of day-to-day routine.[168] He used specific terminology, i.e. "homo-movens", to define capsule living unit users. Homo movens referred to people who changed their location and home due to constant travel.

In order to support his argument, Kurokawa also cited Jean Fourastier, who was an economist[169] to support his argument that people will need mobility oriented concepts in the future. According to Fourastier, people were going to work less in the future.[170] Thus, people were going to have more time to spare at various locations such as the seaside, rural areas,etc. Kurokawa predicted that in this near future capsules will be suitable for this user profile.

Another prediction that highlighted the demographic changes was family structure. Before the war, due to patriarchal understanding and the given priority to a large family, the most important part of the dwelling was the common living area. After the war, this order left its place to bedrooms, since the married couple was the center of the living unit; even having a child was optional, which means a children's unit could have been added later as needed.[171] Towards this situation, Kurokawa projected that in the future:

> Individuals, both male and female, have capsules of their own when they are single. When a man and a woman marry, they will

165. Ibid. 77

166. Ibid. 76

167. Ibid. 76

168. Ibid. 77

169. "Jean Fourastie; Economist Who Aided Reconstruction of France," Los Angeles Times, accessed September 2023, https://www.latimes.com/archives/la-xpm-1990-07-30-mn-749-story.html

170. Ibid. 77

171. Kisho Kurokawa, Metabolism in Architecture, (Studio Vista, 1977), 80

> furnish their respective spaces to form a necessary space for themselves as individuals- living space for the couple will not be provided first and rooms added later for individuals around it.[172]

Kurokawa highlighted that capsule living units were not more affordable than conventional living units yet they offered new living scenarios to their users. This expression summarizes the downsizing of the unit not related to any economic concerns or being an alternative solution to existing problems; it's connected with the selling of a certain lifestyle and illustrates that the idea of designing a new life through architecture has remained in the background of economic concerns.

Thus, the Nakagin Capsule Tower emerged as a result of the listed predictions and motivations for constructing and designing future life scenarios. However, In the The Architects' Newspaper article titled "A Successful Failure: Remembering the Nakagin Capsule Tower" which was written about the decision to demolish it in 2022, Nakagin was mentioned as follows:

> Still, the fact that it got built was fantastic. It was possible in Japan only at this time of expansion and optimism. This was the future city Kurokawa showed us a version of a possible pod world that proved to be immensely influential, for better and worse. While we shouldn't repeat the tower's mistakes, its optimism about alternative futures is a legacy worth noting.[173]

Consequently, Thomas Leslie, architect and the writer of the article,"Just What is it that Makes Capsule Homes So Different, So Appealing? Domesticity and the Technological Sublime'' summarized these productions of the 1960s as follows:

> Paralleling the ultimately optimistic-some would say naive-motives of those interested in housing as a problem of social science, this fringe group saw the cultural potential for housing as a radically efficient process.[174]

On the other hand, in the same period when the Nakagin Capsule Tower was designed with the agenda of producing a new living order based on

172. Ibid.

173. Mark Dyhtam, "A successful failure: Remembering the Nakagin Capsule Tower," The Architect's Newspaper, June 22, 2022, https://www.archpaper.com/2022/06/a-successful-failure-remembering-the-nakagin-capsule-tower/

174. Thomas Leslie, "Just What Is It That Makes Capsule Homes So Different, So Appealing? Domesticity and the Technological Sublime, 1945 to 1975," Space and Culture 9, no.2 (2006): 207, http://dx.doi.org/10.1177/1206331205275009kagin-capsule-tower/

architecture, a parallel but exceptional approach was also observed in the Italy: New Domestic Landscapes Exhibition. Emilio Ambazs, curator of the exhibition underlined that designing the future was not the solution to today's problems, and in fact, they emphasized that today's problems should not be ignored while focusing on the long journey, and they criticized modern architects in this context. He stated that it was not necessary to design the future or save the present, but to provide parallelism and to think long term. This approach explained by Emilio Ambasz as follows:

> It becomes evident that neither the experiences of today nor the vision of tomorrow can be emphasized at the expense of one another, and that the search for quality in daily existence cannot afford to ignore the concomitant problems of pollution, the dete rioration of our cities and institutions, and poverty. The task, there fore, is to reconcile the overview with the exigencies of the mo ment, to be aware of both the goal of the long journey and of the day-to-day activities along the way.[175]

This approach was also expected to be referenced in the environments in the exhibition. Consequently, throughout this agenda, altering lifestyles combining "more informal social and family relationships, and evolving notions of privacy and territoriality; as well as to the exploration of new materials and techniques of production" considered in the design process of the environments.[176] Besides, in addition to specific considerations, general considerations are also presented to designers in the sections "The Domestic Landscape as Urban Society" and "The Domestic Landscape as Family Environment". "The Domestic Landscape as Urban Society" constituted urban life projections in the 2000s-2010s. It has been highlighted that the majority of the population will live in the city and future considerations will not be sufficient for individual industrial solutions. Thus, predictions have also been a part of the exhibition and considering the long journey.

175. The Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design (Greenwich: New York Graphic Society, 1972), 137

176. The Museum of Modern Art Department of Communication, Italy: New Domestic Landscapes, Press Release," 1972, 2

3.2. 2000s-2010s: Saving the Day

In the 21st century, the motives behind the design and experimentation of prefabricated micro living units have undergone significant changes compared to the 1960s. This shift can be explained by the following factors: During the 1960s, the production of prefabricated micro living units was primarily driven by the motive to design for future life and ideals, often catalyzed by the predictions. Architects and designers focused on envisioning innovative living spaces that would accommodate the changing needs and expectations of inhabitants in the years to come. In contrast, in the 2000s, the emergence of prefabricated micro living units became one of the alternative solutions to address critical contemporary challenges. Rather than focusing on optimistic future living scenarios like in the 1960s, architects started to design living units to save the day; by facing and minimizing the negative effects of the current societal, environmental and economic conditions.

3.2.a. Megacities and Demographic Shifts

One of the current circumstances that catalyzed the production of prefabricated micro living units was the rising numbers of megacities around the globe. According to 2018 data from the United Nations, there are 33 megacities in the world and by 2030, this number is expected to rise to 43.[177] Megacities are attractive locations for busy work schedules and dynamic social life routines for young professionals, couples and individuals. Chris Weller who is senior editor in Business Insider explains these circumstances in his article titled "27 Crazy Pictures of Micro-Apartments Around the World" as follows:

> Humanity is increasingly moving into cities, but the Earth isn't getting any bigger. That means our apartments are getting smaller and our living arrangements denser. Some people get roommates to avoid living in such small spaces. Others, because of poverty or personal obligations, have no choice but to accept their crowded circumstances. We don't know how they do it, but somehow they make it work.[178]

177. United Nations, Department of Economic and Social Affairs, "Population Division, The World's Cities in 2018—Data Booklet," (2018), 2 https://www.un.org/en/development/desa/population/publications/pdf/urbanization/the_worlds_cities_in_2018_data_booklet.pdf

178. Chris Weller, "27 Crazy Pictures of Micro-Apartments Around the World," Business Insider, February 1, 2017, https://www.businessinsider.com/craziest-microapartments-around-world-2017-1

Urban density due to migration from rural areas to urban areas increased the square meter costs in cities. According to the 2022 data from the Global Property Guide, the buying price per square meter in Hong Kong was $23,695, in Germany it was $5,585, in France it was $14,808, and inurkey it was $1,955.[179] Thus, due to the the challenge regarding finding affordable housing, minimizing the living spaces became a necessity. Especially in urban scenarios in order to lower the footprint that living units occupy, architects tend to minimize the base area. Both as a unit of measurement to highlight the small scale of the living units and as an alternative site selection regarding land ownership, car parks have been used. Thus, prefabricated micro living units have emerged in an environment in which houses have become smaller enough to compare with car and parking lot sizes. For instance, regarding similar approaches, Tikku House occupied space as much as the parking lot which was equal to 2.5mx5m. The same attitude can be observed in Tricycle House with the measure of the unit is 1.44mx2.2.60mx2.50m without its cycle which easily can be located in the parking lots.[180] This issue in the Tricycle House was also related to site-specific conditions. There is no right of owning private land in China.

Another factor that catalyzed the widespread productions of the prefabricated micro living units was the demographic shifts. Before the 1950s common family typology was predominantly nuclear family while today, there is an increase in one-person households, and individuals tend to live in smaller units.[181]

On the other hand, rapid urbanization and the rising number of megacities resulted in changing social and individual habits which led to a change towards the way people dwell and live in the cities in 2000s-2010s. In the scale of urban mobility, it is mostly related with the rapid growth in the number of megacities and densely populated urban areas, and with the amenities that the city offers. Thus, urbanites started to develop new habits that resulted with the shift in the perception of living units. For instance, there is research conducted by Yanni Yang, Alex Pentland, and Esteban Moro, titled "Identifying Latent Activity Behaviors and Lifestyles Using Mobility Data to Describe Urban Dynamics" that reveals how urbanites interact with the surrounding city environment. The study constitutes "privacy-enhanced dataset of the mobility visitation patterns of 1.2 million people to 1.1 million places in 11 metro areas in the U.S. to detect the latent mobility behaviors and lifestyles in the largest American cities."[182] The research shows that

179. "Global SQM Prices by Country," Global Property Guide, accessed September 2023, https://www.globalpropertyguide.com/most-expensive-cities

180. "Tricycle House," Architizer, accessed June 2023,https://architizer.com/projects/tricycle-house/

181. Esteban Ortiz-Ospinahe, "The Rise of Living Alone: How One-Person Households are Becoming Increasingly Common Around the World," Our World in Data, December 10, 2019, https://ourworldindata.org/living-alone

182. Yanni Yang, Alex Pentland and Esteban Moro, "Identifying Latent Activity Behaviors and Lifestyles Using Mobility Data to Describe Urban Dynamics," EPJ Data Science 12, no.15 (2023), 1, https://doi.org/10.1140/epjds/s13688-023-00390-w

people who go out to run errands also eat outside. Additionally, committed public transportation users prefer socializing and spending time in their districts. In addition, the research reveals that there is a connection between work life and experiencing nightlife.[183] These habits emerge as a result of the amenities, services, and socializing opportunities that the city offers, such as art and sport facilities, a diverse range of restaurants, washers and dry cleaners, etc. These emerged habits have led people to spend less time at their living units. Thus, living units become a space for sleeping like a hotel. Therefore, with the merger of high sqm prices and demographic shifts, architects invite living unit's users to take advantage of their surrounding city. Getting smaller in the context of a living unit does not mean compromising life quality. Both Tikku House by Marco Casagrande and Tricycle House by People''s Architecture Office and People's Industrial Design Office architects highlighted this approach through their concepts.

The design process of Tikku House is influenced by the daily habits of urbanites and how they shape their lives. Unlike traditional living units, Tikku House did not constitute a sewage system, running water, or a conventional kitchen. However, the project is conceived as a comprehensive package, where essential services such as food and water can be obtained from nearby establishments such as restaurants, cafes, gyms, and health spas in the city. That is probably why the designer, Casagrande, described Tikku House as a "contemporary cave for a modern urban nomad."[184] Similarly, Tricycle House shares a similar approach to Tikku House. The design of Tricycle House raises questions about the relationship between users and the land they occupy, particularly in terms of permanence and transience. Tricycle House combines cycle and attached living units which can be used both in move or located in parking lots. As seen in Figure 40, this design allows users to move their living unit with themselves wherever they want to go. As an alternative approach, Tricycle House can be mobile and adaptable, allowing it to be located in various settings, including parking lots, based on different usage scenarios. The design approach leans on a shift towards reducing footprint in private life and utilization of the use of public amenities, "public parks replace personal gardens, public toilets replace private toilets."[185]

Thus, while the production of living units was focused on larger-scale mobility scenarios in the 1960s and 1970s, examples also incorporated urban mobility in the 2000s-2010s.

183. Ibid.12

184. Lucy Wang, "Skinny Micro-Apartment can Pop Up in a Parking Space in Just One Day," Inhabitat, October 17, 2017, https://inhabitat.com/skinny-micro-apartment-can-pop-up-in-any-city-in-just-one-day/tikku-by-casa-grande-laboratory-10/

185. "Tricycle House," Architizer, accessed June 2023, https://architizer.com/projects/tricycle-house/



Figure 40: Tricycle House on the move (Source: Archdaily)

3.2.b. New Life Order for the Present

Advancements in the internet, flat-screen television, wireless phones and diverse household appliances have become important features of day- to day routines and the way people live in the 2000s-2010s. There has been a paradigm shift towards definition and perception of wealth from owning a property to reaching compact technologies.[186] These changes made inhabiting smaller spaces possible because compact technologies, including the internet and household appliances, have also reduced the need for the physical space. With the adaptation of the internet, tablets and mobile phones to daily life, space was and is no longer needed to stock books, magazines, CDs, etc. The reflections of this paradigm shift at the architectural scale is examined in the book Micro Architecture by Richard Horden. According to Horden "we can now touch and be touched by the world from a tiny space." [187] Horden claimed that the new spatial configuration of the compact and smart solutions meant "focusing on the essential - less is more." [188]

Towards reaching an environmentally conscious life, prefabricated micro living units may be instrumental with their features like occupying minimal space, consuming fewer resources and generating less energy. Prefabricated micro living units embody environmentally ethical stance. Especially after the industrial revolution, there has been an increase in the emission of harmful gasses into the atmosphere and the use of fossil fuels. Consequently, due to technological advancements and industrialization, alterations have occurred in the world's climate system. For example, the levels of carbon dioxide emissions have increased from 22 billion metric tons in 1990 to 34 billion metric tons in 2020.[189] After realizing the irreversible impact of human activities on climate change and the deteriorating balance of the natural environment, it has been tried to prevent negative results with sustainable approaches. In November 2016, the United Nations took action in response to this issue within the Paris Agreement. This agreement contained a set of rules and actions to lessen the emissions and cooperation with each country to comply with climate change and its impacts.[190] Sustainable policies have reflections in different fields, and environmentally friendly actions have begun to be taken in architectural production and design processes such as considering carbon footprint, energy consumption, CO2 emissions of the design. In addition to the embraced sustainability approaches in the design processes, it is also

186. Richard Horden, Micro Architecture, (London: Thames Hudson, 2008), 234

187. Ibid.

188 "M-ch" last accessed 11.06.2023 http://www.microcompacthome.at/company/

189. Hannah Ritchie, Max Roser and Pablo Rosado "CO_2 and Greenhouse Gas Emissions," Our World in Data, May 2017, https://ourworldindata.org/co2-and-greenhouse-gas-emissions

190. "The Paris Agreement, What is Paris Agreement," United Nations Climate Change, accessed June 2023, https://unfccc.int/process-and-meetings/the-paris-agreement

possible to present a sustainable life in the final product and the life scenarios the design envisaged in it. Thus, prefabricated micro living is a total package of sustainable architectural practices since it offers a lifestyle that focuses on minimalism, downsizing and generating less energy through maximizing spatial efficiency.

Implementation of ethical stance and environmental concerns in the 2000s is apparent in Tikku House by Marco Casagrande and his professional attitude. The approach of Finnish Architect Marco Casagrande from Casagrande Laboratory defined Tikku House as developing a "safe-house for neo-archaic biourbanism".[191] Biourbanism reflects environmental concerns and seeks out solutions to climate emergencies through the idea that "cities must be considered as a form of nature" [192] In addition to Biourbanism, the theoretical framework of Tikku House is derived from urban acupuncture. Casagrande explained his theory as follows:

> Urban Acupuncture is pliant, organic and relieves stress and industrial tension in the urban environment - thus directing the city towards the organic: urban nature as part of nature. Urban Acupuncture produces small-scale, but ecologically and socially catalytic development on the built human environment.[193]

Based on this definition, he has described Tikku House as "a needle of urban acupuncture".[194] Consequently, it is designed to address current issues by creating a life scenario centered on its small scale and environmental considerations. In many ways, through integration of concepts like Urban Acupuncture and Biourbanism, Tikku House was located within an urban environmental discourse. This theoretical framework was put to practice through self-sufficient features in Tikku House to create a sustainable living unit that uses solar panels for energy generation, adopts dry toilets and avoids installing a running water system.

Tricycle House also prioritized sustainable approaches. Even the emergence of Tricycle House was a part of a Biennale that investigated the future of architecture through sustainability. With this proposal Tricycle House blur the line between its user and the site that user occupies that they inhabit while offering an off-grid living unit powered by man power or batteries. In other words, in addition to eliminating the problems caused by the ban on land ownership in China, the project also addressed the concerns

191. "Tikku," Casagrande Laboratory, accessed June 2023, https://www.casagrandelaboratory.com/projects/tikku

192. "What is Biourbanism?" Biourbanism, accessed June 2023, https://biourbanism.info/about/

193. Marco Casagrande, "From Urban Acupuncture to the Third Generation City in the Teaching Landscape: The Studio Experience," Journal of Biourbanism 4, (2016), 8

194. Tim Nelson, "Helsinki Architecture Firm Launches Prefab, Solar-Powered Homes That Fit in a Parking Spot," Architectural Digest, October 12, 2017 https://www.architecturaldigest.com/story/helsinkHelsinki Architecture Firm Launches Prefab, Solar-Powered Homes That Fit in a Parking

on sustainability. Tricycle House highlighted the amenities that the surrounding city contained such as gym, restaurants etc. In this context, Tikku House and Tricycle House share similar agendas through sustainable arrangements within the urbanite life scenarios. This approach represents the reduction of individual footprint through the utilization of public resources, which is quite similar to using public transportation.

Mobile Dwelling Unit's approach to sustainability was in terms of up-cycling existing and working systems including water tanks, shipping containers, etc. In the MDU Lot-Ek preferred to up-cycle existing shipping containers. Ada Tolla, the co-founder of Lot-Ek, stated in one of the interviews that:

> The reason why we use existing containers and existing objects in particular is not because we are interested in recycling and environmental issues at first concern. Although we are very happy that they have come along with that we are doing, we are more interested in the creative process that develop in working with existing objects.[195]

To sum up, observations reveal that there have been shifting ideals in the production of prefabricated micro living units during two distinct historical periods: the 1960s-1970s and the 2000s-2010s. These changes are primarily influenced by the economic conditions of each era, ongoing technological advancements, and shifts in the demographic structure. Furthermore, specific factors unique to each period, such as environmental concerns and the rise of megacities, have played significant roles in leading a paradigm shift and evolving needs. Consequently, while prefabricated micro living units in the 2000s focused on addressing immediate challenges, those in the 1960s aimed to construct new living scenarios with optimistic plans for the future.

195. Robert Kroenberg, Christopher Scoates, Aaron Betsky, ed. Henry Urbach, Lot-Ek: Mobile Dwelling Unit (California: D.A.P./University Art Museum, 2003), 82

Continuing Visions

04

Despite the differences between the prefabricated micro living units produced between 1960s-1970s and 2000s-2010s, especially regarding their historical and the social contexts as well as the motives of the architects, there also are common features shared by micro living units produced in both periods. This chapter examines the common features that unite them. The aim in exploring these shared characteristics, is to get a deeper understanding of the evolution and significance of prefabricated micro living units. The chapter is composed of two main parts: "Interplay Between Mobility and Prefabricated Micro Living Units" and "Relationship between Spatial Configuration and Envisaged Lifestyle".

4.1. Interplay Between Mobility and Prefabricated Micro Living Units

Prefabrication enables the living units to be mobile, as they are suitable for easy assembly and disassembly. Unlike conventional units, their relationship with the ground is temporary and they have lightweight components which enables them to be easily transportable. Additionally, small scales also contribute to their mobility. This way, they can be moved as a whole with various transportation mediums without being disassembled, including seaways, highways.

In the historical trajectory, architects' predictions regarding mobility of the society have played a prominent role in the production of prefabricated micro living units 1960s-1970s and the 2000s. For instance, Kisho Kurokawa, the architect of the Nakagin Capsule Tower and Richard Horden, the architect of the Micro Compact Home, made similar statements regarding the arrival of the mobility oriented features. According to Kurokawa, in the future signs of wealth would be based on ownership of equipment that allowed high mobility, unlike the ownership of land and properties at a time.[196] Similarly, in the 21st century, Richard Horden noted that the previous order, which defined wealth in properties and objects, has gradually been replaced by "a

196. Kisho Kurokawa, Metabolism in Architecture, (Studio Vista, 1977),78

high degree of physical and intellectual mobility."[197]

These concepts aimed to depict and represent future cities and life scenarios, emphasizing the importance of mobility in shaping urban environments. Nakagin Capsule Tower was another project that consisted of a service structure and attached capsules, designed with the dream to achieve the high level of mobility. In order to achieve this goal, Nakagin was designed to enable the movement and the potential re-plugging of the capsule living units to another capsule tower's main structure. And yet, such structures were never built.[198] On the other hand, Nakagin was used by the mobile population as predicted, including by people who already had dwelling outside of Tokyo but also preferred to occasionally stay in the city.[199] Kurokoawa's "Homo Movens" was a reality.

As a continuing vision regarding the mobility of the prefabricated micro living units, Mobile Dwelling Unit and MDU Harbor shared a similar approach with inspiration drawn from 1960s megastructures and plugged in living units. The MDU was designed with the intent of transforming standardized shipping containers into dwelling. Due to the standardized size of shipping containers, Mobile Dwelling Unit can be transported to any location through highways, railroads, and seaways. Lot-Ek themselves explain the project as "The MDU travels with its dweller to the next long-term destination, fitted with all live/work equipment and filled with the dweller's belongings."[200] MDU's user profile is the people who prefer to change their location frequently. Yet MDU was also compatible for permanent usage.

The concept of singular MDUs, which is based on the relationship between mobility and temporality, was also articulated with the MDU harbors project. As seen in Figure 41, there are depictions of cranes and highlighting the "ever-changing city matrix."[201] MDU Harbors was the megastructure that allows stacking MDU's in the various harbors around the globe. MDU harbors were similar in context to Nakagin Capsule Tower, with its main structure and detachable capsule living units. These main structures constituted infrastructural systems including water and electricity to provide a semi-permanent living environment to MDU users who prefer transience and mobile lifestyle. These two initiatives which emerged at different periods of time, reveal continuing vision through mobility-oriented productions.

Consequently, in the 1960s-1970s and 2000s-2010s, prefabricated micro living units were designed with mobile usage scenarios. Even though the pursuit of this continuing vision differs in terms of agendas, predicted and

197. Richard Horden, Micro Architecture, (London: Thames Hudson, 2008), 234

198. Zi Ye, "Z-Cube: Mobile Living for Feminist Nomads" (Master Thesis, University of Massachusetts Amherst, Amherst, 2017), 56, https://doi.org/10.7275/10099872

199. Kisho Kurokawa, Metabolism in Architecture, (Studio Vista, 1977), 105Amherst, 2017)

200. "MDU-Mobile Dwelling Unit," accessed June 2023, https://Lot-Ek.com/mdu-mobile-dwelling-unit

201. Ibid.

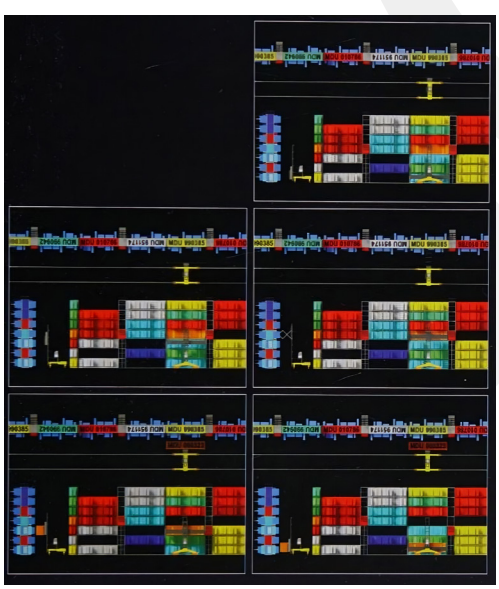


Figure 41: Crane depiction in the MDU Harbors (Source: Robert Kroenberg, Christopher Scoates, Aaron Betsky, Henry Urbach, Lot-Ek: Mobile Dwelling Unit)

intended mobility life scenarios have been more integrated into daily life in the 2000s-2010s with advancement in technology, demographic change, globalization. Moreover, the predictions and projections made in the 60s have been met with contemporary reality.

4.2. Relationship Between Spatial Configuration and Envisaged Lifestyle

Despite the differences in historical and social contexts, prefabricated micro-living units have emerged to meet basic human needs in limited space. In order to respond to this common agenda, parallel interior scenarios and configuration have been experimented with both in the 1960s-1970s and 2000s-2010s. In this section, the common life scenarios derived in these two distinct periods, spatial configuration approaches and how functions are distributed within the prefabricated micro living units are discussed.

4.2.a. Common Features of the Spatial Configuration in the Prefabricated Micro Living Units

Due to their small scale, precision in design becomes crucial in prefabricated micro living units, as every centimeter must be utilized to avoid wasting space. Therefore, in order to maximize spatial quality in the limited areas, common spatial configuration actions have been taken [Figure 42].

In contrast to conventional living units which employ room-oriented spatial configurations, prefabricated micro-living units consist of zones. In these zoning systems, often functions are overlapped. For example, eating and cooking areas often intersect, or working and eating share the same surfaces. Consequently, this zoning system serves to open-plan layout to create openness and continuities in the space while highlighting natural light and ventilation with avoiding unnecessary dividers in such limited space. In scenarios where open plan is used in spatial configuration, light dividers such as curtains, sliding doors are used to provide private space when it's needed.

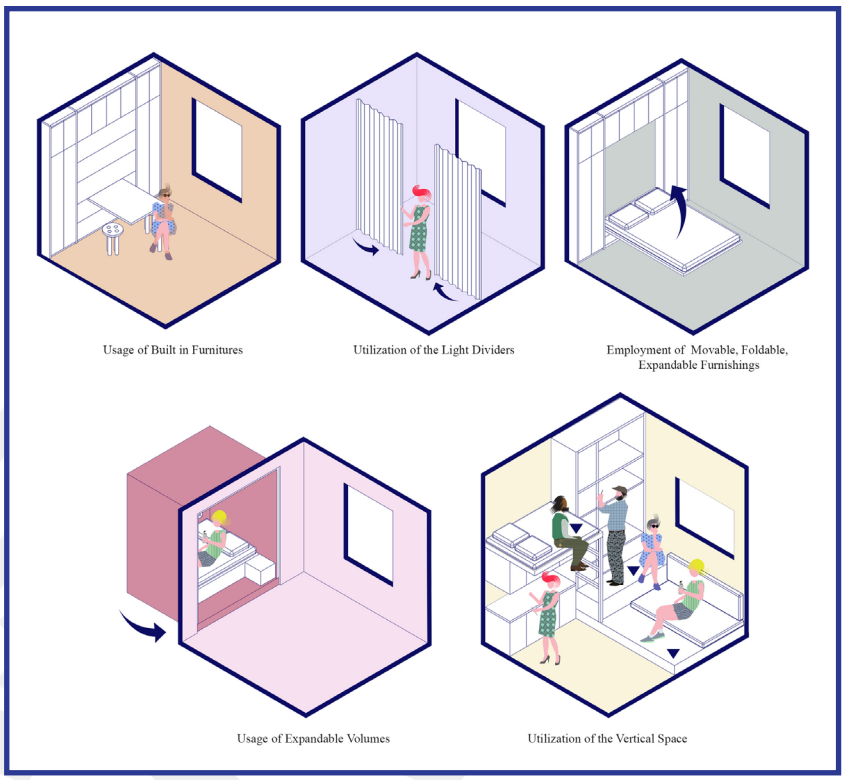


Figure 42: Common Features of the Spatial Configuration in the Prefabricated Micro Living Units (Drawn by Author)

Another prevalent design action in the design process of prefabricated micro living units is the utilization of the vertical space. Utilization of the vertical space both helps to keep base area at minimum and allows for efficient use of the available space. In this design approach, the space is not defined by stories, but by functions assigned to different levels. Utilization of vertical layout can be observed in Tikku House with the aim of keeping the base area at minimum while continuing utilizing stories.

In Micro Compact Home, on the other hand, there is both minimum base area and utilization of the levels rather than stories. Level usage can be observed in the main floor, sitting zone and sleeping zone relationship. As seen in Figure 43, the sitting zone is located on a lower level than the main floor in order to place a foldable bunk bed on top of the sitting zone.

Tricycle house adopts a similar approach to the Micro Compact Home in the employment of the vertical space. The space has been extremely minimized so that the unit can be mobile by attaching it to the back of a bicycle. This minimization resulted in the utilization of different levels. For instance, the same furniture unit performs different functions in different levels including storage, table and bed.



Figure 43: Utilization of different levels in Micro Compact Home (Source: http://www.microcompacthome.at/index.php)

Utilization of the vertical space and sustaining open plan layout is strongly connected to the adopted interior furnishings. Thus, Prefabricated living units are predominantly designed as a complete package, encompassing both the outer shell and inner spatial configuration. In this context, features of flexibility and functionality become prominent to cater to spatial transformation within the limited space. Convertible or pop-up furnishings and light dividers, such as curtains or sliding panels, are commonly used to optimize the usable area. These kinds of design decisions help living units to adapt to different activities and functions during the day while creating multifunctional space according to the requirements of the moment. Thus, the design aims to maximize the usability and practicality of the living space while accommodating the diverse needs of the occupants.

This housing typology frequently employs built-in prefabricated interior furnishings. For instance, the distinctive exterior shell shape of Futuro House directly influences the interior space and how furnishings align with the unique form, as seen in Figure 44. Nakagin Capsule Tower, Mobile House, Mobile Dwelling Unit and Tricycle House consist of built-in interior furnishings.



Figure 44: Inner Shell and Spatial Configuration Relationship in the Futuro House (Source: https://www.visitespoo.fi/en)

Furthermore, a unique approach observed in some prefabricated micro living units, like the Tikku House, is the absence of pre-designed furnishings. Instead, users have the flexibility to shape each storey according to their preferences and needs. However, as seen in Figure 45 in the Tikku House prototype they inserted regular and mobile furniture.

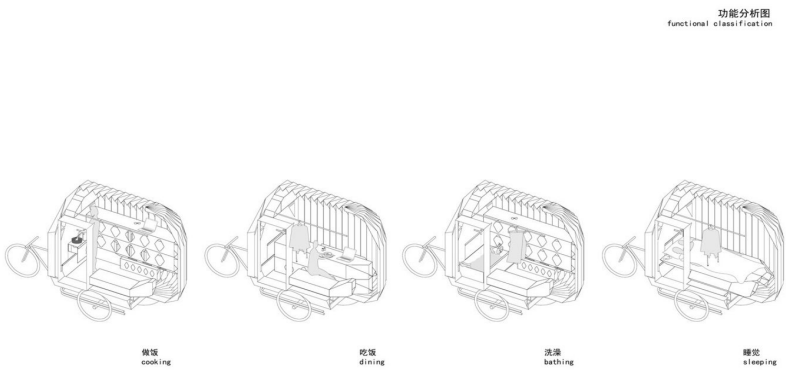
There is the utilization of multifunctional and adaptable spaces in the prefabricated micro living units through built-in furniture. These spaces often encompass compact options such as movable, foldable, and expandable furnishings and fixtures. Unlike the conventional, mass-produced furnishings which often cater to regular-sized interiors, in the prefabricated micro living units, designers seek unique solutions to reach optimum space arrangements. Therefore, a completely designed interior space plays a crucial role in improving the quality of life in such spaces.



45. Interior of the Tikku House with Conventional Furnishings (Source:Dezeen)

There is the utilization of multifunctional and adaptable spaces in the prefabricated micro living units through built-in furniture. These spaces often encompass compact options such as movable, foldable, and expandable furnishings and fixtures. Unlike the conventional, mass-produced furnishings which often cater to regular-sized interiors, in the prefabricated micro living units, designers seek unique solutions to reach optimum space arrangements. Therefore, a completely designed interior space plays a crucial role in improving the quality of life in such spaces.

However, limited space in the prefabricated micro living units affects the level of interior movement possibilities. Some prefabricated living units are configured to extremely confined spaces, such as the Micro Compact Home, Tricycle House, and Nakagin Capsule Towers, all of which are around maximum 10 square meters. Consequently, movement and repose activities are very limited in such compact spaces, and these units focus on utilizing transformable furnishings within the limited area rather than emphasizing extensive spatial transitions and interior mobility. For instance, as seen in Figure 46, there is employment of specific solutions like openable desks and beds, or transitional furnishings akin to those found in the Tricycle House, utilizing convertible furniture that can transform from a bed to a dining table and then into a countertop, all within the confines of a very limited space.



202. The Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design (Greenwich: New York Graphic Society, 1972), 182

Figure 46: Convertible Furnishings according to Functions in the Tricycle House (Source: ArchDaily)

On the other hand, As seen in Figure 47, The Mobile House was expandable on two sides, two facade sides expanded through folding plastic surfaces and the wall that enveloped the folding structure became a terrace area. The other two facades constituted metal capsules that stored services and a closet which was expandable. In the Mobile House there is more free space to move the interior furnishings based on the envisaged lifestyle in the unit, since, "…interior life its own, thus offering the user a psychological dimension of space responsive to his own will".[202]

As a result of a holistic design approach that encompasses both exterior and interior, prefabricated micro living units are often presented in a way that aligns with the envisioned lifestyle and defined living scenarios that users may encounter. Within a total living package and a significant living scenario, certain customization options are often offered to the user to highlight the sense of belonging, including interior color schemes and preferred fixtures in both periods. For instance, As seen in Figures 48-50, the Futuro House had different color schemes for both the exterior and the interior, which also differed according to the country where it was sold, including white, yellow, light blue, and, for different countries, there were gold and green selections. Interior color schemes commonly employ blue, red, orange, or violet color selections, which are strongly connected with the space age influence.

Similarly, in the Nakagin Capsule Tower, customization options were available for the capsule units based on user preferences. There were eight types of interior furnishings and two types of bathroom unit options

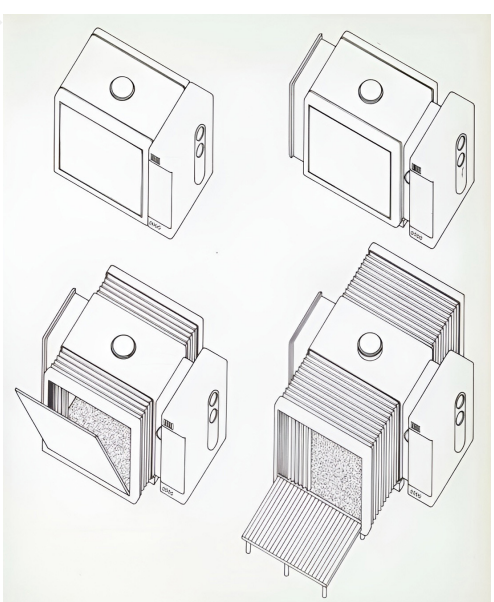


Figure 47: Movement and Repose in Mobile House (Source: Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design)

introduced to the customer yet not all variations were built.[203] In the 2000s-2010s, Micro Compact Home offered customization options within the size while Mobile Dwelling Unit provided the user can customize the furnishings including plywood, color of the plastic and coated panels in the expandable panels as they wish as seen in Figure 51.

Within the envisaged lifestyle and the agenda of the productions, in the prefabricated micro-living units, there is utilization of industrial, futuristic aesthetics both in the exterior and interiors in two periods. In the spatial configuration, the employment of technological fixtures within the built-in furnishings can be observed. This employment may be the representation of living the futuristic dreams, surrounded by diverse technological equipment and life scenarios that living units depicted both in the 1960s and also in the 2000s-2010s, within the motivation for the entrance of the 21st century, which is the millennium. Thus, these installations contribute to providing a futuristic image. For instance, the Nakagin Capsule Tower incorporates a colored TV embedded in the storage unit and appears as a flat screen, desk calculators, and radios, which were cutting-edge technologies of the time. [Figure 52] Similar approaches can be observed in the Mobile Dwelling Unit. As a part of the spatial configuration, there are intended illustrations of technological fixtures, including screens, stereos, and telephones in multiple zones [Figure 53].



Figure 48: Customizable Red Interior Color Scheme of the Futuro House (Source:https://www.inner-magazines.com/)

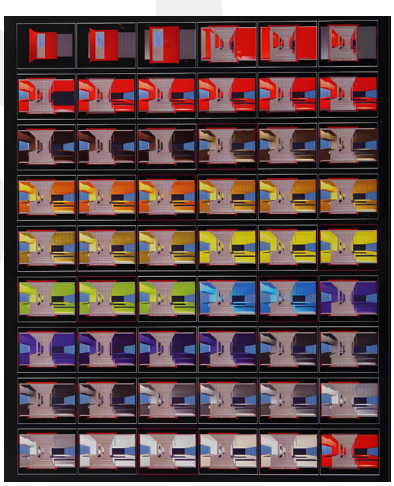


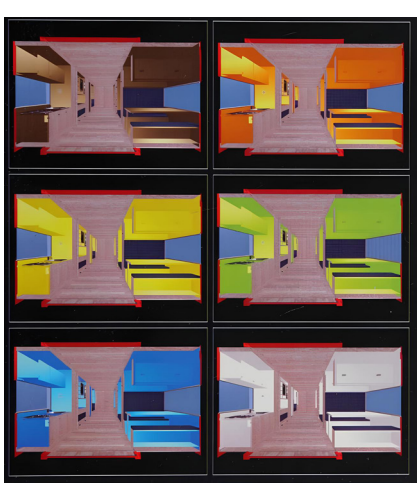
Figure 49: : Customizable Violet Interior Color Scheme of the Futuro House (Source: https://www.cultofweird.com/)



Figure 50: Customizable Blue Interior Color Scheme of the Futuro House (Source: https://www.thefuturohouse.com/)

Figure 51: Representation of Customization Option for Mobile Dwelling Unit (Source: Robert Kroenberg, Christopher Scoates, Aaron Betsky, Henry Urbach, Lot-Ek: Mobile Dwelling Unit)





To sum up, independent of the time period, both in the 1960s-1970s and in the 2000s-2010s, similar approaches in the spatial configuration of the

203. Kisho Kurokawa, Metabolism in Architecture, 105(Studio Vista, 1977), 105

prefabricated micro-living units can be observed. This parallelism is often related to the small scale, which necessitates the systematization of living space by maximizing space to fulfill basic human needs in a limited area through an open plan layout, utilization of vertical space, movable and transformable furniture, and overlapping functions.

4.2.b. Function Distribution in Spatial Configuration

Prefabricated micro living units commonly embody essential functions such as cooking, sitting (which combines working and eating), cleaning, and sleeping. These functions address the minimum level of needs required in the context of living units. However, depending on the designed life scenario, some functions may be omitted, or alternative approaches considered, and the distribution and juxtaposition of functions may vary based on their priority.



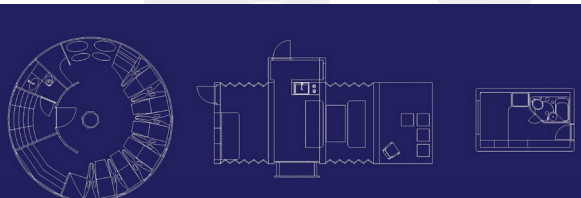
Figure 52: Utilization of Technological Equipments in Nakagin Capsule Tower (Architectural Digest)



Figure 53: Utilization of Technological Equipments in Mobile Dwelling Unit (Source: https://lot-ek.com/)

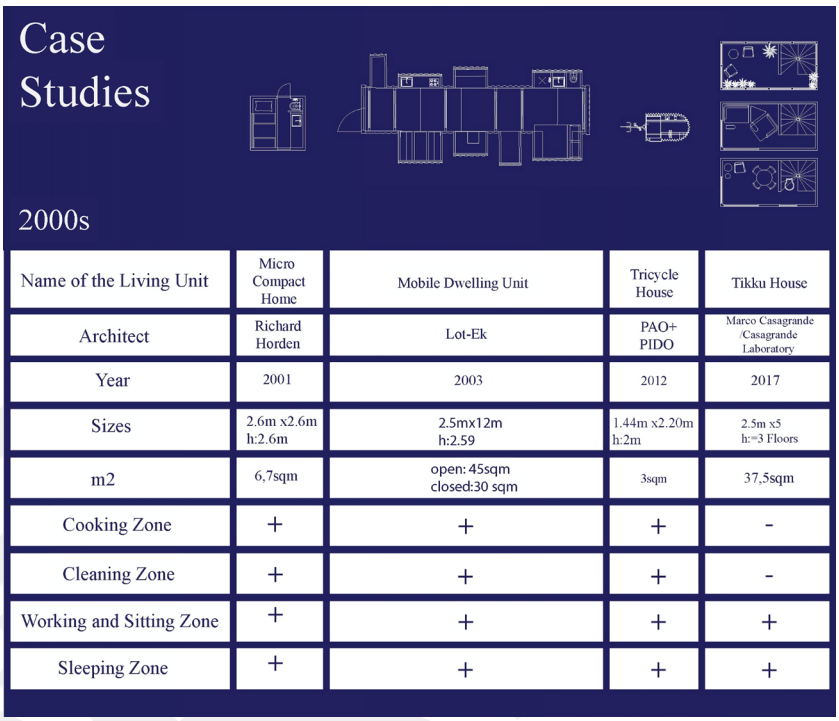
Case Studies

1960s-1970s



Name of the Living Unit	Futuro House	Mobile House	Nakagin Capsule Tower
Architect	Matti Suuronen	Alberto Roselli	Kisho Kurokawa
Year	1968	1972	1972
Sizes	Ø 8m h:4m	2.5m x4m h:2.1m	2.5m x4m h:2.1m
m2	50sqm	10sqm	25sqm
Cooking Zone	+	+	-
Cleaning Zone	+	+	+
Working and Sitting Zone	+	+	+
Sleeping Zone	+	+	+

Figure 54: Function Distribution in the 1960s Case Studies (Drawn by Author)



Name of the Living Unit	Micro Compact Home	Mobile Dwelling Unit	Tricycle House	Tikku House
Architect	Richard Horden	Lot-Ek	PAO+ PIDO	Marco Casagrande /Casagrande Laboratory
Year	2001	2003	2012	2017
Sizes	2.6m x2.6m h:2.6m	2.5mx12m h:2.59	1.44m x2.20m h:2m	2.5m x5 h:=3 Floors
m2	6,7sqm	open: 45sqm closed:30 sqm	3sqm	37,5sqm
Cooking Zone	+	+	+	-
Cleaning Zone	+	+	+	-
Working and Sitting Zone	+	+	+	+
Sleeping Zone	+	+	+	+

Figure 55: Function Distribution in the 2000s-2010s Case Studies (Drawn by Author)

4.2.b.1. Cooking Zone

In addition to the prefabricated micro living units that have a cooking area in their spatial setup like Futuro House [Figure 56], Mobile House [Figure 57], Mobile Dwelling Unit [Figure 58], Micro Compact Home [Figure 59], there are also examples that do not have a cooking area, such as Nakagin Capsule Tower, and Tikku House. In these living units within the envisaged lifestyle of the designers, dedicating a space to cooking areas might have seemed like a waste of valuable space.

This situation is based on the assumption that urbanites will often consume takeout food, order food delivery, or prefer to eat outside their homes. For instance, the spatial configuration of the Nakagin Capsule Tower resembles that of a conventional hotel room, designed as a place to stay at night rather than spending the whole day in it. The envisaged lifestyle for its users involves spending most of the time around the city. As a result, there is no cooking area, reflecting both the small scale and the lifestyle preferences. The Tikku House is another example that doesn't consist of any cooking area. Tikku House provides a safe, private area, while other functions are already available in the surrounding city environment, including various dining areas.









Figure 56: Cooking Zone in the Futuro House (Source: https://www.facebook.com/)

Figure 57: Cooking Zone in the Mobile House (Source: Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design)

Figure 58: Cooking Zone in the Mobile Dwellling Unit (Source: Lot-ek)(Source: https://lot-ek.com/)

Figure 59: Cooking Zone in the Micro Compact Home (Source: http://www.microcompacthome.at/index.php)

4.2.b.2. Cleaning Zone

While the majority of prefabricated micro living units include cleaning zones, there are also cases where shower and toilet areas are not included in the unit with the assumption that urbanites can use facilities like gyms for showers, and public toilet areas in the city. Tikku House does not contain any sewage system or a fresh water supply, which results in not having a cleaning area. According to the design team, amenities such as showers, saunas, and laundry spaces are conveniently located around the city, justifying the exclusion of these features. However, Tikku House does employ dry toilets, which require the occupants to carry freshwater. Similarly, the Tricycle House's module can be on the move within its cycle, enabling direct access to various amenities in a very short time. As a result, the unit also lacks a toilet but features a folded bathtub [Figure 60] and sink furnishings.

Mobile House, Mobile Dwelling Unit, Futuro House and Micro Compact Home had cleaning zones. The Nakagin Capsule Tower contained a fully equipped bathroom zone constructed with washable plastic, including the walls. As seen in Figure 61, the bathroom unit was well-furnished with amenities such as a soap dispenser, lamp, towel holder, and small shelves. The

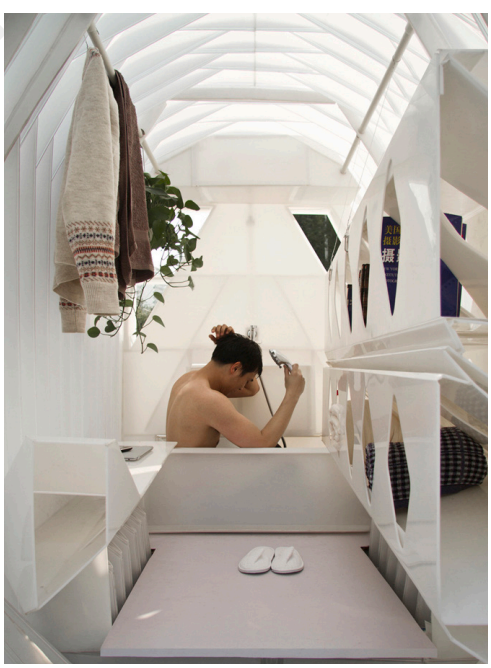


Figure 60: Tricycle House Cleaning Zone (Source: ArchDaily)



Figure 61: Nakagin Capsule Tower Cleaning Zone (Source: https://japanpropertycentral.com/)

toilet and bathtub were combined into a single unit.

On the other hand, when prefabricated micro living units are designed for rural life scenarios, they do include cooking and cleaning areas, as there may be limited amenities in the surrounding area. For instance, the Futuro House, originally designed as a ski chalet but was adaptable for various sites, and similarly, the Mobile House, both contained fully equipped cooking and cleaning areas to meet the self-sufficiency needs of rural living.

Additionally, the MDU and mc-h models are versatile, suitable for both urban and rural locations. They include cooking and cleaning areas in their spatial configuration to accommodate different living scenarios, ensuring the residents have access to essential amenities regardless of the environment.

4.2.b.3. Sleeping Zone

The sleeping area occupies a considerable space in the scale of prefabricated micro living units. To minimize this situation, alternative solutions are employed for positioning the bed within the spatial configuration. For example, bunk beds are used, with the bed positioned on top to utilize the bottom space efficiently. An illustration of this approach is observed in the Micro Compact Home as seen in the Figure 62, where a foldable bunk bed can be opened up on top of the eating area when needed.

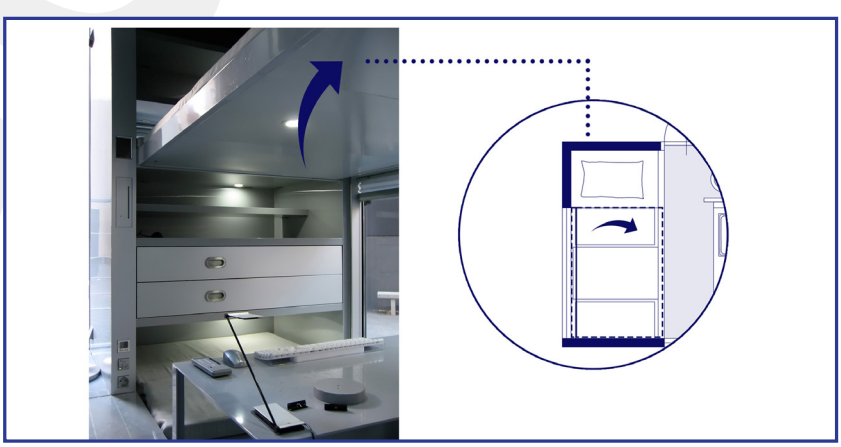


Figure 62: Openable Bunk bed in Micro Compact Home (Image Source: http://www.microcompacthome.at/index.php) (Diagram:Drawn by Author)

The Tricycle House utilizes the transformable interior furnishings to make the most of the sleeping area. When the hanging storage is unraveled,

it turns into a bed base, utilizing a foldable polyurethane surface to provide a sleeping space for one person [Figure 63].

The number of beds and their placement in the spatial hierarchy offer insights into the designed lifestyle. While some prefabricated micro living units are designed to accommodate a maximum of 2 people, others have spatial arrangements that allow for the accommodation of multiple individuals in a limited area. For example, the lifestyle envisaged in Nakagin Capsule Towers is centered around providing accommodation for those who already own a living unit outside Tokyo but need space in the city due to work or leisure activities. As seen in Figure 64, the sleeping area plays a significant role in the unit. Therefore, a single-sized bed is positioned in the central part of the room, taking up all the space it needs. Similarly, MDU consists of a real-life size bed as part of one of the extendable volumes. On the other hand, Tikku House does not include a conventional bed; it is predicted that a couch can be used as a sleeping area.

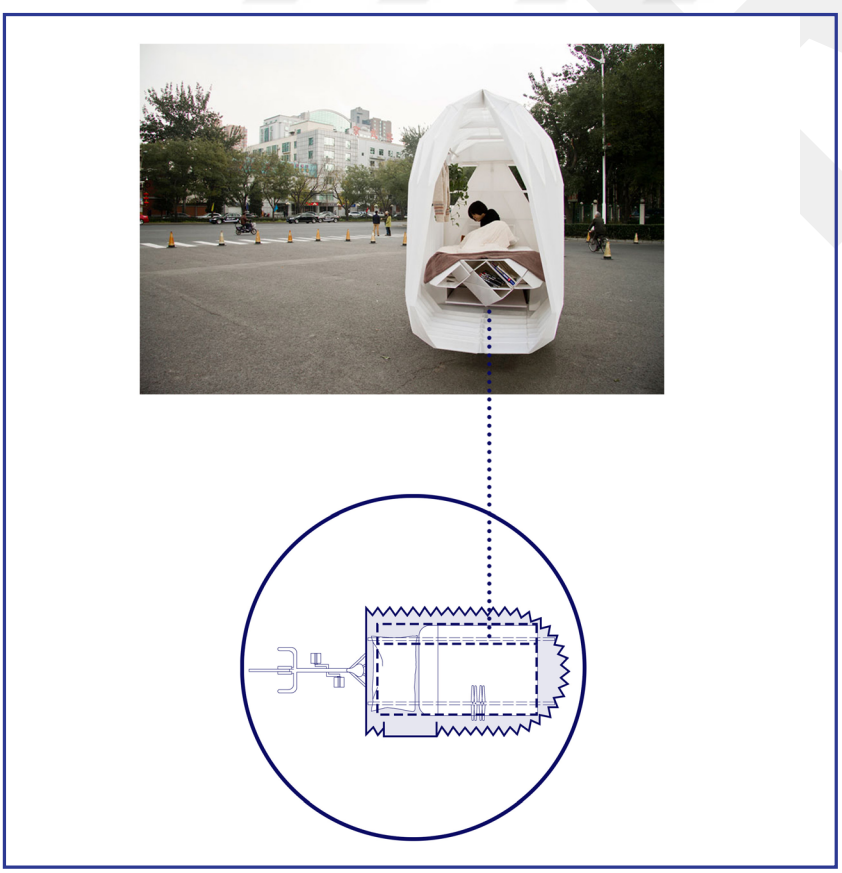


Figure 63: Convertible Sleeping Zone in Tricycle House (Image Source: ArchDaily) (Diagram:Drawn by Author)



Figure 64: Sleeping area in Nakagin Capsule Tower (Source: Divisare)

In the context of sleeping areas, there are examples that utilize a transformable bed unit to save space. For instance, in the Futuro House, single seating equipment can be converted to a bed by repositioning the back [Figure 65]. With this feature, the Futuro House can accommodate up to 6 people.

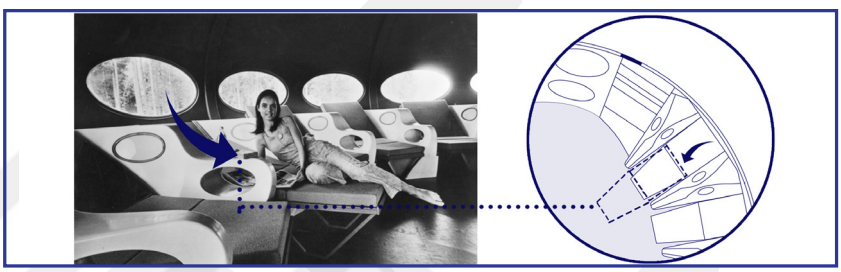


Figure 65: Re-positioned sitting elements in the Futuro House (Image Source: https://www.atlasobscura.com/) (Diagram:Drawn by Author)

The Mobile House as well proposes a sleeping area where the sofa were overlapped. As seen in Figure 66, there was one openable sofa/sleeping unit and top of it another openable bunk bed inserted. Two of these beds can be totally closed when they are not needed. This configuration allows the Mobile House to accommodate up to 5-6 people.

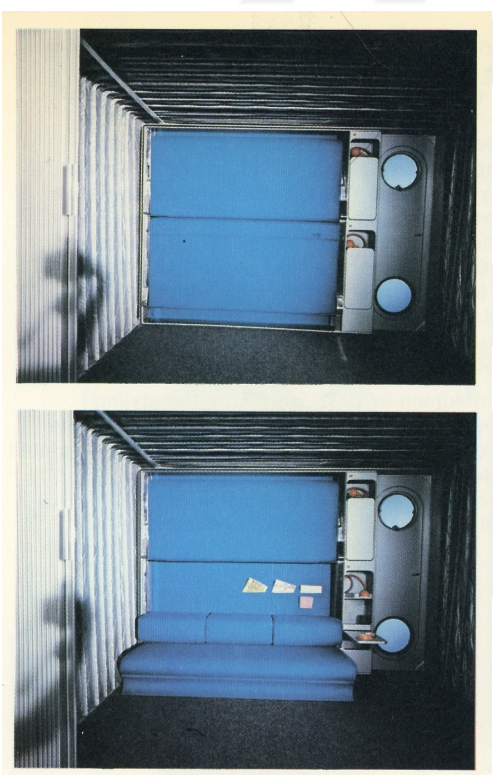


Figure 66: Foldable Sofa with stacked Mattresses in Mobile House (Source: Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design)

4.2.b.4. Working and Eating Zone

Working and eating zone employs a table or assigned surface to perform eating, working etc. As a result of the similarity of the ergonomic positions to perform these two functions, they are commonly juxtaposed. For instance, Tikku House has a conventional table chair set up, Micro Compact Home consists of a working and eating zone that allows 8 people to sit [Figure 67]. Mobile Dwelling Unit employs an eating working zone in one of the expandable volumes which works like a sitting booth [Figure 68], while Tricycle House's working and eating zone [Figure 69] and Nakagin Capsule Tower's [Figure 70] working and eating zone utilize a transformable configuration and they are only suitable for 2 people maximum.







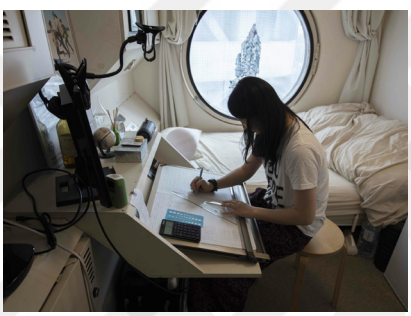


Figure 67: Cooking Zone in the Futuro House (Source: https://www.facebook.com/)

Figure 68: Cooking Zone in the Mobile House (Source: www.rudygodinez.tumblr)

Figure 69: Cooking Zone in the Mobile House (Source: https://lot-ek.com/)

Figure 70: Cooking Zone in the Micro Compact Home (Source: http://www.microcompacthome.at/index.php)

4.2.b.5. Storage Zone

When sufficient space is available after accommodating the vital functions, specific storage areas are often incorporated into the spatial arrangement. Alternatively, leftover spaces are utilized for storage to maximize space usage. Storage units are distributed to suitable places, including under or on top of the bed, or under staircases or any other leftover spaces.

For example, The Mobile House, MDU, and Futuro House employ separate storage spaces in addition to distributed storages. On the other hand, there are also usage scenarios where storage areas contain functions within themselves. The Tricycle House features exposed racks that serve as both hanging storage [Figure 71] for belongings and clothes while they can be transformed table and bed at the same time. Similarly, in the Mobile House, there are openable shelves besides the sofa/bedding unit that works like a nightstand and consists of bedside lamp for both storey of bedding unit.

In the Nakagin Capsule Tower, storage itself is designed to serve various functions. Fixed interior furnishings with a depth of 35 cm include a television, appliances, wardrobe, bookshelf, and a dining table that can be closed when not in use, optimizing the use of space within the capsule.



Figure 71: Storage Space that convertible to Table/ Bed Unit in Tricycle House (ArchDaily)

Locating Volu-te within the Context of Prefabricated Micro Living Unit Experiments

05

In this chapter, the aim is to locate Volu-te within the context of the production of 2000s-2010s prefabricated micro living unit experiments. Volu-te was a prefabricated micro living unit experiment developed within the scope of a graduate program at MEF University titled Alternative Architectural Practices (AAP).

Alternative Architectural Practices Program is focused on the major shifts in the context of teaching, learning and practicing architecture with all the consideration of current debates, and thresholds. Each term, a team of students worked on the design and documentation of a project on a selected theme. The period that I participated in, the cycle themed “Small Scale Decent Change,” was focused on micro living units. The theme was inspired from the MoMa Exhibition titled “Small Scale, Big Change: New Architectures of Social Engagement”.

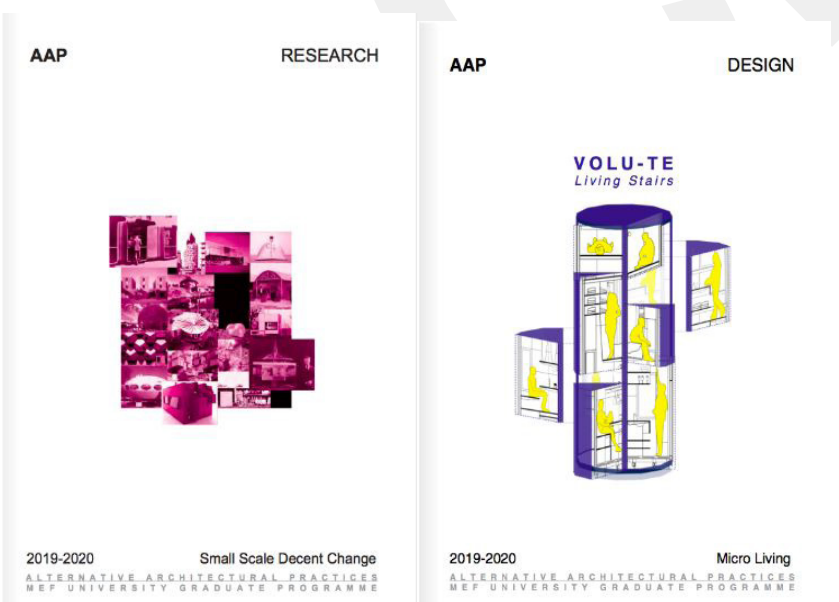


Figure 72: AAP-Small Scale Decent Change Research Book and AAP-Volu-te Design Guidebook

This exhibition brought together projects with "'socially responsible architecture" is reminiscent of the ideals of twentieth-century masters, but these designers eschew their predecessors' utopian, wholesale blueprints for change imposed from above. Small Scale, Big Change presents radically pragmatic, "acupunctural" projects—limited interventions with wide-reaching effects."[204] However, AAP's approach leaned towards perceiving small scale interventions as a catalyst and alternative solution for the existing challenges rather than categorizing them as a "big change" with the expectation of ultimate solutions. The program consisted of 3 semesters, including research design and make, and each semester was also documented in book format [Figure 72].

5.1. Locating Volu-te within the 2000s Case Studies

Volu-te [Figure 73] was a prefabricated micro-living unit developed within the AAP graduate program's curriculum. The Volu-te utilized a 4.5-square-meter base area and emerged from a 2.42 meters diameter, while the height of the Volu-te was 6 meters. The living unit could accommodate two people. It also contained zones including cooking, cleaning, sleeping, working, sitting and storage.



Figure 73: Volu-te (Source: AAP-Volu-te Design Guidebook)

204. "About the Exhibition," MoMA, accessed Ju2023, https://www.moma.org/interactives/exhibitions/2010/smallscalebigchange/about.html

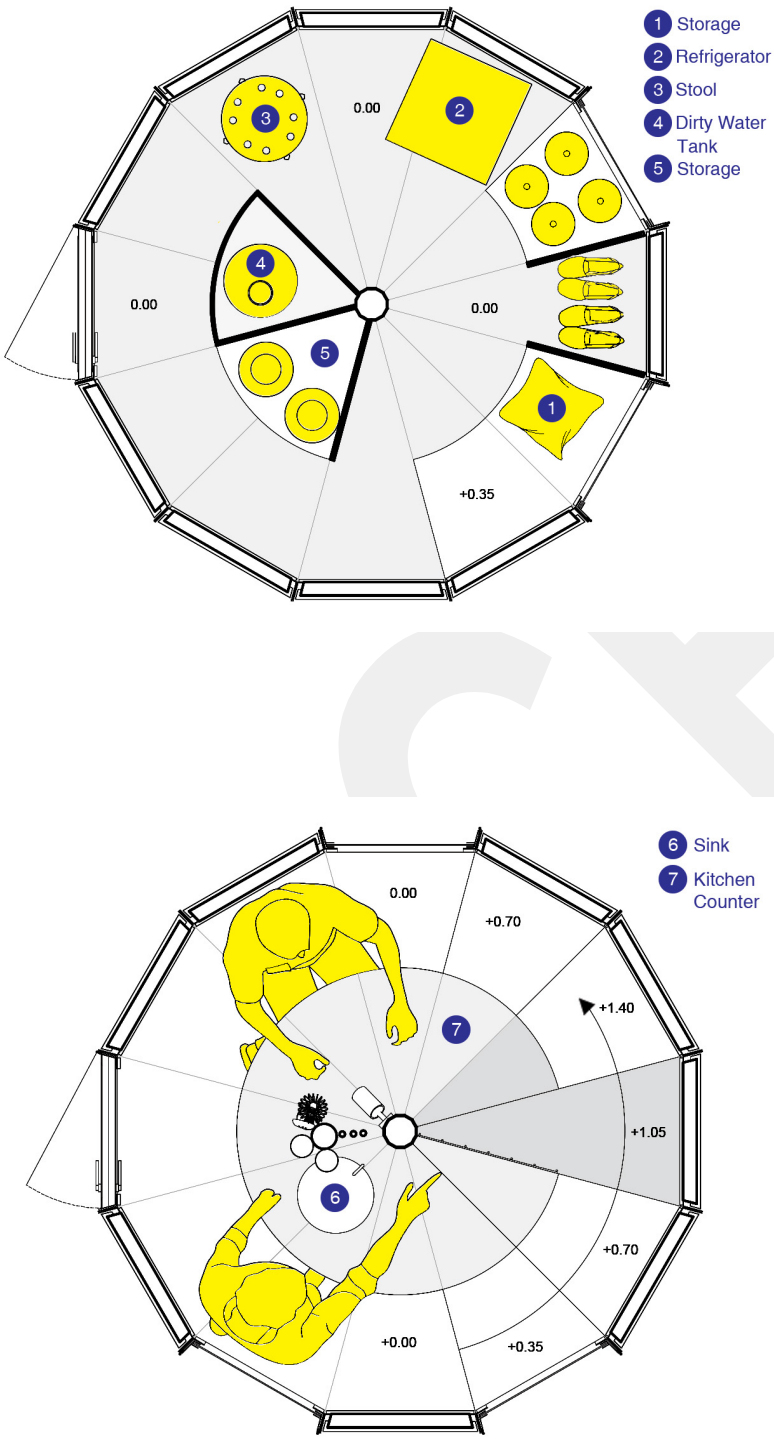
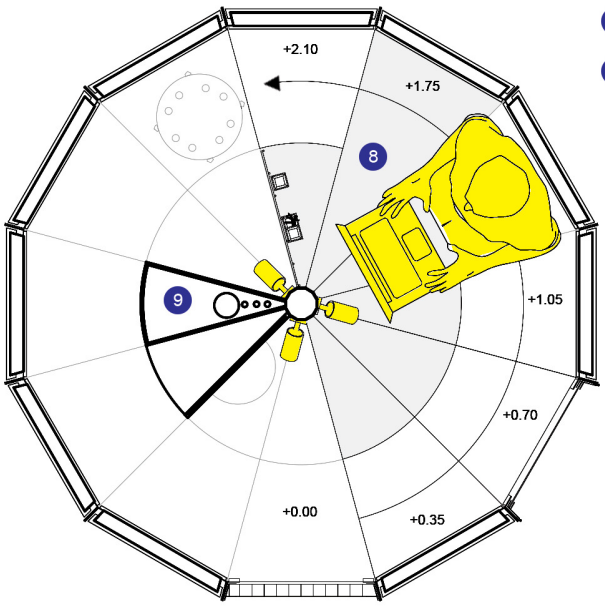
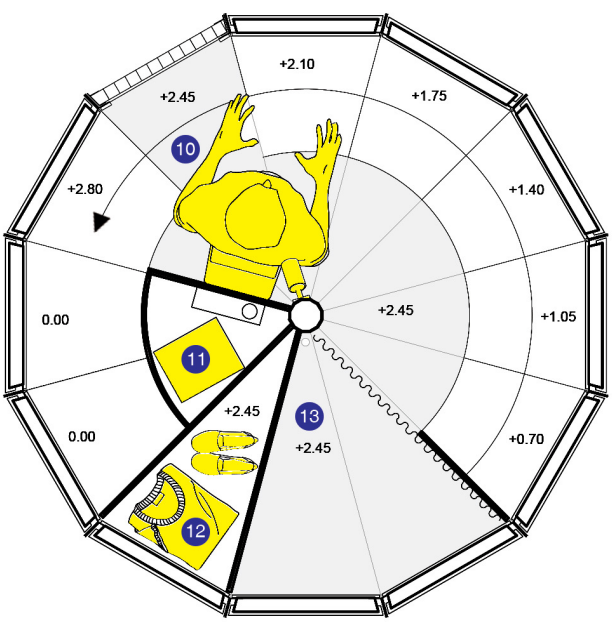


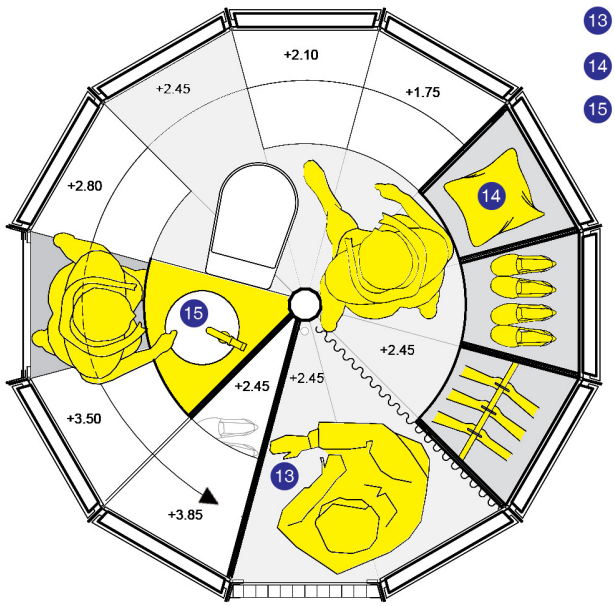
Figure 74: Volu-te Plan Drawings (Source: AAP-Volu-te Design Guidebook)



8 Working Station
9 Storage



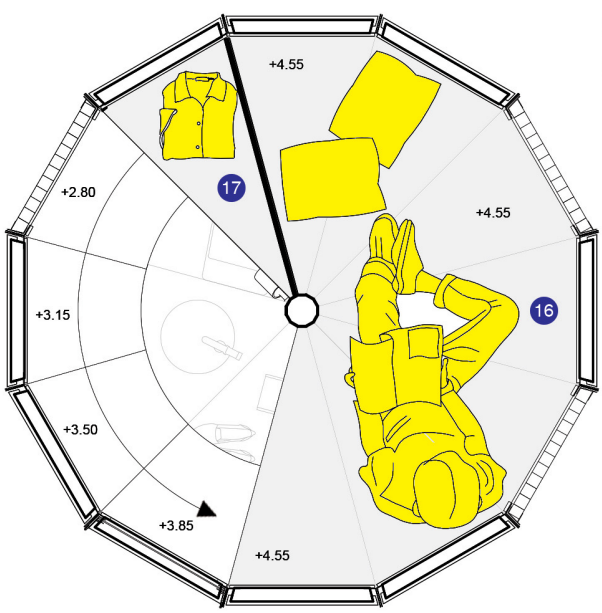
10 Toilet
11 Washing Machine
12 Storage
13 Shower



13 Shower

14 Storage

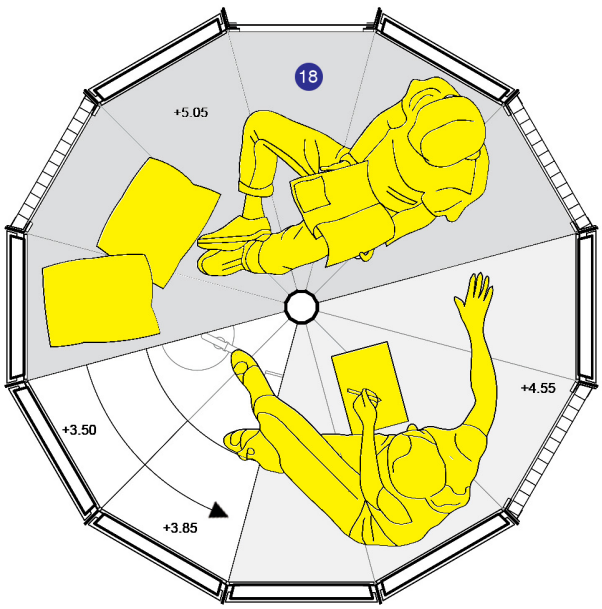
15 Sink



16 Sleeping Pod

17 Storage

205. Fibro Concrete is a technology developed by one of AAP's industry partners.



The prefabrication process of Volu-te consisted of simple and easy-to-produce details, rather than involving complex and high-tech solutions. Volu-te embodied the advantages of prefabrication, such as affordability, reduced waste production, and lower labor inefficiency. Moreover, prefabrication allowed for easy assembly and disassembly while also enabling it to be mass-produced.



Figure 75: Built Prototype of the Volu-te (Source: https://www.instagram.com/aap_mef/

There were some differences between conceptual project proposals and the built prototypes. The built prototype of the Volu-te [Figure 75] featured a two-piece 60mm Fibro Concrete shell, mounted and stitched together with a total of 14 joints in two sizes, and an internal galvanized steel core structure that is prefabricated separately from the shell.[205] The outer shell and inner structure were prefabricated separately and assembled together in the factory. In window openings, a steel frame merged with translucent corrugated polycarbonate was used to bring in the daylight. For the interior, plywood coverings and claddings were used in order to create surfaces and separators. On the other hand, the conceptual project of Volu-te consisted of a galvanized steel frame structure with concrete panel claddings that were assembled together.

As seen in Figure 76, Volu-te was suitable for transportation as a

whole unit on highways and can be re-positioned on a site using a crane. Furthermore, the conceptual version of the Volu-te was also transportable as a flat-pack via diverse transportation mediums.

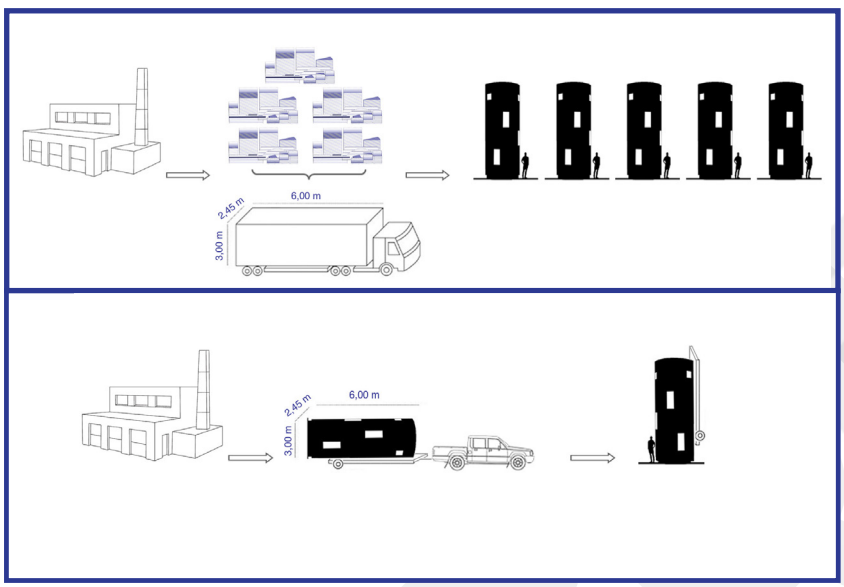


Figure 76: Transportation Scenarios of the Volu-te (Source: AAP-Volu-te Design Guidebook)

Volu-te's goal was to offer alternative solutions for contemporary housing challenges, economic crisis and habits linked to the demographic shifts, and environmental concerns of the 2000s-2010s. Parallel to the emergence of prefabricated micro living units in the 2000s-2010s, Volu-te focused on developing an alternative living unit typology rather than providing an ultimate solution for present issues. Unlike the optimistic dreams of the 1960s that aimed to shape future life scenarios, Volu-te's agenda encompassed modest, realistic interventions in the current environment within the acceptance of the existing circumstances. As a result, it was set to make a practical difference in the living conditions of the transitory urbanites.

Volu-te is aimed to provide affordable living units to individuals with limited budgets and targeted mobile populations including tourists, young people—gen Z and gen Y. During the design phase, the design team observed the demographic distribution of this user profile in Istanbul and closely examined the behavioral patterns of this mobile population.For instance, Istanbul's demographic distribution in 2021 was predominantly (34% or 54%) consisted of young people aged between 20-40 years old.[206] Thus, a significant majority of Istanbul's population comprised working and studying individuals who are identified as gen Z and gen Y. This aligns with the Volu-te's targeted

206. "İstanbul Nüfusu," Nüfusu, accessed June 2023, https://www.nufusu.com/il/istanbul-nufusu

user typology.

In addition, Istanbul is a touristic destination that attracts many visitors around the world. During the first six months of 2021, 2,720,000 tourists visited Istanbul.[207] Thus, Volu-te became a suitable option for tourists due to its features of affordability, numerous site options from the city center to the periphery, and spatial experience. Consequently, the user profile of Volu-te combines students, adults in transition, and tourists who need temporary accommodation within a certain time period and budget. Through its mobile application [Figure 77], Volu-tes will be situated in various locations around the city to be rented temporarily. In order to serve this user profile, Volu-te has its own mobile application that provides temporary or short-term accommodation for the mentioned user profiles.

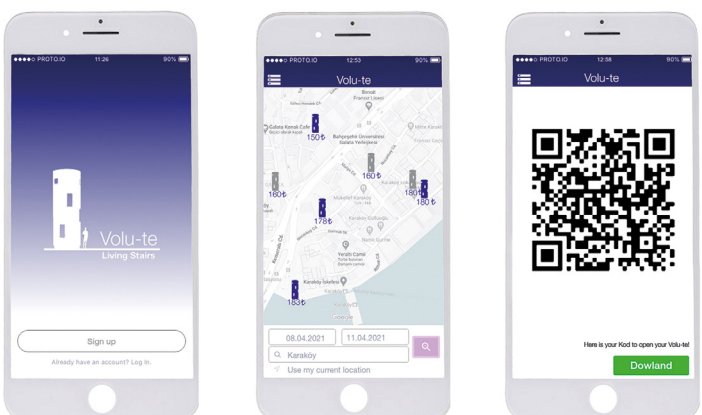


Figure 77: Volu-te Application (Source: AAP-Volu-te Design Guidebook)

Consequently, Volu-te has been developed in the context of Istanbul as a megacity, serving as an alternative housing typology for tourists and neo-nomads seeking short-term stays within a mobility-oriented lifestyle dynamic. Its adaptation to another megacity is highly feasible.

In addition to the adaptability of Volu-te to other megacities, it shared common concerns and parallels with the prefabricated micro living units of the 2000s-2010s. For instance, Volu-te emphasized environmentally conscious living scenarios through its design. It has similar sustainable approaches that were widely employed in prefabricated micro living units during the 2000s-2010s. Common sustainable approaches observed in 2000s-2010s case studies can be listed as follows: downsizing to consume less energy, utilization of renewable energies, and reducing the footprint of

207. İstanbul Turizm Bülteni, Ağustos, Ağustos 2021, accessed June 2023, https://ipa.istanbul/istanbul-turizm-istatistikleri-agustos-2021/

living units. Volu-te sought sustainable approaches both in its design processes and the lifestyle it offered to its users. For instance, Volu-te employed domestic wind turbines and solar panels to generate renewable energy. As seen in the Figure 78, It also included "designed plug-in storage, including the battery, rainwater collection tank, and black water storage."[208] Furthermore, to minimize heat loss, the base area of the unit was kept in the minimum while maximizing the usable volume aimed. This resulted in the optimization of the thermal efficiency of the living space. Within these approaches Volu-te paid utmost attention to the ecosystem whether it involved living creatures or existing surroundings, whether it was in the city or in the rural area.

Consequently, Volu-te has been developed in the context of Istanbul as a megacity, serving as an alternative housing typology for tourists and neo-nomads seeking short-term stays within a mobility-oriented lifestyle dynamic. Its adaptation to another megacity is highly feasible.

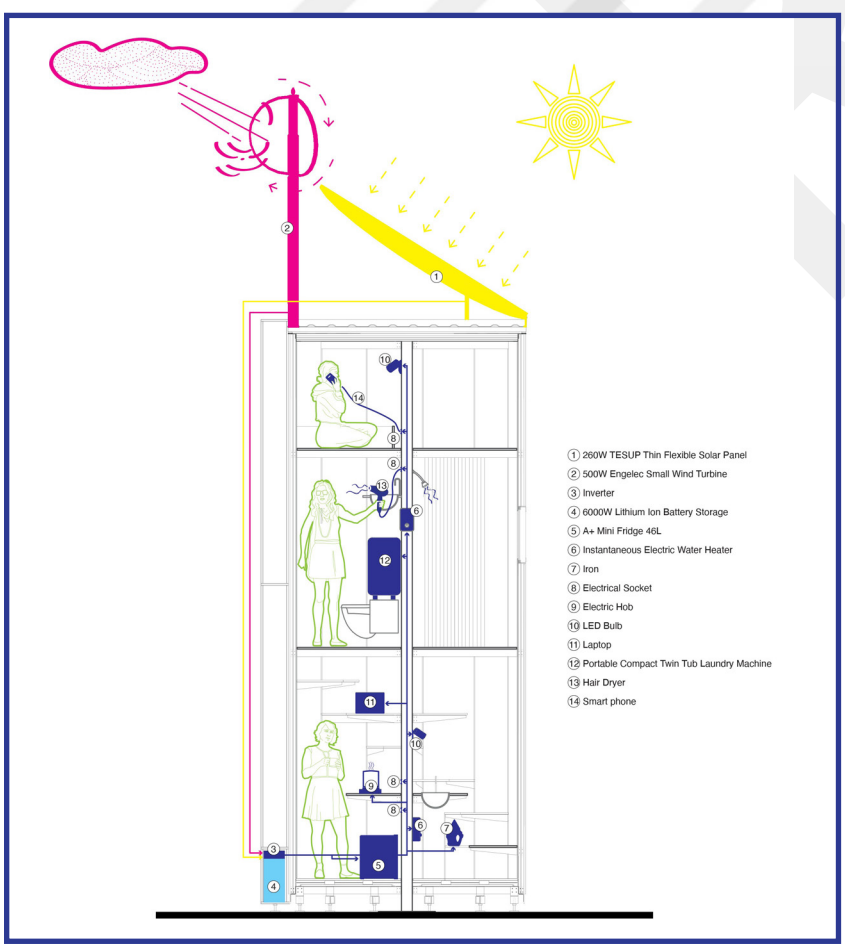


Figure 78: Cycles of Volu-te (Source: AAP-Volu-te Design Guidebook)

208. Ahmet Yaymanoğlu et al., "AAP Volu-Te Design Guidebook," ed. Oral Göktaş, Yumpu, 2020, 49 https://www.yumpu.com/en/document/read/65263933/aap-volute

In the 2000s, much like other megacities around the globe, Istanbul encountered similar challenges related to high population density, resulting in high land values, which made finding affordable living units a challenging task. According to data from TUIK, Istanbul was a densely populated megacity within the 15 million population in 2022.[209] Furthermore, by 2040, it is projected to increase to 35 million people.[210]

Volu-te also examined the urban patterns of Istanbul as well as those of other megacities that show similar urban patterns. In the AAP Design Book, "Volu-te: Living Stairs" this situation is summarized as follows:

> Istanbul is one of the cities where organic urban texture is dominant and it is in constant change with new construction law every year construction law every year. Besides, the urbanite transforms spaces with the legal gaps and then a new law is enacted again. There are lots of unstable factors on urban texture and they create the "leftover spaces" behind the scenes. There is a powerful potential to think about "the leftovers of the city" in the human scale rather than "dealing with" them, design book and the small scale of interventions suggest the possibility of transforming the function of space. [211]

Thus, due to its small scale, Volu-te is very suitable to be located in the leftover spaces in urban areas such as derelict areas, roofs, common areas of usage, roadside parking space, parking lots, etc. As seen in the Figure 79, there have been depictions of the Volu-tes inserted in parking lots. In fact, two Volu-tes could be located in a single parking lot with standard size of 2.5 meters by 5 meters. With this feature, Volu-te shares a similar agenda with Tikku House, focusing on minimization of the base area and utilization of the vertical space.

Another parallel approach which Tikku House and Volu-te have shared was their emphasis on multiple small scale interventions in urban scenarios. The design team of Tikku House described this approach as "Many Tikkus can grow side-by-side like mushrooms and they can fuse into larger organisms." Similarly, Volu-te's design team stated a parallel approach aiming to "become a part of the social network in the city."[212] One of the program coordinators, Assistant Professor Dr. Sevince Bayrak explained this aim as follows:

209. "Adrese Dayalı Nüfus Kayıt Sistemi Sonuçları, 2022," TÜİK, accessed August 2023, https://data.tuik.gov.tr/Bulten/Index?p=49685

210. "İstanbul Yıllara Göre Nüfus Projeksiyonları," İBB, accessed June 2023, https://data.ibb.gov.tr/dataset/istanbul-yillara-gore-nufus-projeksiyonu-verisi/resource/0c38878b-e425-441c-8455-5dc36f80e29b

211. Ahmet Yaymanoğlu et al., "AAP Volu-Te Design Guidebook," ed. Oral Göktaş, Yumpu, 2020, 16 https://www.yumpu.com/en/document/read/65263933/aap-volute

212. Ibid.

AAP wants to raise the question of whether or not a small scale living unit can propose an active network in a metropolis. Volu-te is not a single unit, it comes with a proposition of a network system. With the idea of this small-scale living unit network, the efficiency of being small comes together with the power of being united.[213]

213. Ibid.2
214. Ibid.23
215. Ibid.25
216. Ibid.

5.2. Spatial Configuration of the Volu-te

In the design process of the Volu-te, the aim was to create a living unit that occupies less space and consumes less energy. To achieve minimum space and reduced floor area, Volu-te employed alternative spatial configuration approaches that are commonly observed in prefabricated micro living units [Figure 80].

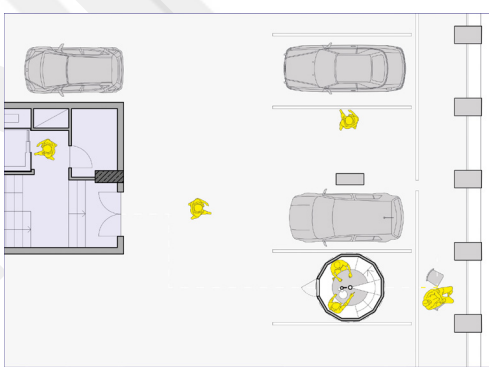


Figure 79: Mobility Scnerios of Volu-te (Source: AAP-Volu-te Design Guidebook)

5.2.a. Common Features with 2000s-2010s Prefabricated Micro Living Units

Volu-te featured an open plan layout within the zoning system that employed functions. Two main features of this spatial configuration were the core area where functions are integrated and surrounding steps where functions are performed. Thus, each level, and even each step, becomes a living space. Each step was 35 cm in height and 50 cm in depth. The design process aimed to explore alternative ergonomics that departed from Neufert's guide and its rigid set of dimensions. [214]

Consequently, instead of pre-defined floor areas, actions were performed in levels.[215] Functions were not segregated; they were overlapped through defined usage scenarios within the Volu-te.[216] For instance, multifunctional steps could serve multiple functions, surface for the performing functions, storage space and sitting elements. Minimizing the base area while maximizing height necessitates arranging space to use every surface and volume in a very precise and efficient way. A similar approach could be observed in Micro Compact Home, where levels are utilized to reserve necessary functions.

Offering customization options based on customer preferences was common practice in both the 1960s and 2000s-2010s. As seen in Figure 81, Volu-te is aligned with this approach within the employment of various customization options. For instance, individual Volu-te units could be clustered to create facilities or villages. In Volu-te's conceptual project, the modular nature of the units allowed for two or more units to be merged to provide accommodation for more than two people according to the user's preference.

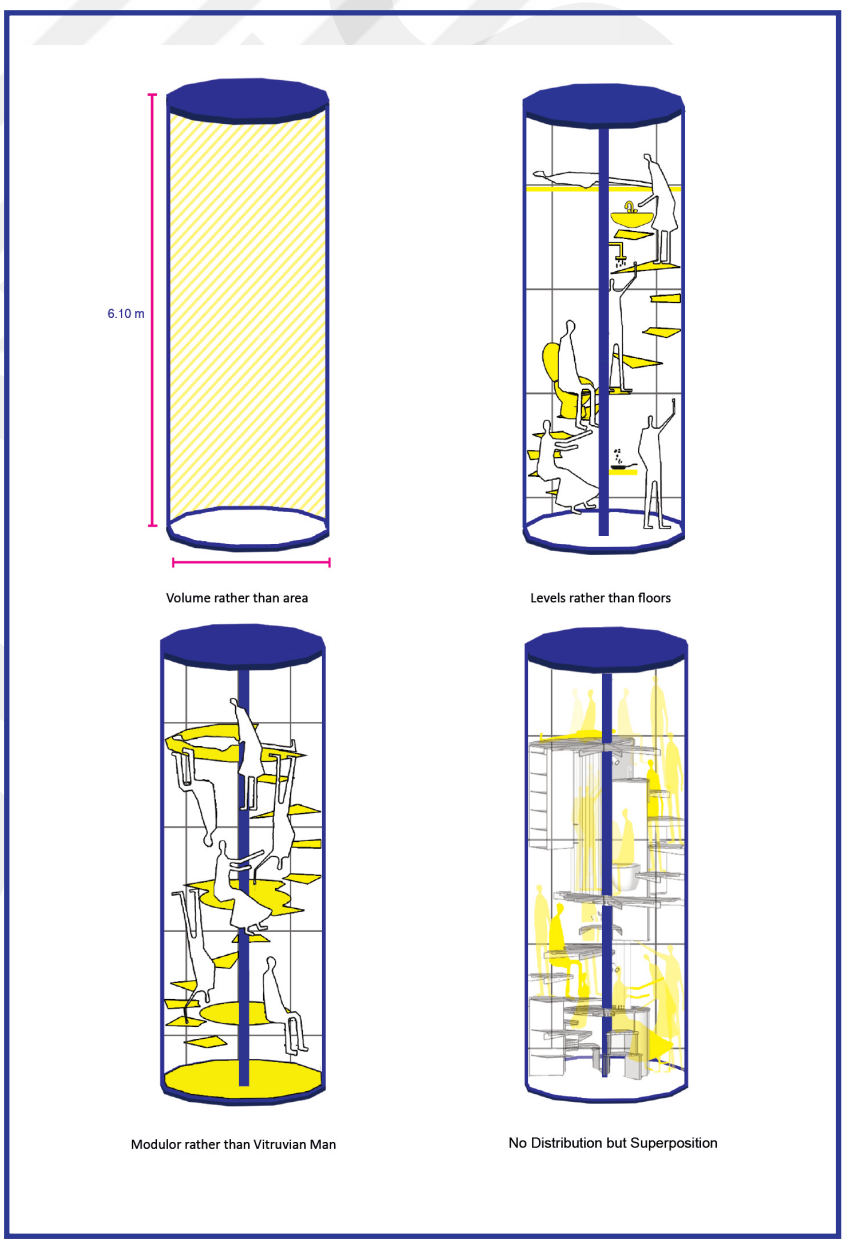


Figure 80: Conceptual Diagrams (Source: AAP-Volu-te Design Guidebook)

In addition, Volu-te units could be stacked to create multi-level structures as well as individual units. In multi-level usage scenarios, Volu-tes are suitable to be stacked. Within this usage scenario, by removing the facade claddings and interior furnishings, Volu-te's structural system and staircase could be repurposed as circulation structures to access units located on upper levels.[217]

The concept of creating living scenarios that encompassed the use of clustered living spaces can be observed in 2000s-2010s case studies including Micro Compact Home and Mobile Dwelling Unit which integrates structures that allow living units to be conglomerated.

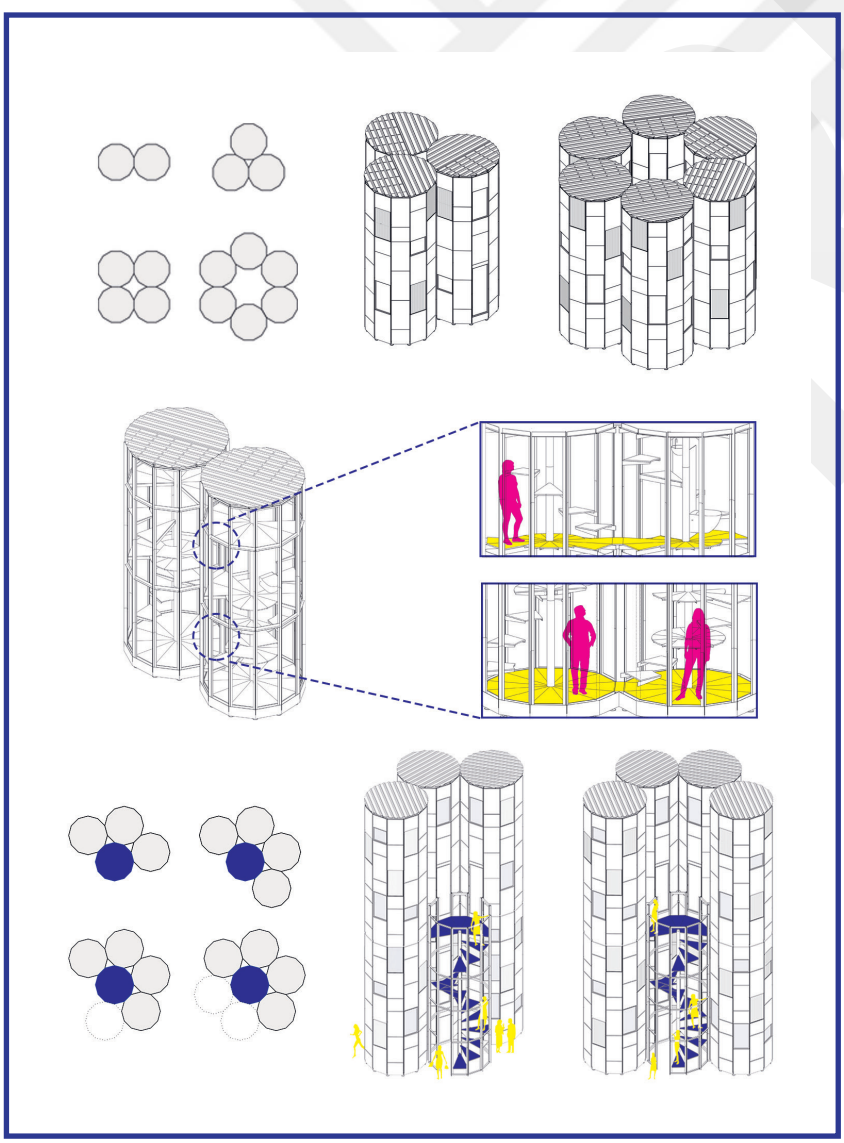


Figure 81: Volu-te Usage Scnerios (Source: AAP-Volu-te Design Guidebook)

217. Ibid.46

5.2.b. Function Distribution in the Volu-te

Volu-te encompasses essential functions, including cooking, working, eating, cleaning, sleeping, and storage, which fulfill the basic needs within the context of living units.



Figure 82: Spatial Configuration of the Volu-te (Source: AAP-Volu-te Design Guidebook)



Figure 83: Cooking Zone (Source: AAP-Volu-te Design Guidebook)

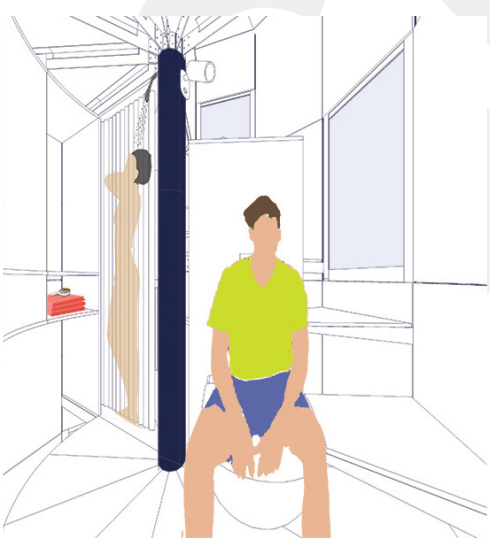


Figure 84: Cleaning Zone(Source: AAP-Volu-te Design Guidebook)

5.2.b.1. Cooking Zone

Cooking zone [Figure 83] was situated in the entrance area, featuring a sink, mini fridge, and circular counter integrated with the sitting zone. This configuration distinguishes Volu-te from the Tricycle House and Tikku House which are two of the case studies of 2000s due to inclusion of a fully equipped cooking area, and Volu-te is aligned with the Micro Compact Home and Micro Dwelling Unit within the inclusion of cooking zone.

5.2.b.2. Cleaning Zone

Cleaning zone [Figure 84] distributed in different levels in the unit. Due to usage of the steps where different functions can be performed, a toilet was attached to the core, reachable through one of the steps. It was not enclosed, yet privacy could be ensured with the use of a curtain. The sink was located on another step, while the shower was positioned at the back for privacy purposes.

Volu-te differed from Tricycle House and Tikku House with its sewage system and appropriately sized shower and sink setup. The approach of not

employing a cooking and cleaning zone and inviting the user to use amenities in the city, which was seen in some of the case studies in the 2000s-2010s, was not adopted in Volu-te. In this context, Volute demonstrated similarities with Micro Compact Home and Mobile Dwelling Unit with its equipped cleaning and cooking zone.

5.2.b.3. Storage Zone

Main storage [Figure 85] was situated near the shower for easy accessibility when needed. Additional storages were strategically distributed to the leftover spaces around the living unit including under the counter and staircases. The placement of the storage spaces exhibited parallel configuration in both periods.

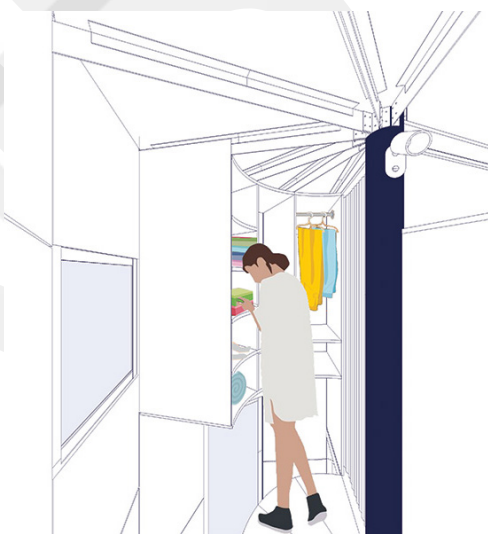


Figure 85: Storage Zone (Source: AAP-Volu-te Design Guidebook)

5.2.b.4. Sleeping Zone

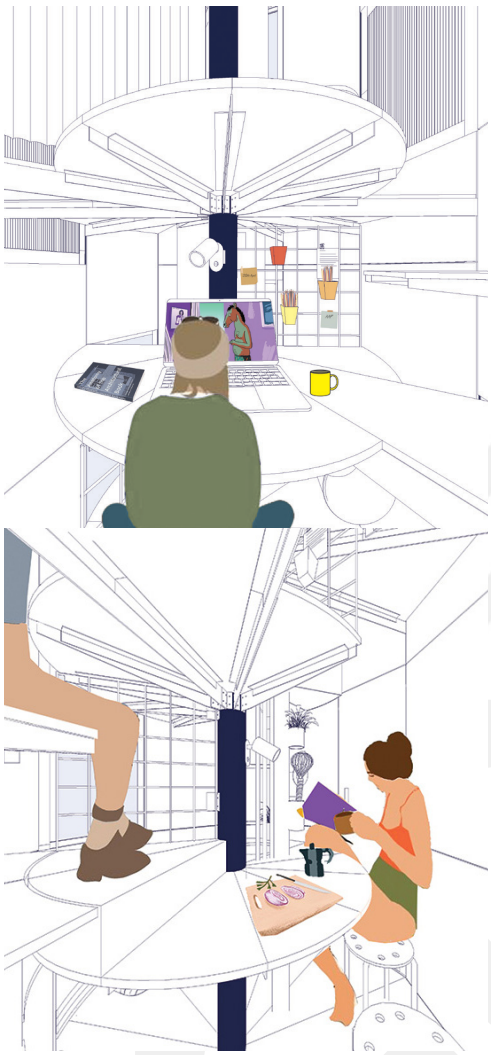
The sleeping zone [Figure 86] was situated at the top level of the living unit, only allowing the user to sit down, without being able to stand up. A custom mattress was placed to ensure a comfortable and ergonomic sleeping environment. The envisioned life scenario of the living unit parallels how people in the 2000s began to use their living units similar to hotel rooms for sleeping. However, Volu-te featured a fixed sleeping zone, differing from the transformable beds seen in the Tricycle House and Micro Compact Home.

5.2.b.5. Working and Eating Zone

As seen in Figure 87, Volu-te incorporates two working and sitting zones. One of these zones is integrated into the cooking zone counter and the other one is positioned within the central core and is connected to one of the steps as a sitting element. Volu-te employed a stable working and sitting zone without any moveable features.



Figure 86: Sleeping Zone(Source: AAP-Volu-te Design Guidebook)



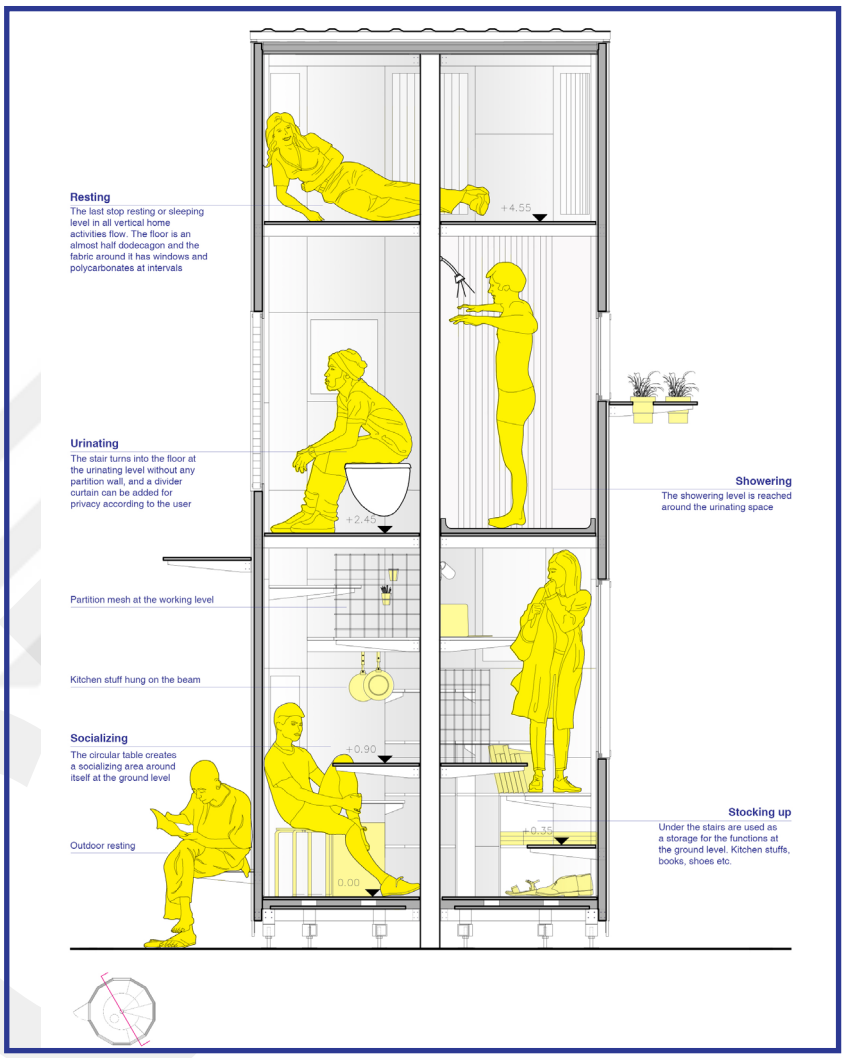


Figure 87: Working and Sitting Zone (Source: AAP-Volu-te Design Guidebook)

Figure 88: Function Distribution in the Volu-te (Source: AAP-Volu-te Design Guidebook)

To sum up, Volu-te took a stance regarding the contemporary circumstances within its position with the 2000s-2010s case studies.Volu-te's approach to contemporary issues aligns with the case studies from the 2000s-2010s within the agenda of saving the day. On the other hand, Volu-te employs continuing visions that are observed in both periods that serve the mobile population throughout its concept and production method. Furthermore, Volu-te embraces common spatial configuration approaches that were witnessed in both 1960s-1970s and the 2000s.

Conclusion

The emergence of prefabricated micro living units in the 2000s-2010s is commonly regarded as a new and alternative housing typology, developed in response to contemporary socio-economic challenges. However, upon closer inspection of the historical trajectory, it becomes evident that experimental attempts at the production of prefabricated micro living units in the 1960s inspired their contemporary counterparts. There are series of productions in the 1960s-1970s while there is discontinuation in the years between 1980's to 2000s-2010s. However, in the 2000s-2010s there have been growing productions of prefabricated micro living unit experiments that appeared through renewed interest and developments. The experimental attempts to produce prefabricated micro living units in the 1960s ultimately served as a source of inspiration for the production of contemporary examples in the 2000s-2010s. In the context of prefabricated micro living units, certain features have remained consistent and enduring across historical eras, including mobility oriented features. The use of prefabrication techniques and smaller scales allowed for increased mobility, which was seen as a desirable lifestyle feature. In fact, designers anticipated that mobility would become an essential aspect of daily life, providing users with the luxury of mobility-oriented features to support their lifestyles.

In both eras, designers aimed to create living spaces that meet basic living requirements while maximizing space efficiency. Throughout this aim, designers employed common spatial configuration methodologies. These methods encompassed utilization of the vertical space, incorporation of built in furnishings with movable, transformable features, utilization of light dividers and expandable volumes, etc.

In many ways productions of the 1960s-1970s served as the foundations for the productions of the 2000s-2010s. The projections made in the 1960s-1970s regarding the future life scenarios found their representation in the 2000s-2010s. These include the integration of mobile life scenarios and the priority given to individual/singular living scenarios.

Despite the connection that can be drawn between these two historical periods, the socio-economic factors and production goals that underpin the development of prefabricated micro living units, each period

has differences, reflecting the changing needs and habits of their historical contexts. During the 1960s-1970s, a strong desire to build a better future drove architectural experimentation with prefabricated living units. This optimistic outlook was fueled by advancements in technology, successful space exploration, and a thriving economy. In this context, designers developed visionary proposals that imagined new life scenarios and constructed a new order for the future. In contrast, the 2000s were marked by a focus on finding solutions to pressing social and economic issues such as the global financial crisis, environmental concerns, and urban density. Rather than envisioning a future, architects sought to address immediate challenges and mitigate societal problems. The rising cost of real estates and increased urbanization resulted in a need for affordable housing in cities, while demographic changes such as the preference for single occupancy, spending less time at home led to a growing interest in downsized living units as an alternative.

In addition to their role in inspiring contemporary productions, the prefabricated micro-living unit experiments of the 1960s have been subject to criticism for their perceived failure to not become a common housing typology. These units were often deemed too ahead of their time and faced a variety of challenges that prevented their widespread adoption. For example, the success of the Futuro House was interrupted by the oil crisis. Similarly, the Nakagin Capsule Tower, despite its potential for mobility, never reached its full potential and was demolished in 2022.

Within this socio-historical context, Volu-te is positioned and discussed in terms of the changing ideals and continuing visions. Volu-te shares parallel agendas within the 2000s-2010s prefabricated micro living experiments, accepting the current conditions and producing solutions. Thus, Volu-te gives priority to small scale interventions to mitigate contemporary circumstances while taking into account sustainable approaches, and answering modern man's daily routines within the total understanding of an existing order. Furthermore, the living unit incorporates mobility-oriented life scenarios and shared common spatial configurations, as observed in both eras.

To sum up, although historical contexts and associated agendas may differ, there is a connection and drawn inspirations from the prefabricated micro-life experiments of the 1960s-1970s in production in the 2000s-2010s. The lifestyles that were mentioned and envisioned in the 1960s-1970s have become more relatable today with the use of adopted means of transport and

technologies. Due to the redefinition of physical space in the 2000s-2010s, mobility-oriented features that were fully integrated with the global scale in the urban scale became internalized. Mobility, prefabrication and small scale were interwoven, mutually reinforcing one another and the formed core structure of the prefabricated micro living units in both periods.

GCRIS

References

"2012 Get It Louder Exhibition Design." accessed June 2023. http://www.peoples-architecture.com/pao/en/project-detail/20

ABC News in Depth."Decades Before the Tiny House, There was Futuro I Retro Focus." March 1, 2020. Old Footages. 3:13. accessed March 2023.. https://www.youtube.com/watch?v=Yy-oxyphwWs

"Developing the American Dream: A Comparison of Levittown, New York and Celebration, Florida." 3, accessed June 2023. https://ats.emory.edu/_includes/documents/ARTHIST_InDesign%20Final%20Paper_example%204.pdf

CNN Business. "The Flying-saucer Shaped Futuro Home was Doomed to Fail." Interview with Futuro Owner. 3:03. accessed March .2023. https://www.youtube.com/watch?v=EZ8jnR09eLE

Architizer. "Tricycle House." accessed June 2023. https://architizer.com/projects/tricycle-house/

Arieff, Allison. Prefab. Utah: Gibbs Smith, 2002.

Benson, Paula. “2001 A Space Odyssey – a Close Look at those Fabulously Futuristic Djinn Chairs and How Kubrick’s Vision ofthe Future was Brought to Life Through ‘Product Placement’.” Film and Furniture, 30 April, 2014. https://filmandfurniture.com/2014/04/kubricks-vision-of-the-future-brought-to-life-through-product-placement-in-2001-a-space-odyssey/

Bevilacqua, Marco Giorgio. “Alexander, Klein and the Existenzminimum: A ‘Scientific’ Approach to Design Techniques.” Nexus Network Journal, Vol 13, No.2 (2011):297-313. https://doi.org/10.1007/s00004-011-0080-6

Biourbanism. “What is Biourbanism?.” accessed 08.06.2023. https://biourbanism.info/about/

Bradley, Michelle Cadoree. “Sputnik and the Space Race: 1957 and Beyond.” Library of Congress, 2007. https://guides.loc.gov/sputnik-and-the-space-race

Brysch, Sara.“Reinterpreting Existenzminimum in Contemporary Affordable Housing Solutions.” Urban Planning 4, no. 3 (2019): 326-345. https://doi.org/10.17645/up.v4i3.2121

Burke, Nial. “The Micro Compact Home by Richard Horden.” Humble Homes, April 2, 2014. https://www.humble-homes.com/micro-compact-home-richard-horden/

Büyükyıldırım, Nilüfer Karanfil. "Türkiye'de Lojman Modeli: LPS* ile Konut Üretimi ve Ereğli Demir Çelik Lojmanları Örneği." Betonart, no.60, (2019): 46-53.

Cambridge Dictionary. "Definition of Assembly Line." accessed June 2023. https://dictionary.cambridge.org/dictionary/english/assembly-line

Casagrande Laboratory. "Tikku." accessed 08.06.2023. https://www.casagrandelaboratory.com/projects/tikku

Casagrande, Marco. "From Urban Acupuncture to the Third Generation City in the Teaching Landscape: The Studio Experience." Journal of Biourbanism 4, (2016)

Cauter, Lieven De and Véronique Patteeuw. The Capsular Civilization: On the City in the Age of Fear. Rotterdam: nai010 publishers, 2005.

CNN. "Koreans make plastics without fossil fuel chemicals." accessed September 2023. http://edition.cnn.com/2009/TECH/science/11/23/ ecokorea.plastic/index.html

Colomina, Beatriz, Evangelos Kotsioris, Ignacio González Galán, Anna Maria-Meiste. The Radical Pedagogies Project. Massachusetts: MIT Press, 2022.

Council of Economic Advisers. Economic Report of the President, 1967: Chapter 5, Growth and Balance in the World Economy. Washington: Biblio Gov, 2012.

Davies, Colin. The Prefabricated Home. London: Reaktion Books, 2005.

Dejtiar, Fabian. "Modern, Low-Budget and Easy to Build Living Spaces: The Case Study House Program." ArchDaily, March 29, 2021. https://www.archdaily.com/913748/case-study-houses-lessons-on-modern-low-budget-and-easy-to-build-living-spaces?ad_campaign=normal-tag

Dickens, Charles, A Tale of Two Cities Great Britain: Biddles Ltd, Guildford, Surrey for J. M. Dente Sons ltd, 1906.

Dyhtam, Mark. "A successful failure: Remembering the Nakagin Capsule Tower." The Architect's Newspaper, June 22,2022. https://www.archpaper.com/2022/06/a-successful-failure-remembering-the-nakagin-capsule-tower/

European Commission. "Paris Agreement." accessed June 2023. https://climate.ec.europa.eu/eu-action/international-action-climate-change/climate-negotiations/paris-agreement_en#:~:text=The%20Paris%20Agreement%20sets%20out,support%20them%20in%20their%20efforts.

FRAC Centre-Val de Loire, "Radical Architecture." accessed March 2021. .https://www.frac-centre.fr/_en/resources/thematic-exploration/radical-architecture/radical-architecture-362.html

Furuto, Alison. “Tricycle House and Tricycle Garden / People’s Architecture Office (PAO) + People’s Industrial Design Office (PIDO).” ArchDaily, December 27, 2017. https://www.archdaily.com/312651/tricycle-house-and-tricycle-garden-peoples-architecture-office-pao-peoples-industrial-design-office-pido

Global Property Guide. “Global SQM Prices by Country.” accessed September 2023. https://www.globalpropertyguide.com/most-expensive-cities

Horden, Richard. Micro Architecture. London: Thames Hudson, 2008.

Hutchison, Allie. “2001: A Space Odyssey is Still the Most Scientifically Accurate Space Film Ever.” Inverse, April 8, 2023. https://www.inverse.com/culture/2001-a-space-odyssey-55-year-anniversary-nasa-science-accuracy

IMDB. “2001: A Space Odyssey.” accessed 08.06.2023. https://www.imdb.com/title/tt0062622/

İBB. “İstanbul Yıllara Göre Nüfus Projeksiyonları.” accessed June 2023. https://data.ibb.gov.tr/dataset/istanbul-yillara-gore-nufus-projeksiyonu-verisi/resource/0c38878b-e425-441c-8455-5dc36f80e29b

“İstanbul Nüfusu.” accessed June 2023. https://www.nufusu.com/il/istanbul-nufusu

İstanbul Turizm Bülteni, Ağustos 2021, accessed June 2023, https://ipa.istanbul/istanbul-turizm-istatistikleri-agustos-2021/

Jelly. "A Brief History of Cross Laminated Timber Construction." Seagate Mass Timber, August 27, 2019. https://seagatemasstimber.com/a-brief-history-of-cross-laminated-timber-construction/

Jeska, Simone. Transparent Plastics: Design and Technology. Berlin: Birkhäuser, 2007.

Kelly, Burnham. The Prefabrication of Houses. New York: The Technology Press of Massachusetts Institute of Technology, John Wiley and Sons, Inc, 1951.

Kroenberg, Robert, Christopher Scoates, Aaron Betsky, Henry Urbach. Lot-Ek: Mobile Dwelling Unit. New York: D.A.P./University Art Museum, 2003.

Kuitunen,Anna-Maija. "Futuro no. 001 – Documentation and Evaluation of Preservation Needs" Conservation Historical Interiors Bachelor's Thesis, Metropolia University of Applied Sciences, 2010.

Kurnalı, Melih. "İç Mekanda Prefabrikasyon ve Günümüz Prefabrik İç Mekan Ürünlerine Yönelik İnceleme" Master Thesis, Hacettepe University, Ankara, 2015.

Leslie, Thomas. "Just What Is It That Makes Capsule Homes So Different, So Appealing? Domesticity and the Technological Sublime, 1945 to 1975." Space and Culture 9, no.2 (2006): 180-194. http://dx.doi.org/10.1177/1206331205275009

Lin, Zhongjie. “Nakagin Capsule Tower and the Metabolist Movement Revisited.” Journal of Architectural Education 65, no.1 (2011): 514-527. https://www.acsa-arch.org/proceedings/Annual%20Meeting%20Proceedings/ACSA.AM.98/ACSA.AM.98.62.pdf

Logé, Guillaume. “About the Exhibition.” Artistic Lab, accessed June 2023. http://artisticlab forumviesmobiles.org/en/oeuvre/neo-nomads-a-lifestyle-of-the-future

Los Angeles Times. “Jean Fourastie; Economist Who Aided Reconstruction of France.” July 30, 1990. https://www.latimes.com/archives/la-xpm-1990-07-30-mn-749-story.html

Lot-Ek. “MDU-Mobile Dwelling Unit.” accessed June 2023. https://Lot-Ek.com/mdu-mobile-dwelling-unit

Marchand, Bruno. “Moving on: Is Existenzminimum Still Relevant?.” Urban Planning 4, no.3 (2019): 186-195. https://doi.org/10.17645/up.v4i3.2451

Mızrak, Abdullah Kutalmış. “1965 yılında Türkiye’de ilk defa portatif kamp evleri satışa çıkarılmış!.” Emlak Kulisi, November 28, 2014. https://emlakkulisi.com/1965-yilinda-turkiyede-ilk-defa-portatif-kamp-evleri-satisa-cikarilmis/315463

Micro Compact Home. “Mc-h.” accessed June 2023. http://www.microcompacthome.at/index.php?con=projects&l=e

MoMa. “About the Exhibition.” June 2023. https://www.moma.org/interactives/exhibitions/2010/smallscalebigchange/about.html

Mooble House. “Mooble House Tiny House Doğadaki Eviniz.” accessed September .2023. https://mooblehouse.com/uploads/sayfa-resimleri/e-katalog_501_.pdf

Moore,Andrew. “5 Benefits of Building with Cross-Laminated Timber.” NC State University, College of Natural Resources, August 1, 2022. https://cnr.ncsu.edu/news/2022/08/5-benefits-cross-laminated-timber/

Morris, Ali. “Casagrande Laboratory Designs Wooden Micro House for City Dwellers.” Dezeen, 23 October, 2017. https://www.dezeen.com/2017/10/23/casagrande-laboratory-designs-tikku-micro-house-cross-laminated-timber-installation-helsinki-design-week/

Mumford, Eric Paul. The CIAM Discourse on Urbanism, 1928-1960. Cambridge: The MIT Press, 2002.

Muraben,Billie. “Stanley Kubrick’s Meticulous Set Designs Made His Films Strikingly Eerie.” Artsy, April 30, 2019. https://www.artsy.net/article/artsy-editorial-stanley-kubricks-meticulous-set-designs-made-films-strikingly-eerie

National Research Council, Division on Earth and Life Studies, Board on Earth Sciences and Resources, Committee on Strategic Directions for the Geographical Sciences in the Next Decade. Understanding the Changing Planet: Strategic Directions for the Geographical. Washington: National Academies Press, 2010

Nelson, Tim. "Helsinki Architecture Firm Launches Prefab, Solar-Powered Homes That Fit in a Parking Spot." Architectural Digest, October 12, 2017. https://www.architecturaldigest.com/story/helsinkHelsinki Architecture Firm Launches Prefab, Solar-Powered Homes That Fit in a Parking Spoti-tikku-prefab-solar-powered-homes-that-fit-in-a-parking-spot

OED Online, "Compact Meaning." accessed June 2023. https://www-oed-com.ezproxy.mef.edu.tr/view/

OED Online, "Tiny Meaning." accessed June 2023. https://www-oed-com.ezproxy.mef.edu.tr/view/Entry/202346?redirectedFrom=tiny#eid

OED Online. "Micro Etymology." accessed June 2023. https://www-oed-com.ezproxy.mef.edu.tr/view/Entry/117905#eid37170117

Olivia B. Waxman. "Lots of People Have Theories About Neil Armstrong's 'One Small Step for Man' Quote. Here's What We Really Know." Time Magazine, July 15, 2019. https://time.com/5621999/neil-armstrong-quote/

Olsson, Melanie. “Living Tiny - An exploratory study of the tiny house movement in Sweden” Master Thesis in Sustainable Urban Planning, KTH Royal Institute of Technology, Stockholm, 2020.

Ortiz-Ospinahe, Esteban. “The Rise of Living Alone: How One-Person Households are Becoming Increasingly Common Around the World.” Our World in Data, December 10, 2019. https://ourworldindata.org/living-alone

Özkan, Süha. “Turkey: Foam Domes,” Mimar: Architecture in Development 8, ed.Hasan-Uddin Khan., 1983, 59-63.

Patrick Seguin. “Jean Prouve Architecture, 6x6 demountable House, 1944.” accessed June 2023. https://www.patrickseguin.com/en/designers/architect-jean-prouve/available-houses-jean-prouve/6x6-demountable-house-1944/

Pernice, Raffaele. “Metabolism Reconsidered Its Role in the Architectural Context of the World.” Journal of Asian Architecture and Building Engineering 3, no.2 (2004): 357-363. https://doi.org/10.3130/jaabe.3.357

Pettersson, Susanna. “The Nostalgia of the Future. The Architect Matti Suuronen’s Plastic House Was to be the Trademark of the New Space Age and of Trendy Neo-Nomads.” Nomadic Art Review, January, 1999. https://mikataanila.com/wp-content/uploads/2014/02/futuro.pdf

Potter, Brian. “The Rise and Fall of the Mail-Order Home.” Construction Physics, 11 June 2023. https://www.construction-physics.com/p/the-rise-and-fall-of-the-mail-order

Rethinking the Future. “An Architectural review of 2001: A Space Odyssey.” accessed Septemeber 2023. https://www.re-thinkingthefuture.com/rtf-architectural-reviews/a8893-an-architectural-review-of-2001-a-space-odyssey/

Ritchie, Hannah, Max Roser and Pablo Rosado. “CO_2 and Greenhouse Gas Emissions.” Our World in Data, May 2017. https://ourworldindata.org/co2-and-greenhouse-gas-emissions

Scanlon, Lisa. “The House of the Future That Wasn’t.” MIT Technology Review, January 1, 2005. https://www.technologyreview.com/2005/01/01/231834/the-house-of-the-future-that-wasnt/

Schalk, Meike. “The Architecture of Metabolism. Inventing a Culture of Resilience.” Arts 3, no.2 (2014): 279-297. https://doi.org/10.3390/arts3020279

Senk, Peter. “The Concept of Capsule Architecture as Experiment Origins and Manifestations with Selected Examples from Slovenia and Croatia.” Prostor 21, no.2. (2013): 351-361. https://hrcak.srce.hr/file/167344

Senk, Peter. Capsules: Typology of Other Architecture. Slovenia: Taylor & Francis Ltd, 2017.

Smith, Ryan E.. Prefab Architecture: A Guide to Modular Design and Construction. Canada: Wiley, 2010.

Statista. "Number of Flights Performed by the Global Airline Industry from 2004 to 2021, with Forecasts until." December, 2022. https://www.statista.com/statistics/564769/airline-industry-number-of-flights/

T.C. Başbakanlık D.P.T., "Kalkınma Planı – İkinci Beş yıl 1968-1972," http://www.sp.gov.tr/upload/xSPTemelBelge/files/D2PxI+plan2.pdf

Tau, Ihuhwa Marta. "Brief History of CAD," Scribd, accessed March 2023. https://www.scribd.com/document/369186131/Brief-History-of-CAD

Teige, Karel. The Minimum Dwelling. trans. Eric Dluhosch. Cambridge: MIT Press, 2002.

Tekin, Ömer Faruk. "Poliüretan Kubbeyi Yerelleştirmek." Arkitera, January 29, 2020. https://www.arkitera.com/gorus/poliuretan-kubbeyi-yerellestirmek/

The Futuro House. "So Just How Did They Get To Where They Were Going?." accessed 09.062023. https://thefuturohouse.com/futuro_house_transporting_and_moving.html

The Futuro House. "The Futuro House-Concept, Design & Manufacturing." accessed September 2023. https://thefuturohouse.com/futuro_house_concept_and_design.html

The Museum of Modern Art Department of Communication, Home Delivery: Fabricating the Modern Dwelling Presents the Most Thorough Examination to Date of Historical and Contemporary Prefabricated Architecture, Press Release, 2008

The Museum of Modern Art Department of Communication, Italy: New Domestic Landscapes, Press Release. 1972.

The Museum of Modern Art, "Mobile House, Release No 42." 1972.

The Museum of Modern Art, ed. Emilio Ambasz, Italy: The New Domestic Landscape Achievements and Problems of the Italian Design. Greenwich: New York Graphic

The Urban Land Institute. "The Macro View in Micro Unit." 2014. http://uli.org/wp-content/uploads/ULI-Documents/MicroUnit_full_rev_2015.pdf

Tiny House Kickstart, "The Tiny House philosophy," Medium, December 7, 2020. https://tinyhousekickstart.medium.com/the-tiny-house-philosophy-65d0abdc1bd3

Travis, Alan. “More Young Adults in 20s and 30s Living with Parents than in Past 20 Years.” The Guardian, December 8, 2009. https://www.theguardian.com/society/2009/dec/08/young-adults-living-parental-home-ons

TÜİK. “Adrese Dayalı Nüfus Kayıt Sistemi Sonuçları, 2022.” accessed August 2023. https://data.tuik.gov.tr/Bulten/Index?p=49685

Türk Yapı Sektörü Raporu. 2014. http://www.yapi.com.tr/TurkYapiSektoruRaporu2014/files/assets/basic-html/index.html#3 quoted in “İç Mekanda Prefabrikasyon ve Günümüz Prefabrik İç Mekan Ürünlerine Yönelik İnceleme” by Melih Kurnalı, 2015

Two Tickets Anywhere. “Digital Nomad Statistics: How Big is the Nomad Movement In 2023?.” August 25, 2023. https://www.twoticketsanywhere.com/digital-nomad-statistics/

United Nations Climate Change. “The Paris Agreement, What is Paris Agreement.” accessed June 2023. https://unfccc.int/process-and-meetings/the-paris-agreement

United Nations, Department of Economic and Social Affairs. “Population Division, The World’s Cities in 2018—Data Booklet.” (2018). https://www.un.org/en/development/desa/population/publications/pdf/urbanization/the_worlds_cities_in_2018_data_booklet.pdf

UNWTO. “International Tourism Growth Continues to Outpace the Economy.” accessed February 2023. https://www.unwto.org/international-tourism-growth-continues-to-outpace-the-economy

Vadot, Chlo. “Collecting Architecture: Jean Prouvé’s Prefabricated Homes Around the World.” Architizer, accessed June 2023. https://architizer.com/blog/practice/materials/jean-prouve-at-galerie-patrick-seguin/

Vadot, Chlo. “Video: Explore the House of Jean Prouvé, the Pioneer of Prefabrication.” Architizer, accessed June 2023. https://architizer.com/blog/inspiration/stories/video-jean-prouves-house/

Wang, Lucy. “Skinny Micro-Apartment can Pop Up in a Parking Space in Just One Day.” Inhabitat, October 17, 2017. https://inhabitat.com/skinny-micro-apartment-can-pop-up-in-any-city-in-just-one-day/tikku-by-casagrande-laboratory-10/

Weller, Chris. “27 Crazy Pictures of Micro-Apartments Around the World.” Business Insider, February 1, 2017. https://www.businessinsider.com/craziest-microapartments-around-world-2017-1

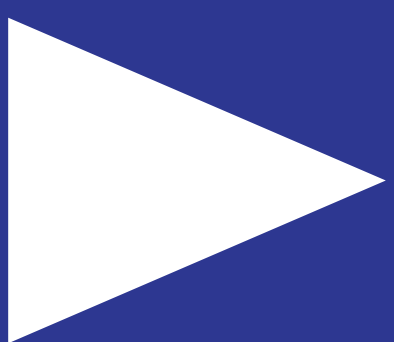
Yang, Yanni, Alex Pentland and Esteban Moro. “Identifying Latent Activity Behaviors and Lifestyles Using Mobility Data to Describe Urban Dynamics.” EPJ Data Science 12, no.15 (2023) https://doi.org/10.1140/epjds/s13688-023-00390-w

Yaymanoğlu, Ahmet, Aysima Akın, Damla Kaleli, Dilek Yürük, Ebru Şahinkaya, Eda Yavaş, İlayda Baydemir, Nur Gülgör, Sena Hut, and Zeynep Ulusoy. "AAP Small Scale Decent Change." Edited by Oral Göktaş. Yumpu, 2019. https://www.yumpu.com/en/document/read/65263911/aap-smal-scale-decent-change.

Yaymanoğlu, Ahmet, Aysima Akın, Damla Kaleli, Dilek Yürük, Ebru Şahinkaya, Eda Yavaş, İlayda Baydemir, Nur Gülgör, Sena Hut, and Zeynep Ulusoy. "AAP Volu-Te Design Guidebook." Edited by Oral Göktaş. Yumpu, 2020. https://www.yumpu.com/en/document/read/65263933/aap-volute.

Ye, Zi., "Z-Cube: Mobile Living for Feminist Nomads" Master Thesis, University of Massachusetts Amherst, Amherst, 2017.

Young, Angelo and Michael B. Sauter. "3D printing, E-cigarettes among the most important inventions of the 21st century," USA Today, January 9, 2020. https://www.usatoday.com/story/money/2020/01/09/21-most-important-inventions-of-the-21st-century/40934825/



MEF
ÜNİVERSİTESİ
Öğrenmeye Sınırsız Özgürlük