Tiny house on wheels: POD THOWs. Image by the authors

A new construction approach for tiny house on wheels: POD THOWs

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Abstract: Although the size of the houses has increased in recent years, the number of house users is decreasing. The decrease in the number of users has brought forth the concept of tiny houses which use less materials, less energy, and produce less waste compared to large houses. There are several types of tiny houses, with tiny houses on wheels (THOWs) being the most preferred type. However, THOWs are subject to high-way rules because they are not permanent structures. Such rules limit the dimensions of THOWs, thus preventing the creation of necessary spaces in the interior. In this study, we exanimated mobile housing, revealed barriers to their use and dissemination, and proposed a system called POD-THOW, which could offer a solution to the space needs of THOWs. As a result, it was understood that POD-THOWs provide a solution to size restrictions, but they should be combined with lightweight constructions and sustainable energy sources to prove effective.

Keywords: tiny house; tiny house on wheels; tiny house barriers; POD THOWs.

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1. Introduction

Today, the increasing housing crisis and the preference for solitary vacations away from the city have led to an increase in the demand for small-sized buildings. Social housing, holiday homes, caravans and tiny houses are examples of these small structures. Small social housing is a type of housing that responds to physical and social needs at a minimum level and can be produced in large numbers as a response to the housing crisis. These houses, which are produced with a low-cost production approach, are preferred in neighbourhoods with low-income levels, immigrant centres, and natural disaster areas. Holiday homes are commonly located within rural areas, during short holiday intervals. Caravans, with their small size and low cost, are popular among people who prefer to have a vacation in nature. Caravans are diversified into motor-homes, pop-up caravans, slide-out caravans, tent trailers, camper trailers and fifth wheelers. To describe briefly, a motorhome is a type of caravan in which the living space and the vehicle engine are on the same chassis. Pop-up caravans and slide-out caravans are caravan types that can expand from the top and sides with their special compartments. Tent trailers are two-wheeled vehicles with a canvas shelter that can be opened up above the body. Fifth wheelers are caravans that are attached to a vehicle using a hitch or mount placed over the back of a tow vehicle (Auto Smart Retail, 2020).

The concept of tiny houses is an architectural movement that is highly preferred today and is expected to gain more popularity in the future according to researchers. Although the practice has a long history, academic research on this movement is quite new in parallel with the recent boost in its popularity. When the studies in the literature are examined, it is seen that there are concepts such as “freedom” and “individualism” as the starting point of the movement. However, detailed investigation shows that the economic and environmental crises around the world also have contributed to the increasing popularity. Due to the ongoing housing affordability crisis, the decrease in fossil fuels and finally the COVID-19 global virus epidemic which has affected the whole world, the attention toward Tiny Houses has increased according to data obtained from various web search engines.

Being a product of a new architectural movement, Tiny Houses have encountered many different barriers, particularly in terms of legal and social aspects, and have also been exposed to various positive and negative effects. The most important of these effects and the determining factor for the tiny house is size. Size plays a significant role in terms of countries’ legal limitations and requirements for the tiny house movement, which lacks a specific definition in the literature. However, different countries vary in their legal assessment of size, which creates a barrier for tiny house designs.

The tiny houses that are the subject of this article have two different types; fixed and wheeled. Tiny house on wheels (THOWs), which is the most preferred tiny house type today, is subject to highway rules because it is not a permanent structure (considered as a vehicle). The same factor that limits THOWs’ dimensions especially in terms of height and width thus also limits the the creation of necessary spaces in the interior of the house. Due to this negative factor, users who require additional areas, especially families with children, do not prefer THOWs.

The structure of this article involves the examination of mobile housing, which is an alternative way of living and working today where technology, industry and tourism standards continue to develop, revealing the barriers to their use and dissemination. Finally, the introduction/preparation of POD THOWs, and an innovative proposal for the solution of size, which is the most important of size problems for THOWs will be presented.

2. Literature review

Tiny house movement, which has gained increasing popularity around the world, especially after the 1990s, has also increased its appearance in academic studies. From the 2000s to the present, various academic studies on many fields have been put forward on subjects regarding tiny houses such as planning, legal regulations, social life, sustainable contributions, construction costs, etc. The literature reviews that, similar to how other newly developed architectural movements faced barriers, the obstacles faced during the use of tiny houses also have some reasons. The main reason to increase in their use while economic, environmental and social positive effects could be counted, be the absence of specific legal regulation (and the economic problems that arise due to these), the socio-cultural structure of the society and the planning deficiencies. Studies in this field generally focus on the environmental effects, social and societal effects and legal barriers that affect the Tiny House movement.

2.1 The Tiny House movement

The Tiny House movement, as it stands today, is rooted in the trend towards smaller homes that began in the USA in the 1850s, a cultural response to conspicuous consumerism, the search for “freedom” and individualism, and the desire to live simpler. the neo-liberal economic policies and deregulation in the housing finance market, especially in the USA in the 1990s, greatly impacted housing prices. As a result, the first production of tiny houses

started, similar to its use today (Hodkinson & Robbins, 2013). The 8 m^2 mobile housing built in the late 1990s by Jay Shafer (2009), who is regarded to be the founder of the Tiny House movement, is considered to be the first tiny house similar to the houses of today (Groeninx van Zoelen, 2021). The structures built in this period are generally in the form of a mobile structure on a trailer and an average size of 37 m^2. These mobile homes are not travel-based like caravan culture, emerging as a solution to the ecological, economic and political problems experienced such as global warming, climate change and the decrease in energy resources (Mutter, 2013). In this direction, the concept of "tiny house" is an important point in terms of sustainable designs.

In recent years, the concept and understanding of the tiny house is becoming more and more popular. Popular internet searches between 2016 to 2019 were examined, revealing a sudden spike following the COVID-19 pandemic experienced in 2019 (Google Trends, 2021). During the pandemic, users preferred tiny houses, which offered more economical and isolated opportunities, especially during travels and holidays. In 2021, the concept of tiny house has increased its popularity considerably thanks to the programs made in mainstream media and the shares on social media. In addition, while the tiny house movement, which has emerged as an architectural trend, still represents a small portion of the market share, in parallel with the increasing permits and incentives in all countries of the world, market activities and the number of manufacturers is expected to increase globally.

2.2 Definition and characteristics of Tiny House

A precise definition of tiny house has not yet been made, but some countries define it through various restrictions in their national construction laws. While New Zealand and Australia, which are countries where tiny housing activity is quite high, do not have a clear definition, in New Zealand, according to 'Bryce', the maximum size allowed is 19.2 m^2 (8 m. long trailer), and in Australia, residences below 37 m^2 are generally accepted. In the USA, in the Appendix Q of the 2018 International Housing Code (IRC) (ICC, 2017) defines tiny houses as a house that is 400 square feet (37 m^2) in area or less. Specific attention is given to features such as compact stairs, including stair handrails and headroom, heights in lofts, guards, emergency escape and rescue opening requirements at lofts (IRC, 2018). However, in Turkey, there are decisions regarding temporary buildings in the 61st article of the Planned Areas Zoning Regulation contradicting the concept and movement of tiny houses, which is on the agenda today, in terms of building construction area, number of floors, and building height (Çevre ve Şehircilik Bakanliği, 2017).

Tiny Houses are also defined through various classifications and limitations such as the article made by Shearer and Burton (2018). According to this article, the concept of tiny houses encompasses several elements, including size, mobility, design – do it yourself (DIY), environmental sustainability, affordability, legal status, and social characteristics.

Mangold and Zschau (2019) enumerated the reasons for living in tiny Houses for users in the USA. The users initially stated that they were interested in downsizing or simply looking for a cheap, newer home. Additional concepts were incorporated further along in the study, including increased self-confidence, fostered connections with friends and family, a simpler lifestyle, and more affordable livelihoods tiny house lifestyle, according to the interview participants, represented financial security, freedom-autonomy, meaningful relationships, simple life, and new experiences. In line with these results, the following model was created.

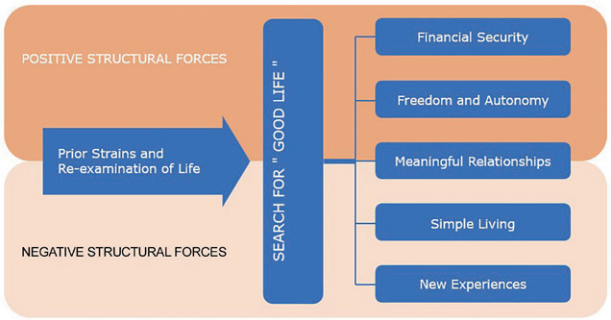


Figure 1 | Conceptual model for TH lifestyle appeal (Mangold and Zschau, 2019).

As can be seen in the created model; while economic and social factors are more prominent for users, sustainability and environmental factors remain in the background. However, as a result of the literature review of popular media sources conducted in Shearer (2018), the primary motivation for Tiny House users is the high cost of housekeeping, while environmental sustainability takes the second place. The reason THOWs are the most preferred type of tiny house was explained by Shearer and Burton (2021) to be the economic factors, environmental sustainability, and the freedom they provide.

There are different barriers with tiny houses, similar to all building types, which vary from country to country, but are common to the vast majority. Some barriers are associated with the economic and legal aspects, while others result from the introduction of a new housing

concept that necessitates individuals who are accustomed to culturally traditional homes to take time to adopt it. The most common barrier all over the world is legal incompetence. For example, tiny houses face barriers to urban integration due to existing regulations that discourage building small houses or even prohibit them entirely in some urban areas in the US (Harris, 2018). In this respect, when we look at the obstacles faced by the tiny house, it is seen that most of them are mainly related to THOWs. According to Shearer et al. (2018), the most common barriers include complex legislations, planning scheme, building code, expensive land, and legality. As can be seen from these obstacles, legal and economic difficulties are greater than social difficulties. THOWs are not like permanent residences and cannot be subject to zoning rules. In this sense, there are decisions taken by the countries themselves.

3. Methodology

A solution will be proposed for one of the most prominent problems of THOW users in terms of space in interior design due to the legal barriers determined by highways based on size and weight. The study focusing on this problem consists of four phases (Fig. 2). The first phase includes literature research, the second phase is composed of two parts: detection of the problem and a solution, in the third phase, the case study is presented and the last one consists of the discussion and conclusion.

4. Pop-Out Deck Thow design concept

The design for the pop-out deck tiny house on wheels (POD THOWs) outlined in this chapter offers a potential solution to the size restrictions and barriers explained in the previous chapters into a thoughtfully planned design concept. The POD THOWs design concept proposed within this article, is based on giving the THOWs a high adjustability feature. For this feature, the house must have a roof that is able to rise/decrease. Similar to the POD THOWs approach, caravans and mobile scenes also widely use this method. In addition, it is also possible to find a similar flexible design approach in aeronautics when designing passenger compartments of different classes within a fixed cabin size.

This feature is provided by pneumatic lifters placed inside the square section steel study elements that lift the flat roof (sliding out upwards) and provide extra space/floor (detailed in section 4.1). This design concept proposed is new and unique. It utilizes features from other contemporary tiny house buildings. With this feature, POD THOWs can provide a more effective solution to the need for emergency shelter in case of natural disasters. Based on the social housing features of tiny houses, easy shipment, low cost and fast construction provide a quick response to the problem of emergency shelter in natural disasters. The high mobility of tiny houses enables the creation of easy, fast, and variable neighborhood units, allowing for different social interactions. For example, after the major earthquakes in southern Turkey, the demand for tiny houses has increased dramatically. In the context of social housing, in addition to earthquake victims preferring tiny houses for their shelter needs, tiny house villages have started to be established in Turkey's earthquake-risked metropolises and popular rural areas.

If the tiny house is used as a commercial enterprise, it could offer more business space. POD THOWs can be used not only as a residential and commercial business structure, but also as a multifunctional one thanks to its expansion feature. For example, POD THOWs will be able to create a stage for a concert with its rising roof while at the same time creating a housing area for a musician band.

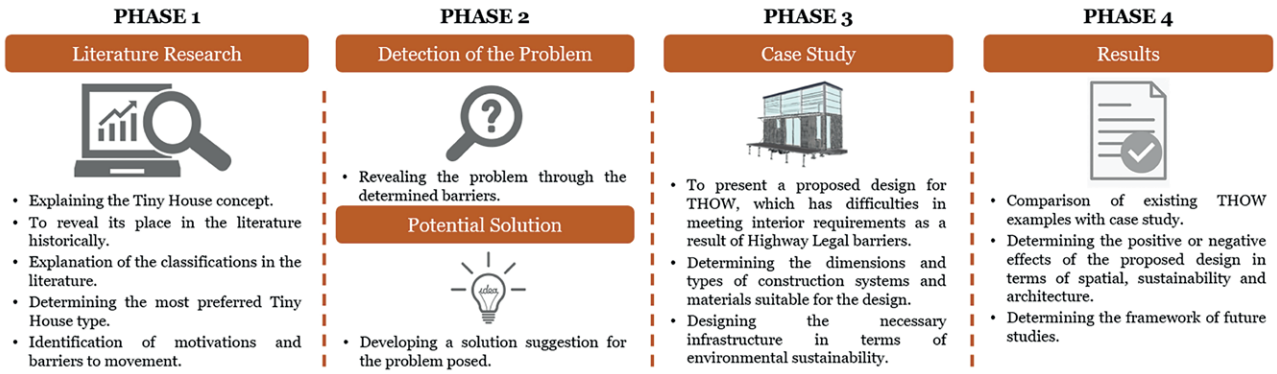


Figure 2 | Methodology of study.

Figure 3 | 3D drawings (interior and exterior) of POD Tiny house (case study).

In this part of the article, a case study approach was used to evaluate the potential and applicability of POD THOWs design concept to reduce size restrictions associated with height.

4.1 Case study

A case study of the POD THOWs design will be explained in detail in this chapter, beginning with concept design and conceptual spatial development. Next, the components/materials and space conditions/energy efficiency properties in the design will be addressed via table 4 and 5.

4.1.1 Concept design

A case Study POD THOWs aims to combine a container and folding cabins. In an attempt to create the mentioned design, the exterior will be corrugated metal cladding,

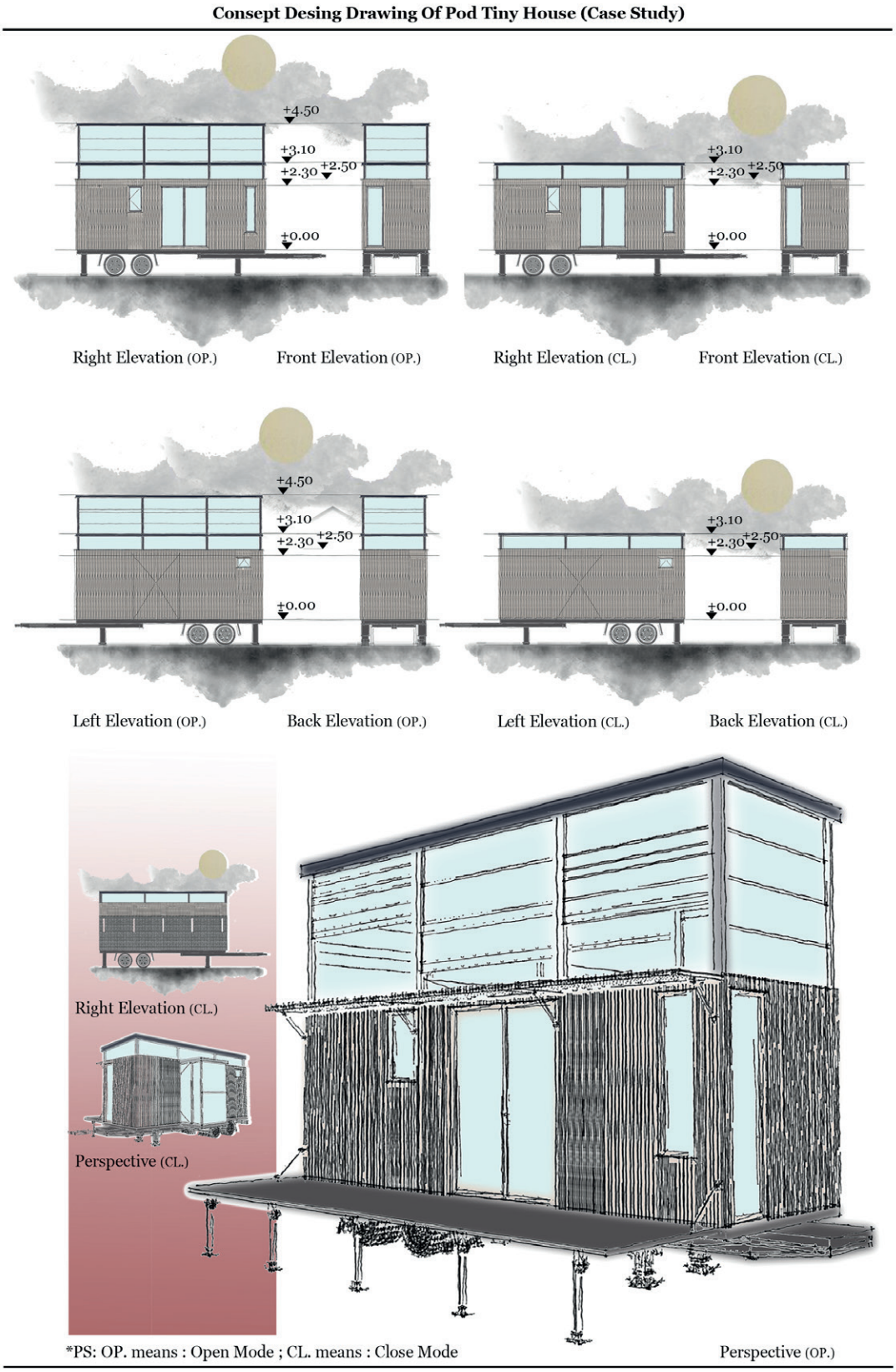


Figure 4 | Concept design drawings of POD Tiny house (case study).

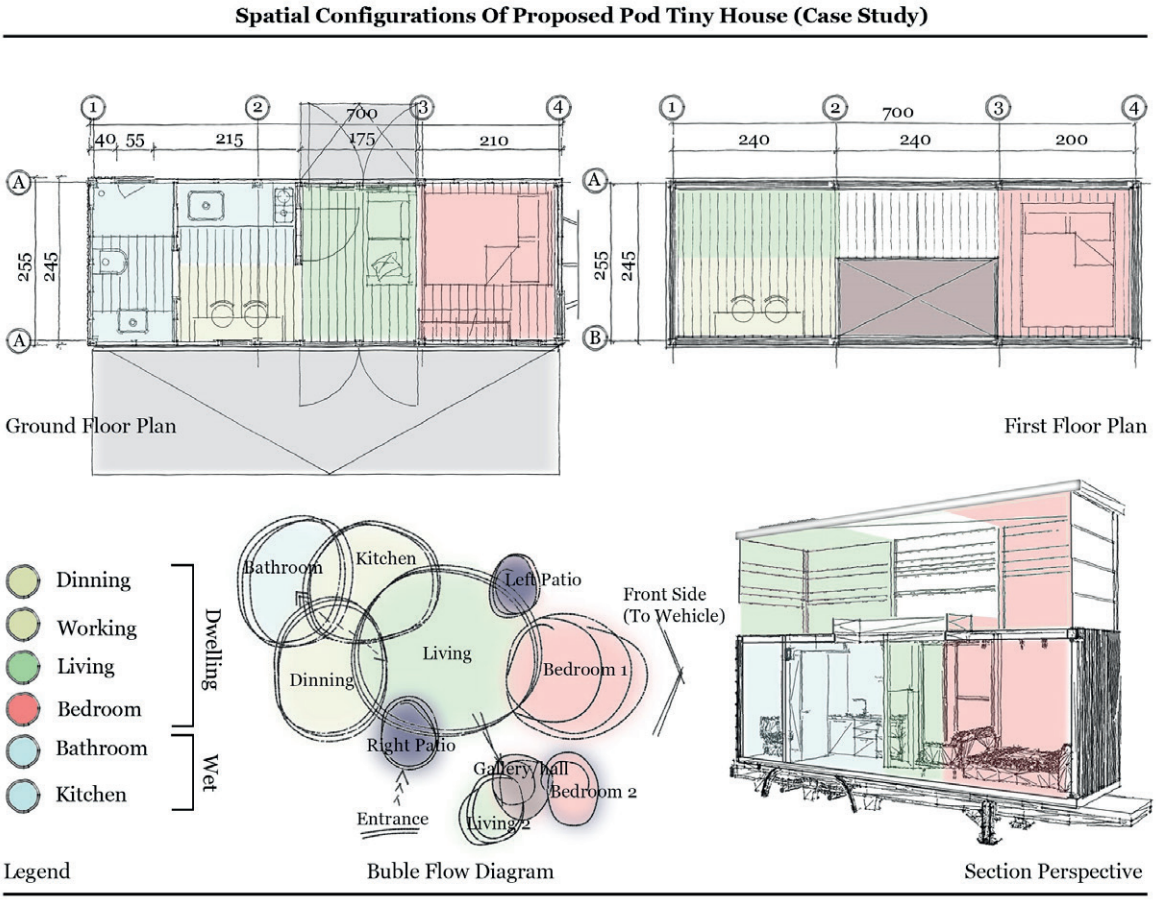


Figure 5 | Spatial Configuration of POD Tiny house (case study).

with a folding patio and porch and pop-up flat roof. The interior will all follow the same theme. In addition, the scenario created is that the proposed design will be able to serve a small family that consists of three people (two adults and one child) and must meet the needs of the family throughout its existence. There are three occupants in the case study building and all explanations and calculations of the proposed design are given in this context. In the core of the study is a house that incorporates caravan strategies.

4.2 Spatial Configuration and Plans

The POD THOWs is available in multiple configurations, to serve as either a home office, living space, bedroom, or an entire tiny house. In a case study, entire tiny house configurations by authors have been chosen. The basic configuration of a case study THOW includes a small kitchen, bathroom, living/working space, sleeping area and two patios (both long sides) on the ground floor, and a sleeping area and working space on the loft floor (when it opens up). In addition, there are minimal storage options. In order to visualize the spaces required for each person of a family and explore possible arrangements of the spaces based on needs, bubble flow diagrams were created (Fig. 5).

The options of spatial layouts available for THOWs are limited due to size constraints of the building. At the point of size restrictions, two specific requirements were taken into account, including the requirement that the building be long and narrow in order to fit on the road and the overall size of the structure would be as close to 37 m^2 as possible (Kautz, 2011). THOWs have additional limitations that are imposed with the specifications provided by the governments/legal institutions and the dimensions of trailers on which they are situated. Therefore, The POD THOWs selected as a 2.55 m x 6.8 m x 3.1 m and is built on a steel framed trailer, with steel framed walls, floors and roofs (slide out upwards roof flat).

An important decision in determining the spatial layout of any THOW is the location of the bathroom and kitchen (Morrison and Morrison, 2017). It was decided in a case study that combining the kitchen and bathroom in one end of the tiny house (front side) for freeing up a lot of space for living area was possible. In this configuration, attention should be paid that odors from the bathroom may be noticed in the kitchen and to avoid it, a strong bathroom fan and a sliding door to divide the two spaces should be added ied (Morrison and Morrison, 2017). There is an open living room with a moving TV wall and bedroom on the ground floor. As the building unfolds, the scenario unfolds, revealing the presence of the second floor, which encompasses a bedroom and workspace accessible via the staircase located in the gallery area.

4.2.1 Building Information and Properties

The basic architectural concept of the POD THOWs aimed to establish the maximum usage floor area that was required to meet ideal user requirements of interior and exterior spaces. The sizes of the minimum basic requirement spaces in a standard dwelling and the basic requirement spaces in the proposed tiny house are presented in Table 1 comparatively. The minimum furniture sizes in a standard dwelling and the furniture sizes in the proposed tiny house are presented in Table 2 in comparison. Information about the designed case study such as total area (dwelling and wet), total area with patio (auto controlled) and total weight is given in Table 3. It can be seen in the table that in the open mode, the total area increases nearly twice.

Table 1 | Comparison of the minimum basic requirement spaces in a standard dwelling and the size of the basic requirement spaces in the proposed tiny house (Neufert and Neufert, 2012).

Spaces	Space sizes in standard dwelling	Space sizes in the proposed tiny house (closed mode)	Space sizes in the proposed tiny house (open mode)
Living	12.00 m^2	4.30 m^2	7.25 m^2
Dining/Working	2.35 m^2	2.65 m^2	5.60 m^2
Bedroom	12.60 m^2	5.15 m^2	10.30 m^2
Bathroom	3.30 m^2	2.70 m^2	2.70 m^2
Kitchen	5.00-6.00 m^2	2.65 m^2	2.65 m^2

Table 2 | Comparison of the dimensions of furniture in a standard dwelling and the dimensions of furniture in the proposed tiny house (Neufert and Neufert, 2012).

Furniture	Furniture dimensions in standard dwelling	Furniture dimensions in the proposed tiny house
Sofa (2 people)	0.80 m x 2.00 m	0.70 m x 1.35 m
Bed (2 people)	2.00 m x 2.00 m	1.35 m x 1.85 m
Wardrobe	0.60 m x 3.50 m	0.45 m x l,35 m
Dining table (2 people)	0.50 m x 1.10 m	0.35 m x 1.30 m
Kitchen countertops	0.60 m x 3.00 m	0.60 m x 1.70 m
Shower cabin	0.80 m x 0.80 m	0.70 m x 1.15 m
Sink	0.55 m x 0.60 m	0.45 m x 0.35 m
Closet	0.40 m x 0.70 m	0.35 m x 0.50 m

Table 3 | Case Study Building Information Card.

	Open mode	Closed mode
Total area	29.5 m^2	15.8 m^2
Dwelling area	26.8 m^2	13.3 m^2
Wet area	2.7 m^2	2.7 m^2
Patio	11.8 m^2	0 – 11.8 m^2
Gallery area	2.5 m^2	0 m^2
Total area with patio	41.3 m^2	27.6 m^2
Average floor space per person (m^2)	10.6 m^2	5.27 m^2
Height (road pavement to roof)	5.4 m.	3.5 m.
Space volume (ground floor h:2.3 m.; first floor h:2.1 m.)	62.94 m^3	36.34 m^3
Total weight	3490 kg	
Frame weight	2090	
Coatings and home stuff	1400	

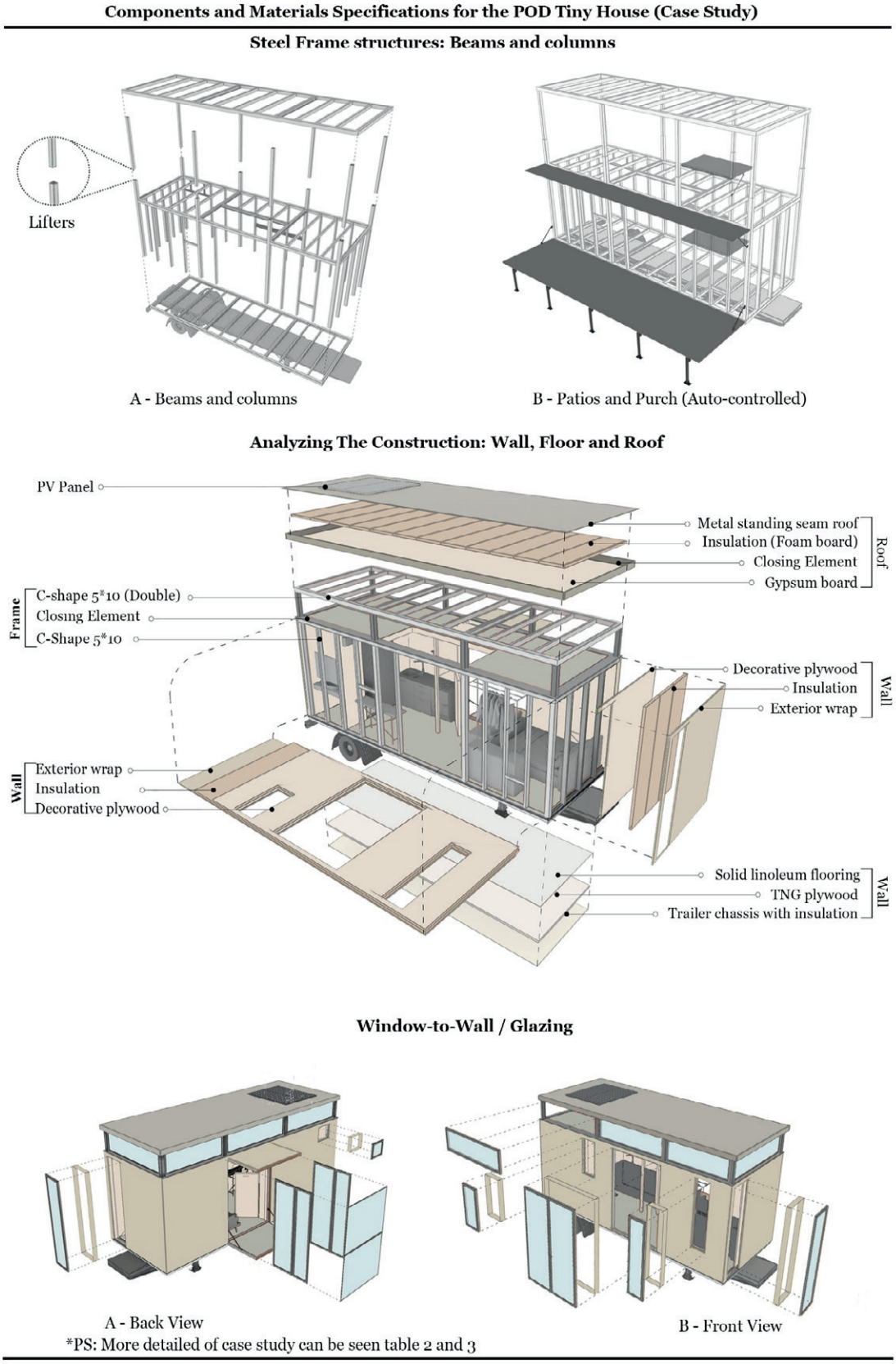


Figure 6 | Components and materials specifications for POD Tiny house (case study).

Table 4 | Components and Materials Specifications for the POD Tiny House (Case Study).

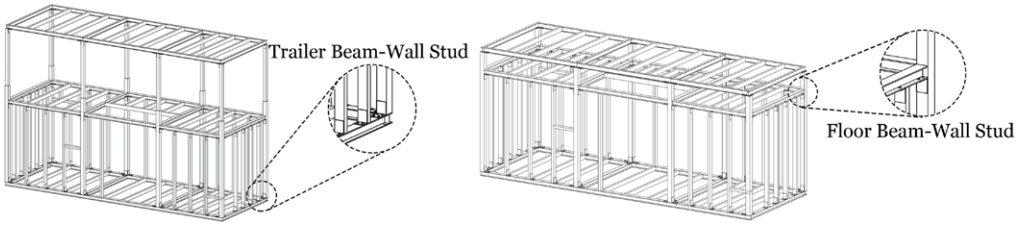
Characteristics	Source	Information
Construction (calculated via Structural BIM Software by Civil Engineers and construction meets engineering requirements) (Mukhopadhyay, 2020).		
- Trailer	Manufacturers data	A deck over is a trailer where the deck is located over the top of the wheel wells, which provides room for a wider trailer than car hauler styles. Owing to adjustable interior height, deck over trailer that combines with a foam board and waterproof insulation materials was used (Kautz, 2011).
- Wall Construction	Construction drawings	For ground floor walls: corrugated metal facade cladding (vertical) exterior (house) wrap – (EN 13859-1:2014) plywood - 12 mm PFC/U profile 100*50*3 mm / Insulation (Foam board) interior wrap (vapor barrier) decorative plywood - 12 mm For second floor walls: transparent PVC Sheet (with nano heat insulation film)
- Floor Construction		For subfloor/ground floor: trailer chassis with insulation TNG plywood - 18 mm (trailer deck) solid linoleum flooring For second floor: gypsum board – 12.5 mm (interior) interior wrap (vapor barrier) Frame C. PFC 100*50*3 mm / Insulation (Foam board) TNG plywood - 18 mm (trailer deck) solid linoleum flooring
- Roof/Ceiling Construction		Roof to ceiling metal standing seam roof roof membrane – 3 mm plywood - 12 mm frame C. PFC 100*50*3 mm / Insulation (Foam board) interior wrap (vapor barrier) gypsum board – 12.5 mm (interior)
Mechanical Systems (System controlled by a mechanical engineer and construction meets engineering requirements)		
- Lifting System	Construction drawings	A pneumatic lifting system has been designed inside of square steel stud that allows the roof deck to rise.
- Patio and Porch		It was aimed to perceive the THOW as a closed box from the outside. Patios of different sizes were placed on both long sides and they are electrically controlled.
Plumbing Electrical System Electrical Demand	Author chooses	Gas - CVPC Sewer - PVC Water – polyethylene (all of must be perform a leak test) Indoor wire/copper cable 60-amp plug Power Box - Solar Powered (Inverters can be noisy)
Windows and Doors	Aluminum frames-laminated glass with high insulation value and moisture resistance ability selected for door/windows. Type of the windows and doors is casement window (ground floor), louvre window (second floor), slider doors.	
Fixtures and Finishes	The key factors to consider for interior wall finishes for THOWs are weight, environmental impact, ease of installation, long-term maintenance needs, and cost. Stone and concrete are not suitable for a tiny house due to its heavier weight and somewhat brittle nature (Louche, 2012).	
Cabinets and Shelving	For the cabinets in THOW could either purchase pre-built cabinets, they can be custom ordered or built by owner. In addition, in closed mode, the first floor space can be used as storage space in POD THOW applications.	
Structure Design		

Table 5 | Space Conditions/Energy efficiency properties for POD Tiny House (Case Study).

Characteristics	Source	Information
Building Envelope	Construction drawings	The building envelope of the THOW is built using methods of construction which include insulation in between steel frame that is covered with interior and exterior cladding. The simple box-like shape of the THOW contributes to the ease of achieving low infiltration levels.
- Insulation		Foam board insulation (extruded polystyrene - XPS)
- Moisture Management		Interior wrap - ceiling wrap (both of vapor barrier)
- Sheathing		Exterior (house) wrap – (EN 13859-1:2014)
- Strapping	Manufacturers data	Trailer metal frame to trailer wood decking/subfloor: stainless Steel (18-8) Carriage Bolt (dome head) diameter: 6 mm, Length: 25 mm placed in both end of lumber Trailer metal frame to THOW walls frame: stainless Steel (Min. Grade 316) brackets thickness: 0.9 mm placed in each frame component (stud) THOW walls frame to THOW loft floor's joist: stainless Steel (Grade 316) brackets (frame to joist) thickness: 0.9 mm stainless Steel (18-8) Carriage Bolt (joist to deck) diameter: 6 mm, Length: 25 mm
Window-to-Wall area	Construction drawings	For ground floor walls: %15 (walls average when left side folding patio close) % 22 (walls average when left side folding patio open) For second floor walls: % 88 (all walls average)
Glazing U - factor	Manufacturers data	1.6 W/m^{2}K (acoustic laminated glass) 1.25 W/m^{2}K (PVC Sheet with nano heat insulation film)
Space Conditions	Author chooses	Considering THOW will be in areas with various climates, its needs a unit that combines both cooling and heating functions.
- Heating-Cooling System	Manufacturers data	Mini split air conditioner with space heater on first floor Mini split air conditioner
- Ventilation - Conditioning Systems		Natural ventilation (via windows, doors, gallery space) Bathroom fan (with moisture sensor switch) Kitchen fan (with moisture sensor switch)
Energy - Renewable Energy	Manufacturers data	Solar panels (solar can be mobile and is compact) system voltage 12V (700 W/12 V – 58 amp load) charge controllers (wall mounted) 60-amp 700 W system and 12 V battery bank inverter-batteries (deep-cycle) - Ah capacity is 200Ah back-up power - gas-powered generator
- Sourcing water/demand - Water conservation	Same place less than 6 months: water delivery services or rain catcherst. Same place 6-12 months: storage tank (6 m^3 - full-time use by four adults for 4-6 weeks - unless gravity fed, needs pump) same place for more than 5 years: Well or storage tank (> 6 m^3) (Morrison & Morrison, 2017)	
- Rainwater Harvesting	There are concealed gutters all around the roof. They divert water from the roof into a storage tank with a filtration system (17 m^2 roof surface can supply 0.6 m^2 water) (Morrison & Morrison, 2017)	
Space and Location Site Decisions Building Orientation	THOWs are on wheels, thus intended for use in possibly a wide range of climates. Systems that can be used in different climatic regions have been proposed together within the scope of the study. In addition, its orientation on site can vary. When moved later to another site, near or distant, THOWs orientation likely will change.	

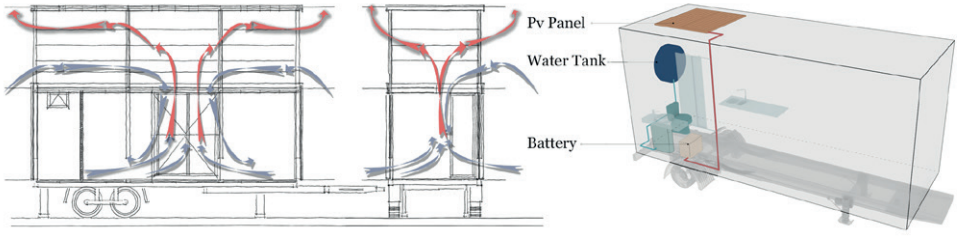


Table 6 | Comparison of POD THOW type and THOW type of constructing the same building.

	POD THOW	THOW
Total area	29.5 m^2	15.8 m^2
Average floor space per person (m^2)	10.6 m^2	5.27 m^2
Space volume (ground floor h:2.3 m.; 1. floor h:2.1 m.)	62.94 m^3	36.34 m^3
Total weight	3476 kg	3160 kg
Frame weight	2090	1820
Energy Consumption	1630 kWh	1420 kWh
Three occupant (two adult and a child) per year include such as laptop, lights, energy efficient fridge and fans etc. basic equipment		
Energy Production	1040 kWh	1040 kWh
4 solar panels used and calculated from average natural sunlight is available on Europe's wettest and driest cities per year		
Water Consumption (three occupant per year)	42 m^3	42 m^3
Twenty percent less average water consumption for Europeans		
Rainwater Harvesting (with 17 m^2 flat roof per year)	19 m^3	19 m^3
Total annual rainfall that is averaging annual precipitation a year on average for Europe's wettest and driest cities is 1013 mm		
Estimated Costs It may vary by country because of free market	average 40.000 $	average 44.000 $

5. Discussion

The information obtained when compared to POD THOWs and normal THOWs are given in Table 6. As can be seen from this table, POD THOWs have increased usage area and more floor space per person (10.6 m^2). However, in the POD THOWS, due to the big volume change of the interior spaces, energy demand and consumption are more in comparison to normal THOWs. This increase remains limited to a percentage of 15 and can be solved easily with additional measures of insulating and the usage of passive energy sources. In addition, its weight is 10 percent more due to the second floor and its furnishings. So, lightweight construction methods or beam-pillar systems can be selected, and, in this way, POD THOWs can stay in the same weight class with standard THOWs.

6. Conclusion

There are vehicle size restrictions to ensure that vehicles on public roads do not hit low bridges or cause accidents because they are too wide and high. Even though these limits vary from country to country, there are some general principles. One of these principles related to height is that maximum vehicle heights must be 4-4.5 m. As is the case with vehicle height, vehicle width limit is 2.6 m. These dimensional boundaries create some problems, especially in the usage area of THOWs (Kautz, 2011).

In this article, we set out to develop a new type of tiny house on wheels called as POD THOWs to expand its usage area to contribute to the solution of problems caused by the size limitation. The main feature of POD THOWs is a sliding section, which could pop-out to provide extra space (floor) above ground floor. A case study was conducted to investigate the applicability of the new approach suggested in the study. The overall project process and expected key events are explained in detail.

As a result of the case study, it was understood that POD THOWs contribute to overcoming size obstacles and increase the usage area. For users who need additional spaces such as families with children, a solution can be provided with POD THOWs. However, POD THOWs design process should be combined with lightweight frame systems and more efficient passive energy systems because of the increased weight and energy consumption value compared to normal THOW. Thanks to this proposed feature, POD THOWs can respond to the emergency shelter needs as social housing in natural disaster areas with variable capacities. Closed mode tiny houses solution can be used for small families. For multi-population families, an open-mode tiny house solution can easily be used. In the context of social housing, it is the feature that distinguishes our proposal from other tiny houses.

This study has not sought to develop a new theory, but to offer a framework for an innovative way of thinking. While the study offers intriguing insights into what could

be done to enlarge these buildings, there is much more subject to work on about THOWs. Future research should therefore not only aim to expand the space area of THOWs, but it should also engage in other important issues such as making more sustainable THOWs, identifying the areas required for THOWs in terms of urban planning, producing THOWs with zero carbon emissions, producing THOWs that are affordable.

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