

DESIGNING “FUGACI”, A MODULAR, MULTIFUNCTIONAL TRAILER

BY

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THESIS

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ABSTRACT

This project explores the potential of travel trailers as personal space for a variety of purposes. The study includes literature reviews, case studies, user behavior mappings, and proposes a design for a modular multi-functional trailer which is readily customized to suit different needs. This is particularly timely as the character of Recreational Vehicle (RV) travel and of remote working have significantly changed in recent years.

The study sketches the variety of spaces that people may want to use in trailers. In different times and circumstances, people may have various goals for travel, they may either want to relax, work, rest, or enjoy other activities around their mobile trailer.

The design outcome, Fugaci, is a multifunctional trailer with modular customization kits/furniture units. With easy operating mechanisms, the trailer can be converted to different floor plans and configurations to meet users' needs for different activities. These trailer types include a study, a yoga room, a bedroom, and more, useable either in proximity to the owner's home or anywhere the trailer can be hauled to. The size and weight of the trailer enables it to be towed by compact SUVs or other medium sized cars. It is also useable as an Auxiliary Dwelling Unit (ADU) parked outside the owners home.

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CHAPTER 1: INTRODUCTION

Camping and road trips have always been a way for people in the USA to get closer to nature and discover a wide and exciting world. During the 20th century, recreational vehicles, or RVs, have become a popular choice when it comes to camping and travelling. There have been a wide range of successful RV designs. However, most of them just try to provide residential functions in a van outside home. They mean to “feel like home”, but this is not always the expectation of travelers leaving home. A premier travel experience is not to copy the home, but to create something unique beyond home. To create such experiences, a versatile personal space on wheel is a concept worth studying. Even when located back home, the trailer remains an attractive unit in your backyard.

As domestic travels remains popular, it is worth considering providing specific facilities to enhance the experience of a short period of travel time. Minimizing maintenance, and saving space and resources in the vehicle for fun or creative use is an intention of this project. During the pandemic of Covid-19, many people have found a mobile space provides security and privacy, and a recreational vehicle or trailer could be an attractive alternative to a hotel.

The primary goal of the thesis project is to create a mobile recreational place in a trailer. Instead of just residential function, this design focuses on creating unique spatial experiences for users.

CHAPTER 2: BACKGROUND AND OPPORTUNITIES FOR RECREATIONAL VEHICLE USE

2.1 HISTORY OF RECREATIONAL VEHICLES IN AMERICA

In late 1910s, with the development of automobile technology, motorized vehicles became available for recreational travel. The first popular commercially available RV was the Curtiss Motor Bungalow, was built by aircraft engineer Glenn H. Curtiss in 1919. It was a solid-body trailer coach. Comfort and luxury were the priority of the model. The later model Curtiss Aerocar, came to the market in 1928, combined more aeronautic technologies. Victorian furnishing was installed in the trailer, offering a living experience to customers who could afford it similar to their permanent residence . Tyler (2010) concludes “It reveals the American desire to insert ‘home’ into wherever they are, even on the road”. While Curtiss’s initial designs actualized the desire of wealthy American people for recreational travel, the U.S. automobile industry soon began to answer the needs of middle class consumers.

The commercial trailer industry in the USA dates back to 1928, when Arthur Sherman created a hard-sided trailer in Indiana called the Covered Wagon. Then Sherman displayed his trailer at the Detroit Auto Show in 1930, beginning to receive and fulfill orders. The interiors offer the comforts of home. However, compared to the expensive Curtiss Aerocar, the price of the Covered Wagon was considerably cheaper, closed to the price of staying at conventional home.is only slightly more than staying at home.

Streamlining is one of the most popular and influential styles of American design in the 20th century, and widely applied in vehicles. Built with smooth curves, streamline design uses organic forms and has good aerodynamic performance. The most iconic streamline trailer design is the Airstream, and it has become a long-lasting model in production for over 80 years. In 1936, the first Airstream trailer model Airstream Clipper came to the market. The Clipper was designed by aerospace engineer Hawley Bowlus. The Airstream was built with aluminum and rounded outlines, two features that have remained in the brand design language to the present time. Streamlining has some functional advantages for towing but also emphasizes freedom of mobility through design features related to speed. (Tyler, 2010) The smaller, smarter and practical living space satisfied the demand of 1930s America for good modern design. The Great

Depression, starting from 1929 and continued through the 1930s, generally affected every segment of the United States, and certainly including the American trailer industry. During the Great Depression, trailers were no longer considered just a recreational product but became permanent housing for countless Americans. The families who used to buy recreational vehicles could hardly afford such non-essential objects at that time. The role of trailer dramatically changed during the depression. Mobility had once been a popular recreational concept but now became a need for survival. When people were desperately hunting for jobs and incomes, they lived in trailers to be able to live cheaply and to move to wherever the jobs were

However, from that period the trailer industry divided into two. One branch continued to serve the mobile RV market whilst the other developed into modular and manufactured homes that were technically mobile but rarely moved from their parking locations in trailer parks.

Companies like Airstream and Winnebago still focused on the recreational market, trying to keep positive imagine of the RV industry. Advertisements became conservative, for example, in late 1920's advertisement for Outers Equipment Co.said, "Sleep in Your Car", and the Kozy Coach company states, "Home Sweet Home, Wherever You Roam" in 1936. While the manufacturers tried to save the trailer's image as a desirable recreational product, people's impression of trailers turned negative. Using a trailer as permanent housing was not an ideal lifestyle. Those trailers were torn and shabby and their dwellers were often in unsanitary conditions. Trailers were related to a negative impression during the great depression.

The negative impression over trailer and trailer parks did not end with the Great Depression in 1939 since World War II marked the critical time in the moment. The advent of World War II had a big effect on the industry. There was a rationing of critical materials during the war time, and recreational vehicles were seen as unnecessary being only objects for leisure. Meanwhile, the Trailer Coach Manufacturers presented an argument to the Council of National Defense that mobile homes would be built as housing for war workers. After that, the trailer industry declared the trailers were mobile housing, essential to support the War effort. They were cheap and fast to manufacture, easy to scrap or repurpose when they are no longer needed. Trailer manufacturers accepted the fact that they built housing during the war time, but they did not

expect to produce it forever. Hopefully, the war was going to end, and they planned to build smaller trailer with mobility once they got permission for non-war-related manufacturing. Companies were anticipating the original market returning after the war, when they would revert to the strategy of creating small, agile transportation rather than large boxes for permanent housing.

After the war, aeronautic technology was applied to the trailer industry, reducing weight and air resistance, making trailers more suitable for road driving. In the years following 1945, the United States economy was influenced by consumerism more than ever. Motor homes became an influential part of American popular culture. A major factor in the mythology and identity of the USA was the westward migration by wagon train across the prairies to California in the late nineteenth century. Trailers continued that myth and acted as an icon of American dreams, representing the freedom to travel and the ownership of a home. Trailers for recreational use did return to the market. However, the image about trailer industry still related to low-end housing. There was also a new demand for large motorized recreational vehicles rather than the towable trailers. The market was now more diverse than in the pre-war time. Recreational vehicles were now both vehicle and shelter. The industry finally divided into two branches with different objects- as recreational RVs and trailers and as modular and manufactured housing.

Some manufacturers came back to the market with their mobile war house building experience and then produced manufactured or modular housing. Due to the housing shortage after the war, large numbers of Americans bought trailers as homes. At the fraction of the cost of a conventional house, consumers could live in something that performed as well as permanent housing. For the people who could not actually afford a real house, a trailer or manufactured home made it possible to own a freestanding home, and socially, move to a respectable, higher class.

However, housing trailers had some inherent disadvantages. Compared to conventional housing, trailers were narrow with thin walls lacking heat and sound insulation, contributing to lack of privacy for occupants. Also, some trailer habitants could not own pets because of the limitation from many trailer parks. Living in the trailer fulltime was a kind of compromise. Trailer families

actually experienced marginalization, defined as a lower class. Manufactured housing became the province of the working class, a situation that has recently begun to change with a developing proliferation of prefabricated housing units at all levels of the market. This is a response to rising costs for conventional buildings as well as the need for mobility and temporary housing. According to US Census Bureau (2019), around 5.5 % of the US population live in trailer parks.

In the future, housing trailers may play an role as an accessory dwelling unit.

According to American Planning Association(n.d.), an accessory dwelling unit, or ADU, is a small independent dwelling located nearby a single-unit house. Common types including internal ADUs , attached ADUs, and detached ADUs. A detached ADU is a stand-alone unit, sometimes called backyard cottage. ADUS were originally developed to increase housing capacity by building in the large backyards of existing houses, and is very popular in California where demand and provision of affordable housing do not line up.

Some ADUs are used for elderly relatives enabling them to live near their family. It increases the choices to live in an community, making better use of existing neighborhood space.

The RV trailer industry branch created in late 1950s, grew towards a flourishing future. In 1950s, more and more Americans resumed their interest in travel and camping. Many new camping manufactures came forth, and new products such as travel trailer, motor homes, truck campers and fifth-wheel trailers emerged(Harmon, 2001). For example, Volkswagen rolled out the camper bus. Walt King established the first pickup camper company, leading the way of truck campers. Holiday Rambler was an early representative of fifth-wheel trailer builder. On the other hand, to reduce the aerodynamic drag of trailers, companies like The KIT Kamper built teardrop-shaped vehicles which were small and streamlined.

In the second half of the twentieth century, recreational vehicle manufacturer boomed thanks to the revival in American camping culture.

2.2 ACTIVITIES IN RVs

This paragraph lists some possible activities in RVs:

Entertainment-video watching or gaming

Some RVers choose to have entertainment electronics in their vehicles. With TVs, media players, sound system, gaming consoles, they can watch movies, enjoy music or play video games.

Cooking/dinning

Cooking lovers may spend great time with the kitchen on RV. Some RVs enable outdoor cooking and picnic.

Party

An RV is able to hold table for board game, multiple seats and a bar counter. This can be an ideal place for party.

Meeting

Safe and private, the RV interior space matches the requirement for a meeting room.

Creativity studio

With certain facilities, the personal space inside RV would benefit creative work. This could include space for:

- Music
- Art/Photography
- Reading and writing
- Handcraft
- Woodworking
- Planting
- Mobile gym

2.3 OTHER OPPORTUNITIES IN THE COVID PANDEMIC

As the coronavirus crisis began in 2020, RVs emerged as a solution for safer travel and remote working.

The COVID-19 pandemic changed many peoples way of life. It made people rethink the way we work and the implications this may have on commuting activity (Felkai, 2021). Working from home, or WFH, has become the “new normal”.The trend of WFH is not likely to end with COVID-19. As the use of the Internet plays a dominant role in working, physical gathering in an office is no longer necessary in many jobs. Companies including Facebook are considering keeping WFH permanently even when pandemic ends. WFH will continue to be a common working mode in the future. However, WFH need not necessarily be limited to work inside the users house. Home is safe and comfortable, but as a working place, it can be distracting, dull and lack of inspiration. The key feature of home office is privacy. One solution is to use a mobile office inside a travel trailer.

CHAPTER 3: PRODUCT RESEARCH

3.1. VEHICLE TYPE.

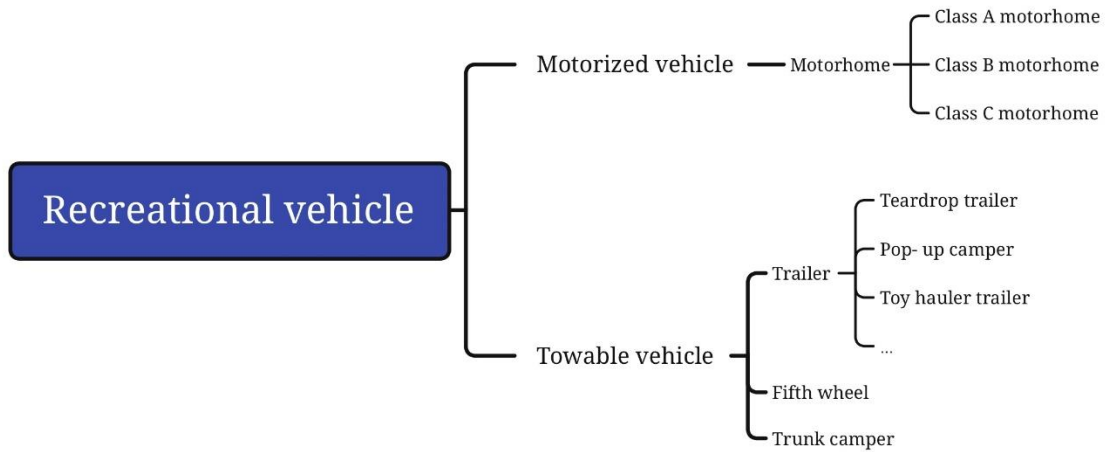


Figure 3.1: Recreational vehicle types.

Above is a mind map listing the major kinds of recreational vehicles on the market.

One noticeable type is toyhauler-an RV with garage that allow users to store small vehicles or other equipment inside it.The toyhauler is interesting because of its simplicity and versatility . Originally with just four walls and a floor, it is easy to repurpose the rear garage space as an office, a hobby room, or workshop. Some many with a patio deck and overhead awning, adding extension to space utility.

3.2. FUNCTIONAL FLOOR PLANS

The interior design of RV is function-centered and various between models. Below are some RV floor plans designed for different functions.

Rear Storage Floor Plan has flexible space- it can be room for small vehicles, or to convert into a studio, office or gym.

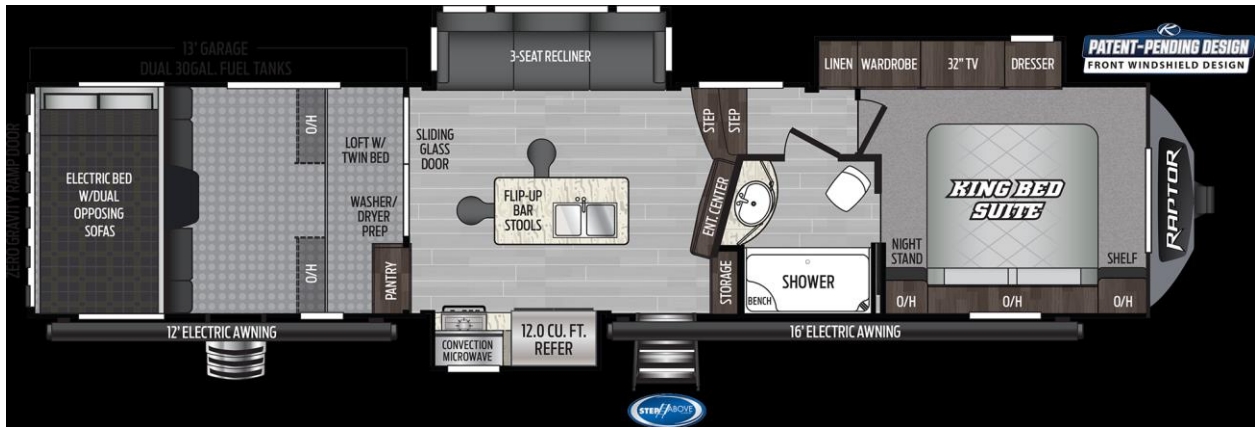


Figure 3.2: Rear storage floor plan.

(Photo source: <https://www.lazydays.com/rv-lifestyle/5-unique-rv-floor-plans-rvers-should-know-about>)

Front-Living, Entertainment-Focused Floor Plan has plenty of seating, perfect for indoor entertainment.



Figure 3.3: Front living floor plan.

(Photo source: <https://www.lazydays.com/rv-lifestyle/5-unique-rv-floor-plans-rvers-should-know-about>)

Extra Sleeping Space and Storage Floor Plan can accommodate multiple users and provide comfortable living space.



Figure 3.4: Sleeping and storage floor plan.

(Photo source: <https://www.lazydays.com/rv-lifestyle/5-unique-rv-floor-plans-rvers-should-know-about>)

Sizable Kitchen Floor Plan is a choice for users who enjoys cooking and dining in travel.



Figure 3.5: Kitchen floor plan.

(Photo source: <https://www.lazydays.com/rv-lifestyle/5-unique-rv-floor-plans-rvers-should-know-about>)

3.3 CONSTRUCTION AND MATERIALS

Frame, wall and roof

The RV construction comes in two types: laminated or Stick-n-tin.

Stick-n-tin refers to the structure of wooden frame with an aluminum skin. Comparing to the laminated, Stick-n-tin RV is cheaper and easier to repair or replace. Laminated RVs are those built from structural laminated panels usually comprising a rigid foam interior with skins of aluminium or hardboard. The strongpoint is lightweight, good corrosion resistance and easy cleaning.

Common roof materials of RVs on the market are fiberglass, aluminum or rubber.

A key factor to consider is that roof material should be durable. However, Rubber roof has a problem because it deteriorates fast, and is hard to maintain. Aluminum and fiberglass are relatively durable, except for delamination problem One kind of well-designed roof is a long sheet panel that overlaps the front and back walls of the vehicle.

Floor:

Three commonly used RV floor materials are carpet, laminate hardwood flooring, vinyl flooring. They are all affordable and easy to install. Carpet has a good insulating effect, is easy to install and is comfortable to walk on. However, it is difficult to clean and maintain. Laminate flooring is tough and durable, with various design options including hardwood, stone, and tile. Vinyl flooring is waterproof, flexible and durable. It is an economical option for flooring, and is easy to clean. The disadvantage is that it may look cheap and dull. There are also other flooring options, like solid hardwood, ceramic tile, and bamboo.

Ceiling:

Ceilings are either covered in fabric or vinyl. The latter is easy to clean, looks good and does not stain.

Windows:

RV windows have different types: sliding panes, fixed panes, awning, frameless, and Egress RV Window. Some RVs use single pane RV windows, while others are equipped with double pane

RV windows, or thermal windows. Thermal windows have relatively good insulation effects that maintain mild temperature in variable weather conditions and reduce road noise. Window treatments options include blinds and shades. They adjust the light and provide privacy. Further, the awnings over windows protect the vehicle interior from rain and heat when windows are open.

3.4. SOME MODEL EXAMPLES

3.4.1 Adaptiv™ system of Happier Camper

Happier Camper shows flexibility in a modular and customizable travel trailer. One of its most popular models HCI, is the ultra-light molded fiberglass trailer with a retro-modern design and breakthrough flexible interior. The featured trailer interior system is Adaptiv™.



Figure 3.6: Happier Camper

(Photo Source: <https://happiercamper.com/pages/adaptiv%E2%84%A2-for-campers>)

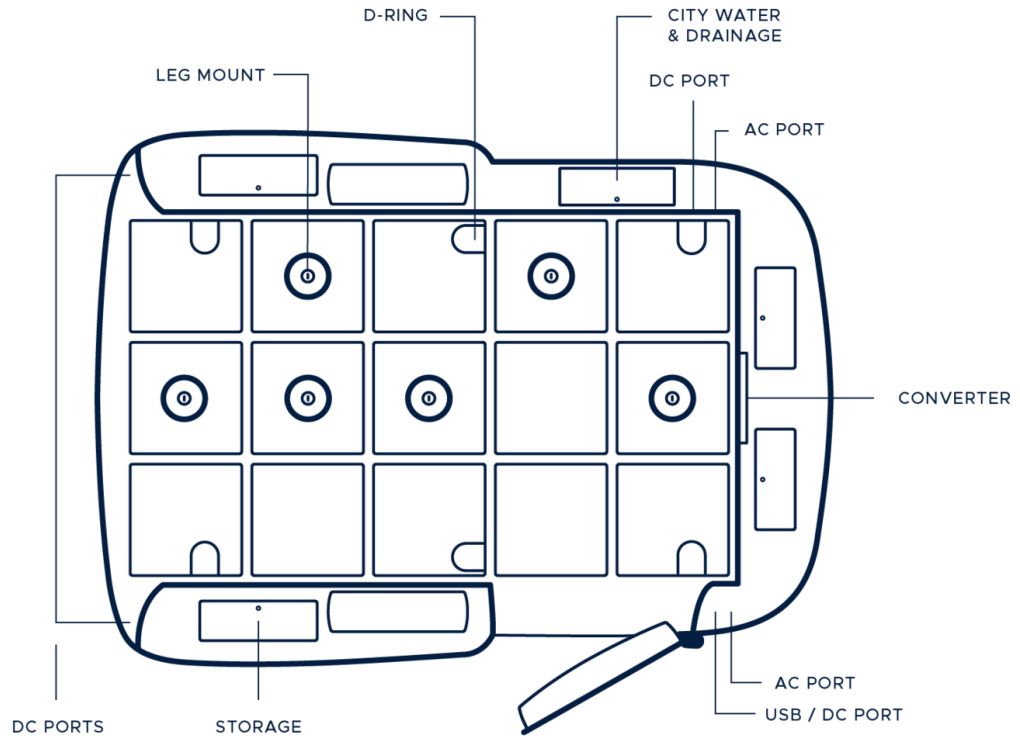


Figure 3.7: the Adaptive™ interior floor

(Photo Source: <https://happiercamper.com/pages/adaptiv%E2%84%A2-for-campers>)

The Adaptiv System uses no holes, screws or other small parts to configure, keeping a clean surfaces. Modules in cubes fit into the grooves on the strong honeycomb fiberglass floor. Setting up is easy, free of tools, and the cubes are light enough to move. They can freely combine, change position, and overlay on each other.



Figure 3.8 : the Adaptiv™ interior

(Photo Source: <https://happiercamper.com/pages/adaptiv%E2%84%A2-for-campers>)

Different pieces are design for storage, seating, cooking, and sleeping. With fitted cushions and tabletops, cubes provides countertops and resting place. The modules can be either placed inside the vehicle or outdoors, so users can bring the units out and enjoy outdoors cooking, dining or other activities.

3.4.2 Van Conversion Kits- Wayfarer

A camper van provides an alternative option to live on the road, and several custom conversion companies sell conversion kits to help users create it. Van conversion kits consist of a bed, shelving and maybe some more functional pieces to build a equipped camper. Modular camper van conversions have little or no permanent alterations to the van. Wayfarer is a company that offers modular camper van conversions.



Figure 3.9: Wayfarer van conversion kits

(Photo Source: <https://wayfarervans.com/walt-camper-kit/#>)

The conversion includes: “flooring, with integrated cargo management tracks; wall and ceiling paneling with 100% natural wool insulation; perimeter shelving; a kitchen galley with 5 gallon fresh and grey water tanks, sink and hand pump; storage boxes; hideaway table, and privacy paneling for the sliding and rear door window areas.” “a bed platform ...with bed cushions, and the bench box and boot box come with cushions” (Wayfarer Vans, 2021).

The van conversion kits need installation work. Though it is not easy to change the floor plan the modular design is flexible as it is possible to place and remove.

3.4.3 Airstream Bambi

Airstream is an iconic design in trailer history, started from 1930s, and still in production with many early models still in use. The classical streamlined design of curved aluminum remains a symbol of speed and freedom, and American creativity. Among all the iconic trailer models of Airstream, Bambi is the smallest. Lightweight, towable by regular family SUV, but still equipped with completed kitchen, bathroom and sleeping place, with all essentials needed. Airstream Bambi is able to provide camping experience with comforts of home and towable mobility. It is a long-tested compact travel trailer design, and the sleek, metallic profile is inspiring.



Figure 3.10: Airstream Bambi

(Photo Source: <https://www.airstream.com/travel-trailers/bambi/>)

3.4.4 U-haul

U-haul is a rental company offering moving equipment and storage, including cargo, trailer, and other equipment.



Figure 3.11: U-haul trailer

(Photo Source: <https://www.uhaul.com/Trailers/5x8-Cargo-Trailer-Rental/AV/>)

The U-Haul cargo trailers are a series of enclosed trailers designed for people moving house contents. The trailer is lightweight, towable by family vehicles. The trailer has aluminum frame, edges covered with curved aluminum panels, and the trailer surfaces are supported by wood struts.



Figure 3.12: U-Haul Manufacturing

(Photo Source: <https://www.youtube.com/watch?v=JB6FV8gyW04&t=116s>)

The trailer looks like a round-cornered Box with silver edges, and the signature livery of white and a horizontal orange stripe. The wheels are extended from both sides, covered and connected with panels, so they do not occupy the room, keeping a full box shape interior space. The rectangular shape allows maximizing the use of space, so that the trailer is able to hold more goods.

3.4.5 Nissan NV

Nissan NV is a popular choice for van conversion.

Here is an innovative example: Nissan has collaborated with UK-based design workshop Studio Hardie to transform its zero emission e-NV200 van into the all-electric mobile office – the e-NV200 WORKSPACE (Nissan Official U.S. Newsroom, 2019).



Figure 3.13: e-NV200 WORKSPACE

(Photo Source: <https://usa.nissannews.com/en-US/releases/the-future-of-working-nissan-e-nv200-workspace-is-the-world-s-first-all-electric-mobile-office#?&>)

Another example is this woodworking shop concept on Nissan's NV300 (Uncrate, 2019). There is a steel track that allows a working stool moving through. Modular bins are easy to set up or remove.



Figure 3.14: Nissan's NV300 woodworking shop
(Photo Source: <https://uncrate.com/nissan-nv300-workshop-concept-van/>)

3.5 RESEARCH SUMMARY AND INSIGHTS

It was decided to focus on the design of a trailer rather than an RV as the lower cost and increased versatility makes them more useful for a wide variety of people.

The original use of RVs and trailers were for camping, and this will continue but the uses of a trailer can expand from just providing sleeping space to providing for a wide variety of activities.

At the time when working from home is becoming more popular, the trailer provides an option for a remote working office. Additionally, it can be a creativity studio for art, music and so on.

Space conversion solutions will enable the trailer to become multi functional.

CHAPTER 4: DESIGN DEVELOPMENT

4.1 EARLY IDEATION / DESIGN BRIEF

The design is a towable trailer for travel of short time and distance. It serves a small family or groups of friends.

The trailer will hold 1-4 people for daytime event, or accommodating 2 people for a weekend getaway.

The trailer is lightweight and built in compact size. It is towable by family vehicles and easy to park.

The trailer is a vehicle similar to a lightweight toyhauler in some ways, but not necessary to hold toys. It is important to keep the interior space empty and free, easy to hook up and transit. Hook-up compartment is needed, possibly including tie-down fasteners and protective basic frame

The trailer should be useable:

1. As part of house when back at home.
2. Able to drive out for recreation.
3. Easy to change and set up.

To summarize, the product is going to be a trailer which is easy to set up for a variety of uses., using a range of functional modules to provide facilities.

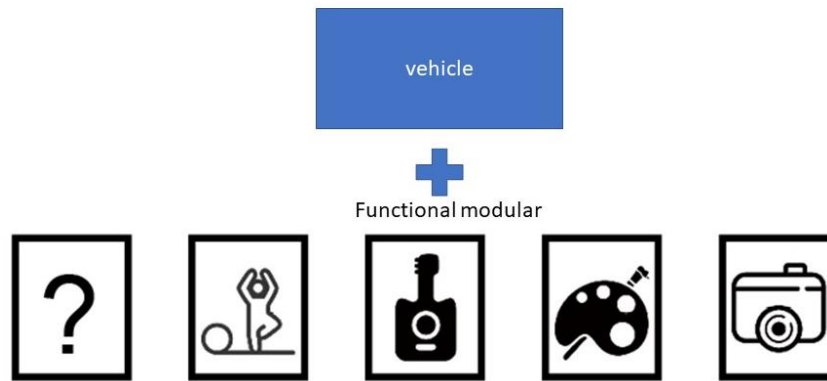


Figure 4.1 The design concept of the modular trailer.

Multiple concepts arise in ideation process:

1. A functional room on wheel move as a whole;
2. A system that can easy hook up on an empty frame;
3. vehicle with base frame and conversion kits.

4.2 DESIGN CONCEPTS

4.2.1 A single functional space

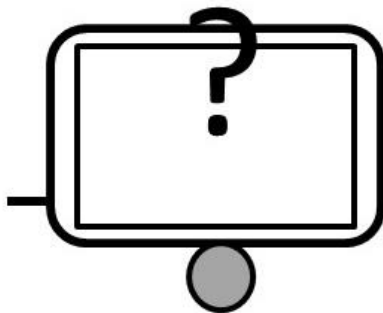


Figure 4.2: Concept 1- A whole functional room.

Pros of the idea: As an independent space on wheels, user can drive it anywhere to enjoy- and it is always ready to use, no needs of installation.

Cons of the idea: This concept is the least flexible one, almost unable for users to change it every time. It takes too much space and money to own multiple units with various functions.

4.2.2 A trailer with add-on cube

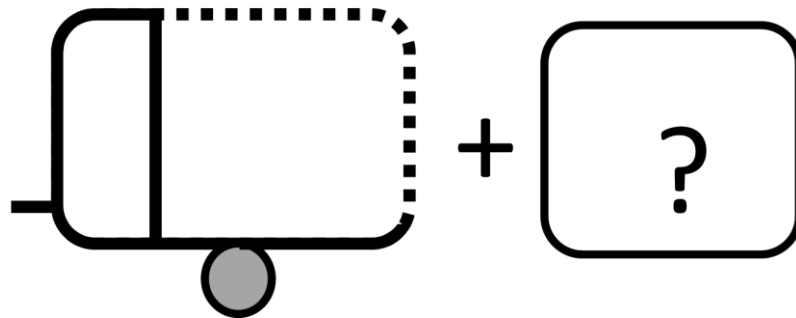


Figure 4.3: Concept 2- A functional cubic on the trailer.

Pros of the idea: A cube can install as a whole, so that users would not bother how to combine the furniture every time. The cube is always ready to use as a functional room, on the vehicle or somewhere at home.

Cons of the idea: The big module takes much efforts to move and install from space to space. It occupies much space at home.

4.2.3 The trailer frame with conversion kits

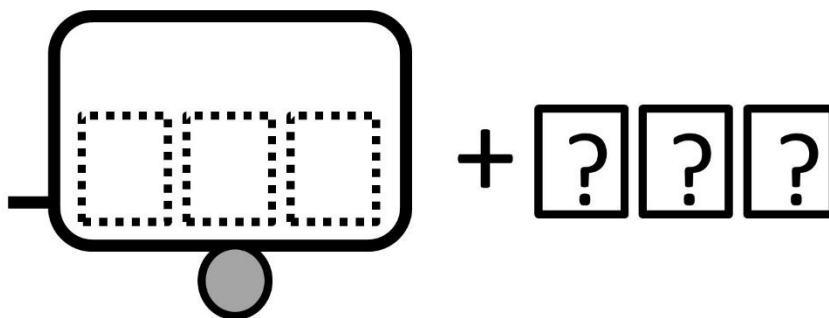


Figure 4.4: Concept 3- The trailer frame with conversion kits.

Pros of the idea: It's very flexible. Each unit is light.

Cons of the idea: So many pieces take much time to construct.

4.3 CONCEPT SELECTION

To evaluate the effectiveness, it is time to review the goal of this project: to explore an alternative of personal space on the way with variety of purposes and flexible arrangement.

The essential difference between these concepts is the size of modules- bigger, or smaller. Bigger modules keep most functional completeness and convenience, so user can directly plug them in and go- they won't have trouble arranging the space and building them up piece by piece.

However, big units bring the problem of difficult installation, as well as storage. For most users, it will be expensive and inconvenient to buy several vehicle units or functional cubes and store them somewhere at home for replacing when not using them. The bigger the modules are, the less versatile the arrangement becomes. To provide most flexibility, the decision is to keep up with the concept 3: the trailer frame with conversion kits.

4.4 IDEA DEVELOPMENT

The large door at back allows furniture components to be easily loaded. It can be lowered down to a slope as an aid to move furniture. When in horizontal position, it will be a deck addition to the trailer's space.

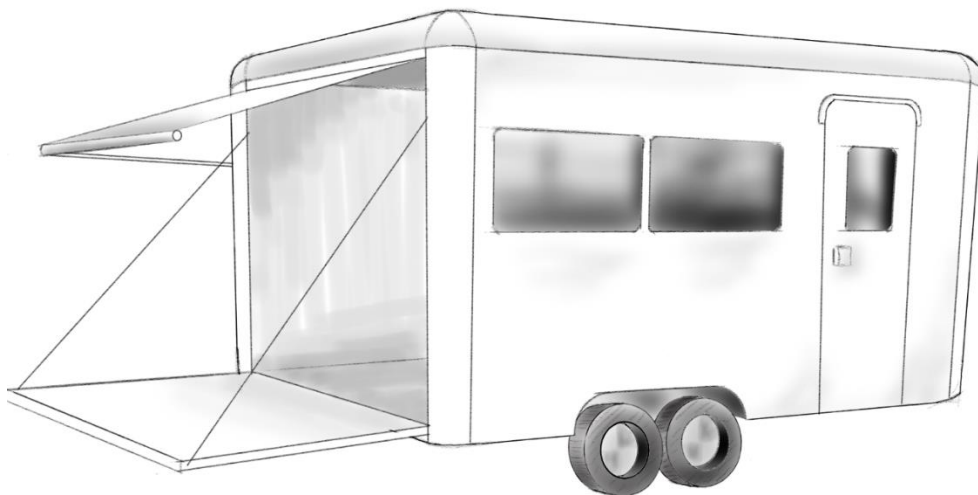


Figure 4.5: Rear loading idea.

The general idea is to keep conversion kits modular, so the room function inside trailer is flexible. A bathroom and a small kitchen is provided as a permanent installation of compact size with service hookups.

4.5 DIMENSION DEVELOPMENT

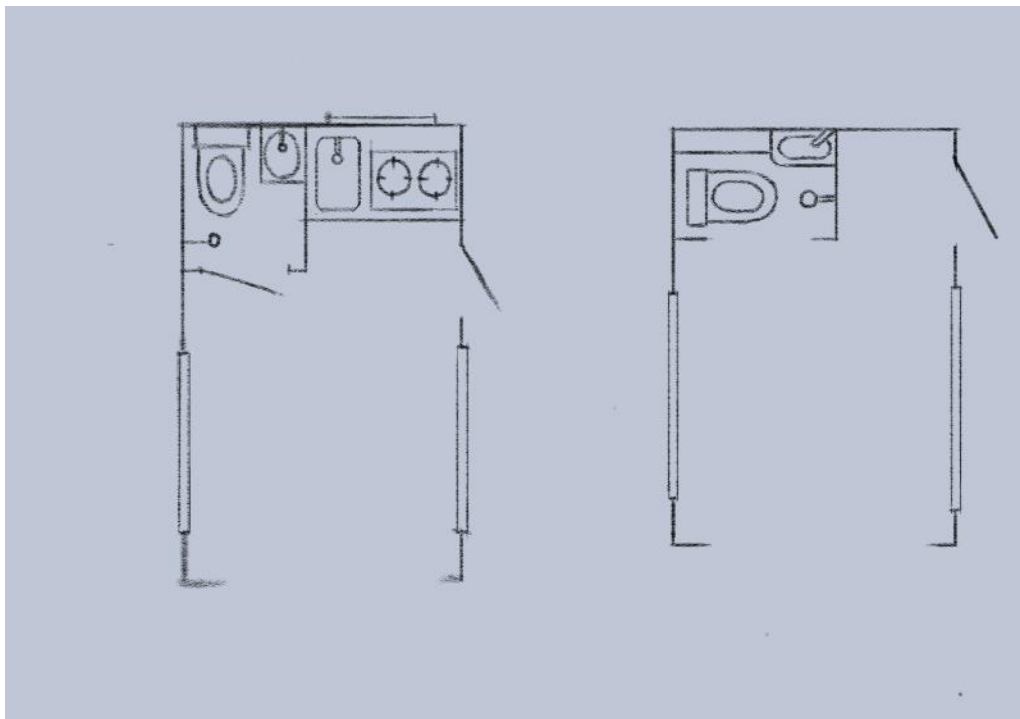


Figure 4.6: Permanent facilities at front.

The next step is to consider the dimensions of the trailer. Conventional RVs are generally 8 feet (2438 mm) wide, and Lite Travel trailers width is usually 6-7 feet(1829-2134mm). Since the project insights is to accommodate a small group of travelers in short distances and time, a lite travel trailer size would be enough to satisfy the needs while maximize motility. In consideration of ergonomics factors, the interior space size is set to 14'(l) x 7'(w) x 7'(h) (4267mm x 2134mm x 2134mm), which allows user easily doing daily activities with necessary facilities. The actual external product size would be larger with the thickness of construction materials, which would be discussed later.

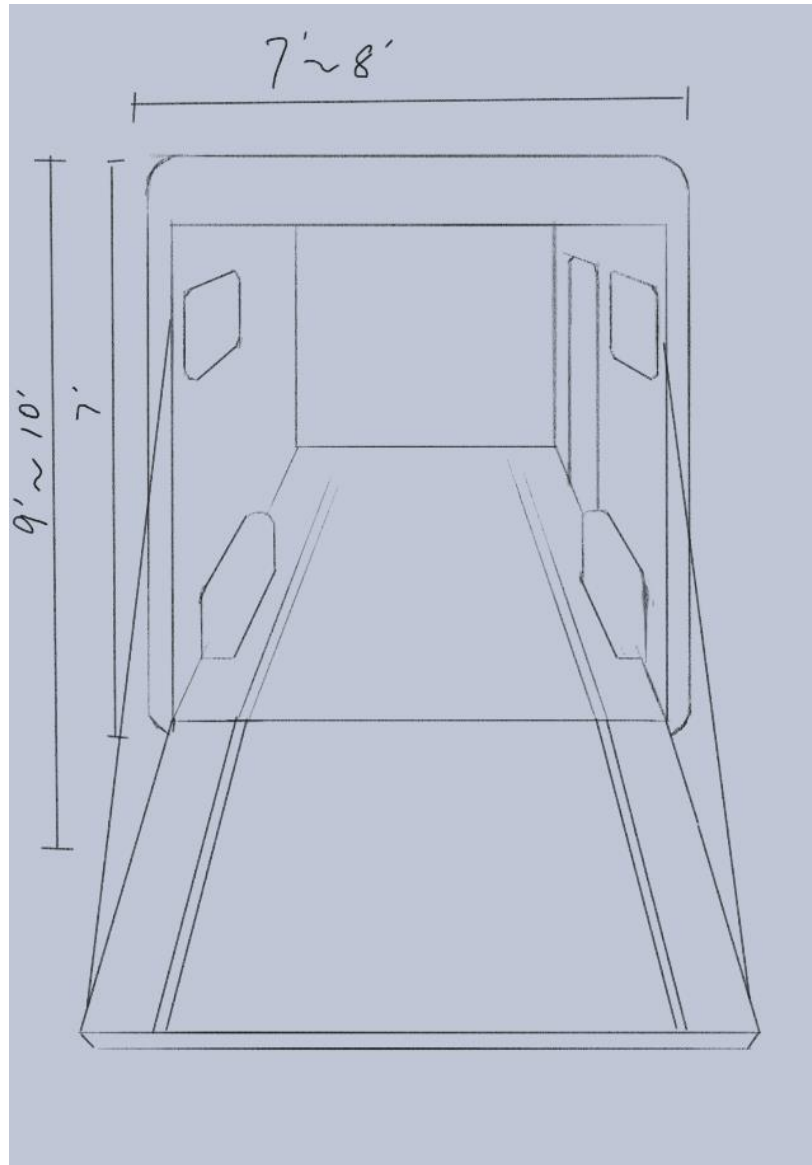


Figure 4.7: Dimension ideation.

The author drew a rough model on the floor to test if the space is enough for regular activities.



Figure 4.8: Modeling- dimension practice

One important design feature for the trailer is the cuboid shape with round corners. To maximize the internal space utilization, the trailer is initially designed to a box shape, with edges vertical to each other. To optimize the design, rounded corners are added to the outside

The external rounded corners provide a smooth and gentle looking exterior. An internal rectangular space is more practical and universal for all facilities and activities. To keep most use of the space, the internal radius of the trailer needs to be kept small. The inside space of the trailer is a rectangular box to facilitate furniture installation.

After consideration, the outside radius of the rounded corners is 6 inches (152 mm) as the inner diameter is 2 inches (51 mm)

The trailer uses 215/70R14 tires. After discussing with the committee, the vehicle is designed with double axles with 4 wheels. Comparing to single axle, it has more stability and weight capacity, enabling the use of smaller wheels, improving the floor layout.

4.6 FURNITURE INSTALLATION STRUCTURE:

L-Tracks

To create both Versatility and strength, the solution is to use L-tracks as Cargo management track on the trailer. L-tracks, known as Logistic Track, is a widely-used mechanism in modular trailers and converted vans, often for truck bed or flexible tiedown system . Consisting of aluminum rails and fitting, L-track shows a sleek and compact profile and offers quick installation. With satisfying versatility and strength, the track allows equipment to be easily and securely fastened down.



Figure 4.9: Conversion Kits from custom conversion company Zenvanz
(Photo Source: <https://www.zenvanz.com/kits/>)



Figure 4.10: L-track fasten used in DIY van conversion.
(Photo Source: <https://www.vantasticmedia.com/vanbuild-posts/2018/6/21/l-track-for-the-win>)

4.7 ESSENTIAL UTILITIES:

A 12-volt DC automotive system powers the devices in the cargo area. The trailer is equipped with clean & gray water hookups. Three water tanks are located on the underside of the trailer. There are 17-gallon freshwater and gray-water tanks, which would be enough for 2 people drinking, minimal dish and person washing and showering in two days. A blackwater tank is also installed.

Water consuming estimation:

Drinking and minimal washing (2.1 gal*2 people*2 days) = 8.4 gal

Quick Showers (2 gal) *(2 people)*(1 showers in 2 days) = 8 gallons

Toilet flushing (1 gal)(2 people)*(2 days) = 4 gallons. However, it is possible to use grey water for toilet flushing so it does not count for fresh water consuming.

The trailer use awning windows, opening from the bottom, allowing opening even in rain, with double-paned glass for insulation.

4.8 DIGITAL SKETCHING:

After the basic shape is modeled, ideation goes on to explore different separation of the surface. Multiple parts on surfaces may be differentiated by various materials or painted colors, or ridges and gaps.

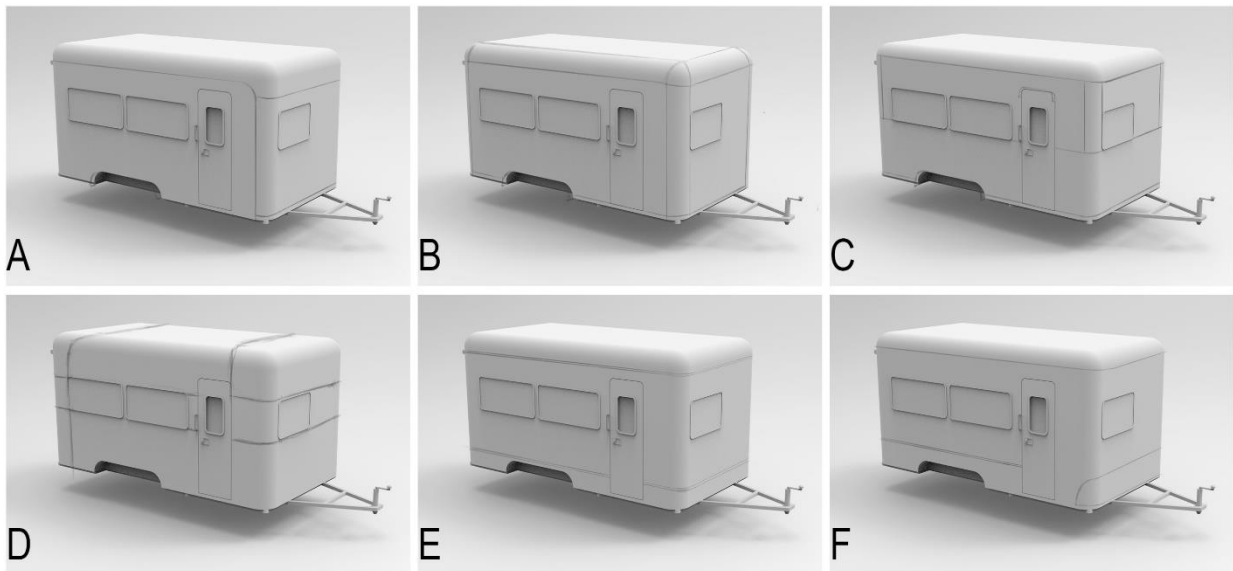


Figure 4.11: Design sketches

After discussing with the committee, the choice is plan B with plain painting. However, all kinds of styles are kept for further design development.

4.9 TRAILER BODY CONSTRUCTION



Figure 4.12: Construction- Aluminum frame

As mentioned above, there are two main forms of RV construction: Stick-n-tin and Laminated.

Comparing the features of these two types, the laminated construction is more lightweight, durable, and with more admirable designs, which suits better for the chosen concept.

The project is to be built in a laminated way. This RV construction is supported by internal aluminum frame. The sketches show how the frame is organized beside the body panels of aluminium or fiberglass. This construction is similar to that used by U-Haul for their cargo trailers, combining extrusions and panels to create the exterior.

Computer---Aid 3D modeling:

A CAD model was developed in Fusion360.

CHAPTER 5: DESIGN OUTCOME

Based on the previous design process, the final concept FUGACI is created.

The product name Fugaci, is derived from the word “fugacious”, referring to something lasting a short time. The title emphasizes the key feature of the modular system-flexibility.



Figure 5.1: Fugaci.

5.1 BRIEF

Fugaci is a modular trailer system that includes the vehicle and modular conversion kits/furniture units. It can be converted to different modalities to meet users’ needs for different activities in its functional space on the way. It can also be set up as a mobile studio or for other functions

The idea of the project is to create an alternative transportable personal space. This concept meets the needs of privacy, flexibility and mobility.

5.2 DIMENSIONS

The figure reveals the dimension of this trailer: the trailer box is 14 2/3 ft by length, 7 2/3 ft by width, and 7 2/3 ft by height (4470mm x 2337mm x 2337mm), with a 14ft by 7ft by 7ft(4267mm x 2134mm x 2134mm) interior space. With the size of chassis and wheels, the whole trailer is 224in by length, 92in by width, and 110in (5690mm x 2337mm x 2794mm) by height.

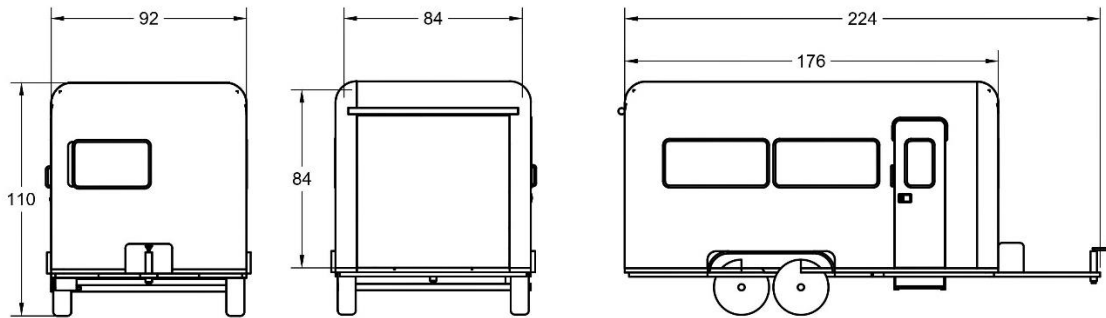


Figure 5.2: Detailed dimensions.

Base specs

Shell Length: 14' 8" (4470mm)

Exterior Height: 9'2" (2794mm)

Overall Length: 18'8" (5690mm)

Inside Length: 14' (4267mm)

Inside Width: 7' (2133mm)

Inside Height: 7' (2133mm)

Gross Vehicle Weight Rating: 3500 LBS (1588kg)

Panoramic Windows: 5

Walkable Floor Space: 84SF (7.8m²)

The trailer uses 215/70R14 tires, double axles.

5.3 CONSTRUCTION AND MATERIALS

As mentioned in the last chapter, the trailer uses laminated construction, consisting of panels over an aluminum frame, with Luan backer and foam insulation. For some part of the trailer, as shown in the rendering, the outer structure is replaced with Aluminum sheet.

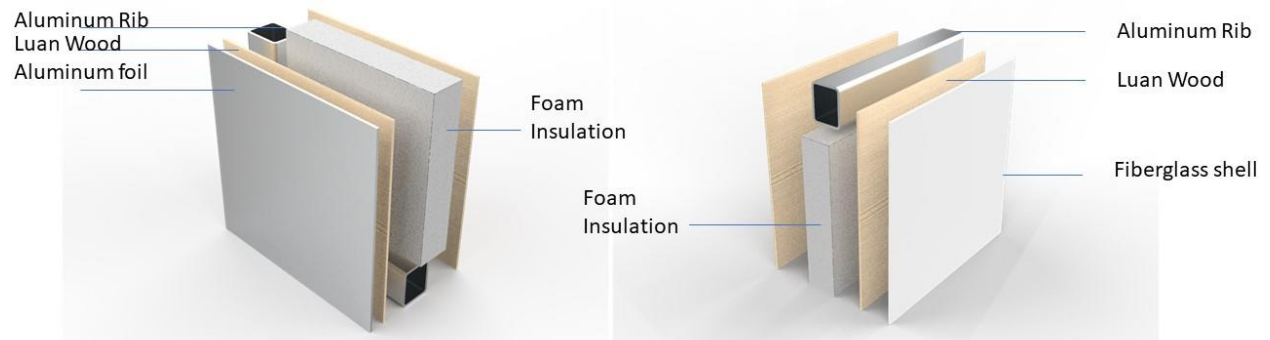


Figure 5.3: Construction- layers.

A key feature of the modular system is the cargo management tracks where the furniture units connected with the trailer inner face. There are two parallel rails on the floor that allows furniture moving through, and horizontal L-tracks on each side wall. To maintain steady and safe in driving, units can be fixed on the L-track with the mechanism shown in the picture.



Figure 5.4: Cargo management track

5.4 FUNCTIONAL MODALITIES

With the modular units the trailer can be set up in various ways.

Most furniture modules are placed at both sides of the room and have the same width of the space to rail. The module typologies include desks, storage, sofas, and bed. Users choose and make combination of furniture to build ideal floor plans.

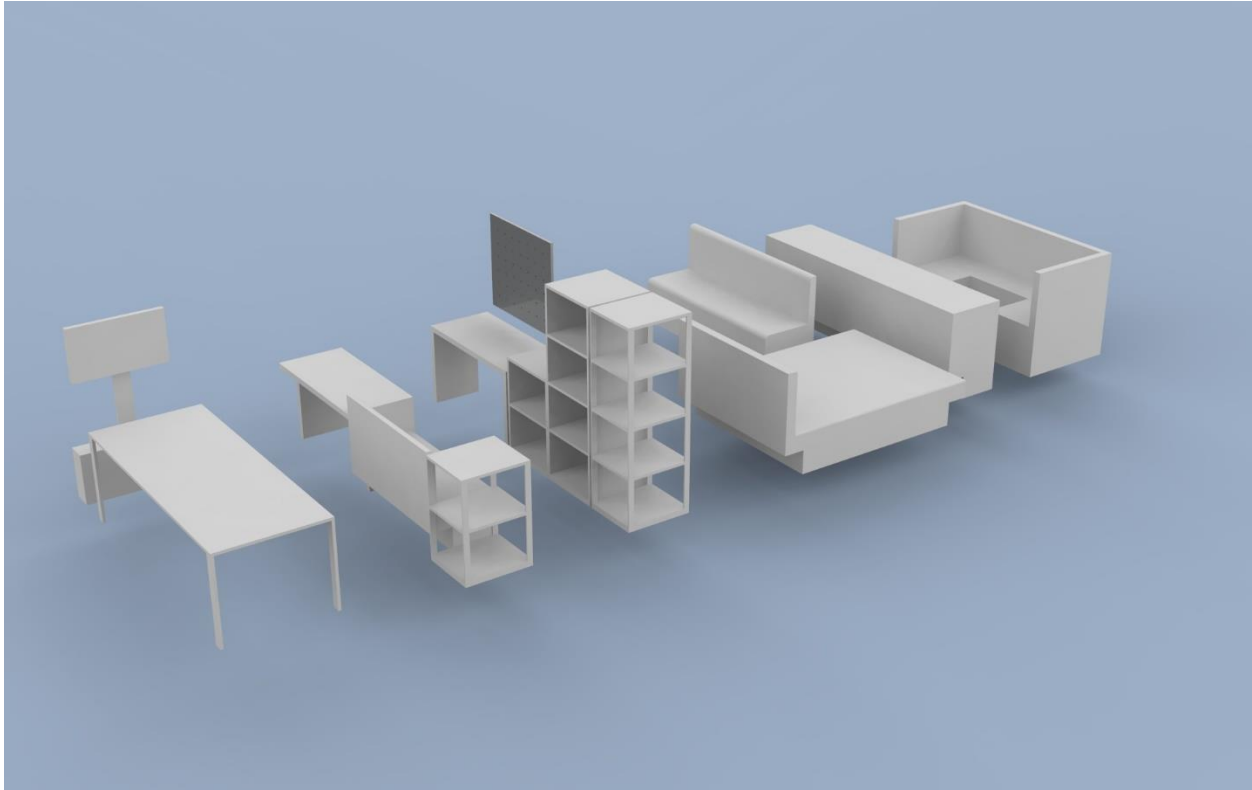


Figure 5.5: Modular furniture units.

There are some possibilities of floor plans listed below: crafting studio, Music studio, Entertainment room, Yoga room, Art or photography studio, Bedroom, meeting room, Kitchen& dining room. Obviously, the modular system contains more custom potentials to explore.

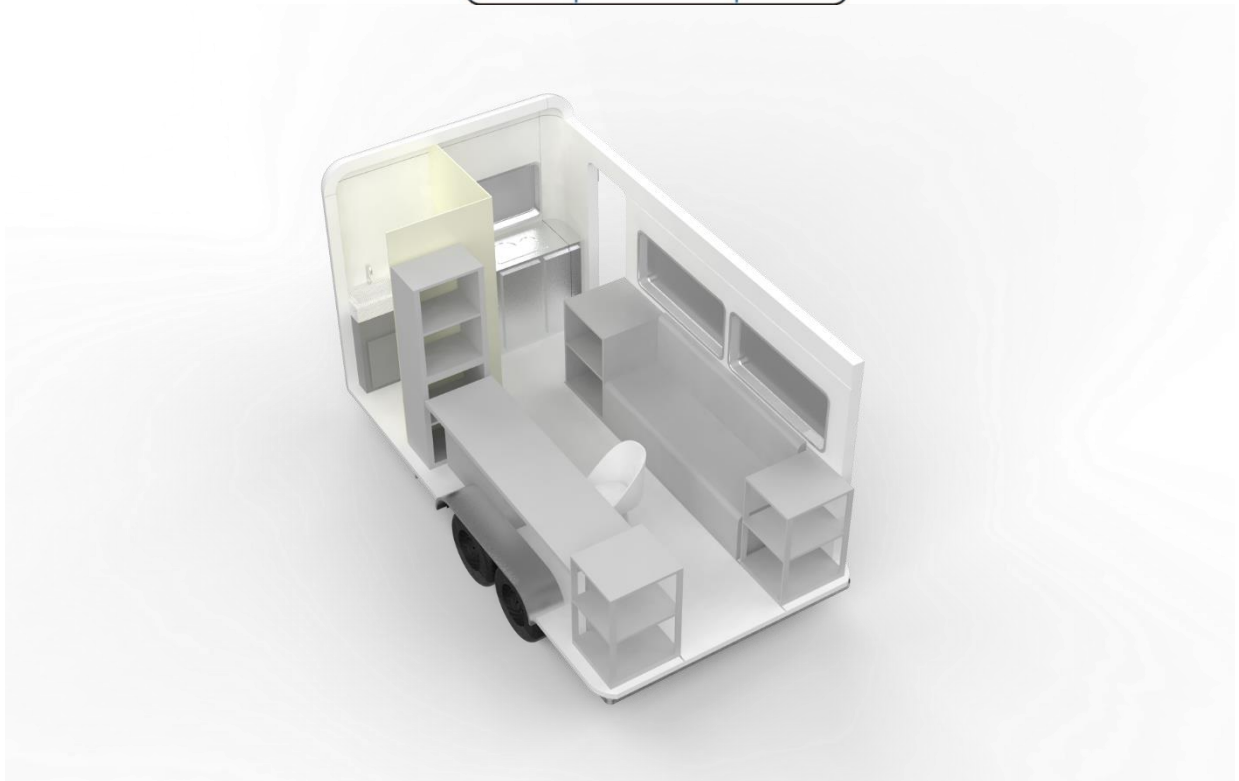
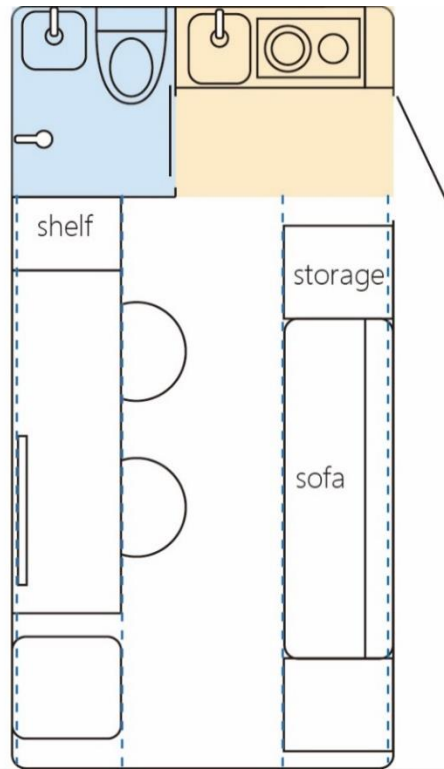


Figure 5.6: floor plan- study

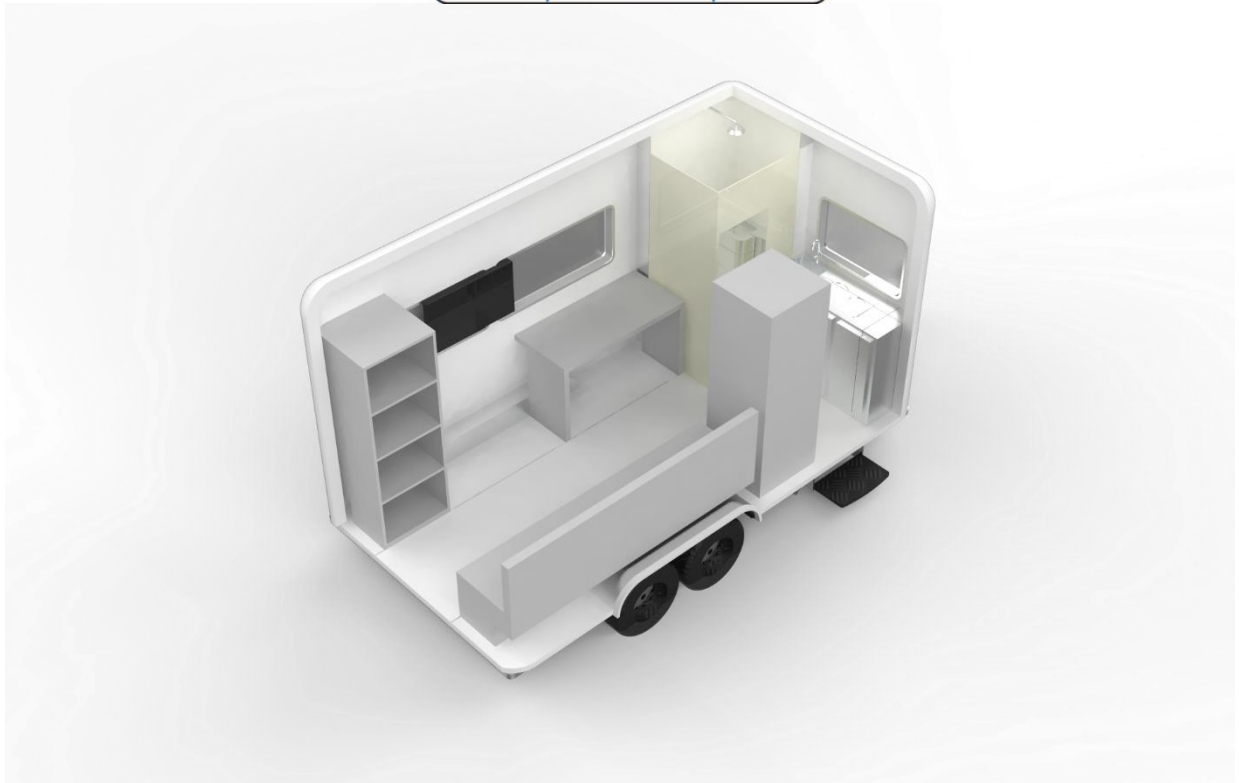
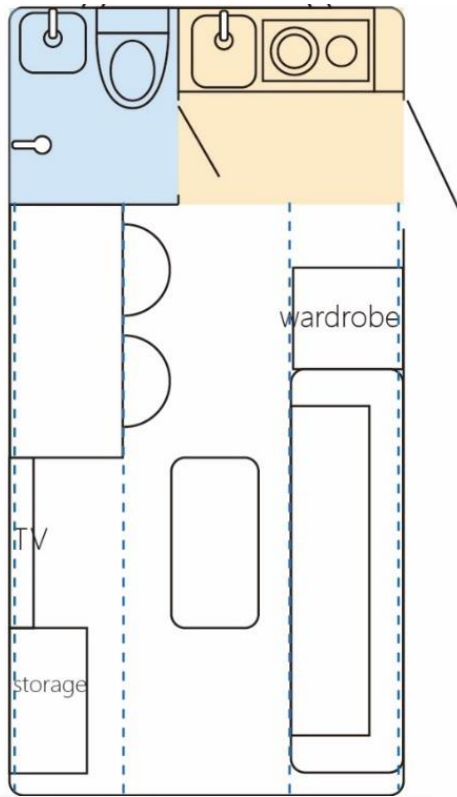


Figure 5.7: floor plan- entertainment room

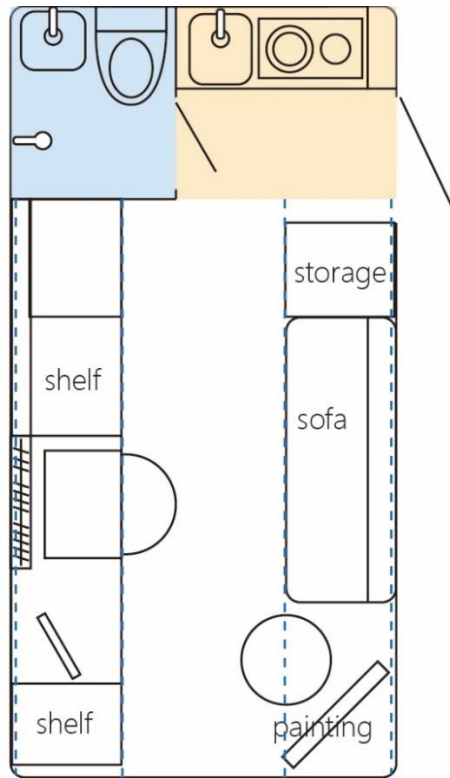


Figure 5.8: floor plan- art studio

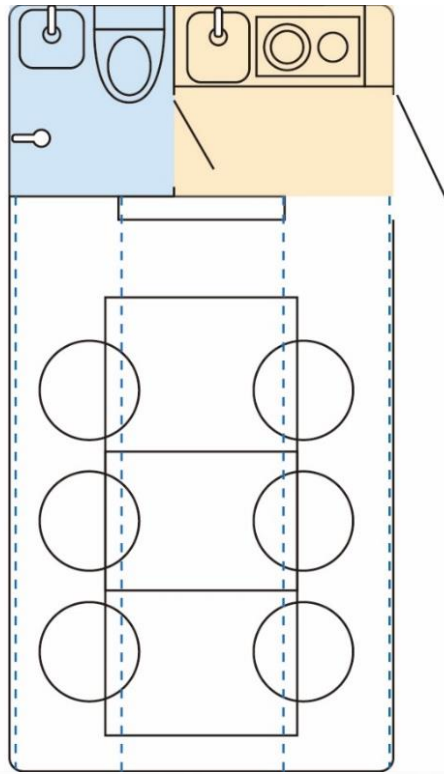


Figure 5.9: floor plan- meeting room

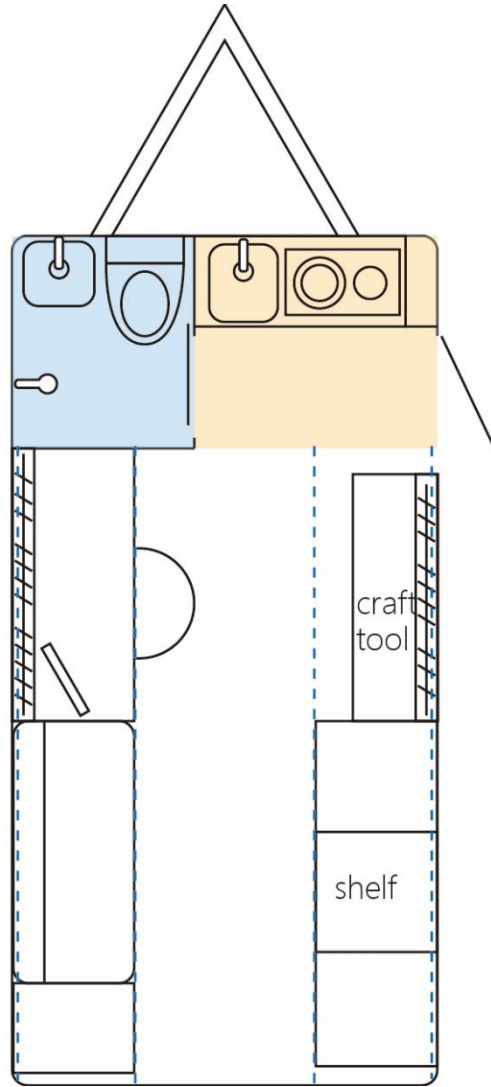


Figure 5.10: floor plan- crafting studio

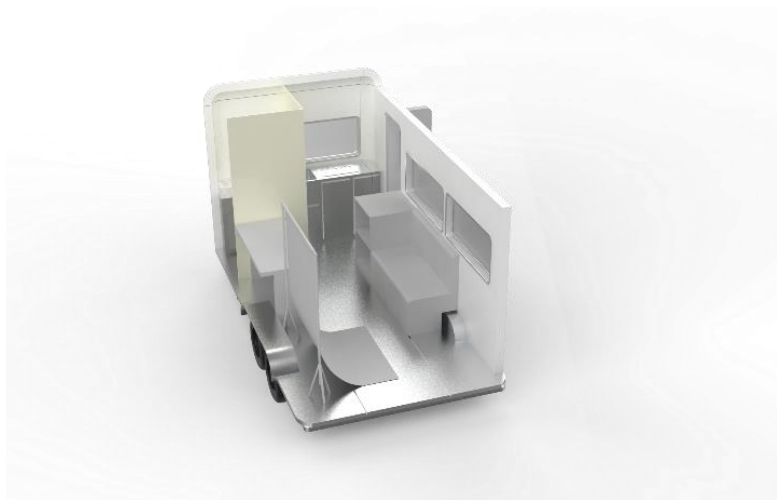
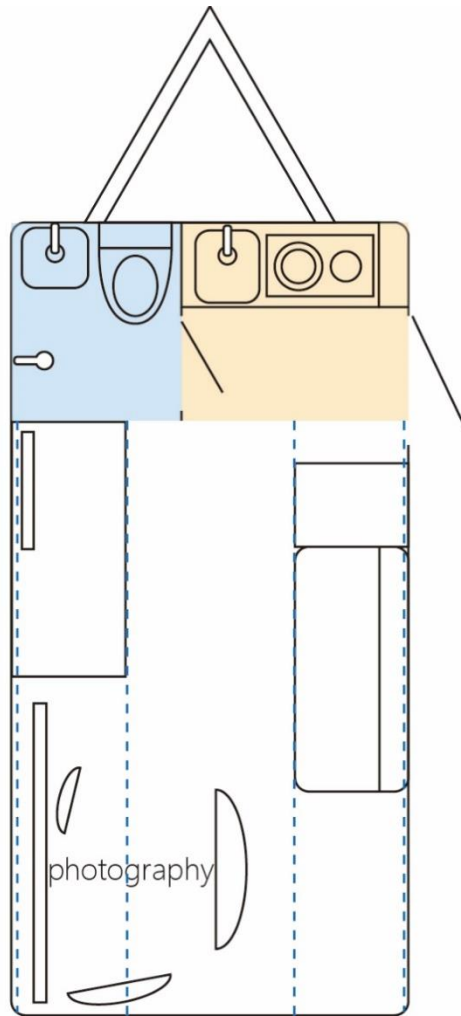


Figure 5.11: floor plan- photography studio

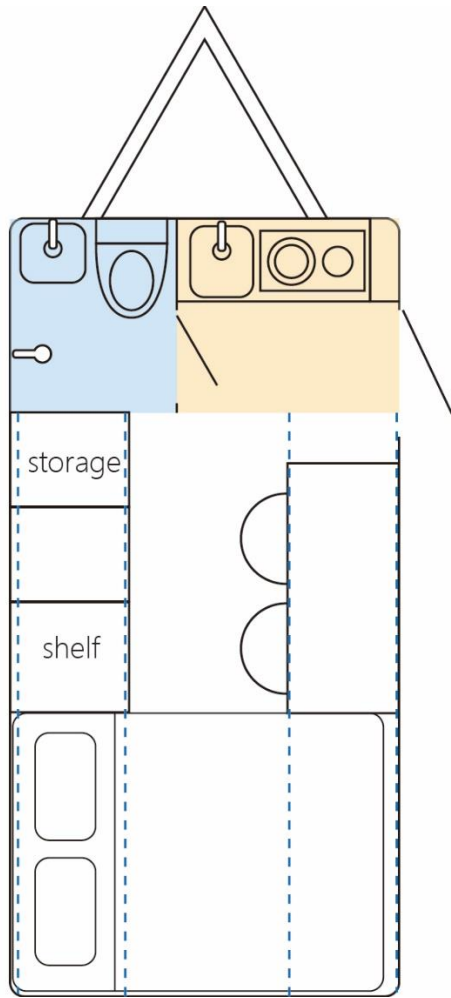


Figure 5.12: floor plan- bedroom

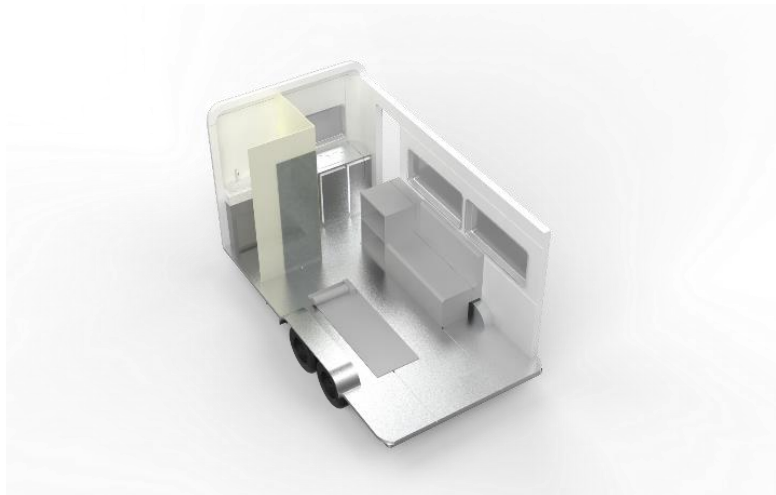
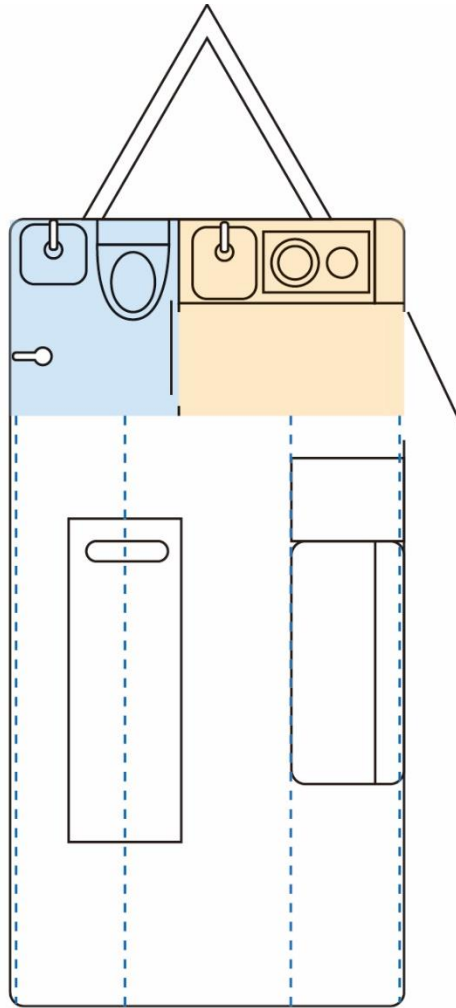


Figure 5.13: floor plan- yoga room

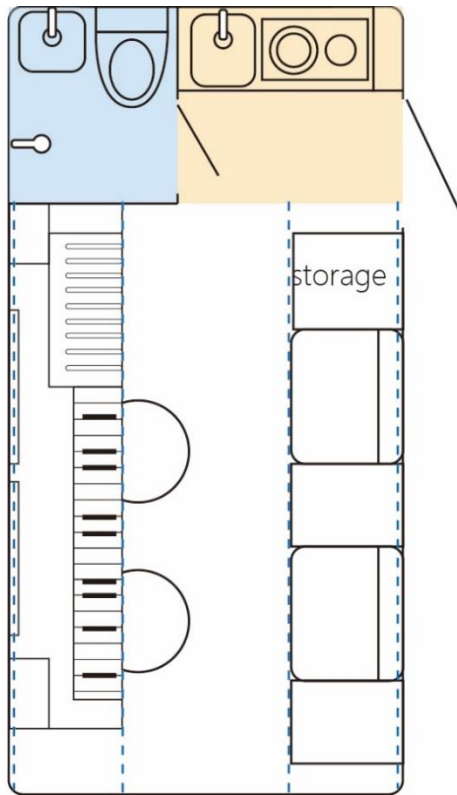


Figure 5.14: floor plan- music studio

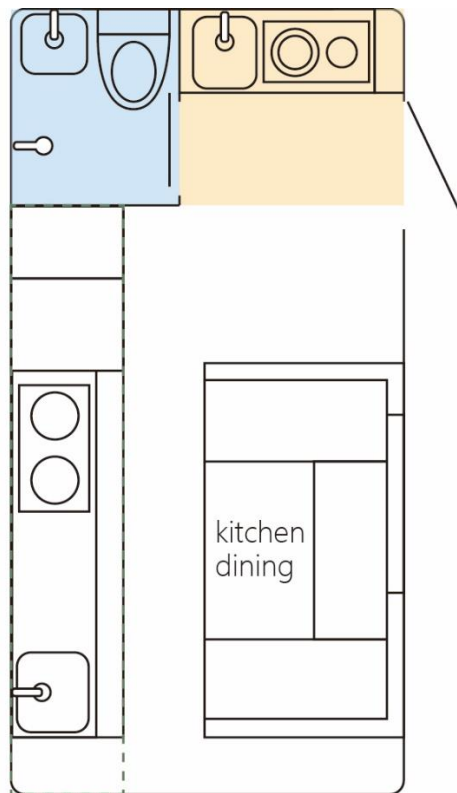


Figure 5.15: floor plan- kitchen& dining

5.5 SYSTEM WORKFLOW

The story board illustrates how to use the modular units:

- 1 Pulling down the rear door as a ramp;
2. Pushing the units along the track to the proper position.
3. Fasten the furniture with the L-track on the wall

After use:

The furniture units can be stored in the garage or re-deployed for other uses in the house

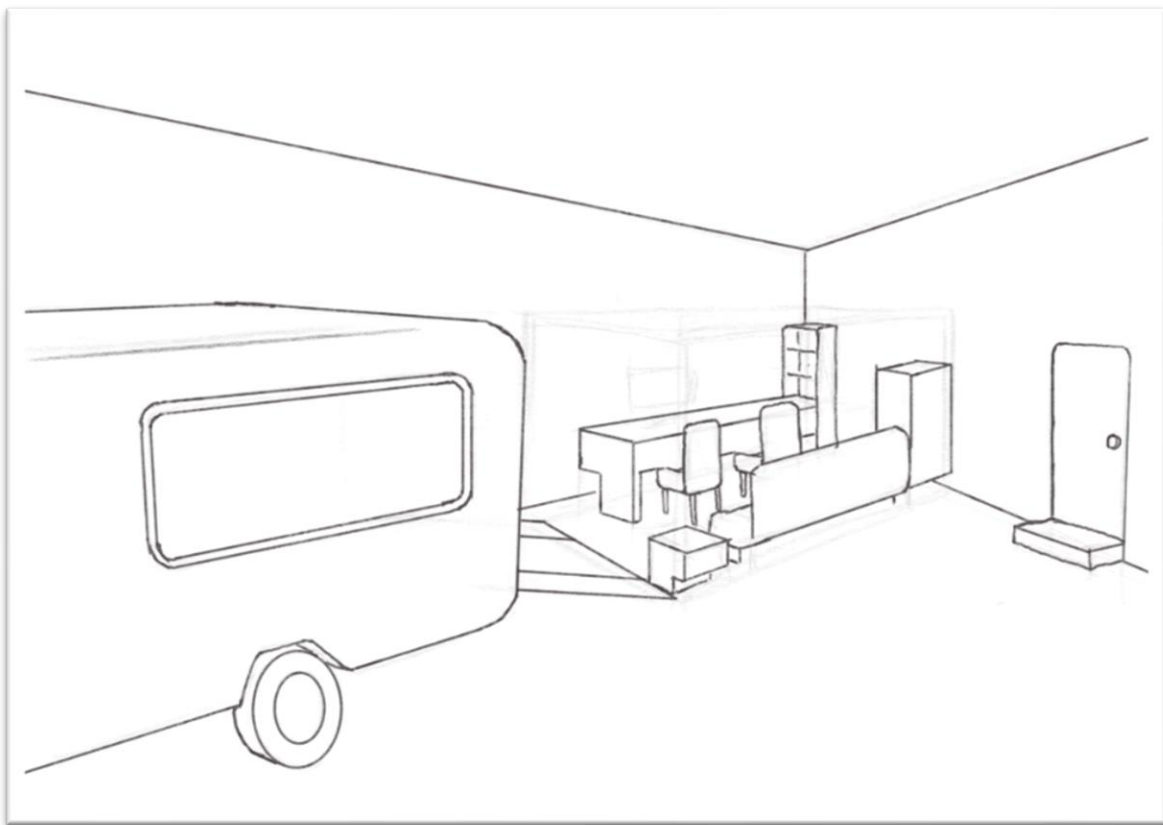


Figure 5.16: Back-up furniture at home.

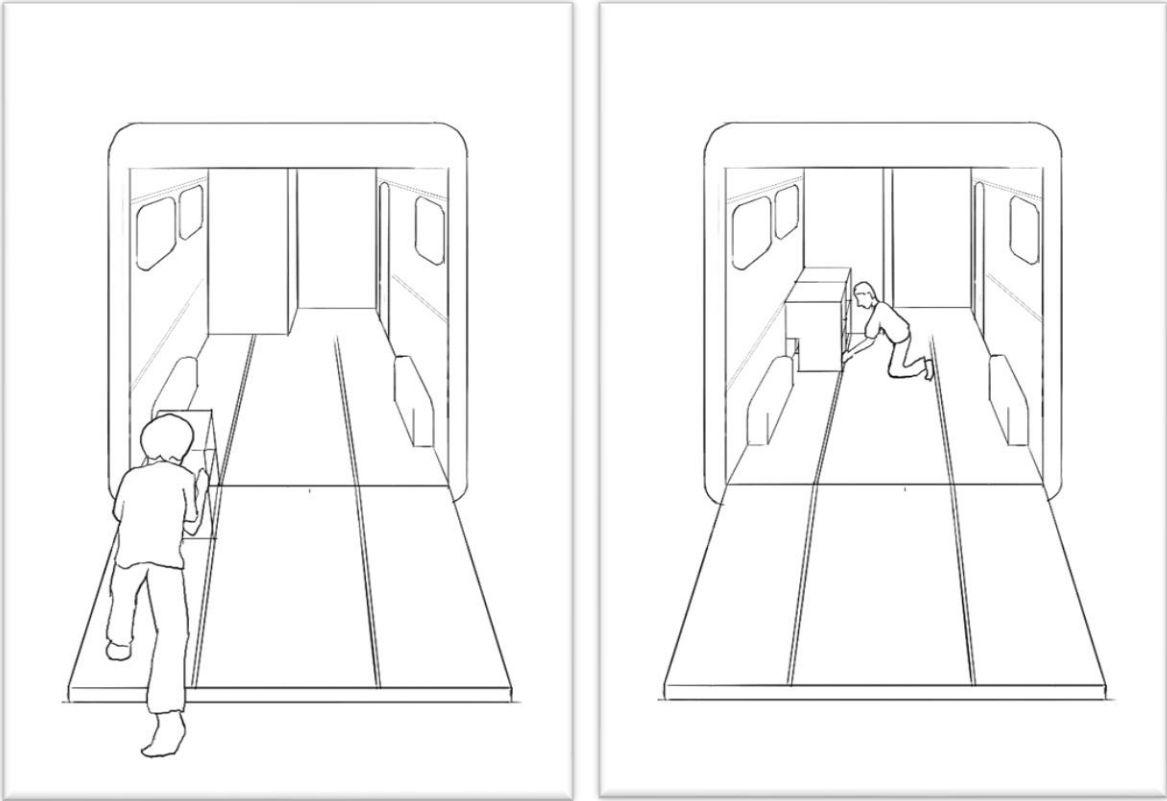


Figure 5.17: Furniture installation.

ADU: The trailer can be used as an Auxiliary Dwelling Unit (ADU) parked by the owner's home yard.

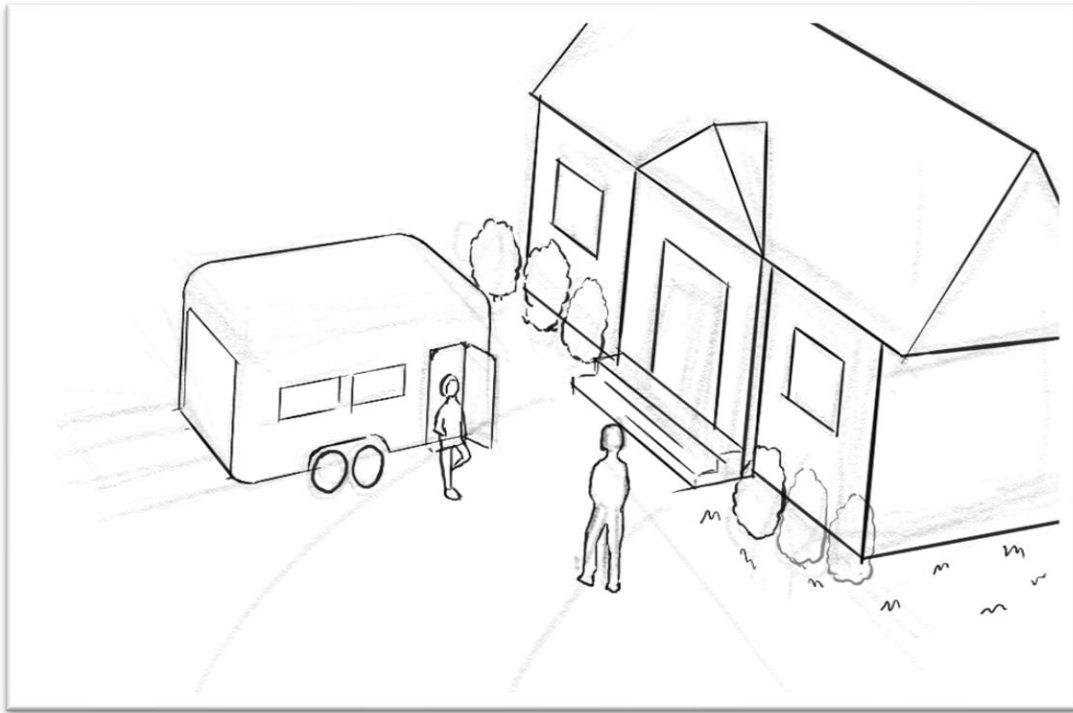


Figure 5.18: ADU use.

5.6 FLOOR PLAN EXAMPLE

Here is a case that illustrates how this trailer system works.

The users are a young couple, Rosie and Jacob.

Scenario 1

In this journey map shown in the figure, Rosie is a writer working remotely. Rather than staying at home, she prefers to go and work in a productive space. With simple operation to install furniture, she converts the trailer into a proper working space with necessary facilities. Then she drives it out and parks where she finds it inspiring and free from disturbance. She works at the desk and enjoys the outside view. In relaxation time, she can make a cup of coffee in the kitchen and rest in the sofa or puts the sofa down to the bed form and has a quiet afternoon nap.

Persona/Journey map



Prepare to
work remotely
in trailer

napping in the
trailer

Name: Rosie

Age: 26

Location:
US

Occupation:
Writer

- Easy furniture installation
- Drive away to find a productive environment for working

Working in the
study on
wheel

- Keep social distance with other people in Covid
- Away from attractions at home in remote work

- Comfortable sofa bed
- Kitchen & bathroom facilities

Figure 5.19: Persona/Journey map-Rosie.



Figure 5. 20: Indoor scene.

Scenario 2

For the same user family, perhaps in another trip, the user can leave the study furniture and replace it with other recreational facilities. This time, Jacob would like to get together with his friends at leisure time. They want to explore somewhere new while having a comfortable place to meet. Jacob converts the trailer into an entertainment room for four people by moving and changing a few furniture units. The group of friends drive to a RV park and start a small party in the trailer.



Figure 5.21: Journey map-Jacob.



Figure 5.22: Entertainment room.

Scenario 3

This time, Rosie and Jacob plan for a weekend vacation together. To build a room that accommodates two people, they install the bed unit at the back part of the trailer space. The queen size bed is one of the biggest modules of the product series. So, the vehicle is converted to the common type of mini camper trailer for two people sleep. Since the inner space is limited, the user couple don't spend much time in their weekend adventure. But it is comfortable enough to stay overnight.



Figure 5.23: Journey map-weekend trip.



Figure 5.24: Bedroom.



Figure 5.25: Bedroom.

More scenarios

Moreover, the trailer has more possibilities with various flexible modalities. The trailer can shift into a meeting room, or a Yoga room, or even more possibilities.



Figure 5.26: Yoga room.



Figure 5.27 : Scenario- Yoga workout on the deck.



Figure 5.28: Scenario- on the way.

5.7 POSTER BOARD

· In quarantine time or remote working life

· An alternative choice of personal space out of home

· Various recreation and creativity on wheels

· Sets of functional facilities to easy set up every time

A mobile studio or a functional room at home

· Various functional space

· As part of house when back at home

· Able to drive out for recreation

· Easy change and set up

· Lightweight, affordable, free space

- Trailer with base frame
- +
- Conversion kits

· ? · Or · Or · Or · Or

Figure 5.29: Poster board1.

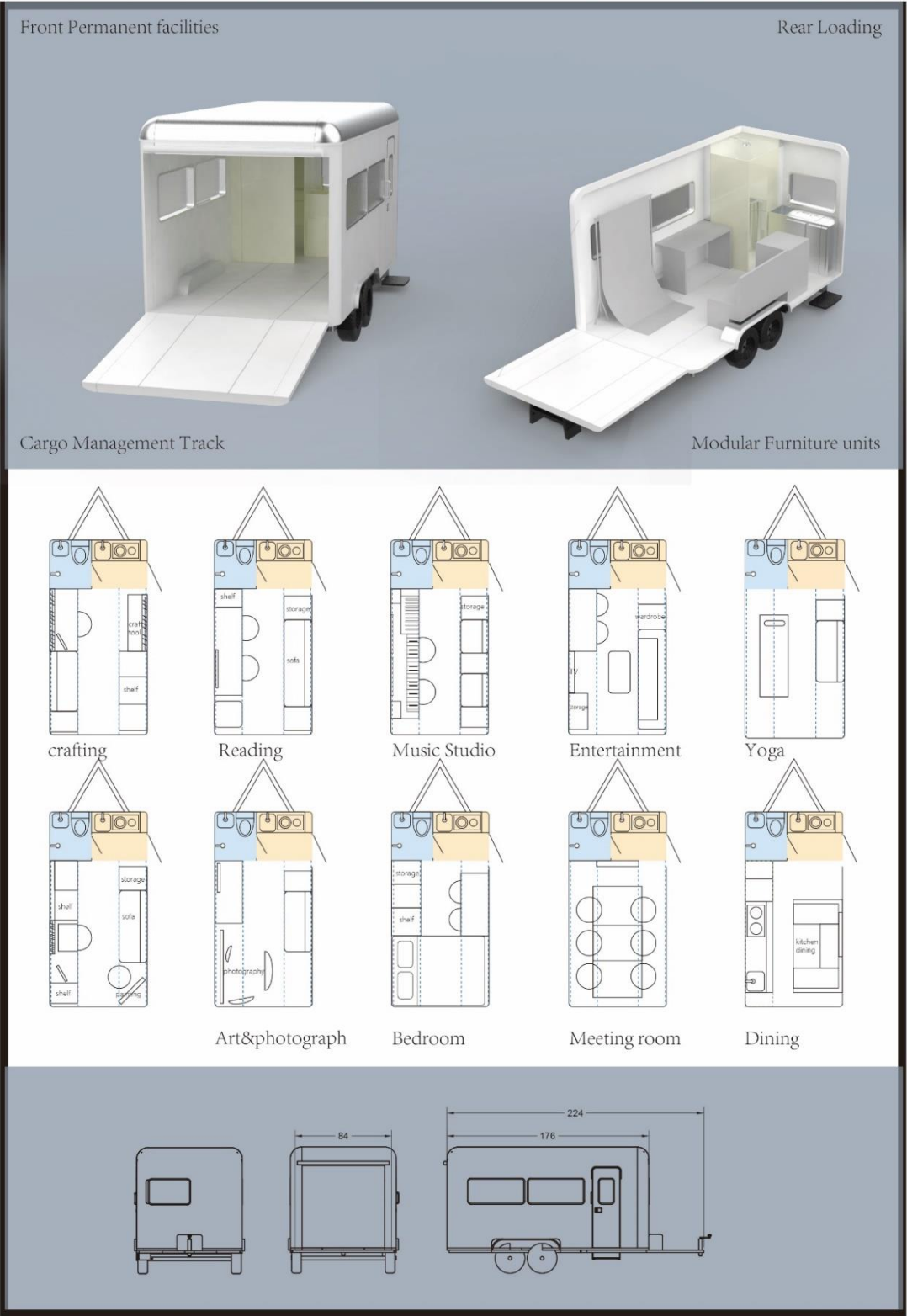


Figure 5.30: Poster board 2.



Figure 5.31: Poster board 3.

CHAPTER 6: CONCLUSIONS

This thesis aimed to explore a concept of flexible personal spaces in a trailer. The design enables building multifunction spaces in a modular travel trailer.

The design solution is Fugaci, a modular solution to enable users to pick flexible and individualized furniture units combinations to fit their needs in various scenarios.

While the study clearly suggests the solution to various individual activities in a trailer, the project is at a concept design stage, and more technical details are needed to refine the idea.

The details of furniture units can be further defined, including the functional structure and the aesthetic considerations. Physical prototype and feedback from testers are expected to refine the concept.

The details of furniture units can be further defined, including the functional structure and the aesthetic considerations. The form and material design of furniture and panels can be refined to shape certain interior style. More options of color and material could be created to meet demand. The present design uses aluminum panels to build the external surface. Possible alternatives could be fibreglass. Painting or livery design could add to the vehicle exterior, to provide custom options.

Because of the effects of COVID 19 on access to facilities a model or complete physical prototype has not been built in the design process. Moving into the next phase, there is a need to mock up a series of physical models, including a scale model of trailer exterior, a full-scale model of interior space and furniture units, partly furniture mechanism, and a walkable scenario with full-size prototypes. The designer could test furniture mechanism, collecting and analyzing performance data, and optimize the mechanism for better usage. The necessary step is to test the prototype with potential users, getting feedback to refine the concept.

Another expectation is to explore the business mode of Fugaci. One future plan is to set up a brand showroom, where the trailer and furniture series are displayed. The furniture would be probably sold in units or in sets of popular combination. With the high level of interest in RVs, Tiny houses and ADUs, Fugaci should have a promising future.

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