DYNAMIC MODULAR HOUSING

The University of Colorado Boulder
School of Environmental Design

Andrew Hoover

Thesis Chair
Kim Drennan
ENVD

Honors Council Representative
Georgia Lindsay
ENVD

Outside Member
Wil Srubar
Engineering
I would like to thank UROP for sponsoring my exploration of Dynamic Modular Housing

&

a special thanks to
Kim Drennan, Georgia Lindsay, and Wil Srubar.
Without their help and support none of this would have been possible.
# TABLE OF CONTENTS

- [ABSTRACT]
- [INTRO]
- [BACKGROUND]
- [CASE STUDIES]
- [CONDITION DIAGRAM]
- [THE GAPS]
- [EXPERIMENTATION]
- [PILOT STUDY]
- [NEW CONCEPT]
- [KIT OF PARTS]
- [VOLUMETRIC CONCEPTS]
- [COMPARTMENTALIZING PROCESSES]
- [HOME DESIGN CONCEPT]
- [PROJECTED DESIGN]
- [CONCLUSION]
- [DEFINEING TERMS]
- [REFERENCES]
[ABSTRACT]

The exploration of Dynamic Modular Housing provides new ways to create homes, with a process of compartmentalizing individual rooms into separate modules that can interchange, move, or be relocated throughout the home. This compartmentalization process allows homes to even be relocated to new locations. The concepts of modularity and organized systems help to inform and rationalize the modules. The purpose through prototyping models illustrates the need for this dynamic modular system. Modeling the modules illuminated the problems in design. I found that the only private module or rather private space you needed in a home was the bathroom and bedroom. With this finding it allowed more freedom for open floor plan programming of the space.

[Intro]

In a typical home the condition is stationary. It is a fixed building and the building rarely changes. The biggest changes happen when you build, buy, or demolish. In order to modify the current building a remodel or an addition takes place. This process can be costly, and take a long time. The traditional home can grow in size however it is not variable. You cannot modify the rooms and program to the varying circumstances. Thus creates a question, how can we as designers create a home with a more flexible program for an ever-changing living situation? The current scenario needs to utilize the space available this in entails that the certain requirements for the
spaces need to vary. In the new condition the building needs to be adjustable. This is to accommodate for the needs and necessities of the inhabitants.

As a family changes so too should the home. The changes in family may include the addition of a family member however; it could also be deduced by separation, divorce or even death. With the addition of a family member, the addition of a room or module must be added to the home. The same goes for the subtraction of a family member perhaps a child going off to college. What I my design utilizes that others do not is the way the child leaving home can utilize the module. In fact they can take it with them to their new location. This module will be a basic building block for creating a new home else ware. This module will need to have a few additions in order to create a new home however this is much more adaptable than todays fixed conventional home. The only additional module that the new homeowner needs is bathroom with attached exterior connected kitchen, a core, exterior glazing, and floor and ceiling cassette. With this addition process it also allows for freedom perhaps for elderly if they decide to move back in with their adult children possibly due to health issues. This will create a new more dynamic way to live among people and could possibly create new family dynamics.

This additive and subtractive concept matters because it lays the groundwork for an articulating modular unit. This modular concept also provides with an option for module to start a house anew. The module will
allow for a living condition to be moved around to different locations rather than being constrained by a single non-modular structure. The modular unit is important because it is time to break away from the conventional paradigm of building and rather act in congruence to a more systematic evolution process of building. I believe that this will foster a more informative and productive structure, by addressing the functionality of the existing building in order to create an adaptable module to change for various new functions to be explored. While others modules have been attempted such as Hivehaus, few have been as adaptable as my Dynamic Modular Home. This is due to the limitations that constrict the home from changing. A major issue with the Hivehaus is the geometry limitations with angular walls rather than straight becomes problematic in certain conditions. Accommodating for various life situations is the underlining principal for the home.

To challenge the 100-year building time frame as a measure of sustainability, I propose using a 5 to 10 year period so that the dynamic parts can be constantly upgraded, recycled, and better fit to new users and programs.

I view humanity at a turning point where by the consequences of our actions will be evident in our resource consumption strategies: resources scarcity, rapidly changing urban living conditions and new economic pressures. With this in mind why are we still building as if there is a great bounty of materials at our fingertips?
Similar to the Dynamic Modular Home daily life is also dynamic with our every changing living condition. Not only do I propose a more ecologically sustainable way of building I believe that this will re invigorate peoples connection to the built environment.

Every day technology is advancing and out pacing itself. The built environment should also follow suit. Dynamic Architecture should be changing and advancing forward towards a more progressive and efficient architecture. The increasing demand for a more sustainable architecture is forcing change in the industry, evident by the new more stringent building codes. For years to come these codes will only become more and more strict.

The current condition of a home evolution along with the family in the United States:

(Hoover, 2015)
Many architects and designers in the past have created from a modular approach. These architects include Buckminster Fuller and Le Corbusier. They took inspiration from a number of ordinary objects for instance Le Corbusier and his wine rack, which later became his inspiration for Unité d'Habitation (Bergdoll, Christensen, Broadhurst, 2008). The housing units were representations of wine in a wine rack. Rather than having just one bottle of wine he wanted variety, just like the various floor plans for the Unité d'Habitation. Unité d'Habitation lacks the variety of modularity with numerous configurations for the space however; the wine bottle and the Dynamic Modular Homes module act similar in the way to be configured.

**Figure 1.** Buckminster Fuller’s inspiration was more mathematical. His Dymaxion house was designed with the concepts of form, geometry, and geodesic shapes. Fuller was the inventor of numerous products ranging from a car, to geodesic domes, and even modular homes. Buckminster’s created products before his time his Dymaxion car outperformed many cars of the time. **Figure 2.** The same can be said for his home designs. Buckminster made the Dymaxion house and the Wichita house. The Dymaxion house was suspended upon a central core with all the utilities for the home located there. **Figure 3.** As for the Wichita house it was constructed of steel and plastics. The Wichita house with a distinct dome and stainless steel skin showcased a new way to build a modular method for constructing. **Figure 4.**
Figure 1. Top
Figure 2. Middle Left
Figure 3. Bottom Right
Figure 4. Bottom Left
(Bergdoll 2008)
Similar to Buckminster Fuller’s design, I will utilize a central core construction this is where the internal workings of the dwellings are located. This is where the internal access points will be located such as the stairs and the elevators if necessary. Buckminster’s design that I have not incorporated into the design is the elevated lookout of the Dymaxion house, as well as the circular layout of the Wichita house. By utilizing new concepts in order to create a new modular dwelling and thus compartmentalizing the new or modified programmatic uses within the home. The adaptation of the new module, which is similar to Corbusier habitation, is beneficial to create new adjustable living spaces for every day living. I however, am utilizing this concept in a residential housing style layout, where the dwelling is not always uniform but rather it configures in a more natural way for expansion.

[CASE STUDIES]

BLU HOMES
Blu homes are a modular system that unfolds into a home. The unfolding technique’s purpose is to create a home from a single or multiple transport modules that conveniently fit on the back of a semi truck. This compartmentalization system has to be set up for the rooms that the client has requested in the plan; then the home is folded up in to a shipping module. The simple packing and folding up of the interior space is done to maximize transport space while not neglecting the essential for functions of the home.
The assembly method of unfolding is rather complex, with numerous hinges and pivot points. Blu homes first arrive on site in a sipping container format with the homes actual floor set up as the base of the shipping module. This shipping module is placed upon the poured foundation. **Figure 5. on page 13** illustrate homes the process of a Blu home as it unfolds. The homes are fabricated with joinery and the homes systems already set in place. This is to ensure the unfolding process works with little room for error. **In Detail 1 on page 13** the homes hinge is showcased to illustrate how it relates to the wall and floor section while unfolding. With Blu showcasing design evolution it lacks in maneuverability and functionality to multiple varying locations. This is due to the limitations of a permanent foundation and only one mode for transport, thus far the only option for Blu homes are by truck. The home can be relocated however a concrete foundation must be poured in the new location. It has not been modified to any other means such as cargo ships, that shipping methods would be other possibilities for distribution. The container would also have to be reduced in size to accommodate for containers size on the rails or high seas. Blu also has a design conflict in the relationship between the design space and the natural landscape it is dropped into. There is a clear disconnect incorporating the outside siting and the interior space. They claim they bring the outside in and to an extent they do however, there should be more done to do this by creating more centralized open spaces. Blu homes should re think their long-term foundation in search of a less permanent and temporary foundation; this
would be more beneficial for relocation due to an already expensive home.
WICHITA HOUSE

The Wichita House, by Buckminster Fuller provides insight into an innovative more self-sustainable, and organized compartmentalized spaces that showcase the home design. Fuller utilized the latest building materials of the time ranging from aluminum, stainless steel, to plastic. His home design was cylindrical and reminiscent of a World War II airplane (Di Mari and Yoo 2012.) This is the first clear example of self-sufficiency with a self-contained HVAC unit. Having a self-contained HVAC unit was revolutionary at this time. Most did not have air conditioning at this time, and Buckminster Fuller wanted to make it standard in all of his homes. The house was designed to be portable in order to be moved to different locations if the need should arise.

The Wichita house utilized a unique design with its hoop style construction method. The hoop construction consisted of central mast running cables down towards the floor. The cables connected to the first hoop similar to a bicycle rim with spokes. The next outward corresponding hoop was placed and after it was set into place then the stainless steel sheeting was applied to the outside façade. As the façade is applied it creates a dome rooftop. The last hoop frame provides the walls of the structure this is where exterior of the structure is covered in this steel skin encapsulating the home (Bergdoll 2008).

Figure 6 on page 15 diagrams the erection process of the Wichita house.
While Buckminster revolutionized the building concepts he had trouble selling his ideas to the public. Wichita house at 1,100 square feet it has its downfalls. The first noticeable issue with the home was the lack of right angles for corner walls. This means that some areas of the interior space would be underutilized as a result. This creates empty or wasted space that the inhabitants would not be able to utilize. However, Buckminster fuller did create a home that could be moved from location to location and this was a success. All that was needed for relocation was time, labor, a truck, and a crane. This gave the Wichita house a freedom compared to traditional homes of the time.

**VIPP SHELTER**

The VIPP Shelter is a dwelling that is designed by the VIPP Company. Vipp is a factory that usually produces household goods and in this instance the shelter was a experiment that Vipp wanted to experiment with what housing could be like if you utilized industrial production techniques, and factory home construction methods. This all-inclusive 55 meters squared shelter arrives on location with little assembly required. It is shipped to the desired location by way of semi truck and is placed upon the desired location with utilization of a crane much like the other examples thus far. It consists of a kitchen, living space, bathroom, and bedroom.
Figure 7.

The shelter sits upon a 6-pier caisson system rather than a conventional foundation. This is done to reduce the impact on the site and is shown here in Figure 7. Above. The shelter contains large full wall windows that can be opened fully in order to open the space to the natural surroundings. The first area it lacks is that VIPP utilizes the shelter as a weekend getaway, not as in fact a home according to VIPP. The weekend getaway is so the people of the city could go and get away from the busy city when they wanted. The second the industrial design is reminiscent of a ship or boat rather than a home or shelter. This container style of shelter is cumbersome when trying to be placed in certain site location. This is due to the access for the crane in remote locations, and issues of placement in dense vegetative areas. Lastly, while the
VIPP Shelter utilizes a module there is no room for additions in time just another module of the same configuration. A retrofitted addition would be beneficial for Vipp.


**HIVEHAUS**

Hivehaus is a home that is based on the honeybee organization system of a hexagon. It consists of six corner joists that act as the exterior framework of the Hivehaus. These corner joists are bolted on six identical floor pieces and connected with bolts to the six ceiling pieces. The Hivehaus dimensions are 13.1’ x 8.2’ with a central circular skylight that is 3.9’ in diameter. With these large windows the space requires little electricity to light in the daytime. The walls can be opened up to create more space when deemed necessary. The Hivehaus can be assembled in one day and requires little help. With just a few people you can create a home this is drastically reduced compared to other projects mentioned thus far. With the addition of multiple pods the more space you have. In Figure 8 you can see how the pods are not only erected but also the desired compartmentalized organization to them. The problems of the Hivehaus are that only one pod can have one designated room. One pod is a kitchen, one pod is a bedroom, and one pod is a living room, which requires three pods to make a cozy home. Similar to this system the dynamic modular home will have a compartmentalized privacy module for both the
bathroom and the bedroom. The sizes of the pods are also a downfall seeming on a rather small size it requires numerous pods for a home. However in the dynamic modular home the pod will fit inside of a larger superstructure. The fact the Hivehaus pods cannot be stacked also leaves valuable vertical space being under utilized. Although all this being said it is the only projects mentioned that does not require much assistance for assembly. It does not need a crane for installation and with the walls being able to swing open for added space the downfall to this is the swinging opens up to the elements so on a cold day the people inhabiting the space might have to squeeze back into the small pod if the weather turns to poor conditions.

Figure 8.
DMH is Dynamic Modular Housing

<table>
<thead>
<tr>
<th>Blu Homes</th>
<th>Wichita House</th>
<th>VIPP Shelter</th>
<th>Hivehaus</th>
<th>DMH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some assembly required:</td>
<td>XX</td>
<td>XXX</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

XXX = Means exponentially more is required

Requires a crane for assembly: | X | X | X | X |

Requires a permanent foundation: | X | X | X | X |

Requires large truck for shipment: | X | X | X | X |

Have multiple rooms for one module: | X | X | X | X | X |

Lightweight materials utilized: | X | X | X | X |

Home has the ability to transform: | X | X | X |

Home is all-inclusive: | X | X | X |

Created for interaction with nature: | X | X | X |

[THE GAPS]

The gaps that I have arrived at is that while all the precedents have limitations. The Hivehaus has limitations due to the rather large amounts of parts not to mention the angles of the walls are not all 90 degrees. This being said I will construct with 90-degree angles and the modules will be boxes.

The Blu home has limitations in regards to transportation and location. The home is shipped to the location and a separate crane must put the home into
place. In the Dynamic Modular Home a crane is utilized in the core section to assist in assembly. The shipping container concept for modules is to be utilized, while not already being assembled in order to reduce weight of the module. The Dymaxion house downfalls are requirements of a crane to set into proper location. The Dymaxion house also is in a cylindrical shape this is an issue when it comes to proper room configurations. Room configurations must be able to change in order to maneuver to create new spaces. The VIPP shelter has a similar issue as Blu does. Even though the VIPP shelter is all-inclusive it also has the same limitations in regards to transportation and set up for the shelter. A problem for the model to address is how the modules will connect together and how this configuration works with the inhabitable space. The individual modular units can work in unison and or individually with the already set up Dynamic Modular House by being a satellite structure similar to a pool or carriage house if needed. This is in direct correlation to these issues involving power, water, and waste disposal. Another gap I took a look into is the methods of shipment opposed to an on site construction scenario. I found that there was a benefit to the construction of a module in a factory that included the quality control of the products like VIPP for instance. The VIPP shelter has such a high standard of quality it really needs nothing else other than what it is shipped with. It is a self-contained unit from the beds to the cutlery it comes with. I also found that building in a factory setting not only saved on waste but also on the energy savings. However the factory assembly was less efficient on the shipment and set up portion of the
modular concept. This was due to the distance the module would have to travel from the factory. However if there was a factory in all major cities this could be avoided. One of my objectives for this endeavor was to design Dynamic Modular homes that can serve who seek shelter; and the goal is to be able to provide it to all.

[EXPERIMENTATION]

The purpose for this next design concept is to create a basic massing model. This massing model showcases the basic volumetric modules as well as, how to possibly configures the modules with the core. The basic volumetric modules consist of the rooms, compartmentalizing them while creating connection points, and developing around the central core. These connection points are the not only the physical spaces in the modules where they connect they are also the spaces where the inhabitants would want to connect.

Figure 9. On page 24
This is a way to showcase what a basis kit of parts should entail in order to produce the dynamic modular home. This kit should include the core, bedroom, bathroom, exterior glazing, floor and ceiling cassettes and doors for entry and egress of the Dynamic Modular Home. The home utilizes some ideas, concepts, and physical products utilized in the precedents studies from earlier.

For instance, the concepts of the Wichita and Dymaxion house by Buckminster Fuller’s “concern was with an efficient design that anticipates the sustainability movement by decades; he sought to demonstrate that autonomous ways of life in an industrialized society” (Bergdoll 2008). Utilizing Fuller’s design around a central core reduces amounts of vital materials within the modules’ space. Applied to my concept, in a slightly different way, my modules will be utilizing the central core as a utility core. This power core can
create with fewer limitations than a basic system that can provide utilities throughout the module or home. This in affect will be essential necessity for this to achieve the desired result of a self-contained self-reliant home.

[KIT OF PARTS]

Self-leveling hydraulic feet

- This allows for a lite touch on site, meaning not disturbing the site in comparison to conventional building and homes.

- The home requires a level building platform for assembly once the core is installed it creates a baseline for all additions thereafter.
Glazing

- The Glazing provides the necessary light in for the space.

- It also offers foldable walls of glass to better let the surrounding environment in to the space, while also creating a more open experience.

- Lastly the glazing offers a suitable interior environment in times adverse weather conditions.
Ball bearing walls

- The Ball bearing wall offers a means of support while also creating a basic partition for the home.
- The ball bearings run in a channel on the dynamic modular floor and ceiling.
- This channel is in place on the ceiling and floor of the structure and is in place to reduce friction while allowing movement on a grid

Figure 10.

Detail 1. Bellow Ball bearing wall
Stairs or Elevator

- The options for either stairs or elevators are available depending on the model of the home.

- This is also an added benefit to the elderly looking to purchase a home that can accommodate their needs.

Radiant heating

- The homes floor panels have a radiant heating system in order to help with the comfort levels especially for the cold winter days and nights.

MODULE

The module is a basic room that fits inside of an outer lining superstructure. It is the basic private rooms that reside within the superstructure. These private rooms are the bathrooms with outer wall plumbing for kitchen set up. The other private room is the bedroom however, both room need natural light so an added small window toward the top of the room adds the much-needed light. The module has the only added walls next to the ball bearing walls. This is not only for privacy but also support for the modular home itself. The modules can be added to the space to create new rooms for inhabitants while they also can be removed. This removal can be done to accommodate needed space or even to provide a new dwelling to a family.
member that might be leaving this dwelling to create a new dwelling of their own. The module concept was conceived similar to Le Corbusier Unité d’Habitation. This basic interchangeable module can come in many different sizes to the specifications of the inhabitants. This module also can be relocated in order to create a new dwelling in a new location.

**CORE**

The core is the heart of the home.

It is dropped in place by a truck similar to a large roll off. When the truck arrives on site it extends out the outriggers. Once the outriggers are in place the truck sets the core into place from a tilted on its side horizontal orientation to its proper vertical orientation. This is illustrated on Figure 11. On page 28 with a single story core stands at 16’x16’x20’ not including the feet. There are also options for taller cores depending on the amount of floors the modular home might have. The core has self-leveling hydraulic feet that support and act as a foundation. On the roof of the core there are a few essential pieces of equipment. First there is a remote operated crane it is in place to assist the owner in the set up process. It can extend out to 28’ and rotate a full 360 degrees. The rooftop of the core also has a water collection system to utilize for the dwelling and surroundings if necessary. The stairs or elevator access is located here to meet the needs of the inhabitant. At the top of the stairs is a hatch to access the roof in this single floor model. The Tesla Power Wall is also located within it can use up to 13.5 kWh per day and if needed you can
add additional Powerwall to make the overall greater if necessary. With a reverse osmosis system located under the stairs this allows the home to reuses water but also purify water collected from the roof collection system. Located below the floor is the umbilical caste. It contains a spool of all essential utility connections for operations the house.

**Figure 11.**
Addressing the specifications for the utilities in the umbilical maximum and capacity as well as the power to and from. This system acts as the arteries of the home in order to provide necessary power, drainage, and water. This includes the plumbing and black/grey water supply and return from the water closet to the reverse osmoses system. While the modules have pre piped access for the utilities; this is done to make the set up and design process more efficient. The umbilical can be spooled back to the cassette if needed. This can be done for ease of transport to and from locations.
FLOORS & CEILINGS

Creating ceiling panels and floors that can interlock with excursions that go into one another offers up added support and rigidity. **Figure 12.**

The inhabitant physically turning a wheel motor to connect the two together or automated by remote and a small can do this motor. **Figure 13. On page 31**

These floors and ceiling panels also include the predetermined conduit pathways for the cores umbilical as well as a radiant floor heating system.

Floor and ceiling will have a recessed channel for the ball bearing wall to move throughout the home. The floors and ceiling need to keep an airtight fit and must be level this can be obtained with the hydraulic feet. The exterior glazing creates some support for the ceiling while the ball bearing walls will take the majority of the forces from the ceiling. As the home becomes larger the more of the ball bearing walls will be required to keep up the ceiling. In addition to this small columns may be added for even more support.
A fundamental concept is to explore with volumetric designs of spaces in regards to creating a modular home pushed new avenues for module design. Shown in **FIGURE 14.** on page 34 illustrates some plenary example for designs. “The architect, by his arrangement of forms, realizes an order which is pure creation”. (Le Corbusier. *Towards a New Architecture*. New York: Dover Publications, 1986).

A possibility when architects are arranging forms they are creating program. Forms could be the placement of rooms to form the building, however the arrangement was static up to this point. Now the creation of variations produces new avenues for the dwelling. According to Anthony Di Mari and, Nora Yoo a “Volumetric relationships, proximities, adjacencies, and experimental factors without being weighed down by their preconceived
notions of what the space was meant to be." (Di Mari, Yoo. *Operative Design: A Catalogue of Spatial Verbs.* Amsterdam: BIS Pub, 2012. 23). With this in mind the model must reflect a similar volumetric process. By utilizing voids, expansions, extrudes, interlock, and fractures it showcased how the model could evolve. The spaces are multi purpose in one instance the space could be for dining and in another instance the space might be for family relaxation. This volumetric thinking was then applied to diagrams illustrated bellow in order to suggest new explorations for what the spaces could be.
Figure 14.

[COMPARTMENTALIZING PROCESSES]

There are countless variations of how to compartmentalize the modular pieces. “The new spatial language” (Di Mari and Yoo 2012, 23) as it is referred to is what is being explored. I know that this idea of continual modulation is very different from the numerous variations of the past. By allowing the
inhabitant to change their space provides countless opportunities for layout configurations. The idea of utilizing an additive and subtractive process for the modular unit, for the purpose of augmenting the spaces for the conditions needed. The creation of the subtractive units such as a bathroom, or most commonly a bedroom, which can be removed form, an existing unit in order to create a new modular unit in a different location has not been done. Out of this volumetric process of earlier the findings suggest that it is better to have a module already assembled rather than a kit of individual pieces that needs to be assembled. This not only will save time on assembly but also reduce the on site labor not to mention the on site construction and assembly time.

**What I am proposing is below**

(Hoover, 2015)
Design Exercises

The design exercise 1 explores the connections between the core and the individual spaces. The mock-ups below illustrate the connection of the individual spaces into the core. Similar to the Dymaxion house I started with a central core. The core creates a starting platform for which all other spaces can branch off of. A discovery found out after this study was that the cores should also be able to stack upon one another. This stacking process would be helpful for module’s expansion on the vertical axis.

The Core is the heart of the modular home. The core contains all essentials utilities for the home. These include the HVAC, Tesla power wall components, water storage, as well as grey water storage.
Arrangement 1 consists of a Bedroom, a bathroom and some connection space such as in this case a hallway. By opening up the space rather than incasing it created a more inviting module.

Arrangement 2 is the kitchen, and dining area. The large vertical mass is the stairway to get to the second floor. The articulating bedroom can pivot depending on the inhabitant’s needs or wants. Below illustrates both scenarios with the bedroom between floors and extended out to interact more with the surroundings as well as opening up the space.
Arrangement 3 has two bedrooms a patio as well as a central space to enhance coming to gather for the inhabitants of the home. Below also shows the articulating bedroom in the enclosed position and fully extended position.
Utilizing elements from precedent studies helps support the evolution of the dynamic modular home. Examples include the lightweight, modular construction of the Hivehaus to the central core concept of the Dymaxion house. The conclusion from this study with the massing model, I have found I will need to find a way to reduce the weight of the modules but not the sacrifice the strength of the materials. I found the module’s need to be designed with an open floor plan style in order remove the feeling that the inhabitants are being confined. I know this can be accomplished by utilizing glass or translucent materials. The importance of the natural surrounding being incorporated in the modules is also apparent. By creating alcoves, corridors, and patios will bring the natural surrounding into the spaces.

[NEW CONCEPTS]
To provide each module with the necessary utilities an umbilical will connect each one. These utilities include water from a collection system located in the core, electrical that runs from the Tesla power wall to the surrounding modules, and also from the Photo Voltaic panels to the Tesla power wall. Rather than having a large flexible cord to maneuver throughout the modules floors it would be in the best interest to have utilities already pre set up conduits upon assembly of the floors and ceilings then the umbilical would be feed through the modules. It would connect to the core and can run to predetermined connection points in the dwelling where the rooms would be located.

Adaptability of the Core is a vital component in the core design. As an example on a single floor layout the core will contain stairs, and at the top of the stairs will be a hatch access in order to utilize the space above and access the roof. This stair area in the core could also be swapped out for an elevator if needed. This will be very useful especially if the dwelling becomes more than two stories or if the owners of the dwelling become old and need accessibility assistance. The stairs and elevator offer a way to expand vertically if needed. However if the dwelling becomes multiple stories the elevator will be adopted for ease. While another core may be added to help with emergency egress of the dwelling. With regards to the adaptability for the dwelling as a whole if the dwelling becomes too large and the inhabitants want to downsize the existing modules can be added to others dwellings that need additional space rather than ending up in a dump. Perhaps not all of the
parts module can be utilized than the additional parts could be sold to others in need of additional components for their dwelling.

Utilizing open the open concept floor plan creates a sense of spaciousness while at the same time the module might not be. In keeping the program of the home so it can change this scenario will have exceptions to the private spaces such as the bedrooms and the water closets. These are the two locations that privacy should detach the inhabitants and provide a safe place to reside. This being said I believe that the ceiling should offer some natural light perhaps an opaque ceiling section over the rooms where natural light might be helpful. While skylights can be utilized the top portion of the modules walls will allow the natural light in while supporting privacy properties. This also would be beneficial for the restrooms or areas where added light would be an improvement for vision. The open floor plan will also create less of a boundary delineating the natural environment to the built.
COMPARTMENTALIZING PROCESSES

STEP 1
• The truck arrives at location with the core securely stowed.

STEP 2
• The truck extends out the outriggers, and then the truck sets up the core to the proper orientation.

STEP 3
• The truck then heads back to the factory.

STEP 4-5
• The core utilizes the crane and begins to set up the self-leveling hydraulic forms to accommodate the floor sections.
STEP 6-8

- The crane applies the floor sections to the forms, and extends out the internal supports to create a more stable platform.
STEP 9
• The crane sets up the exterior glazing and sets in place the ball bearing walls for roof structural support.

STEP 10-12
• The crane applies the remainder of the roof panels to the Dynamic Modular House. Once completed the crane returns to stow away mode on top of the core.
HOME DESIGN CONCEPT

Potential home location in urban Denver area

THE HIGHLANDS
A COST ANALYSIS FOR PROPERTIES WITH POTENTIAL LOCATION

Potential home location in urban Denver area
Home design scenarios

**Scenario 1**

A small family of starting out. They move from rented flat to their own home. Then family enjoys all the comforts and style. The father, Nick, works in sales. His day starts early and ends in the early evening. Komar, the wife, works at an office. She sleeps for about three hours a day, five days a week. The family enjoys the city and its activities. Kat works as a teacher and plays tennis on the weekends. The family enjoys staying fit and socializing with friends. The two enjoy having social gatherings and Kat likes to have dinner parties. Kat is very handy and enjoys making furniture in her free time.

- Kat
- Katie
- Nick
- Moo-moo

---

**Scenario 2**

A new couple both young professionals taking a big step in life. They move from rented flat to their own home. The two ladies are both very active and enjoy their surroundings. The two enjoy having social gatherings and Kat likes to have dinner parties. Kat is very handy and enjoys making furniture in her free time.

- Katie
- Kat
CONCLUSION

My project’s function was to explore modular living and design for a less static home. The purpose is to create a kit of individualized compartmentalized parts for the Dynamic Modular Home. This kit of parts includes the rooms as modules that connect and disconnect depending on the purpose of the space. The modular units should be able to be added to a larger structure, as well as subtract a modular unit when necessary. This housing system is perfectly suited for new communities that rely heavily on
technology, have rapidly changing lifestyles and are sensitive to growing environmental and economic pressures. This Dynamic Architecture where spaces can articulate, augment, as well as be provided with numerous internal spatial program is vital to the evolution of the home.

If the status quo for Dynamic Modular Housing is to update, recycle, and modify to new conditions every 10 to 15 years this will push the boundaries for not only sustainability but also efficiency for this dynamic architecture by keeping the dwelling always new always vibrant rather than introducing degradation to the home.

The time has come for humanity to realize better ways of consuming, in order to address the required urban living conditions, while not only sustaining them but also allowing for flourish. This must be thought of in tandem with the consequences for the economic pressures taking a toll at the same time.

Life happens and with this happening your life changes the living condition is ever changing it is adapting all the time while your family does this the same always changing always adapting. This process of constant change must also be applied to the home. While always changing or even thinking of change to a positive end for the built environment, for a more ecological and sustainable means in order to provide for future generations to flourish.
[DEFINING TERMS]

**Dynamic modular homes:**
A home comprised of numerous modules that can be articulated to different configurations depending on the needs and wants of the spaces inhabitants in order to produce an effective program.

**Focus Funnel Diagram:**
Creation of a basic diagram similar to a web diagram that is meant to take small topics, ideas, or concepts that are placed to focus in from the exterior components to the larger end or final topic.

**Massing model:**
Is the creation of a volume base model in order to showcase the basic connections of the modules operations throughout the design.

**Void:**
*Is an unfilled space in a wall, building, or other structure.*

**Egress:**
The action of going out of or leaving a place.

**Expansions:**
The action of becoming larger or more extensive

**Extrudes:**
Thrust or force out

**Interlock:**
*(of two or more things) engage with each other by overlapping or by the fitting together of projections and recesses*

**Fractures:**
The cracking or breaking of a hard object or material

**Core:**
The part of something that is central to its existence or character.

**Static:**
Lacking in movement, action, or change, especially in an undesirable or uninteresting way

REFERENCES


