Life, Living, & Space

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Life, Living, & Space
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Abstract

The thesis is an attempt to define and design a house by utilizing modernized construction technologies.

From a single cell, a man grows up into a complex creature with an independent life. A livable space for a person starts from the mother’s womb, then moves on to a crib, a full-size bed, a room, and finally a house. We can say, therefore, “a living room” originates from an independent life and is created for a person.

Man cannot and does not live alone. Human interactions help develop the spatial relationship among rooms in a house, and among houses in a community. Social relations, such as those found among family, friends and neighbors, define the mental and physical dimensions as they are manifested in the demarcations of rooms, halls and houses. Sadly, modernization seems to have destroyed the human basis for spatial relations, as we no longer can find these attributes in contemporary designs where elevators and stairs have replaced alleys and backyards where neighborhood children once played and housewives enjoyed socializing.

Industrialized processes have allowed us to build more space more quickly, but, unfortunately, these processes have also simultaneously equalized qualities in housing design today.

Because of the potential complexity of these questions, I am compelled to focus on a room or a house as the scope of the study. The aim of the thesis is therefore the study of the development of a socially and technically responsive house in the face of growth and change in an industrialized world.

In Part One, I shall start with an analysis of historical precedents and the development of a working concept for the design. Part Two ponders how to use minimum materials and sizes to create maximum spaces and capacity. The final section includes the demonstration of the design process involved in the creation of a future oriented house.
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0. Introduction

A Room for Living

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1.0 Literature Review and Case Study

Diagram

This thesis defines “living” as a sum of a life and a space. For the convenience of discussing the interactions among lives and spaces, this research creates a series of diagrams to present the concepts.

Life Unit

Firstly, the circular diagram with various gray fan-like graphics is developed from Leonardo’s drawing of the Vitruvian Man. The circle marks the limit of the furthest reach for a standing human body, while the gray perimeter marks are applied to present a body’s actions, such as the hand shaking and foot stepping, beyond the boundary. It not only shows the physical arrangement of a human body’s size and actions but also presents a conceptual unit of a life. This life unit will also be used in combinations of two or more to present interpersonal relationships, such as within a family.
Space Pattern

"Houses generated by patterns"
– Christopher Alexander

Hardware Frame Unit

Secondly, the squared double-lined frame diagram represents the spatial unit from which the houses’ hardware frames could be conceptually developed. This research assumes that the frames will be modularized and prefabricated in the industrial construction process.

Also, according to the different types of prefabrication systems, the groups of square frame diagrams are expected to present the three major ways that the spatial units form a house. The first way is to divide the spatial unit into two, three or more rooms within a limited size frame. This provides a convenient building process, but it also limits the total area of a house to fit within transportation limits. The second way is to expand the original frame to create an additional room or rooms. This will make the prefabrication work of the double shell more complicated but will provide more possibilities to overcome the transportation limits and to construct a house of proper size from a unit. The last way to form a house using a system of prefabrication is to add another unit or units. These relations among the frame patterns can be found in the following case studies.
Case Study

Prefabication is recognized as one of the most efficient systems to produce mass housing. The key issue here is how to produce houses that can adapt to various living situations quickly and simultaneously. There are various concepts of construction systems for prefabrication, including composing utilities and functions of living needs into an unit boundary (Case 1 and 2), dividing rooms within an existing frame (Case 3 and 4), adding modular pieces to build house models (Case 5 and 6) and developing extended spaces from the original shell of the shippable container-like boxes (Case 7 and 8).

However, the main problems of these prefabrication systems are the limited size of components for convenient transportation and the difficulty of creating proper dimensions and divisions of rooms in the limited space for living. The selected cases show how different prefabrication systems can work with the possibilities of materials and also the architectural design elements to overcome the limitation of size. The diagrams beside each case give the ideas of how the project defines the relationships between human life or lives and the spatial units.
The Cushicle is a complete nomadic unit, and it enables a man to carry spatial and equipment needs on his back. It can carry food, water, radio, projecting television, a bed, and air conditioning systems, etc.

It is a perfect case to explain how a room satisfies a man's minimal needs with ideal equipment, which cover the human boundary as membranes. The diagram is used to present a room or a manufactured object, developed from a man's scale, size and action arrangements.

The size limited unit is filled with divisions of space and equipment for the minimal living needs of a businessman. The hard frame gives a more practical construction than the ideal skin-like external enclosure in the Cushicle project. Although it could be considered as a room or a machine to serve a person's basic needs, it could never be said to be a house to satisfy human physical and mental needs for living because its space is so tiny. It reveals the difference between architecture and merely "a machine for living."
The most important prerequisite for a prefabricated system is that every piece of the system should be made in a transportable size. The economical size of a truck container seems to be the proper answer for this requirement.

This KFN mobile home, which was called SU-SL, is a good example of ways of designing a living space inside a container. The quality of space is acceptable but obviously not good enough to generously accommodate a couple’s daily life—rather than satisfying people’s natural needs, it forces people to live within the construction limitation.

Instead of enlarging the floor area in order to satisfy people’s needs in space, this project chooses to use various re-configurable architectural elements to act on and integrate the residential living space. On the second floor of the building, for example, the sliding doors are used to provide several planned layouts for different living conditions. The boundary of the rooms can be overlapped by actively using the architectural elements, and hence the functions of the rooms can be multiplied.
The two containers for the lower and upper levels were constructed separately for this project. The upper level container, which serves as the second floor, was added to extend the living space. This solution can save some construction cost, primarily in labor, but the livable space is still limited to the size of the container.

This project used modular timber frames to construct a house with sufficient capacity for two families. Each panel of both the exterior and interior walls was built separately in the factory before being transported to the site. Then the panels were put together to build the house. This system provides more freedom to configure spaces and rooms due to the variable panels that can be customized for each wall. However, it will not be cost-effective because of the greater labor costs for assembling and joining the panels.
The single metal container unit presents a concept of how to compose a larger room by overcoming the limitations of its original size. It is prefabricated with an inner construction frame within its outer shell. The whole building can be easily displayed at chosen sites by sliding out the inside box on rails.

The projects designed by team LOT/EK carry the same concept as in the previous project further, applying it in more practical situations. The sliding boxes on the long sides of the container-size units functionally provide larger floor area, and the construction process of the architectural units can be easily accomplished on site.

LOT/EK used shipping containers made of aluminum or steel, inexpensive basic “building blocks” for a variety of facilities or housing. The ways of expanding space by pulling out the inner smaller frames from the larger ones not only overcome the limitation of a block’s size but also provide more functional spaces for dwelling or for formation of portable storage systems.
"We make our buildings, and our buildings make us."
– Winston Churchill

"Man is the measure of all things."
– Protagoras

According to the case studies in chapter one, the objective of this research is to define the relationships between the hard frame of the living space and the physical occupation of space by the residents. In chapter two, the first project defines three sizes of a man’s spatial limits and uses them as the measures to create a single man’s living room. In the second project, because of transportation limits, study models are used to define and revise the various configurations of units in a ‘true container’. The third project attempts to use the results of the previous studies to design a house in order to present the relationships among the site, the hard frame of the living space, and the residents.

The diagrams insert a man’s different physical dimensions into a square hard frame. They are used to present the concept of the possible relationships between people’s physical occupation and the space defining elements.

2.0 Research & Study Projects
2.1 Size & Scale

A house for a single man to live in

Here, the sizes of a man's spatial movements are revised in three types (Fig.), and these three scales are individually defined by motions of a human body. Human physical movements that are extremely intense or severe, such as running, are not expected inside a usual residential house, and therefore are not considered here.

Each movement of a human body requires some room in the space. When these movements are put together in a big room, the patterns of activity overlap. The figures apply the three sizes as the measuring system to define the space for a sequence of living needs, such as entering a door, laying down in bed, and cooking in front of the stove, etc. As for the result, the house is designed according to the human body's boundaries of spatial movements, instead of the sizes of standard materials and building construction.

The functions of each room in a house commonly have a clear boundary and definition, but in this project the overlapping areas for a human body's spatial needs can be actively flexible and adjustable, thus requiring a smaller total area of interior space.
2.2 Transformation in Containers

These models are used to study the limitation of a container's size on possible application in creating spaces. The container here stands for the dimensional constraints of a standard shipping container and not necessarily an actual shipping container.

A Construction Unit

The first part of the study tries to design one or two universal units and using them to develop various layouts with different dimensional combinations. The concept of this study is to create a simple modular system for flexible dwellings.
Transformation of a Container

The outlines of the six surfaces of a container are the maximal boundary for a container-based space. To create a livable room that is able to provide excellent living quality and to satisfy living needs, the formats and functions of the six surfaces become important.

First of all, these surfaces are defined as walls, roofs and floors. Moreover, the openings in them, such as windows and doors, including shadings elements and shelves, etc. are defined as architectural elements. To be able to achieve the goal of creating the qualified and livable room, we have to activate these elements with spatial transformation, including slicing, rotating, folding, flipping, and overlapping, etc.
This project applies the research results of Chapters 2.1 and 2.2 to the design of a house for a couple. With two flexible container-based constructions, the house not only provides living equipment and qualified spaces, but also successfully structures the site and actively organizes the interior space. However, compared with the requirements of a modular dwelling system, the configuration and details of this house are still too complicated.

- Shipping limits = The size of a truck container
- Container = Small room
- Extending = Enlarging a small room
- Enlargable room = Moveable furniture
- Changeable structure = Gaps in between
- Gaps = Light
- L shape plan = Yards
- Crossing paths = Connection of interior and exterior
- Layers of wooden slats = Layer of space in the office
- Moveable walls in the office = Connecting interior and exterior space
- Big windows of the living room = Garden extends to interior
3.1 A Container Becomes A House

Introduction

This project is trying to use a container to solve most of the problems in making living space. According to the conclusions of the previous research, a proper space for a human to live in should satisfy three important necessities: First, it should fit within the size limits for economical transportation; second, it should use multiple layers or a properly designed structural frame to provide a container-based modular construction with extendable possibilities for maximal total area; third, from the interior space to the exterior space and the site, it should use the minimal amount of architectural elements to maximally define the spaces.

By starting with a standard container-size of 10’x13’x40’, I eventually decided to use three layers of the structural frame and establish the layer containing the largest surface area as the space extending dimension to develop the spaces of the house. The second layer of the structural frame is made of transparent materials to obtain maximal daylighting and extend the perceptual limits of the space in the perpendicular dimension. The two largest outside surfaces also contain three projecting external walls for site structuring.
3.2 Concept

The three external enclosure frames are built in different sizes, so they can sequentially contain each other like Russian nesting dolls. The gaps between the different sizes of frames on the deployed condition provide space for fixed loading. The space of the smallest frame (frame three) contains the storage room and the service equipment, such as air-conditioner and kitchen utilities. The gap between frames one and two provides the space to store unfolding shelves that can be used as interior partitions.
The outside frames are the main structure. The support points are at the quarters. When being shipped, the yellow temporary structural frames will be at the support points and help to fix the whole container.
3.3 Section Model

Folded boxes & Roof arms

Step 1: The middle box comes out
Step 2: The small box comes out
Step 3: The roof arms and panels rise
Step 4: The raised arms unfold and extend. The second part of the arms stretch to reach the structural frame.

Step 5: The third part of the arms are extended.

Step 6: Filling in floor panels.
3.4 Structuring the Site

Structuring the site

A house can gain more with fewer architectural elements. An open and implied line sometimes defines much more than an enclosed one. After being settled on the site, the three external walls can simply structure the outside areas, defining the front and back yards and the main and back entrances.

Space overlapping

In the project, the plan shows the arrangement for active use of the space by redefining and overlapping each functional room. A smaller floor area or fewer walls can help to activate the sequential space in the house. For example, the kitchen, the office, and the dining table can share an integrated space without walls; the rotating shelf or partition between the living room and the bedroom can help to define different ways of using the space at different times of the day or night.
The 2’x4’ mobile modular panels can help defining and enriching the intermediary space between the house and yards. They can be used as a series of decks connected to the house or as benches in the gardens or under the trees.
Interior Views

Western Window & Sky Light

Eastern Window & Sky Light
Interior Views

Southern Window & Living room

Office Corner & Kitchen
3.5 Materials and Details

Roof Arm

Moveable Wall Structure

Surface Structure
4. Conclusion

The final version of the project results in a house, developed from a container size object. It provides a generous space for a couple to live in. A few simple transformations define the site, the yards, the open spaces surrounding it, and the interior rooms. Eventually, it can help other designers to rethink the relationships between people and space, people and the site, and finally people and nature.

Three simple extended walls give the site its structure. The gardens or yards are drawn out by a modular panel, which presents the border between public and private areas. The large frontal glass window and the glazed roof bring in views and light while psychologically enlarging the space in both vertical and horizontal dimensions. The multiple uses of redefined architectural elements, such as walls and windows, show the possibilities of complexity in architecture.

More importantly, the house can become a conceptual model for mass housing. In a future design phase, it may be used to build a community of houses, a landscaped town, or an apartment complex.
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