UBC Social Ecological Economic Development Studies (SEEDS) Student Report

An Investigation into UBC Farm Sustainability College: What Are the Social, Ecological and Economic Factors to Consider When Planning Sustainable Housing Options?

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Submitted to Professor Carla Paterson

ABSTRACT

UBC Farm emphasizes the importance of "down-to-earth" and "low-tech" sustainability philosophy. And, Véronik Campbell, the project stakeholder, emphasizes two essential factors for this UBC Farm Sustainability College Project: a housing option must have minimum environmental impact and must be able to create community involvement (Campbell, 2012). With these essential considerations, the research has thoroughly done.

Due to limited academic resources, three commercial products representing today's leading sustainable housing are presented in this report: m-ch, Dwelle and 4Treehouse. Then, a triple bottom line assessment has been performed to analyze each housing option. As stated in the project guideline, the sustainability college shall have single occupancy units and family occupancy units. Approximately, it should be able to occupy 75-100 residents. Since a single house of each option cannot satisfy the desired number of occupants, multiple of those houses will be applied during assessment.

The definition of sustainability is very broad; no single housing option can fulfill the purposes. Thus, a combination of m-ch, dewell.ing, and 4Treehouse will be ultimately selected for UBC Farm Sustainability College project.

TABLE OF CONTENTS

ABSTRACT ii
LIST OF ILLUSTRATIONS iv
GLOSSARY v
LIST OF ABBREVIATIONS vi
1.0 INTRODUCTION 1
2.0 THREE HOUSE CASES 3
2.1 m-ch 3
2.2 Dwelle 4
2.3 4Treehouse 5
3.0 ASSESSMENT INDICATORS 7
3.1 ECONOMIC INDICATORS 7
3.1.1 Affordability 7
3.1.2 Durability 8
3.2 SOCIAL INDICATORS 8
3.2.1 Social Involvement 8
3.2.2 Health and Safety 9
3.2.3 Effectiveness of Sustainablity Promotion 10
3.3 ENVIRONMENTAL INDICATORS 10
3.3.1 Pollution 10
3.3.2 Energy Consumption 11
3.3.3 Environmentally Friendly Design 11
3.4 SUMMARY CHART 12
4.0 CONCLUSION 16
5.0 OTHER RECOMMENDATION 17
REFERENCES ..... **Error! Bookmark not defined.**
APPENDIX A 20
APPENDIX B 23
APPENDIX C 25

LIST OF ILLUSTRATIONS

Figure 1 m-ch <http://www.microcompacthome.com/thumb.php?d=ltd_1.jpg&b=458&n=0> 4

Figure 2 dwelle housing <http://www.dwelle.co.uk/> 5

Figure 3 4treehouse <http://assets.inhabitat.com/wp-content/uploads/maintreehouse1.jpg> 6

GLOSSARY

Carbon footprint	The amount of carbon being emitted to the environment
Cellulose fibre	A material that is extracted from recycled paper products such as newspapers and magazines
Eco-village	A type of residential community that intends to achieve social, environmental and economic sustainability
European union energy label	A rating of the appliance in terms of its energy efficiency in European union
Long axis	A straight line which is parallel to an object lengthwise
Prefabricated house	A type of house that is built in factory and later delivered to site and assembled
Triple bottom line assessment	An analysis that examines social, economic and environmental factors

LIST OF ABBREVIATIONS

CFL	Compact Fluorescent Lamp
FSC	Forest Stewardship Council
LED	Light-emitting Diode
m-ch	Micro Compact House

1.0 INTRODUCTION

In the current global community, a few people strive to find ways to counteract global warming; on the other hand, some people fail to recognize the importance and seriousness of it because the quality of their lives has drastically improved. Some scientists say greenhouse gases have already reached a dangerous tipping point and some say climate change has boosted odds of extreme weather (ABC News, 2012). All these side effects of the purpose to achieve human life quality improvement will subsequently earn catastrophic results such as food supply shortage and a potential war for water supply. Nowadays, one of the remedies to promote sustainability is considering a sustainable housing. Although a demand for sustainable housing has noticeably increased, there has not been a prevalent one in the world (NAHB, 2007). University of British Columbia, a global leader in sustainability, steps forward to promote an idea of sustainable housing.

As an important part of the "living lab" of UBC, the UBC farm needs sustainable housing for visiting scholars and graduate students specialized in sustainability. Thus, the farm desires to have a very specific housing style which will allow minimum environmental impact, and will create a community involvement. The objectives of this project are to research possible options, to evaluate the performances, and to make a recommendation for UBC Farm Sustainability College.

The UBC farm is the only one of few university farms that is actually in the campus region. It creates community activities and spreads a sense of involvement around the town. In addition, UBC students are able to learn hands-on experiences in the farm. Currently, the farm has a plan for constructing a farm centre and housing for potential residents. In preparation for the future planning, this report has chosen three potential housing options: Micro Compact House", "Dwelle.ing", and "4Treehouse". These candidates are carefully chosen with the stakeholder's requests and UBC Farm's needs.

This report is divided into the following primary sections: “Four House Cases”, “Assessment Indicators”, “Conclusion”, and “Other Recommendation”. In the “Four House Cases” section, each four housing options will be examined regarding its technical specifications, economic factors, and social impacts. In the “Assessment Indicators” section, how we determine the economic, social, and environmental indicators are explained, and a summary chart with a point scale of 1 to 3 is demonstrated. In the end, this report will be concluded with a recommendation on which housing option is the most suitable for the UBC Farm Sustainability College.

2.0 THREE HOUSE CASES

In order to find credible information for this project option, the research concentrated on both commercial products and sustainability journals. Nonetheless, all sustainability journals from UBC library and other reliable sources contain very technical aspects; it is hard to fully analyze the housing options with all economic, social and environmental indicators. Also, such journals are reported with different test methods in various countries; therefore, they do not give an objective perspective.

Keywords such as eco-village, tree house, cube house and micro house are used to find current commercial products around the world. The primary consideration is focused on the design. The idea of a large building in UBC Farm is not a suitable choice in terms of nature preservation; there will be unnecessary spaces such as hallway, and most importantly its meaning to promote sustainability becomes nothing more than newly built townhouses around UBC Farm. Thus, the research rather focuses on a small sustainable house. Multiple of these houses will be considered to compensate for 75-100 people.

2.1 m-ch

The micro compact house has the size of 2.66 cubic meters that can easily adapt to different environments and minimize its footprint. This house is designed for short stay accommodation. The design is inspired by traditional Japanese tea-house; modern technologies are added to complete high quality compact living space. As the designers say, “short stay, smart living” has become true. (m-ch, 2012)

In 2001, Technical University Munich proposed a research project to design a 2.6m cube dwelling. Tokyo Institute of Technology started to collaborate with Technical University Munich. The first village comprised of micro compact houses was publicly exhibited in 2005. Its unique design inspired Marijke de Goey (the artist from Amsterdam) to create the design of “reed huis” which has a concept of short stay for summer sailing and winter skating.

It is easy to place the micro compact house between trees and shrubs because of its small dimensions. A light crane, a trailer or even a helicopter can deliver the house into any landscape. This product is fully-assembled so that the construction time is very short. In addition, the house can integrate with other micro compact houses in horizontal or vertical arrangements to extend the size of interior.

Figure 1 m-ch housing <http://www.microcompacthome.com/thumb.php?d=ltd_1.jpg&b=458&n=0>

2.2 Dwelle

Dwelle.ing is a new range of prefab micro houses produced by Dwelle, a UK based architect company. Originally created by architect Ric Frankland, these buildings are designed to be highly adaptable to various uses and to serve as an alternative to the high-cost and limited housing in the UK. At a quite affordable price, Dwelle.ings features a healthy internal environment, high quality design and environmental sustainability (dwelle, 2012). All of these elements make Dwelle.ing chosen as one of the housing options for the sustainability college.

According to the official website of Dwelle, there are four models of dwelle.ing available for different uses. They vary not only in sizes but also in features. Home dwelle.ing is the original model while little dwelle.ing is a mini version of home dwelle.ing. Both of them are designed for people who look for a place to live. Office dwelle.ing and holiday dwelle.ing are specified for business and vacation respectively (dwelle, 2012).

Figure 2 dwelle housing <http://www.dwelle.co.uk/>

2.3 4Treehouse

In order to maximize nature preservation and to harmonize UBC Farm surroundings, promoting a tree house is an ideal option. Out of all tree house models/concepts, 4Treehouse designed by Lukasz Kos catches the most attention. This Japanese lantern looking tree house has been selected for numerous publications and exhibits until now. 4Treehouse was built in 2003 and it is currently located in Lake Muskoka, Ontario, Canada. This two-ton, 410-square-foot house is 20 feet above the ground. At the base of the house, a staircase rolls on casters upon two stone slabs, allowing occupants to enter and exit. Its design creates a great ecological sensitivity by preserving trees' health and growth. At top, the tree house is completely penned in, a suspended patio with a ceiling of sky. This house succeeds in minimizing the impact to the trees and giving natural harmonization with the natural setting. (Kos, 2012)

Figure 3 4treehouse <http://assets.inhabitat.com/wp-content/uploads/maintreehouse1.jpg>

3.0 ASSESSMENT INDICATORS

The following indicators are carefully chosen with advice from the stakeholder and Dr. Paterson: affordability, durability, social involvement, health and safety issue, sustainable importance, pollution, energy consumption, and environmental friendly design. (Campbell, 2012) These indicators will guide the triple bottom line assessment for three selected housing cases and these will ultimately give a conclusion for UBC Farm Sustainability College. A relative evaluation is used to grade each indicator. A scale of one to three, three presents the most suitable feature for UBC Farm housing and vice versa. At the end, all grades will be added and will be presented in a chart with valid reasons; the housing option with the lowest score will be selected for UBC Farm Sustainability College.

Due to limited access information, not all indicators are able to provide detailed description of the housing options. Although requests for more information were made to each company/designer, there were unfortunately no replies to the interests of this project.

3.1 ECONOMIC INDICATORS

Economic indicators are the affordability and durability of the housing options.

3.1.1 Affordability

The affordability includes the cost of production, the cost of material and the cost of delivery. Since UBC Farm is within the limited budget, saving the money is necessary for other sustainable activities such as farm market.

m-ch: It costs $48,250 (EUR 38,000) for each house. It is possible to get a discount if fifty or more houses are purchased. In average, it costs $633.64 per square feet.
Dwelle.ing: Four models are available according to the official website. The office dwelle.ing and beach dwelle.ing do not include bedrooms, so home dwelle.ing and little dwelle.ing are more suitable for the resident application. Since the sustainable college aims to provide housing for both single and family visitors, a certain amount of home dwelle.ing houses are needed as well as little dwelle.ing. Each home dwelle.ing costs

$119,800 (UK 75,000 pounds), while the cost of building a little dwelle.ing ranges from 20,000 pounds to 35,000 pounds ($31,691 ~ $55,460) (dwelle, 2012).

4Treehouse: The budget for 4Treehouse was approximately $50,000 for 410 square foot. This is equivalent to $121.95 per square foot.

3.1.2 Durability

The durability is the cost for maintenance and operation.

m-ch: N/A

Dwelle.ing: Dwelle.ing utilizes a timber frame structure so that the maintenance tasks are greatly simplified. Moreover the cladding of the house only requires very little maintenance. In other words, the cost of maintenance will be largely reduced. The structure of dwelle.ing is light weighted yet strong. It is designed to have a lifespan of at least 60 years and it could be still in good condition after centuries (dwelle, 2012).

4Treehouse: N/A

3.2 SOCIAL INDICATORS

The analysis on social aspect has these elements: social involvement, health and safety and effectiveness of sustainability promotion.

3.2.1 Social Involvement

The social involvement includes a sense of community and a creation of welcoming atmosphere. In addition, it connotes doing social activities within the community.

m-ch: In 2005, o2 village is created; it's composed of seven m-ch houses. The purpose is to accommodate six students who go to Technical University Munich. As shown in the pictures, the houses are closely located each other so that students enjoy the sense of community. At the end of the year, students wanted to extend their stay at the village.

Dwelle.ing: This house can be purposely modified into a home gym with sauna and hot tub. This home gym will attract people around town who come visit UBC Farm during market day. It is also a great place for residents to communicate and enjoy extreme

coziness surrounded by nature. In addition, a house can be turned into a space for children to play like an indoor playground.

4Treehouse: This 3 storey tree house will attract many residents to meet and communicate. It is a perfect tree house for a party or a meeting; its natural surroundings create a very welcoming, cozy atmosphere. In fact, it does not have a kitchen; thus, one large kitchen or several kitchens have to be built outside of the tree house. Many would think that this is a critical drawback; however, it creates an immense opportunity for residents to interact, understand different culture, and most importantly share valuable information or knowledge.

3.2.2 Health and Safety

The following content shows what features each house deliver to provide comfortable and safe environment for living.

m-ch: The micro compact house is designed to provide social, student and short stay business or leisure accommodations. The house can be grouped in horizontal or vertical arrangements when more space is needed. The micro compact house has a frame structure composed of timber and aluminium. The surface is shielded with polyurethane foam to insulate the inside from the outside. When the house is delivered, a light aluminium support bracket is combined to effectively separate the house from the ground. In addition, the house is fully air conditioned and heated. (See Appendix A) The interior of micro compact house is like a business hotel room including a small kitchen. Two compact double beds, storage spaces, sliding table, flat screen television and shower and toilet cubicle are included in the house.

Dwelle.ing: The home dwelle.ing is originally designed for permanent residence. All the essential elements for living such as kitchen are already included in the house. With internal area of 43 square metres, home dwelle.ing has an efficient and compact layout. Moreover, the indoor space is extended by introducing the second floor, providing a more spacious environment. In addition to interior space, dwelle.ing ensure quiet indoor environment. Both of the windows and doors made from aluminum timber composite as well as the cellulose fibre contribute to high insulation. (See Appendix B) In order to

ensure the safety of the house, dwelle.ing is equipped with wire-free intruder alarm for preventing crime and a smoke alarm for detecting fire.

4Treehouse: The whole house is supported by only one high strength wires. Although it minimizes the environmental concern, its look may raise some safety issues by residents. In case of an earthquake or high speed wind, it might cause an unwanted, catastrophic result. Furthermore, bugs and insects will cause problems.

3.2.3 Effectiveness of Sustainability Promotion

This section investigates how each housing option contributes to increase people's awareness of the importance of sustainability.

m-ch: According to m-ch's marketing press release, the micro compact house can affect people to think about sustainable development. The house is designed to be placed near small trees and shrubs and integrate into landscape.

Dwelle.ing: A dwelle.ing was built this year and will be open next year for public visits. This house will be used as a showroom to show people what an efficient home looks like and how to make less negative impact on the environment. At that time, Dwelle.ing will become the first centres for promoting Carbon Literacy in the UK.

4Treehouse: There is no fancy technology to support sustainability; it rather allows people to recognize the importance of it by giving them opportunities to interact with the nature. For instance, living around large trees with cozy wind, and sunlight through the trees will make people to enlighten about the sustainability without any kind of sustainable technology. Actually, its design of the house allows people to become acquainted with the natural surroundings.

3.3 ENVIRONMENTAL INDICATORS

Environmental indicators include: pollution, energy consumption and environmentally friendly design.

3.3.1 Pollution

The pollution measures toxic emissions from construction of a house and generation of electricity.

m-ch: Options for PV solar cells and wind turbine are available; zero CO2 emission is possible.

Dwelle.ing: With the integration of renewable energy systems, dwelle.ing can leave a lighter or even zero carbon footprint on the Earth. Currently the only clean energy system Dwelle.ing offers is solar energy. According to Environment Canada Climate Weather Office the sun shines for roughly 2,100 hours per year in Vancouver (SolarBC, 2012). Thus, this system is able to take advantage of the climate and generate ample power to the houses without polluting the environment.

4Treehouse: N/A

*According to Environment Canada Climate Weather Office the sun shines for roughly 2,100 hours per year in Vancouver. Thus, this system is able to take advantage of the climate and generate ample power to the houses without polluting the environment.

3.3.2 Energy Consumption

The energy consumption measures electricity in kWh and efficiency of using energy.

m-ch: It uses 123 kWh in summer and 348 kWh in winter. It is possible to attach wind turbine and PV solar panels for self-sufficiency.

Dwelle.ing: Dwelle.ing has several approaches to achieve reduction in energy consumption. First, low energy lighting such as LED light bulb is used for the entire house. A LED light bulb consumes only 2 to 17 watts of electricity, which is 1/3 to 1/30 of Incandescent and CFL. Secondly, all the kitchen appliances have A+ Energy Labels. The Energy Label indicates the rating of the appliance's energy efficiency in terms of energy efficiency classes ranging from A+++ to G (Eartheasy, 2012).

4Treehouse: N/A

3.3.3 Environmentally Friendly Design

The environmental friendly design analyzes the building materials and nature preservation near the construction site.

m-ch: Since m-ch is designed to fit into any environment, it is well around with surrounding environments. In addition, m-ch is composed of the aluminum which is the main material for the house and can be recycled with 0.3% wastage in the process.

Dwelle.ing: The walls, floor and roof of dwelle.ing are insulated using cellulose fibre instead of fibre glass, an insulation material commonly used in existing houses. Cellulose fibre is made from recycled paper products such as newsprint, and generally has at least 82% of recycled material content.

4Treehouse: This tree house is built with the base of four existing trees and only one high strength cable is attached to each tree to give minimal impact on the growing trunks. Thus, it does not occupy any ground level land. The lattice-like skin acts like a tree canopy, filtering sunlight in the interior spaces. (See Appendix C)

3.4 SUMMARY CHART

Followings are the point charts (scale of one to three where three is the highest) for each housing option:

Economic		
	Affordability	Points
m-ch	- $48,250 (EUR 38,000) ($633.64 per sq ft.)	3
Dwelle.ing	- $63,000 (UK 40,000) ($146.51 per sq ft)	1
4Treehouse	- $50,000 ($121.95 per sq ft)	2

Economic		
	Durability	Points
m-ch	- N/A	1
Dwelle.ing	- At least 60 years	3
4Treehouse	- N/A	1

Social		
	Sense of Community	Points
m-ch	- Existing (successful) community	2
Dwelle.ing	- Can be modified into a home gym with sauna and hot tub - Can be turned into a space for children to play like an indoor playground	1
4Treehouse	- Can attract many residents due to its natural surroundings - Good for party or meeting - No kitchen thus, opportunity for residents to interact	3

Social		
	Health and Safety	Points
m-ch	- Frame structure composed of timber and aluminium - The surface is shielded with polyurethane foam - Light aluminium support bracket to separate from the ground - Air conditioned and heated	2
Dwelle.ing	- Designed for permanent residence - Efficient and compact layout - Extended space by having a second floor - Windows and doors made of aluminum timber composite and cellulose fibre to achieve high insulation	3
4Treehouse	- Supported by only one high strength wires - Safety issues due to its design	1

Social		
	Sustainable Importance	Points
m-ch	- Can affect people to think about sustainable development - Integrate into landscape so that sustainability is highlighted	2
Dwelle.ing	- Model house for less negative impact on the environment - The first centres for promoting Carbon Literacy in the UK.	1
4Treehouse	- No fancy technology to support sustainability - Providing an opportunity to interact with the nature	3

Environmental		
	Pollution	Points
m-ch	- Zero emission (PV solar cells and wind turbine)	3
Dwelle.ing	- Zero emission (solar energy)	1
4Treehouse	- N/A	2

Environmental		
	Energy Consumption	Points
m-ch	- 123kWh (summer) 348kWh (winter)	3
Dwelle.ing	- Several approaches to reduce energy consumption - LED light bulb - Kitchen appliances have A+ Energy Labels	2
4Treehouse	- N/A	1

Environmental		
	Environmentally Friendly Design	Points
m-ch	- Designed to fit into surrounding environments - Composed of the aluminum which is the main material for the house and can be recycled with 0.3% wastage in the process	2
Dwelle.ing	- Walls, floor and roof insulated using cellulose fibre - Cellulose fibre is made from recycled paper products	1
4Treehouse	- Built with the base of four existing trees - Minimal impact on the growing trunks - Does not occupy any ground level land	3

Total Points		
	Information	Points
m-ch	- Highest points; compact size	18
Dwelle.ing	- Solid construction; big space	13
4Treehouse	- It’s a part of nature	16

4.0 CONCLUSION

According to the chart shown above, the best available selection for UBC Farm is m-ch. The price is considerably cheap compared to other project options while it includes all the features that normal houses would have. It is proven to be a sustainable housing with zero emissions and it does not raise health and safety concerns. Also, a successful m-ch community already exists in Europe which UBC Farm may be able to benchmark its strengths and mitigate its drawbacks.

As mentioned at the beginning of the report, sustainability has a very broad meaning. No single technology can define sustainability. Although dwell.ing is chosen for UBC Farm housing, it is strongly recommended to apply all three housing options. Dwell.ing may not have certain features that can be replaced by m-ch and 4Treehouse. A variety of sustainable housings can enforce more sustainable awareness than a single sustainable housing does.

Although m-ch is fully furnished, is equipped with green technology, and has all the features that normal houses have such as heat and ventilation system, it is a very tiny house with only 76 sq.ft .m-ch is the most ideal house for a single resident; therefore, dwell.ing can be more suitable for couple or family size residents. Furthermore, 4Treehouse should be used as a commonplace rather than as a living house. In this tree house, people will be able to communicate easily due to such natural surroundings. It is a perfect place for social involvement such as meetings and parties. Most importantly, its surroundings and its environmental friendly design will comfort people; it is a potential escape from city complexity and drastic technology developments.

In light of all the circumstances, this project option should promote a combination of all m-ch, dewell.ing, and 4Treehouse to create an ideal sustainable housing/village in UBC Farm. There is no right ways and answers to introduce sustainability. Many different housing styles have their own unique ways to promote sustainability; however, all of them have the common goal of staying ‘green.’

5.0 OTHER RECOMMENDATION

In order to promote sustainability, architects around the world have numerous creative designs of sustainable homes. Although the housing styles and construction cost vary from house to house, all of them share several notable benefits: reducing pollution, less maintenance and energy efficient. To design an energy efficient home, the recommendations provided below should be considered. For receiving the maximum amount of sunlight, the house is recommended to be located at a place where there are not many trees and tall buildings to cause too much over shading. The orientation is ideal when the daytime living area of the house is facing north with the house's long axis is in east-west direction. It is also important to improve the insulation of the house because house with high insulation avoid heat loss in winter and prevent heat transferring into the house in summer. Another method to reduce heat transferred is to install shading. External shading such as sunshade is capable of keeping the solar heat out gain of the house low while internal shading such as curtains and blinds can prevent warm air entering the house. The house which satisfies the conditions suggested above can significantly improve the energy efficiency.

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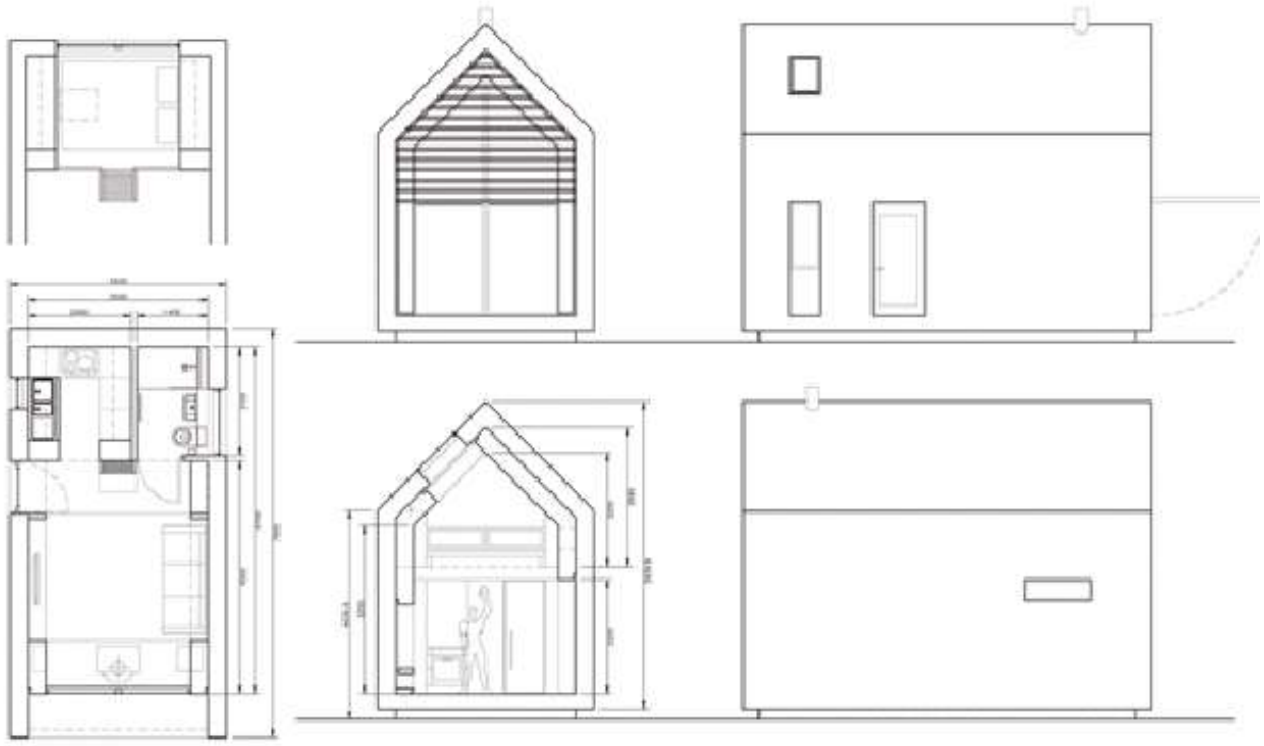
APPENDIX A

The construction starts with putting the frames together.

Although m-ch is a very tiny house, it can fit seven people around the table.

m-ch uses the space very intelligently and efficiently to maximize the usage.

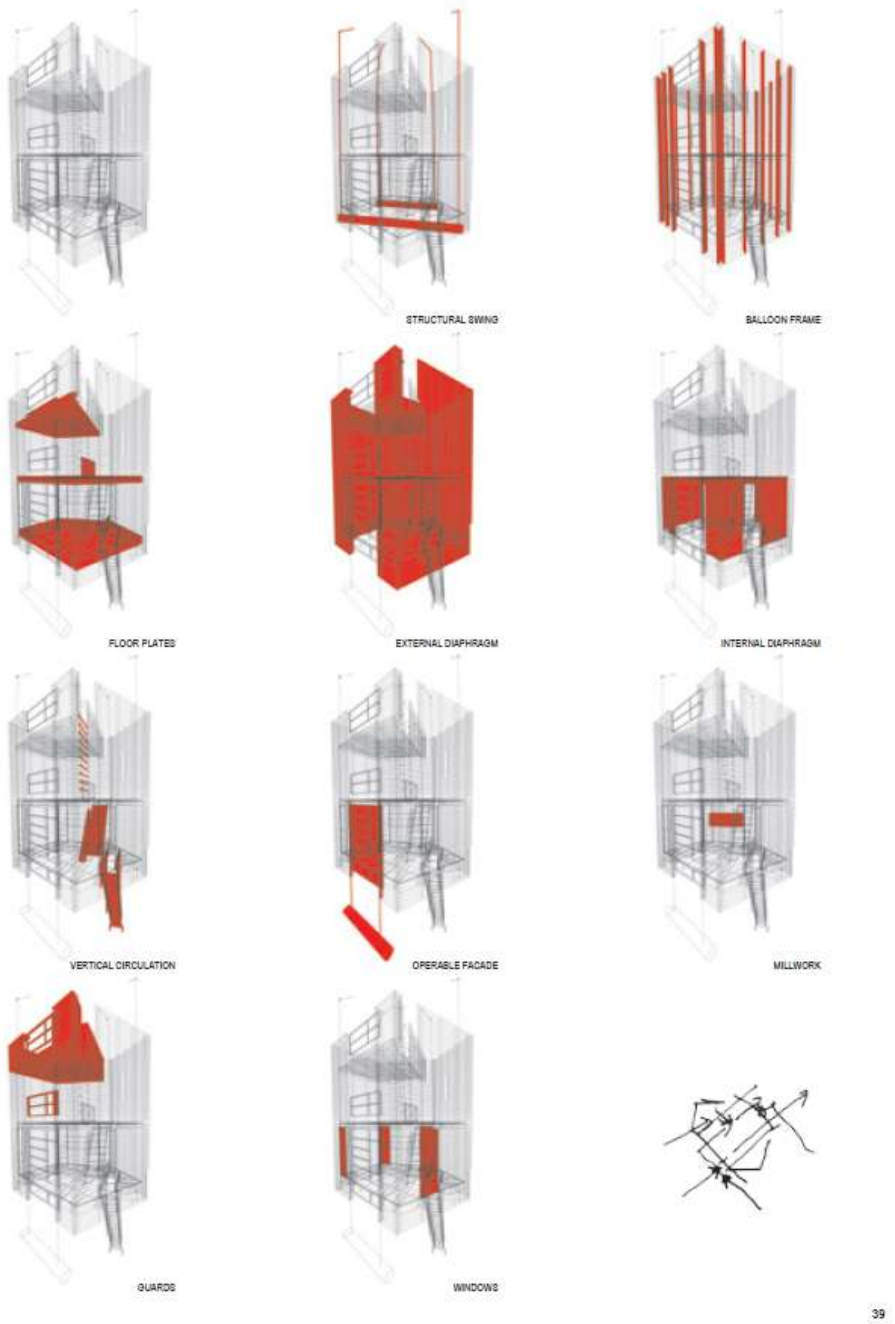
APPENDIX B



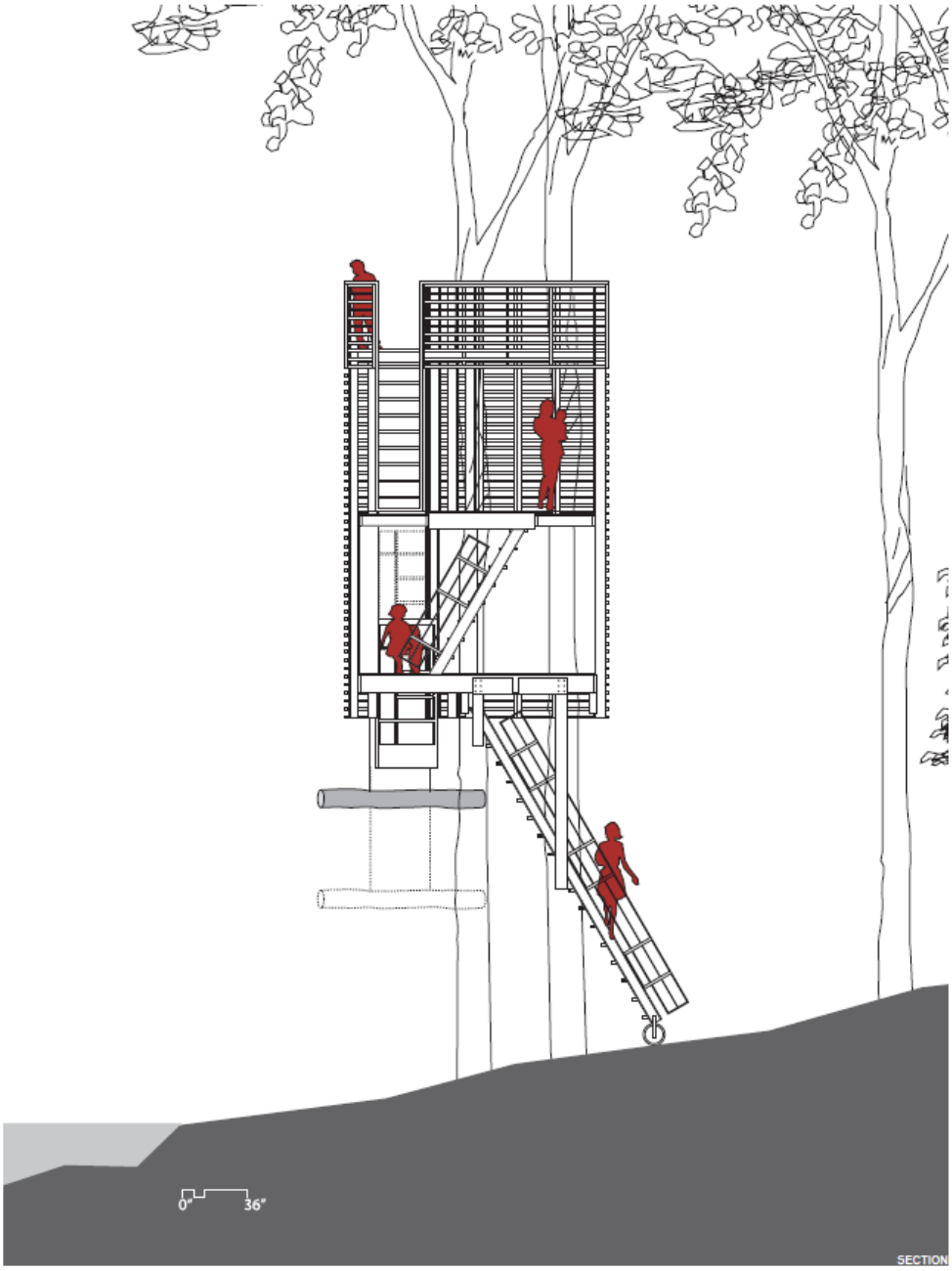
This is a basic layout of dwell.ing.

This shows a 3-D modeling of dwell.ing.

APPENDIX C

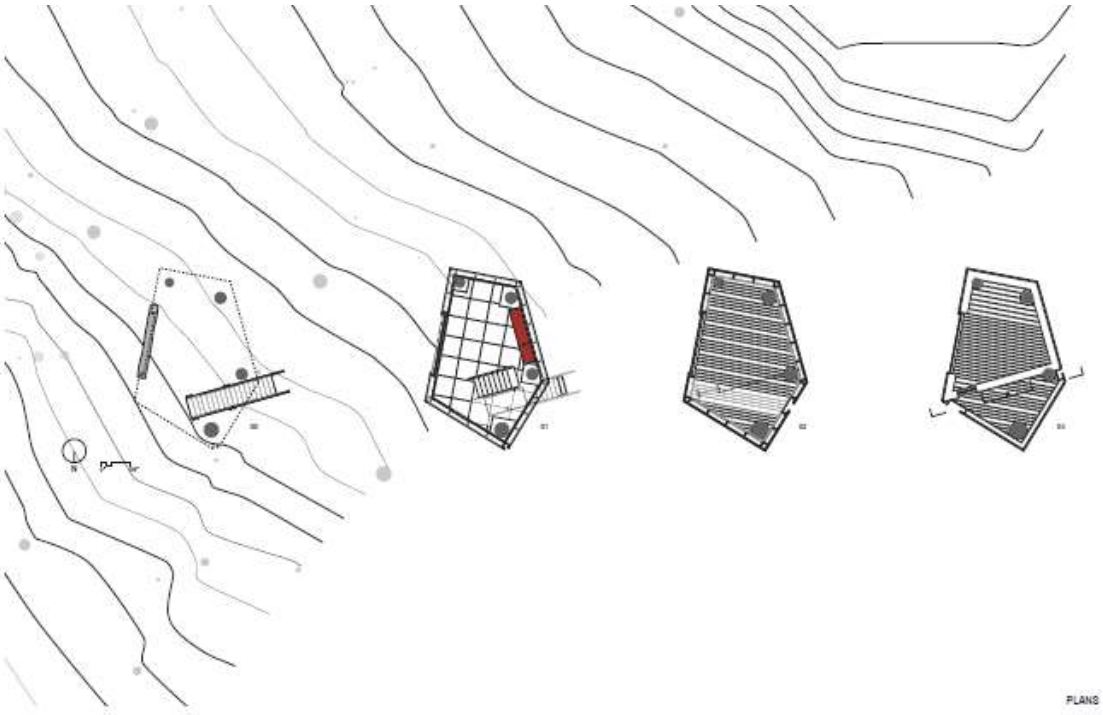


This picture shows different components such as floor plates and main frames for 4Treehouse.



38

The picture shows a layout of 3 storey high tree house. At the top, it is a patio so there is no roof.



4 dots in the picture represent four trees for foundations. 4Treehouse is hanging above ground supported by these trees.