Start Small Initiative.
Exploring Urban Change through Virtual Networks.

Development of an online platform
as a channel for knowledge sharing.

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Abstract

In the majority of third world countries, such as Cape Town, South Africa people are living in harsh climatic conditions. Together with this, most people have limited financial means to build resilient and sustainable homes and as a result South African cities are rapidly developing into dysfunctional entities. Most people build their own domestic structures, commonly known as shacks on the periphery of the cities in order to be close to the central economic hubs of the city. These structures are substandard and don't comply to justifiable living conditions as they deliver a very low level of comfort.

On the contrary, South Africa's internet system is reliable, and most people have access to this service. With our digital-technological way of living; our ideas, expertise and knowledge can be shared much quicker to transform complex issues at hand like these occurring in the built environment. In this way, potential is seen in using the internet as a tool to rethink how people can be empowered who can't afford professional services. This research therefore aims to explore the potential and power of knowledge sharing via an online platform called *Start Small.* to create urban change.

The methodology considers the local weather conditions and delves into a deep evaluation of the thermal performance of local, accessible and affordable materials in and around Cape Town. As a result, data sets and results are freely open to the user on the online platform that suggest construction configurations that drastically increases the percentage of comfort in their homes.

Start Small. aims to holistically educate the self-builder on the potential of materials and how to use them to create the best comfort. Through this tool, the hope is for the urban form and fabric to change through the hands of the people and not only professionals.

Keywords: *shack development, virtual platform, digital education, resilient, sustainable, thermal performance, biscuits*

INTRODUCTION

Cities are reflections of the political, social and climatic programmes in which the exist and part take in. Adding to this idea, cities are expanding unstoppably globally. Zooming into the South African urban context, its cities have been shaped by its former apartheid regimes and presently, the socio-economic patterns of today. People need to be closer to the economic hubs of the cities. As a result people develop slums on the periphery. Moreover, one of the biggest issues at hand is the large discrepancy between rich an poor which is evidently expressed through the built form. With such a layered issue, this research targets only to solve a very small part of the problem; *how to provide better homes for people that build their own homes.*

VISION

The larger vision of this project is equipping and educating people through an online platform. This online tool targets to empower people that can't afford professional services such as architects or engineers in the built environment. The study focuses on informal settlements around the periphery of Cape Town's inner city where people build their homes with very limited resources.

The aim of the study therefore is to suggest solutions that are small and affordable but has a big impact on the level of comfort within their homes. In essence, the project will address two channels, namely educating people and impacting the built landscape in small ways.

CONTEXT AND CLIMATE

Cape Town is located on the southern most tip of Africa. About 30% of the city's population lives in slum areas where the housing is substandard.

As a starting point Cape Town's climate was investigated and evaluated. From the study undergone two main factors were concluded; the big day-night swing (which means there is potential for thermal mass) and there is a high level of radiation From this a deeper understanding of the local climate was established.

Average outdoor temperatures vary from 6 °C-28°C. Cape Town also experiences high level of rainfall and high wind speeds are experienced during the winter months.
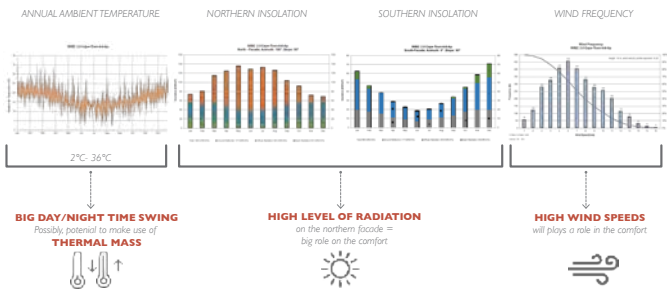
Figure 1: Graphs expressing the climate of Cape Town

APPROACH AND METHODOLOGY

Initially, the project had a very strong vision and goal, but as the research started many ideas were considered and explored. It was clear that the process definitely was not a linear one. The thought processes were sporadic in nature. Eventually three main focus areas were decided on to attain the vision and bigger goal of the project.
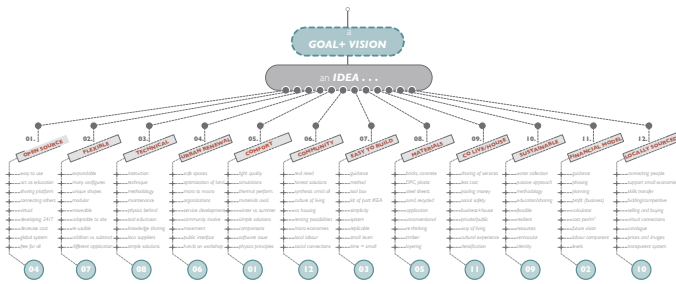

Figure 2: Goal, vision and countless ideas that were explored

The three focus areas which were pin pointed were divided into three parts. It was vital that the solution or product needed to propose something which address the comfort level within homes, that the solutions should be easy to build and thirdly that there should be a financial model linked to the solution.

From this approach the methodology was set out. The methodology was then divided into four main parts and coherently the areas were distilled into sub categories. These categories were; Cape Town climate profile, revisiting of the focus areas, the establishment of unit of comparison, the exploration of variants, an exploration of geometry, the development of the online tool and as a conclusion; the future plans.

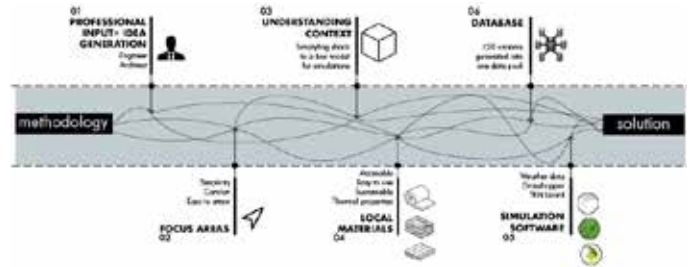*All images used throughout report is attached as appendix*

Figure 3: Methodology, input and tools that helped achieve the solution.

COMPARISON BENCHMARKS

As a way of comparing the research and simulation results four comparison indicators were used to compare and evaluate all findings through the whole study. The four comparison indicators were; percentage of time, PMV (Predicted Mean Vote), the level of practicality (how easy it is to build and work with the materials) and a financial measure which is directly linked to the respective materials.
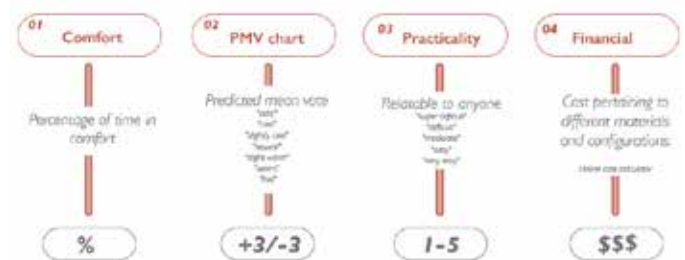

Figure 4: The four comparison indicators

MATERIAL EXPLORATION AND SETTING UP OF THE BASE CASE

Following the set out methodology, the next step was to understand what materials are locally available and what their performance abilities are. This was a vital exploration as it reminded us that the materials need to be affordable and be available easily to anyone.

A material matrix was set up and from this relevant, contextual materials were identified to be used in the simulation studies. The matrix compares the materials properties (U-value, K-value, heat capacity etc.). A continuation of the matrix the materials were even further explored in terms of their: attainability, costs, time to build/work with the material, structural performance, thermal mass and insulating properties.
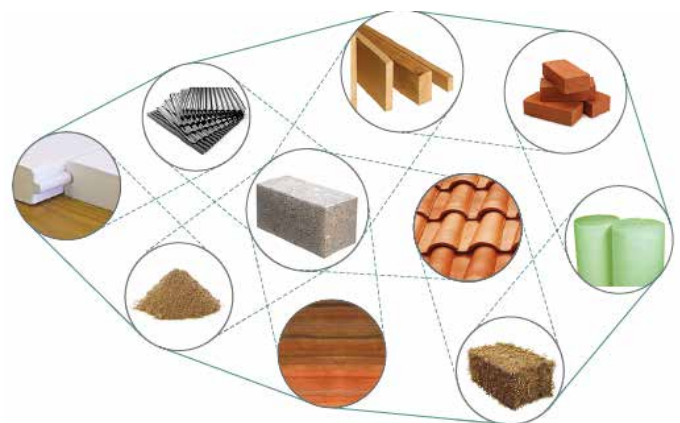

Figure 5: Material exploration and identification

Apart from the material matrix investigation, a Base-Case model was established that would be used for all simulations and studies. Due to the complex nature of the informal settlements in which the shacks occur it was decided to do all simulation studies on a box model which is based on a typical size and shape of the shacks found in the slum areas. In the figure below you can see the basic shack model.
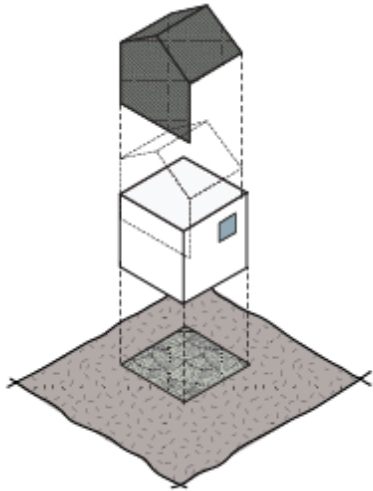

Figure 6: Base Case model

SOFTWARE USED FOR RESEARCH

Rhino was used to set up the geometry of the base case, followed by TRNLizard which is a free plug-in for Grasshopper for parametric 3D building simulation developed by Transsolar. All weather analysis was carried out by the Transsolar in-house FET weather tool.

Figure 7: Grasshopper, TRNLizard and FET weather tool

SETTING UP AN ARRAY OF VARIANTS

The next step in the process was looking at the different comfort levels that are derived by using different materials for different parts of the building. In essence, the idea was to set up different configurations for each: floor, wall, ceiling, roof and window. These different configurations would then be simulated on the set up Base-Case model. 7776 simulations would need to be run. This, however, was to many simulations to develop the power of the tool. A process of reconsideration and simplification was undergone.

The simulation needed take into account other factors such as: WWR (window to wall ratio), orientation of window and glazing type. It became evident that these factors play a big role in the level of comfort within the houses.
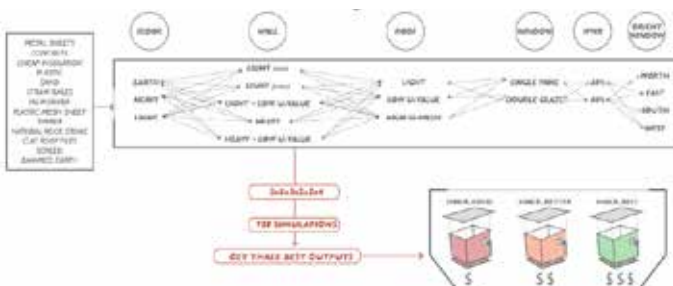

Figure 8: Different configuration for each building part
All images used throughout report is attached as appendix

The configuration for each building part (floor, wall, roof) was simplified to being a either 3-5 characteristics seen in the table on the left. Additionally factors such as the window type, WWR and orientation of window was incorporated into the list of variants. This drastically decreased the number of simulations. From these simulations three cases were picked and classified according to their performance, cost to build.
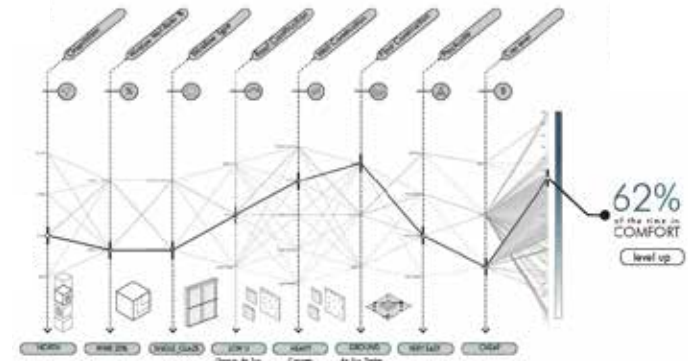
FIRST RESULTS: 3 PRESCRIBED OPTIONS.

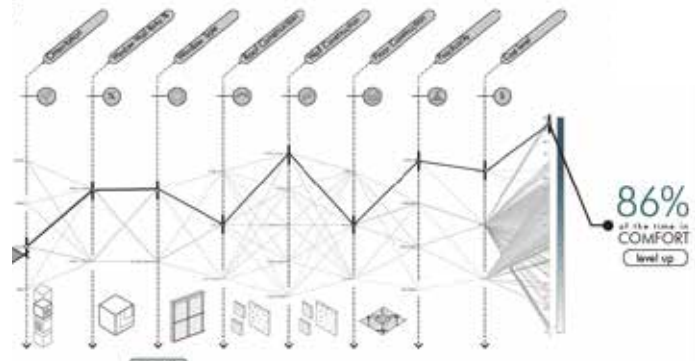This is the results of the base case, cheapest, mid range and most expensive solution.

BASE CASE RESULTS
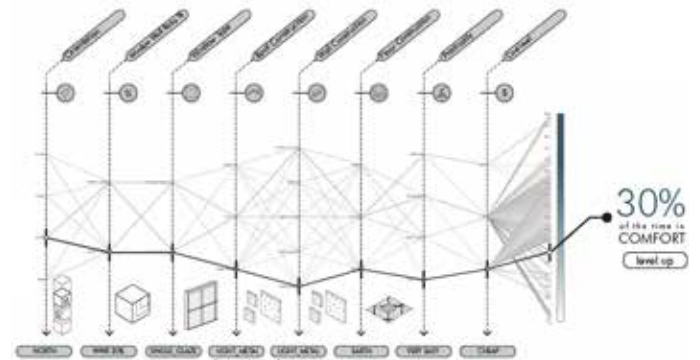
CHEAPEST OPTION

MID RANGE OPTION
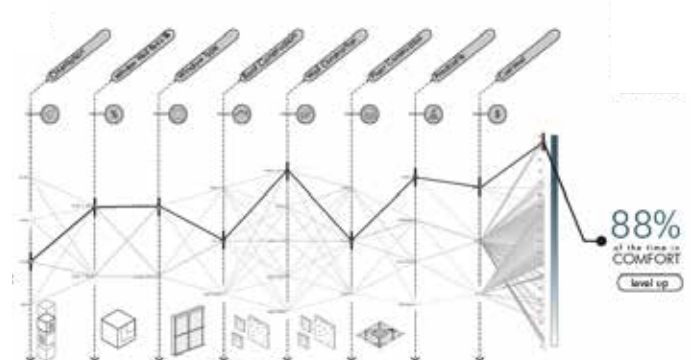

MOST EXPENSIVE OPTION

Figure 9: Three solutions

3

STRIVING FOR A DYNAMIC SOLUTION

Apart from giving the user the freedom to choose from the three set-up, prescribed solutions, the solution still lacked dynamism. In contexts such as slum areas each building case is so extremely different. Socially, financially, topographical and skills are so different in every scenario.

Retracing to the initial vision (*empowering the self build independently from the professional*) it was decided to explore the possibility of making the solution more dynamic. That meant that the solution would need to allow the user to be able to decide how he would build each part of the building (floor, wall, roof, window etc) based on the users situation in terms of materials, context and skills. Each user would have different needs and expectation.
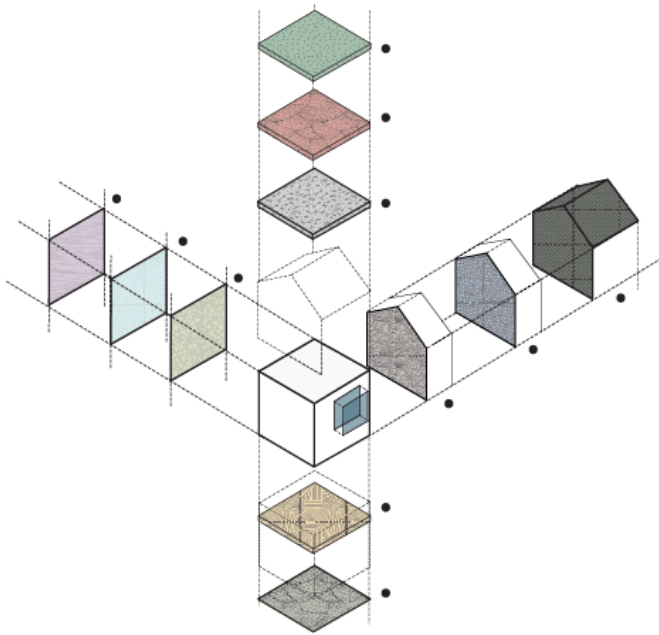
Figure 10: Exploded axo expressing multi layers in a building.

DEVELOPMENT OF A DATABASE

Apart from the three prescribed solutions, all the simulation results were saved in a form of a database. This database was expressed as a *parallel coordinated graph* seen below.

This graph allows the user a much more dynamic-interactive experience. By this Start Small. gives the user the opportunity to enter his or her own puts as needed by the site or by what materials are accessible at the given time and context. In this way the tool also becomes more educating and intuitive. The user now has the power to determine the level of comfort in his or her own home.

Figure 11: Parallel coordinated graph supported by the database

All images used throughout report is attached as appendix

PASSIVE STRATEGIES

Even though Start Small. was designed to be as dynamic as possible in the short time that it was developed, it still seemed promising to explore suggestive passive strategies to the users.

Hence, a last source of knowledge; climate-applicable low cost passive strategies are introduced and explained. Through simple, diagrammatic sketches the user is able to understand how the concept works and how to apply it their homes.
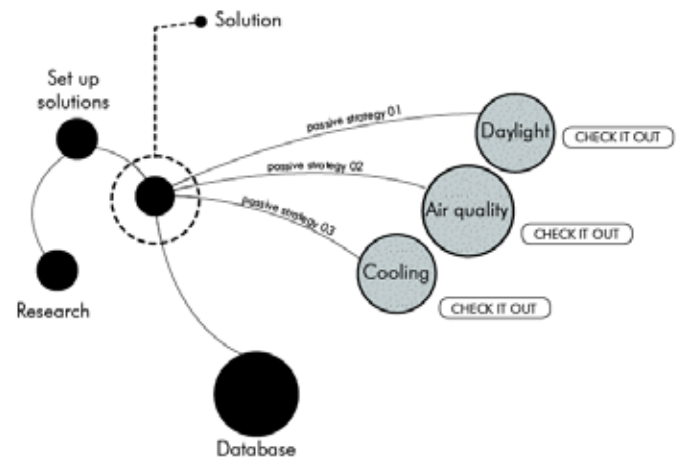

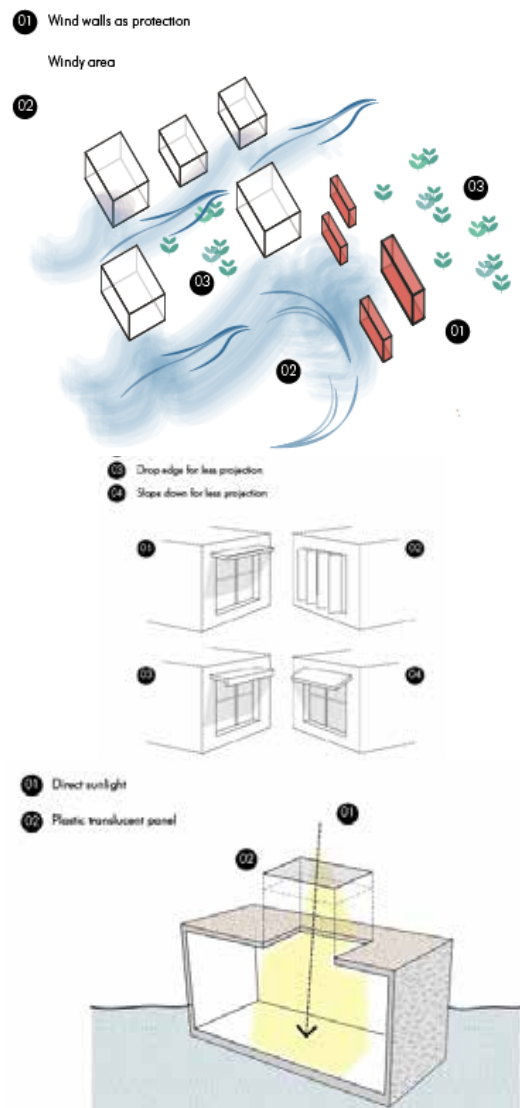*Figure 12: The addition of the passive strategies to the solution.*

Figure 13: Adding a translucent roof sheeting to increase light quality

ENCOURAGEMENT OF A SOCIAL NETWORK

Apart from the improved comfort levels within the homes of the user, Start Small. to deliver a network that even further supports the user in creating a better home.

In todays fast paced world, we are experiencing rapid globalization which means that many smaller economies are dominated by bigger fish. Often, this means that these smaller, more vulnerable economies collapse. Through the Start Small. I initiative a network of local enterprise are connected. This network is divided into 5 main categories. Namely; architects, non-profit organizations, workshops, selling of second hand or new building materials and building teams

The goal is to stimulate and strengthen the local economy. Through putting people in touch and encouraging connection the urban form can be developed by the local user and not bigger capitalist.
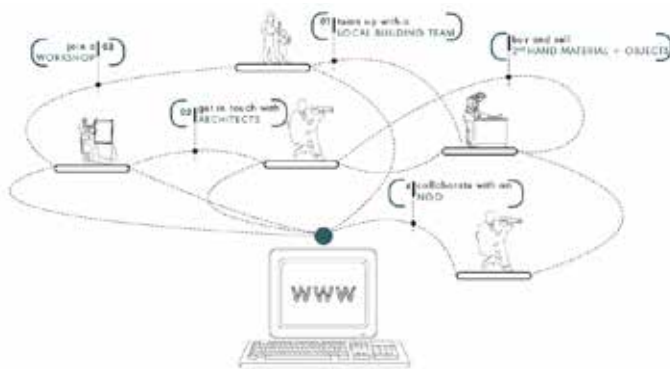
Figure 14: The social network that the user could use

NEXT STEPS

Moving forward from the online platform that was developed, the next steps would be to materialize the tool through actually redeveloping a real shack with someone from a slum area in Cape Town.

Moreover, building on the social network would be a vital step in making the project a sustainable, economic one. I also believe that there is space to expand and develop the database to something which could be more dynamic and locally linked to materials with their corresponding costs. This exploration has set up a framework which could possibly be developed into something more complex that houses more intricate models and scenarios.
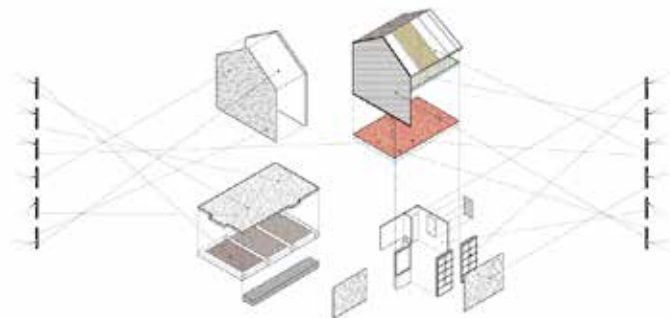

Figure 15: The abstraction of a house as a kit of parts

CONCLUSION

This project has proved to me that South Africa's slum situation is much deeper than merely at a building level. Nevertheless, I believe there is great power in having small, powerful ideas that lead to bigger impact in the long run. My hope is for the project to grow virtually, but more importantly to have a impact in the built environment.

Reflecting back on the research and process that was undergone, I am excited to see what the future-potential is when software developers, engineers like Vu Hoang (my mentor) and creatives join up to design *something* that benefits people that don't have access to our fields or the possibility of an education.

I believe that through explorations such as these we always get a deeper understanding of our own contexts and how much deeper the issues at hand really are.

Remember, you have to risk it to get the biscuit...

IMAGES USED IN THE REPORT

ANNUAL AMBIENT TEMPERATURE   NORTHERN INSOLATION   SOUTHERN INSOLATION   WIND FREQUENCY

2°C- 36°C

BIG DAY/NIGHT TIME SWING
Possibly, potenial to make use of
THERMAL MASS

HIGH LEVEL OF RADIATION
on the northern facade =
big role on the comfort

HIGH WIND SPEEDS
will plays a role in the comfort

Figure1: Graphs expressing the climate of Cape Town

01
PROFESSIONAL INPUT+ IDEA GENERATION
Engineer
Architect

03
UNDERSTANDING CONTEXT
Simplyfing shack to a box model for simulations

06
DATABASE
720 variants generated into one data pool

methodology   solution

Simplicity
Comfort
Easy to attain
FOCUS AREAS
02

Attainable
Easy to use
Sustainable
Thermal properties
LOCAL MATERIALS
04

Weather data
Grasshopper
TRN Lizard
SIMULATION SOFTWARE
05

Figure 2: Methodology, input and tools that helped achieve the solution.

01 Comfort
Percentage of time in comfort
%

02 PMV chart
Predicted mean vote
"cold"
"cool"
"slightly cool"
"neutral"
"slight warm"
"warm"
"hot"
+3/-3

03 Practicality
Relatable to anyone
"super difficult"
"difficult"
"moderate"
"easy"
"very easy"
1-5

04 Financial
Cost pertaining to different materials and configurations:
Online cost calculator
$$$
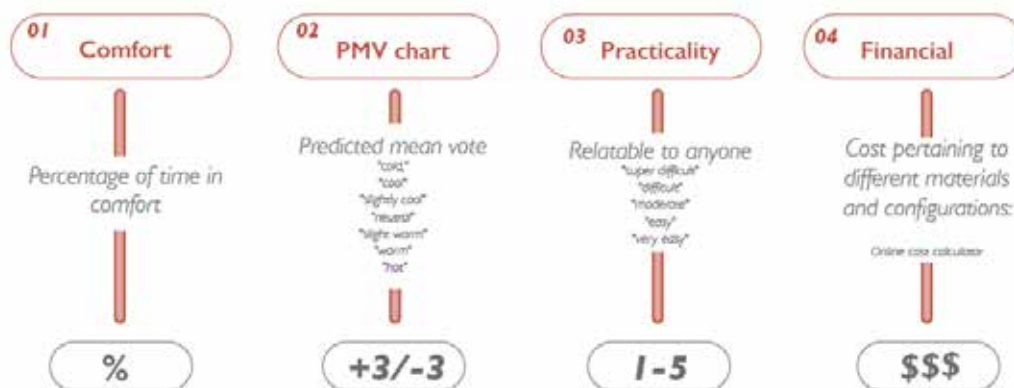
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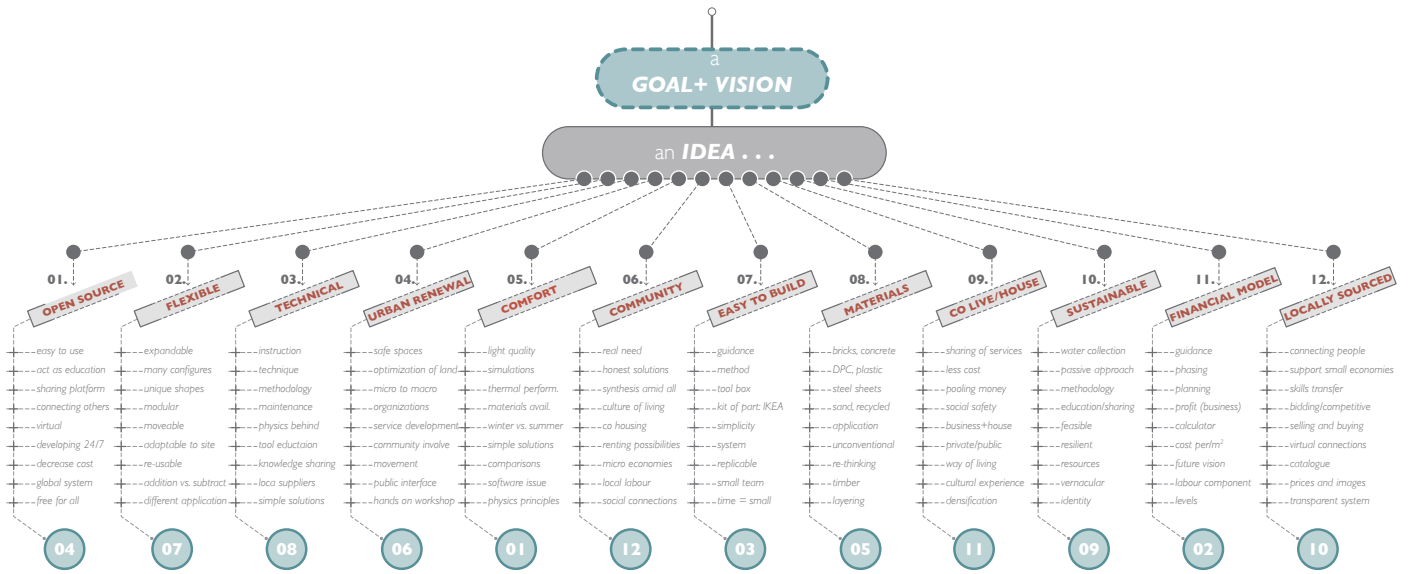
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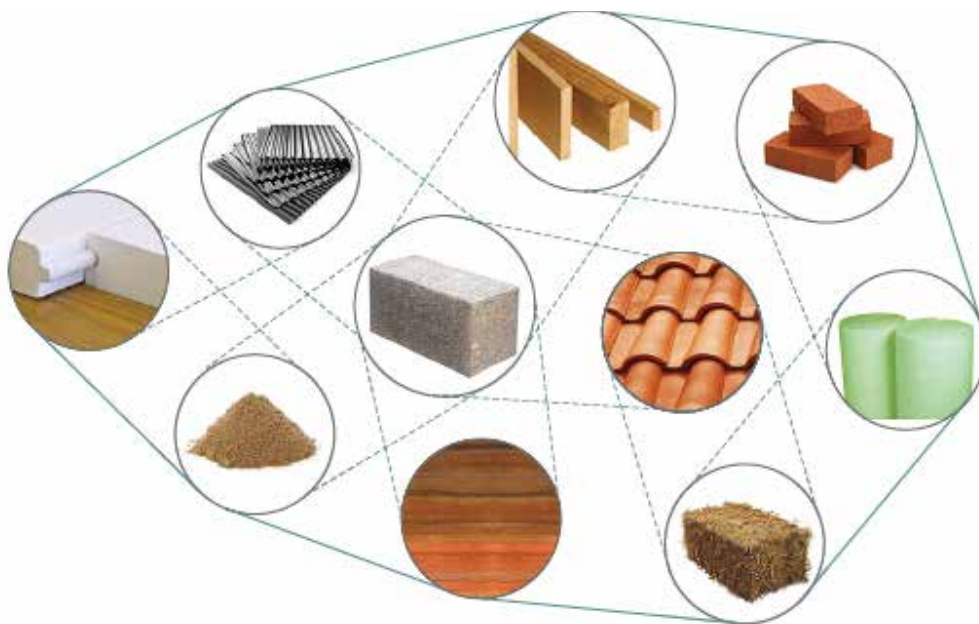
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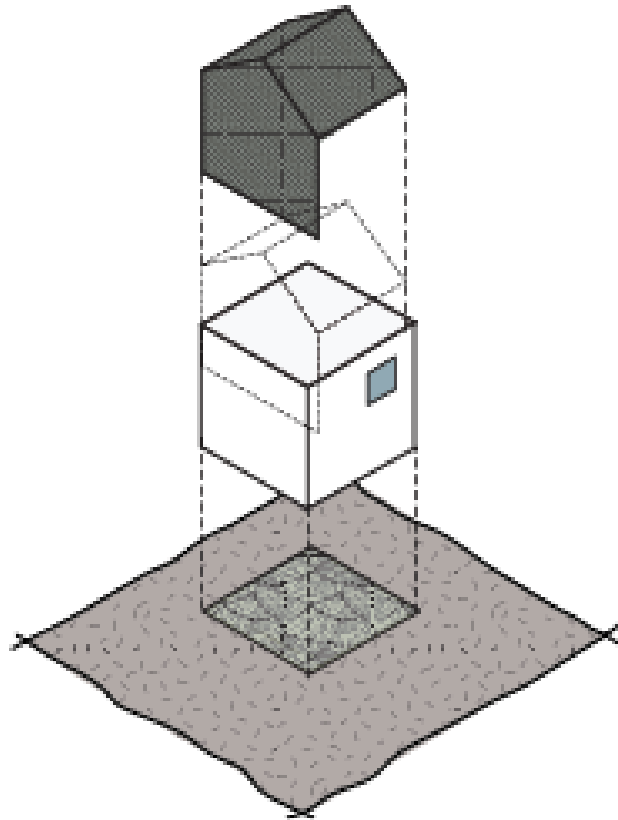
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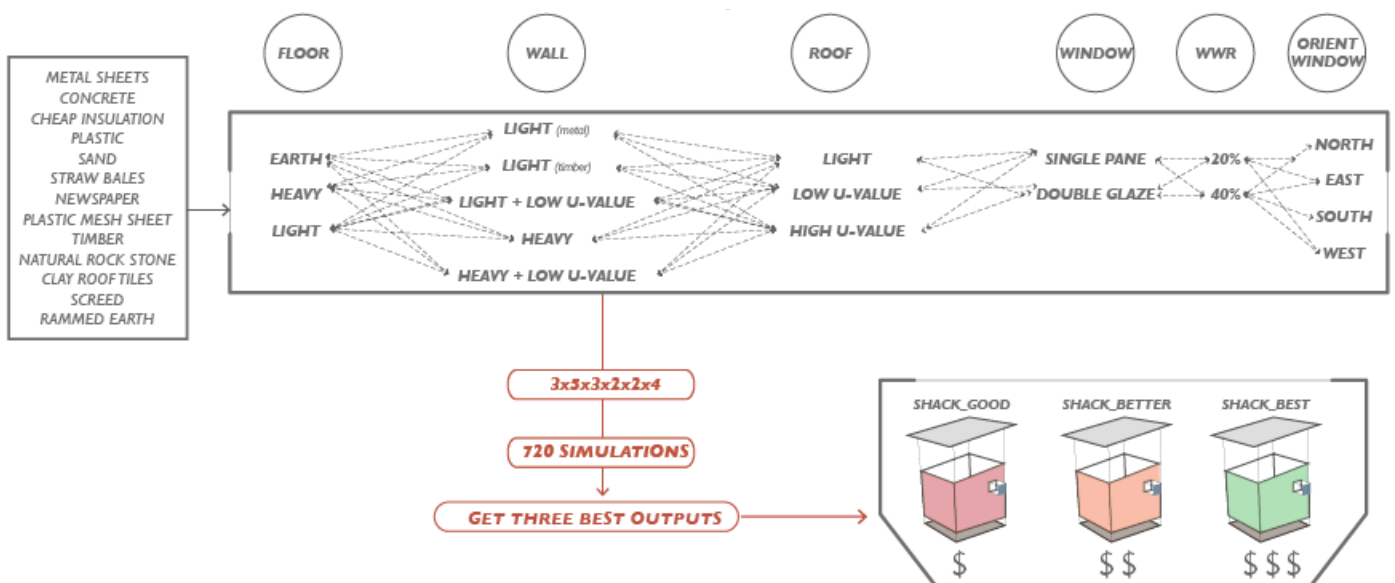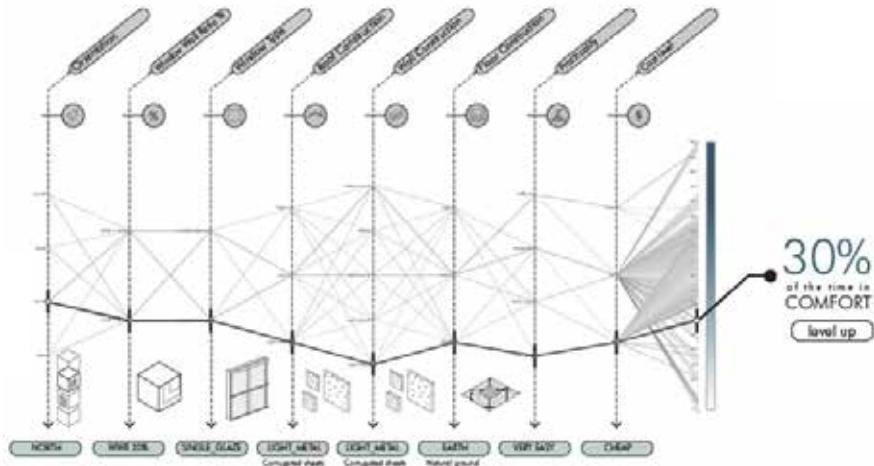

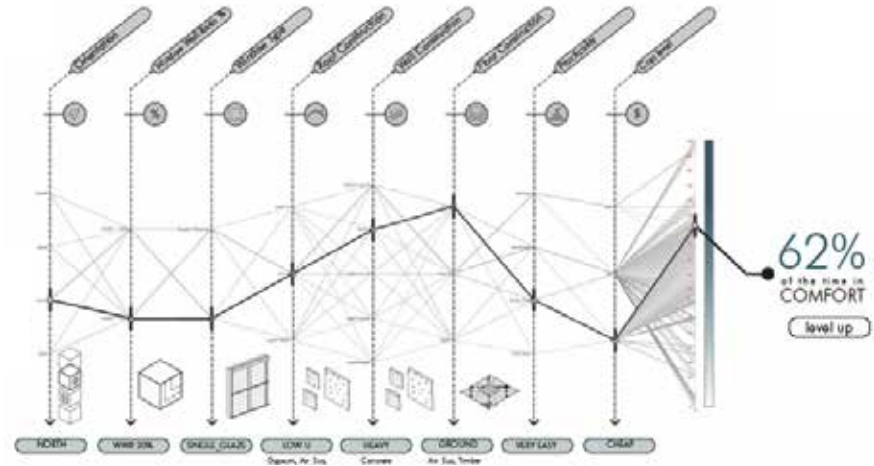*Figure 7: Grasshopper, TRNLizard and FET weather tool*

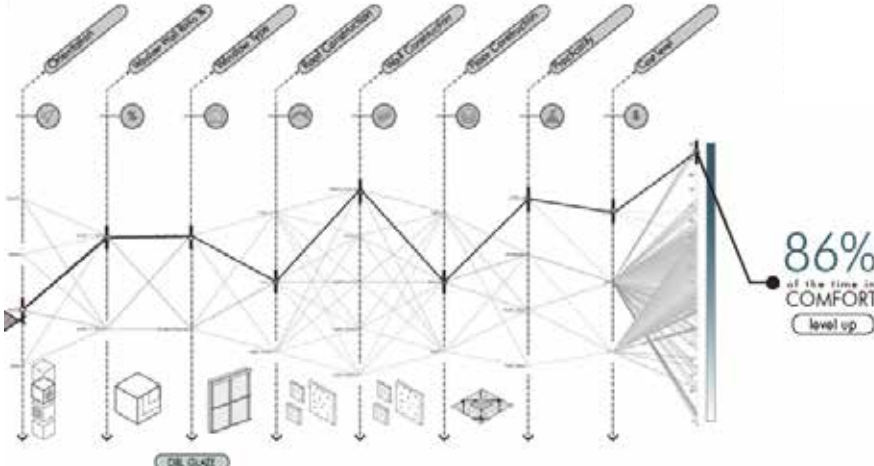*Figure 8: Different configuration for each building part*

BASE CASE RESULTS

CHEAPEST OPTION
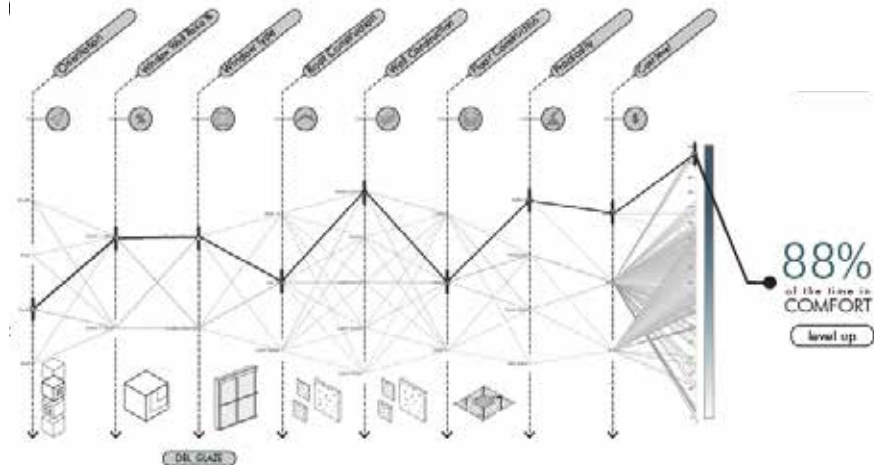

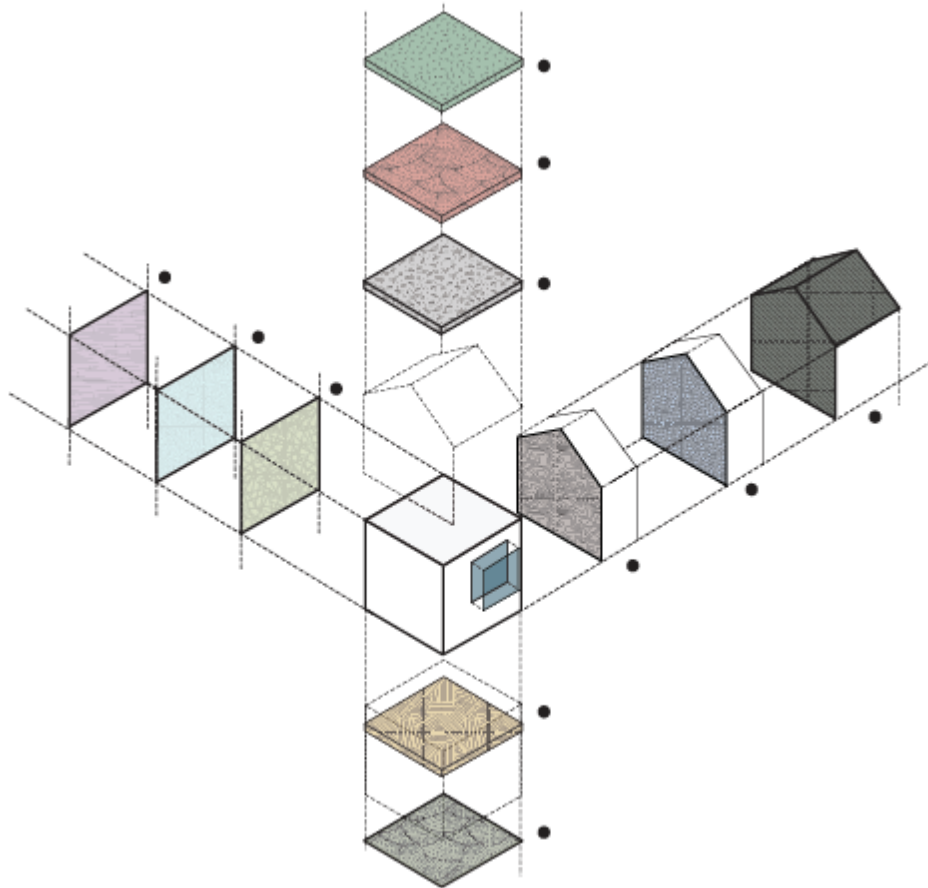**MID RANGE OPTION**

MOST EXPENSIVE OPTION

Figure 9: Three solutions
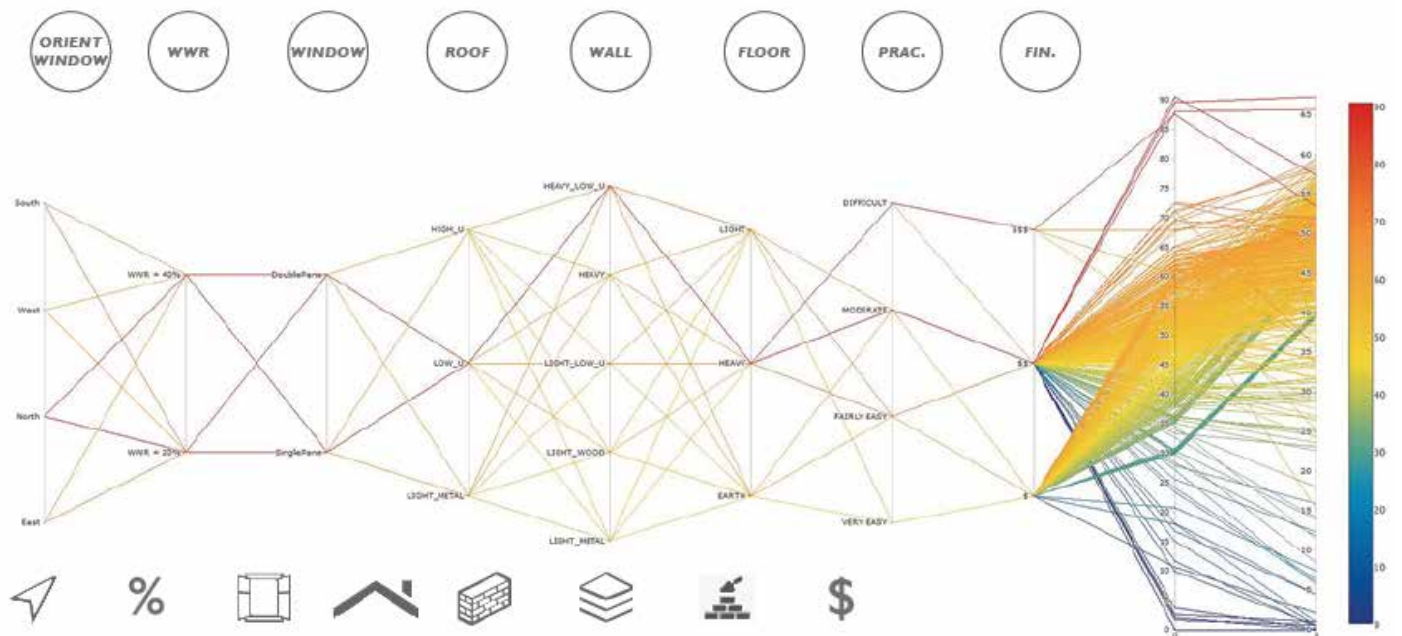
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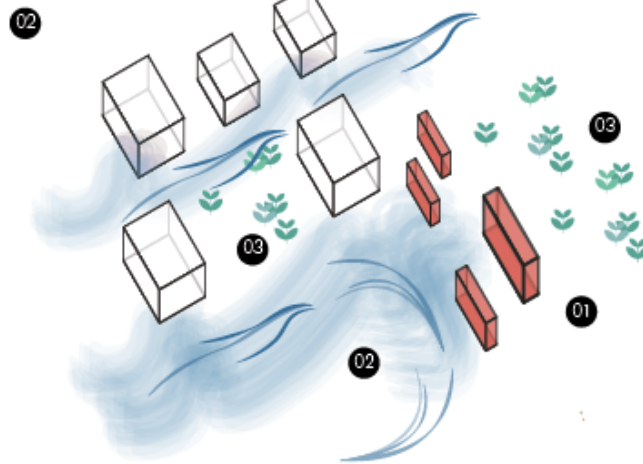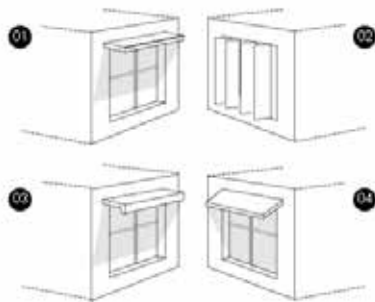*Figure 11:* Parallel coordinated graph supported by the database
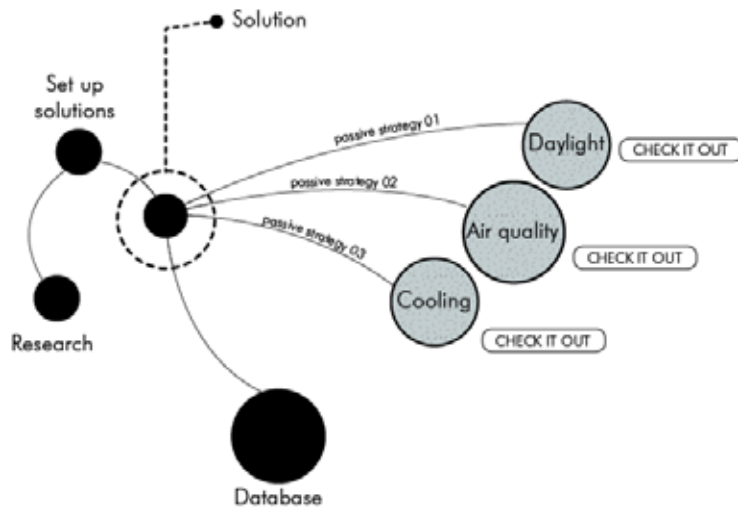
Figure12: The addition of the passive strategies to the solution.

01 Wind walls as protection

Windy area

03 Drop edge for less projection
04 Slope down for less projection

01 Direct sunlight
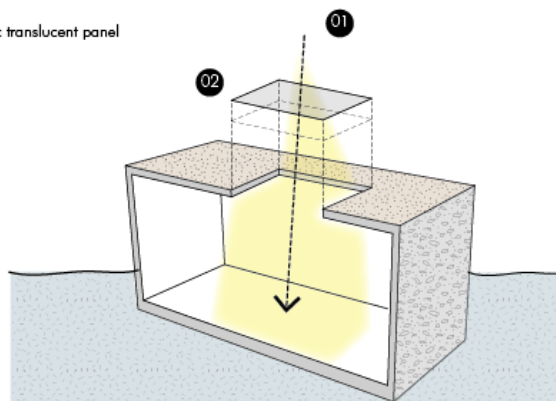
02 Plastic translucent panel

Figure 13: Adding a translucent roof sheeting to increase light quality
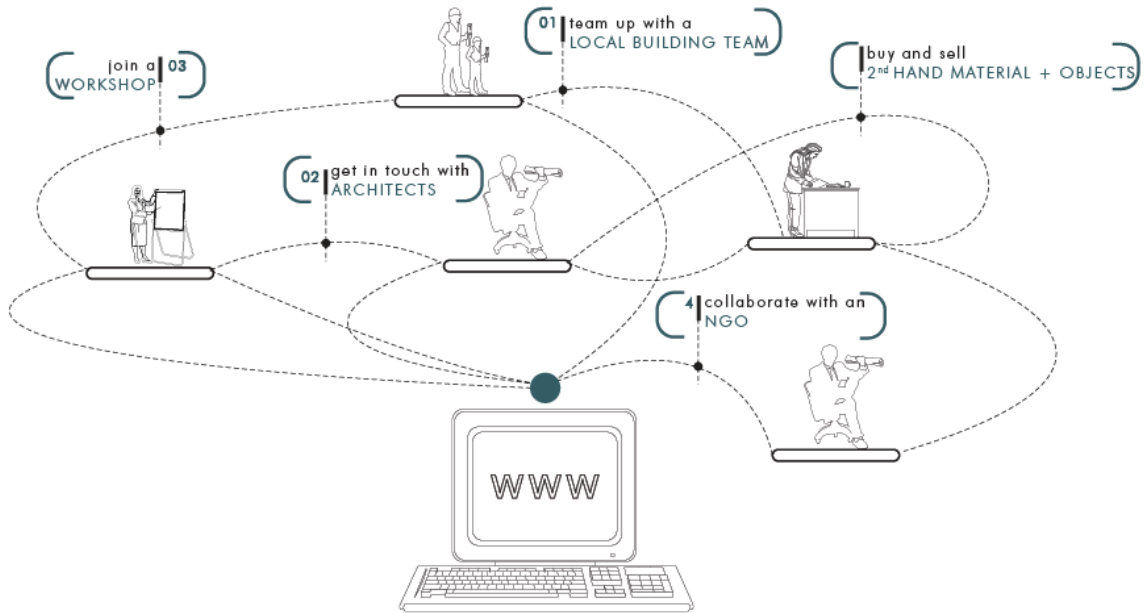
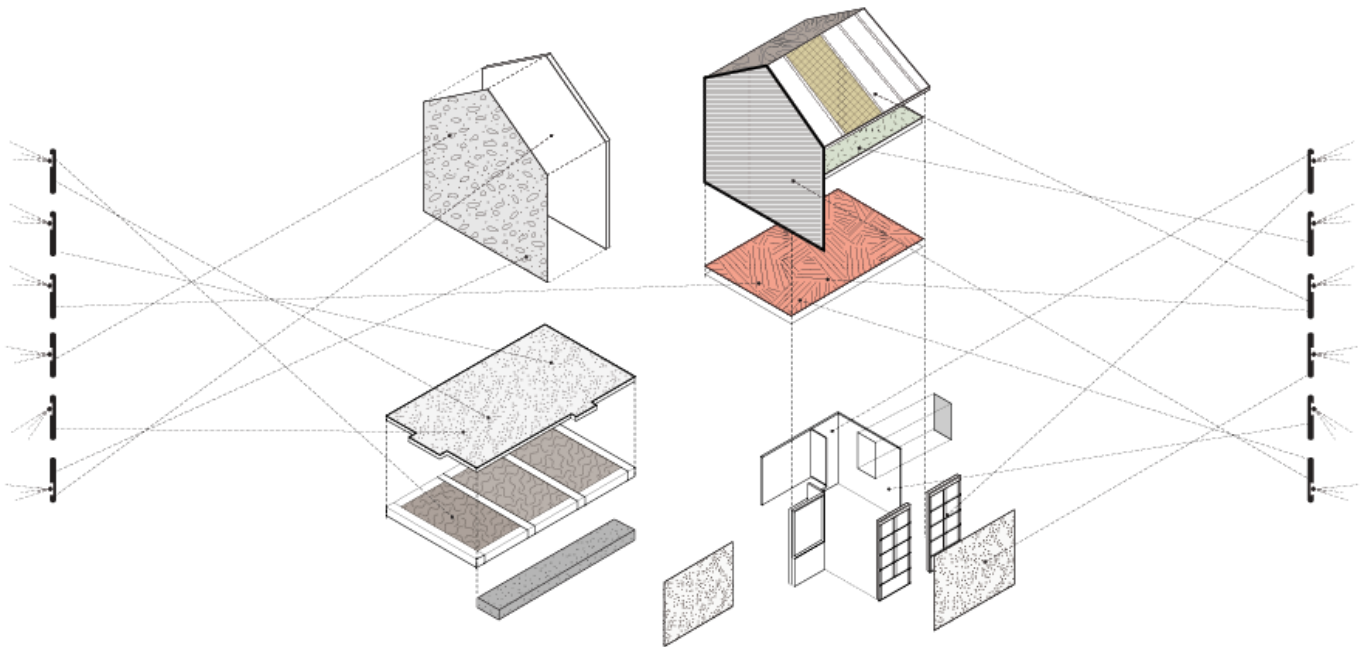*Figure 14: The social network that the user could use*

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