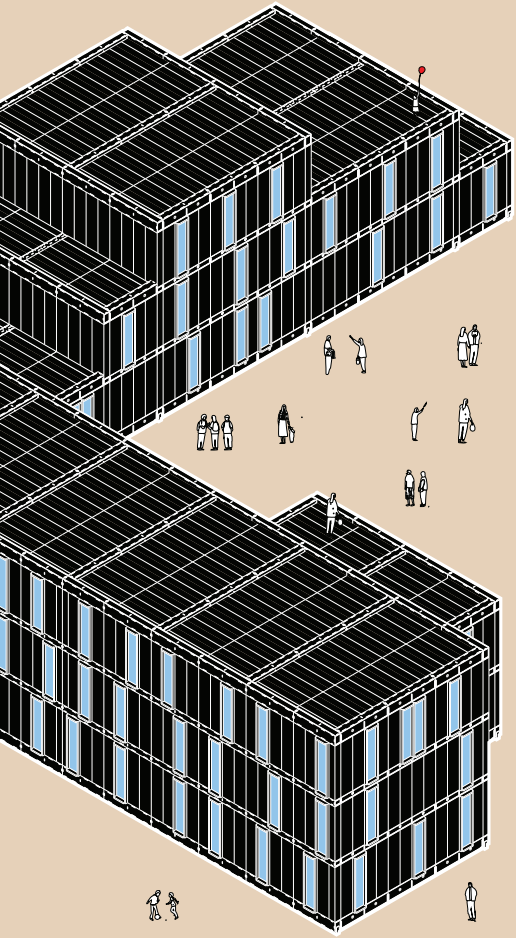


DAMIANO MAURIZI

RELEASING ARCHITECTURE

TOOLING COMMUNITIES WITH
OPEN-SOURCE ARCHITECTURE

//CONTENTS

“ WHAT DETERMINES THE PERMANENCE OF A BUILDING IS NOT THE WEALTH OF THE DEVELOPER OR THE MATERIALS THAT ARE USED, BUT THE SIMPLE QUESTION OF WHETHER OR NOT THE RESULTING STRUCTURE IS SUPPORTED BY THE PEOPLE “

SHIGERU BAN

Today only the 2% of the world population live and benefit from buildings designed by architects.
The present Master Thesis work focuses on a specific building system towards a more democratic building production. The aim is to be a starting point in providing the tools to the remaining 98% of the population.
The work does not focus on exploring architectural qualities, however, once the system is explored, improved and utilised these qualities will not fail to be recognised.

//INTODUCTION

Knowledge is spreading through the web in countless fields nowadays. Open-source platforms transform this knowledge into practice creating an enormous power in sharing production. Factories today are no longer in one place, they are everywhere, bringing benefits to communities and the environment. How does this idea apply to architecture? "Printing" your house.

The thesis work started analysing the WikiHouse system: a completely free open-source system that allows anyone to go online download an house model and print it where needed.

Such system, a part from using an extensive quantity of material and time in the production process, has two main limitations: it is not a ready to use product and it is not adaptable for medium scale developments. This means that for non-professionals individuals the whole system is complex to understand properly and needs to be re-adapted for every project. The aim of the thesis is therefore to design a different and more design-friendly open-source construction system.

The result is an easy and ready to use building system that consumes 30% less material while reducing the production time by 80%. It is not based on the whole structure as single element but rather based on single product-like components which assembled together create bigger structures.

The system uses the Wikihouse open-source platform so now all the infos and files are under the "featured projects" folder. Being it open source, this is just the beginning. It waits to be improved from the thousands of professionals and enthusiasts. Which, one of them, might be you.

//OPEN-SOURCE AND DIGITAL REVOLUTION

Two main factors are shaping a new revolution in production and knowledge. These factors are the catalyst for a new approach towards architecture. An architecture that is not made anymore just by the few, but by everyone for everyone.

The main factors are:

*The **Digital Revolution** gives the possibility to own and use the tools for production*

***Open-Source** Communities spread knowledge while being open for improvements and adaptations*

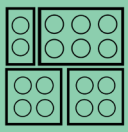
The digital revolution brings machineries anywhere, lowering the cost of production. The open-source platform provides the knowledge and the software to be freely shared.

Many things can be ***manufactured locally*** *by anyone*

Open-source platforms allows ***free spread of knowledge***

The main and most important shift is the consumer that now becomes the creator owning the whole process: from design to production. This puts the people in complete control not being anymore in the hands of big developers, corporations and industries.

*The **means of production** and the know-how are in the hands of everyone transforming consumers into creators*



Open-source building system

//CONTEXT AND PRECEDENTS

The initial aim of the thesis was to showcase the capabilities, while discovering architectural qualities, of the already existing systems such as WikiHouse and Facit Home. In the process of discovering and testing these systems many "weak" points came across. The research then radically changed the aim of the thesis: attempting to improve and discover new possibilities, instead of focusing on the existing system. The new system designed departures and take inspiration from the great work already made on the subject.

The already existing building systems:

WikiHouse is an open-source building system. Many designers, collaborating to make it simple for everyone to design, print and assemble low-energy homes, customised to their needs.

FACIT HOMES

Facit Homes is a company that uses CNC to simplify the construction and design process. Their houses are designed for assembly, with much of the process taking place on-site.


FACIT HOMES

PROS	*CONS*
Open-Source Platform	*Limited system*
Design Principles	*Material Usage*
Passionate R&D community of 1000s designers	*System Accessibility*
Joints design	*Medium Scale Adaptability*

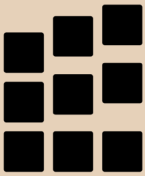
Points of departure

Open-Source platform and DIY approach +
Design Principles and typology of connections

FACIT HOMES

PROS	*CONS*
Wall Panel System	*Private System*
On Site Construction	*Use of other materials other than plywood*
Medium Scale Adaptability	*Metal parts and connections*

Points of departure

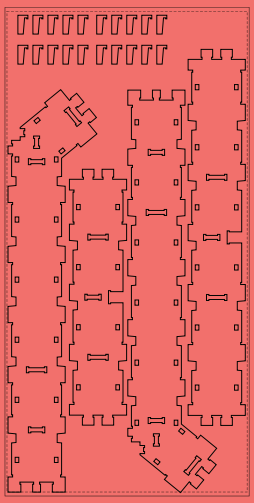


Wall system typology + Medium scale adaptability

//WIKIHOUSE LIMITATIONS

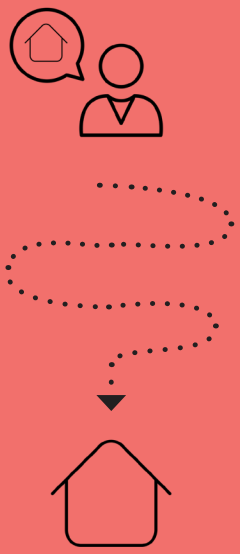
The work proceeded in looking carefully into these systems. Facit home is a closed, private and protected building system. The actual data and details are not available.
Identifying the main limitation of the Wikihouse system was the starting point of the actual design principles. Identifying and framing these limitations made the points to act upon very clear.

***Material usage** and fabrication time*



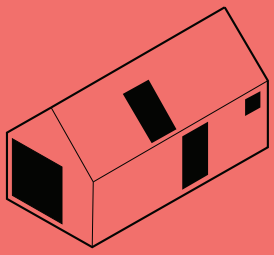
***4/5 plywood sheets** per square meter*
***30 minutes** average cutting time per sheet.*
*The design of each element is designed to **not exceed the cutting area**, it is not designed to optimize cutting surface area. Most of the elements are small and have an **articulated profile**, this increase plywood usage and cutting time.*

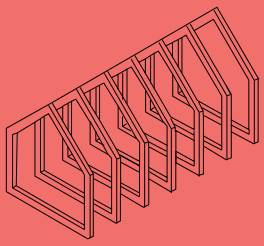
System Accessibility



*Wikihouse is **not a ready to use product**. For planning it has the **same process** and professionals have to be involved.*
*Wikihouse provides just a **12 sqm studio** as a ready to build product. Common people are not very interested in using such a system. For non-in-the-field people the whole system is not very easy to understand.*

Medium scale *adaptability*



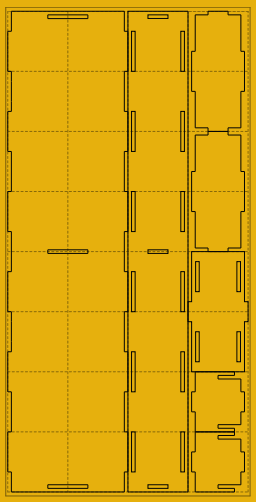


The frame are repeated every 1.2 meters, this leaves a ***1.050 meters opening*** *which is not enough for passage in housing standards. The structure can only* ***grow along one direction****.*

//DESIGN PRINCIPLES

The design phase started solving the limitations. These being the starting points set the framework of the whole design.

***Material usage** and fabrication time*



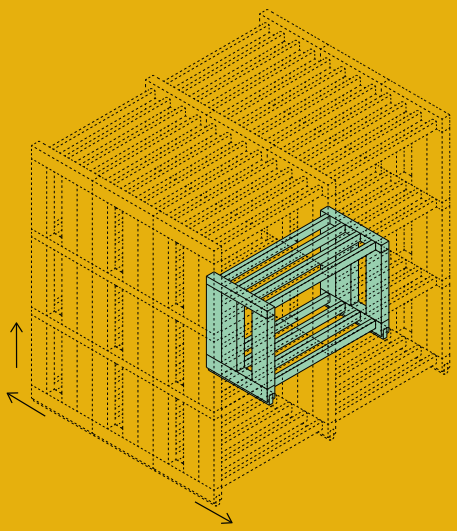
*To reduce plywood usage the design of each piece in each component is designed according to the **maximum cutting surface area**. This means that the different parts can easily fill a sheet. It is all based by dividing the panel in smaller **proportional modules** from 15x15 cm to 60x240 cm.*
*To reduce cutting time the pieces have **simple and straight lines**.*

Results:
***3.5 plywood sheets** per square meter*
***6 minutes** average cutting time per sheet*

System Accessibility

*The system offers a **ready to use building system**, not based on the whole construction as an element but rather **based on single components**.*
This provide an easy to use and safe system that works directly and the people still have the freedom to choose.
*At the same time the system is **open source** allowing anyone to make changes, **improve** it and **adapt** it to special needs.*

Medium scale *adaptability*

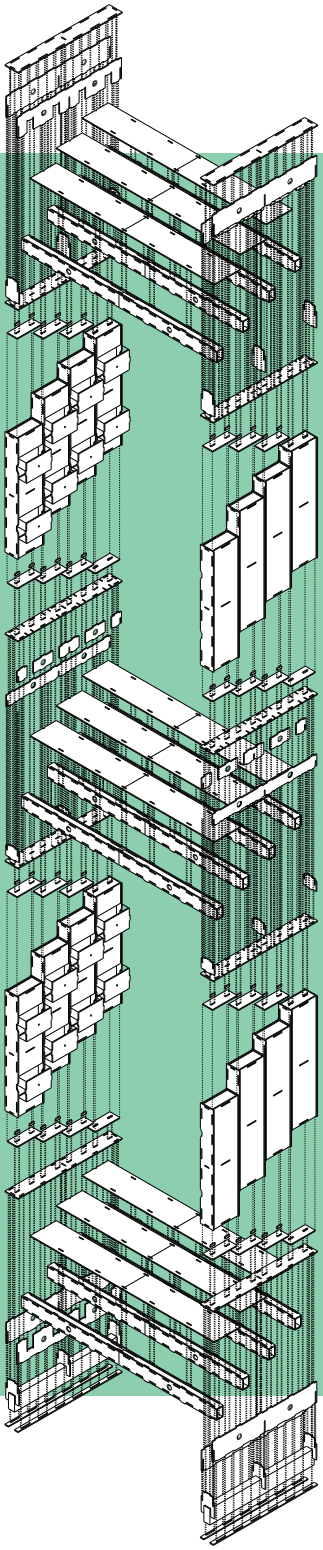


The system offers a ***span*** *of* ***4.2 m*** *(multiple storey) and* ***6.6 m*** *(single storey). The structure can expand in both direction leaving a 1.2 meters passage for internal movements.*

Results:

The system can be ***expanded*** *in width and length. The* ***4.2 m span*** *allows to have space for internal connections.*

//THE SYSTEM



The design of the actual system is the main part of the work undertaken. The system was design taking into consideration the final user. From there every detail and connection was carefully design in order to make the construction process as easy as possible keeping in mind the handling and the weight of each piece or component.

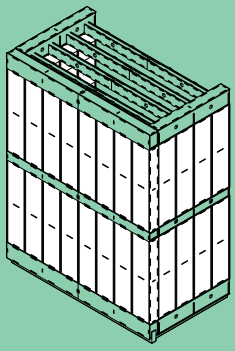
The process went back and forth between digital and physical models working in 1:6 scale using the laser cutter on 3mm plywood sheets. In real scale all the parts are supposed to be cut using a CNC milling machine on 18mm plywood or OSB sheets.
The sheet is 2400mmx1200mm therefore every piece does not exceed these dimensions.

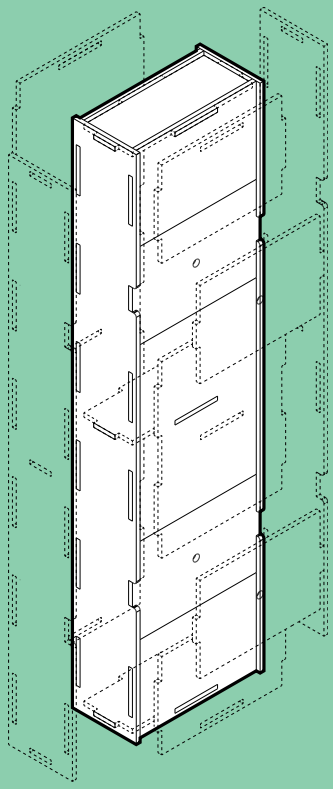
The system is arranged using different components that assembled together can create structures adaptable to the users needs. The components are divided in seven different classes or typology. Each of the class represents a specific use such us walls, beams etc. They own their specific use and characteristics while being part of a whole structure system.
Apart from the components a main design challenge was to create the actual connection between them.

The final user would use the system just like Lego bricks, arranging them to create the structure. One of the next step, to make the system even more user friendly, will be to create a plug-in for Sketchup that arranges the components automatically according to the specifications given from the user.

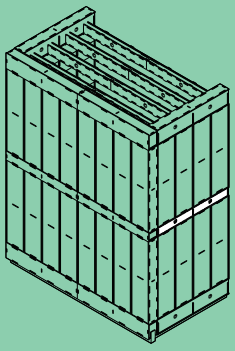
In the following pages each component is shown in detail.

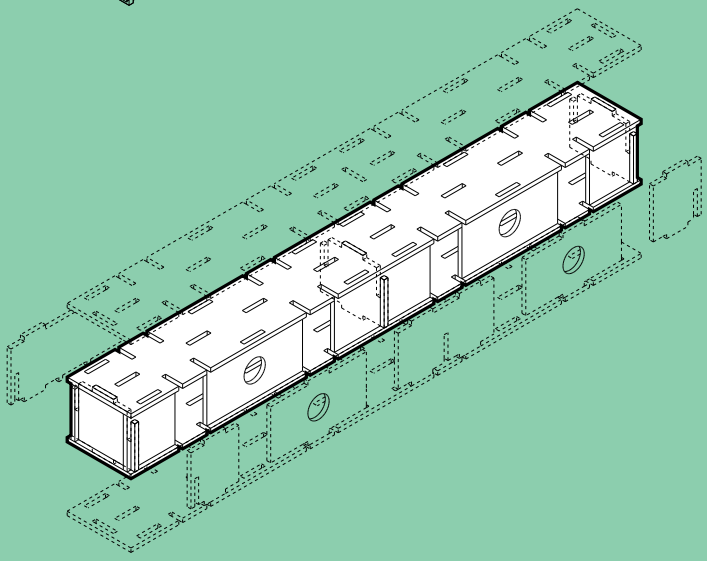
CLASS A ≈ 1.7 sheets
30x60x240cm



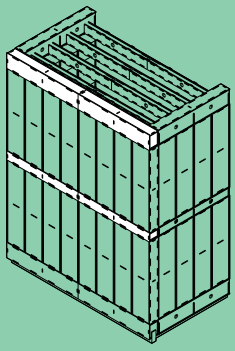


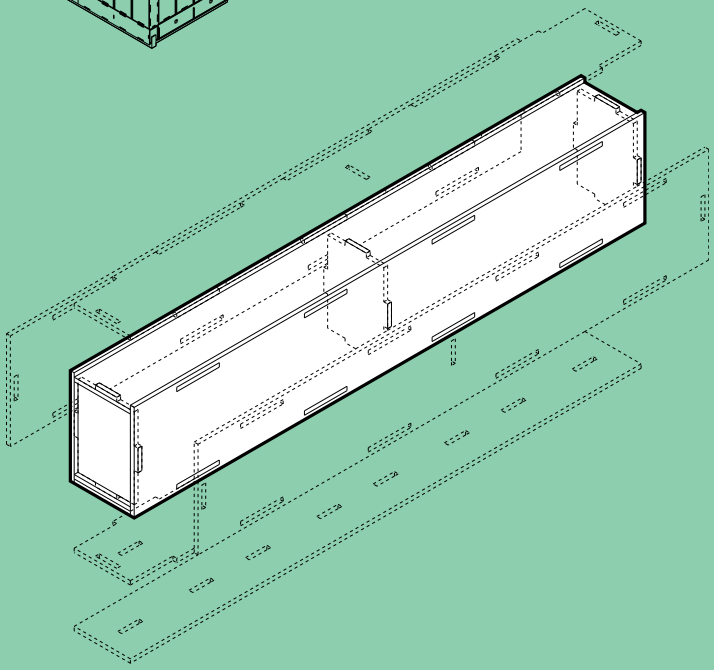
CLASS B ≈ 1 sheet
27x30x240cm



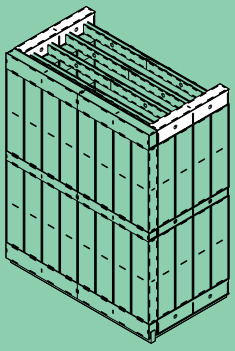


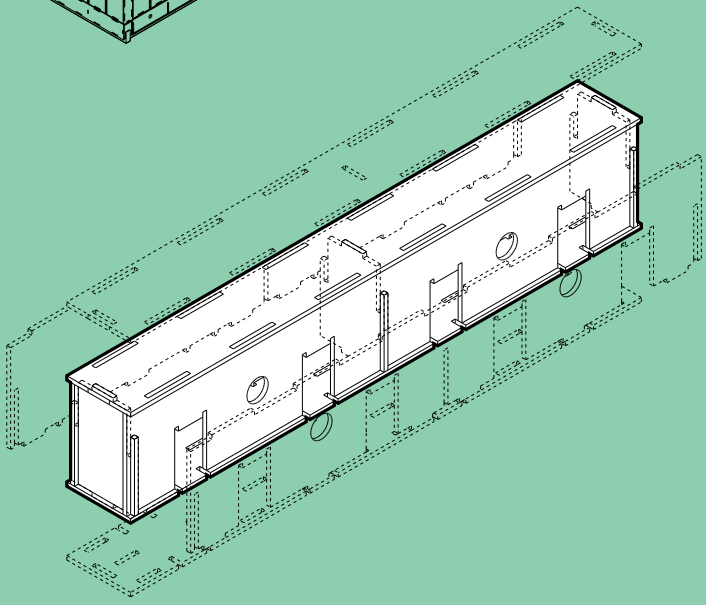
CLASS C ≈ 1.2 sheets
45x30x240cm



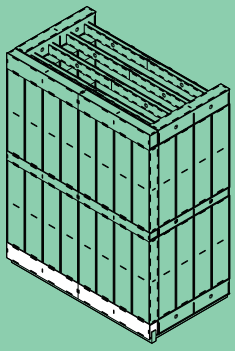


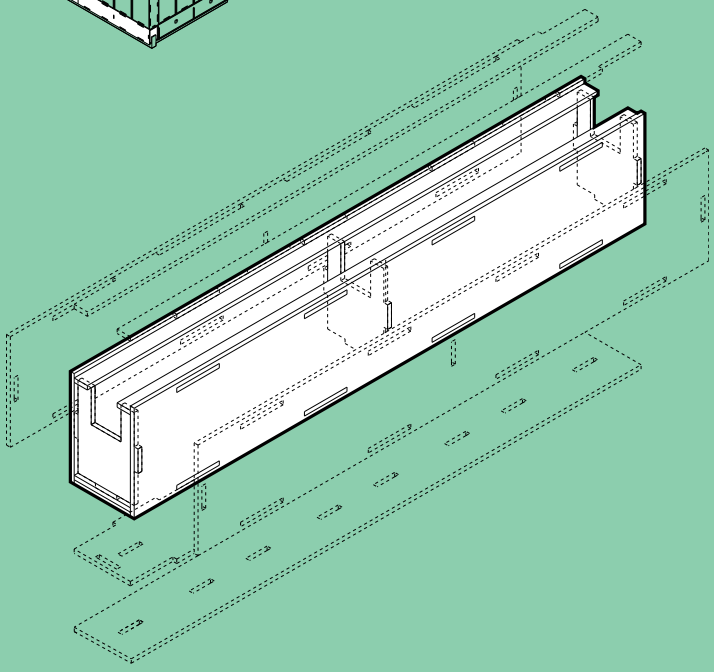
CLASS D ≈ 1.2 sheets
45x30x240cm



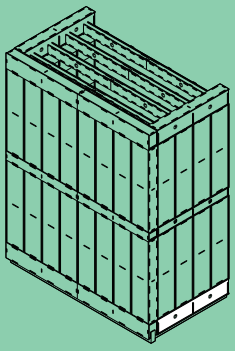


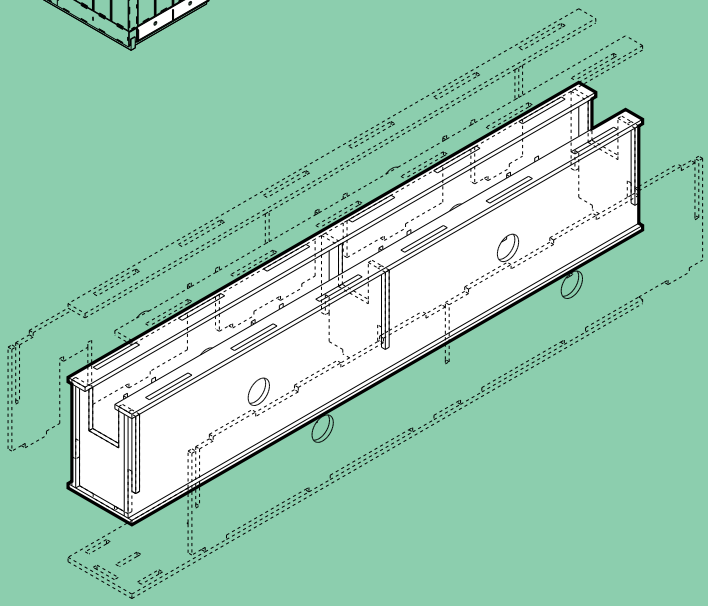
CLASS E ≈ 1.2 sheets
45x30x240cm



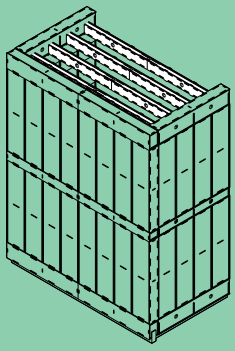


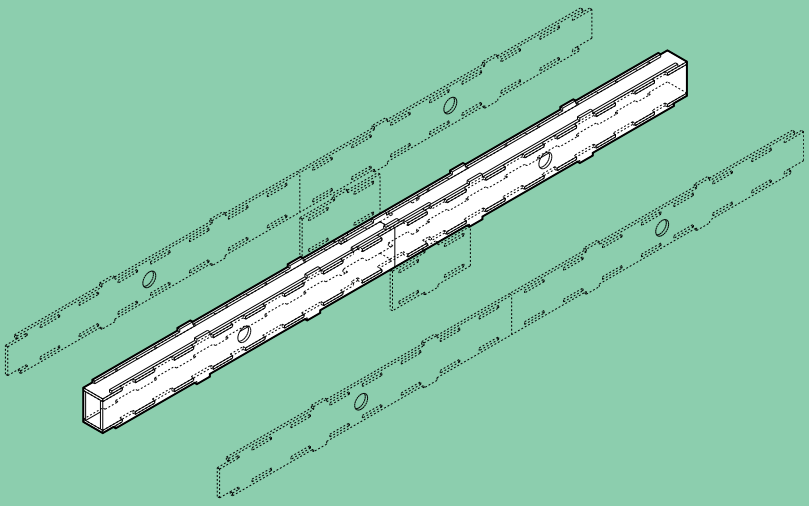
CLASS F ≈ 1.2 sheets
45x30x240cm



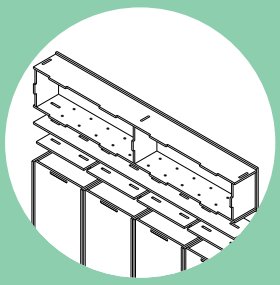


CLASS G ≈ 1.6 sheets
15x30x450cm

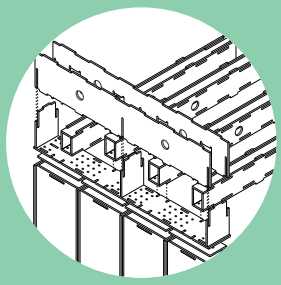




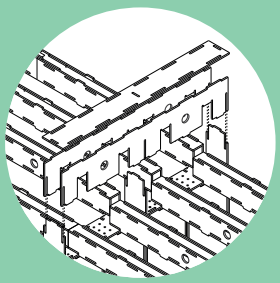
ASSEMBLY DETAILS



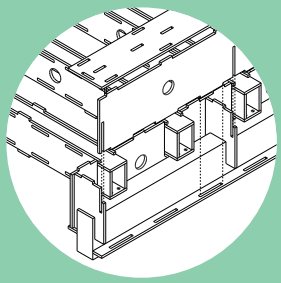
Class C Connection to walls



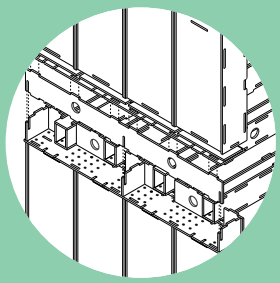
Class D Connection to Beams and Walls



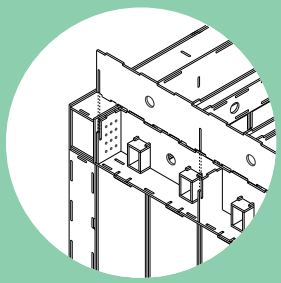
Class D Double Side Structure



Class F Connection to Timber Joists

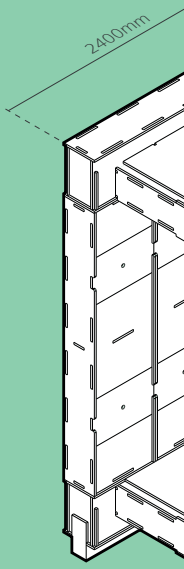


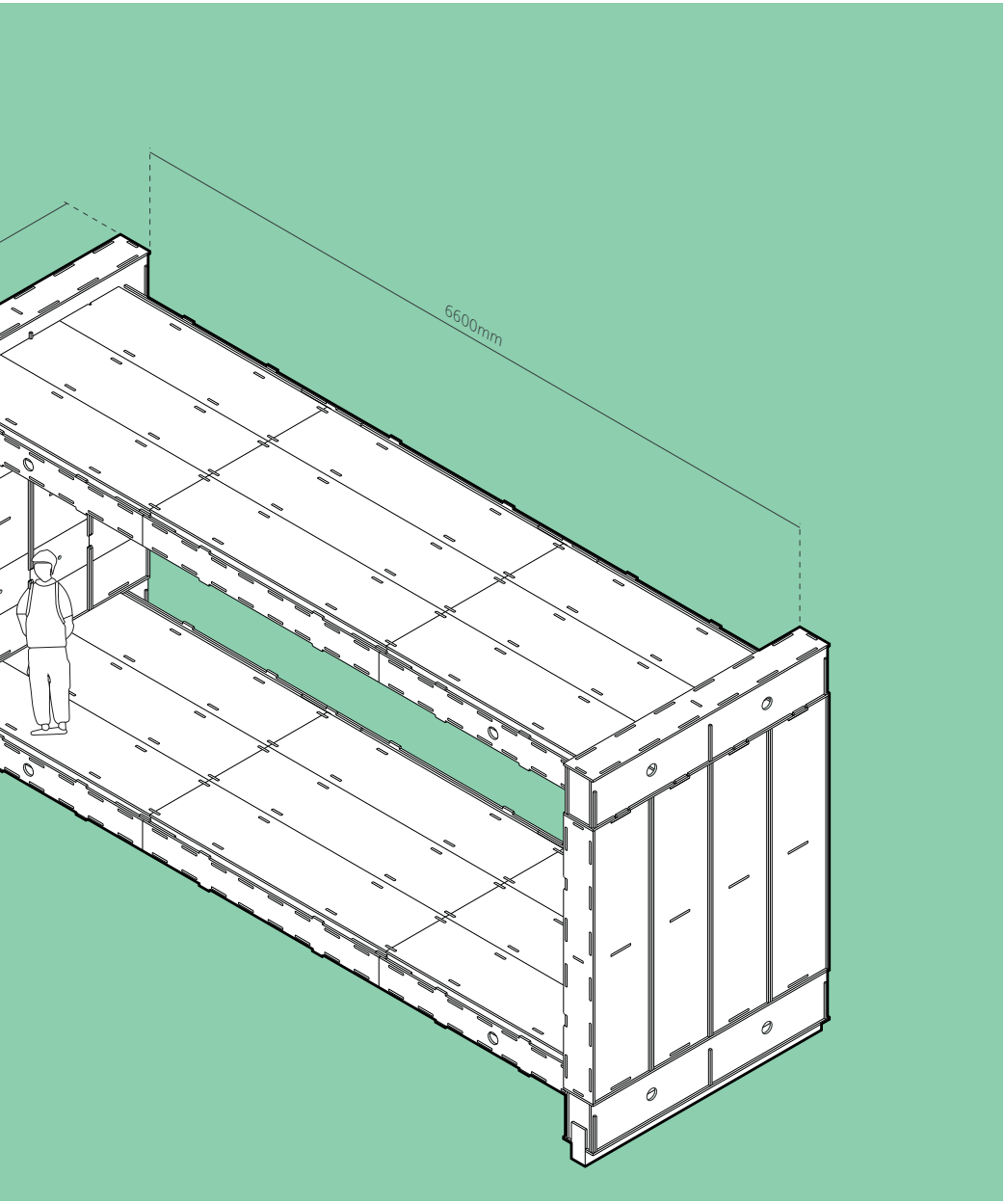
Class B Connection - Double Storey



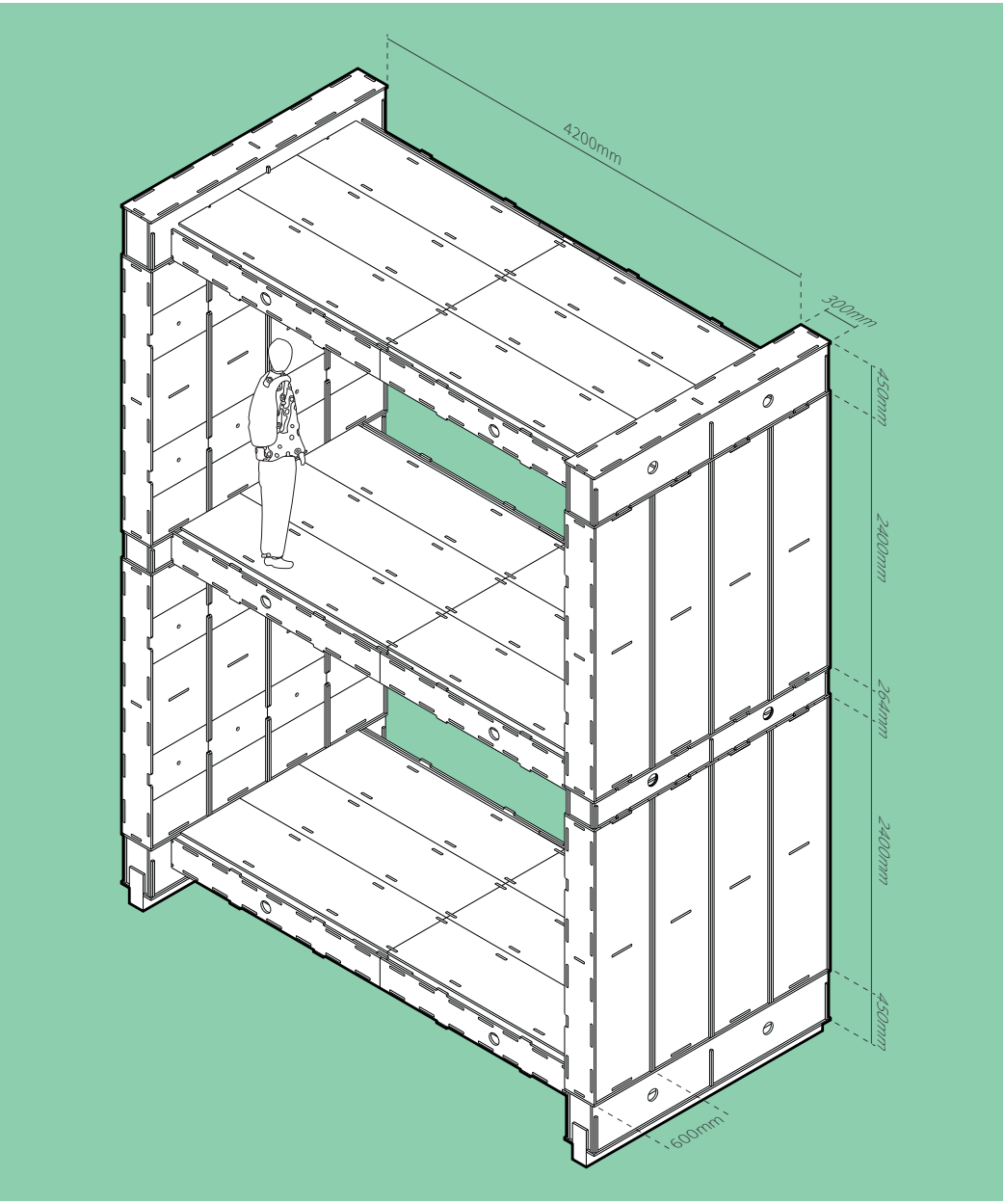
Class C and D Corner Connection

ONE STOREY STRUCTURE




6600mm

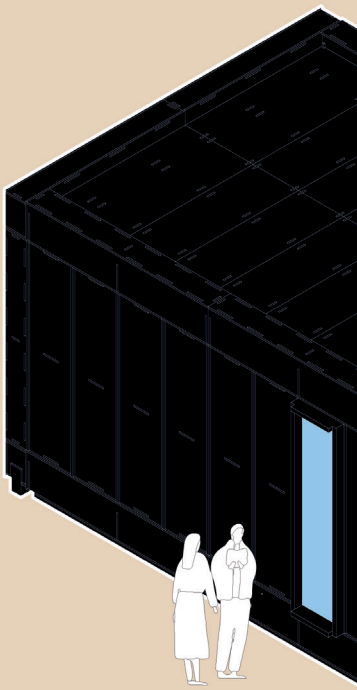
MULTIPLE STOREY STRUCTURE


4200mm
300mm
450mm
2400mm
760mm
2400mm
450mm
600mm

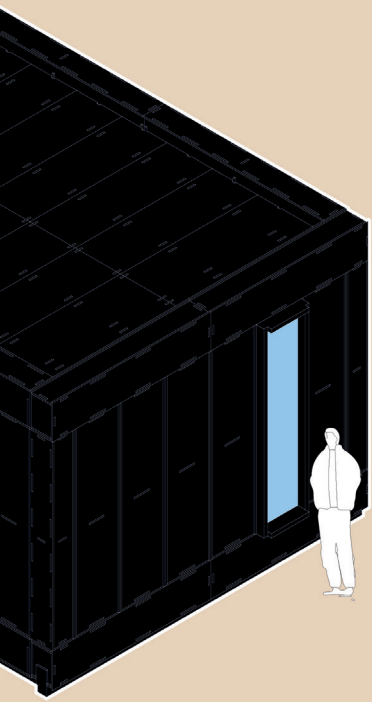
//SCENARIOS

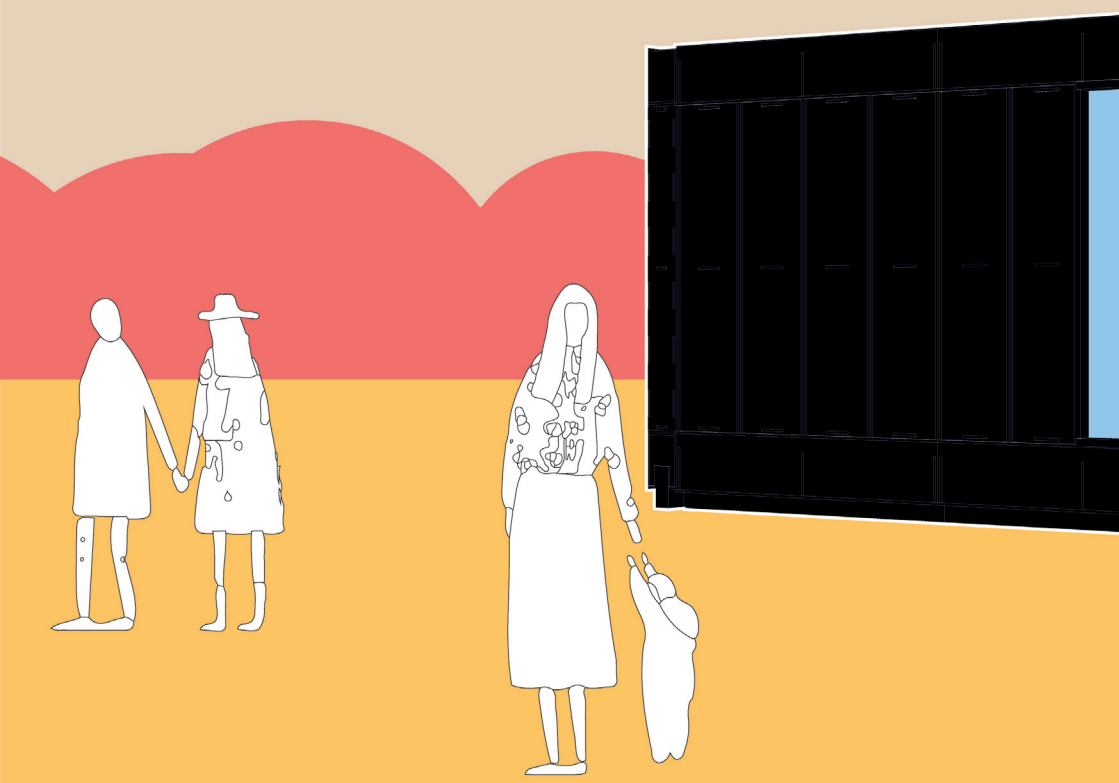
The system can successfully be used through many different scales and adapting to many different programs.
The examples here shown take into consideration three different scenarios, ranging from a small 25 sqm studio to an housing development.

A T T E F A

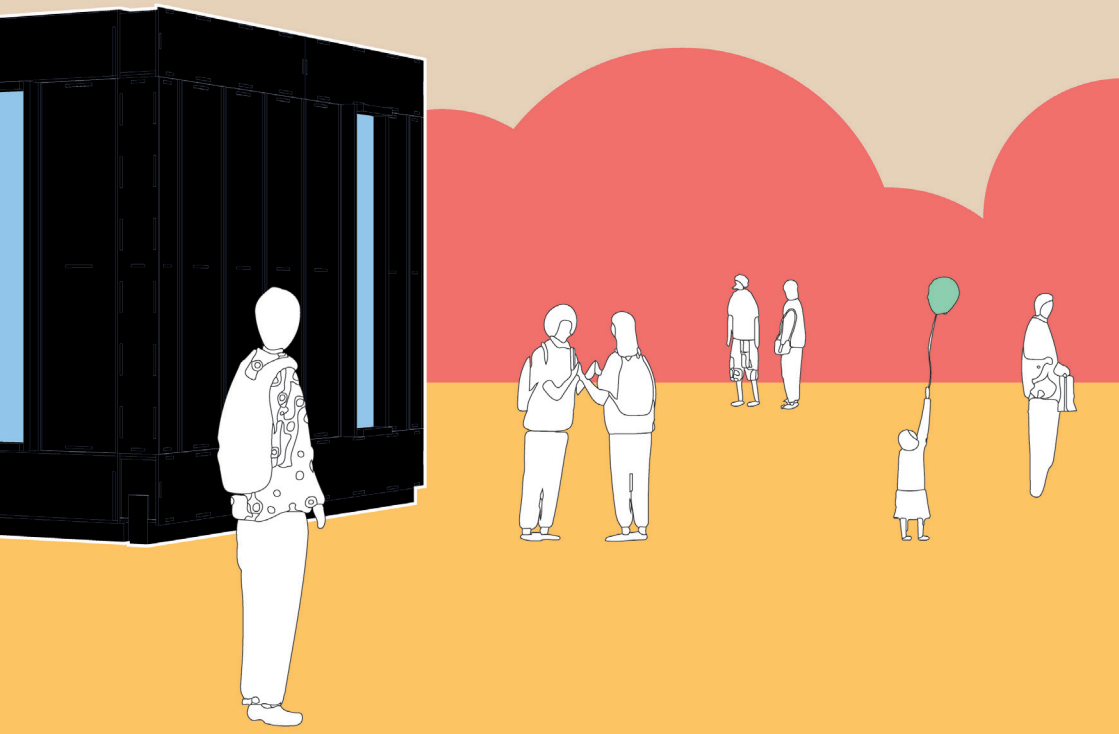


L L S H U S



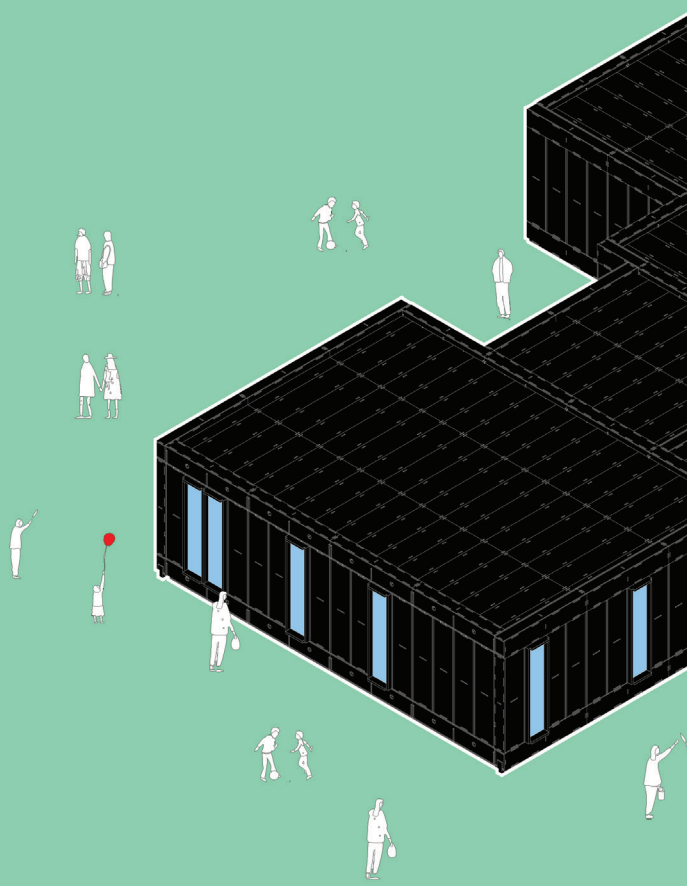


CLASS A 28 units - CLASS C 4 units - CLASS D 4 uni

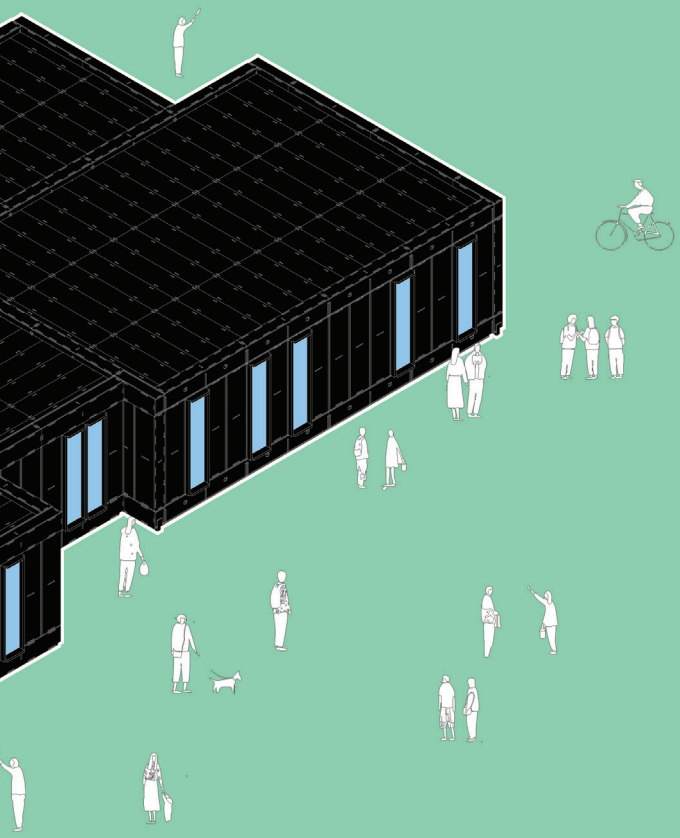


its - CLASS E 4 units - CLASS F 4 units - CLASS G 16

F A B



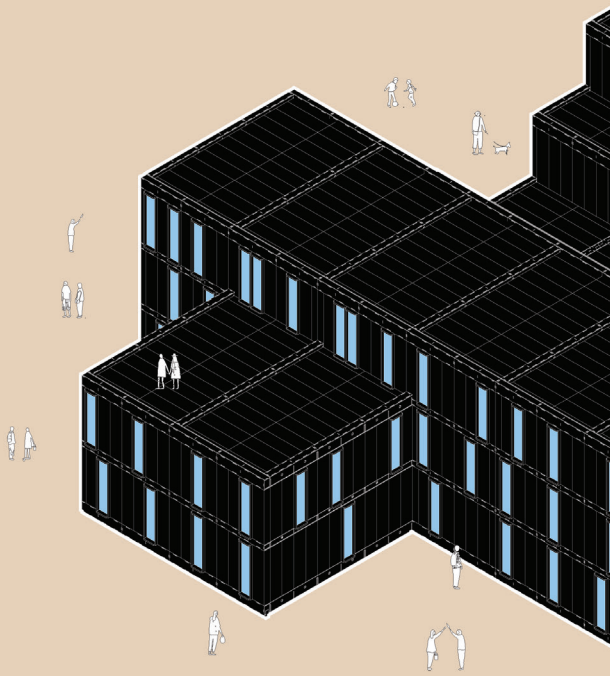
L A B



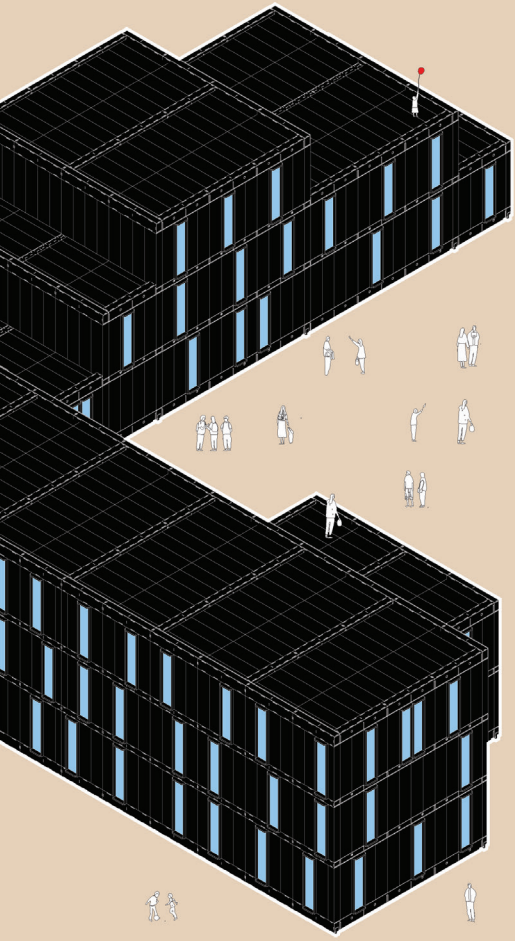
CLASS A 116 units - CLASS C 20 units - CLASS D 20 un

its - CLASS E 20 units - CLASS F 20 units - CLASS G 104

H O U



S I N G



CLASS A 1257 units - CLASS B 222 units - CLASS C+E 68 u

nits - CLASS D 73 units - CLASS F 79 units - CLASS G 816

//JOIN THE COMMUNITY

Designing and making the system work is an ongoing process, made possible with the collaboration of different professionals.
Being this and open-source system we do need and appreciate your help.
If you feel like helping in making the system better scan the QR code and join the common folder. You can find the system files under the "Feature Project" folder. It's all open and editable, ready for you to make awesome improvements.

//CONCLUSION

The thesis work is more of a question and a conversation point of departure in improving these kind of systems. This will help exploring the many ways they could actually be used and improved.
The system is now in the featured project in the Wikihouse common folder. This is a great point of arrival for the master thesis work and a great point of departure for the improvements of the actual system.
The open-source platform will help boost the system characteristics by the support of thousand of people interested in the conversation.
This is just the beginning, a stepping stone toward a more democratic architecture.

//REFERENCES

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Open Desk*, opendesk.cc*
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