EMERGENCY MODULE

BLUA DOMO

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HBK Saar
SS 2012
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1. OBJETO DEL PROYECTO

Cuando empezamos a desarrollar nuestro Proyecto Final deCarrera para la Hochschule der Bildenden Künste Saar decidimos orientarlo hacia un fin social, ya que pensamos que este tipo de diseñp es, en muchas ocasiones,olvidado por la mayoría de diseñadores.
Tras una primera aproximación a este mundo nos pareció interesante la planidicacion de los campos de refugiados ya que fuimos conscientes de las deficiencias que presentan.
Finalmente decidimos desarrollar un nuevo concepto de tienda de emergencia, su función: **proporcionar a las victimas de distintos desastres naturales una vivienda temporal digna.**

2. DESARROLLO DEL PROYECTO

2. 1. Ayuda humanitaria

Para el desarrollo de nuestro proyecto fue necesaria una inmersión completa en el mundo de la ayuda humanitaria, después de todo este proceso tomamos unos puntos fundamentales que nos servirían de apoyo el resto del proyecto:

2. 1. 1. Campos de refugiados

Lo primero dar una defición clara de qué es un campo de refugiados:"Un campo de refugiados es un asentamiento temporal contruido para alojar refugiados.

Los campamentos de refugiados son generalmente establecidos de forma improvisada y diseñados para satisfacer las necesidades humanas básicas por sólo un corto periodo de tiempo.

Las caracteristicas varían mucho de unas situaciones a otras, pero no se recomienda que los campos superen las 20.000 personas.

2. 1. 2. Infraestructuras

Los campos de refugiados constan de:
-Alojamientos
-Instalaciones de higiene (limpieza y aseo)
-Suministros médicos
-Protección de los bandidos

2. 1. 3. Transporte

En este tipo de situaciones es fundamental la forma de organización y distribución de la ayuda

Dadas las condiciones en que pueden llegar a encontrarse estos lugares,es fundamental que estos métodos de transporte sean universales para que puedan ser transportados en distintos medios y entre distintos países.

Hay dos elementos que cumplen estas características y que se verán presentes a lo largo de nuestro proyecto: el container y los pallets

2. 2. Estado del arte

Hay muchos tipos de construcciones dedicados a este tipo de situaciones,realizamos un estudio de cada uno y los problemas que estos presentaban,aquí presentamos algunos ejemplos:

Paper log house, 1995. Shigeru Ban.

Fabric tent.

Analizando sus deficiencias decimos los obejtivos de nuestro proyecto.

2. 3. Objetivos del proyecto

-Diseño para emergencias(desastres naturales)

- ensamblaje de las piezas facil y rápido.

-Transporte fácil y económico.

-Ahorro de espacio:en uso,tranporte y almacenaje.

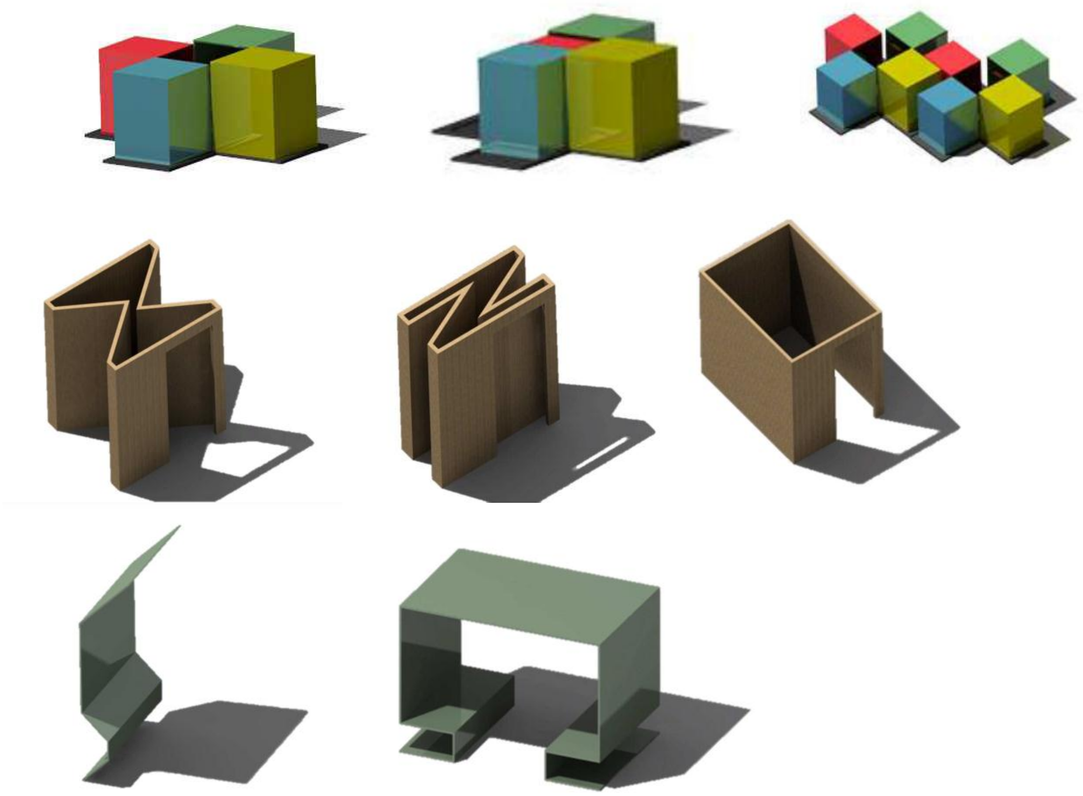
-Bajo coste

-Uso de materiales recilcados

-Desarrollo de un campo de refugiados completo (distribución,organización)

2. 4. Ideas previas

En las primeras fases del diseño se barajaron muchas opciones:

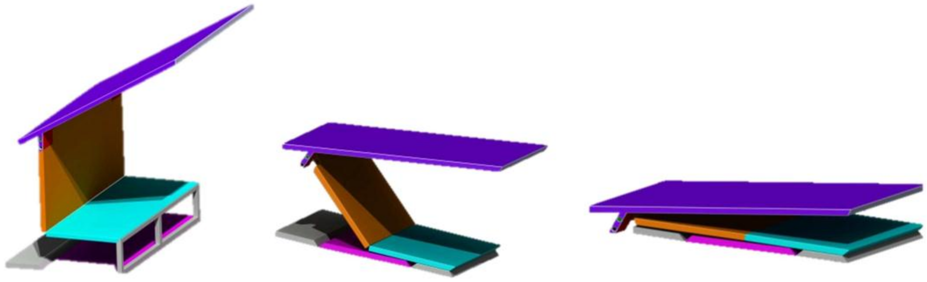


2. 5. Solución final

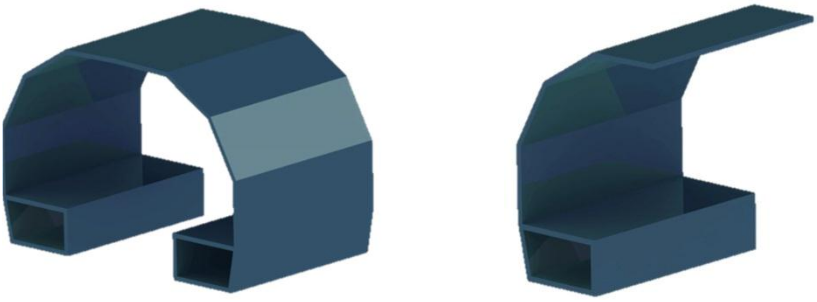
Para la solución final nos decantamos por un modulo que fuese plegable,muy versátil y que se pudiese montar facilmente

2. 5. 1. Primera aproximación

Realizamos una primera aproximación,el diseño es muy parecido al final pero se minimizó el tamaño para ser mas fácilmente trasnportable.

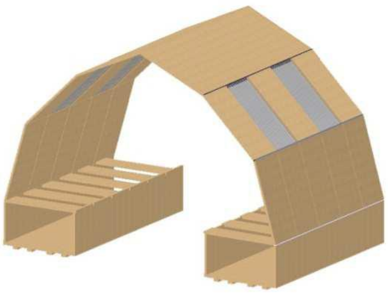


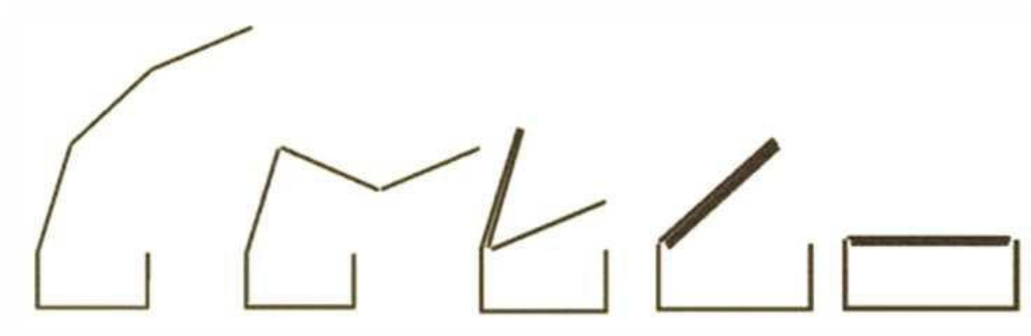
2. 5. 2. Segunda aproximación



Esta segunda aproximación es casi idéntica al diseño final,salvo por la falta de ventanas y cama,se trata de modulos dobles,simétricos,que quedan compactados en una caja.

2. 5. 3. Diseño final

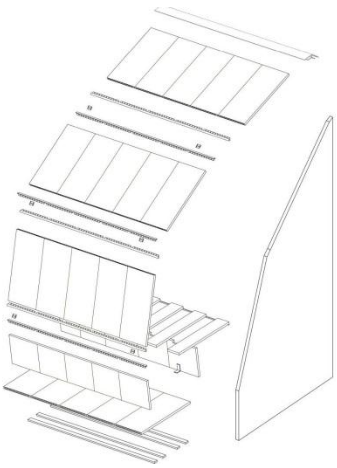




Aquí se encuentra el diseño final con su forma de plegado,en el paquete final se incluye un kit básico de supervivencia dentro de la caja final.

3. DESCRIPCIÓN DE LA SOLUCIÓN FINAL

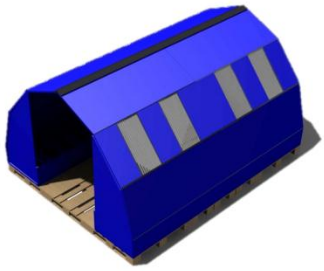
3. 3. Producto final

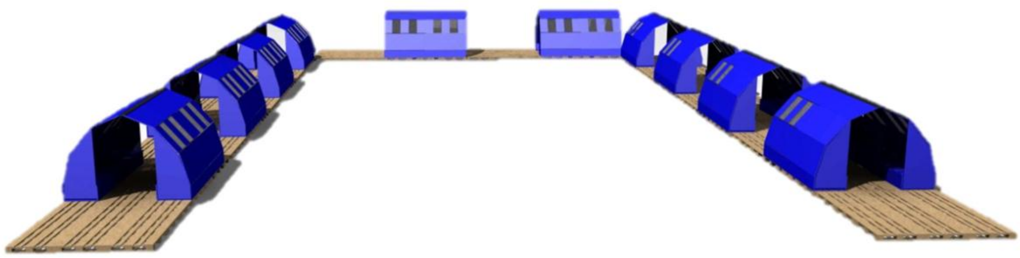


En este apartado se desarrollo completamente el diseño final

En la memoria se recoge una descripción detallada de cada una de las piezas, asi como planos de todas ellas y su forma de montaje.

Ademas,se realizaron varios render del aspecto final del modulo, y su colocación sobre pallets mediante una serie de guias que hacían a su vez de railes.





3. 4. Elección del nombre

En cuanto a la elección del nombre se eligió uno en esperanto, ya que es el idioma de la esperanza y es lo que la máxima que seguimos durante todo el proyecto.

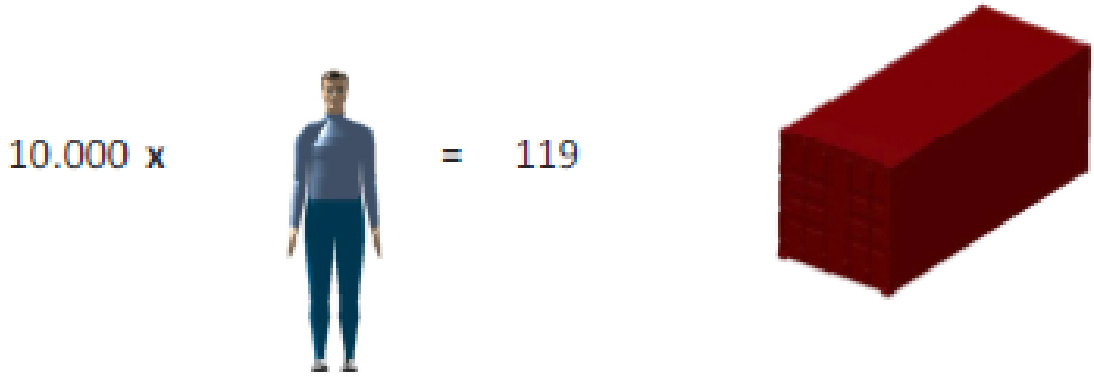
Blua domo = casa azul

4. PRODUCCIÓN

En este apartado desarrollamos todos los aspectos que conciernen a la elección de materiales de procesos productivos, además de adjuntar distintos documentos como los planos de todas las piezas el presupuesto y el peso.

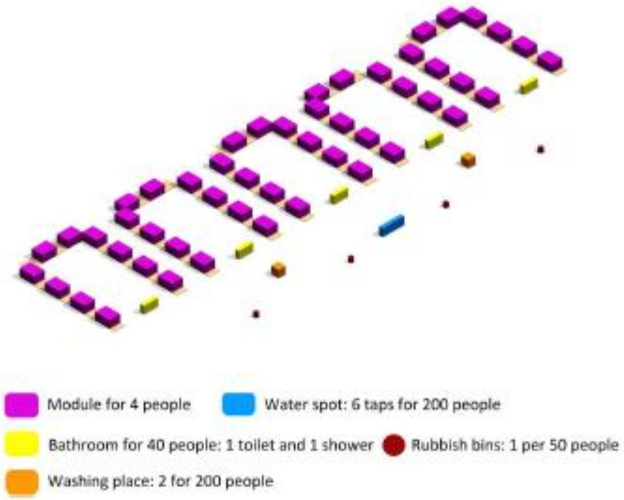
PROPUESTA DE CAMPO DE REFUGIADOS

Finalmente desarrollamos una propuesta de campo de refugiados, utilizando nuestros modulos,para ello se realizo el calculo de cuantos containers eran necesarios para transporter todos los modulos y , siguiendo las recomendaciones de distintas guias,utilizamos dichos modulos para distintas necesidades basicas de los campos.

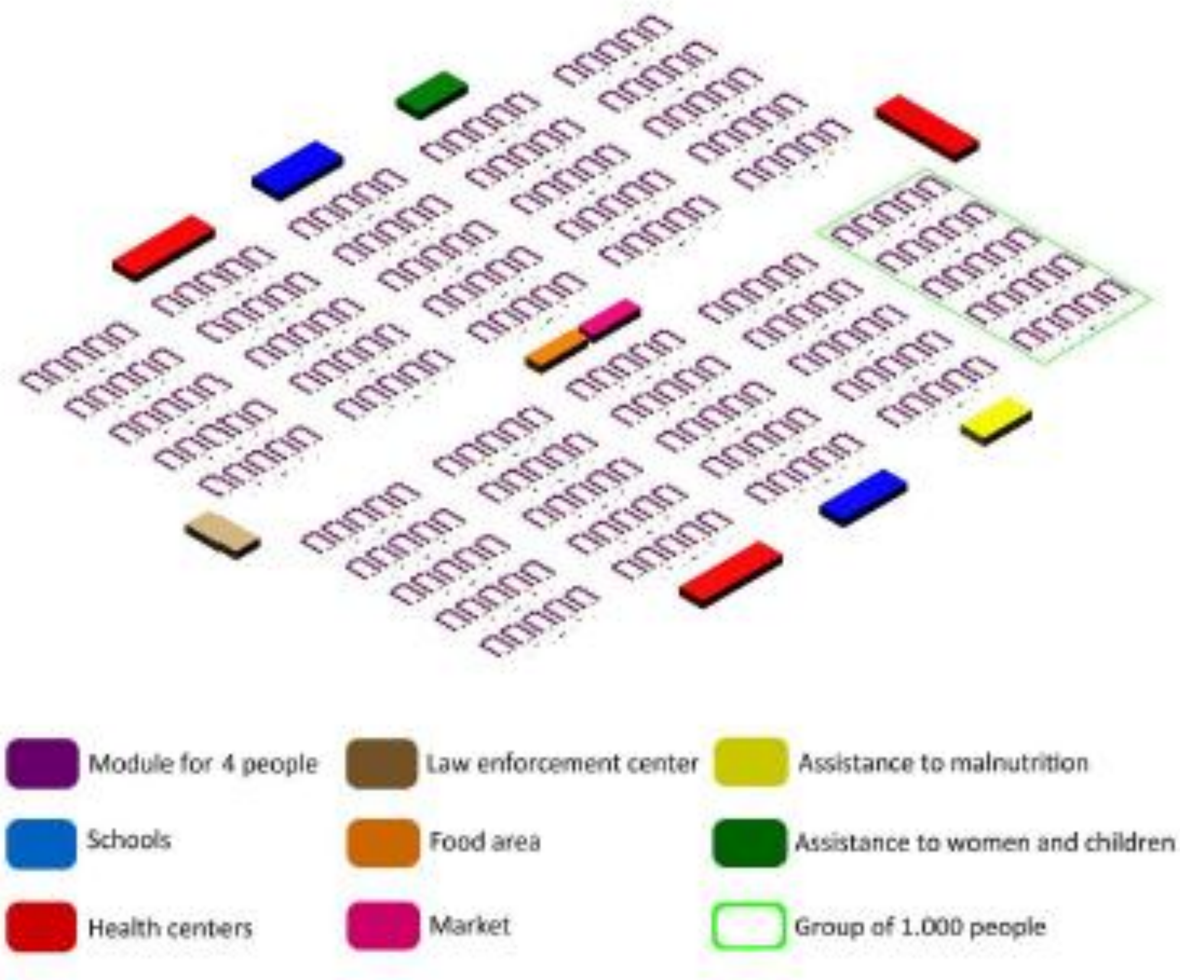


Los conjuntos mas pequeños estaban compuestos por 40 personas y gracias a la versatilidad de nuestros modulos podían ser colocados en distintas capacidades para todos los tipos de familias.

Propuesta de grupo para 200 personas con los servicios básicos:



Propuesta de Campo para 10.000 personas y utilización de los containers.



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Objective of the project

- We focus our project in a **social way.**
- Reason: the social way is sometimes forgotten by designers.
- Decision: development of a **emergency tent.**

Choice of the name

- Our design interact with the concept of hope; the hope of refugees to return to their daily lives.

- Decision: choose a name in **Esperanto.**

- Reason: Esperanto is a language created to foster harmony between people from different countries. Lázaro Zamenhof created it with the hope of that language become the international auxiliary language.

- Name: **BLUA DOMO.**

- Blua Domo = "blue house".

State of the art

There are a lot of emergency architecture examples,but most of them have some type of mistakes.

Paper log house, 1995. Shigeru Ban.

- Too many time to be builded
- People can take it as a permanent home
- Paper is not good with bad weather conditions

Uber shelter, 2009. Shelter competition.

- Too many time to be builded
- Small pieces that can be lost
- Difficult assembly

Basic house, 1999. Martín Ruiz De Azúa.

- Is not like a real house
- Is not solidenought

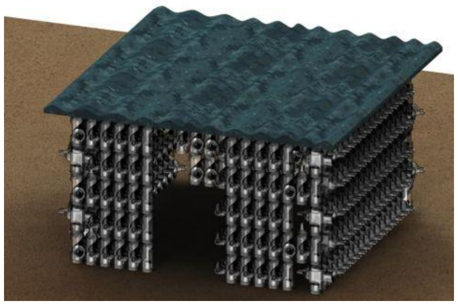
Shellhouse, 2008. Carolina Pino.

- Is not like a real house
- Paper is not good with bad weather conditions
- Too small

Fabric tent.

- Is not like a real house
- Is not strong enought
- It can not be placed in an orderly way
- Too small for a family

Bottles House, 2008.
Matt Nápoles and Peter Zummo.



- Too many pieces
- Too dificult to be biult
- Too many time to be built

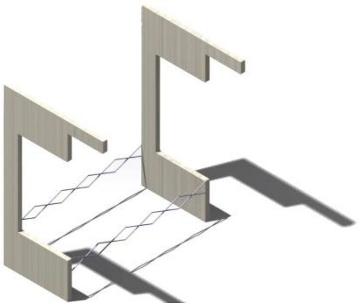
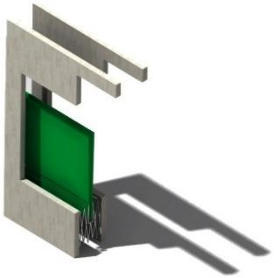
Aims of the project

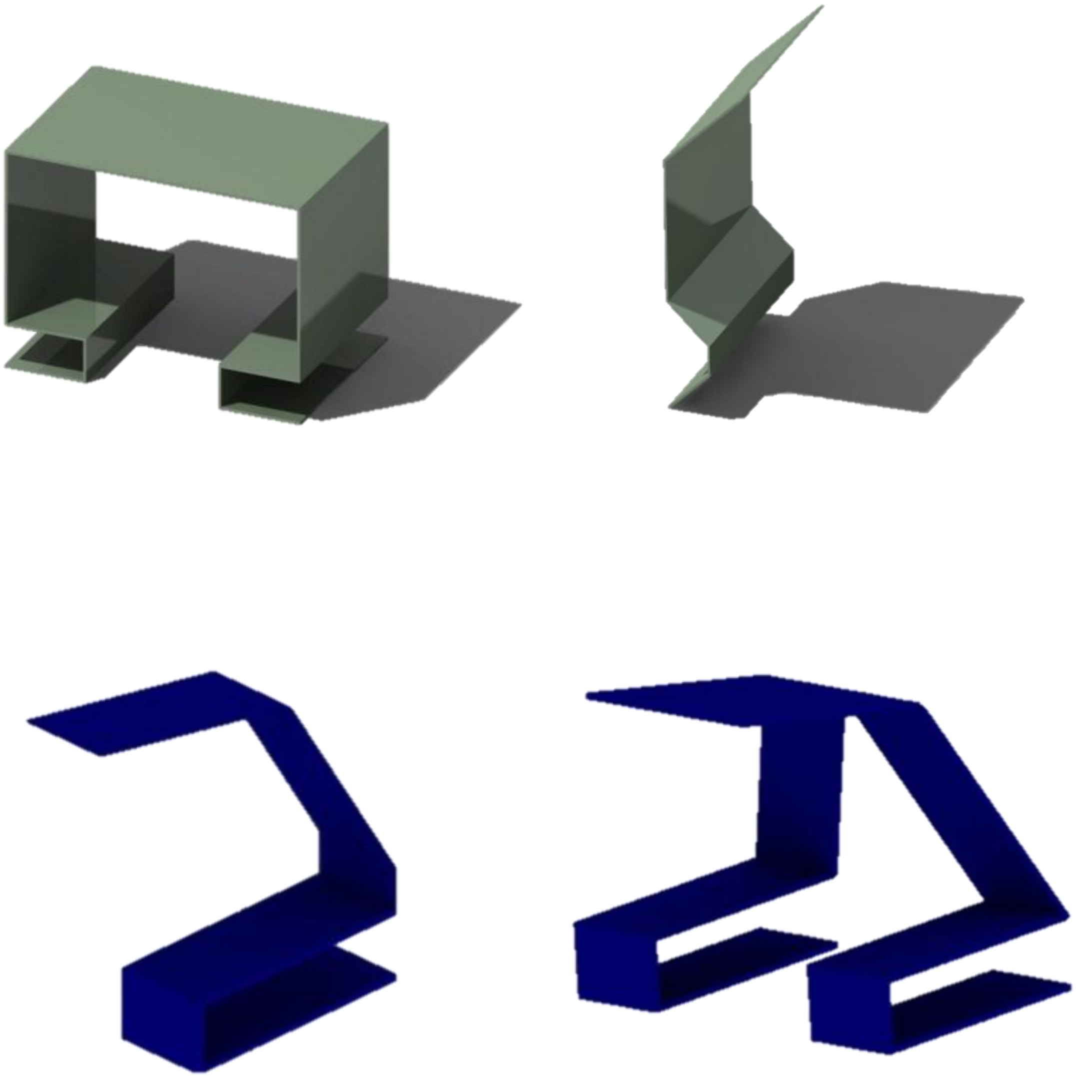
- For emergencies (natural disasters).
- Easy and fast assembly.
- Easy and economic transport: containers.
- Space saving: in use, transportation and storage.
- Low cost.
- Recycled materials.
- Develop a complete refugee camp.

Previous ideas

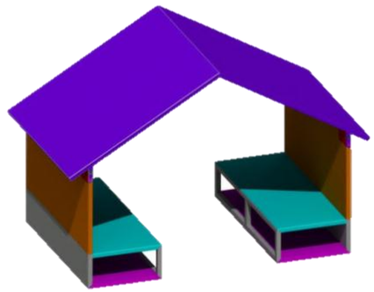


Folding modules

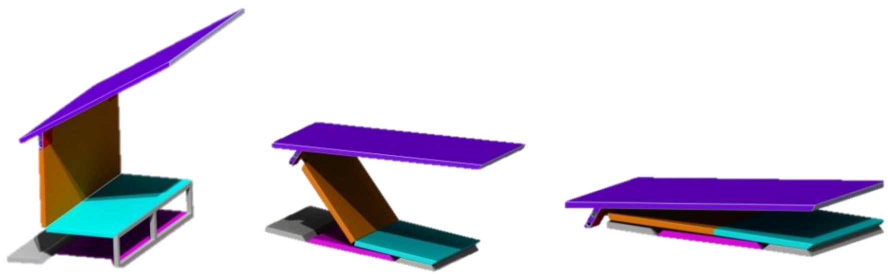





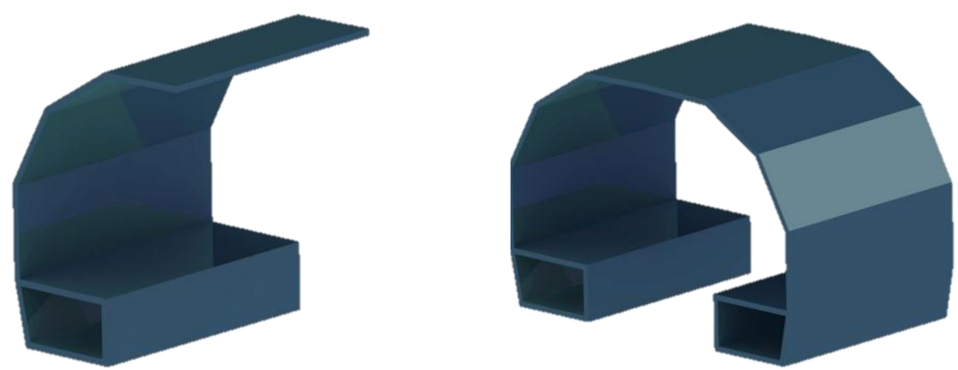
Continous
profiles



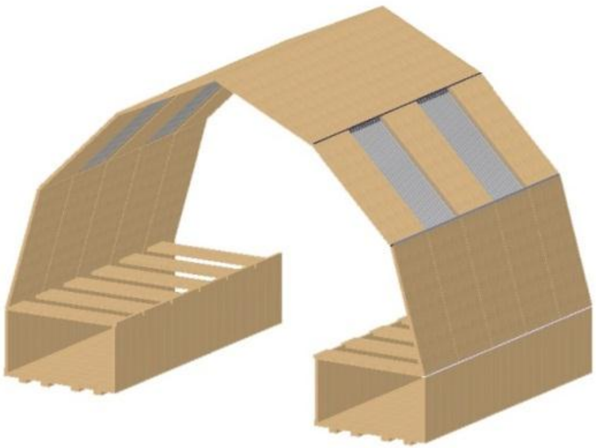
First approximation



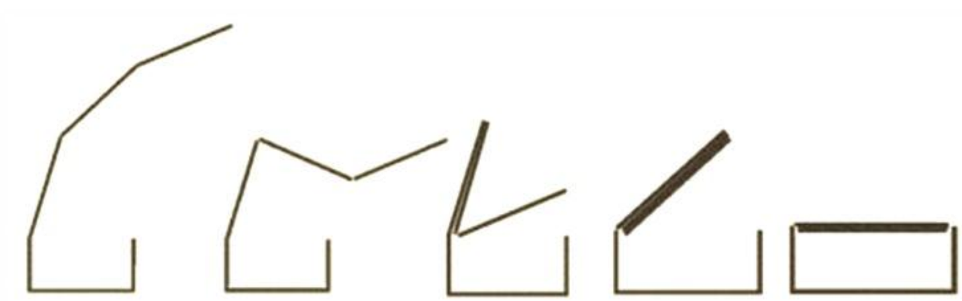
Second approximation



Final design

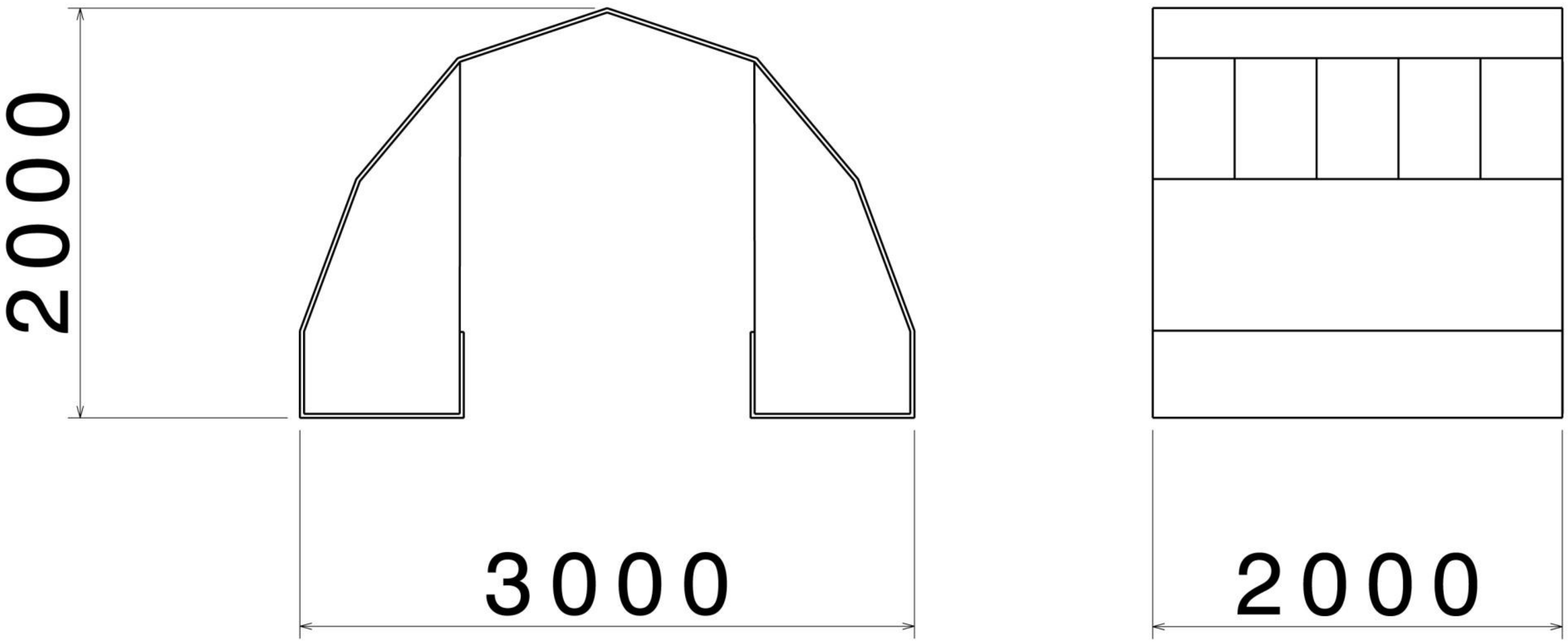


Final aesthetic



Way of folding

Dimensions



Components

Lateral sheets

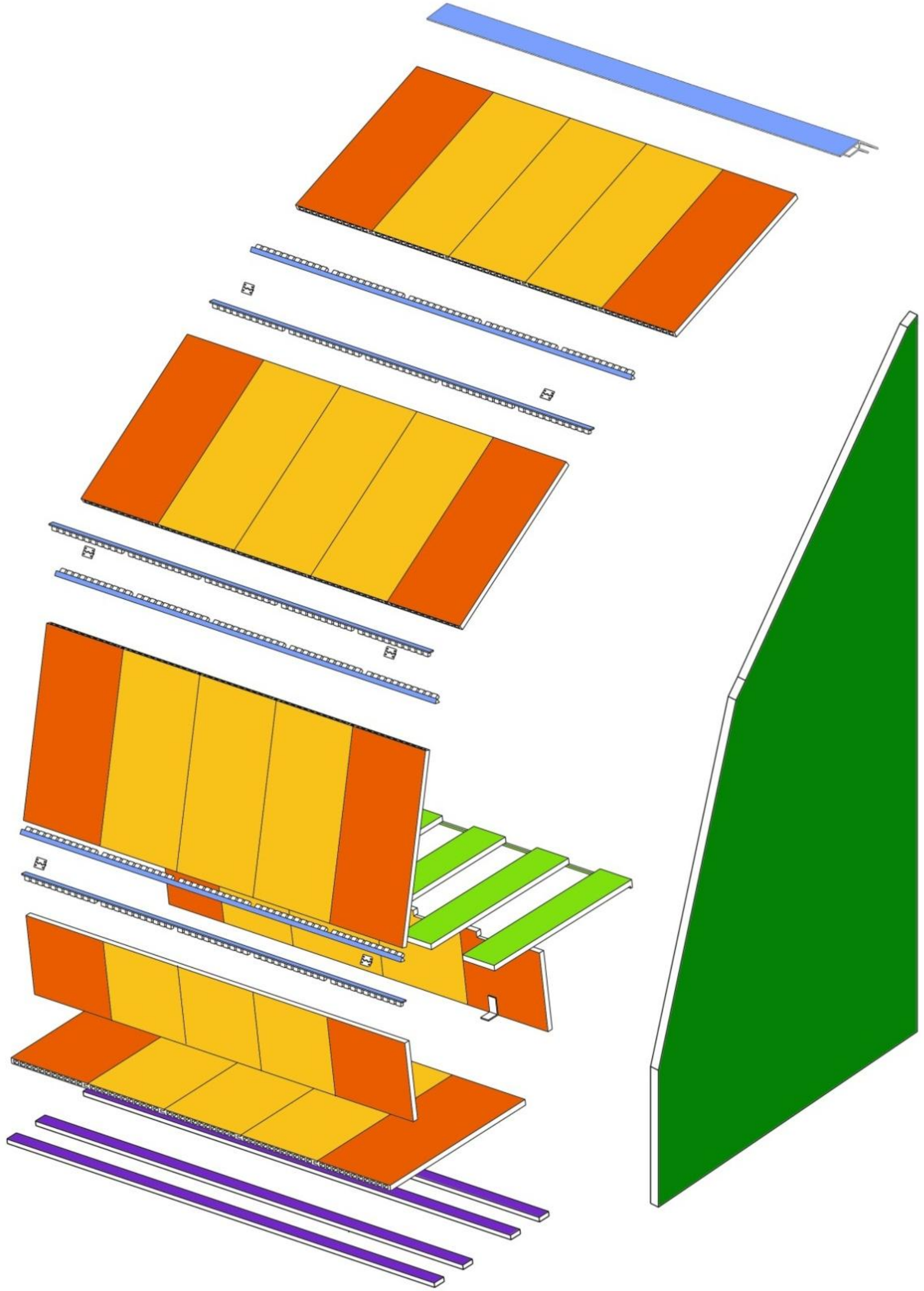
Central sheets

Bed sheets

Connecting pieces

Slats

Frontal cover



Central sheets

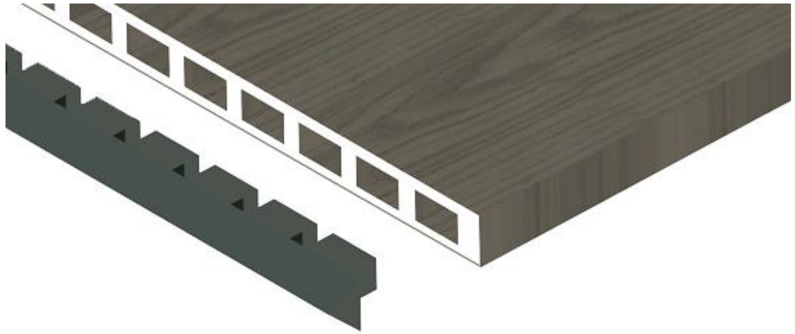
Lateral sheets

Assembly

Complete panel

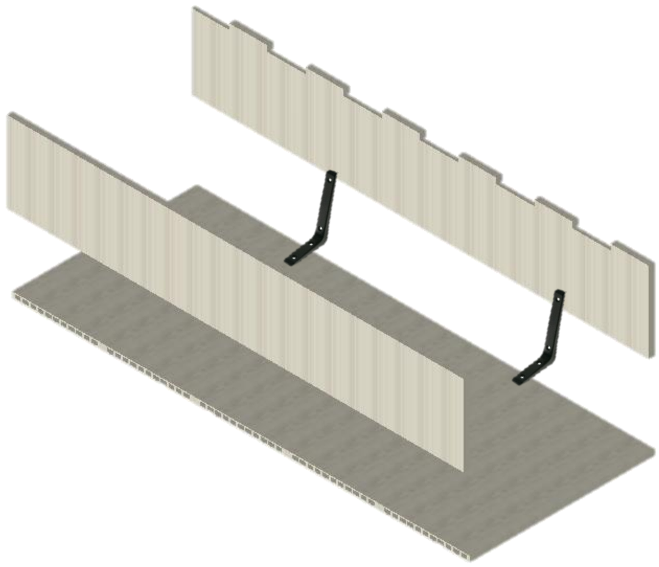
Assembly

The panel are joined by **connecting pieces**



Assembly

Box structure - we included 2 corner brace in order to guarantee the union



Assembly

Bed structure - the sheets have to slide.
We included rails.

Transport

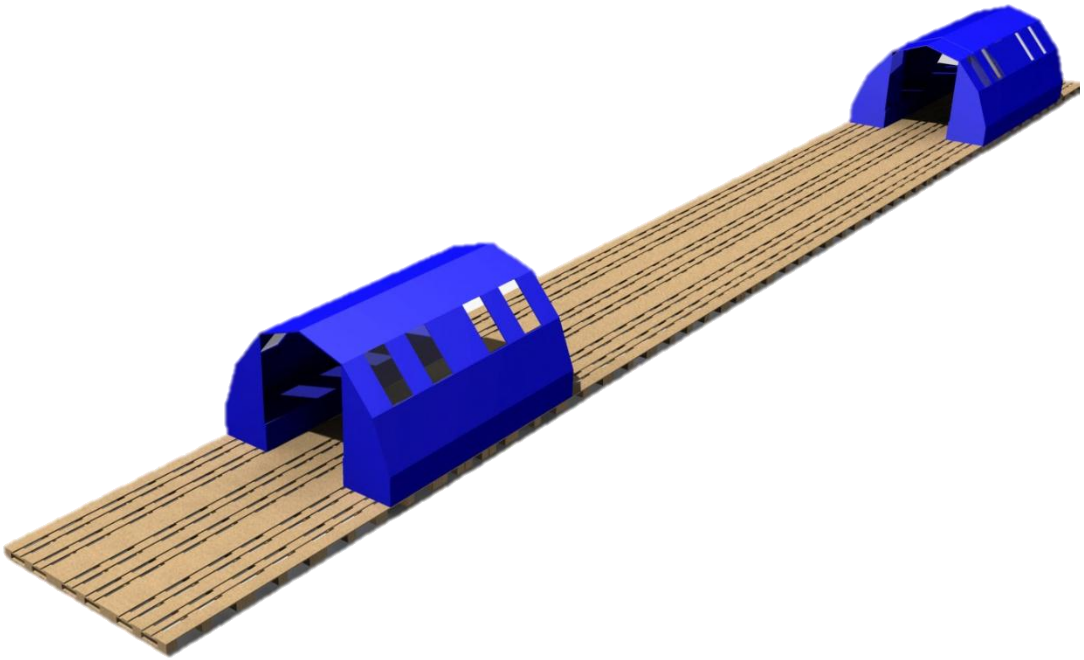
- Catastrophe → Organization of aids.

- Use of globally standardized methods.

- Most universal transport: CONTAINER.

PALLET for small packages.

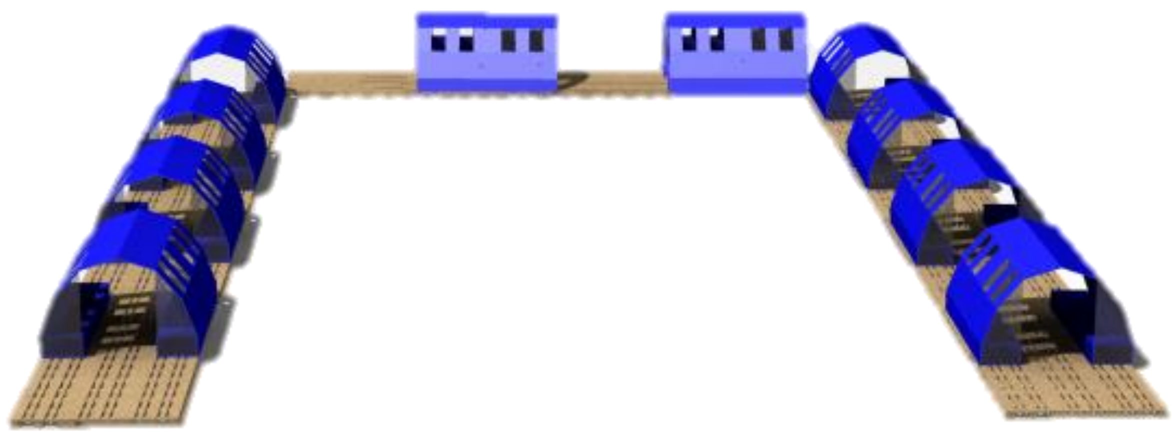
Proposal of a REFUGEE CAMP



The houses will be placed over reused pallets with the help of some slats.

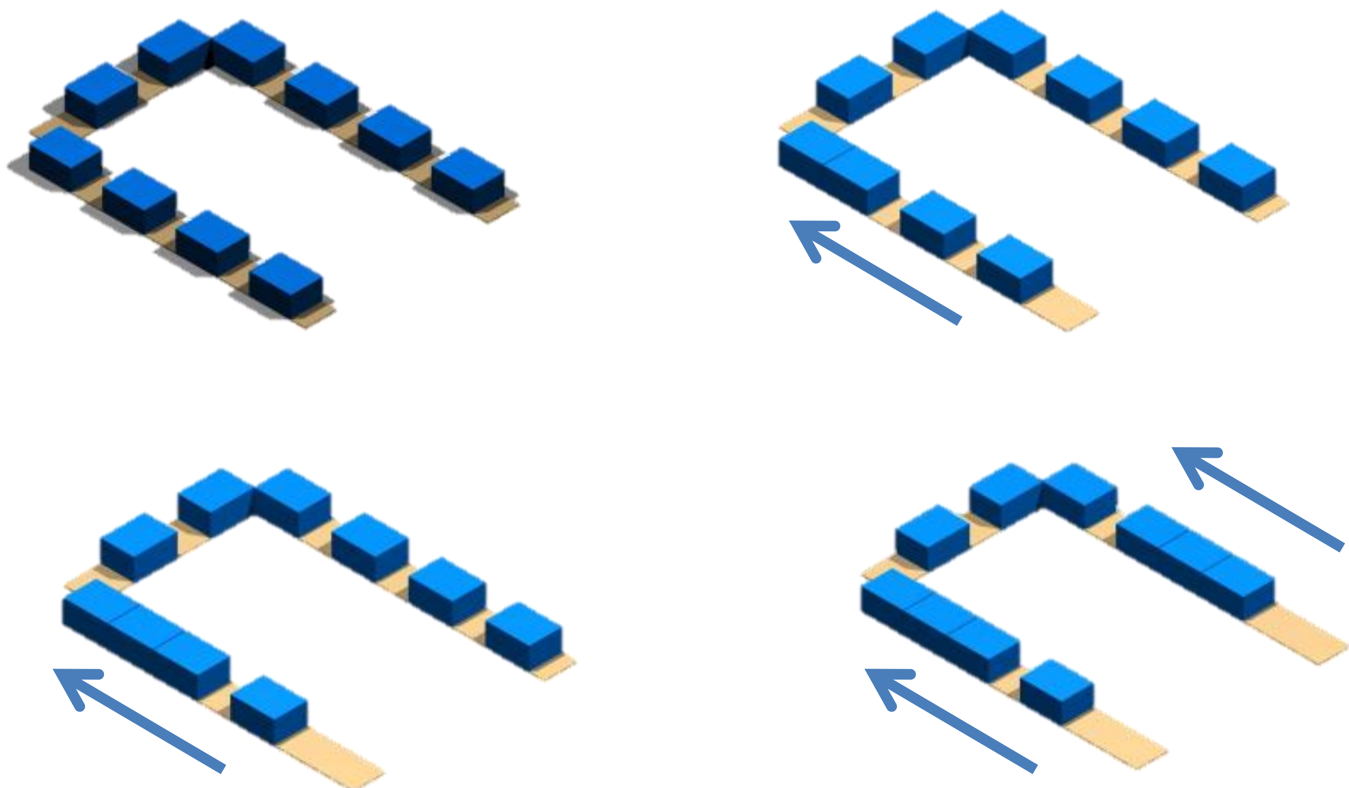
This slats allow the house slide over the pallets.

The houses will be placed over a pallets U form floor.

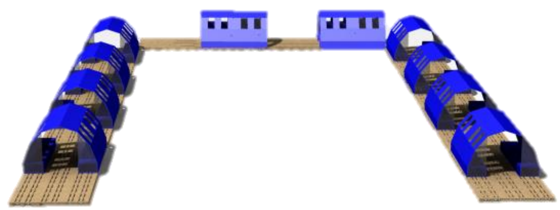


They form groups between 10 and 12 families around a central patio.

Refugees can move the houses in order to get different kind of groups.

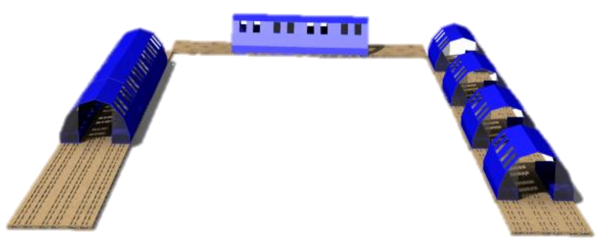


Some examples:

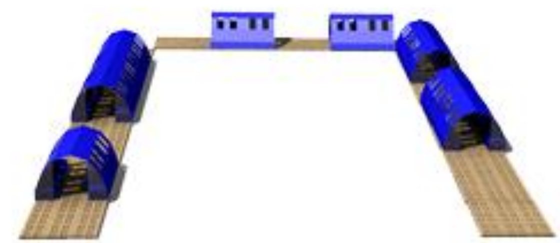


10 houses of 4 people

4 houses of 4 people
3 houses of 8 people



4 houses of 4 people
1 house of 8 people
1 house of 16 people



3 houses of 4 people
3 houses of 8 people

INFRASTRUCTURES OF A CAMP

For each small group of refugees **UNHCR** recommend:

↓

Office of the United Nations High Commissioner for Refugees

1. Groups between 10 and 12 families around a colective patio.

2. Individual access for each house.

3. One toilet and one shower per 20 people.

4 One kitchen for each group of houses.

5 One water point with 6 taps for every 200 people.

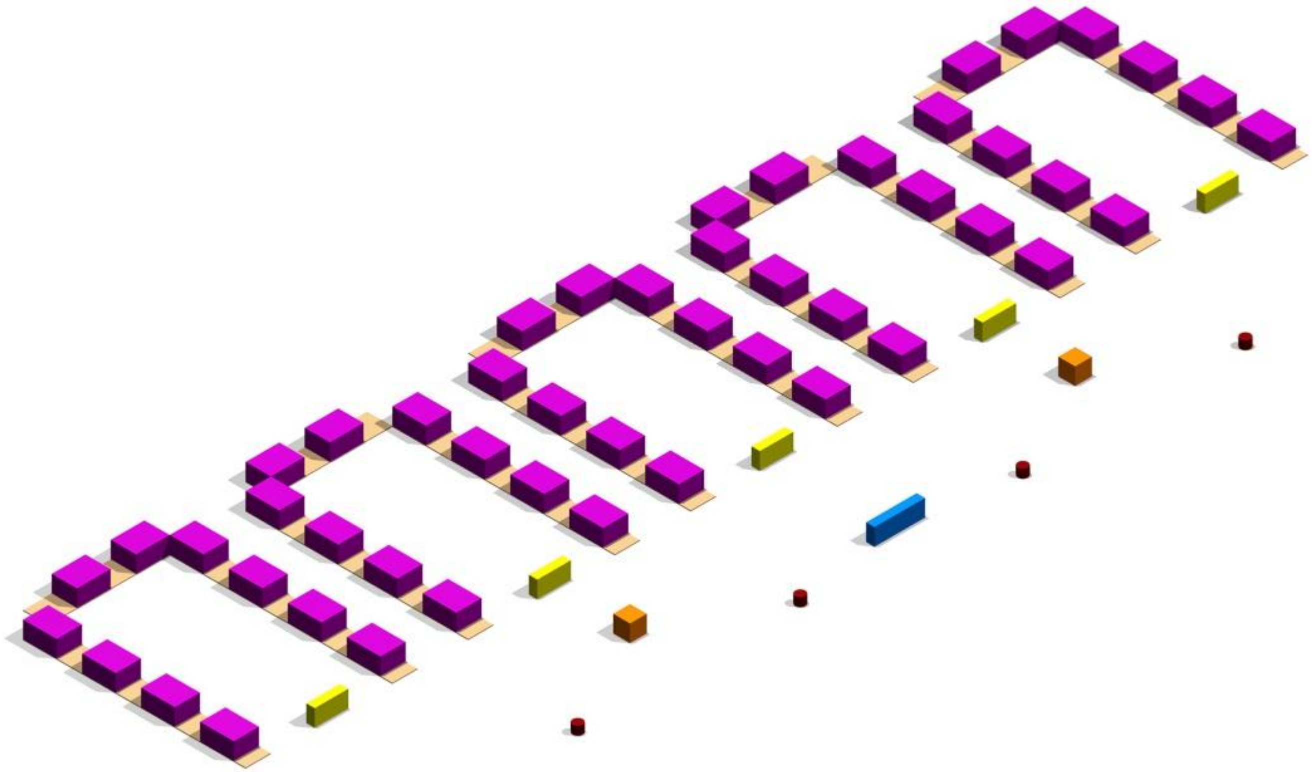
6 An area for the distribution of the food.

7 Two washing places for 200 people.

8 One rubbish bin (capacity for 100 liters) for every 50 people per day. Is also necessary make a pit (dimensions 2m x 5m x 2m) for every 500 people.

9 Firebreaks between the different groups of shelters.

Group of 200 people



Module for 4 people

Water spot: 6 taps for 200 people

Bathroom for 40 people: 1 toilet and 1 shower

Rubbish bins: 1 per 50 people

Washing place: 2 for 200 people

For a refugee camp UNHCR recommend:

- One health center every 3.500 people.
- One school for every 5.000 people.
- A place for assistance to malnutrition.
- A place for assistance to unattended women and children
- A law enforcement center in order to respond to legal demands.
- For each 20.000 people one market.

Production

Polywood	Sheets	Extrusion
Polycarbonate	Translucent sheets	Injection
PVC	Connecting pieces	Injection

MATERIALS

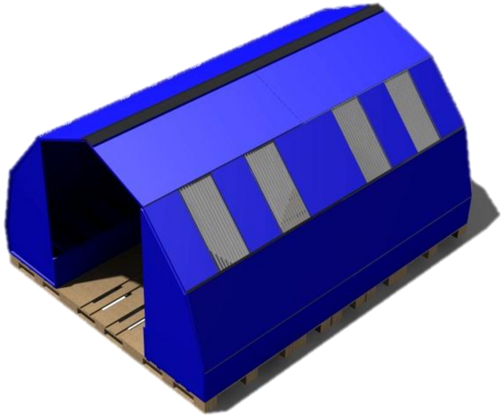
MANUFACTURING

Economic estimate

With the data obtained about the retail prices, we could make a very approximate estimate which could be the real price of our product.
In fact, assuming a large series manufacture, the price would be lower.

Price of a normal tent : **700 €**

Price of our module : **229 €**



Analysis - weight of the module

The weight of the module is calculated from the following densities:

- Polywood: 0,72 g/cm^3
- PVC: 1,4 g/cm^3
- PC: 1,2 g/cm^3

TOTAL weight: **68 kg.**

· Perfect to be enought solid and no too heavy to be carried.

· A container can carry 21.000 kg and we only need to carry 3000 kg to transport ours modules.

Objective accomplished!

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MEMORY

ATTACHED DOCUMENTS

PLANES

ECONOMIC ESTIMATE

ANALYSIS

PROPOSAL OF A REFUGEE CAMP

BIBLIOGRAPHY

MEMORY

1. OBJECT OF THE PROJECT

When we started to develop our Bachelor Thesis for the Hochschule der Bildenden Künste Saar we decided to orientate it in a social way because we think that the social design is sometimes forgotten by most of the designers.

So we decided to look for some information about the planning and design of the refugee camps and even about the deficiencies that they have.

After that we come to the conclusion that we wanted to develop a new concept of emergency tent. Its function: **provide a decent temporary house to the people affected in some natural disaster (earthquakes, tsunamis…).**

2. DEVELOPMENT OF THE PROJECT

2.1. Humanitarian help

2.1.1. Refugee camps

First of all is necessary to know the definition of that: A refugee camp is a temporary settlement built to receive refugees.

Refugee camps are generally set up in an impromptu fashion and designed to meet basic human needs for only a short time.

Also is important to know that every refugee camp is different since every situation is different.

The number of people living in a camp depends on the crisis. When the number of refugees is in the hundreds of thousands, aid agencies try to set up a few smaller camps with populations of no more than 20.000 rather than one massive camp because these camps are easier to manage.

These ones are usually located on the edges of towns or cities in a secure area, away from the border, war zones and landmines. The camp should be set up on sloped terrain that provides natural drainage. It should also be away from breeding sites of insects that can carry disease.

The camps are only designed to be temporary solutions, giving refugees a place to live until they can safely return home. They are not meant to be permanent residences. However, organizers have learned to plan for the long haul because refugees often end up living in the camps for much longer than expected.

In Albania, refugees from Kosovo lived in camps for only three months, while refugees from Somalia have been living in camps in Kenya since 1991. Palestinian refugees have been living in camps in Lebanon for more than 50 years.

2.1.2. Infrastructures of a refugee camp

The facilities of a refugee camp can include the following:

- Sleeping places.
- Hygiene facilities.
- Storage place
- Medical assistant.
- Communication equipment.
- Protection against bandits.

2.1.3. Transport

When there is a catastrophe of any kind, one of the most important things is the proper organization of aid, especially in the form of shipping so all the affected can access to it.

In this type of situations is usual that the transport infrastructures are damaged or even unusable, so it is necessary versatile types of packaging that allow its transport in different forms.

It is also essential that these methods are globally standardized because this help, in most cases, will be transported between different countries.

The key to an emergency situation is the transport of food and medicine to the affected areas. The most universal transport relief is the container, because it is a standardized and versatile element.

A container, also known as intermodal containers or ISO container because the dimensions have been defined by ISO, are the main type of equipment used in intermodal transport, particularly when one of the modes of transportation is by ship.

Containers have standardized measurements *(attached documents 1),* although other lengths exist. In countries where the railway loading gauge is sufficient, truck trailers are often used. Variations exist, including open-topped versions covered by a fabric curtain are used to transport larger loads. A container called a tanktainer, with a tank inside a standard container frame, carries liquids. Refrigerated containers are used for perishables.

Handling equipment can be designed with intermodality in mind, assisting with transferring containers between rail, road and sea. These can include:

- Transtainers for transferring containers from sea-going vessels onto either trucks or rail wagons. A transtainer is mounted on rails with a large boom spanning the distance between the ship's cargo hold and the quay, moving parallel to the ship's side.
- Gantry cranes, also known as straddle carriers, are able to straddle rail and road vehicles, allowing for quick transfer of containers. A spreader beam moves in several directions allowing accurate positioning of the cargo.
- Grappler lift, which is very similar to a straddle carrier.
- Reach stackers are fitted with lifting arms as well as spreader beams and lift containers to swap bodies or stack containers on top of each other.
- Sidelifters are a road-going truck or semi-trailer with cranes fitted at each end to hoist and transport containers in small yards or over longer distances.
- Swap body units are not strong enough to be stacked, but they have folding legs under their frame but they can be moved between trucks without using a crane.

When we talk about transportation in emergency situations we should mention the transport of foodstuffs and other commodities in smaller packages that allow their distribution.

It is here where we will mention other elements of transportation worldwide standardized: **the pallets.**

A pallet ,sometimes called a skid, is a flat transport structure that supports goods in a stable fashion while being lifted by a forklift, pallet jack, front loader or other jacking device. A pallet is the structural foundation of a unit load which allows handling and storage efficiencies. Goods or shipping containers are often placed on a pallet secured with strapping, stretch wrap or shrink wrap and shipped.

While most pallets are wooden, pallets also are made of plastic, metal, and paper.

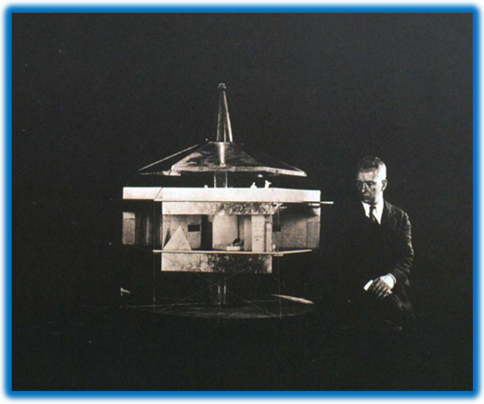
Pallets have also a standardized measurement *(attached documents 2).*

2.2. State of the art

There are a lot of constructions applied to this type of situations (emergencies). Following is a great variety of examples classified according to their characteristics.

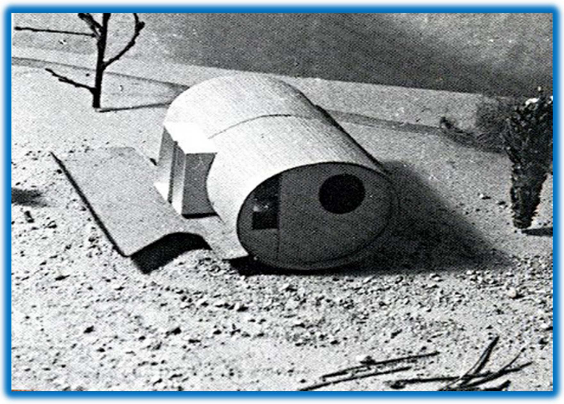
2.2.1. Modular architecture

· ***Dimaxyon house, 1929. Richard Buckminster Fuller.***



The *Dymaxion house* was developed to address several perceived shortcomings with existing homebuilding techniques. Fuller designed several versions of the house at different times, but they were all factory manufactured kits, assembled on site, intended to be suitable for any site or environment and to use resources efficiently. One important design consideration was ease of shipment and assembly.

· ***Ellipse house, 1936. Eileen Gray.***

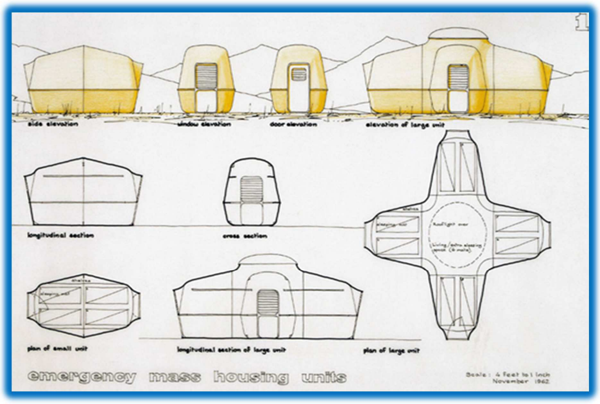


The project combines the concepts of temporary housing with his experimental attitude toward materials and shapes.

Intended for industrial production, is composed of concrete panels.

Complies with elliptic modular pieces to provide flexibility that can be erected very quickly.

· ***Emergency mass housting, 1962. Arthur Quarmby.***



The project combines the concepts of temporary housing with his experimental attitude toward materials and shapes. Intended for industrial production, is composed of concrete panels. Complies with elliptic modular pieces to provide flexibility that can be erected very quickly.

· ***Nakagin capsule tower, 1969. Kisho Kurokawa.***

Reputed to be the world's first structure that implemented the innovative idea of capsule architecture.

Kisho Kurokawa designed the Nakagin Capsule Tower based off of his sustainability concept called "Metabolism", encasing his vision of an architectural movement representative of organic growth and restructuring within building

· ***<u>Kitchen satellite, 1969. Luigi Colani.</u>***

An exercise in extreme ergonomics, Colani's kitchen was designed to have everything at arm's length.

The kitchen pod would connect to the main house. This is sort of the domestic equivalent of Vince Clarke's dome studio, which it is my dream to replicate in my backyard, should I ever have one.

· ***<u>Paper log house, 1995. Shigeru Ban.</u>***

Shigeru Ban's method of architecture is simple; to create structures that challenge the modern concept of materiality. Ban chooses to use simple recyclable material to create structures of magnificence. One of his most successful projects came at a time of great need. All the materials used were to be prefabricated and assembled at the site. Ban used Kirin Beer crates as the foundation for the one hundred and seventy-two foot site. Each of the crates was filled with bags of sand, which helped to anchor the crates to the site. Next, a thirteen by thirteen foot plywood floor lined at the edges with plywood pegs. Four and a half inch diameter cardboard tubes (each four millimeters thick) were slipped into the pegs and sealed at the joints with waterproof sponge tape. The tubes are held together horizontally by two quarter inch steel rods. The gabled roof is also supported by the cardboard tubes and is covered by a thick double-layered tent material. The gabled ends of the roof are operable, allowing the resident to open or close them at times of rapid climate change. The houses also contain operable windows and shutters, both framed in plywood.

· ***Emergency architecture units, 2009. Rintala Eggertsson architects.***

This is an emergency unit builded of modular wood components that provides the module the necessary conditions to resist the weather changes.

· ***Project Blob, 2009. dmvA.***

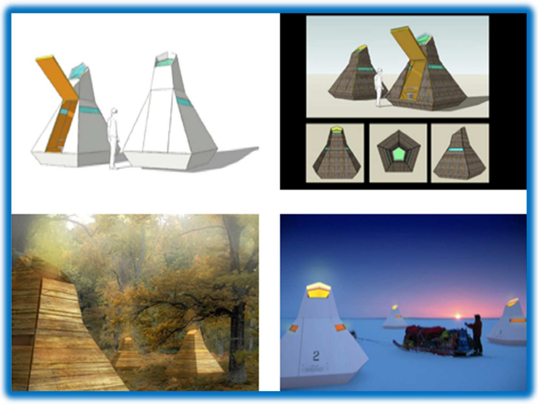
The design dmvA made for the office of XfactorAgencies, as an extension to the house, was relentlessly rejected by local building regulations.

Used to working with limitations and blurring these boundaries at the same time, dmvA answered by designing a mobile unit, a blob.

His space-egg houses all necessary items one could possibly need; bathroom, kitchen, lighting, a bed and several niches to store your stuff. The nose can be opened automatically and functions as a kind of porch.

The material used is polyester, sizes are like a big caravan and it can be moved to any place you like.

· ***Skin design it, 2009. Shelter competition.***



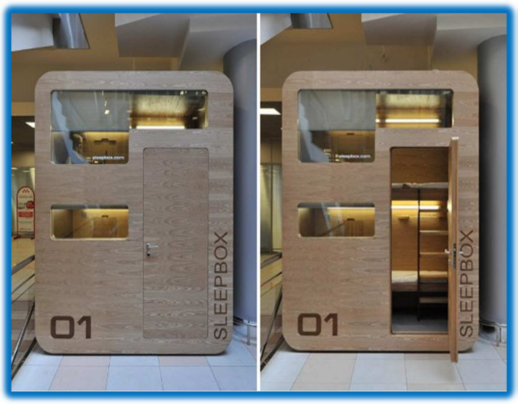
Skin is a shelter that adapts to its environment. The simple metal frame can be skinned with different materials to provide shelter in varying climates, keeping the user comfortable and protected.

The shed skin was for use in forests and the thicker white skin used in harsh conditions such as the Antarctic.

· ***Sleep box, 2011. Arch Group.***

Sleep box is a small space (2m x 1,4m x 2,3m) and its main functional element is a bed which is equipped with automatic system of change of bed linen. Bed is soft, flexible strip of foamed polymer with the surface of the pulp tissue. Tape is rewound from one shaft to another, changing the bed. If a client wants to sleep in maximum comfort, he can take the normal set of bed linen for an extra fee.

It is equipped with a ventilation system, sound alerts, built-in LCD TV, WiFi, sockets for a laptop, charging phones. Also under the lounges is a place for luggage. After the clients exit, automatic change of bed linen starts and quartz lamps turns on.
Payment can be made on a shared terminal, which provides the client with an electronic key. It is possible to buy from 15 minutes to several hours.



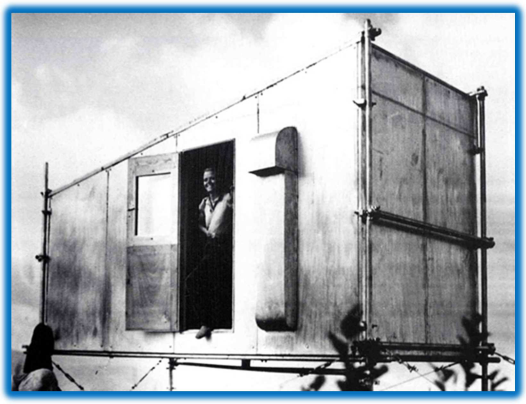
2.2.2. Dismantled architecture

· ***Dismantled house, 1929. GATCPAC.***

It was proposed as a type of dismantled minimum house for the holidays in Cataluña (Spain). The entire house should be above all manageable: volume, weight, size and cost. The house can be expandable and comes with the necessary furniture.

It seeks to live in harmony with the landscape and nature.

· ***Bivouac refuge, 1937.Charlotte Perriand and André Tournón.***



Is an emergency house in the mountains that can be built only in three days.

The house is formed by a lightweight construction of 9 tubular elements, 16 aluminum panels, 4 concrete bases which serve as foundation and other wooden elements that are used on the inside.

· ***Maisons a portiques, 1939. Jean Prouvé, Charlotte Perriand and Pierre Jeanneret.***

These pavilions were designed as removable temporary shelter for disaster victims after the liberation of France during World War II. Anyone of its elements should exceed one hundred kilos.

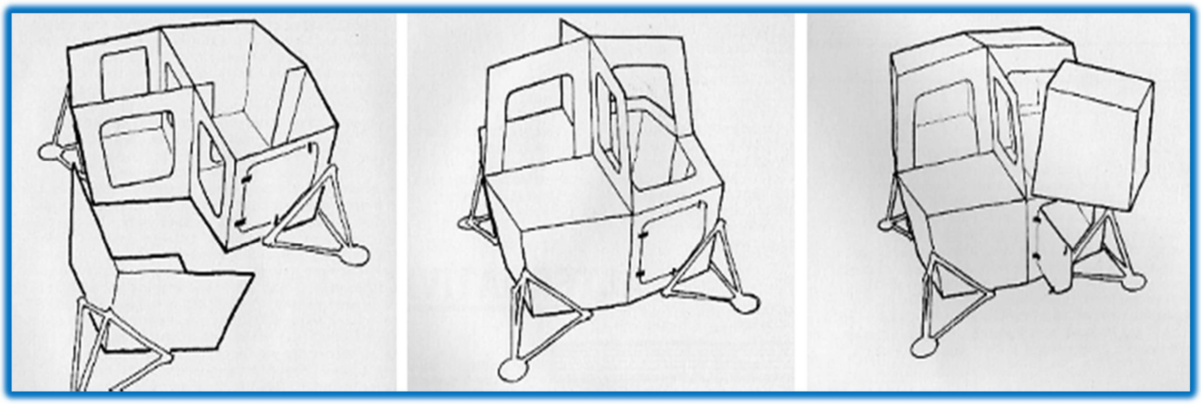
They respond to the idea of a quick and easy installation, without technical aids, that can be transported in a truck once.

· ***Venturo CF-45, 1971. Matti Suuronen.***

Venturo is part of a serie that the architect Matti Suuronen development for the Finnish company "Polikem Ltd" from the late 60's and early 70's.

It is a lightweight and a modular prefabricated structure that requires minimum assembly on site. This house was crafted from fiberglass, anodized aluminum and glass.

· ***8' MICROHOUSE, 1972. Ken Isaacs.***



Ken Isaacs created and designed this modular shelter that is flexible in a way where you can separate and divide it into tiny sections.

Recently in Central Glasgow a micro house based on Isaac's design was featured at the Hotel Gilchrist Exhibition.

· ***Elastic houses, 2008. Étienne Meneau.***

These houses are composed of square units which can be arranged and re-arranged to suit the inhabitant's needs. They are intentionally unstable, forcing the inhabitant to live with the actions and movement of nature. While it may not be the most practical dwelling, it poses questions relating to the relationship between architecture and nature.

· ***Bubble, 2009. MMASA arquitectos.***

It is a temporary shelter, portable, lightweight, easy to assemble and disassemble. The house is stored and transported in an aluminum box, which is integrated in a room of 4 m^2, equipped with water and electricity. The envelope consists in a double layer of plastic which can be used as a storage place.

· ***Y-bio, 2010. Group Archinoma.***

This group designed a temporary and modular colony that presents a new way to create an instant shelter and connection with the nature.

The Y-BIO unit is designed according to the "Sierpinski pyramid" mathematical model and is created by attaching three chains to three vertexes of three tetrahedrons strung up so that they're levitating slightly above the ground. The entire thing is held together using structural steel tubing.

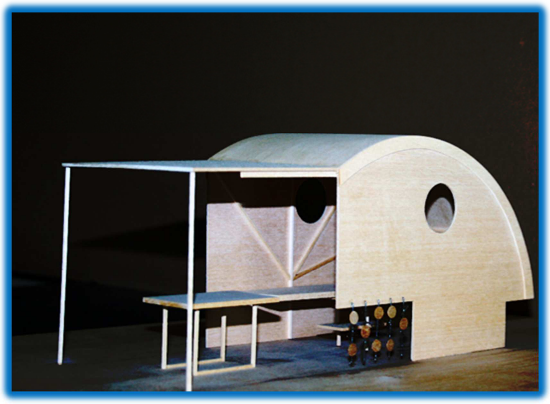
· ***Uber shelter, 2009. Shelter competition.***

Uber Shelter aims to create emergency relief houses for victims of natural disaster and war. Their shelter is portable, recyclable, easy to assemble, and ready to set up on almost any terrain.

The main goal of this pilot is to work with the families living in the shelters to understand from their perspective how to improve the product.

2.2.3. Folding architecture

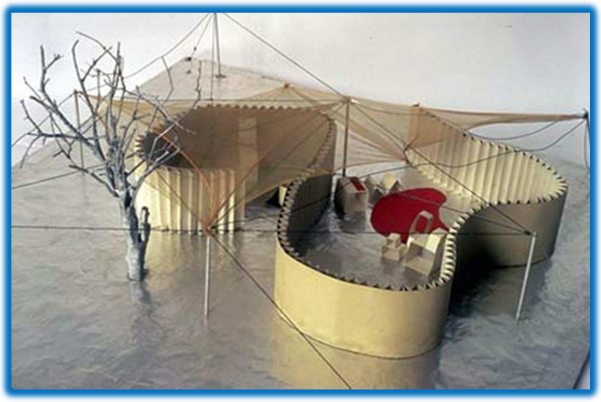
· ***Camping tent,1930. Eileen Gray and Jean Badovici.***



The “camping tent” is a flexible house that reinforced the concept of a life form possible. Eileen Grey designed the cover folding structure as a piece of metal "that could be assembled by a single person" because it is so light. The joints between the different parts were designed carefully. It could be transport by bike or car.

· *Cardboard village, 1969. Guy Rottier.*

This project consisted in "cardboard houses" designed to last three months and be burned at the end of the holidays.



It forces the vacationer to drill the openings and work in the roof with canopies made of plastic removed from the trash.

In short, they are shelters that developing their free plants on the site and promote a way of being new.

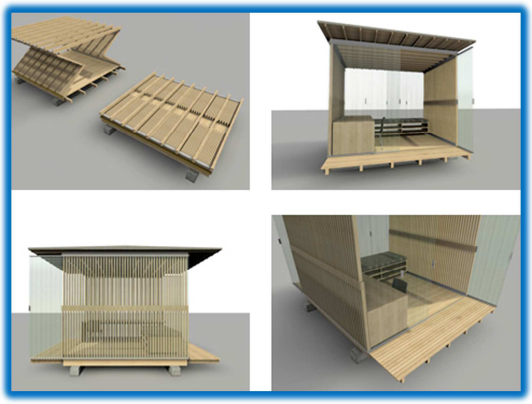
· *Cardborigami, 2007. Tina Hovsepian.*

Cardborigami is a relief shelter for urban homeless or disaster victims and even for people who need a house so immediate and temporary.

It, which can be distributed through various philanthropic organizations and NGOs, provides shelter and protection at low cost, with the immediacy and portability offered by its light weight and compact size.

It is made of standard corrugated cardboard treated for resistance to water and fire.

· *Unfolding View Shelter, 2009. Shelter competition.*



This simple shelter for the United States is made of wood. The walls fold completely to make a transportable structure. This shelter is made of prefabricated materials.

· ***<u>Waste-pickers, 2009. Shelter competition.</u>***

This shelter is made of corrugated metal and acts as a container that is displayed.

It is also easy to transport because it rotates.

· ***<u>Recover accordion, 2009. Shelter competition.</u>***

Designed for disaster relief, it can house a family of four for a month. It can be set up by one person in minutes, collapsed into either of two configurations for transportation (horse-shoe shape or flat), and is made of 100% polypropylene.

The polypropylene makes this shelter 100% recyclable, the ridges can collect drinking water, and the structure can be covered in local materials for better insulation.

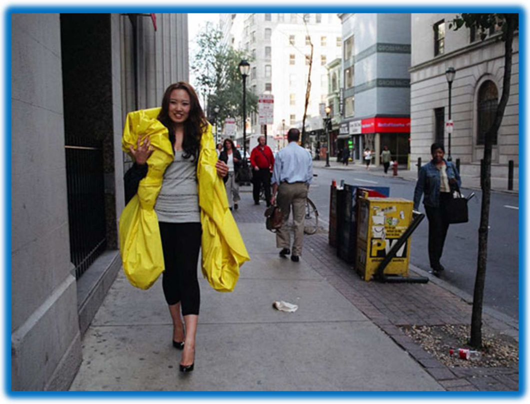
A wonderful giant accordion house to for those who are disaster ridden or a super-hip tent for the super-hip green hipster-camper.

· ***<u>Shellhouse, 2008. Carolina Pino.</u>***

Sellhouse is a cardboard shelter designed as a solution or reflection to the problem of homelessness.

The shape of this shelter is previously designed based on the art of origami.

· ***<u>Wearable shelter, 2009. Jin Hong and Sebastian Brauer.</u>***



Jin Hong and Sebastian Brauer were asked to fabricate solutions for a hypothetical post-disaster scenario in a metropolitan area. Because a cataclysmic event could displace potentially millions of people, the availability of emergency shelter would be a paramount concern.

Their solution was three durable, watertight, and wind-resistant garments that are lightweight enough for everyday wear yet easily convertible into tents or sleeping bags that can brave the elements.

· ***Snail House, 2009. Durica.***

The portable *Snail House* is an easy to transport instant housing option.

Modeled after the shell of a snail, the interior features an inflatable bed with LED chain lights for interior illumination.

The shelter comes in four renditions with different colors, lighting and energy source options, including a sustainable version that integrates solar cells for the nomadic green traveller.

· ***Box tent, 2009. Can Koseoglu.***

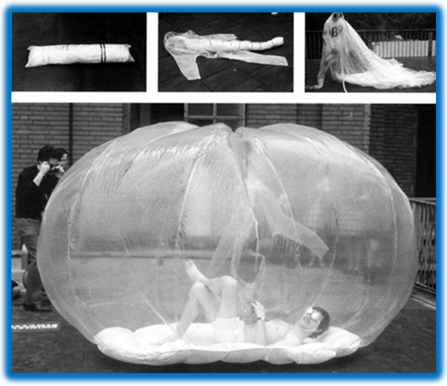
The Turkish designer Can Koseoglu devised an innovative tent that provides instant shelter for the victims during calamities.

Dubbed *Box,* the portable tent folds flat for easy storage as well as transportation that can easily be moved to the affected area. Is made of recyclable corrugated cardboard and polyester.

2.2.4. Inflatable architecture

· ***Cushicle, 1964. Michael Webb.***

This English architect was a founding member of the 1960s Archigram Group, a collection of six young architects who were determined to shake up what they saw as a stodgy British architectural profession. Using a magazine format, Archigram promoted a radical rethinking of the concept of architecture using inflatable structures like this one.



This unit nomad is an invention that allowed a man to transport it easy and quickly. The system is made up of a "cord" which forms the chassis and the envelope is inflated when is necessary. The other main element is an over inflated with additional skins and vision screens.

· ***Inflatonet, 1969. Ant Farm: Curtis Schereier.***

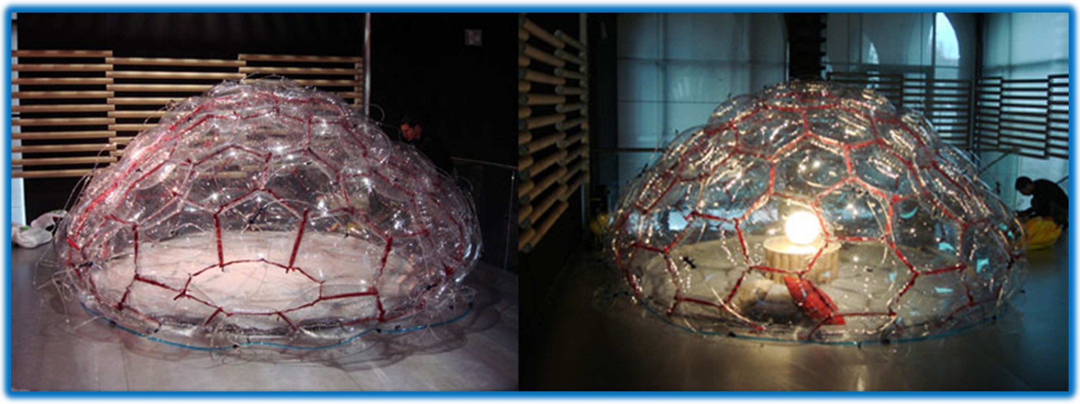
Ant Farm was an avant-garde group of architecture, graphic arts and design founded in San Francisco in 1968 by Chip Lord and Doug Michels.

The group was a self-described "art agency that promotes ideas that have no commercial potential, but which we think are important vehicles of cultural introspection."

“Inflatonet” was one of their inflatables constructions. They thought that the properties of the pneumatic structures were the solution for the mobility needs of an increasingly nomadic society and also allowed a more radical connection with the environment.

· *Smart structure,1968. Jose Miguel de Prada Poole.*

José Miguel de Prada Poole was the first Spanish architect who became in research, application and development of pneumatic structures in Spain. Smart structure is one example of his work. He had an occidental and no-European philosophy. Also he had worked taking into consideration the ecology, the natural sciences, the politic and the experimental engineering.



· *Instant City, 1971. Jose Miguel de Prada Poole.*

The *Instant City* was the headquarters for the International Congress of Design ADI-FAD celebrated in Ibiza (Spain).

It is a pneumatic structure that housed more than 500 people during the event. The conferences participated in the construction of this city.

· ***Neumatic capsules, 1972. Jose Miguel de Prada Poole.***

This construction was the home of the legendary Art Meetings celebrated in Pamplona (Spain).

The project consists of 11 hemispheres of 25 meters in diameter and 12 meters high and a couple if tunnels.

· ***Basic house, 1999. Martín Ruiz De Azúa.***

This easy-to-use house can be inflated with our body heat or the sun.

The golden side protects from the cold, the silver from heat.

It is a 2 x 2 x 2m cubic balloon of metalized polyester that can be easily folded up and carried in one pocket.

· ***ParaSITE, 2000. Michael Rakowitz.***

It was made on a budget of $5.00 from trash bags, ZipLoc bags, and clear waterproof packing tape.

The windows are made of Ziploc sandwich bags and serve as pockets to display personal items and signage for the public. The privacy and the publicity can be regulated by adding or removing objects.

2.2.5. Nature inspired architecture

· ***<u>Tree tents, 1998. Dré Wapenaar.</u>***

Tree tents were originally designed for the Road Alert Group, a group of activists who fighting against the excessive construction of roads through the British forests.

These are composed of a steel frame wrapped in canvas and measure 13 foot tall with a 9 foot diameter.

· ***<u>Folding Bamboo House, 2008.</u>***

These houses are intended to be used as temporary shelters in the aftermath of an earthquake.

They are constructed from renewable materials and can be folded into a variety of structurally sound shapes.

· ***Egg shaped, 2009. Dai Haifei.***

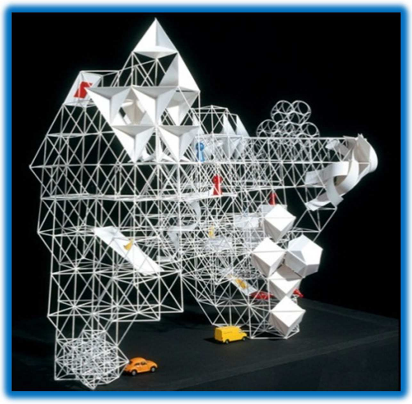
Dai Haifei, architecture student, developed a prototype eco-mobile home and he lived there 2 months.

The Egg shaped was constructed from bamboo strips and layered with bamboo matting.

The little house is equipped with lights, electric blanket and a pump-powered washbasin.

2.2.6. Futuristic architecture

· ***Raumstadt, 1959. Eckard Schulze-Fielitz.***



The concept *Raumstadt* of "space city" is a system of spatial structures through which can continue indefinitely in all directions.

A montage of three dimensional lattices (composed of tetrahedral and octahedral) divides the space.

The assemblies are flexible.

· ***ARCHIGRAM.***

Archigram was an avant-garde architectural group formed in the 1960s that was futurist, anti-heroic and pro-consumerist, drawing inspiration from technology in order to create a new reality that was solely expressed through hypothetical projects.

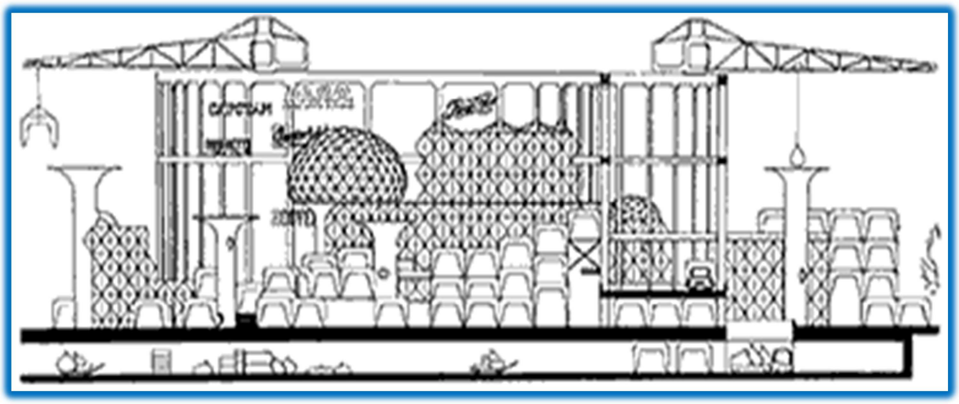
The main members of the group were Peter Cook, Warren Chalk, Ron Herron, Dennis Crompton, Michael Webb andDavid Greene.

Following are some of its main creations:

Plug-in-City, Peter Cook, 1964

Plug-in-City is a mega-structure with no buildings, just a massive framework into which dwellings in the form of cells or standardised components could be slotted.

The machine had taken over and people were the raw material being processed, the difference being that people are meant to enjoy the experience.



The Walking City, Ron Herron, 1964

The *Walking City* is constituted by intelligent buildings or robots that are in the form of giant, self-contained living pods that could roam the cities. The form derived from a combination of insect and machine and was a literal interpretation of Corbusier's aphorism of a house as a machine for living in.

The pods were independent, yet parasitic as they could 'plug in' to way stations to exchange occupants or replenish resources. The citizen is therefore a serviced nomad not totally dissimilar from today's executive cars.

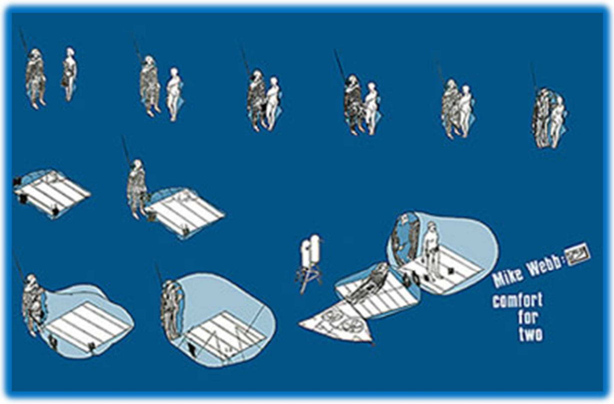
The context was perceived as a future ruined world in the aftermath of a nuclear war.

Capsule houses, 1964

They are prefabricated units relatively easy to assemble. These units are prefabricated modules that allow be replacement by cranes and they would be connected to the main structure, which would contain the core of communication and common services.

Suitaloon, Michael Webb, 1967

Suitaloon was an inflatable envelope for one person (or sometimes two), which is inflated when the resident had the need to feel "at home". Each unit can be connected to another unit to form a common space.



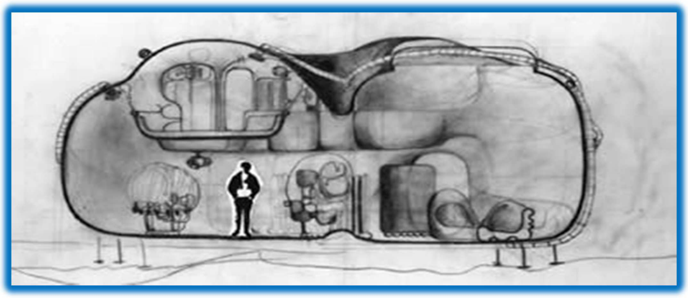
The Instant City, 1969

The *Instant City* is a mobile technological event that drifts into underdeveloped, drab towns via air (balloons) with provisional structures (performance spaces) in tow. The effect is a deliberate overstimulation to produce mass culture, with an embrace of advertising aesthetics.

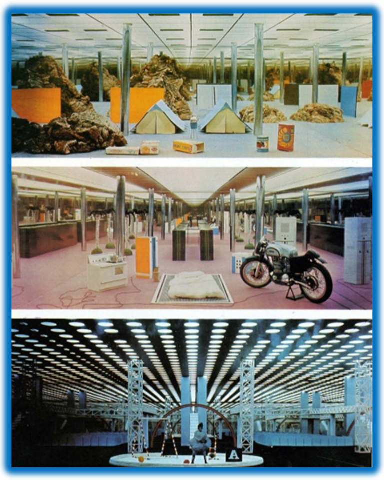
The whole endeavor is intended to eventually move on leaving behind advanced technology hook-ups.

Living pod

It set the tone for a discourse of architecture vis-à-vis technology. Is a lightweight house and it was constructed with amorphous and malleable materials.



· ***No-Stop City, 1970. Archizoom.***



No-Stop City is a qualityless city in which the individual can achieve his own housing conditions as a creative, freed and personal activity.

It is a critical Utopia, a model of global urbanization where design is the essential conceptual instrument used in the mutation of living patterns and territories.

2.2.7. Reused materials architecture

2.2.7.1. Pallet constructions

· ***Installation Big Orbits, 2001. Mehrdad Hadighi und Frank Fantauzzi.***

4600 shipping palettes were stacked in a gallery space, adjoining a courtyard of identical shape. Using elliptical geometry an ovoid volume was carved from the palette stack.

· ***Instant house (Pallet installation), 2004. Onix architects.***

The facility *Pallet installation* develops the concept of "instant home" or place that is constructed and deconstructed in a short period of time.

In the *Instant house* the focus is in the process, in the act of building. This structure, previously posed and stable, can be constructed in one hour.

· ***Pallet house, 2008. Schnetzer Andreas Claus and Pils Gregor.***

It was designed by these two students from the University of Vienna. Made out of reused pallets it is modular, energy efficient and affordable making it good for low income housing.

With this design, they won the Gaudi European Student Competition in 2008.

· ***Manifesto House, 2009. Infiniski (Jaime Gaztelu and Mauricio Geleano).***

The *Manifesto House* is based on a prefab design, allowing for cheaper and faster construction. It goes beyond the traditional modular system, however, with its bioclimatic architecture to allow the house to adapt to different energy needs through positioning. It uses three recycled maritime containers for such flexibility.

With two types of covers for this house, or "skin," the exterior mobile pallets can shed like a snake's skin to reveal wood panels from sustainable forests. In the winter, the open pallets allow the sun to heat the metal surface of the house.

·***The Paletten Pavillon, 2010. Matthias Loebermann.***

The *Paletten Pavillon* is a structure made entirely from shipping pallets and tie rods.

Designed to be easily assembled and dismantled, and then entirely recycled at a later date, the resulting building is intended as a temporary meeting place.

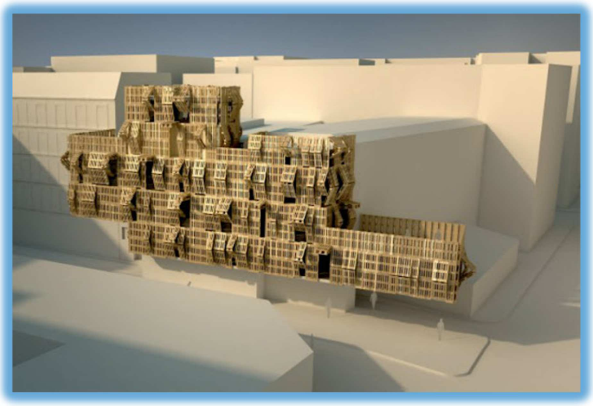
· ***<u>Modular pallet houses, 2010. Schnetzer Andreas Claus and Pils Gregor.</u>***

These two architects built upon what they learned from constructing modular pallet houses, improving upon their original design to make it even more affordable.

In previous designs, the pallets were used as floors, walls, ceilings and cladding, but they required sturdy wood beams, which were the most expensive part of the home.

The new round design eliminates some of these expensive beams, but it's still designed and built to European standards for structural soundness.

· ***<u>AME-LOT, 2011. Stephane Malka.</u>***



The student housing on rue Amelot is a project that inserts itself into an urban interstice: the thickness of a blind wall.

The urban form is an extension of the blind walls, which houses using the existing.

The skin consists of an existing module: the wooden pallet. Held using horizontal hinges, the pallets contract towards the top, allowing privacy or large openings. The modularity of the various palettes creates varied geometries, which are based on use and constantly regenerated.

2.2.7.2. Constructions with other reused materials

· ***<u>Dome theater, 2006. Terunobu Fujimori.</u>***

The *Dome theater* was a part of the exibition of Terunobu Fujimori organized in Japan for the Venice Biennale

The Dome Theater, woven from bamboo and rope, which was very popular in Venice, will be reconstructed here by the Jomon Company. The goal of the designer was to "rethink the basic relationship between architecture and nature using natural materials and plants and get closer to the time when human beings first built the artificial structures known as architecture”.

· ***<u>Church of Beer, 2008 (Brussels).</u>***

This tremendous cathedral constructed from 33.000 crates of Belgian beer brand Jupiler is purported to represent reusability.

The Beer cathedral was designed by the Brussels based architects of V+ as an extension of the Atomium Expo 58 held in the Belgian capital. Inside the cathedral an overview exhibition of the World Expo history was shown.

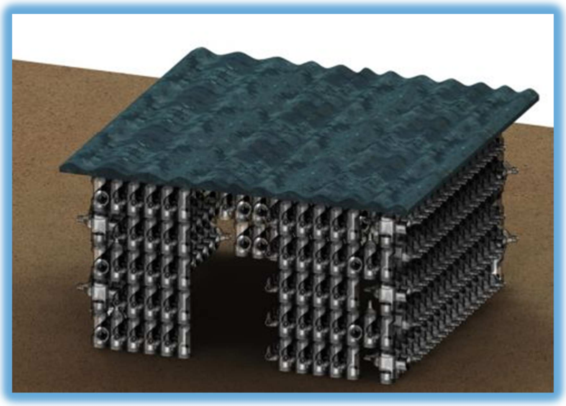
· ***<u>Cans Pavilion, 2008. “Bat Yam, Biennale of Landscape Urbanism“.</u>***

The *Cans Pavillion* was made during the Bat-Yam International Biennale of landscape urbanism in Israel.

This structure was made using old soup cans that were linked together at various points of their surfaces, allowing for an accordion effect. The overall structure is supported by a simple framework of metal rods, while the skin created by the soup cans folds to form a surface for sitting as well.

From afar, the pavilion almost looks like human-sized hive of sorts, remaking an empty, transitional public space into something much more habitable.

· ***<u>Bottles House, 2008. Matt Nápoles and Peter Zummo</u>***



They are two industrial-design students who recently unveiled a plan for water bottles that snap together like Legos.

The bottles stack to create almost any form imaginable, since they connect in two different ways: Click the top of one into the bottom of another for a straight line, or get a plus-sign shape by turning them crosswise and interlocking their notched middles.

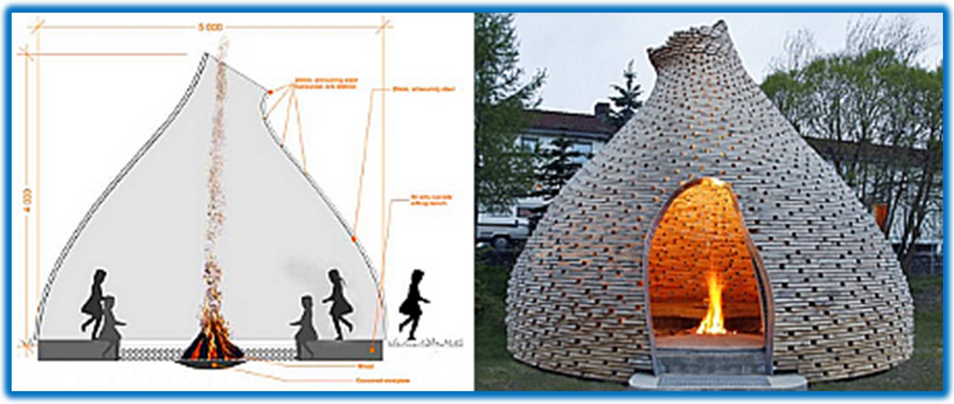
Lego-like though they are, the bottles can create structures far sturdier than a toy and do so essentially for free. Filled with dirt, sand, or another widely available material, the bottles become heavy enough to act like regular bricks. Build a house from them, and the sand or other filler would serve as an insulator to keep rooms warm or cool. Meanwhile, the plastic would make the house waterproof.

· ***Outdoor fireplace, 2009. Haugen/Zohar Arkitekter.***

This construction is an enclosed space for fire, storytelling and playing.

Is made of reusing leftover materials (from a nearby construction site) and is based on short wooden pieces. The structure is made of 80 layered circles and these circles have varied radius and a relative center point in relation to each other. Every circle is made out of 28 pieces of naturally impregnated core of pine that are placed with varied spaces to assure chimney effect and natural light.

Oak separators differentiate vertically between the pine pieces to assure airflow an easy drying of the pine pieces. A double curved sliding door was designed for locking the structure.



· ***Wedding chapel (Villa Escamp), 2009. Dus Architects.***

The *Wedding chapel* is part of *Villa Escamp*. In it, DUS shows how something as prosaic as ventilation pipes can be transformed into a structure that is not only serviceable but which has an almost numinous quality.

The trick lies in the fabrication: the chapel is in fact a scaled-up crocheted hat.

They spent three long days crocheting two kilometers of flexible white ventilation pipes together by hand using a pattern causing a sacral atmosphere with soft acoustics and beautiful lighting.

· ***Bottles House, 2009. Alfredo Santa Cruz.***

Constructed from thousands of Pet plastic bottles, possibly headed for improper disposal, the home created by the Alfredo Santa Cruz family in Puerto Iguazu (Argentina) is made in order to promote ecological and social responsibility.

He has designed their portable structures to be accessible, simple and creative down to the last detail. Alfredo also designed a smaller playhouse out of bottles for his young daughter. Now he is teaching others of his foolproof plan to fight homelessness in Argentina

2.3. Aims of the project

Before develop all the points about the design we have to define the aims that we want to satisfy in our project. These aims are the followings:

- **Designed for emergencies (natural disasters):**

  The chief use our project will be developed is for serve as an emergency accommodation, but it could be adapted to other circumstances which require a massive and impromptu accommodation.

- **Easy and fast assembly of the parts:**

  When there is a disaster the most important thing is the fast and easy distribution of the aid to victims. This is the concept we want to apply to our design, that is, achieve that the modules can be assembled at the disaster site in a simple and especially quick way.

- **Easy and economic transport:**

  Since in most emergency situations the resources have disappeared it will be impossible to build the house in situ. So, one of our main interest, is focused on the possibility of transport the modules in standardized containers and filling minimal space.

- **Space saving: in use, transportation and storage:**

  One of the keys of our design must be saving space, with the intention to transport the largest number of modules in a single container. In this way, the camp construction will be faster.

- **Low cost:**

  Due to the current economic situation and the fact that NGOs do not have many funds, we believe it is necessary to consider the cost of this project.

- **Use of recycled materials.**

- **Develop a complete refugee camp (distribution, organization…):**

  We not only want to focus on the design of temporary housing but also the design and distribution of the different infrastructures necessary when a refugee camp is set up. This refers to the situation of the different modules, the creation of common areas, the needs in terms of hygiene, protection, water and electricity...

2.4. Previous ideas

· *Cross plant:*

A group of modules forming a cross plant was our first idea. This is a set of cubic modules that allow to be stored one inside other. Each module had capacity for two persons and each set had a complete bathroom in the middle.

Although the idea initially met our requirements, the final dimensions were too big for what we wanted. Also, we realized that the idea of a bath per module was unnecessary.

· *Folding wood module:*

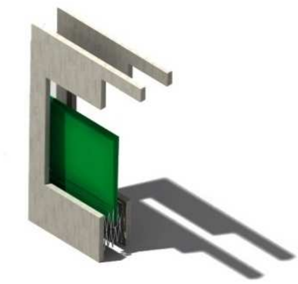
With this idea we developed more the concept of folding, concept that we followed during the development of our project. It is also a cubic module which is folded in one dimension by hinges.

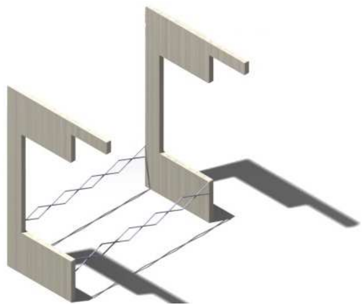
Although it was closer to the final idea, it still had a size too large, as well the way of folding did not let us attach the beds to the module for an easy installation.

· *Folding module:*

At this point we decided to make a separate module into two symmetrical halves as well as allow the use of individual modules. We also reduced the dimensions of the final package.

We continue with the idea of folding modules, but this time following a structure.

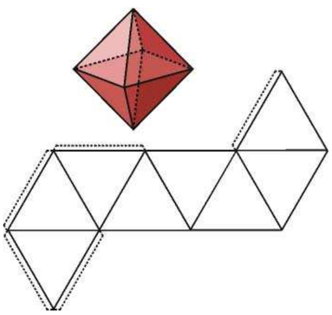


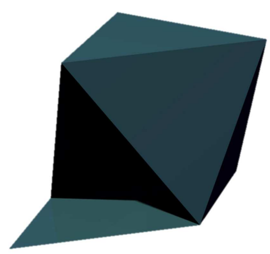


This design was discarded because the structure was not strong enough to the situations it could be seen exposed.

· *Octahedron:*

This time we developed the idea based on a fixed geometry, the triangle, that using different folds form a carrier in the form of an octahedron.

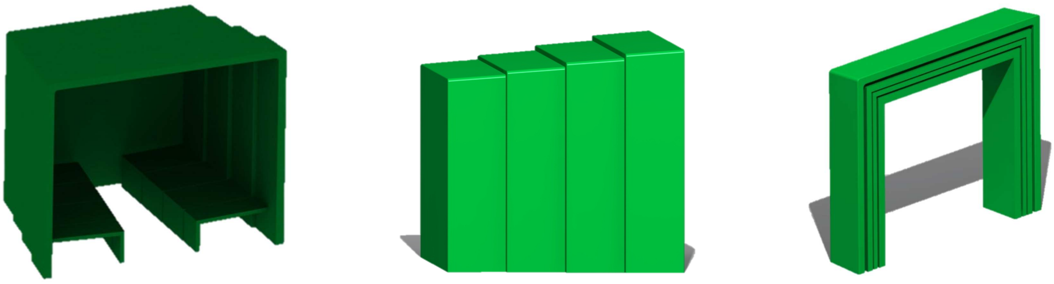




We finally decided that this idea was not functional enough so as it was very difficult to assemble.

· *Accordion module:*

To achieve something more resistant we thought of a module consisting of arches of different sizes that can be placed ones inside others. Each arch has embedded in the wall parts of the beds that are deployed once the module is ready.



Once again we find that the final package was not small enough.

· *Continous profile:*

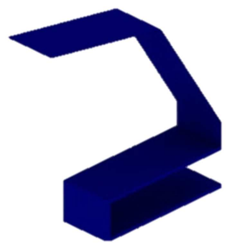
After all the above ideas, we arrived to the concept that would be the base of the final design. This idea continue with the concept of folding module in two symmetrical halves and a simply geometry.

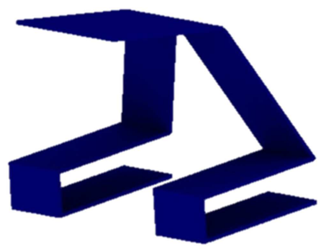
The idea consists of a laminate that by folds and forming a continuous profile creates enough space to accommodate two people with all their belongings. These modules can be used in pairs or individually, as well as could be attached into larger groups.

Obviously this is only a first approximation to what is the final idea, which has gone through various stages shown below.

· *Z profile:*

With this design we intended to test the different directions in which we could unfold the continuous profile, thereby obtaining a space very similar to the previous one (to accommodate two people, individuals or collective facilities...).

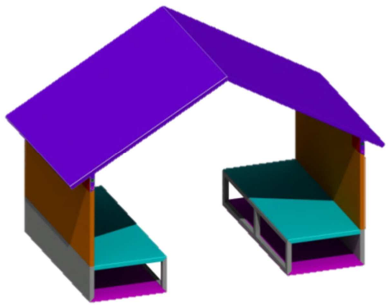




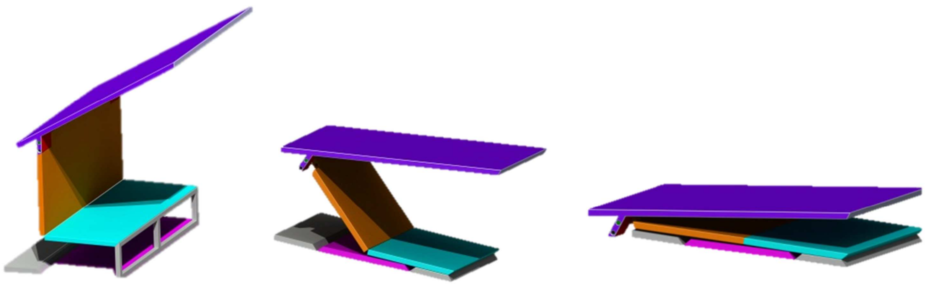
The upside of this module was the use of less material, which ultimately led to a major disadvantage: the module was more exposed to the weather elements.

2.5. Final solution

2.5.1. First approximation



After analyzing all the possibilities that all the different proposals offered us ,we opted for the idea of a continuous profile that would cover the accommodation and storage needs of a person and that could be folded in a compact way. With this idea we wanted to maximizing space and transport storage.

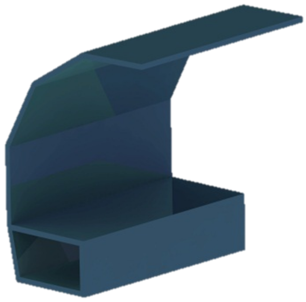


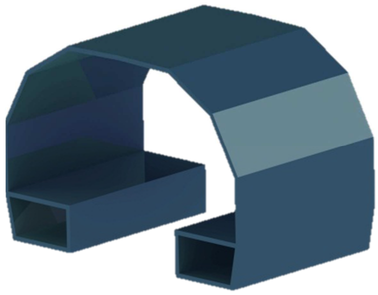
Our first approach fulfilled all the premises we had set, also had a very similar aesthetic result to a royal house and the method of folding was easy and took very little space.

Despite all this we decided to redesign this model as the final product folded measures were not enough manageable for one person.

Thereby adding the ease of handling to the list of requirements that our design was to meet, we come to what is our final design.

2.5.2. Second approximation





The second approximation is similar to the previous, except of the sheets that conform it are much narrower, thus minimizing the size of the final package.

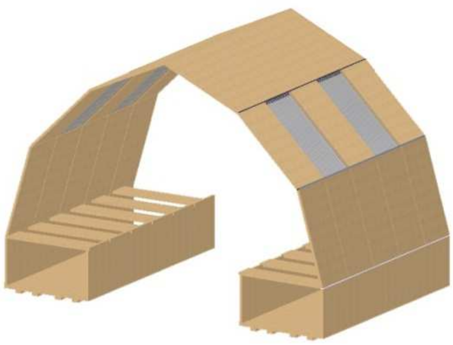
Like previous proposals, it is an indivual module which can be attached easily with others or simply placed on a wall and consists of a bed and storage space.

The method of folding is basic. We decided to introduce hinges to ensure the ability to manufacture or repair without much resources.

2.5.3. Final design

Starting from the idea of the previous module, we come to what is our final solution, which will be shown in detail below.

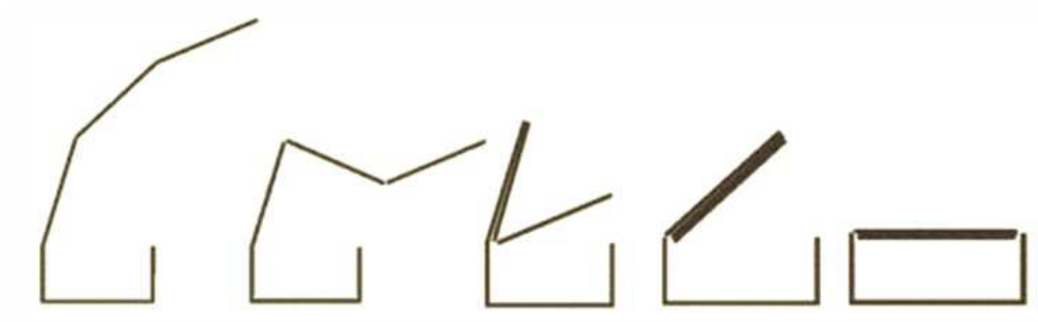
The basic idea is the same, it is an individual folding module divided into two halves which has an own storage space for each.



Furthermore,we decided to make the bed space and storage fixed to give stability to the whole. In this way we would have a storage space from the beginning where we could include, in addition to the module, a basic emergency kit, a blanket and a mattress.

One of the opened sides has a deck that folds out from the ground. The other consists of a textile cover that separates the beds and allows you to create larger modules from these.

We also added two sheets of polycarbonate translucent roof that let in light (without being this too) allowing the stability of the whole.



Way of folding

3. DESCRIPTION OF THE FINAL SOLUTION

3.1. Description of the components

Our product consists in a series of sheets joined together which are formed by several parts. We will describe them below.

3.1.1. Components of the module

SHEETS

Central sheets

All the central pieces share the same design so we name them together, explaining in detail the differences that appear in them and the material they are made.

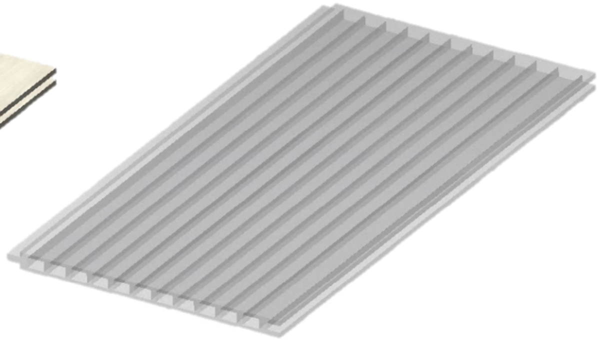
Sheets are manufactured by extrusion with the same profile but in different lengths.

It is the connecting piece between the laterals and it is attached to the other by form giving rise to a full sheet, this sheet is joined to other through components which we will detail later.

Profile of the central polywood sheets

Profile of the central polycarbonate sheets

Furthermore, these sheets are hollow in order to reduce the overall weight and ensure good insulation.



Central sheet of polywood *Central sheet of polycarbonate*

Polywood 800mm length sheets.

The model has 3.

Polywood 790mm length sheets.

The model has 3. These pieces present some holes in order to host the different sheets that compose the bed (these holes are defined in the *planes* of each one).

Example of one of the holed pieces

Polywood 770mm length sheets.

The model has 4. Three of them (central sheet 770 B) have a 45° cut edge in order to fit into the roof piece (this inclination is defined in the *planes*).

Polycarbonate 770mm length sheets.

The model has 2.

Polywood 350mm length sheets.

The model has 3. These sheets have a slot for host the cover when the module is folded (the slots are defined in the *planes*).

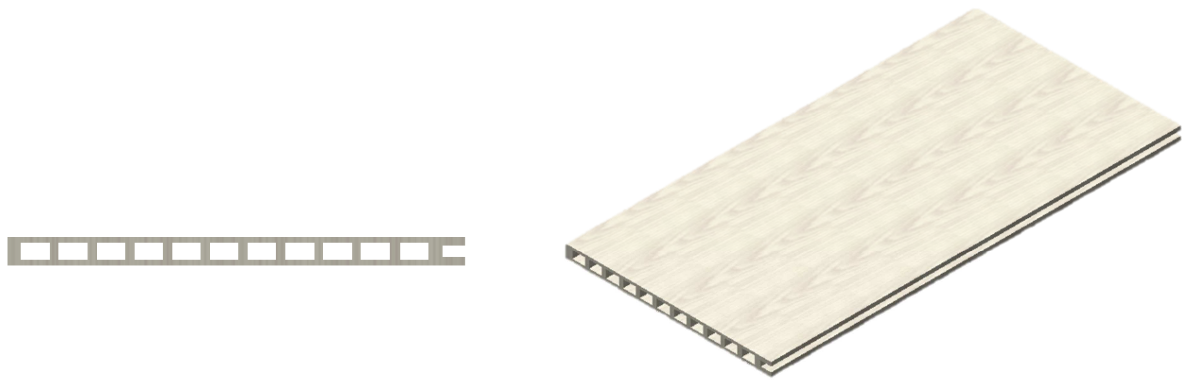
Polywood 375mm length sheets.

The model has 3. These sheets have also a slot for the cover. In addition the superior part of the pieces has a crenellated form (the form and the slot are defined in the *planes*).

Lateral sheets

There are two different types of lateral sheets (A and B); each of them is situated on a different end of the central sheets.

→ Lateral sheets A



Lateral sheet A (profile and perspective)

Polywood 800mm length sheet.

The model has 1. The sheet has two holes to fit the module to the pallet.

Polywood 790mm length sheet.

The model has 1. This piece presents a hole in order to host one of the sheets that compose the bed (this hole is defined in the *planes* of each one).

Polywood 770mm length sheets.

The model has 2. One of them has a 45° cut edge in order to fit into the roof piece (this slot and inclination are defined in the *planes*).

Polywood 350mm length sheet.

The model has 1. This sheet has a slot for host the cover when the module is folded (the slot is defined in the *planes*).

Polywood 375mm length sheet.

The model has 1. This sheet has a slot for host the cover when the module is folded .In addition the superior part of the piece has a crenellated form (the form and the slot are defined in the *planes*).

→ Lateral sheets B

Lateral sheet B (perspective and profile)

Polywood 800mm length sheet.

The model has 1. It has a 10mm length slot in order to host the polywood cover (this slot is defined in the *planes*). Moreover it has two holes to fit the module to the pallet.

Polywood 790mm length sheet.

The model has 1.

Polywood 770mm length sheets.

The model has 2. One of them has a 10mm slot in order to host the polywood cover.

Polywood 350mm length sheet.

The model has 1. This sheet has a slot for host the polywood cover when the module is folded (the slot is defined in the *planes*).

Polywood 375mm length sheet.

The model has 1. This sheet has a slot for host the polywood cover when the module is folded. In addition, the superior part of the piece has a crenellated form (the form and the slot are defined in the *planes*).

BED

Polywood sheets

The bed consists of a set of six polywood sheets of 800mm x 165mm joined together through a continuous profile of the same material. They slide through rails on the sheet of 375mm. They have a T form hole in order to host the carriages of the rail.

On the other hand, they are embedded in holes made in the profiles of 790mm thus they have a recess in one end of 47 °.

Bed sheets (perspective and profile)

Rails

The rails are commercial pieces that are defined in the *attached documents 7.* The function of this piece is to allow the movement of the bed sheets.

Support

Each one of the bed sheets are fix by five 315mm length rectangular profiles that allow to move these pieces together.

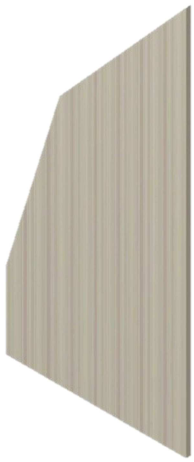
COVERS

Frontal cover

The frontal cover consists in two different parts: a sheet of polywood and a fabric door in the middle of two modules.

→ Polywood sheet

It consists in a solid profile of polywood which is used as support for the superior sheets. It has the shape of the final structure and is folding in order to be stored in the final box.



→ Fabric door

Each module has a half of a door made of fabric that are joined by a zip. This part of the cover is joined to the top of the modules with staples.

Fabric

The purpose of this fabric cover is to create an individual space for each bed. It is joined to the structure by staples and is folded with the other parts of the module.

JOINTS

Hinges

The hinges are commercial pieces that are defined in the *attached documents 6.*

Connecting panel pieces

All the individual panels that conform the parts of our module are joined by form but they have also a special connection piece in order to make this join stronger.

These pieces are use also to cover the union of the complete panels and to support the hinges and there are two different types:

→ Connecting panel pieces A

Perspective

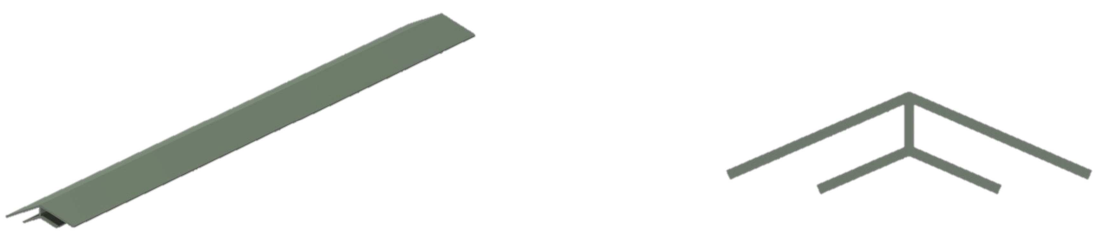
Profile and top view

→ Connecting panel pieces B

Profile and top view

Roof union

This is an L-shaped profile and it is embedded in the sheet which forms the roof of a module. The function of this piece is to ensure the perfect union of two individual modules preventing the formation of slots. In this way we avoid that the rainwater seeps into the shelter.



Roof union (perspective and profile)

FIXING ELEMENTS

Corner brace

The screws are commercial pieces that are defined in the *attached documents 8.*

Screws

The screws are commercial pieces that are defined in the *attached documents 9.*

Adhesive

The screws are commercial pieces that are defined in the *attached documents 11.*

3.1.2. Elements required for the installation

PALLETS

The palets are commercial pieces that are defined in the *attached documents.* They have holes in order to fit the modules through screws.

CONNECTING SLATS TO PALLETS

In the bottom of the box we add 4 polywood slats of 50mm x 2000mm in order to allow the movement of the modules over the palets. These pieces have to fit perfectly into the grooves of the pallets.

The union between the pallets and these slats is made through screws.

FIXING ELEMENTS

Screws and nuts

The screws and the nuts are commercial pieces that are defined in the *attached documents 10 and 11.*

3.1.3. Extra items

These elements are an extra help for the refugees. They are contained in the final box that the module form when is folded. This extra help consists of:

- One mattress.

- One blanket.

- One emergency kit.

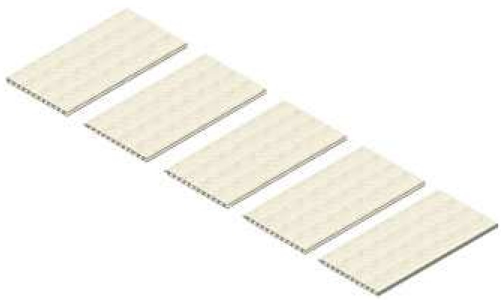
3.2. Assembly of the components

POLYWOOD PANELS

Each polywood panel is made of five sheets: three central sheets, one lateral sheet A and one lateral sheet B.

Lateral sheet A *Central sheets* *Lateral sheet B*

The parts that conform the polywood panels are joined by form.

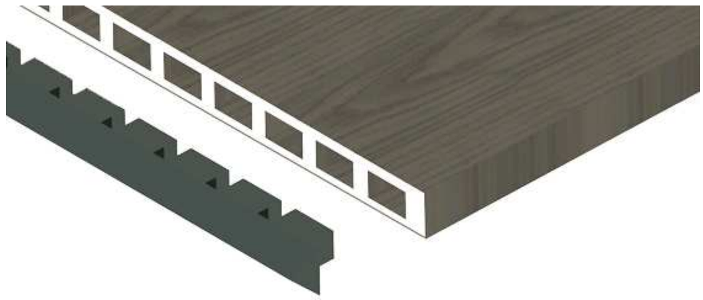


POLYWOOD + POLYCARBONATE PANEL

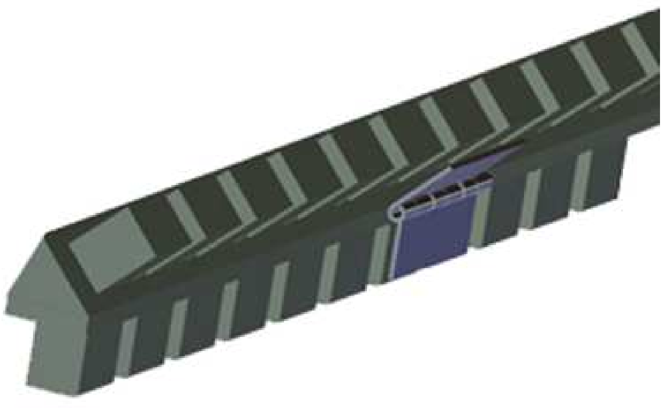
This panel is made of five sheets: three central sheets (one polywood sheet and two polycarbonate sheets), one lateral sheet A and one lateral sheet B.

PANELS + CONNECTING PIECES

The panels are joined together by the connecting pieces A and B.

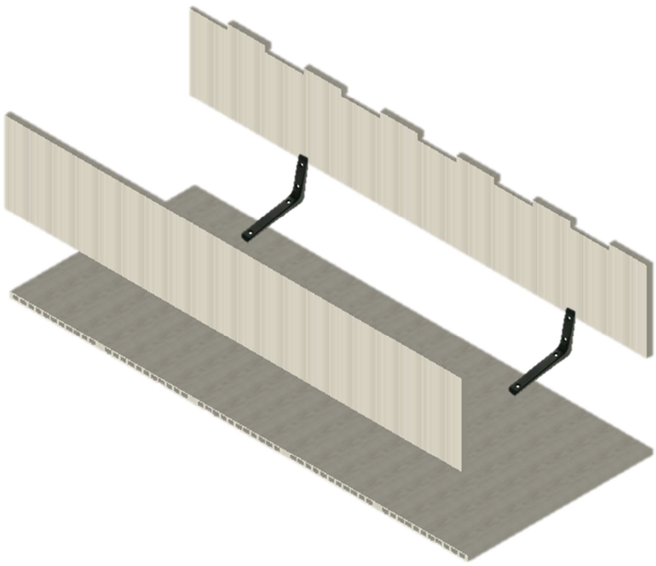


These connecting pieces are also joined together with hinges in order to guarantee the union.



BOX STRUCTURE

The union of the parts that conform the box structure is made by commercial pieces called corner brace *(attached documents 8).*



Detail of the box structure with its corner brace

BED STRUCTURE

The sheets that make up the bed structure are joined by a support in order to create just one piece and allow an easy movement of that. They are fixed by an especial adhesive (*attached documents 11*).

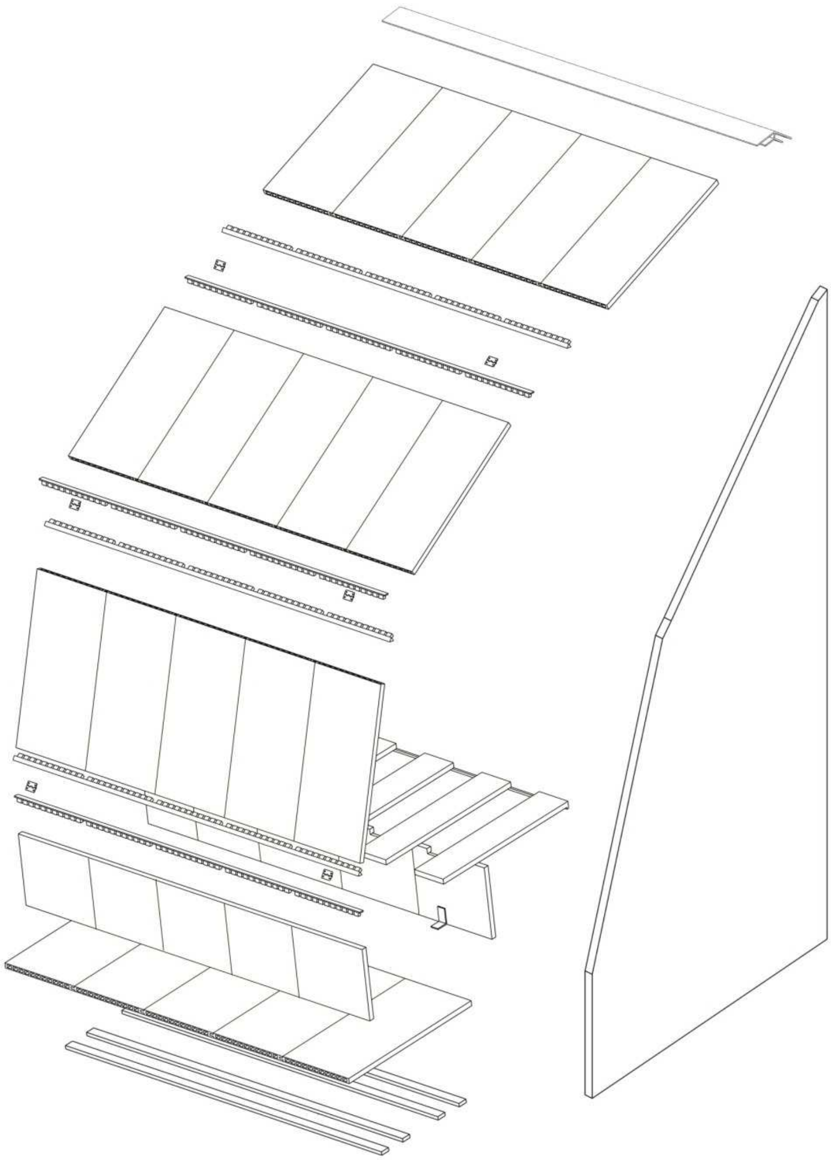
The sheets that make up the bed structure are joined by a support in order to create just one piece and allow an easy movement of that. They are fixed by an especial adhesive (*attached documents 11*).

In the other hand, is necessary that the bed sheets slide over the 375mm panel so we have added one rail for each sheet.

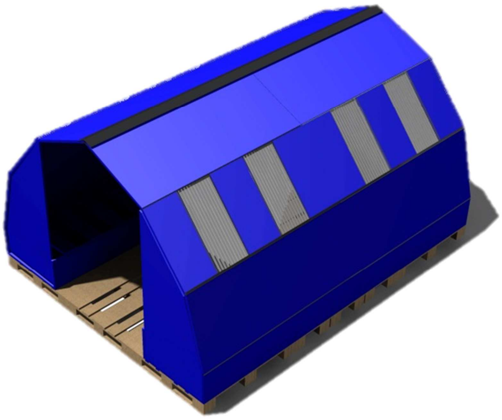
Detail of one bed sheet with its rail

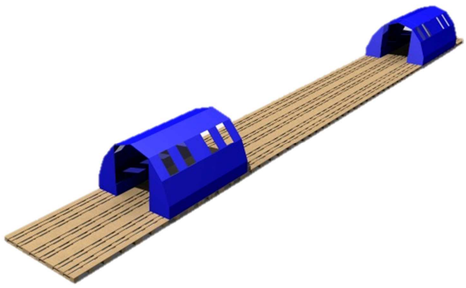
3.3. Final product

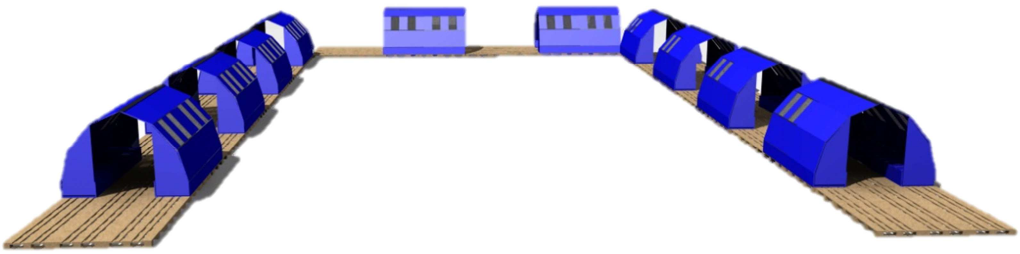
After everything that we explained, we got the assembly of the final model which will be explained in detail in the *planes*:



Some renders of the modules:







3.4. Choice of the name

Our product is designed in order to satisfy a need: to provide an adequate house to the people affected by any natural disaster. This is the reason why our design interact with the concept of hope; the hope of refugees to return to their daily lives.

After some analysis we decided that the house would have a name in Esperanto because this language it was created to foster harmony between people from different countries. Lázaro Zamenhof created Esperanto with the hope of that language become the international auxiliary language.

Finally we decided to call it:

BLUA

DOMO

Blua Domo means “blue house” in Esperanto.

4. PRODUCTION

4.1. Introdution

In this part we proceed to talk about the materials and the manufacturing process used for the development of our project.

From our point of view, the choice of materials is one of the most important decisions in the design of a product. It is important to know that each material has different technical characteristics and not all of them offer the same opportunities in terms of size, shape, efforts to support…

4.2. Materials

4.2.1. Polywood

Wood-plastic composite (WPC) or polywood is a composite material made of wood fibers and plastic.

WPC = 35% HDPE (high density polyethylene) + 60% wood fibers + 5% additives

Wood-plastic composites are still new materials relative to the long history of natural lumber as a building material. The most widespread use of WPCs in North America is in outdoor deck floors, but it is also used for railings, fences, landscaping timbers, cladding and siding, park benches, molding and trim, window and door frames, and indoor furniture.

Finally is necessary to highlight that this material presents two important characteristics for our design; the first one is that it is resistant to UV light and the second is that it is one of the materials with a less low environmental impact.

Wood-plastic composites were first introduced into the decking market in the early 1990s. Manufacturers claim that wood-plastic composite is more environmentally friendly and requires less maintenance than the alternatives of solid wood treated with preservatives or solid wood of rot-resistant species. These materials can be molded with or without simulated wood grain details.

In our design we decided to use polywood profiles because they have extremely interesting characteristics (more technical information in *attached documents 3*):

- High dimensional stability.
- Very high mechanical resistance.
- High resistance to the water.
- Resistant to chemical and other substances.
- Electrical insulator.
- Good surface finishing.
- Low cost of raw materials.
- It is processable by the wood tooling and assembly technology.
- Customize choice of the final mechanical characteristics, through the percentage of each raw materials.

Finally is necessary to highlight that this material presents two important characteristics for our design; the first one is that it is resistant to UV light and the second is that it is one of the materials with a less low environmental impact.

In addition to its good characteristics, the use of this material presents the following advantages:

- Design: the WPC profile can be made in any shape and size, according to his own needs.

- Cheapness: not requiring a specific treatment for the installation or maintenance works.
- Durability: specific laboratory testing and use for many years of this product confirmed that the WPC guarantees its characteristics for very long times.
- Maintenance: remaining substantially intact for several years, the WPC allows considerable savings on maintenance costs, making it even more economically attractive.
- Recycling: at the end of its life the WPC can be recycled 100%.
- Production: in each stage of production, scraps are reused to create another composite.
- No trees are cut: all the wood flour used in the stages of production comes from processing scraps.
- Raw materials: using renewable materials and regenerated polymers for the creation of the composite which is in turn 100% recyclable.

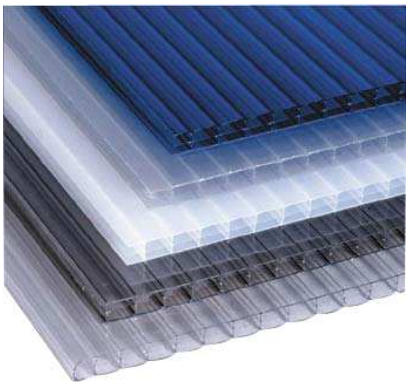
4.2.2. Polycarbonate

Polycarbonate is a material that is formed by a condensation polymerization resulting in a carbon that is bonded to three oxygens. The most common system for this polymerization is formed by a reaction of bisphenol A and phosgene.

Polycarbonates (PC) were first prepared by Einhorn in 1898 and extensively researched until 1930 where they were discarded. Research was then started in the mid-1950s by General Electric and in 1958 the Polycarbonate popularity expanded to a global community. Today, approximately 75% of the Polycarbonate market is held by SABIC Innovative Plastics and Bayer MaterialScience.

We decided to use this material because it presents excellent properties:

- High stiffness.
- Good impact resistance.
- Good resistance to heat deformation.
- Resistant to extreme weather conditions.
- Temperature of use between -150 °C and 120 °C.
- High impact strength.
- Highly transparent to visible light. It has better light transmission characteristics than many kind of glass.



The last two properties are the most important for our design because we thought in this material in order to make a shelter strong and light using polycarbonate sheets.

Also, these unique properties have resulted in applications such as bulletproof windows, break resistant lenses, compact discs, etc.

In addition to their excellent properties it is easily worked, molded and thermoformed.

4.2.3. PVC

Polyvinyl chloride, commonly abbreviated PVC, is the third-most widely produced plastic, after polyethylene and polypropylene.

We decided to use PVC for the connecting pieces of our module because it is cheaper than more durable longer lasting alternatives such as ductile iron.

Moreover, it can be made softer and more flexible by the addition of plasticizers, the most widely used being phthalates. In this form, it is used in clothing and upholstery, electrical cable insulation, inflatable products and many applications in which it replaces rubber.

4.3. Manufacturing

4.3.1. Extrusion

Extrusion is a process used to create objects of a fixed cross-sectional profile. The raw material is pushed or drawn through a die of the desired cross-section.

The main advantage of this process over other manufacturing processes is its ability to create very complex cross-section. It also forms finished parts with an excellent surface finish.

Extrusion may be continuous (theoretically producing indefinitely long material) or semi-continuous (producing many pieces) and can be done with the material hot or cold.

Hollow cavities within extruded material cannot be produced using a simple flat extrusion die, because there would be no way to support the center barrier of the die. Instead, the die assumes the shape of a block with depth, beginning first with a shape profile that supports the center section. The die shape then internally changes along its length into the final shape, with the suspended center pieces supported from the back of the die.

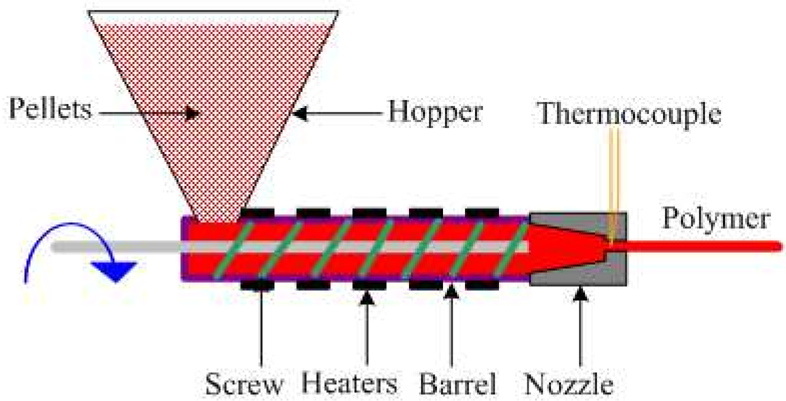
The process begins by heating the stock material (for hot or warm extrusion). It is then loaded into the container in the press. A dummy block is placed behind it where the ram then presses on the material to push it out of the die. Afterward the extrusion is stretched in order to straighten it. If better properties are required then it may be heat treated or cold worked.

The extrusion ratio is defined as the starting cross-sectional area divided by the cross-sectional area of the final extrusion. One of the main advantages of the extrusion process is that this ratio can be very large while still producing quality parts.

Commonly extruded materials include metals, polymers, ceramics, concrete and foodstuffs.

In our case, for the development of our project, we are only interested in the extrusion of plastic materials. **Plastic extrusion** commonly uses plastics chips or pellets, which are usually dried in a hopper before going to the feed screw.

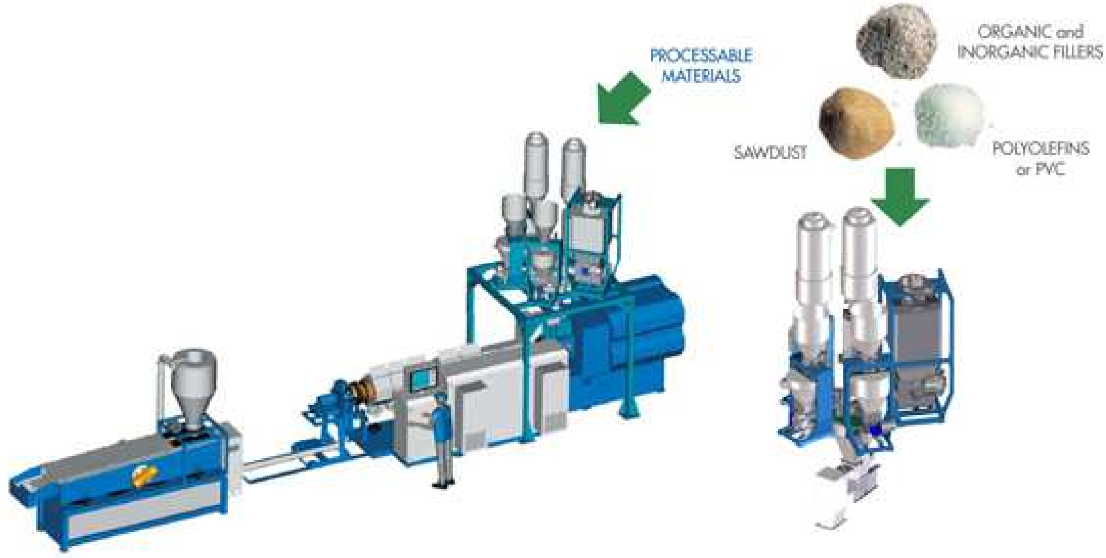
The polymer resin is heated to molten state by a combination of heating elements and shear heating from the extrusion screw. The screw forces the resin through a die, forming the resin into the desired shape. The extruded material is cooled and solidified as it is pulled through the die or water tank.



In some cases (such as fibre-reinforced tubes) this material is pulled through a very long die, in a process called pultrusion.

A multitude of polymers are used in the production of plastic tubing, pipes, rods, rails, seals, and sheets or films.

The polywood, in spite of being a composite material, is extruded in the same way to the rest of plastics.

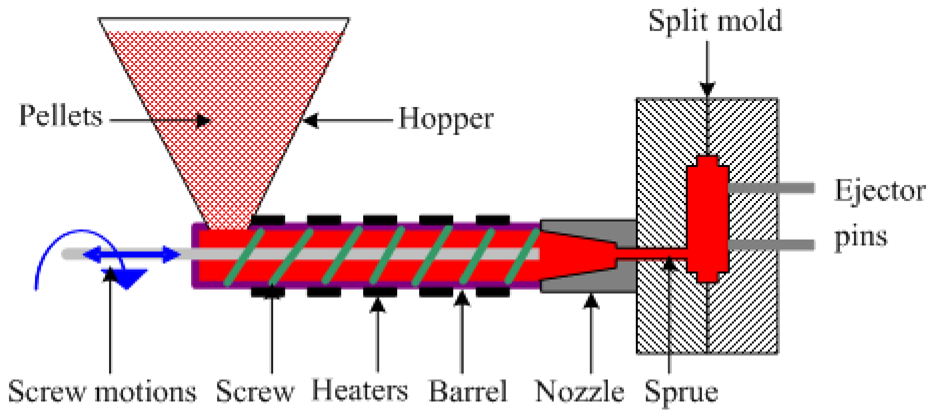


4.3.2. Injection

Injection is a manufacturing process for producing parts from both thermoplastic and thermosetting plastic materials. Material is fed into a heated barrel, mixed, and forced into a mold cavity where it cools and hardens to the configuration of the cavity.

After a product is designed, usually by an industrial designer or an engineer, molds are made by a moldmaker (or toolmaker) from metal, usually either steel or aluminum, and precision-machined to form the features of the desired part.

Injection molding is widely used for manufacturing a variety of parts, from the smallest component to entire body panels of cars.



The process consists of high pressure injection of the raw material into a mold which shapes the polymer into the desired shape.

Molds can be of a single cavity or multiple cavities. In multiple cavity molds, each cavity can be identical and form the same parts or can be unique and form multiple different geometries during a single cycle. They are generally made from tool steels but stainless steels and aluminum molds are suitable for certain applications.

Aluminum molds typically are ill-suited for high volume production or parts with narrow dimensional tolerances as they have inferior mechanical properties and are more prone to wear and damage and deformation during the injection and clamping cycles, but are cost effective in low volume applications as mold fabrication costs and time are considerably reduced. Many steel molds are designed to process well over a million parts during their lifetime and can cost hundreds of thousands of dollars to fabricate.

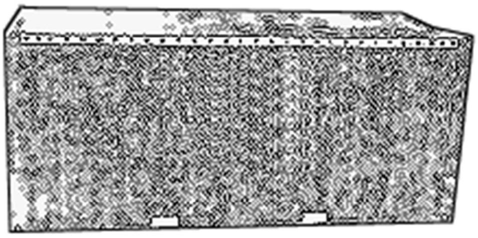
4.4. Summary

Polywood	Sheets	Extrusion
Polycarbonate	Translucent sheets	Extrusion
PVC	Connecting pieces	Injection

ATTACHED DOCUMENTS

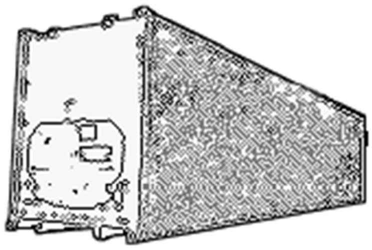
1) Standarized Containers Measurements:

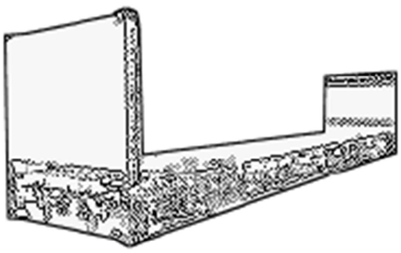
	Standard 20'		Sandard 40'		High Cube 40'	
Inside Length	19'4"	5.89 m	39'5"	12.01 m	39'5"	12.01 m
Inside Width	7'8"	2.33 m	7'8"	2.33 m	7'8"	2.33 m
Inside Height	7'10"	2.38 m	7'10"	2.38 m	8'10'	2.69 m
Door Width	7'8"	2.33 m	7'8"	2.33 m	7'8"	2.33 m
Door Height	7'6"	2.28 m	7'6"	2.28 m	8'5"	2.56 m
Capacity	1,172 ft3	33.18 m3	2,390 ft3	67.67 m3	2,694 ft3	76.28 m3
Tare Weight	4,916 lb	2,229 kg	8,160 lb	3,701 kg	8,750 lb	3,968 kg
Max. Cargo	47,999 lb	21,727 kg	59,040 lb	26,780 kg	58,450 lb	26,512 kg



	Open Top 20' (upgraded also available)		Open Top 40'	
Inside Length	19'4"	5.89 m	39'5"	12.01 m
Inside Width	7'7"	2.31 m	7'8"	2.33 m
Inside Height	7'8"	2.33 m	7'8"	2.33 m
Door Width	7'6"	2.28 m	7'8"	2.33 m
Door Height	7'2"	2.18 m	7'5"	2.26 m
Capacity	1,136 ft3	32.16 m3	2,350 ft3	66.54 m3
Tare Weight	5,280 lb	2,394 kg	8,490 lb	3,850 kg
Max. Cargo	47,620 lb	21,600 kg	58,710 lb	26,630 kg

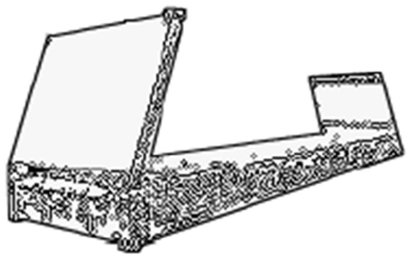
	Reefer 20'		Reefer 40'	
Inside Length	17'8"	5.38 m	37'8"	11.48 m
Inside Width	7'5"	2.26 m	7'5"	2.26 m
Inside Height	7'5"	2.26 m	7'2"	2.18 m
Door Width	7'5"	2.26 m	7'5"	2.26 m
Door Height	7'3"	2.20 m	7'0"	2.13 m
Capacity	1,000 ft3	28.31 m3	2,040 ft3	57.76 m3
Tare Weight	7,040 lb	3,193 kg	10,780 lb	4,889 kg
Max. Cargo	45,760 lb	20,756 kg	56,276 lb	25,526 kg





	Flat Rack 20'		Flat Rack 40'	
Inside Length	18'5"	5.61 m	39'7"	12.06 m
Inside Width	7'3"	2.20 m	6'10"	2.08 m
Inside Height	7'4"	2.23 m	6'5"	1.95 m
Tare Weight	5,578 lb	2,530 kg	12,081 lb	5,479 kg
Max. Cargo	47,333 lb	21,469 kg	85,800 lb	38,918 kg

	Flat Rack Collapsible 20'		Flat Rack Collapsible 40'	
Inside Length	18'6"	5.63 m	39'7"	12.06 m
Inside Width	7'3"	2.20 m	6'10"	2.08 m
Inside Height	7'4"	2.23 m	6'5"	1.95 m
Tare Weight	6,061 lb	2,749 kg	12,787 lb	5,800 kg
Max. Cargo	61,117 lb	27,722 kg	85,800 lb	38,918 kg



	Platform 20'		Platform 40'	
Inside Length	19'11"	6.07 m	40'0"	12.19 m
Inside Width	8'0"	2.43 m	8'0"	2.43 m
Inside Height	7'4"	2.23 m	6'5"	1.95 m
Tare Weight	6,061 lb	2,749 kg	12,783 lb	5,798 kg
Max. Cargo	52,896 lb	23,993 kg	66,397 lb	30,117 kg

2) Standarized Pallets. Measurements:

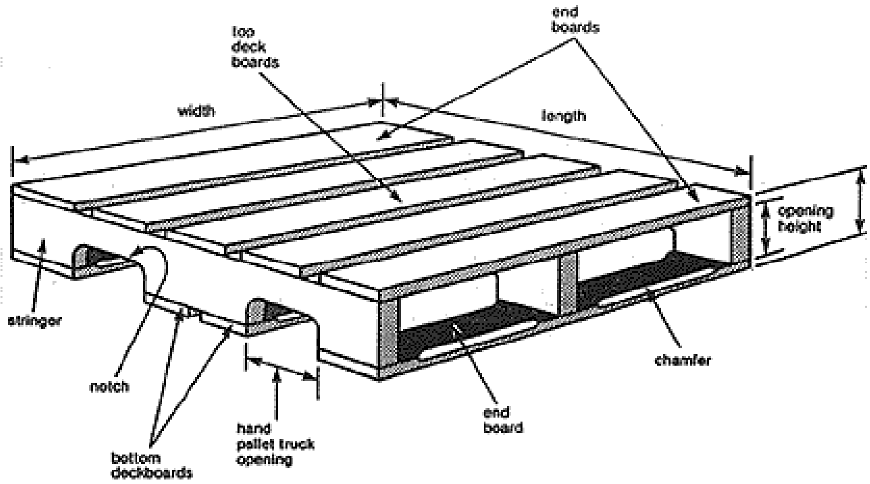
Table 1: Top 10 pallet sizes in North America in 2000 (Southern Illinois University)

Pallet Size (in.)	Production Rank	Typical Industry
48x40	1	Grocery, common in many other industries
42x42	2	Telecommunications, Paint
48x48	3	Drums
40x48	3	DOD, Cement
48x42	5	Chemical, Beverage
40x40	5	Dairy
48x45	7	Automotive
44x44	8	Drums, Chemical
36x36	9	Beverage
48x36	10	Beverage, Shingles, Packaged Paper

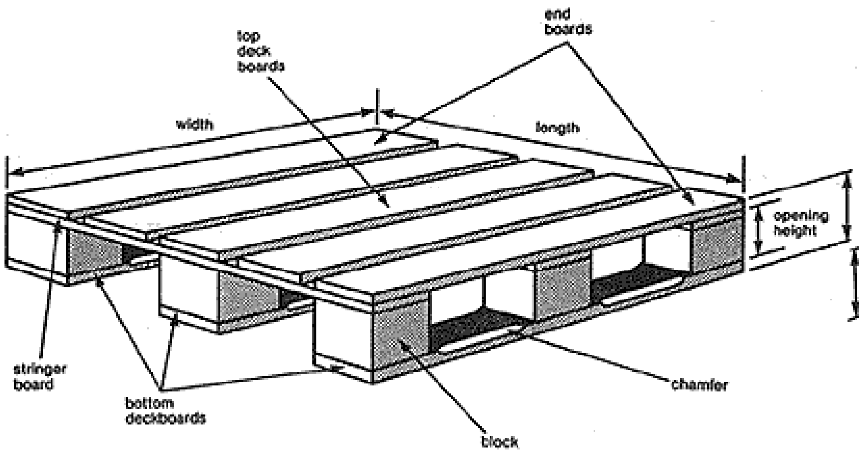
Table 2: Six pallet footprints recognized by ISO 6780

Metric size (mm)	US size (inches)	Region
1200 x 1000	47.24 x 39.37	Europe, Asia
1200 x 800	47.24 x 31.50	Europe
1219 x 1016	48.00 x 40.00	North America
1140 x 1140	44.88 x 44.88	Australia
1100 x 1100	43.30 x 43.30	Asia
1067 x 1067	42.00 x 42.00	North America, Europe, Asia

PRINCIPAL PARTS OF WOODEN PALLETS



Stringer Design



Block Design

3) Polywood. Technical data:

	Testmethod	Unit	Poly-wood	Poly-wood Light
Material	-	-	PE-HD	PE-HD
Specific gravity	ISO 1183	g/cm^3	0,945 - 0,955	0,70 - 0,72
Max. operating temperature	-	°C	70	70
Min. operating temperature	-	°C	- 50	- 50
Molecular weight	-	Mio./m.	> 0,25	> 0,25
Mechanical properties				
Tensile strength	ISO 527-1	N/mm^2	23	15
Breaking strength	ISO 527-1	N/mm^2	32	15
Elongation at break	ISO 527-1	%	> 50	> 25
Modulus of elasticity in tension	ISO 527-1	N/mm^2	800	650
Sensivity	ISO 179	mJ/mm^2	10	8
Ball-thrust hardness 30 secs.	ISO 2039-1	N/mm^2	40	-
Shore hardness D (15 s)	ISO 868	-	63	62
Wear resistance	sand-slurry	-	450 - 550	500 - 600
Thermal properties				
Crystalline grain melting range	DIN 53 736	°C	130 - 135	130 - 135
Thermal conductivity	DIN 52 612	W/m·K	0,43	0,3 - 0,4
Coefficient of linear expansion between 20 and 100°C	DIN 53 752	K^{-1}	$2 \cdot 10^{-4}$	$1,5 \cdot 10^{-4}$ - $2,3 \cdot 10^{-4}$
Vicat-softening temperature - VSP/a/50	ISO 306	°C	123	-
Vicat-softening temperature - VSP/b/50	ISO 306	°C	67	67
Electrical properties				
Insulation resistance	DIN VDE 0303	Ω·cm	$>10^{14}$	$>10^{15}$
Surface resistance	DIN VDE 0303	Ω	$>10^{15}$	$>10^{15}$
Dielectric strength	DIN VDE 0303	Kv/mm	75	25
Proof tracking index	IEC 112	CTI	600	600
Electrical coefficient at $2 \cdot 10^6$ Hz	IEC 250	-	2,5	-
Dielectric loss factor at 10^6 Hz	IEC 250	-	$6 \cdot 10^{-4}$	-
Arc resistance	VDE0303	degree	L4	L4

4) Polycarbonate. Technical data:

PC (High Viscosity, Molding and Extrusion)

General

Designation

Polycarbonate (High Viscosity, Unfilled, Molding and Extrusion)

Density	1190	-	1210	kg/m^3
Price	2.997	-	3.296	EUR/kg
CO2 creation	* 3.92	-	4.34	kg/kg
Production Energy	* 101	-	112	MJ/kg
Recycle Fraction	* 0.45	-	0.55	

Tradenames

Alcom; Alfacarb; Anjalon; Apec; Astalon; AxxisPC; Azloy; Barlo; Bayblend; Beetle; Calibre; CarboGlass; Carbotex; Celstran; Cycoloy; Cyrolon; Dafneloy; Daitoplex; Decarglas; Diaterm; Durmax; Durolon; Dynacom; Ecocarb; Edgetek; Emerge; Ensicar; Forex; Hiloy; Hygard; Hylex; Hynsin; Hyzod; Iupilon; Iupon; Karbolon; Kobaloy; Kopla; Latilon; Lexan; Lubrilon; Lupoy; Luvocom; Makroclear; Makrofol; Makrolon; Markoblend; Maxxam; Megarad; Monogal; Multilon; Navalloy; Naxell; Nirion; Novamate; Novarex; Nyloy; Palsafe; Panlite; Paramighty; PCLight; Perlex; Permastat; Pokalon; Polygal; Polyman; Remex; RowTec; Scantec; SDPolyca; Seracarb; Sewon Glas; Shinite; Signature; Sinvet; Sitralon; Stapron; Staren; Staroy; Stella; Sungal; Sustanat; Tarolon; Tecanat; Teklon; Tekulon; Terez; TismoPoticon; Trirex; Tuffak; Tynec; Ultratuf; Vampcarb; Wonderlite; Xantar; Xenoy; Zelux

Composition

Composition (Summary)

(O-(C6H4)-C(CH3)2-(C6H4)-CO)n

Base	Polymer			
Polymer	100			%

Mechanical

Bulk Modulus	* 3.834	-	4.026	GPa
Compressive Strength	69	-	86.2	MPa
Elongation	110	-	120	%
Elastic Limit	59.1	-	65.2	MPa
Endurance Limit	* 23.7	-	30.81	MPa
Fracture Toughness	2.1	-	2.3	MPa.m^1/2
Hardness - Vickers	* 17.7	-	19.6	HV
Loss Coefficient	* 0.01639	-	0.01724	
Modulus of Rupture	86.2	-	93.1	MPa
Poisson's Ratio	* 0.3912	-	0.407	
Shape Factor	4.6			
Shear Modulus	* 0.8291	-	0.872	GPa
Tensile Strength	62.7	-	72.4	MPa
Young's Modulus	2.32	-	2.44	GPa

Thermal

Glass Temperature	142	-	158	°C
Maximum Service Temperature	* 104	-	119	°C
Minimum Service Temperature	* -43	-	7	°C
Specific Heat	* 1535	-	1596	J/kg.K
Thermal Conductivity	0.189	-	0.205	W/m.K
Thermal Expansion	120.1	-	124.9	µstrain/°C

Electrical

Breakdown Potential	* 15.98	-	19.17	MV/m
Dielectric Constant	3.1	-	3.3	
Resistivity	1e20	-	1e21	µohm.cm
Power Factor	* 8.6e-4	-	9.4e-4	

Optical

Transparency	Optical Quality			

No warranty is given for the accuracy of this data. Values marked * are estimates.

PC (High Viscosity, Molding and Extrusion)

Durability

Flammability	Good
Fresh Water	Very Good
Organic Solvents	Average
Oxidation at 500C	Very Poor
Sea Water	Very Good
Strong Acid	Very Good
Strong Alkalis	Poor
UV	Good
Wear	Average
Weak Acid	Very Good
Weak Alkalis	Good

Notes

Typical Uses

Safety shields and goggles; lenses; glazing panels; business machine housing; instrument casings; lighting fittings; safety helmets; electrical switchgear; laminated sheet for bullet-proof glazing; twin-walled sheets for glazing; kitchenware and tableware; microwave cookware, medical (sterilisable) components.

Reference Sources

Data compiled from multiple sources. See links to the References table.

Links

Reference

Shape

Structural Sections

Producers

ProcessUniverse

5) PVC. Technical data:

CES 2005 EDUPACK

PVC (20% Glass Fibre, Molding)

General

Designation

Polyvinyl Chloride (20% Glass Fibre, Molding)

Density	1430	-	1500	kg/m^3
Price	* 1.882	-	2.07	EUR/kg
CO2 creation	* 7.68	-	8.49	kg/kg
Production Energy	* 109	-	121	MJ/kg
Recycle Fraction	* 0.09	-	0.11	

Tradenames

Acvitron; Advex; Alphacan; Apex; Apiflex; Arlinyl; Asnil; Benvic; Boltaron; Celtec; Certavin; Clealite; Crossvinil; Crylac; Decelith; Dural; Duromix; Ecolvin; Ecovil; Epivyl; EslonPlate; Etinox; Evicom; Evilon; Fiberloc; Formolon; Geon; GeonFiberloc; Hishiplate; Hy-Vin; Indovin; Kaneka; Lacovyl; Lajavinyl; Lucalor; Marvelate; Marvylan; Mazpound; Mecian; Mron; Nakan; NanYa; Neralit; Nipolit; Nordvil; Norvinyl; Novablend; Novacycle; Novatemp; Nuvin; Oxyclear; OxyVinyls; Palvinyl; Petvinil; Pevikon; Polanvil-S; Polyvin; Reon; Rimtec; Simona; Sinvicomp; Sinvoprene; Slovanyl; SolVin; Sumilite; Sunprene; Superkleen; Suvyl; Sylvin; Tanegum; Tarvinyl-S; Tecavinyl; Tefanyl; Treglum; Trocal; Tygon; Unichem; Vinidur; Vinika; Vinnolit; Vinoflex; Vintec; Vinuran; Vinycel; Vinychlon; Vinyfoil; Vistel

Composition

Composition (Summary)

(CH2CHCl)n + Glass filler

Base	Polymer	
Glass (fibre)	20	%
Polymer	80	%
SiO2 (Silica)	20	%

Mechanical

Bulk Modulus	* 7.201	-	7.561	GPa
Compressive Strength	* 56.93	-	84.77	MPa
Elongation	2	-	5	%
Elastic Limit	* 47.44	-	70.64	MPa
Endurance Limit	* 23.72	-	35.32	MPa
Fracture Toughness	* 2.727	-	3.273	MPa.m^1/2
Hardness - Vickers	* 14.2	-	21.2	HV
Loss Coefficient	* 0.01057	-	0.01356	
Modulus of Rupture	97.9	-	155	MPa
Poisson's Ratio	* 0.3661	-	0.3809	
Shape Factor	8			
Shear Modulus	* 1.707	-	2.435	GPa
Tensile Strength	59.3	-	88.3	MPa
Young's Modulus	4.69	-	6.69	GPa

Thermal

Glass Temperature	75	-	105	°C
Maximum Service Temperature	49	-	62	°C
Minimum Service Temperature	* -43	-	7	°C
Specific Heat	* 1335	-	1388	J/kg.K
Thermal Conductivity	* 0.3789	-	0.3941	W/m.K
Thermal Expansion	43.2	-	64.8	µstrain/°C

Electrical

Breakdown Potential	* 14.47	-	17.36	MV/m
Dielectric Constant	* 4.532	-	4.986	
Resistivity	* 1e20	-	1e21	µohm.cm
Power Factor	* 0.01925	-	0.0231	

Optical

No warranty is given for the accuracy of this data. Values marked * are estimates.

Transparency	Opaque

Durability

Flammability	Very Good
Fresh Water	Very Good
Organic Solvents	Average
Oxidation at 500C	Very Poor
Sea Water	Very Good
Strong Acid	Good
Strong Alkalis	Average
UV	Very Good
Wear	Average
Weak Acid	Very Good
Weak Alkalis	Very Good

Notes

Typical Uses

Pipe and pipe fittings; building products; bottles; film; records; floor tiling.

Reference Sources

Data compiled from multiple sources. See links to the References table.

Links

Reference

Shape

Structural Sections

Producers

ProcessUniverse

6) Hinges:

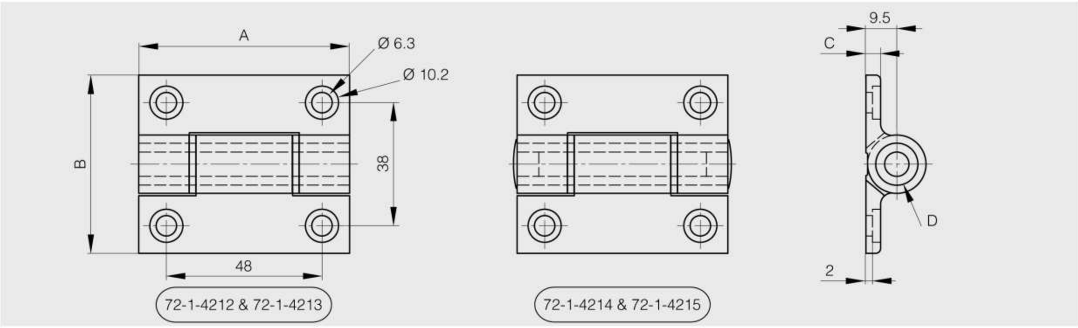
Hinges / Various hinges

Aluminium hinges

new!

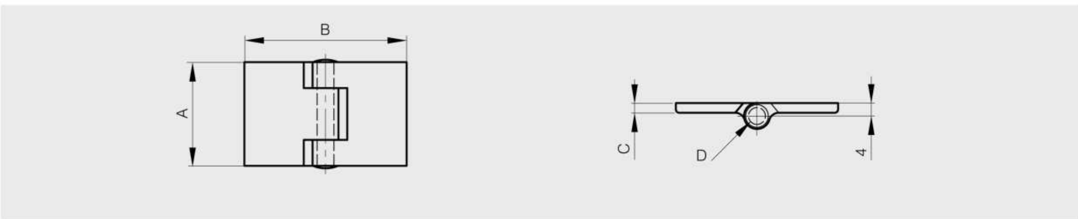
This hinge has the same footprint as our friction, detent and spring hinges.
All are fully interchangeable.
Plastic pin with or without end caps.

A	B	C	D	torque	part number	material	finish	weight
65	55	4.5	13	without cap	**72-1-4212**	alu 6060 T5	clear anodised	130g
65	55	4.5	13	without cap	**72-1-4213**	alu 6060 T5	black anodised	130g
65	55	4.5	13	with cap	**72-1-4214**	alu 6060 T5	clear anodised	130g
65	55	4.5	13	with cap	**72-1-4215**	alu 6060 T5	black anodised	130g



Hinge with 304 stainless steel riveted pin

A	B	C	D	part number	material	finish	weight
32	50	3	5.2	**72-1-3635**	alu 6060 T5	raw	20g
50	50	3	5.2	**72-1-3636**	alu 6060 T5	raw	30g



7) Rails:

COMERCIAL DEL PLATA s.r.l. 17/07/2012

HERRAJES PARA OBRA Y MUEBLE

HERRAJES PARA CORREDIZO — Carros para Rieles

Codigo	Descripcion	Termin.	Medida	Emp.	Unid.	
005560	Carro simple para riel sup. art. 166	Nylon	20 mm	50	unid.	
005558	Carro para riel superior art. 168	Nylon	20 mm	50	unid.	
005554	Carro simple para riel sup. art. 162	Nylon	25 mm	50	unid.	
005556	Carro para riel superior art. 164	Nylon	25 mm	50	unid.	
005559	Carro para riel superior art. 170	Nylon	32 mm	20	unid.	
005563	Carro simple para riel sup. art. 166	Acero	20 mm	50	unid.	
005565	Carro para riel superior art. 168	Acero	20 mm	50	unid.	
005562	Carro simple para riel sup. art. 162	Acero	25 mm	50	unid.	
005564	Carro para riel superior art. 164	Acero	25 mm	unid.	unid.	
005566	Carro para riel superior art. 170	Acero	32 mm	unid.	unid.	
005567	Carro para riel superior art. 172	Acero	38 mm	unid.	unid.	
005568	Carro para riel superior art. 174	Acero	45 mm	unid.	unid.	

HERRAJES PARA CORREDIZO — Topes para Carros

Codigo	Descripcion	Termin.	Medida	Emp.	Unid.	
011753	Tope para carro 168 - 164	Ho. Zinc.		50	unid.	
011754	Tope para carro 170 - 172 - 174	Ho. Zinc.		20	unid.	

HERRAJES PARA CORREDIZO — Rieles Superiores para Carros

Codigo	Descripcion	Termin.	Medida	Emp.	Unid.	
016785	Riel superior Art. 168	Ho. Pul.	24 mm	6	Mts.	
016784	Riel superior Art. 164	Ho. Pul.	30 mm	6	Mts.	
016786	Riel superior Art. 170	Ho. Pul.	38 mm	6	Mts.	
016899	Riel superior Art. 172	Ho. Pul.	47 mm	6	Mts.	
016900	Riel superior Art. 174	Ho. Pul.	55 mm	6	Mts.	

HERRAJES PARA CORREDIZO — Guias de Piso para Puertas Corredizas

Codigo	Descripcion	Termin.	Medida	Emp.	Unid.	
000661	Guia de piso para aplicar	Ho. Zinc.		unid.	unid.	
000662	Guia de piso para aplicar	Nylon		unid.	unid.	

HERRAJES PARA CORREDIZO — Rolletes para Corredizo

Codigo	Descripcion	Termin.	Medida	Emp.	Unid.	
000631	Rollete de canto para guia U	Acero	12 mm	12	unid.	
000633	Rollete de canto para guia U	Nylon	12 mm	12	unid.	
000637	Rollete de canto para guia U	Acero	21 mm	12	unid.	
000639	Rollete de canto para guia U	Nylon	21 mm	12	unid.	
000634	Rollete de centro para guia U	Acero	12 mm	12	unid.	
000636	Rollete de centro para guia U	Nylon	12 mm	12	unid.	
000640	Rollete de centro para guia U	Acero	21 mm	12	unid.	
000642	Rollete de centro para guia U	Nylon	21 mm	12	unid.	

Pagina 1/5

8) Corner brace:

Always close to you.

Corner brace mod.4

Characteristics

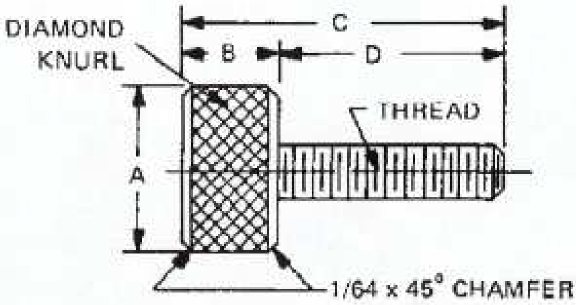
with anchor

Aluminium

Finish	Sizes	Cod.			
White	150x100 mm	7258	25	150	80
White	200x150 mm	7259	20	100	90
White	250x200 mm	7260	10	50	110
White	300x200 mm	7261	10	40	120
Silver grey	150x100 mm	7397	25	150	80
Silver grey	200x150 mm	7398	20	100	90
Silver grey	250x200 mm	7399	10	50	110
Silver grey	300x200 mm	7400	10	40	120
Black	150x100 mm	7401	25	150	80
Black	200x150 mm	7402	20	100	90
Black	250x200 mm	7403	10	50	110
Black	300x200 mm	7404	10	40	120

9) Screws:

METRIC PLAIN THUMB SCREW



ORDERING INFORMATION		
Order Code:	**XXXX — XX — XX** Part # / Material Code / Finish Code	
Example:	**M210 — SS — 14**	

Part #	Thread	A + 0.5 - 0.0	B ± 0.5	C ± 0.5	D ± 0.5
M201 M202 M203 M204	M3 x 0.5	8	5	13 14 16 18	8 9 11 13
M205 M206 M207 M208	M3.5 x 0.6	8	5	13 14 16 18	8 9 11 13
M209 M210 M211 M212 M213	M4 x 0.7	10	5	14 16 18 19 21	9 11 13 14 16
M214 M215 M216 M217 M218	M5 x 0.8	11	5	14 18 18 19 21	9 13 13 14 16
M219 M220 M221 M222 M223	M6 x 1	13	6	19 21 22 24 25	13 14 16 18 19

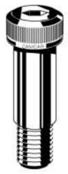
· FOR MATERIAL AND FINISH CODE — SEE PAGE 1

10) Screws for the installation:

Pricing and Product Information – Inch Sizes

Camcar® Stainless Steel Socket Head Shoulder Screws

Made in the U.S.A.



Product Description:

- 300 Series(18-8) Stainless Steel
- Made in USA
- DFAR compliant

Pricing Notes:

- Net Price per/ea. available in listed thread series only
- Bulk pricing available upon request

Shldr. Dia. Recess	Shoulder Length	EDP No.	Thread Dia.	TPI	Price Each	Count /Box	Wt. / Box
1/4" 1/8 Hex	1/8	73000	#10	24	1.21	25	0.3
	3/16	73003	#10	24	1.23	25	0.3
	1/4	73006	#10	24	1.25	25	0.3
	5/16	73009	#10	24	1.26	25	0.3
	3/8	73012	#10	24	1.27	25	0.3
	1/2	73015	#10	24	1.30	25	0.4
	5/8	73018	#10	24	1.35	25	0.4
	3/4	73021	#10	24	1.38	25	0.5
	1	73024	#10	24	1.45	25	0.5
	1-1/4	73027	#10	24	1.54	25	0.6
	1-1/2	73030	#10	24	1.63	25	0.7
	1-3/4	73033	#10	24	1.73	25	0.8
	2	73036	#10	24	1.81	25	0.9
	2-1/4	73039	#10	24	2.49	25	1.0
	2-1/2	73042	#10	24	2.59	25	1.1
	2-3/4	73045	#10	24	2.66	25	1.2
	3	73048	#10	24	2.73	25	1.3
5/16" 5/32 Hex	1/4	73051	1/4	20	1.40	25	0.5
	5/16	73054	1/4	20	1.43	25	0.5
	3/8	73057	1/4	20	1.45	25	0.5
	1/2	73060	1/4	20	1.50	25	0.6
	5/8	73063	1/4	20	1.55	25	0.7
	3/4	73066	1/4	20	1.62	25	0.7
	1	73069	1/4	20	1.72	25	0.9
	1-1/4	73072	1/4	20	1.86	25	1.0
	1-1/2	73075	1/4	20	1.97	25	1.1
	1-3/4	73078	1/4	20	2.09	25	1.3
	2	73081	1/4	20	2.19	25	1.4
	2 1/4	73084	1/4	20	2.91	25	1.6
	2 1/2	73087	1/4	20	3.01	25	1.7
	2 3/4	73090	1/4	20	3.11	25	1.8
	3	73093	1/4	20	3.26	25	2.0
	3 1/2	73096	1/4	20	3.47	25	2.2
	4	73099	1/4	20	3.97	25	2.5

Shldr. Dia. Recess	Shoulder Length	EDP No.	Thread Dia.	TPI	Price Each	Count /Box	Wt. / Box
3/8" 3/16 Hex	1/4	73102	5/16	18	2.01	25	0.8
	3/8	73105	5/16	18	2.08	25	0.9
	1/2	73108	5/16	18	2.15	25	1.0
	5/8	73112	5/16	18	2.23	25	1.1
	3/4	73115	5/16	18	2.30	25	1.2
	1	73118	5/16	18	2.47	25	1.4
	1-1/4	73121	5/16	18	2.61	25	1.6
	1-1/2	73124	5/16	18	2.76	25	1.8
	1-3/4	73127	5/16	18	2.91	25	2.0
	2	73130	5/16	18	3.09	25	2.2
	2-1/4	73133	5/16	18	3.80	25	2.4
	2-1/2	73136	5/16	18	3.95	25	2.6
	2-3/4	73139	5/16	18	4.14	25	2.8
	3	73142	5/16	18	4.28	25	3.0
	3-1/4	73145	5/16	18	4.78	25	3.2
	3-1/2	73148	5/16	18	4.97	25	3.4
	3-3/4	73151	5/16	18	5.69	25	3.6
	4	73154	5/16	18	5.85	25	3.8
	4-1/2	73157	5/16	18	7.00	25	4.2
	5	73160	5/16	18	7.36	25	4.6
1/2" 1/4 Hex	3/8	73163	3/8	16	2.77	25	1.8
	1/2	73166	3/8	16	2.91	25	2.0
	5/8	73169	3/8	16	3.03	25	2.1
	3/4	73172	3/8	16	3.18	25	2.3
	1	73175	3/8	16	3.44	25	2.7
	1-1/4	73178	3/8	16	3.71	25	3.0
	1-1/2	73181	3/8	16	3.99	25	3.4
	1-3/4	73184	3/8	16	4.25	25	3.7
	2	73187	3/8	16	4.52	25	4.1
	2-1/4	73190	3/8	16	5.34	25	4.4
	2-1/2	73193	3/8	16	5.62	25	4.8
	2-3/4	73196	3/8	16	5.88	25	5.1
	3	73199	3/8	16	6.14	25	5.5
	3-1/4	73202	3/8	16	6.45	25	5.8
	3-1/2	73205	3/8	16	6.71	25	6.2
	3-3/4	73208	3/8	16	8.07	25	6.5
	4	73211	3/8	16	8.39	25	6.9
	4-1/4	73214	3/8	16	9.10	25	7.3
	4-1/2	73217	3/8	16	9.41	10	3.1
	4-3/4	73220	3/8	16	9.84	10	3.2
	5	73223	3/8	16	10.13	10	3.3

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Pricing and Product Information – Inch Sizes

Camcar® Stainless Steel Socket Head Shoulder Screws – *continued*

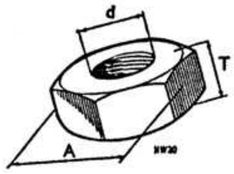
Made in the U.S.A.

Shldr. Dia. Recess	Shoulder Length	EDP No.	Thread Dia.	TPI	Price Each	Count /Box	Wt. / Box
5/8" 5/16 Hex	1/2	73226	1/2	13	5.89	25	3.4
	5/8	73229	1/2	13	6.02	25	3.6
	3/4	73232	1/2	13	6.25	25	3.9
	1	73235	1/2	13	6.74	25	4.5
	1-1/4	73238	1/2	13	7.24	25	5.0
	1-1/2	73241	1/2	13	7.72	25	5.6
	1-3/4	73244	1/2	13	8.26	25	6.1
	2	73247	1/2	13	8.75	25	6.7
	2 1/4	73250	1/2	13	11.35	25	7.2
	2-1/2	73253	1/2	13	12.92	25	7.8
	2-3/4	73256	1/2	13	13.56	25	8.3
	3	73259	1/2	13	14.05	25	8.9
	3-1/4	73262	1/2	13	14.55	25	9.4
	3-1/2	73265	1/2	13	15.04	25	10.0
	3-3/4	73268	1/2	13	15.63	10	4.2
	4	73271	1/2	13	16.12	10	4.4
	4-1/2	73274	1/2	13	17.13	10	4.9
3/4" 3/8 Hex	1/2	73277	5/8	11	11.32	10	2.3
	5/8	73280	5/8	11	11.62	10	2.5
	3/4	73283	5/8	11	12.08	10	2.6
	1	73286	5/8	11	12.88	10	2.9
	1-1/4	73289	5/8	11	14.15	10	3.3
	1-1/2	73292	5/8	11	14.49	10	3.6
	1-3/4	73295	5/8	11	15.76	10	3.9
	2	73298	5/8	11	16.79	10	4.2
	2-1/4	73301	5/8	11	17.94	10	4.5
	2-1/2	73304	5/8	11	19.09	10	4.8
	2-3/4	73307	5/8	11	20.82	10	5.2
	3	73310	5/8	11	21.62	10	5.5
	3-1/4	73313	5/8	11	22.54	10	5.8
	3-1/2	73316	5/8	11	23.81	10	6.1
	3-3/4	73319	5/8	11	25.07	10	6.4
	4	73322	5/8	11	26.45	10	6.7
	4-1/4	73325	5/8	11	35.65	10	6.9
	4-1/2	73328	5/8	11	37.03	10	7.2
	4-3/4	73331	5/8	11	38.30	10	7.5
	5	73334	5/8	11	39.68	10	7.8
	5-1/2	73337	5/8	11	42.55	10	8.5
	6	73340	5/8	11	45.31	10	9.1

Shldr. Dia. Recess	Shoulder Length	EDP No.	Thread Dia.	TPI	Price Each	Count /Box	Wt. / Box
1" 1/2 Hex	1	73343	3/4	10	21.05	10	5.5
	1-1/2	73346	3/4	10	24.73	10	6.6
	1-3/4	73349	3/4	10	26.22	10	7.2
	2	73352	3/4	10	28.18	10	7.8
	2-1/2	73355	3/4	10	32.09	10	8.9
	3	73358	3/4	10	35.31	10	10.0
	3-1/2	73361	3/4	10	39.22	10	11.2
	4	73364	3/4	10	49.91	10	12.3
	5	73367	3/4	10	57.85	10	14.6

11) Nuts for the installation:

NUT — HEXAGON



ABBREVIATIONS

A = Dimension across flats
T = Thickness
UNF = Unified Fine Thread
BSF = British Standard Fine Thread
d = Thread Diameter
NC = National Coarse Thread
NF = National Fine Thread
UNC = Unified Coarse Thread
BA = British Association Thread

Part No.	Thread Diam. (d)	Across Flats (A)	Nominal Thickness (T)
NH2002	No. 5 N.F.	5/16"	·114"/·102"
NH2003	No. 6 N.F.	5/16"	·114"/·102"
NH2004	No. 8 N.F.	11/32"	·130"/·117"
NH2005	No. 10 N.F.	3/8"	·130"/·117"
NH2006	No. 12 N.F.	7/16"	·161"/·148"
NH2007	1/4" N.F.	7/16"	·226"/·212"
NH2008	5/16" N.F.	1/2"	·273"/·258"
NH2009	3/8" N.F.	9/16"	·337"/·320"
NH2010	7/16" N.F.	5/8"	·385"/·365"
NH2011	1/2" N.F.	3/4"	·448"/·427"
NH2012	9/16" N.F.	7/8"	·496"/·473"
NH2013	5/8" N.F.	15/16"	·559"/·534"
NH2057	1/4" N.C.	7/16"	·226"/·212"
NH2058	5/16" N.C.	1/2"	·273"/·258"
NH2059	3/8" N.C.	9/16"	·337"/·320"
HN2002	No. 5 U.N.F.	5/16"	·114"/·102"
HN2005	No. 10 U.N.F.	3/8"	·130"/·117"
HN2007	1/4" U.N.F.	7/16"	·220"/·210"
HN2008	5/16" U.N.F.	1/2"	·270"/·260"
HN2009	3/8" U.N.F.	9/16"	·330"/·320"
HN2010	7/16" U.N.F.	11/16"	·380"/·370"
HN2011	1/2" U.N.F.	3/4"	·440"/·430"
HN2012	9/16" U.N.F.	7/8"	·490"/·480"
HN2013	5/8" U.N.F.	15/16"	·550"/·540"
HN2014	3/4" U.N.F.	1 1/8"	·660"/·640"
HN2016	1 " U.N.F.	1 1/2"	·880"/·850"
HN2051	No. 4 U.N.C.	1/4"	·098"/·087"
HN2053	No. 6 U.N.C.	5/16"	·114"/·102"
HN2054	No. 8 U.N.C.	11/32"	·130"/·117"
HN2057	1/4" U.N.C.	7/16"	·220"/·217"
HN2058	5/16" U.N.C.	1/2"	·270"/·260"
HN2059	3/8" U.N.C.	9/16"	·330"/·320"
HN2060	7/16" U.N.C.	11/16"	·380"/·370"
HN2061	1/2" U.N.C.	3/4"	·440"/·430"
SP22A	No. 2 B.A.	·338"	3/32"
SP22B	No. 4 B.A.	·156"	1/8"
SP22BD	5/16" B.S.F. (Brass)	·525"	1/4"
SP22BE	3/8" B.S.F. (Brass)	·600"	5/16"
SP22C	1/4" B.S.F.	·445"	3/16"
SP22D	5/16" B.S.F.	·525"	1/4"
SP22E	3/8" B.S.F.	·600"	5/16"
SP22F	7/16" B.S.F.	·710"	3/8"
SP22G	1/2" B.S.F.	·820"	7/16"

12) Adhesive:

Structural Acrylics

Permabond structural acrylic adhesives are suitable for bonding a wide variety of materials. The rapid, room-temperature cure coupled with high strength and durability make these adhesives ideal for demanding applications where speed and ease of application of the adhesive is important.

Permabond structural acrylic adhesives are suitable for a variety of applications.

They are ideal for structural bonding of metals, composites, plastics, glass, wood and other materials. Permabond's structural acrylic adhesives have excellent durability. They resist tensile, peel, cleavage, and impact forces as well as resisting the stresses of differential thermal expansion found when bonding dissimilar materials.

They are formulated with resistance in mind, so are suitable for applications that involve exposure to oils, greases, moisture and weathering.

Typical applications include:

- Magnet bonding (particularly for electric motors)
- Metal & glass furniture manufacturing
- Street signs
- Rear view mirror attachment
- Structural bonding - e.g. aluminium panels
- Signs

Permabond offers several types of structural acrylic adhesives.

No-Mix Adhesive & Initiator (Surface Activated)
Initiator is applied to one of the bonding surfaces and the adhesive to the other. Suited to bonding tight fitting parts, this system provides a long open time and a short cure time.

Bead on Bead Part A & Part B
A bead of one part is applied directly over a bead of the other part. No mixing is required. When the two components are pressed together, enough mixing will take place to cure the adhesive.

2-Part
Adhesive is supplied in convenient 1:1 cartridges for use with a dispensing gun. Adhesive is dispensed directly onto the substrate material via a static mixing nozzle.

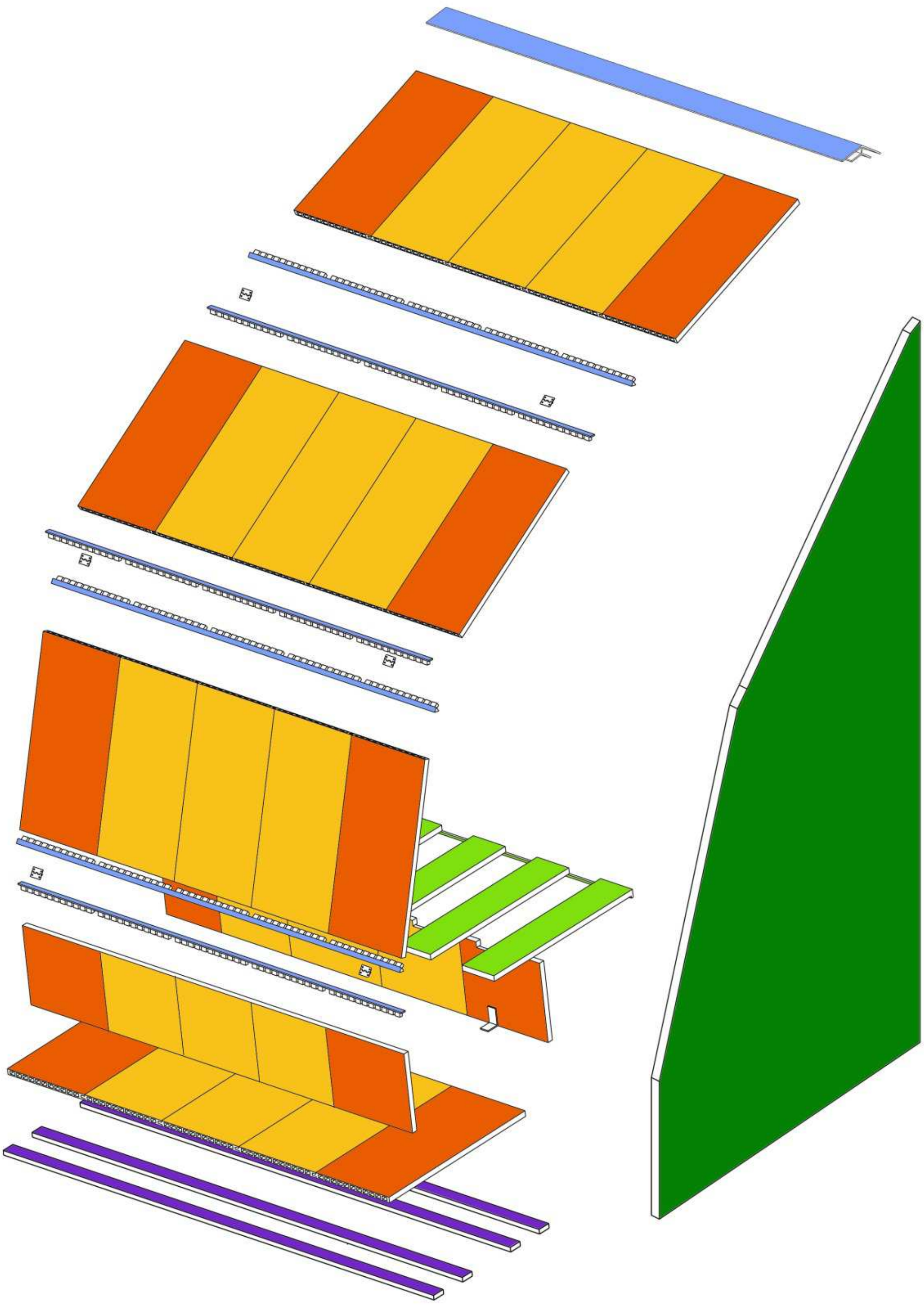
Single Component - No mixing required
These adhesives are simple to apply and cure with or without an activator (activator can be used to reduce cure times to seconds and to cure through larger gaps).

Benefits

- Extrememly high strength bonds increase design possibilities.
- Excellent durability to impact, peel, shear, and thermal expansion increases part life.
- Room temperature cure eliminates ovens and other equipment.
- Rapid cure increases daily output to reduce production costs.
- Bond a wide variety of substrates to increase design freedom.
- Many non-flammable grades available.
- Technical support- application specialists available for assistance with joint design, adhesive selection and production process.

Permabond®
Engineering Adhesives

PLANES



CENTRAL SHEETS

Polywood 800mm length sheet *(Plane 1)*

Polywood 790mm length sheet *(Planes 2, 3, 4)*

Polywood 770mm length sheet A *(Plane 5)*

Polywood 770mm length sheet B *(Plane 5.1)*

Polycarbonate 770mm length sheet *(Plane 6)*

Polywood 350mm length sheet *(Plane 7)*

Polywood 375mm length sheet *(Planes 8, 9, 10)*

LATERAL SHEETS A

Polywood 800mm length sheet *(Plane 11)*

Polywood 790mm length sheet *(Plane 12)*

Polywood 770mm length sheet A *(Plane 13)*

Polywood 770mm length sheet B *(Plane 13.1)*

Polywood 350mm length sheet *(Plane 14)*

Polywood 375mm length sheet *(Plane 15)*

LATERAL SHEETS B

Polywood 800mm length sheet *(Plane 16)*

Polywood 790mm length sheet *(Plane 17)*

Polywood 770mm length sheet A *(Plane 18)*

Polywood 770mm length sheet B *(Plane 18.1)*

Polywood 350mm length sheet *(Plane 19)*

Polywood 375mm length sheet *(Plane 20)*

BED

Polywood sheet *(Plane 21)*

Support *(Plane 22)*

COVERS

Frontal cover *(Plane 23)*

JOINTS

Connecting panel piece A *(Plane 24)*

Connecting panel piece B *(Plane 25)*

Roof union *(Plane 26)*

ELEMENTS REQUIRED FOR THE INSTALLATION

Connecting slats to pallets *(Plane 27)*

ECONOMIC ESTIMATE

SHEETS

Central sheets

Piece: Polywood central sheet 800 No. Of Pieces: 3

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	4		
Cost of the sheet	€ 42.4		
Cost of Raw materials per piece	€ 42.4	/4 pieces	€ 10.6
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 11.1**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**11.45€**

Piece: Polywood central sheet 790 No. Of Pieces: 3

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	4		
Cost of the sheet	€ 42.4		
Cost of Raw materials per piece	€ 42.4	/4 pieces	€ 10.6
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 11.1**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**11.45€**

Piece: Polywood central sheet 770 No. Of Pieces: 4

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	5		
Cost of the sheet	€ 42.4		
Cost of Raw materials per piece	€ 42.4	/5 pieces	€ 8.48
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 8.99**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**9.34€**

Piece: Polycarbonate sheet 770 No. Of Pieces: 2

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x4000)			
No. Pieces per sheet	5		
Cost of the sheet	€ 63.8		
Cost of Raw materials per piece	€ 63.8	/5 pieces	€ 12.7
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 13.2**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION	
	ST1 + ST2 **13.62€**

Piece: Polywood central sheet 350 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	11		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/11 pieces	€ 3.71
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 4.22**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**4.57 €**

Piece: Polywood central sheet 375 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	10		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/10 pieces	€ 4.09
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 4.60**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	3 min.		
Pieces per hour	20		
Cost of workmanship per piece	€ 8.24	/20 Pieces	€ 0.41
		Subtotal 2	**€ 0.41**

TOTAL COST OF FABRICATION	
	ST1 + ST2 **5.01 €**

Lateral sheets

→ Lateral sheets A

Piece: Polywood lateral A sheet 800 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	4		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/4 pieces	€ 10.2
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 10.7**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**11.05€**

Piece: Polywood lateral A sheet 790 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	4		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/4 pieces	€ 10.2
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 10.7**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION	
	ST1 + ST2 **11.05€**

Piece: Polywood lateral A sheet 770 No. Of Pieces: 2

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	5		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/5 pieces	€ 8.18
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 8.69**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**9.04€**

Piece: Polywood lateal A sheet 375 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	10		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/10 pieces	€ 4.09
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 4.60**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	3 min.		
Pieces per hour	20		
Cost of workmanship per piece	€ 8.24	/20 Pieces	€ 0.41
		Subtotal 2	**€ 0.41**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**5.01 €**

Piece: Polywood lateral A sheet 350 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	11		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/11 pieces	€ 3.71
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 4.22**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION	
	ST1 + ST2 **4.57 €**

→ Lateral sheets B

Piece: Polywood lateral B sheet 800
No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	4		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/4 pieces	€ 10.2
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 10.7**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION	
ST1 + ST2	**11.05€**

Piece: Polywood lateral B sheet 790 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	4		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/4 pieces	€ 10.2
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 10.7**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**11.05€**

Piece: Polywood lateral B sheet 770 No. Of Pieces: 2

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	5		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/5 pieces	€ 8.18
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 8.69**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**9.04€**

Piece: Polywood lateal B sheet 375 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	10		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/10 pieces	€ 4.09
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 4.60**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	3 min.		
Pieces per hour	20		
Cost of workmanship per piece	€ 8.24	/20 Pieces	€ 0.41
		Subtotal 2	**€ 0.41**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**5.01 €**

Piece: Polywood lateral B sheet 350 No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	11		
Cost of the sheet	€ 40.9		
Cost of Raw materials per piece	€ 40.9	/11 pieces	€ 3.71
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 4.22**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION	
	ST1 + ST2 **4.57 €**

BED

Polywood sheets

Piece: Polywood bed sheet No. Of Pieces: 6

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:396 x3850)			
No. Pieces per sheet	5		
Cost of the sheet	€ 19.6		
Cost of Raw materials per piece	€ 19.6	/5 pieces	€ 3.92
Machining tolos			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 4.43**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**4.78 €**

Support

Piece: bed support No. Of Pieces: 5

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:10 x3850)			
No. Pieces per sheet	19		
Cost of the sheet	€ 5.4		
Cost of Raw materials per piece	€ 5.4	/19 pieces	€ 0.28
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 0.79**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**1.14 €**

COVER

Piece: cover No. Of Pieces: 1

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:800 x1700)			
No. Pieces per sheet	1		
Cost of the sheet	€ 2.23		
Cost of Raw materials per piece	€ 2.23	/1 pieces	€ 2.23
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 2.74**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**3.09 €**

JOINTS

Connecting panel pieces

→ Connecting panel pieces A

Piece: contecting panel A No. Of Pieces: 2

MATERIAL COST			
RAW MATERIAL			
PVC Pellets (1 kg)			
No. Pieces per Kg	4		
Cost of PVC per kg	€ 3.56		
Cost of Raw materials per piece	€ 3.56	/4 pieces	€ 0.89
Inyection tools			
Inyection Mold	€1663.1		
No.Pieces per mold	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 1.4**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**1.75€**

→ **Connecting panel pieces B**

Piece: contecting panel B

No. Of Pieces: 2

MATERIAL COST			
RAW MATERIAL			
PVC Pellets (1 kg)			
No. Pieces per Kg	6		
Cost of PVC per kg	€ 3.56		
Cost of Raw materials per piece	€ 3.56	/6 pieces	€ 0.59
Inyection tolos			
Inyection Mold	€1663.1		
No.Pieces per mold	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 1.1**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**1.45€**

Roof union

Piece: roof union No. Of Pieces: 2

MATERIAL COST			
RAW MATERIAL			
PVC Pellets (1 kg)			
No. Pieces per Kg	3		
Cost of PVC per kg	€ 3.56		
Cost of Raw materials per piece	€ 3.56	/6 pieces	€ 1.18
Inyection tools			
Inyection Mold	€1663.1		
No.Pieces per mold	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 1.69**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**2.04€**

CONNECTING PIECE TO PALLETS

Piece: WPC slats No. Of Pieces: 4

MATERIAL COST			
RAW MATERIAL			
Polywood sheet (size:10 x3850)			
No. Pieces per sheet	4		
Cost of the sheet	€ 5.4		
Cost of Raw materials per piece	€ 5.4	/19 pieces	€ 1.35
Machining tools			
Cutting tolos	€1663.1		
No.Pieces per tool	3211		
Cost of machining tools per piece	€1663.1	/3211 pieces	€ 0.51
Outsourcing Products			
Cost of outsourcing Produts			€ 0.00
		Subtotal 1	**€ 1.86**
Cost of workmanship			
Qualified Officer			
Hourly fee	€ 8.24		
Time per piece	2.6 min.		
Pieces per hour	23		
Cost of workmanship per piece	€ 8.24	/33 Pieces	€ 0.35
		Subtotal 2	**€ 0.35**

TOTAL COST OF FABRICATION		
	ST1 + ST2	**2.21 €**

SUMMARY

	Nº	price/u.	total
Central Sheets			
Polywood 800mm length sheets.	3	11,45	22,9
Polywood 790mm length sheets.	3	11,45	22,9
Polywood 770mm length sheets.	4	9,34	28,02
Polycarbonate 770mm length sheets.	2	13,62	20,43
Polywood 350mm length sheets.	3	4,57	9,14
Polywood 375mm length sheets.	3	5,01	10,02
Lateral sheets A			
Polywood 800mm length sheet.	1	11,05	8,2875
Polywood 790mm length sheet	1	11,05	8,2875
Polywood 770mm length sheets	2	9,04	13,56
Polywood 350mm length sheet.	1	4,57	3,4275
Polywood 375mm length sheet.	1	5,01	3,7575
Lateral sheets B			
Polywood 800mm length sheet.	1	11,05	8,2875
Polywood 790mm length sheet.	1	11,05	8,2875
Polywood 770mm length sheets.	2	9,04	13,56
Polywood 350mm length sheet	1	4,57	3,4275
Polywood 375mm length sheet.	1	5,01	3,7575
Bed			
Polywood sheets	6	4,78	19,12
Support.	5	1,14	4,56
Cover	1	3,09	3,09
Polywood slats	4	2,21	6,63
Connecting panel pieces A	2	1,75	3,5
Connecting panel pieces B	2	1,45	2,9
Roof union	1	2,04	2,04
TOTAL PRICE			**229,89**

ANALYSIS

1. WEIGHT OF THE MODULE

The weight of the module is calculated from the following densities:

- Polywood: 0,72 g/cm^3
- PVC: 1,4 g/cm^3
- PC: 1,2 g/cm^3

	Cm^3/u.	**g/u.**	**Nº**	**TOTAL**
Central Sheets				
Polywood 800mm length sheets.	4100	2952	3	8856
Polywood 790mm length sheets.	4005	2803,5	3	8410,5
Polywood 770mm length sheets.	3890	2723	4	10892
Polycarbonate 770mm length sheets.	3950	4740	2	9480
Polywood 350mm length sheets.	1220	854	3	2562
Polywood 375mm length sheets.	1232	862,4	3	2587,2
Lateral sheets A				
Polywood 800mm length sheet.	3995	2796,5	1	2796,5
Polywood 790mm length sheet	3890	2723	1	2723
Polywood 770mm length sheets	3400	2380	2	4760
Polywood 350mm length sheet.	1215	850,5	1	850,5
Polywood 375mm length sheet.	1217	851,9	1	851,9
Lateral sheets B				
Polywood 800mm length sheet.	3990	2793	1	2793
Polywood 790mm length sheet.	3885	2719,5	1	2719,5

Polywood 770mm length sheets.	3350	2345	2	4690
Polywood 350mm length sheet	1212	848,4	1	848,4
Polywood 375mm length sheet.	1215	850,5	1	850,5
Bed				
Polywood sheets	210	147	6	882
Support.	22	15,4	5	77
Cover	53	37,1	1	37,1
Polywood slats	30	21	4	84
Connecting panel pieces A	19	26,6	2	53,2
Connecting panel pieces B	15	21	2	42
Roof union	22	15,4	1	15,4
			TOTAL WEIGHT	67861,7

***the weight of the fabric doors and screws is despicable so we just we round the final weight to 68 Kg.**

2. PROTOTYPE

PROPOSAL OF A REFUGEE CAMP

1. DESCRIPTION

First is important to know that the size of a refugee camp should be between 20.000 and 10.000 people but in any case the size has to exceed the figure of 20.000 for health and hygiene reasons. In many cases is preferable to have several small camps that are easier to manage.

For our project we have made a proposal for a refugee camp of 10.000 people with the following characteristics:

- Groups between 10 and 12 families around a collective patio. These kinds of groups allow neighbors have adequate space for different types of gatherings. They also improve the safety and care of wares of the refugees.
  In our refugee camp we decided to group 10 modules of 4 people around a central patio. The distance between the modules will be equal to the width of the modules: 3 meters. This space is very important to create a dry area at the entrance to the house.

- Individual access to each module. With that decision we want to give greater privacy to the houses.

- One toilet and one shower per 20 people. The recommended maximum number of people who should be sharing latrines in an emergency situation is 20 (according to the World Health Organization). The latrines should be located in places easy to access from any point of the camp and the distance between these and the shelters has to be of 30 meters.

- One kitchen for each group of houses.

All the groups will have a solar cooker that is a device which uses the energy of sunlight to heat food or drink to cook it or sterilize it. Exist many types of solar cookers; simple solar cookers use the following basic principles:

- Concentrating sunlight: A reflective mirror of polished glass, metal or metallized film is used to concentrate light and heat from the sun into a small cooking area, making the energy more concentrated and increasing its heating power.
- Converting light to heat: A black or low reflectivity surface on a food container or the inside of a solar cooker will improve the effectiveness of turning light into heat. Light absorption converts the sun's visible light into heat, substantially improving the effectiveness of the cooker.
- Trapping heat: It is important to reduce convection by isolating the air inside the cooker from the air outside the cooker. A plastic bag or tightly sealed glass cover will trap the hot air inside. This makes it possible to reach similar temperatures on cold and windy days as on hot days.
- Greenhouse effect: Glass transmits visible light but blocks infrared thermal radiation from escaping. This amplifies the heat trapping effect.

- One water point with 6 taps for every 200 people. The maximum distance between these points and the shelters has to be 15 meters. At some stage would be necessary to distribute jerry cans for water collection and these are much preferred to buckets which are prone to dirt. During this distribution you can also distribute food and other non-food items such as materials for shelter, blankets and soap.

- An area for the distribution of the food.

- Two washing places for 200 people. These places are designed to wash clothes.

- One rubbish bin (capacity for 100 liters) for every 50 people per day. Is also necessary make a pit (dimensions 2m x 5m x 2m) for every 500 people.

- Firebreaks between the different groups of shelters.

- One health center every 3.500 people. Our camp has capacity for 10.000 people so we need 3 health centers. These should be located in a safe and accessible place, preferably on the periphery of the site in order to avoid overcrowding and allow the future expansion. The space required depends on the type and desired capacity of the medical services to be provided.
- One school for every 5.000 people.

- A place for assistance to malnutrition.

- A place for assistance to unattended women and children. We think that is very important create a space to help women and children that have no family or close people in which seek protection.

- A law enforcement center in order to respond to legal demands.

- For each 20.000 people is necessary to install one market. In our case we only need a little market because our camp is designed to accommodate 10.000 persons. Refugees also can sell their goods and commodities such as cultivated vegetables or crafts.

<u>*Diagram of a refugee camp*</u>

1) Law enforcement center

2) Bathrooms

3) Water spot

4) Food

5) Assistance to malnutrition

6) Assistance to unattended women and children

7) Medical assistance

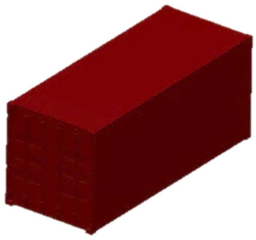
8) Washing place

9) School

2. TRANSPORT

The transport of the houses will be made in containers Standard 40 '(see attachments). Each of these containers will contain inside 84 individual modules:

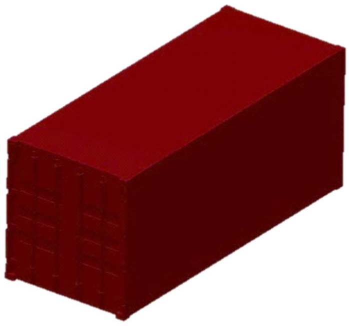
84 **x** (800mm x 400mm x 2000mm) BOX **=**



Therefore, for a refugee camp of 10.000 people will be a total of 119 containers.

10.000 **x**

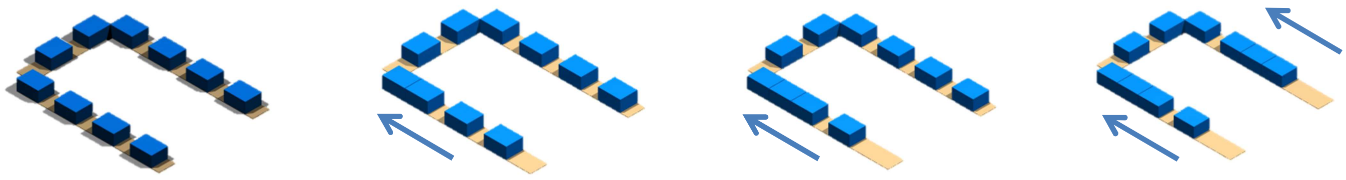
= 119



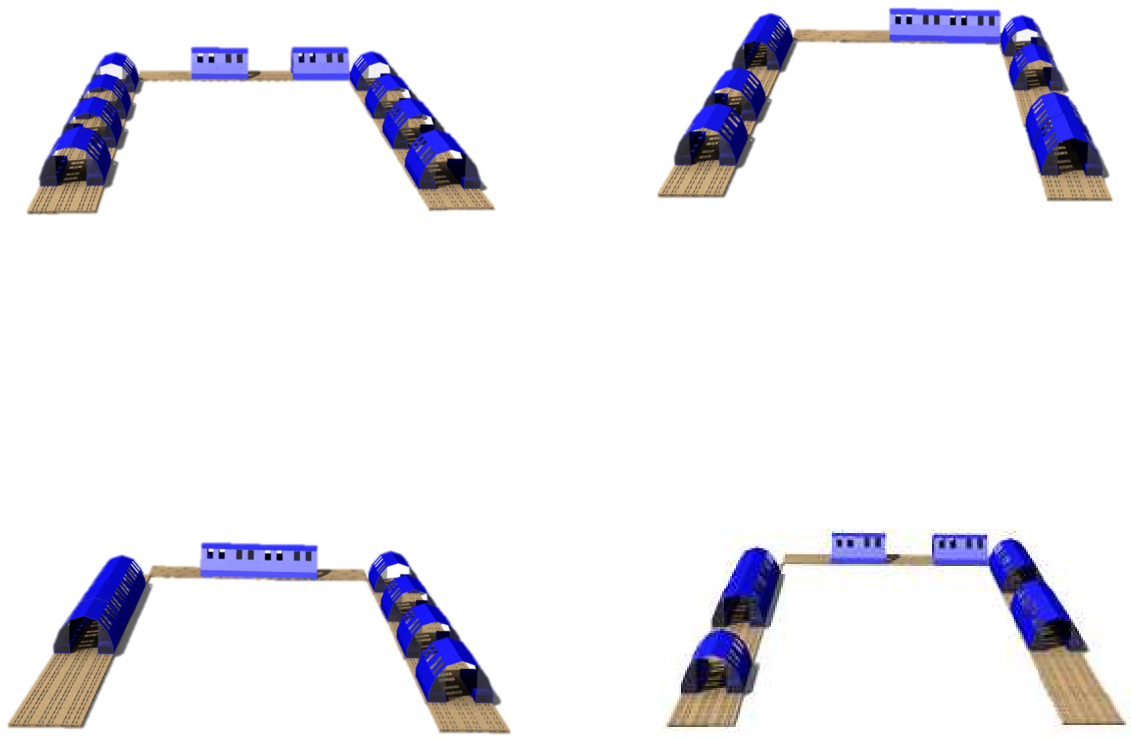
Take into account the necessity of use this kind of transport we decided to reuse the containers for the following areas:

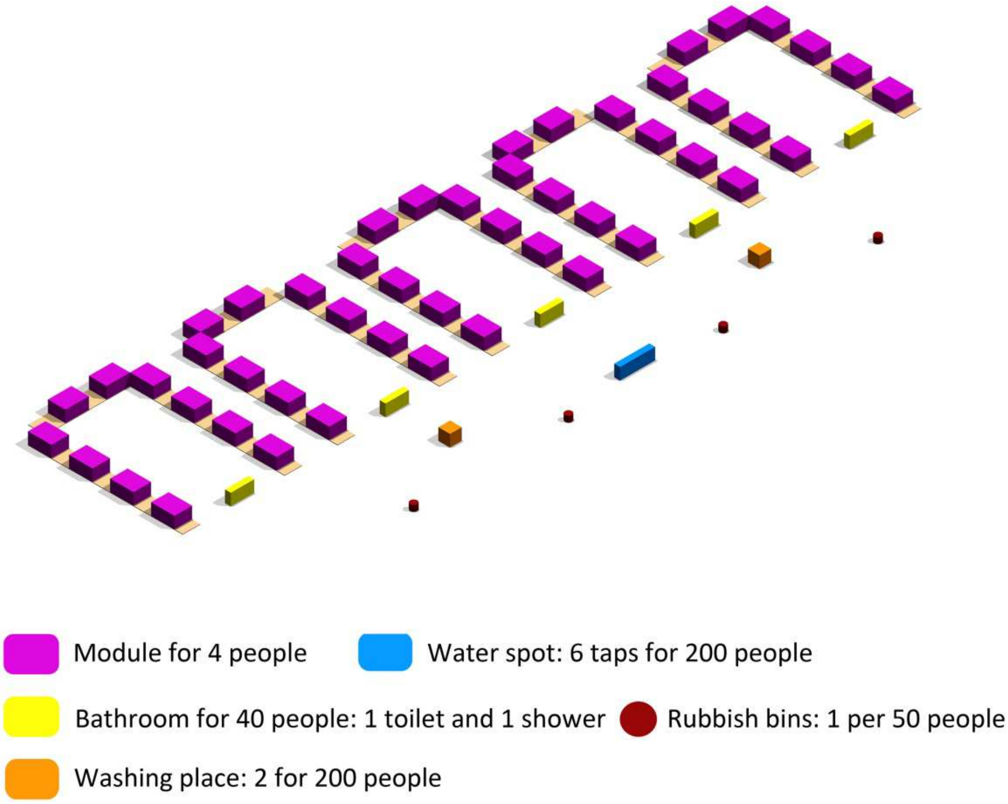
· For the schools we use 30 containers.
· For the health centers we use 30 containers.
· For the law enforcement area we use 4 containers.
· For the market we use 5 containers.
· For the food area we use 15 containers.
· For the assistance to malnutrition we use 15 containers.
· For the assistance to women and children we use 20 containers.

3. PLANNING



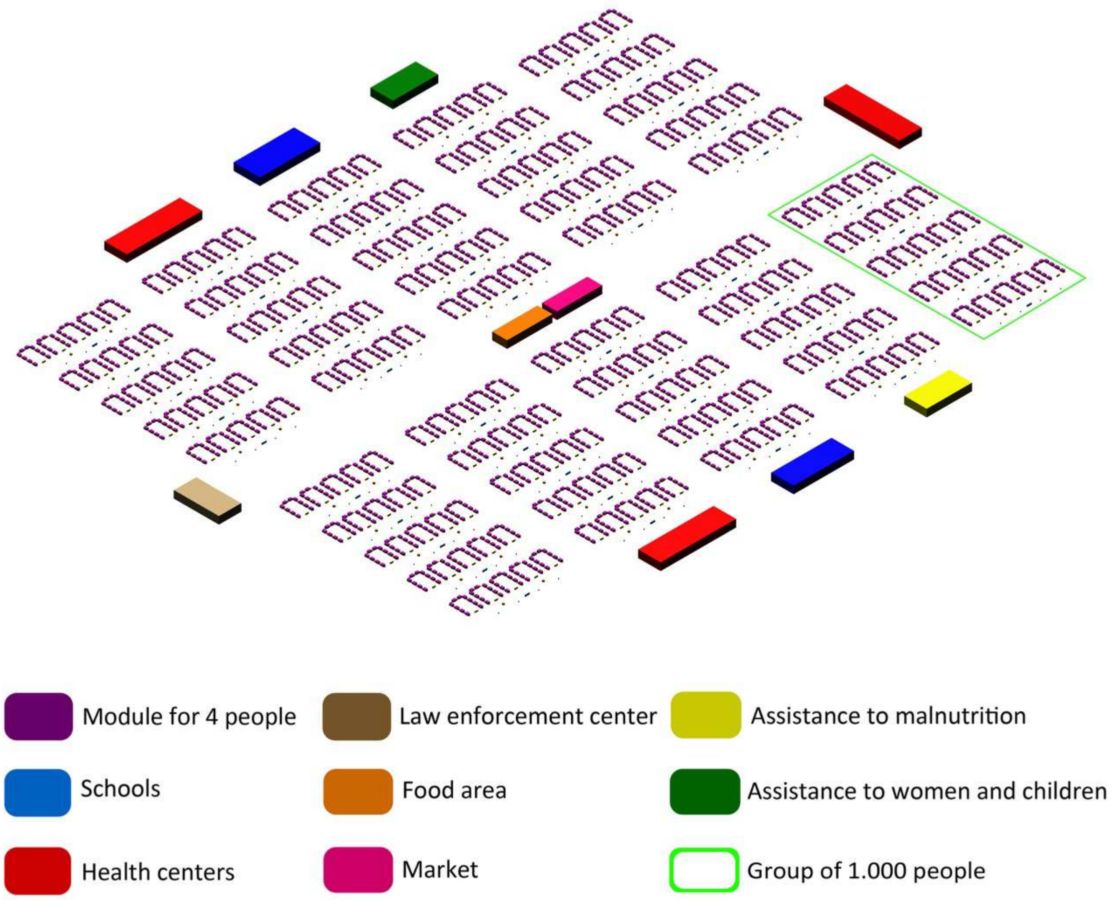
The modules can slide over the reused pallets in order to make different kind of groups.
Then we show some planning proposals:



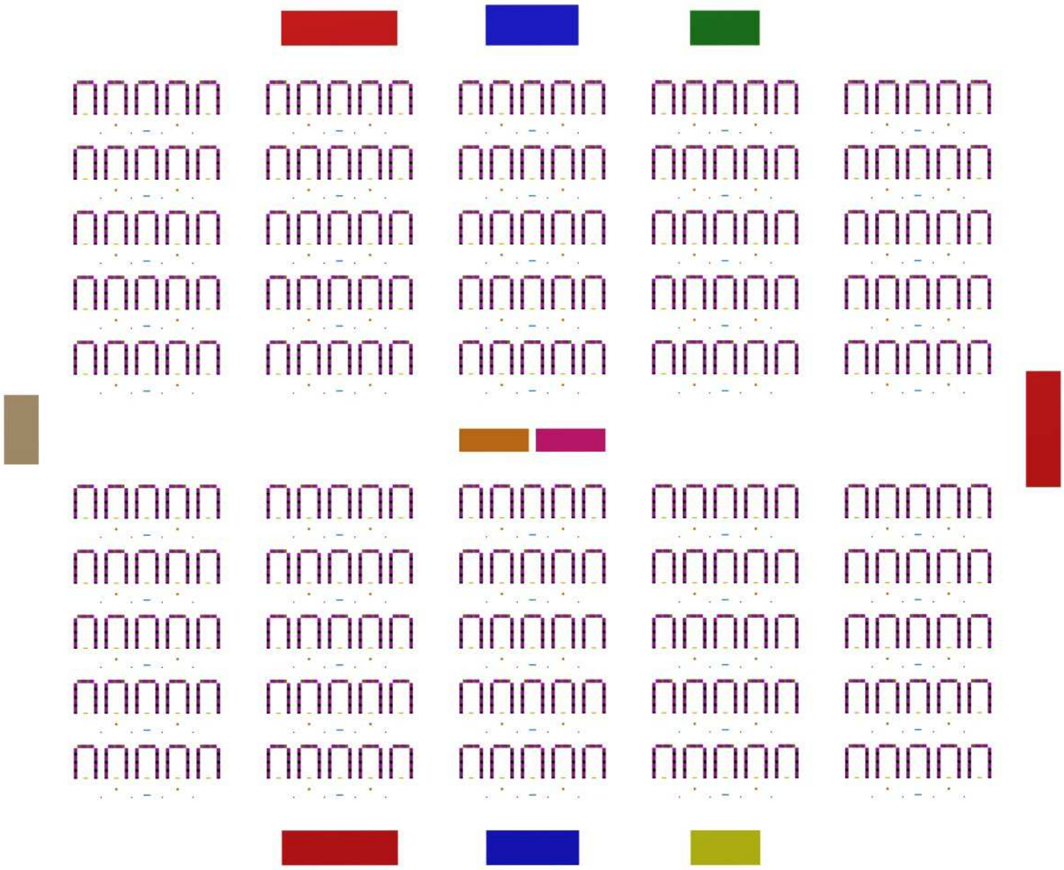


Proposal for a group of 200 people

With 50 groups of 200 people (the previous one) we designed a refugee camp with capacity for 10.000 people:

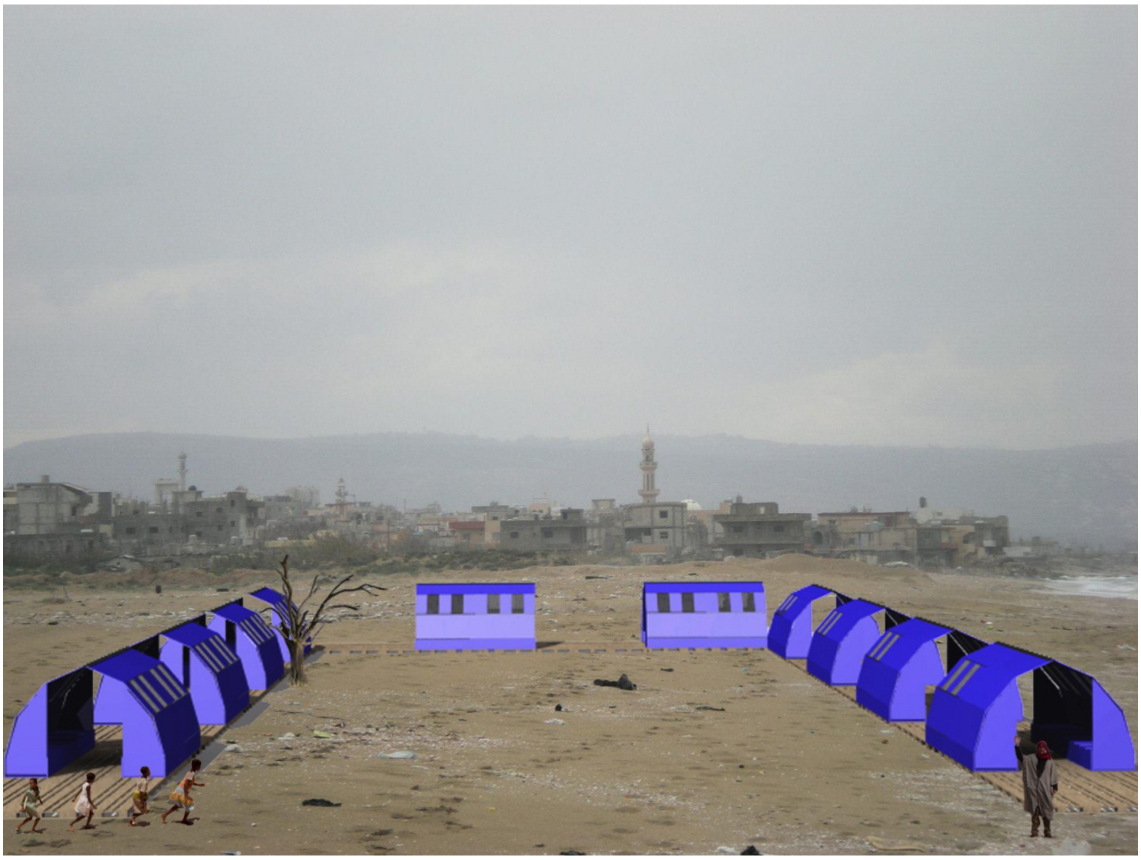


Proposal for a refugee camp of 10.000 people



Refugee camp top view

4. REAL APPLICATION



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Instruction Manual

EMERGENCY MODULE

BLUA DOMO

You just received the emergency module BLUA DOMO.

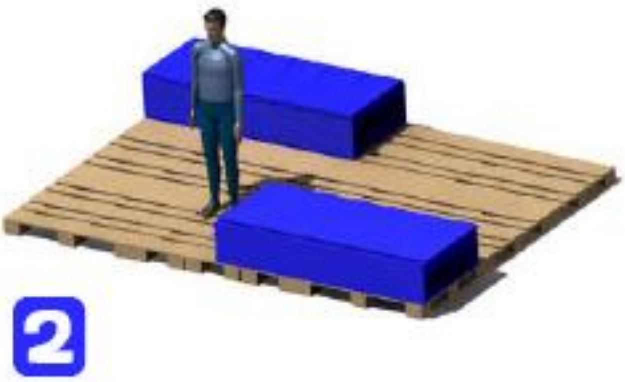
This is a box of 400x800x2000mm in which you cand find all the necessary parts for the assembly of your temporary shelter.

In the bottom of the box you will also find a basic kit with a mattress, a blanket and a first aid kit.

Then we will explain in detail the assembly instructions for your new home.

BLUA DOMO

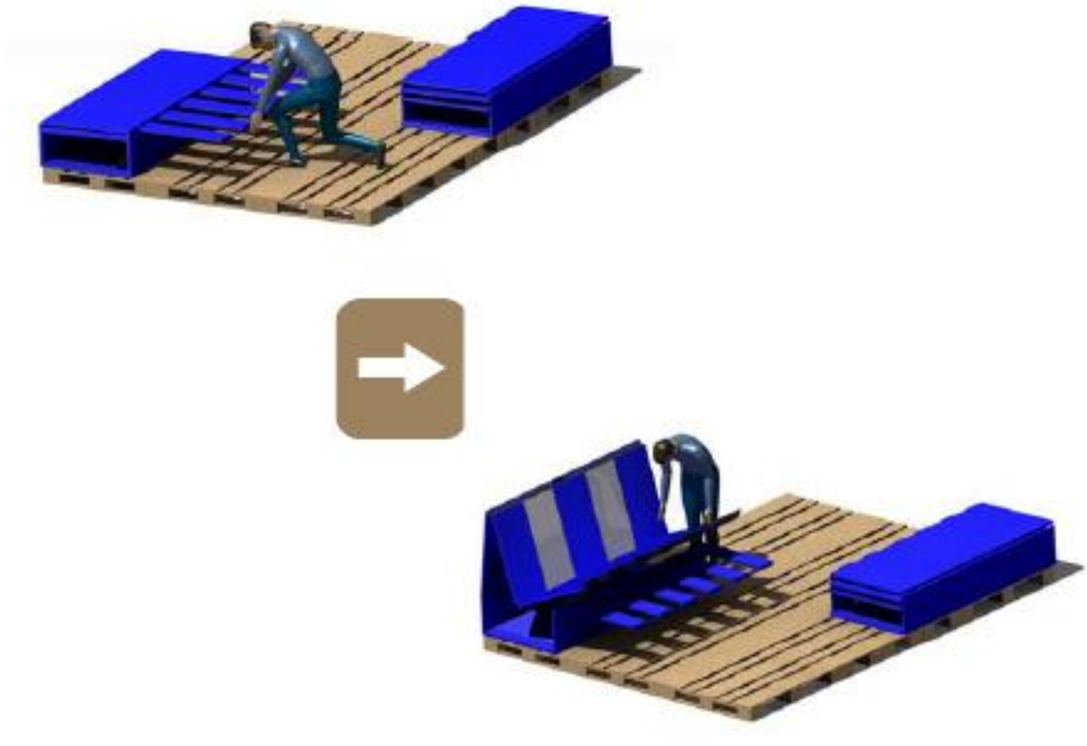
Each module will be assembled with a partner on reused pallets (see photo 1).



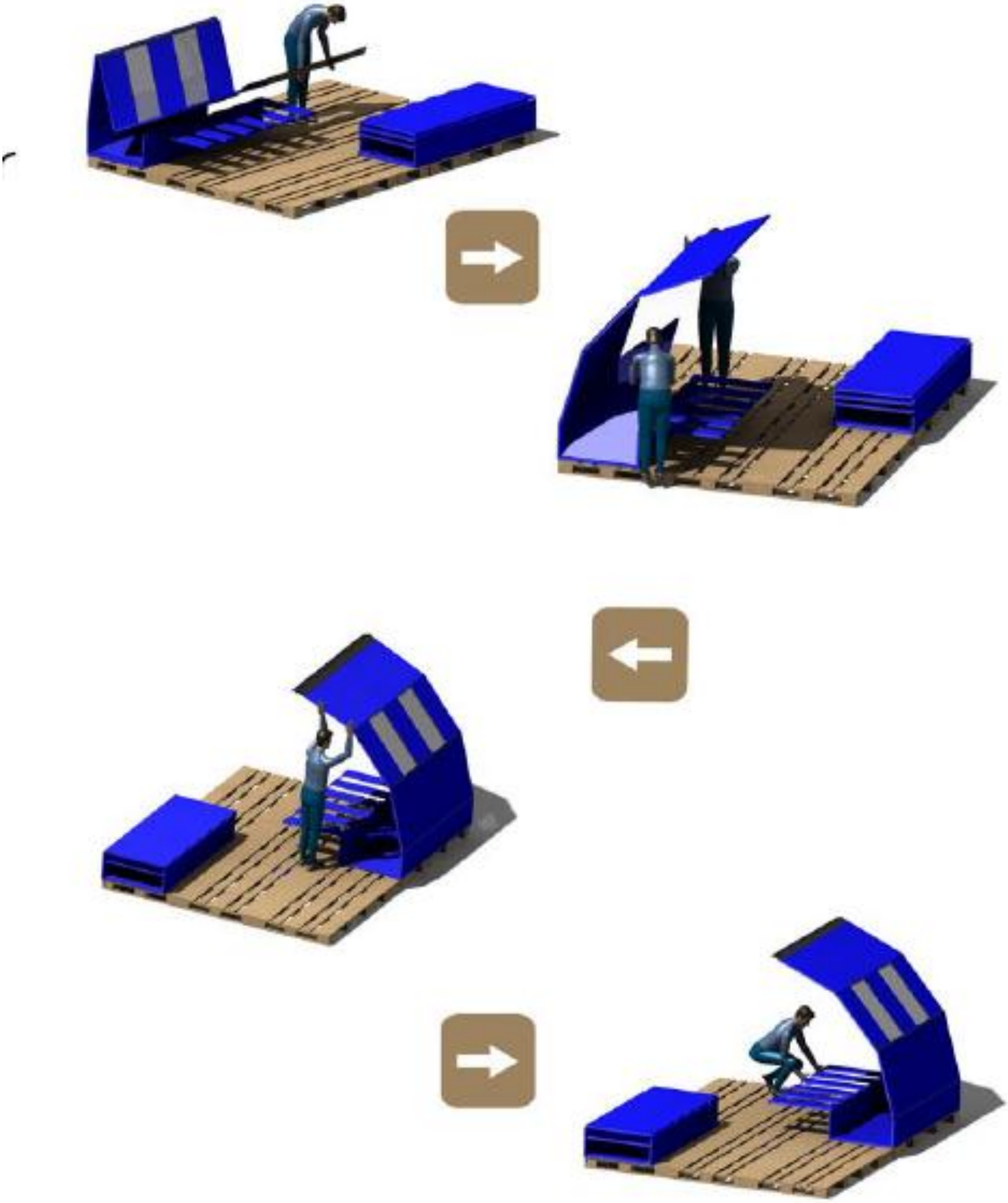
A box will be placed in front of another (see photo 2).

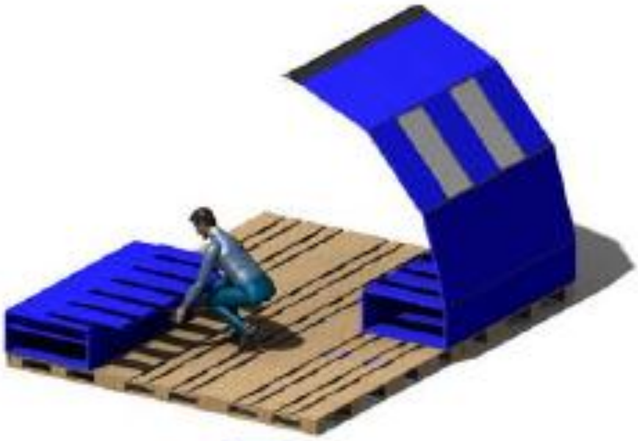
You must proceed to the assembly of the first module according to the photos.

A detailed explanation of the assembly will be presented in the following pages.



BLUA DOMO





3

Slide the top cover (see photo 3).

Open up the first two sheets (see photos 4 and 5).

4

5

BLUA DOMO

6

7

8

Hold sheets 2 and 3 and open up them completely (see photos 6, 7 and 8).

9

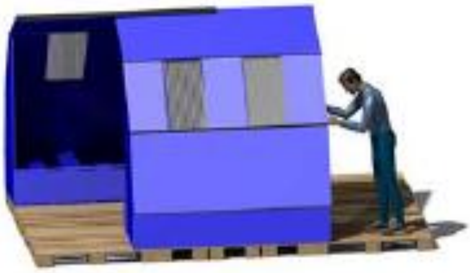
Lift the sheet that will make up the front cover.
This sheet is embedded in a lateral of the initial box (see photo 9).

Close the top cover. You already have the second module built (photo 10).

10

Both modules are already mounted.

The final step is to push one of the modules until it clicks perfectly with your partner (modules slide over the pallets).



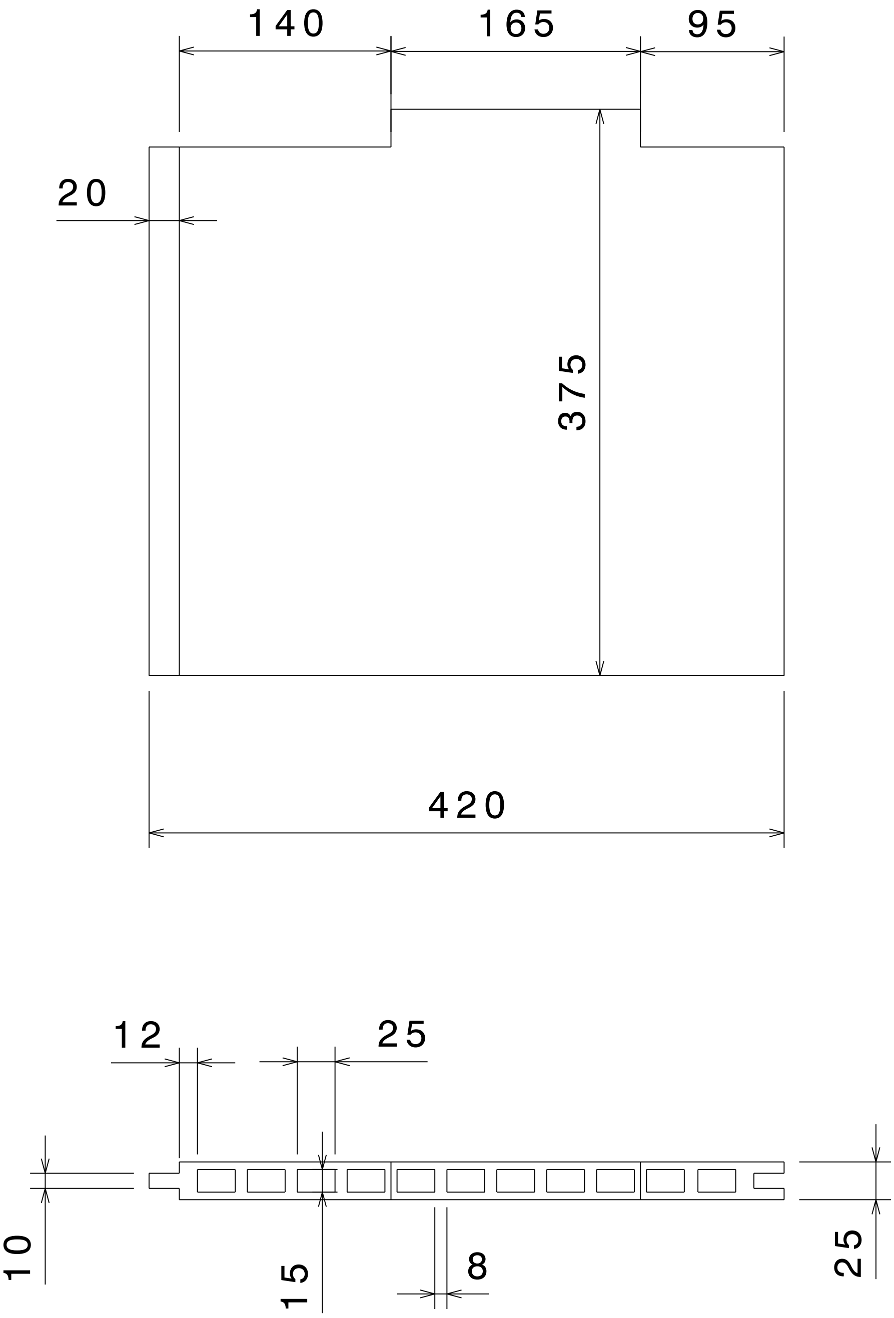
BLUA DOMO

Congratulations!

You have completed the assembly of your emergency module BLUA DOMO.

Place the mattress on the bed frame to complete your home.

Now you have everything you need for your accommodation.



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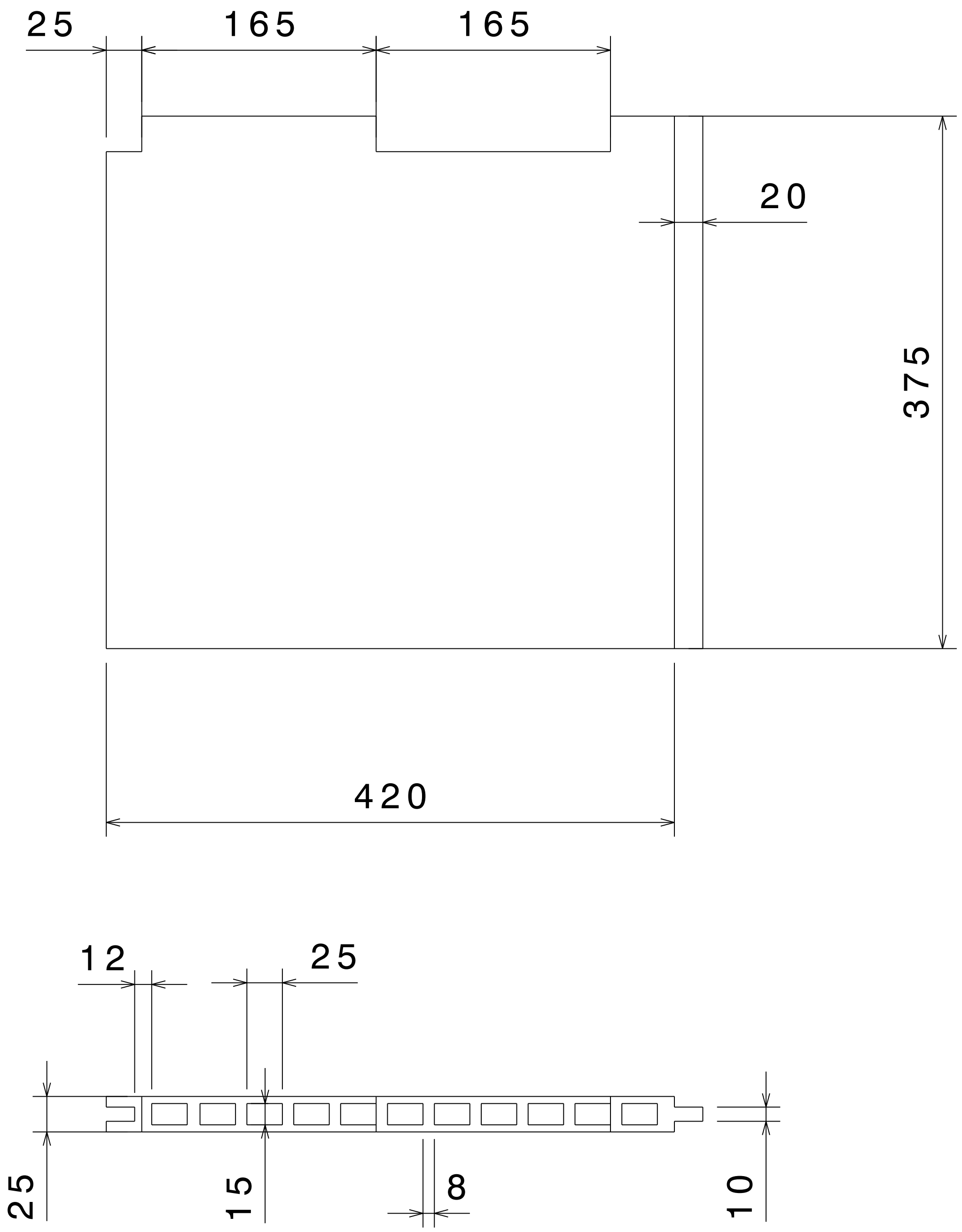

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Maitane Fdez.de Larrinoa
Sonia Cordobés

CENTRAL SHEET 375 3

MODULAR ARCHITECTURE

MATERIAL: Polywood

DATE 27/07/2012

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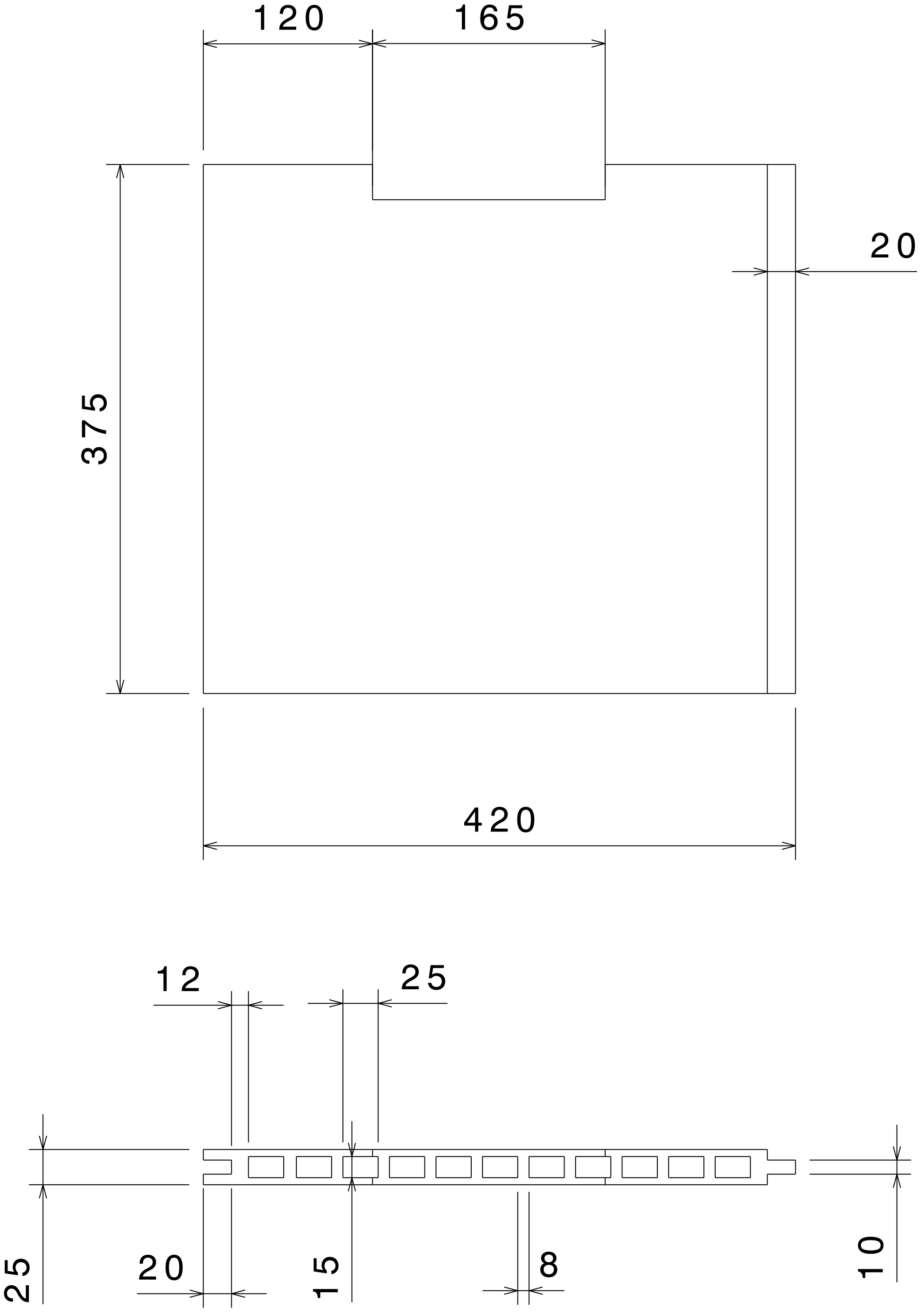
PAGE 9



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Sonia Cordobés

CENTRAL SHEET 375 4

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MATERIAL:
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DATE
27/07/2012

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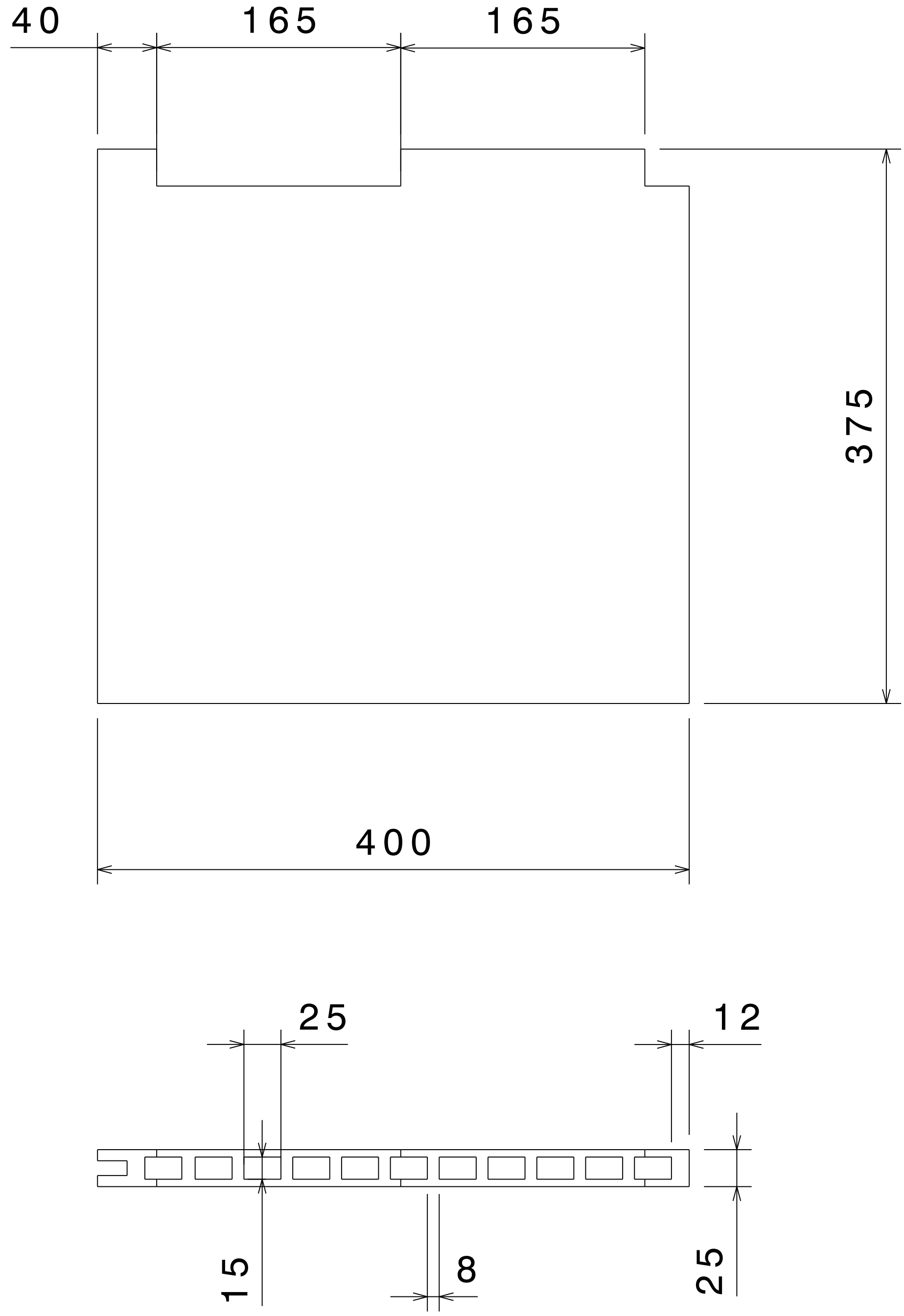

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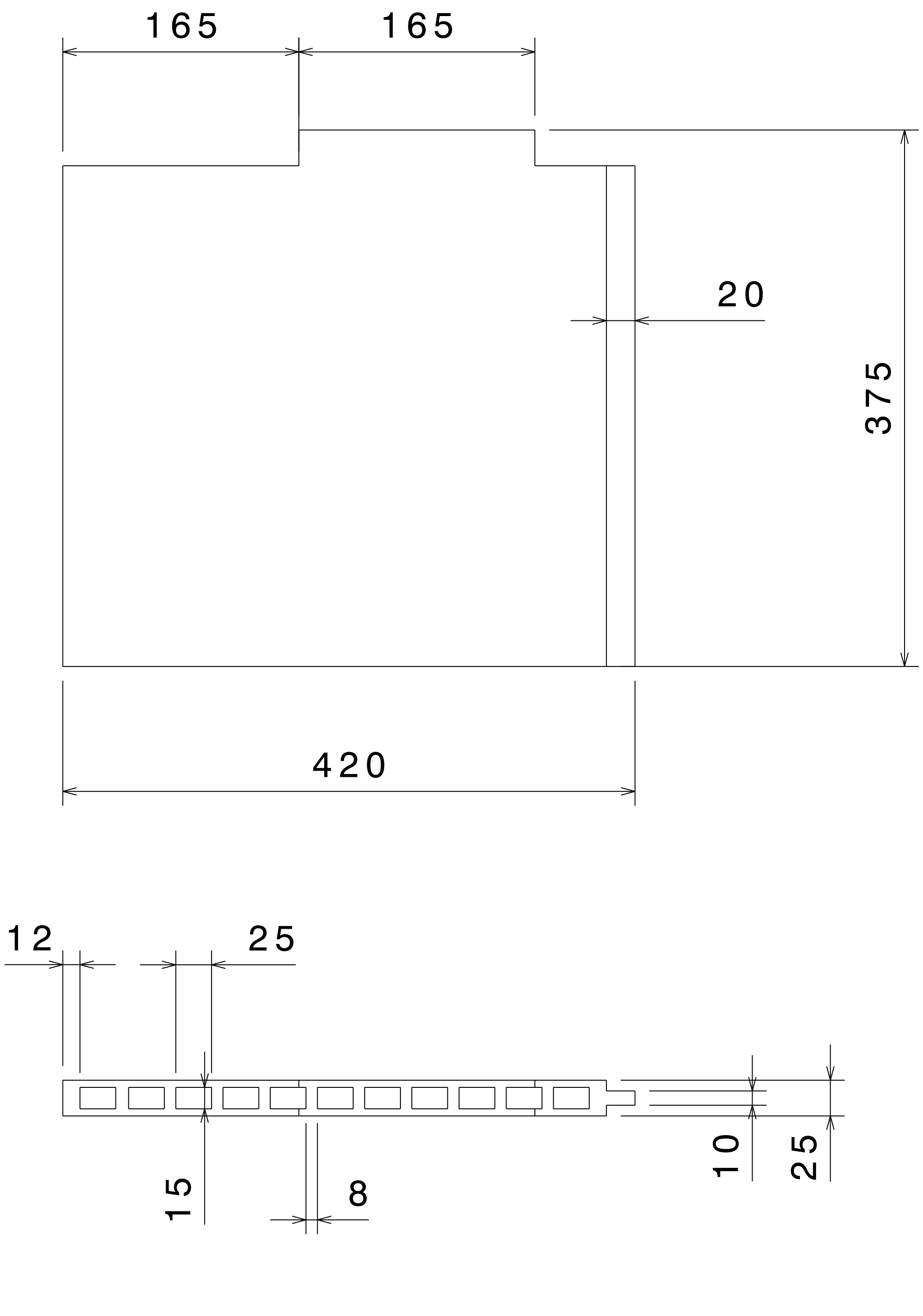

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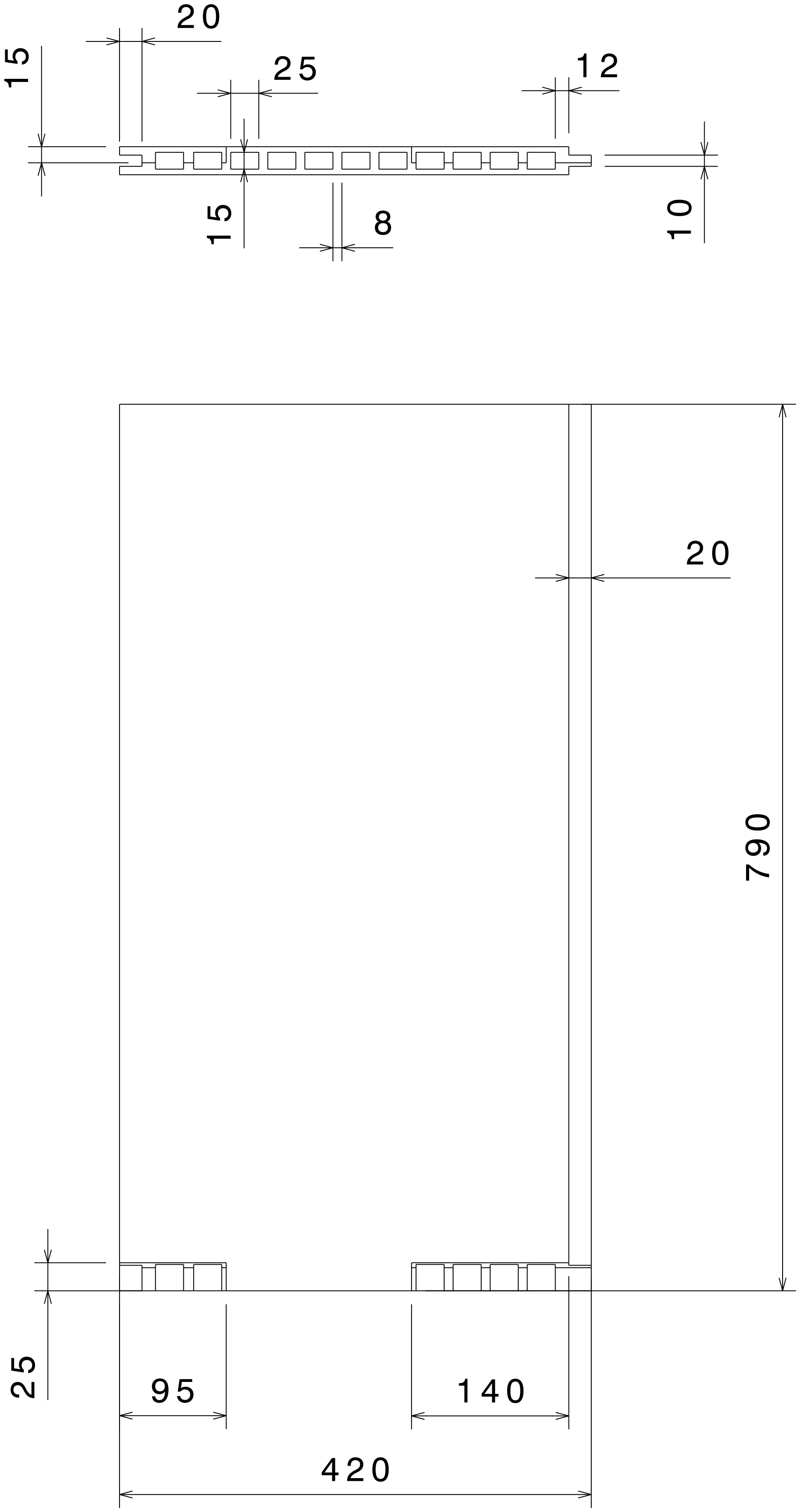

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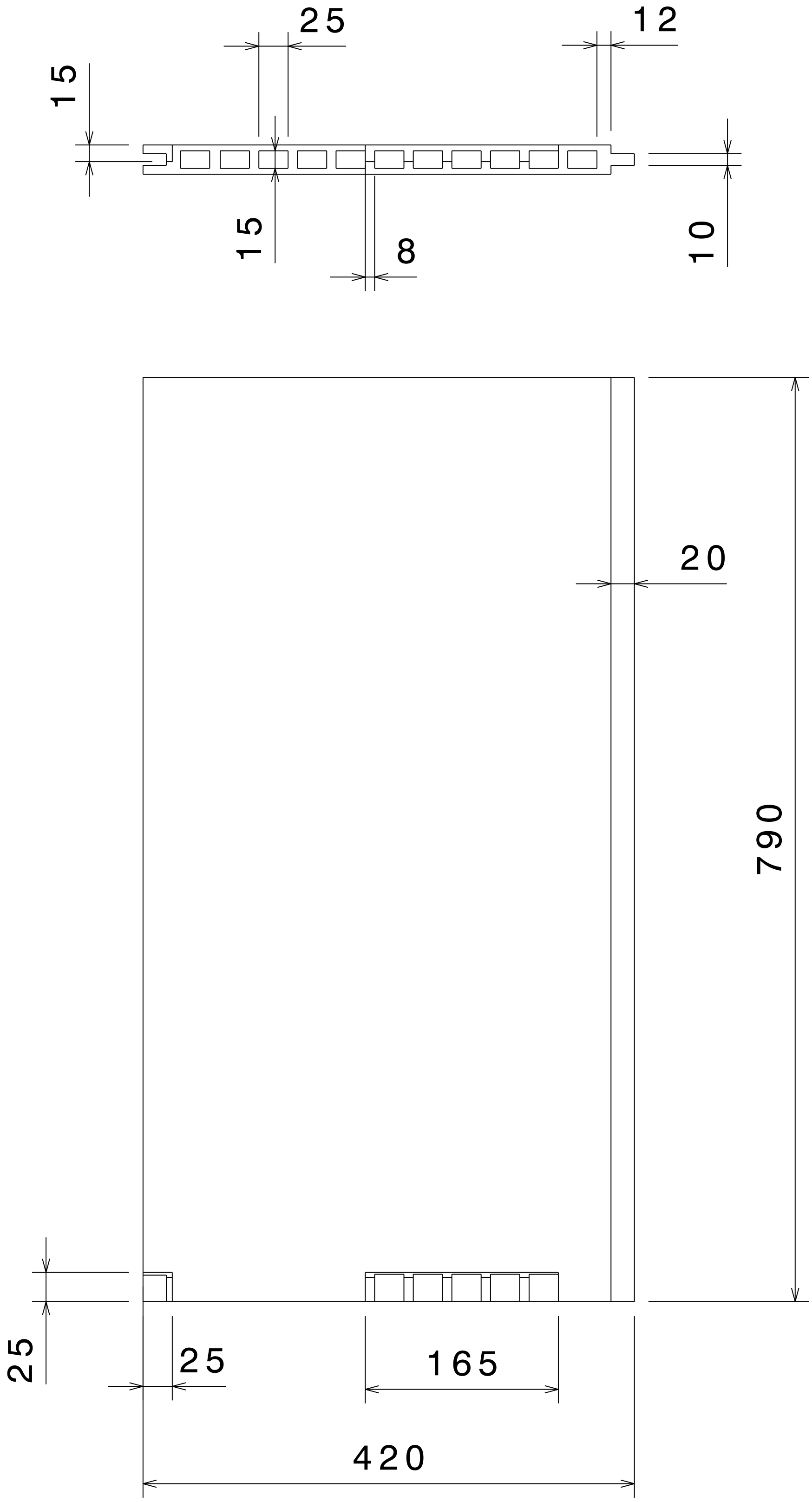

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CENTRAL SHEET 790 3

MODULAR ARCHITECTURE

MATERIAL: Polywood

DATE 27/07/2012

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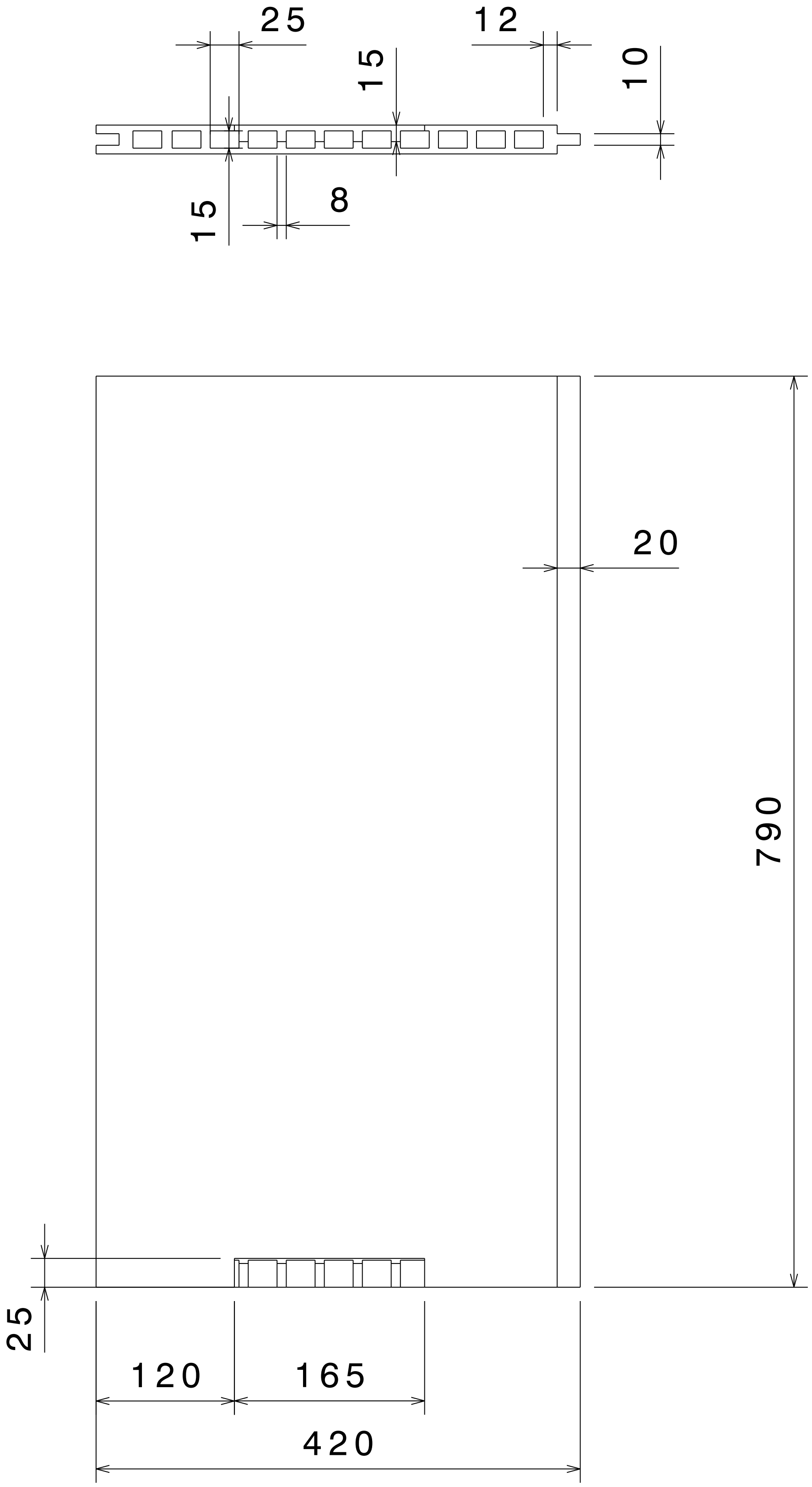

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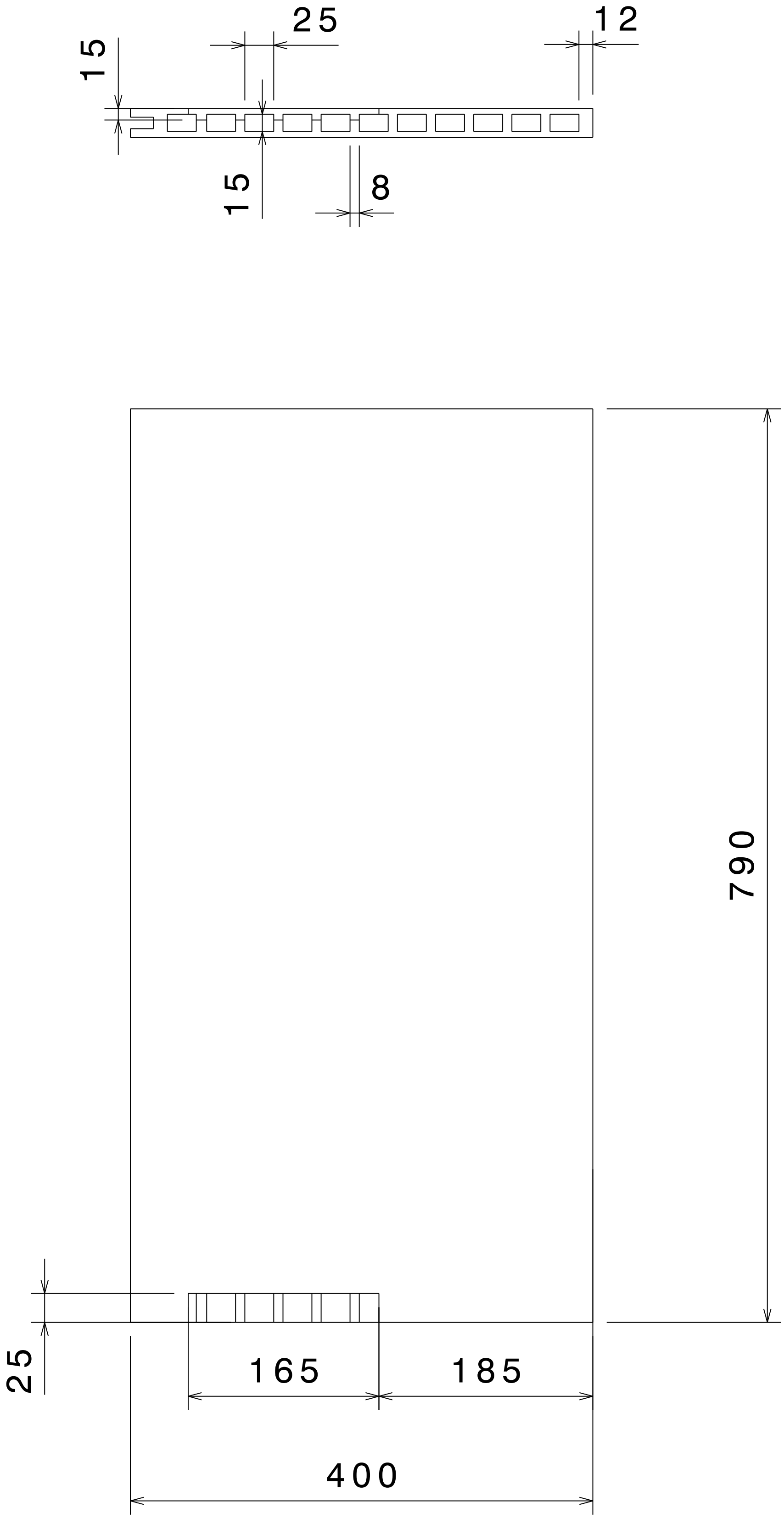

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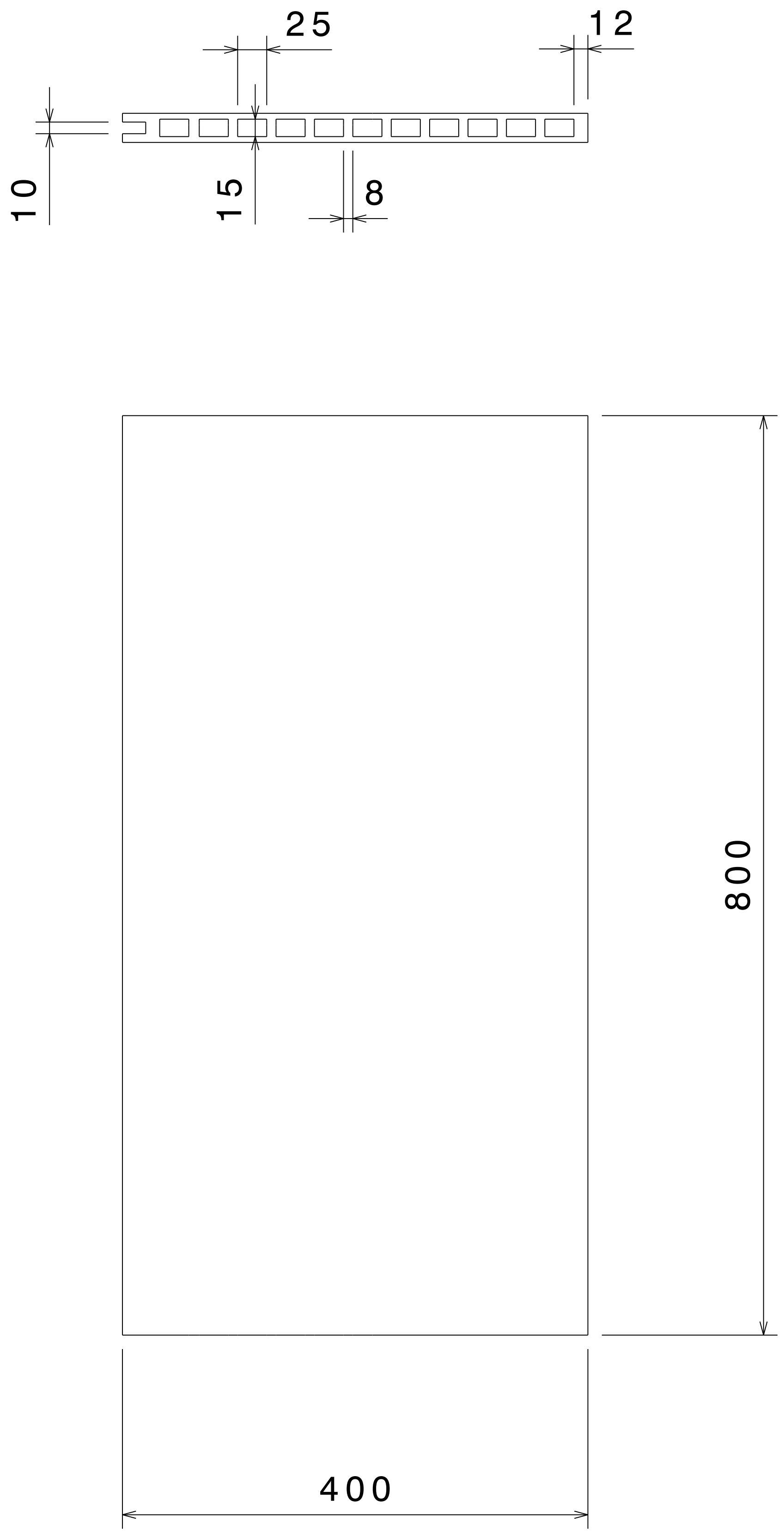

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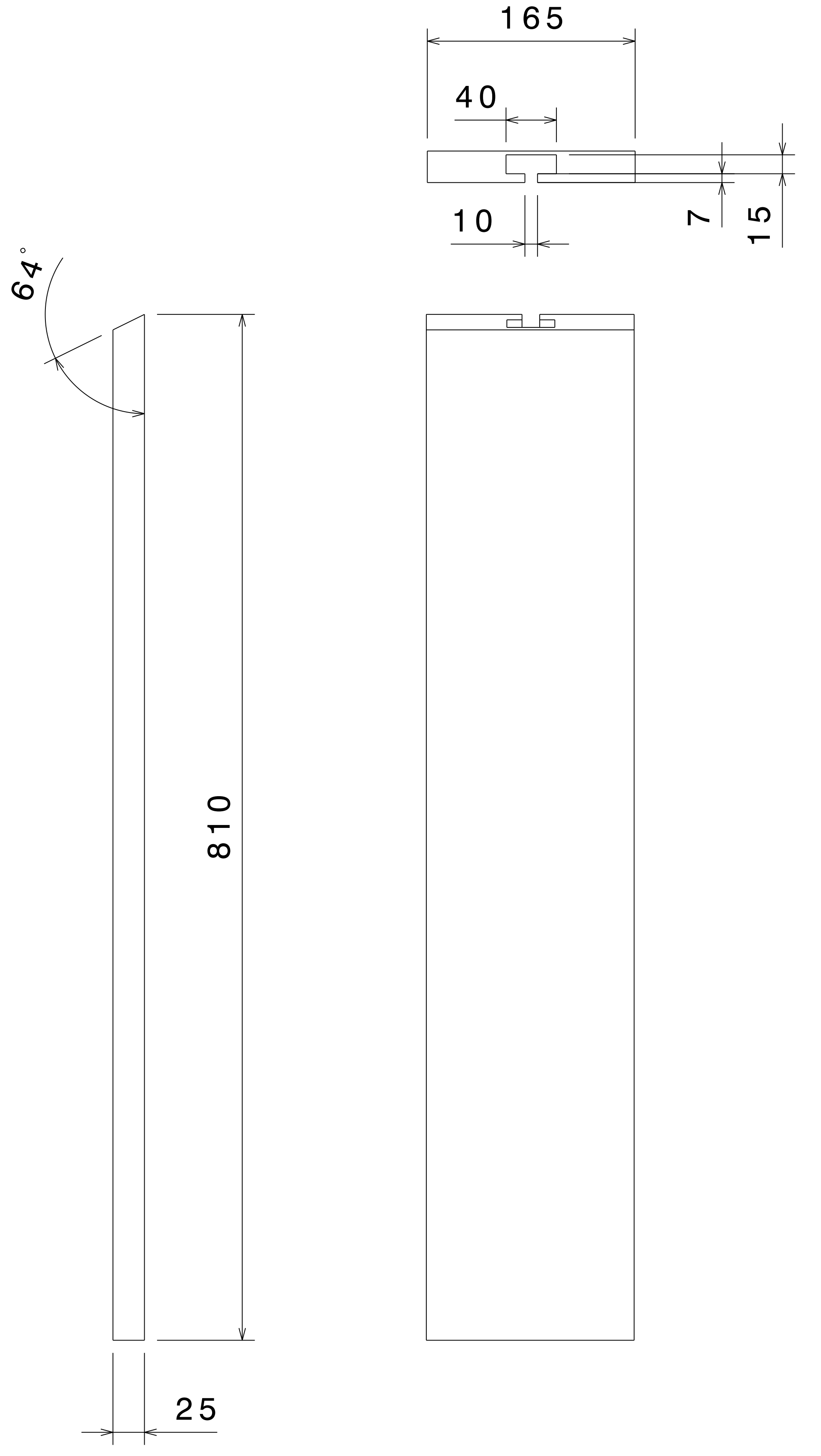

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BED SHEET

MODULAR ARCHITECTURE

MATERIAL: Polywood

DATE 27/07/2012

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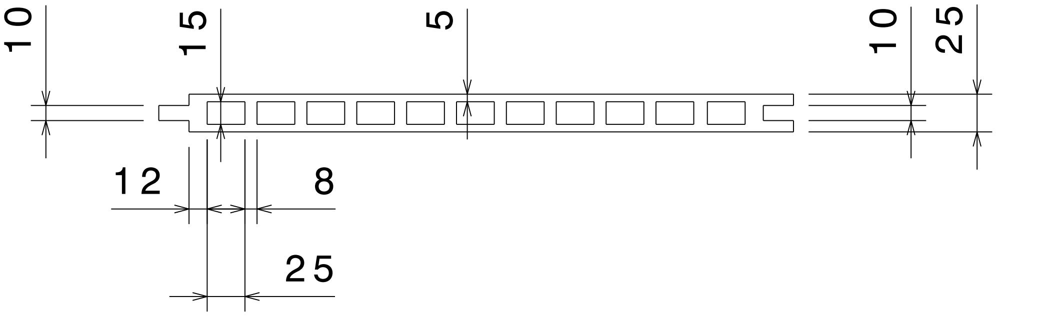

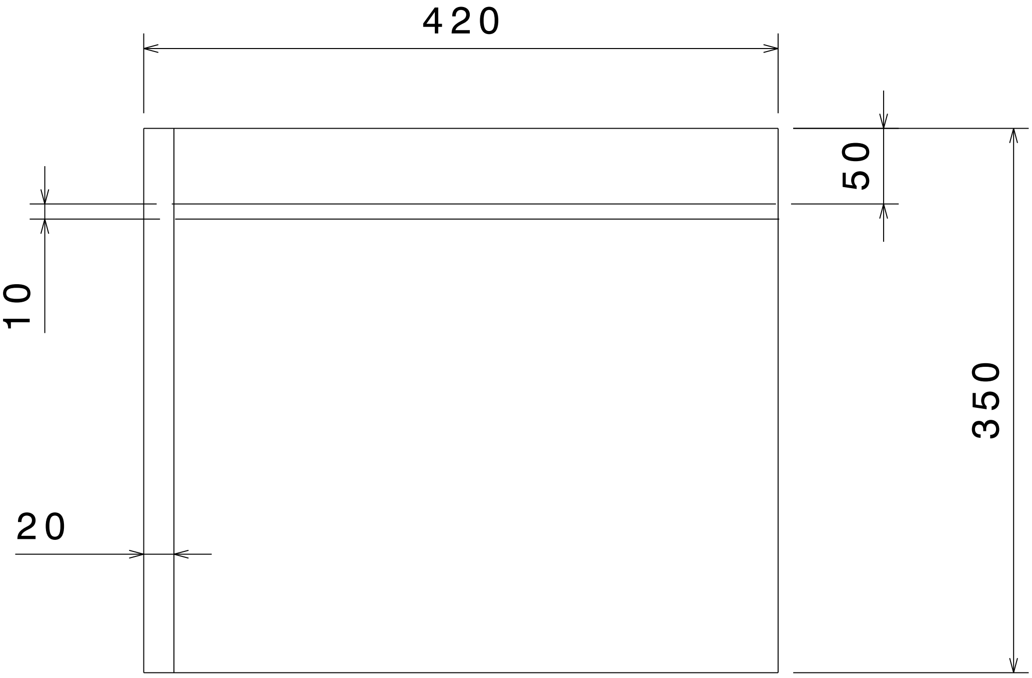

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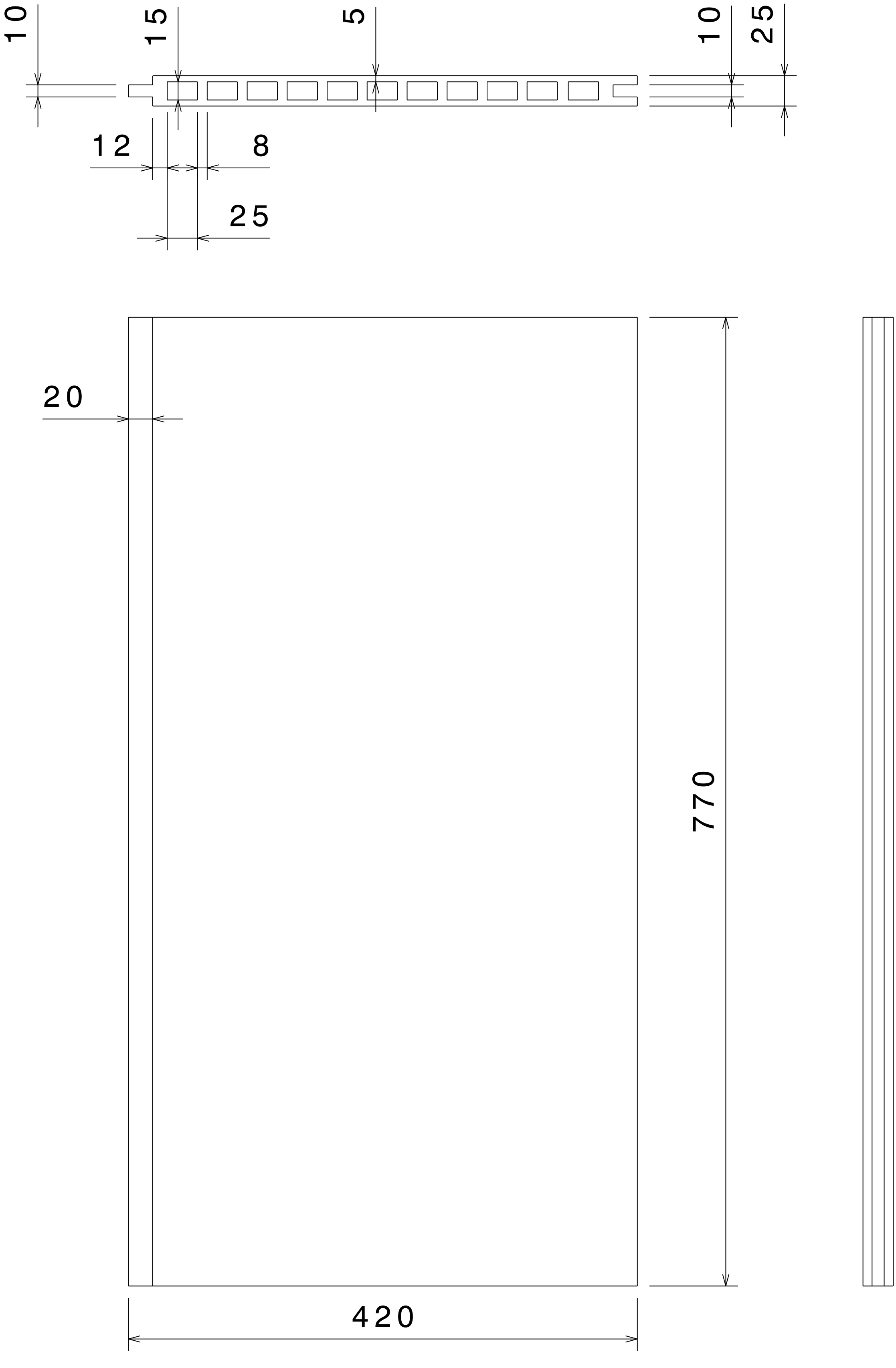

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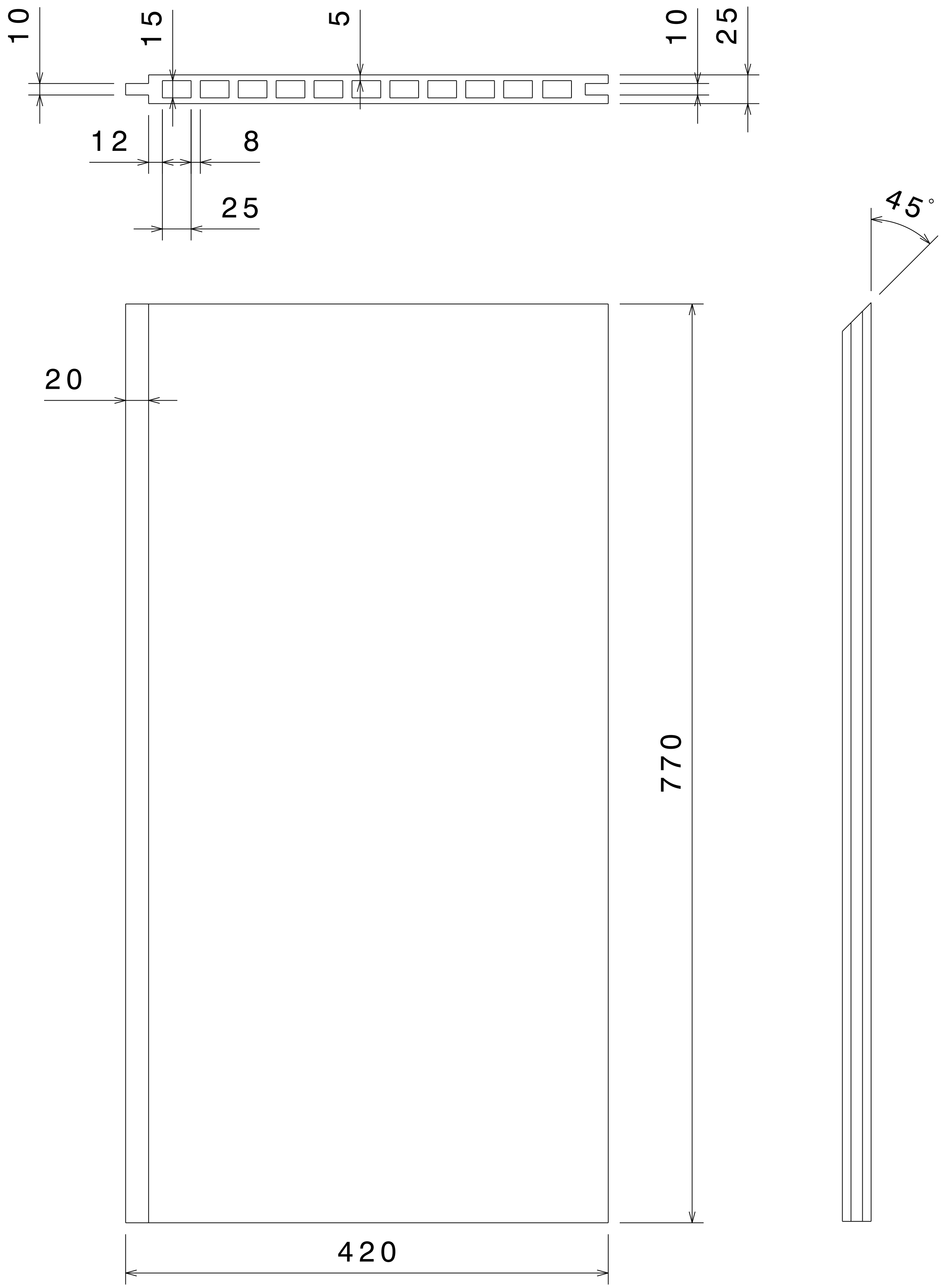

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MODULAR ARCHITECTURE

MATERIAL: Polywood

DATE 27/07/2012

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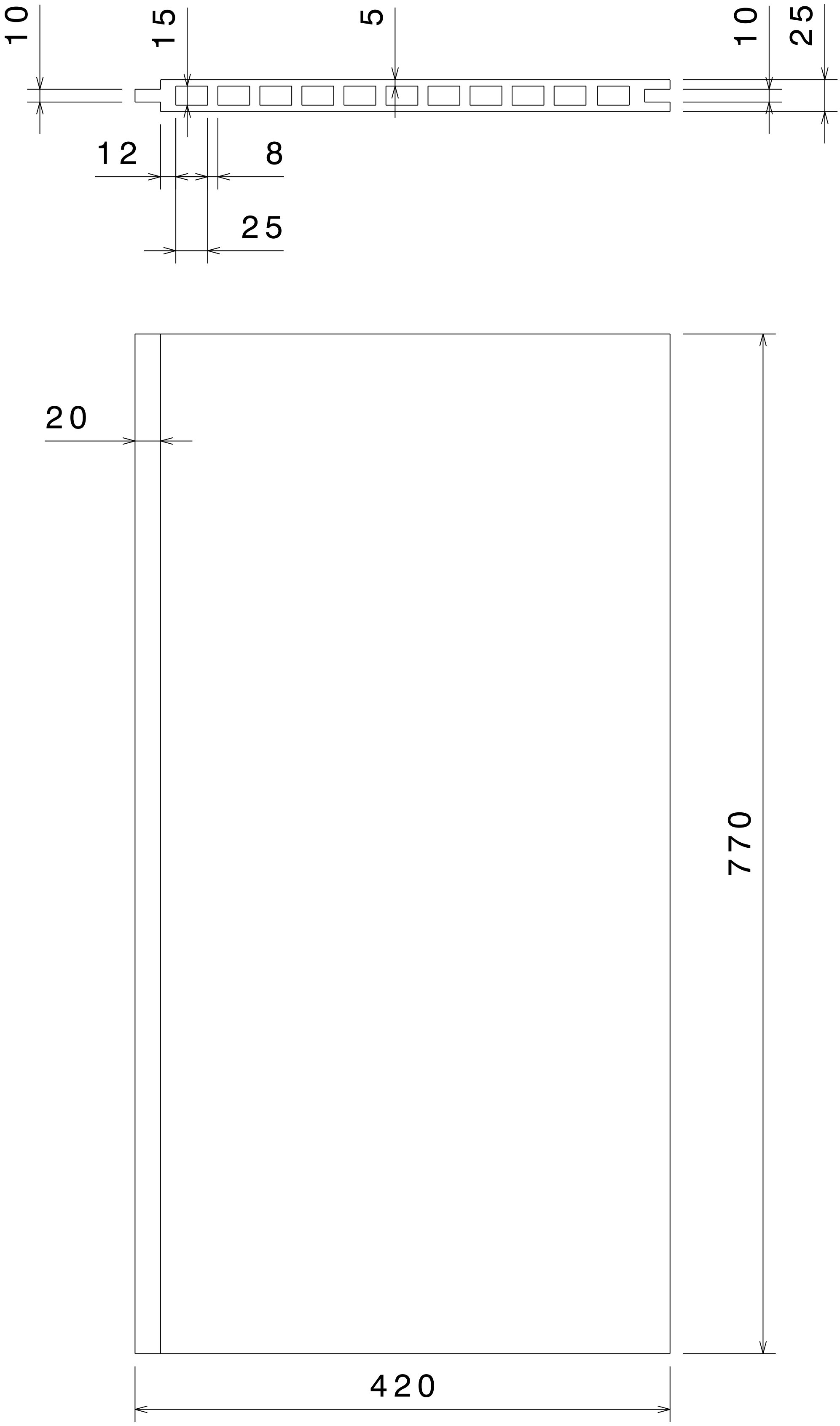

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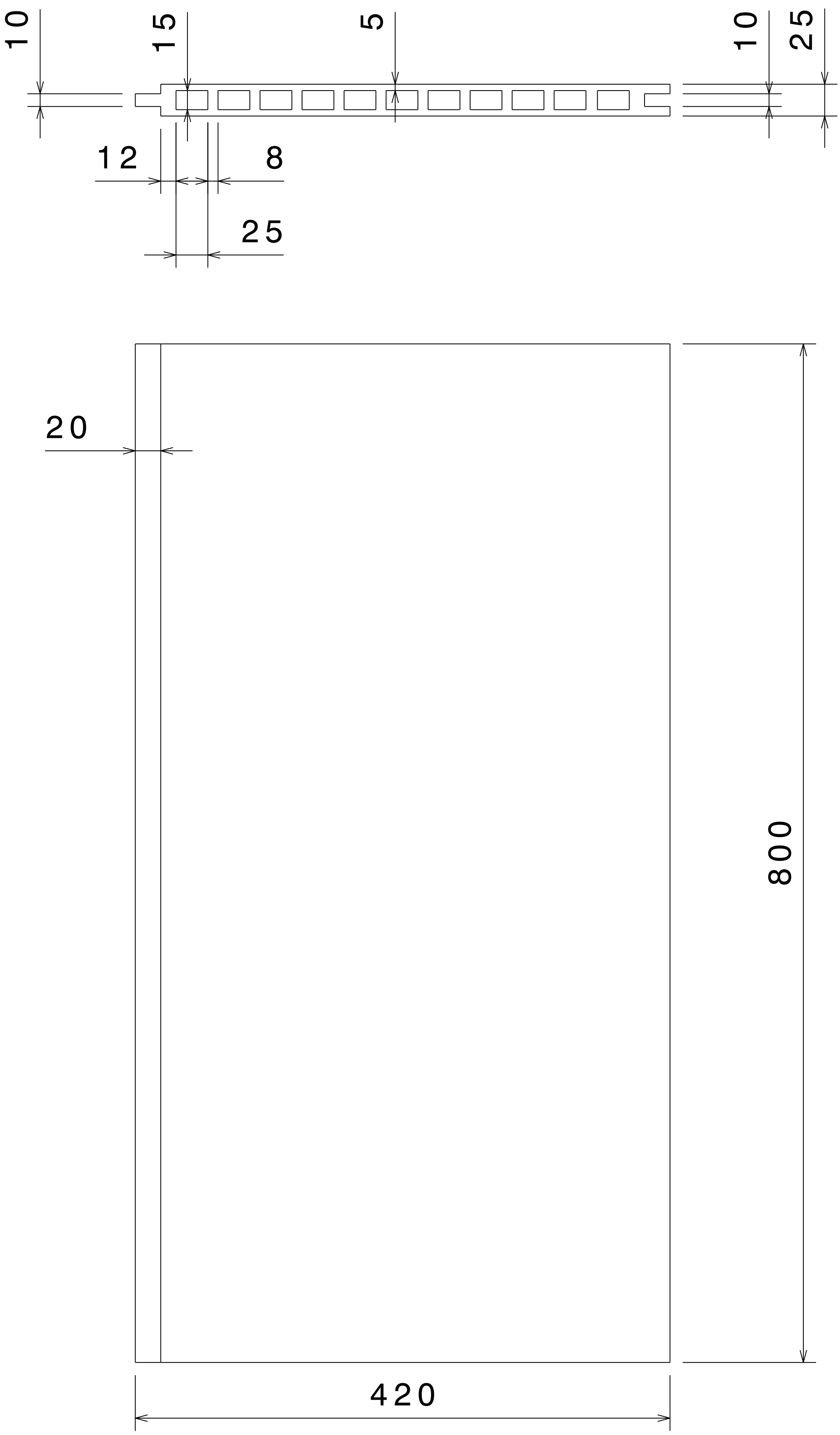

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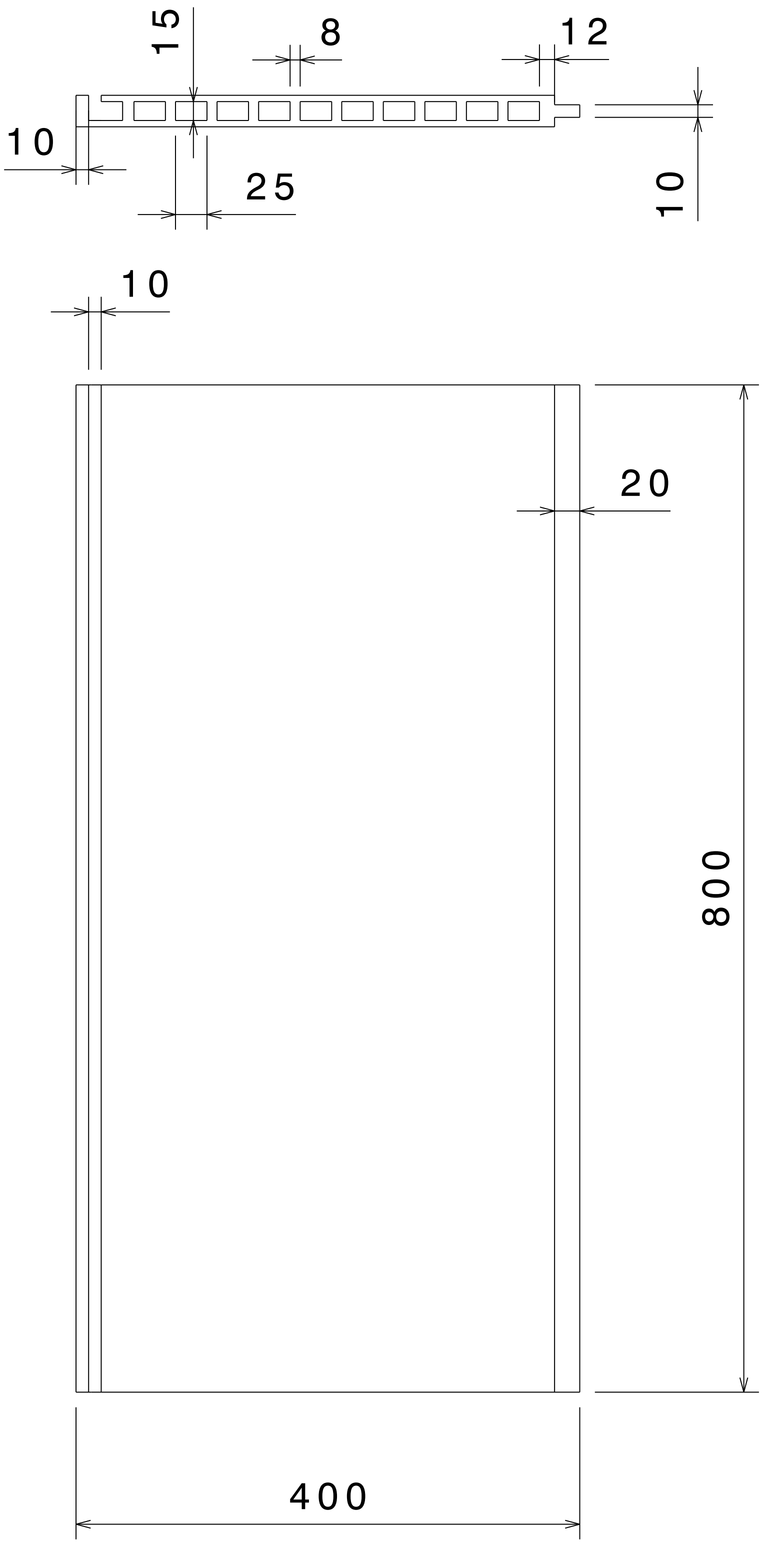

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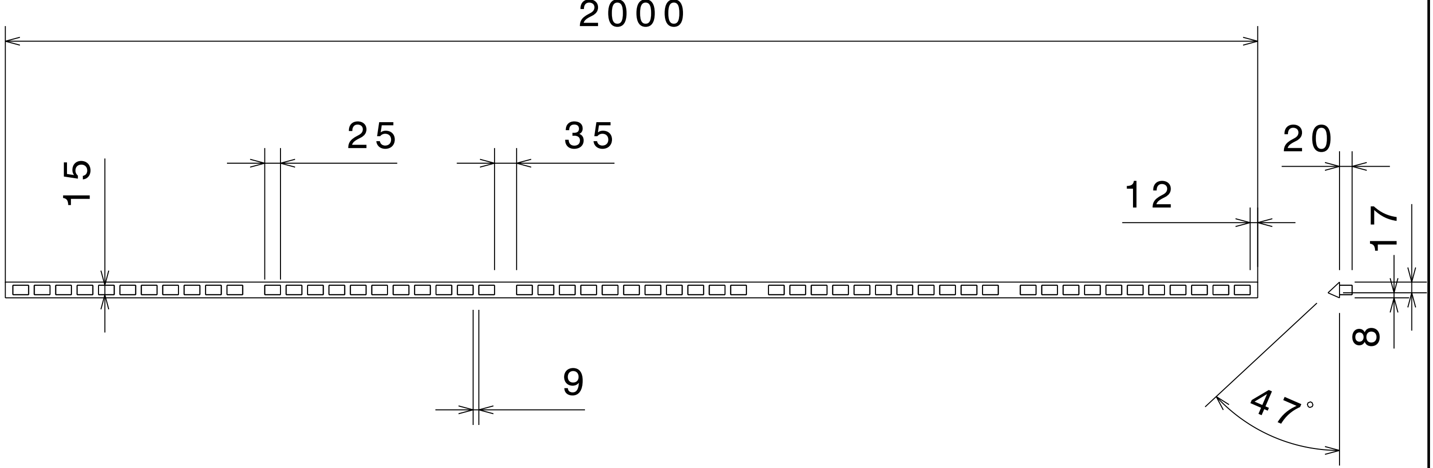

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CONNECTION PIECE A

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MATERIAL: PVC

DATE 27/07/2012

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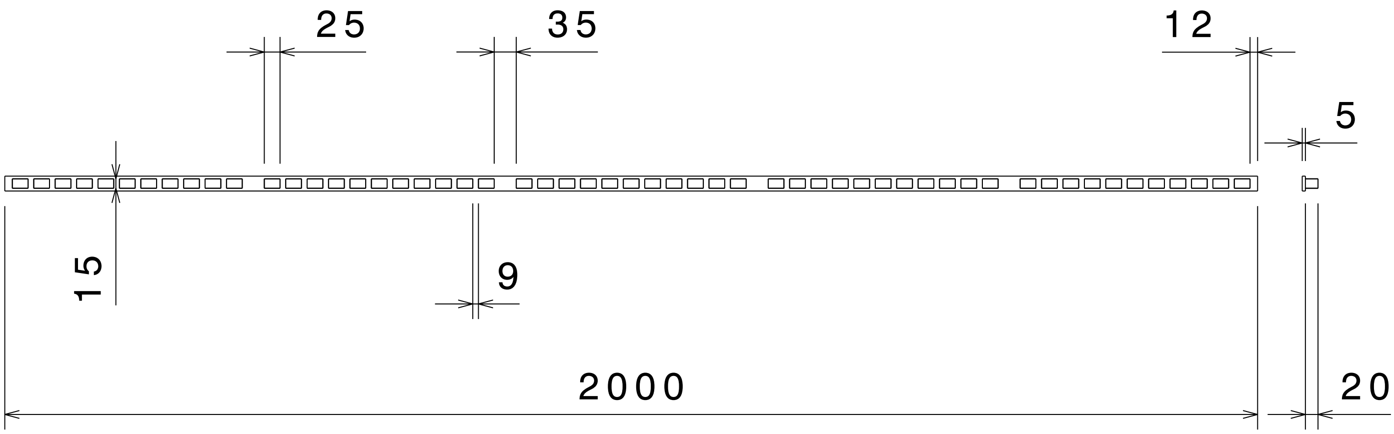

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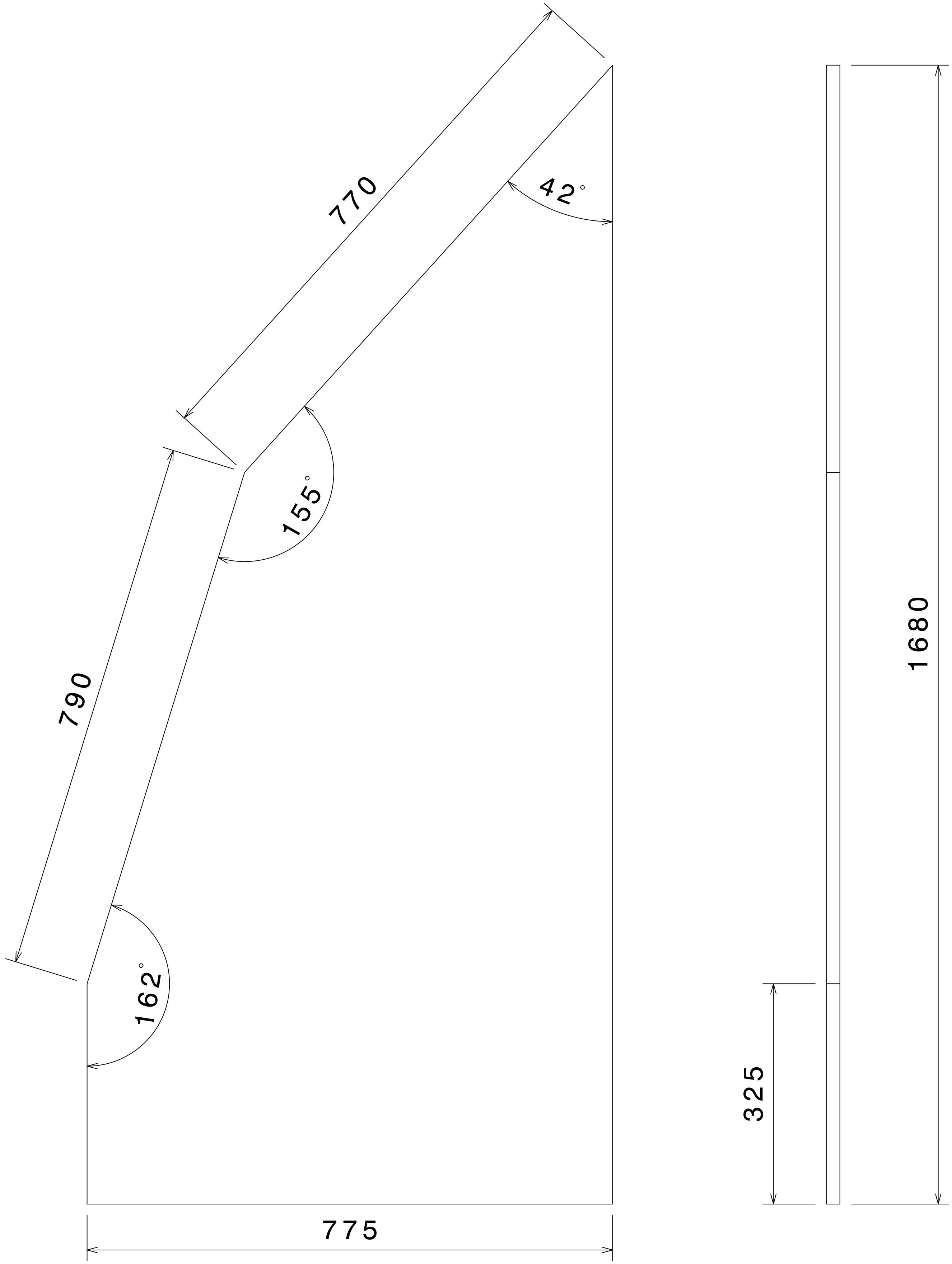

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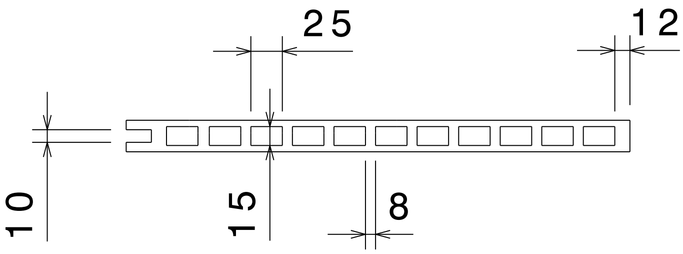

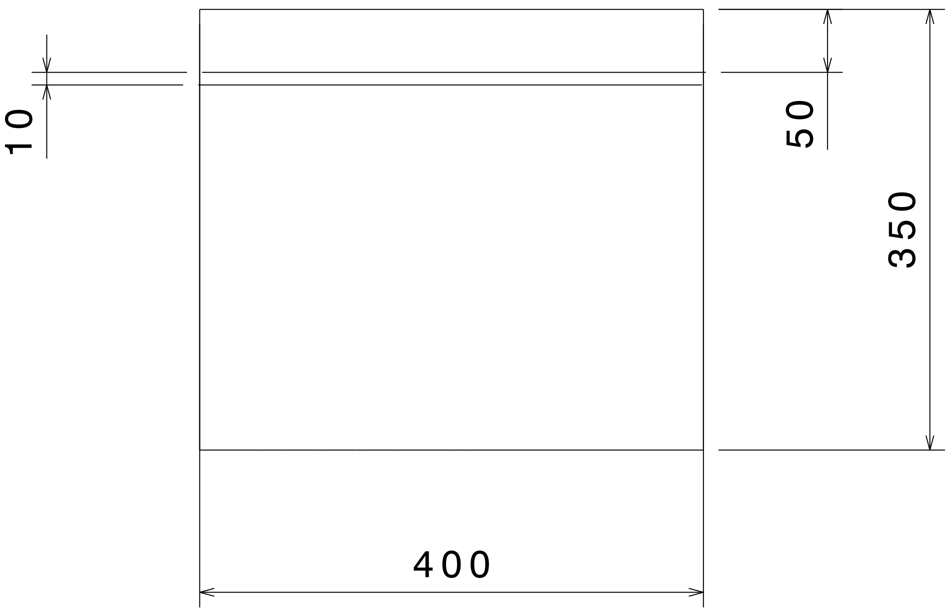

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LATERAL SHEET A 350

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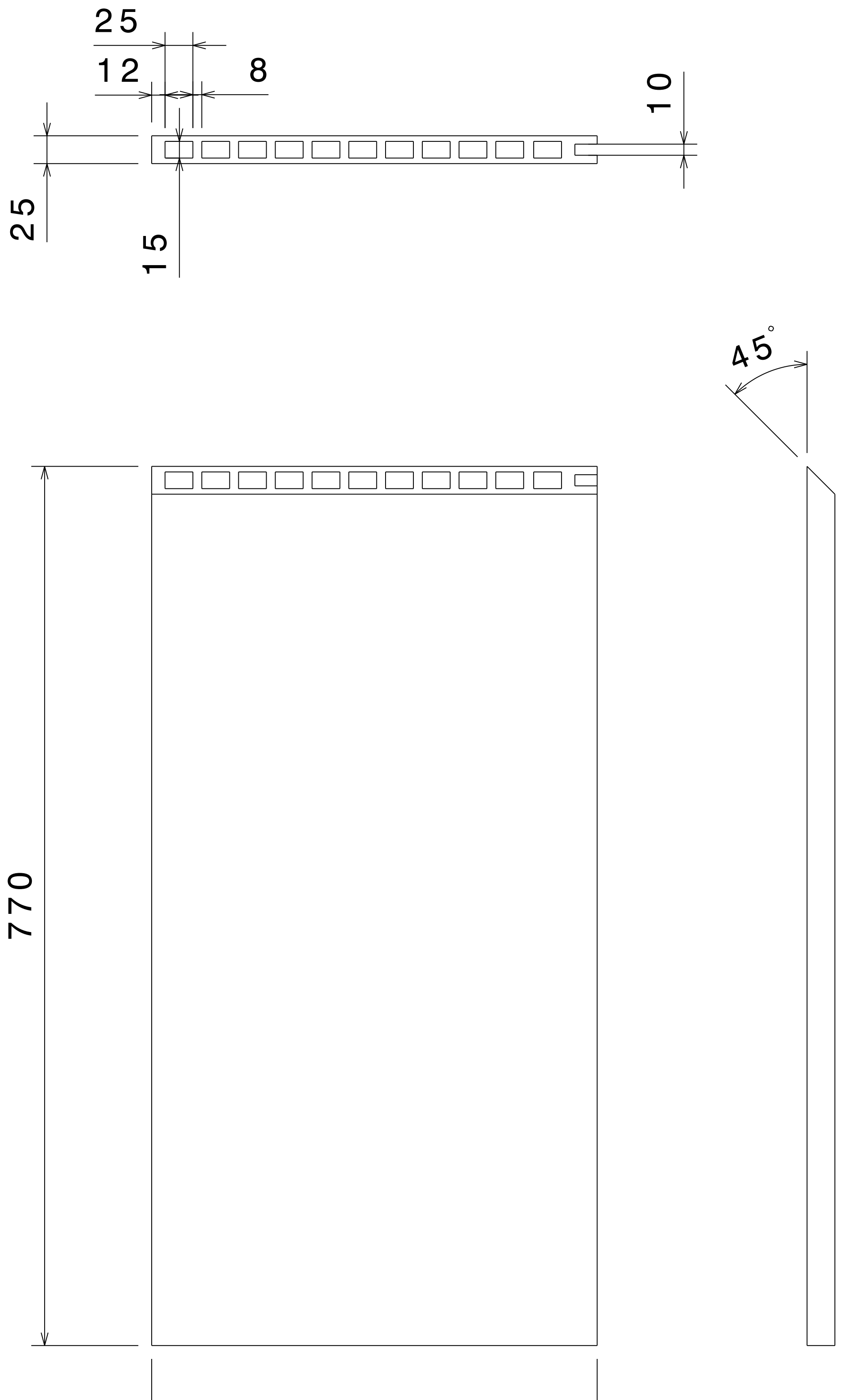

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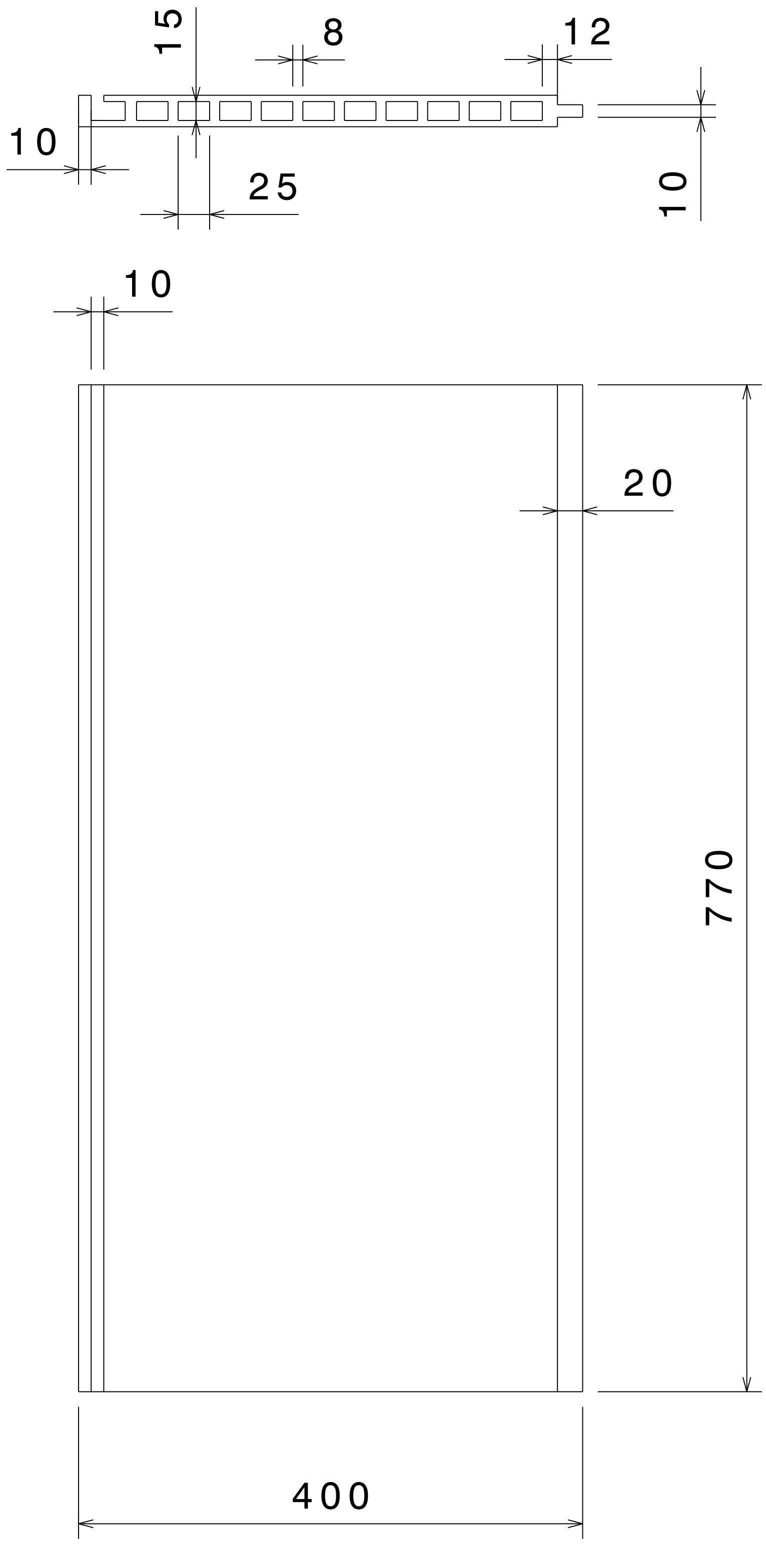

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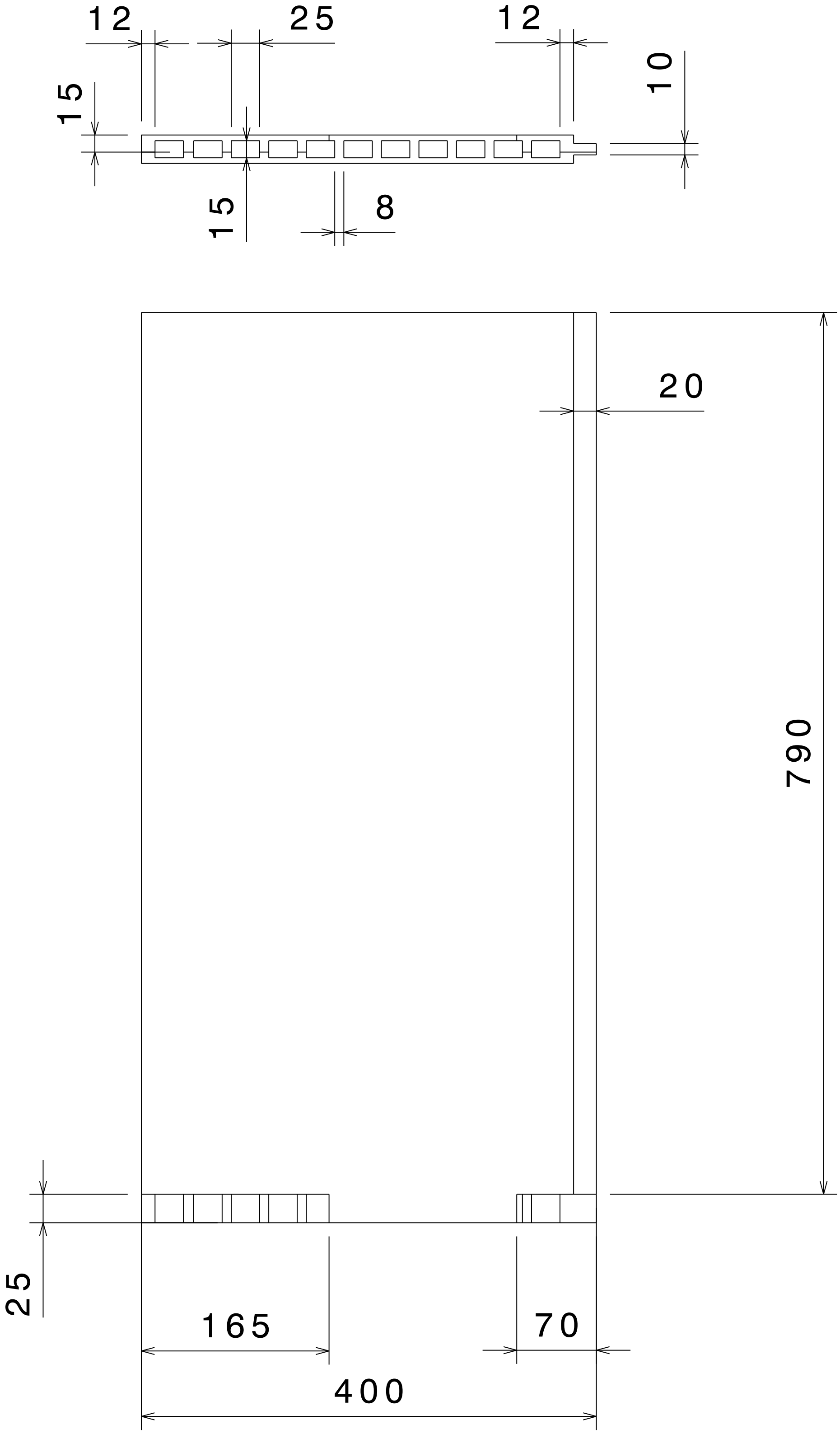

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LATERAL SHEET B 790

MODULAR ARCHITECTURE

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DATE 27/07/2012

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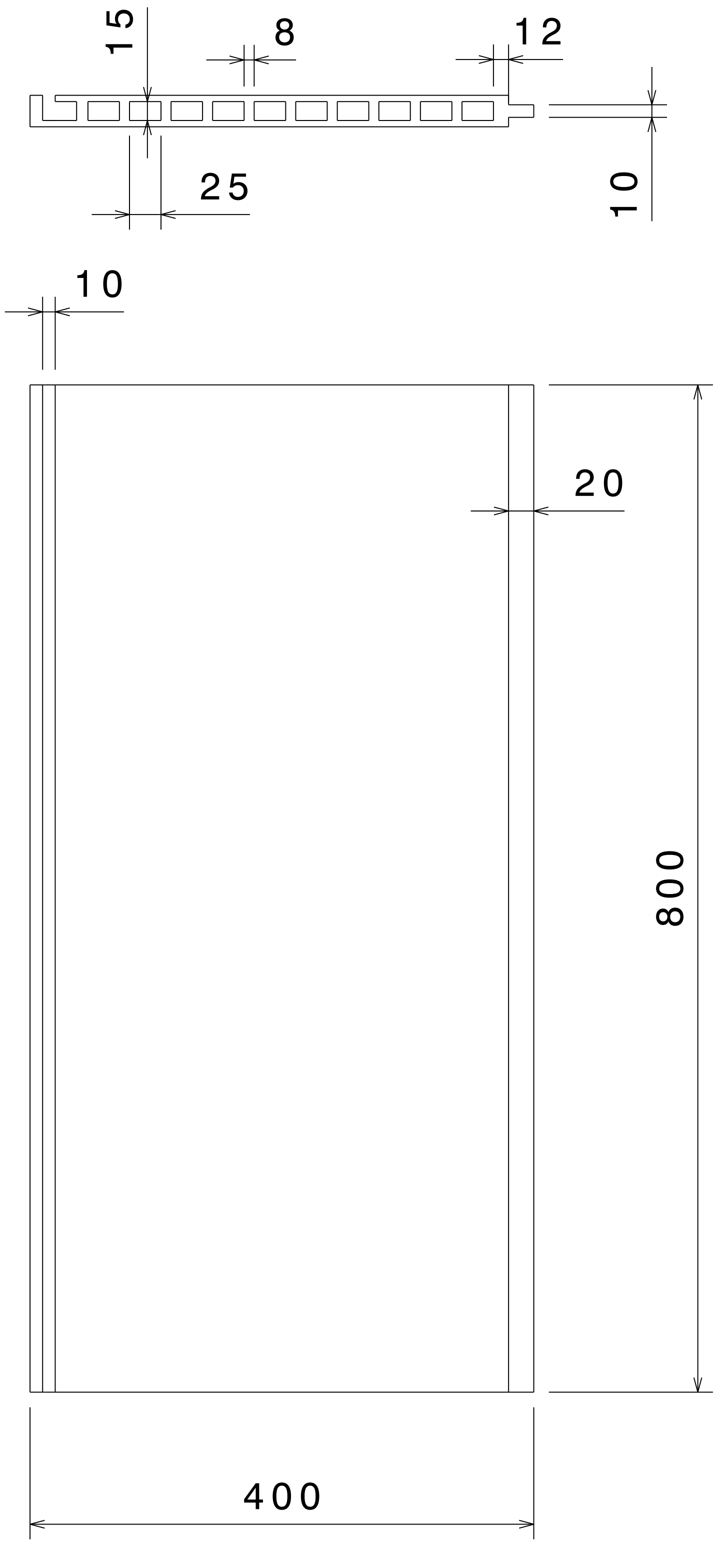

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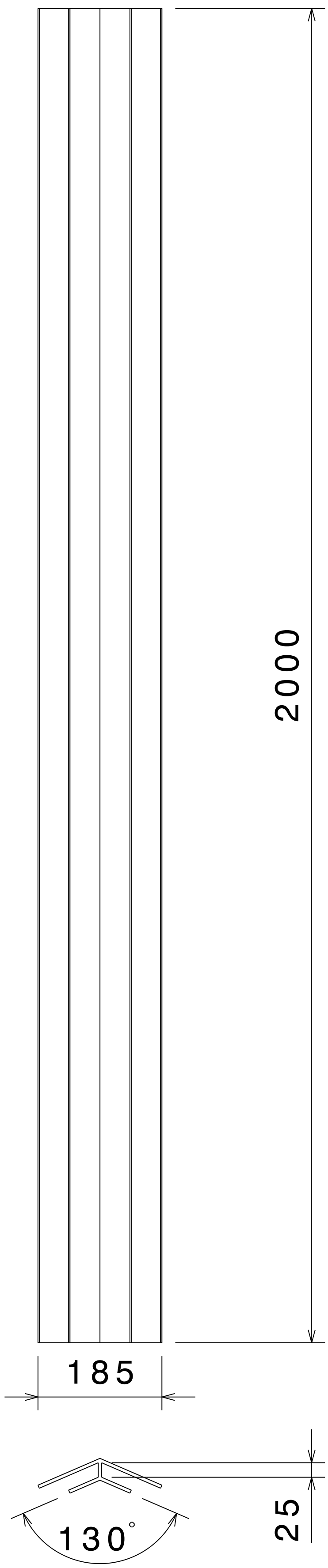

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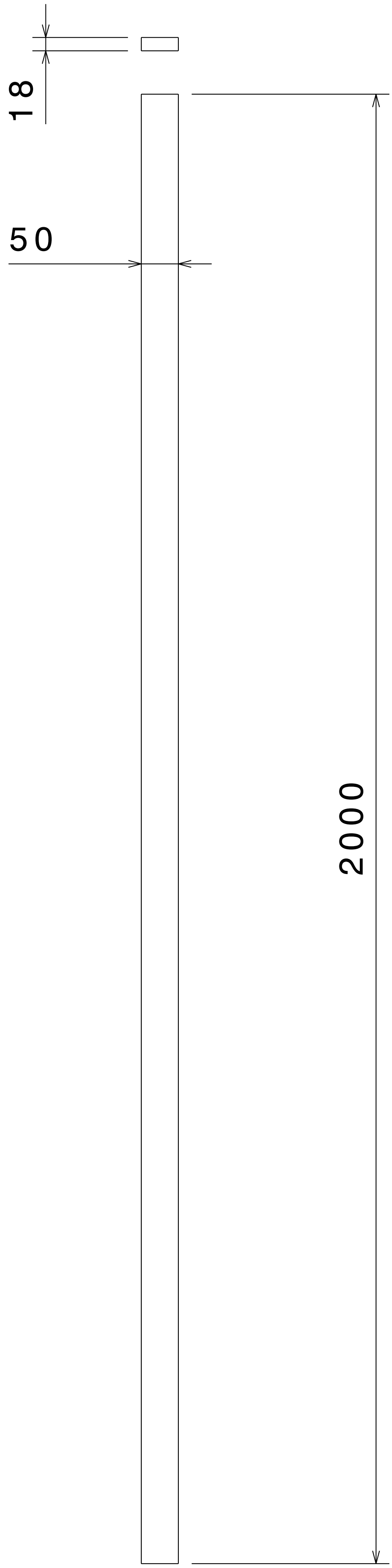

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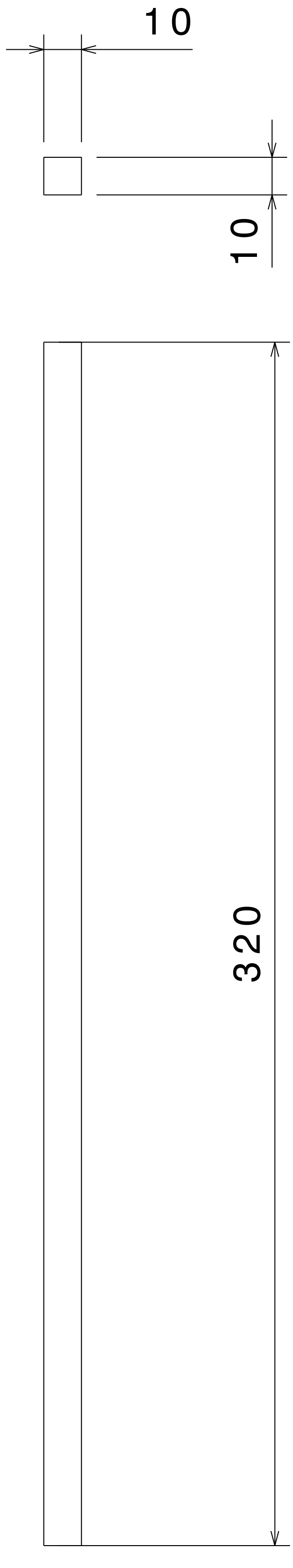

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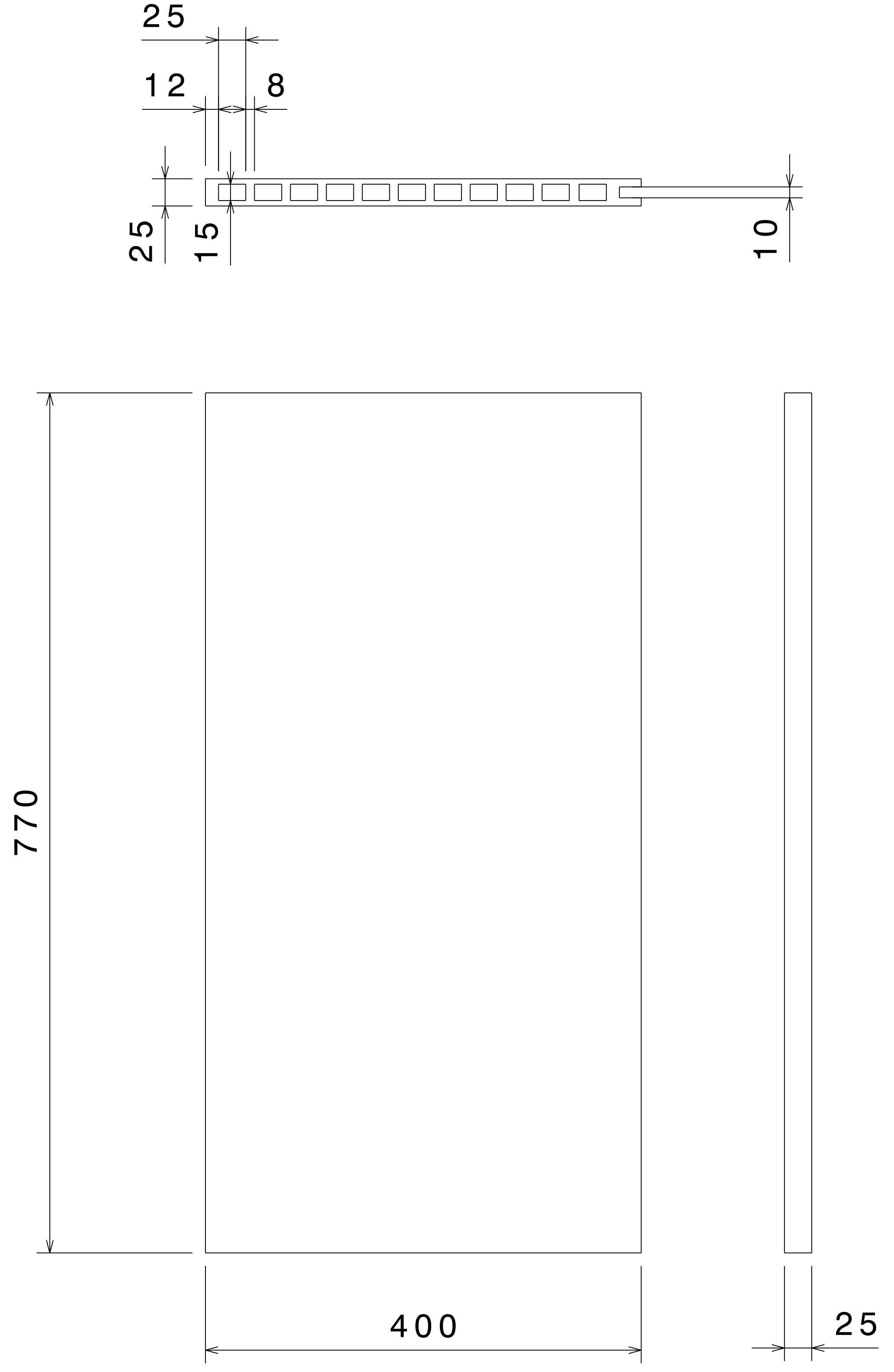

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DATE 27/07/2012

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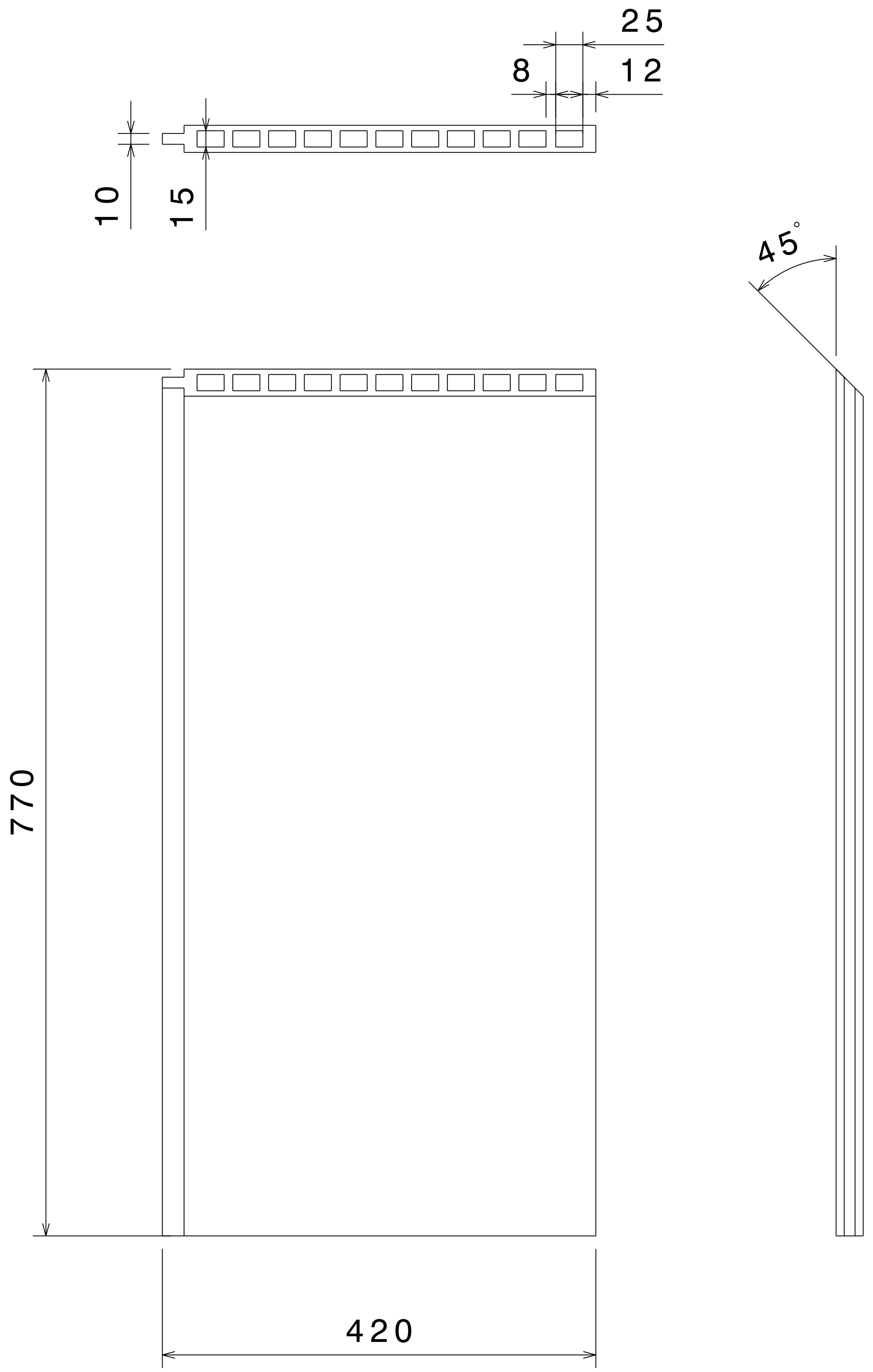

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