8th ICBR Lisbon | Nov 2018
**Building 4Humanity** DESIGN COMPETITION
Category 3: Resilient Projects (**Student Teams**)
Team Members: *Małgorzata Zielonka, Monika Smorąg, Rui Matias Soares Ramalheira*
Supervisor: *prof. Juan Manuel Ros Garcia*
University/School: *Universidad CEU San Pablo, Spain*
Project Location: *Lombok, Indonesia*
Team Code: **B4H-DC3165**

# MAST

modular & affordable & sustainable & temporary housing system

## LOCATION


source: https://bit.ly/2JRJnDq

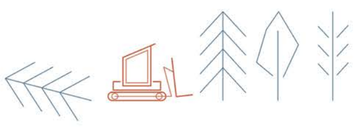
Indonesia is located in Southeast Asia, between the Indian and Pacific oceans. It's the 4th most populous country in the world with over 260 million inhabitants, consisting of 17,508 islands scattered over both sides of the equator. Indonesia's size, tropical climate, and archipelagic geography, support the world's second highest level of biodiversity.

source: https://link.do/jAYEY

Lombok is one of Indonesian islands in the Small Sunda Islands archipelago, located between Bali and Sumbawa. On August 5th a 4.5 magnitude earthquake hit the island and it was was the 22nd "felt" earthquake to have struck the Lombok region in 24 hours. Indonesia's Red Cross says that since July at least 460 people have died, while 7,000 people have been injured. More than 10% of the island's population, around 410,000 people, are still residing in evacuation centers.

## PRIMARY PROBLEMS

### NATURAL



Indonesia has a tropical climate characterized by heavy rainfall, high humidity, high temperature, and low winds. With low temp. around 22ºC, high temp. around 30ºC and with an average humidity of 82%, Indonesia is home to some of the most biologically diverse forests in the world but is hurting from the long-term loss of forests and foliage across the country. Moreover, Indonesia lies along the Ring of Fire, horseshoe--shaped line 40,000km long, that is responsible for about 90 per cent of earthquakes across the globe.

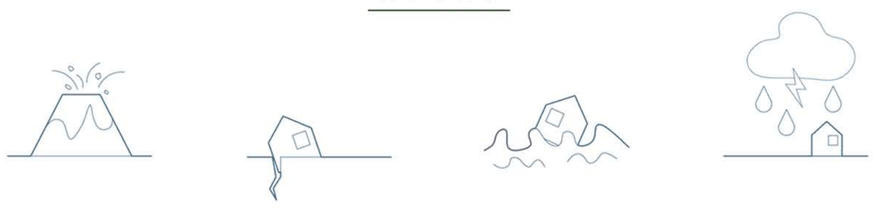
### SOCIAL


Due to a population rise by 64% since 2010, Indonesia population is, nowadays, over 260 million inhabitants. It is a result of an increasing migration and a high birth rate. One of the most concerning problems from Indonesia is the conflict with the increasing number of refugees. In 2001, 1.3 million people were living in inadequate refugee camps without the access to proper sanitation facilities.

### SANITARY

More than 27 million Indonesians lack safe water, and 51 million lack access to improved sanitation facilities. Rural and remote areas have more limited access to healthcare than urban areas. Studies suggest that, as of 2014, 40 per cent of Indonesians did not have access to proper sanitation facilities. Nine million, or 30%, of Indonesian children under the age of five are stunted, and contaminated water due to poor sanitation is an important cause.

## RISKS



### VOLCANIC ERUPTIONS

Indonesia is the country that contains the most active volcanoes in the world. Its placed in 3 active tectonic plates. It has 129 volcanos and is estimated that more than 5 million people are living in the danger zone. It can cause considerable damage to local economies by hurting small and medium enterprises that are involved in tourism, culinary and commercial accommodation. A positive development is that volcano eruptions take less human lives today due to observation methods. The problem is that there are plenty of local residents that refuses to leave their homes.

### EARTHQUAKES

Are considered the biggest threat in terms of natural disasters. They come suddenly and strike in populous areas. Indonesia experience about one earthquake per year with magnitude of six or higher. The latest one, in 5 August 2018, with a magnitude of 6.9 (Richter), made 565 casualties.

### TSUNAMIS

A submarine earthquake can cause a tsunami. In 2004 167000 people were killed by a tsunami and 500000 have seen their homes wiped away. Although the advances in sismic detection have saved thousands of lives, this event happened 30 minutes after the allert which didn´t give time for the population to leave.

### FLOODS

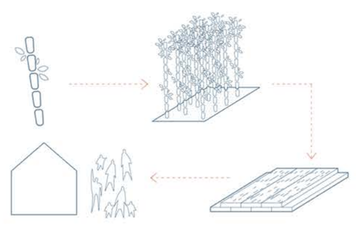
Major rain in combination with deforestation it can cause rivers to overflow. It happens every year and in 2013 affected more the 100000 houses.

### EL NIÑO AND LA NIÑA

In addition, the climate in Indonesia is influenced by the phenomenon known as El Niño, which brings drought and an increase in both air and sea temperature, an event which may cause coral bleaching. The drought caused by El Niño is pronounced between June and August, and even more so between September and November; due to this phenomenon, the fires that are usually set during the dry season can become uncontrollable, and cause the spread of smoke in large areas. The opposite phenomenon, La Niña, brings more rains than usual, while temperatures may become cooler than usual between June and August.

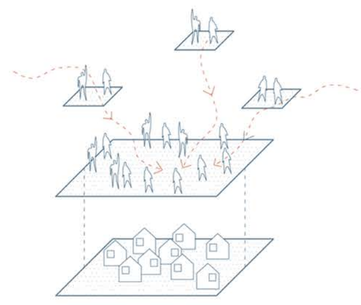
## DESIGN PRINCIPLES

### SELFSUFICIENCY



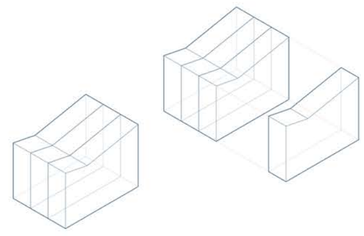
Our goal is to allow residents to build the houses themselves and then pass on the knowledge to other communities. Using locally sourced renewable material, like bamboo, we can improve they knowledge about sustainability and by cultivating, processing and trading the product, that is very easy to harvest, we can raise money for another houses.

### COMMUNITY

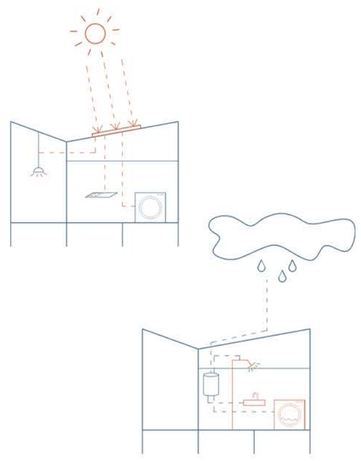


Although good design is crucial, more important is the community oriented and socially supported one. It is essential for architecture to go together with a sense of social responsibility and desire to improve society through the built environment. The main driving force behind MAST is to somehow recreate what these people would have experienced in a more normal situation.

### FLEXIBILITY



By creating modular, transformable spaces we want the house to react to the changing needs of building occupants. MAST is made from 1.2 meter wide segments, that can easily be connected and disconnected, to make the house highly flexible. Moreover, the segments can be reused over and over again and are recyclable.



### SUSTANABILITY

**The exterior features a grid of solar panels, depending on the number of modules used from 2 to 4 solar panels, which can generate up to 4,000 kWh per year, roughly the amount of energy needed to power the home.** Our solar panels are composed with silicon, which is excited by the light rails. There are 2 slides of silicon, one positive and the other negative, so when the light rails touch the panel, it creates a current. To be used at home, this current have to be convert by an inverter. That electric energy produced by solar panels can be used with no environmental impact.

The special roof shape of the MAST enables an effective, natural ventilation, at the same time as it collects the rain water. All the rain water that falls on it to flow down into a gutter. This gutter, made of bamboo, is linked to an other bamboo that recuperates all the water into a 200L tank where the water is filtered and ready to be used. One module can recuperate 82L of water over a year so the three modules used to make the tiny house allow us to recuperate 248L.This renders the areas around the buildings more useful during the rainy season, and gives the possibility of collecting the water in drier periods.

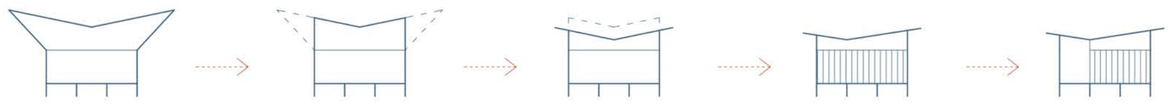
### MODULARITY

In order to adapt to the needs of it's inhabitants MAST comes in 3 sizes:
S, M and L. Modules, measuring 1.2 meter x 1.5 meter, can be easily assembled and disasebled.


### MOBILITY

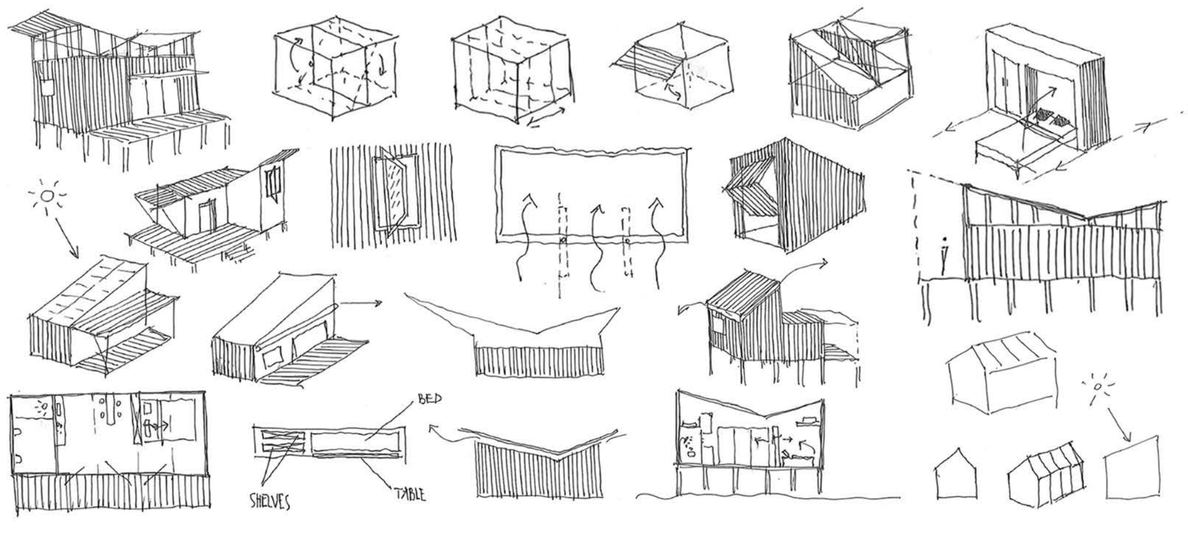
Due to the fact that Indonesia consists over 17 thousand islands and the refugees are spread across the whole country the house has to be portable. Therefore the elements of the structure don't exceed 1,7 x 5,5m and can be easily transported. The segments will be made in a workshops and when ready can be transported and connected on the spot in one day. With an aproxiamted weight of only 500 kilos per segment MAST can be placed wherever is necessary.

### TRADITION



Architecture in Indonesia is mostly influenced by cultural diversity, history, and geography. Indonesia has 33 provinces, each of Indonesia's ethnic groups has its own distinctive form of the traditional vernacular architecture, known as rumah adat. Traditional homes of Indonesia share a number of characteristics such as timber construction, varied and elaborate roof structures. Our aim was to incorporate the traditional Inodesian architecture into XXI century, connecting the heritage with modern development.

## FORM




A major concern in Indonesia is unresolved conflict and its impacts, in particular the increasing number of people living in refugee camps. The number of refugees may increase, not only because of the endless conflict, but also because of natural disasters such as floods and typhoons. The main driving force behind the project was to somehow recreate what these people would have experienced in a more normal situation. To not only provide a shelter for the people in need, but give them a sense of home, architecture they are familiar with.

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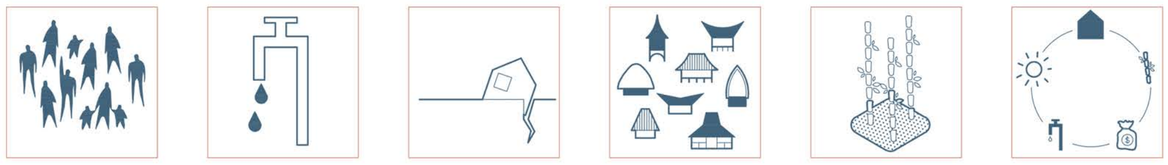
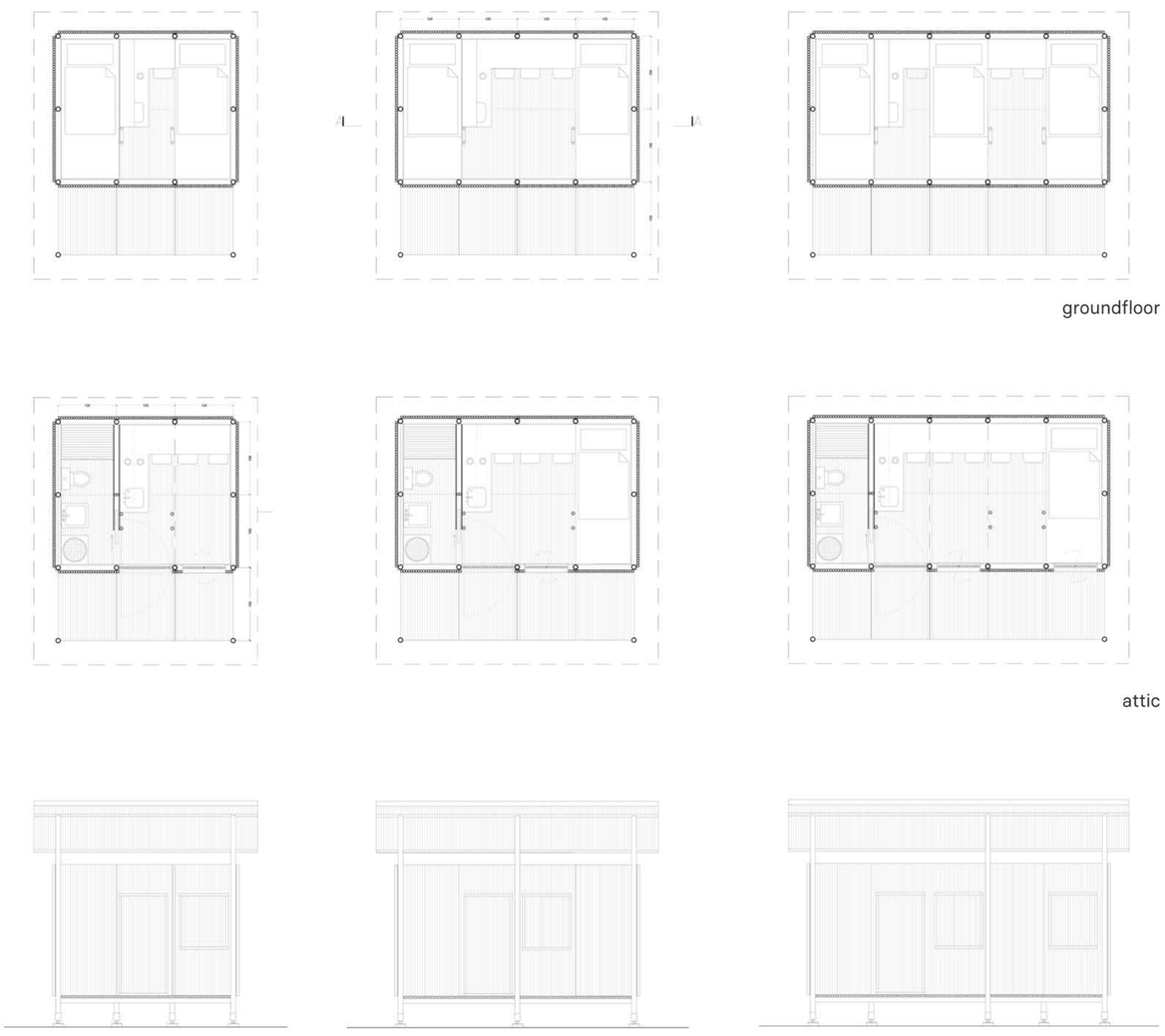
## PROS & CONS

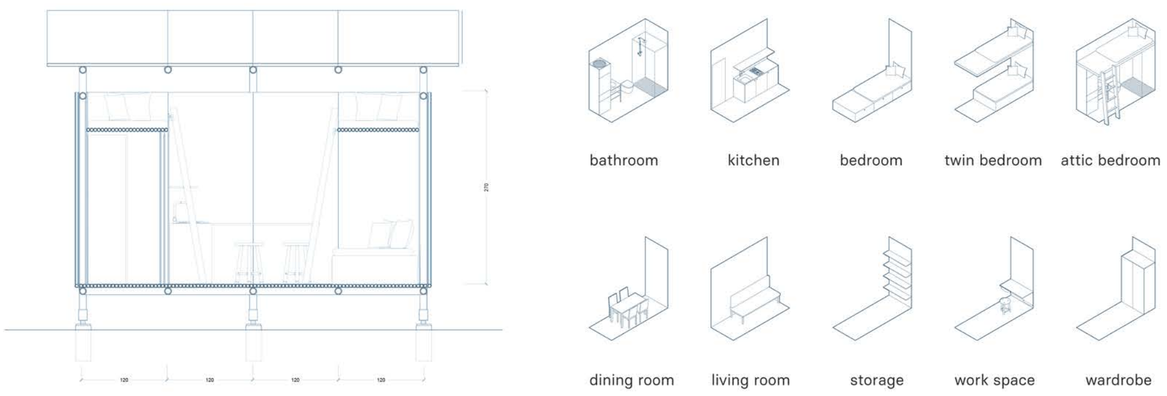


1 imigrant every 3 minutes | sanitary problems | natural disasters | traditional architecture | natural resources | sustainability & affordability

## FORM

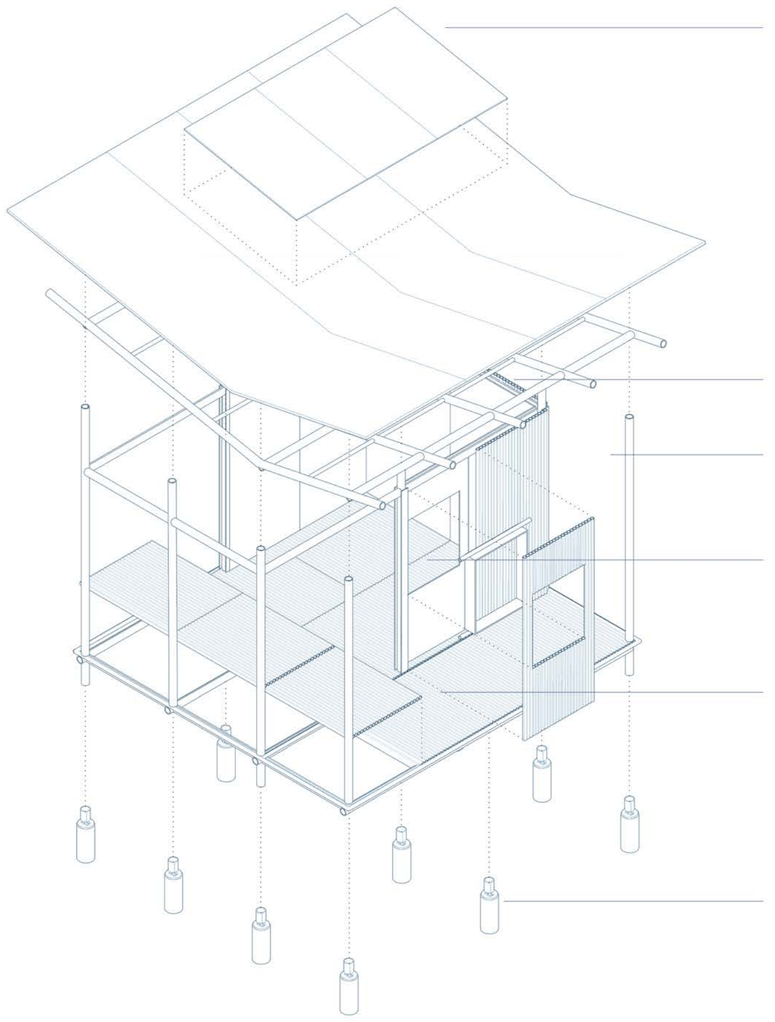



## INTERIOR




The interior of the house can be created depending on the needs. There are several modules to choose from. The interior is mainly made of bamboo. The furniture in the modules can be produced by the inhabitants of the island in local workshops. The terrace is an additional space that can be a dining room, a living room or a place to relax.

## CONSTRUCTION



Roof is one of the most important elements in the building, maximizing the use of natural conditions and creating a link to traditional Indonesian architecture. Raising the structure of the roof allows natural ventilation, while the flexure helps to collect the rainwater and creates the optimum tilt for solar panels.

Wall is made from two elements, bamboo panel visible from the outside and playboo facing the interior, separated by a distance of 10 cm allowing better thermal insulation. Elements are connected with columns through zinc plates and tied with horizontal elements with vegetal/steel cords and metal anchores.

Columns are made from bamboo with a measure of Ø100mm providing the main distribution of weight.

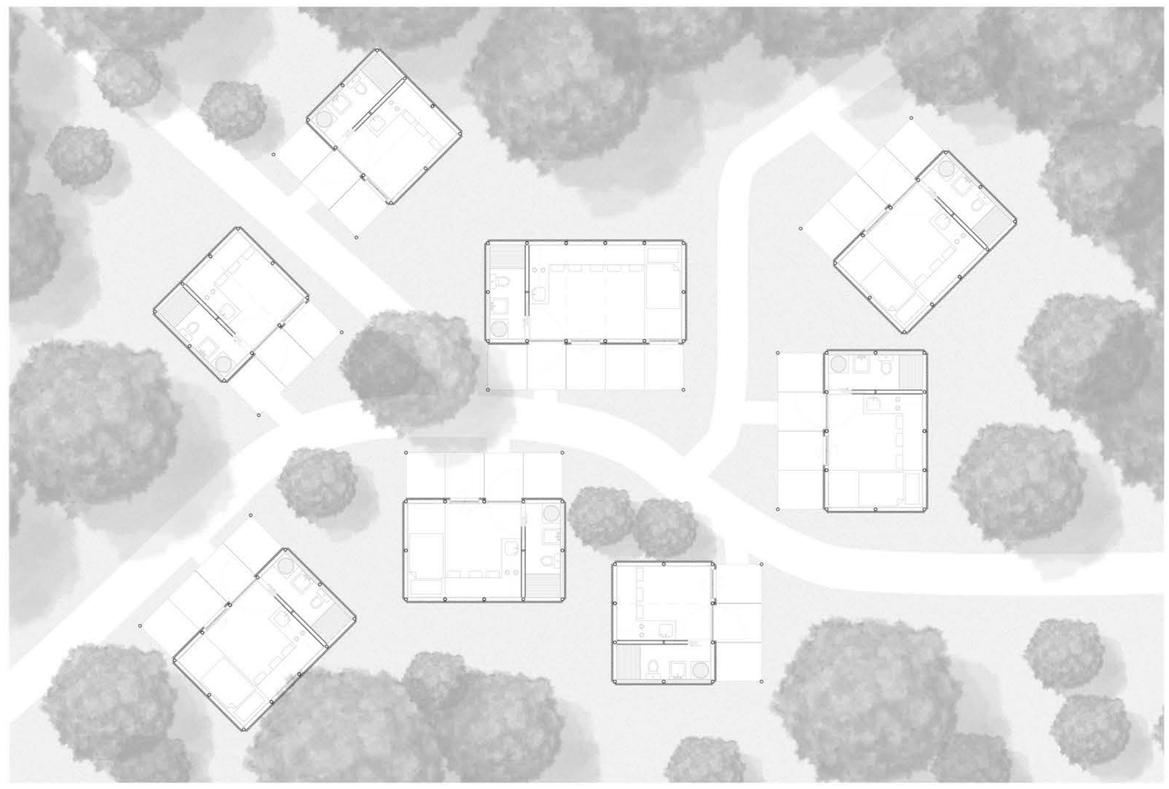
Zinc plates attached to main columns are strengthening the bamboo and allowing the connection of columns with exterior walls.

The floor construction is raised 50cm from the ground to prevent the building inundation during the frequent floods. Horizontal structure elements are made from Ø 100mm bamboo and connected to the vertical structure using traditional techniques with vegetal/steel cords and metal anchores.

Foundations are made from prefabricated elements: concrete base and zinc connectors allowing to easily bind them with the structure. It also allows quick disassembly and mobility.

## SITE PLAN

Houses can adapt to any area. The project concerns the island of Lombok, however, it can be implemented throughout Indonesia thanks to repetitive and easy to transport elements, eveything is based on a module 1,2 meters x 1,5 meters so people can mix the options to create a house that fulfill their needs the best. The aim of MAST is not only to serves its purpose as a shelter and support for the people in need but also, when multiplied, to give people a chance to create community by providing them their own private space, a home to live in and a neighborhood to meet with others.



## VISUALIZATIONS