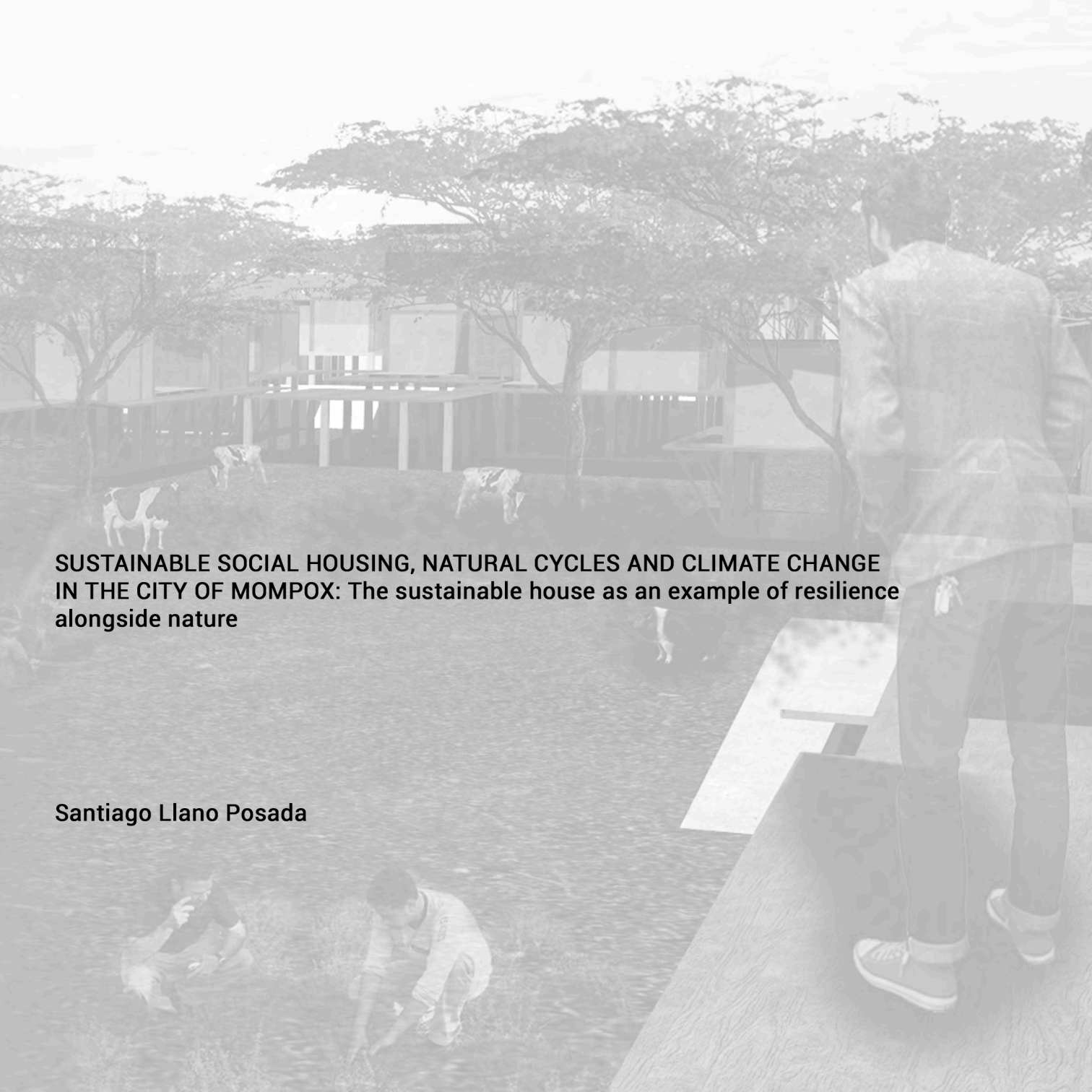

SUSTAINABLE SOCIAL HOUSING, NATURAL CYCLES AND CLIMATE CHANGE IN THE CITY OF MOMPOX: The sustainable house as an example of resilience alongside nature

Santiago Llano Posada

SUSTAINABLE SOCIAL HOUSING, NATURAL CYCLES AND CLIMATE CHANGE IN THE CITY OF MOMPOX:
The sustainable house as an example of resilience alongside nature

SANTIAGO LLANO POSADA

Thesis presented to apply for the master's degree in
ARCHITETTURA PER IL PROGETTO SOSTENIBILE

Tutor
RICCARDO POLLO

POLITECNICO DI TORINO
FACULTY OF ARCHITECTURE
MASTER DEGREE IN ARCHITECTURE FOR THE SUSTAINABLE DESIGN
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2018

I want to dedicate this work to my family that has always supported me, not letting my dreams perish and being strong in the hardest moments. To my friends for their support, ideas and night talks about life looking at the stars. To my tutor for helping me shaping this thesis and without whom this project would not have been possible.

Mainly I want to dedicate this work to the communities in Colombia that one day life will give you what you deserve, a place to live in harmony with nature. This thesis is for you.

Content

Abstract

The social interest housing has always been a delicate and important subject in Colombia, according to the national government (artículo 91 de la ley 388 de 1997); the social interest houses are those developed to guarantee the right of having a house to the families with the lowest income. In every Development National Plan (Plan Nacional de Desarrollo) the national government will establish the type and peak price of the houses for the families.

Bolivar is one of Colombia's regions with more government's help. This region mostly warm and humid is periodically affected by floods. Mompox represents the cultural confluence between the Spanish and the indigenous tribes, working as a catalyst for the region. Water bodies in Mompox are the 32.1% of the municipality's surface, the periodically affected areas by floods are the 38.5%, this is equivalent to 24.662 ha. The last flloding by "La niña" phenomenon in 2011 affected the 29% of the municipality's surfaces, about 18.888 ha. More than the 60 % of the population was affected.

The sustainability subject plays also an important role. There are different approaches and definitions about the relationship between architecture, sustainability, development and environment. To understand where we are now we have to go back and look for definitions, concepts and approaches that have been written since us, as global population began to worry about the environment and our relationship with it. The sustainability concept regards the construction in every aspect: design, construction, use, management and disposal; and in every scale: materials, building, community, city, territory and planet. Otherwise are inherent the "living" aspects: psychological well-being, production, work, mobility, etc.

We can rely on many aspects to explain the demand of social interest housing in Colombia, from the more than fifty years civil war leading to forced displacement, to corruption, poverty, poor economy models and so on. However, in this thesis what is conceived as the problem is the current way the social houses are built, their design from the architecture to the urbanism, not taking into account important issues such as environmental, social and economics, making them minor aspects.

The only thing that actually matters apparently is just to give a house to the people and finish the work there. We cannot undervalue the work of the government with the National planning Department (Departamento Nacional de Planeacion) and the private associates that are developing these houses, but we can do better, with better professionals and with and interdisciplinary teams that, from a holistic approach they can create a sustainable social interest housing.

However, not everything is lost. There are entities

(public and private) concerned about the future of the country, its communities and its sustainable development, and more important, they are committed to generate community. Also students, professionals, thinkers, from every field of action, young people that are able to think and to dream a better tomorrow.

The project's aim is to regenerate the community, by re-locating the new inhabitants, understanding the natural cycles and to live with theme, taking advantage in the best way possible, of resources according to the needs generates in every season. With this, words like sense of ownership and identity come into context. Using low-tech techniques that have been used since the indigenous tribes settled in the region.

Vernacular architecture in these particular regions of Colombia stands for native techniques, born in the place and developed by its people through hundreds of years, failing and succeeding, experimenting, always in harmony with nature. We have also the colonial architecture, techniques brought and adapted to the place and its climate.

The use of raw earth and materials such as wood, straw, and clay is nothing new, is not something "alternative". We have always used it and now is the time to appreciate what a precious heritage our ancestor have given us. Bringing together the indigenous architectural heritage and the knowledge of the XXI century, we can re-think how the cities like Mompox could work in the future, and not necessarily made entirely of concrete and steel.

Context

Location

COLOMBIA
Country

BOLÍVAR
Region

Population	49'291,609	2'122,021
Surface	1'141,748 km²	25,978 km²
Language	Spanish	Spanish

SANTA CRUZ DE MOMPOX

City

Mompox is located in the south of the Bolivar region. Actually is a municipality inside the so called Margarita or Mompox Island, this island is in the geographic situation called "depresión (depression) momposina", showered by the waters from the Magdalena river with its arms of Loba, Mompox and Chicagua.

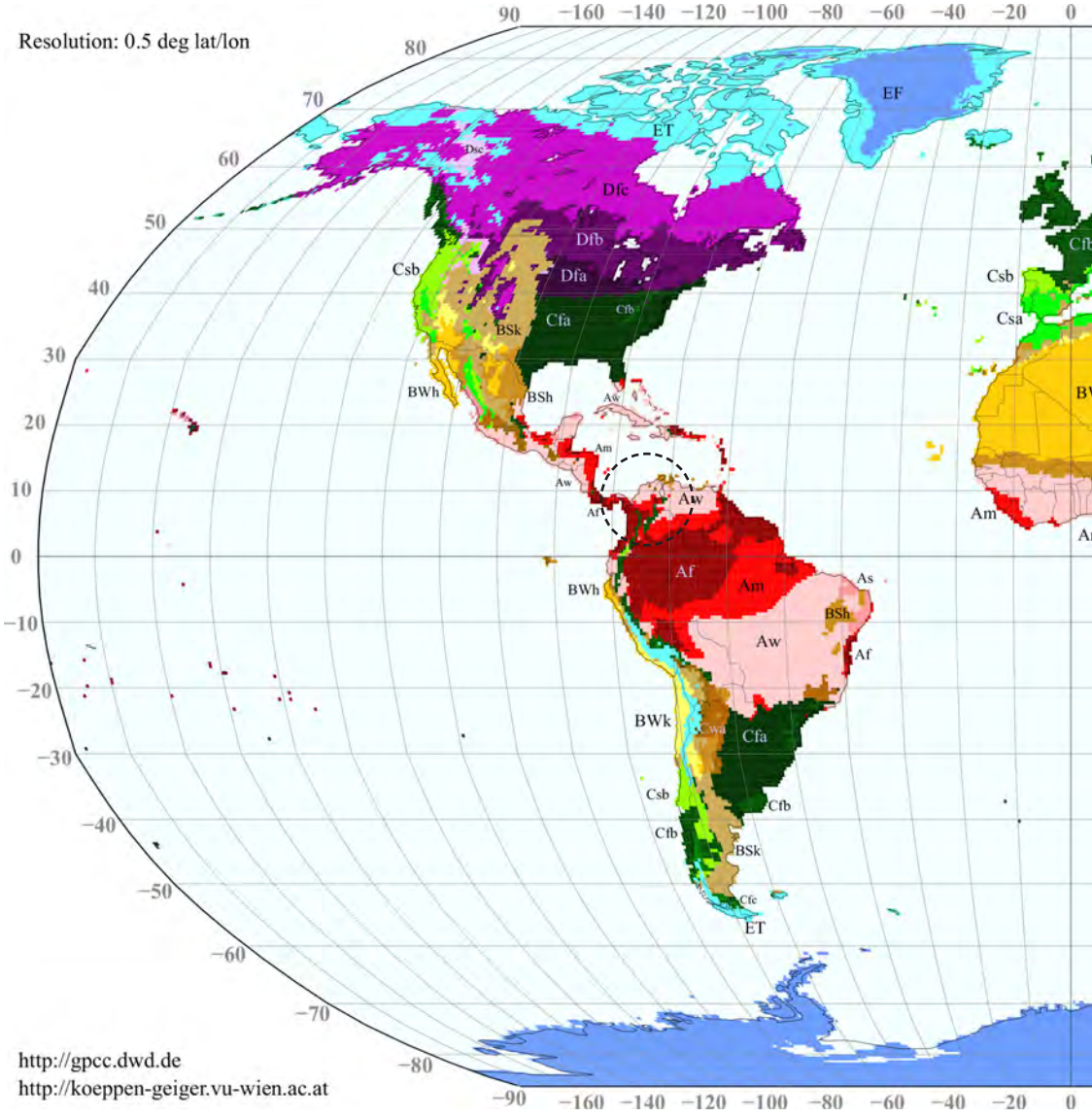
There is a great quantity of little rivers crossing the island in different directions such as el jaguar, el limón, el peludo, la cruz, paloprieto, etc, as well there can be found a lot of "ciénagas" (wetlands or swamps) such as loba, pajaral, jovito, coroncoro, caimans, etc. These wetland and rivers work as communication and mobility for the people of these regions. (Sitio oficial de Santa Cruz de Mompós en Bolívar, Colombia, s.f.)

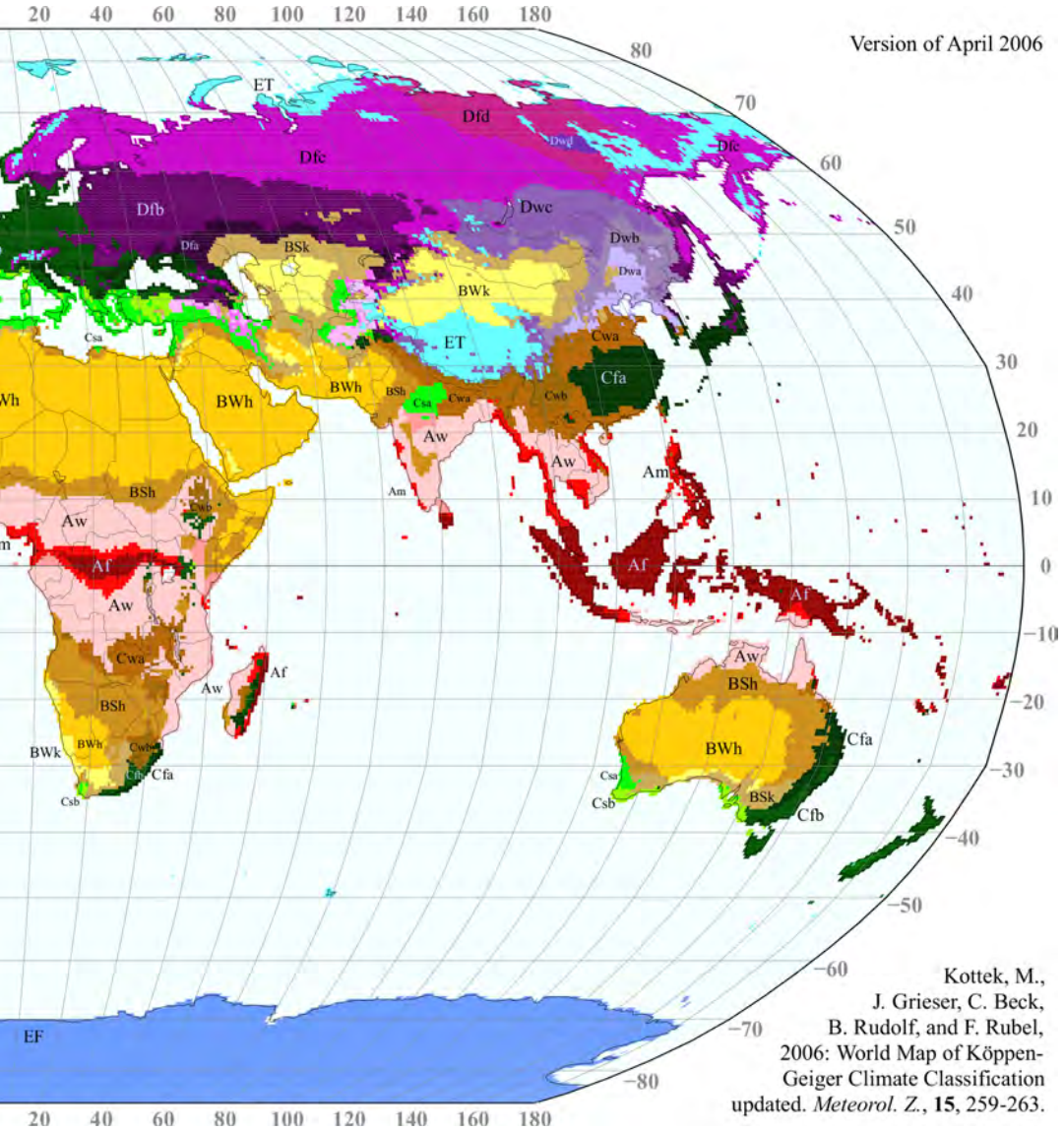
Elevation	33 m.a.m.s.l		
Temperature	31 °C		
	Rural		Urban
Population	18,364		25,441
Surface	623.67 km^2		21.7 km^2
Language	Spanish		

Climate & Weather

WORLD MAP OF KÖPPEN-GEIGER CLIMATE CLASSIFICATION

- *Af*
- *Am*
- **As**
- *Aw*
- *BWk*
- *BWh*
- *BSk*
- *BSh*
- *Cfa*
- *Cfb*
- *Cfc*
- *Csa*
- *Csb*
- *Csc*
- *Cwa*
- *Cwb*
- *Cwc*
- *Dfa*
- *Dfb*
- *Dfc*
- *Dfd*
- *Dsa*
- *Dsb*
- *Dsc*
- *Dsd*
- *Dwa*
- *Dwb*
- *Dwc*
- *Dwd*
- *EF*
- *ET*



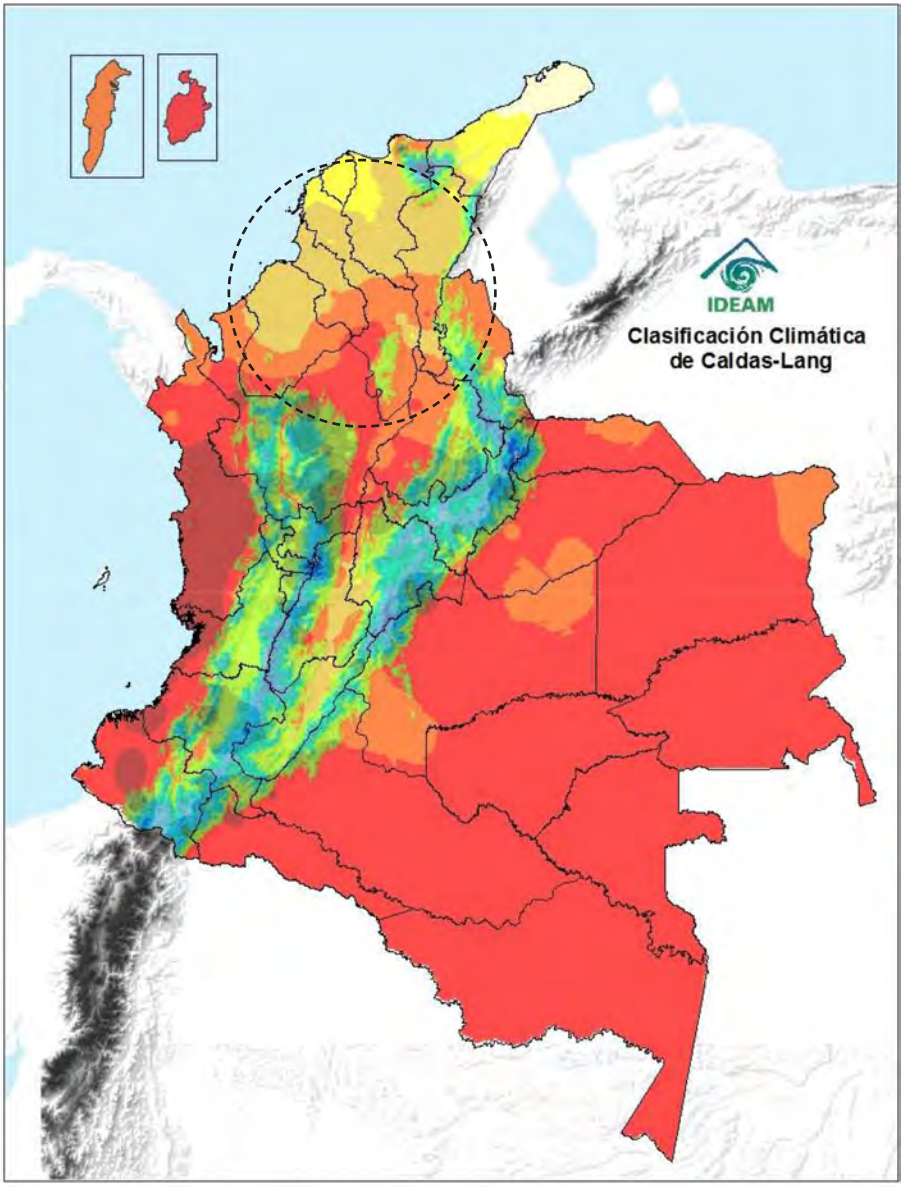


Main climates
A: equatorial
B: arid
C: warm temperate
D: snow
E: polar

Precipitations
W: desert
S: steppe
f: fully humid
s: summer dry
w: winter dry
m: monsoonal

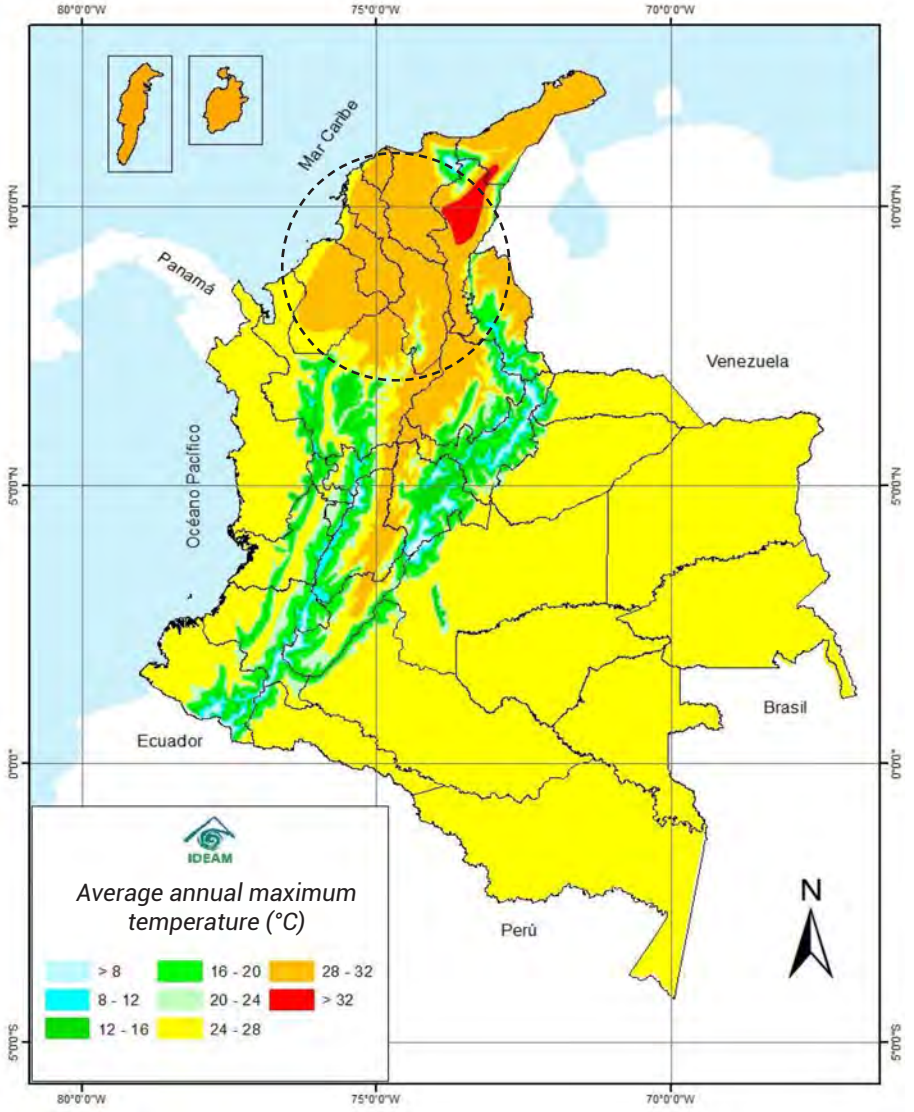
Temperature
h: hot arid
k: cold arid
a: hot summer
b: warm summer
c: cool summer
d: extremely continental
F: polar frost
T: polar tundra

CLIMATIC CLASSIFICATION IN COLOMBIA
CALDAS - LANG



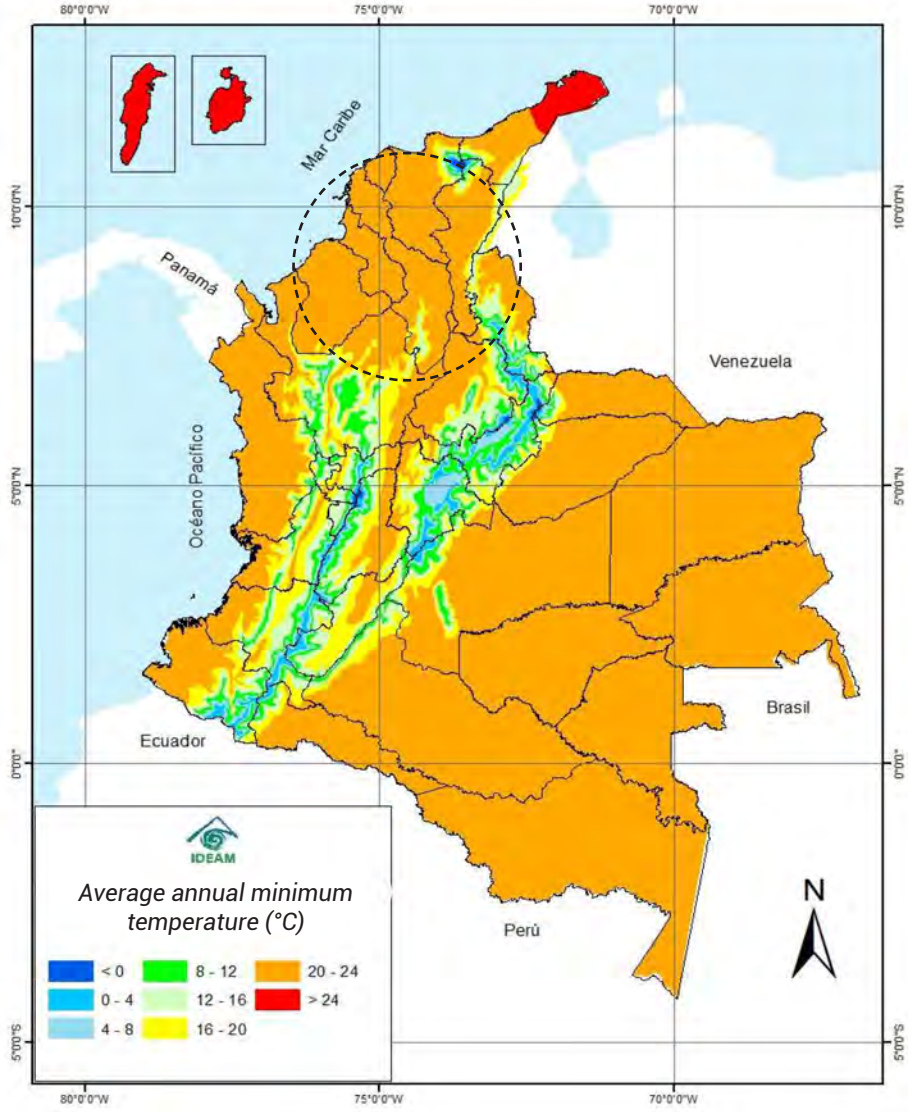
Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

AVERAGE ANNUAL TEMPERATURES IN COLOMBIA
MAXIMUM



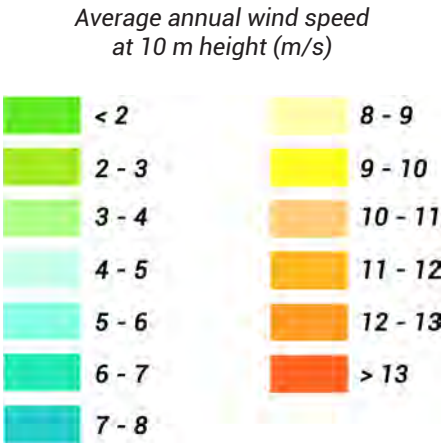
Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

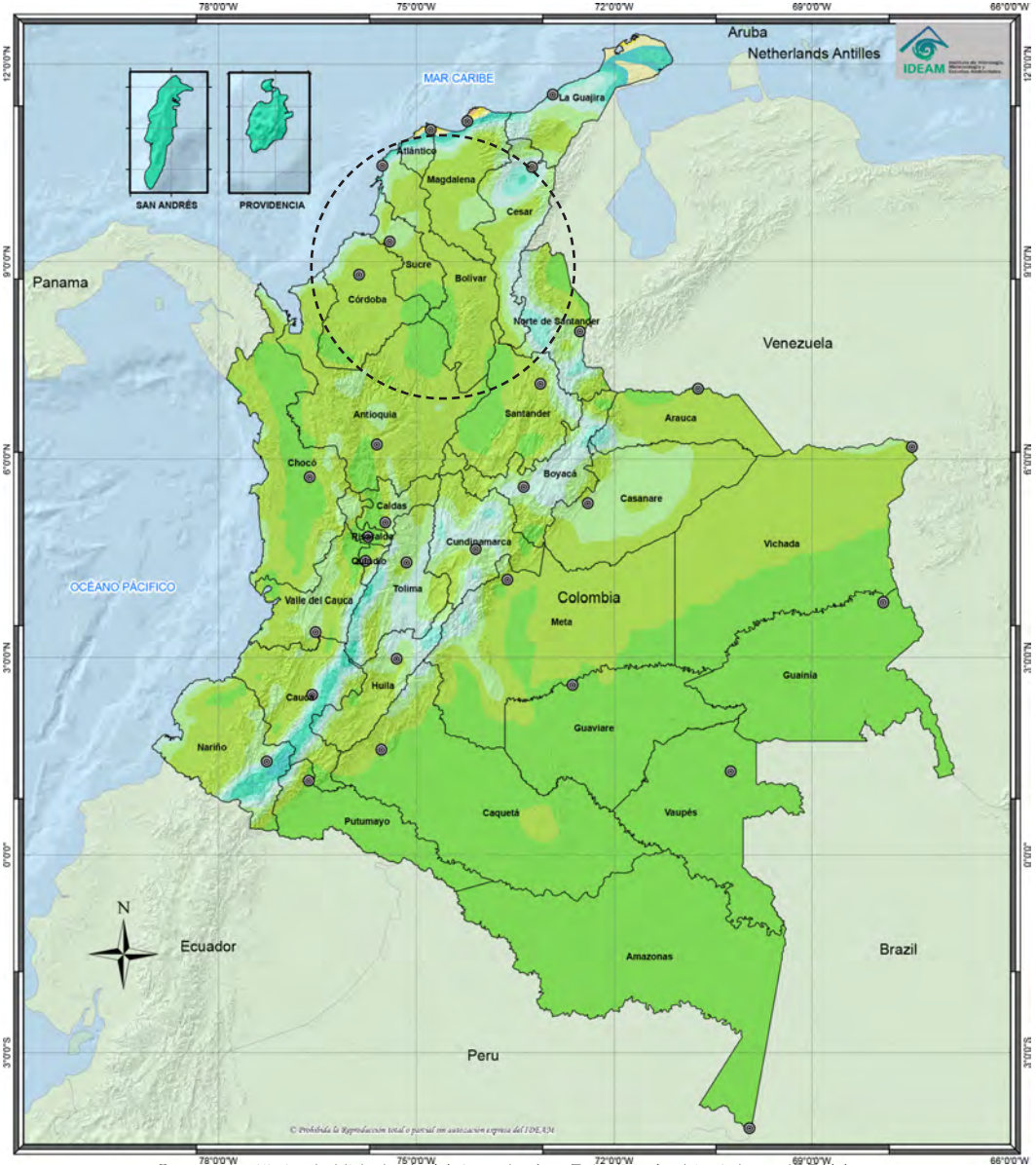
MINIMUM



Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

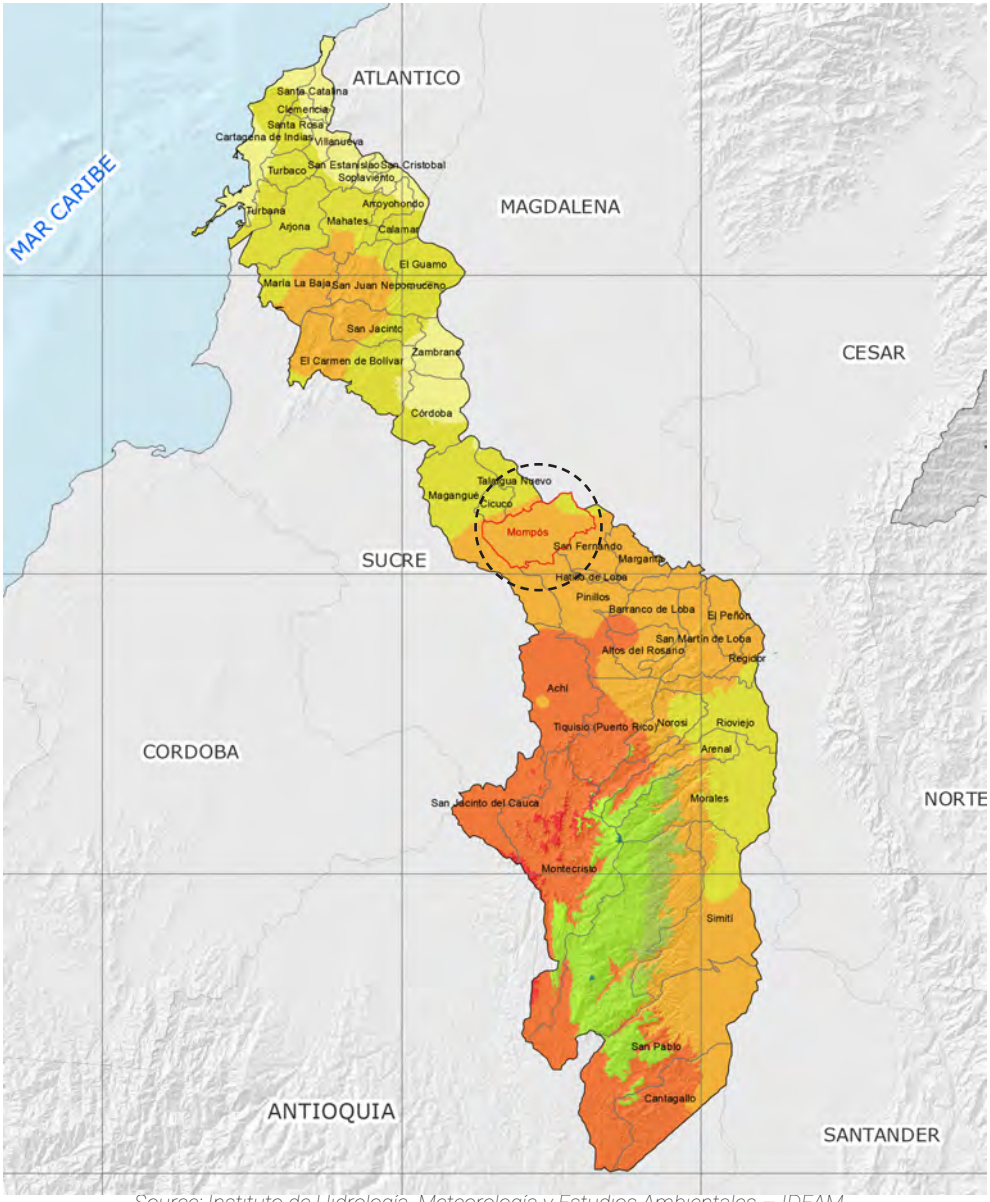
AVERAGE ANNUAL WIND SPEED IN COLOMBIA





Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

CLIMATIC CLASIFICATION IN BOLÍVAR
CALDAS - LANG

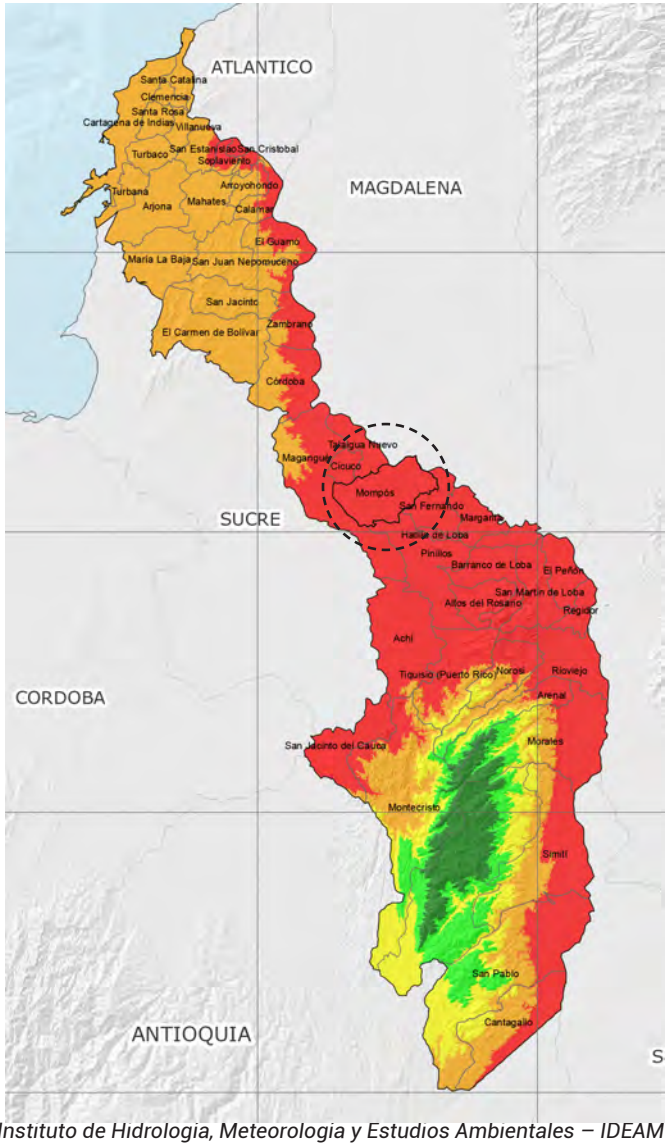


Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

AVERAGE ANNUAL TEMPERATURE IN BOLÍVAR

Average annual temperature (°C)

- < 8 °C
- 8 - 12 °C
- 12 - 16 °C
- 16 - 20 °C
- 20 - 22 °C
- 22 - 24 °C
- 24 - 26 °C
- 26 - 28 °C
- > 28 °C

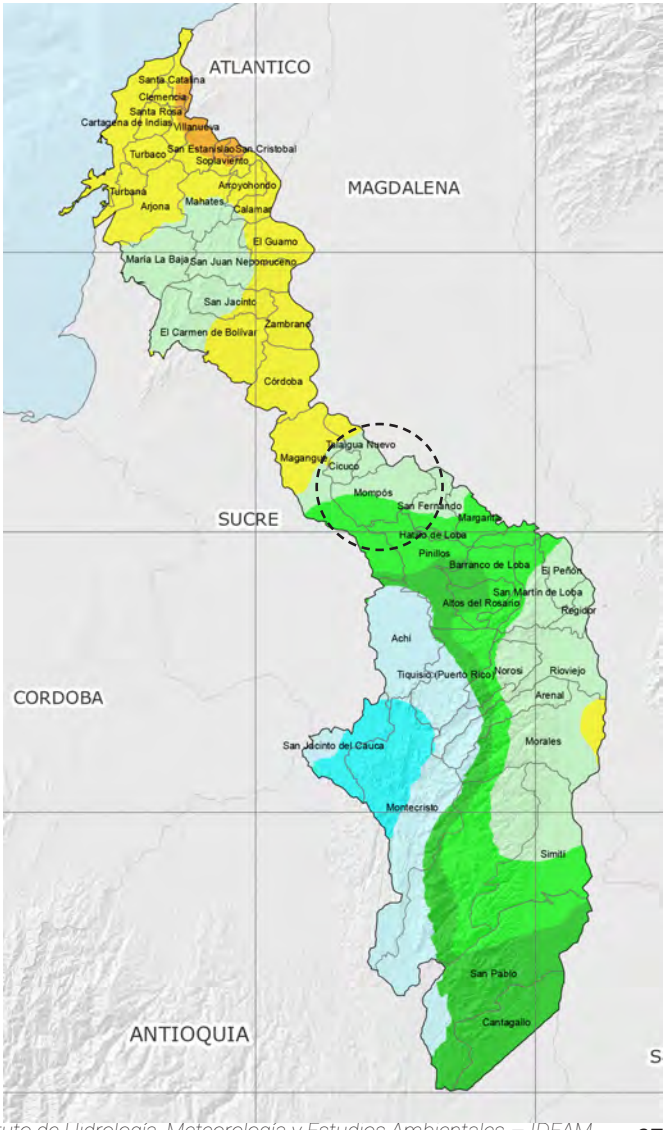


Source: Instituto de Hidrologia, Meteorologia y Estudios Ambientales – IDEAM

AVERAGE ANNUAL PRECIPITATIONS IN BOLÍVAR

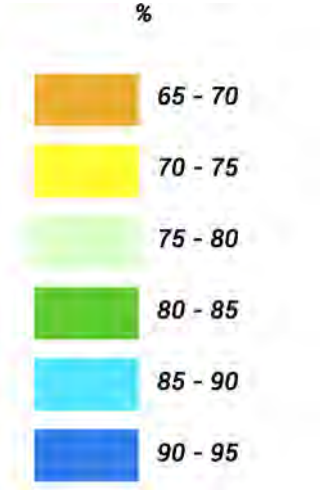
Average annual precipitations (mm)

- 0-500
- 500-1000
- 1000-1500
- 1500-2000
- 2000-2500
- 2500-3000
- 3000-4000
- 4000-5000
- 5000-7000
- 7000-9000
- 9000-11000
- >11000

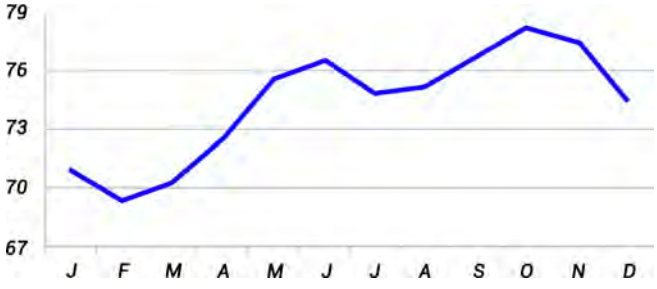


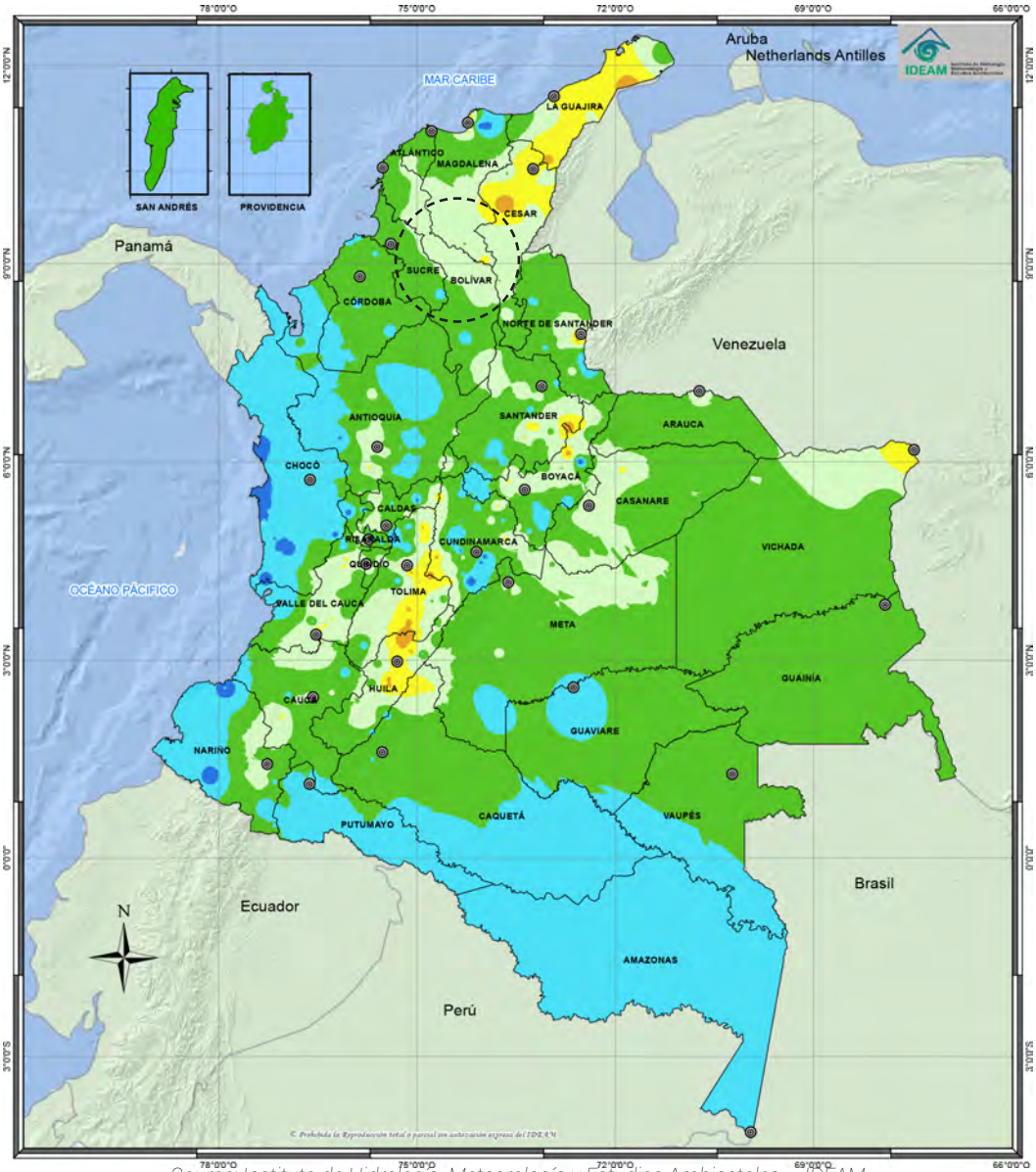
Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

RELATIVE HUMIDITY IN COLOMBIA



Relative Humidity (RH)
Mompox (%)





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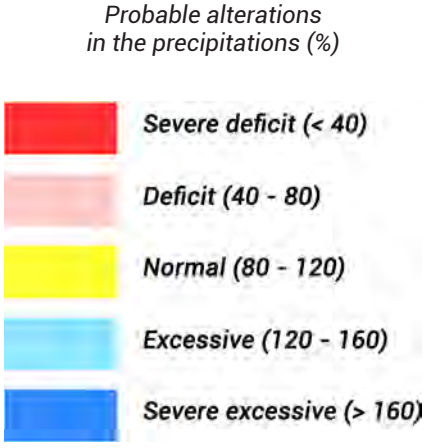
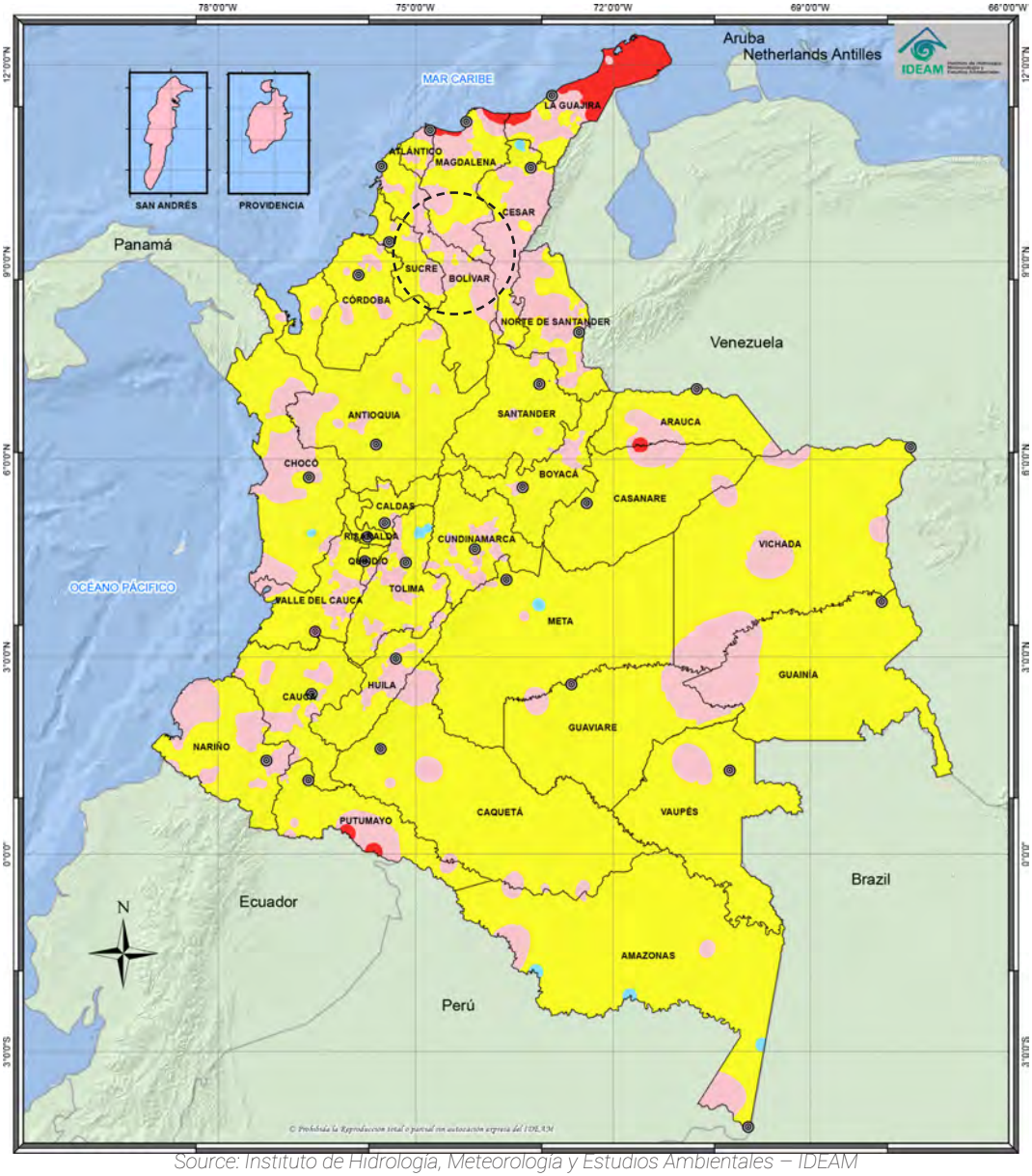
CLIMATE CHANGE: EL NIÑO PHENOMENON IN COLOMBIA PRECIPITATIONS





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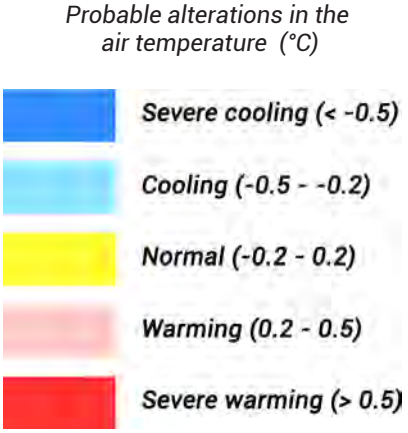
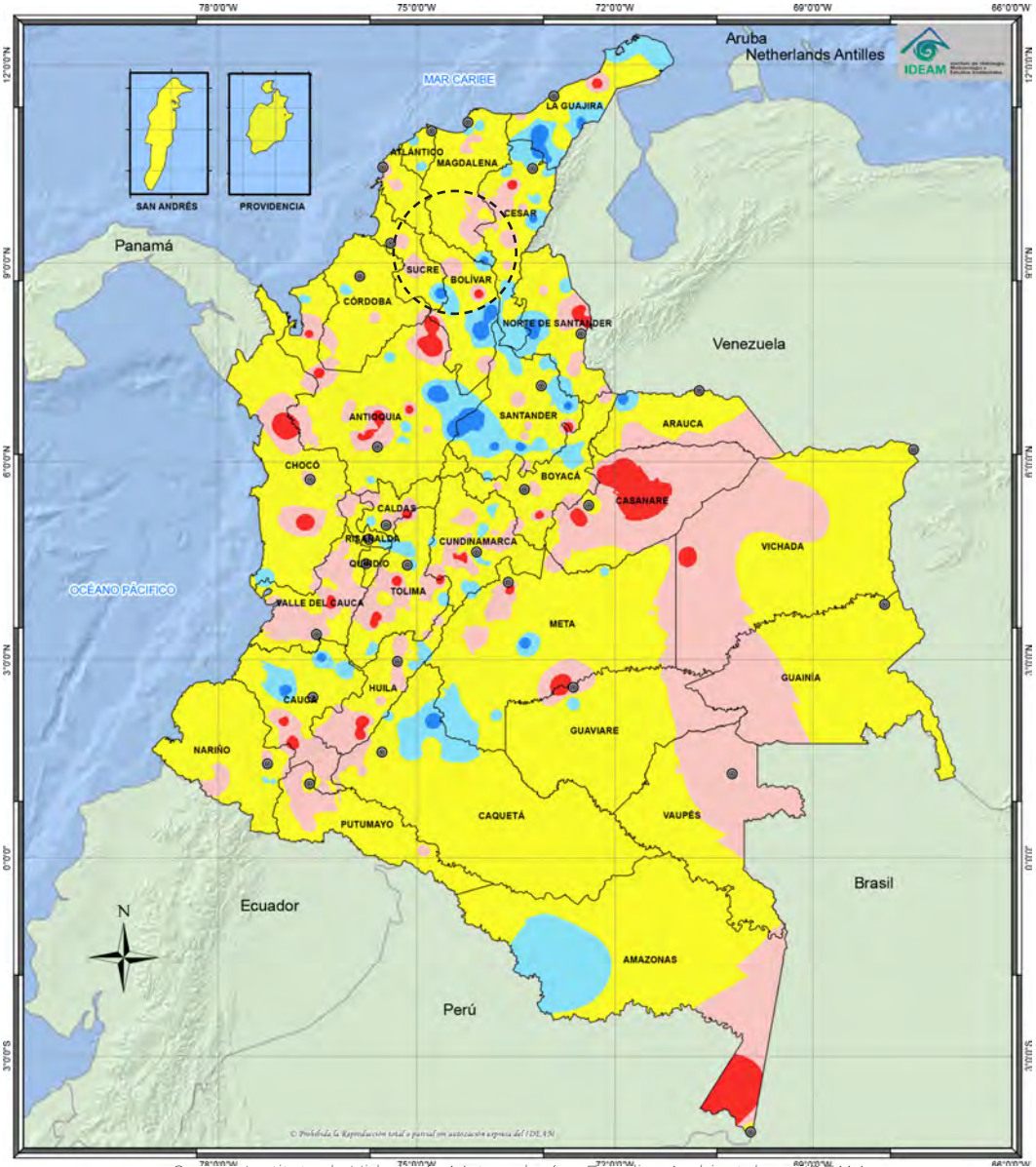
CLIMATE CHANGE: EL NIÑO PHENOMENON IN COLOMBIA
AIR TEMPERATURE





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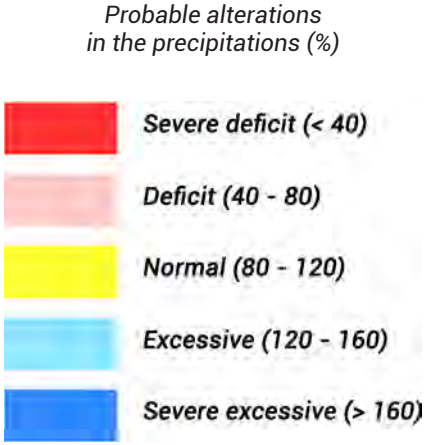
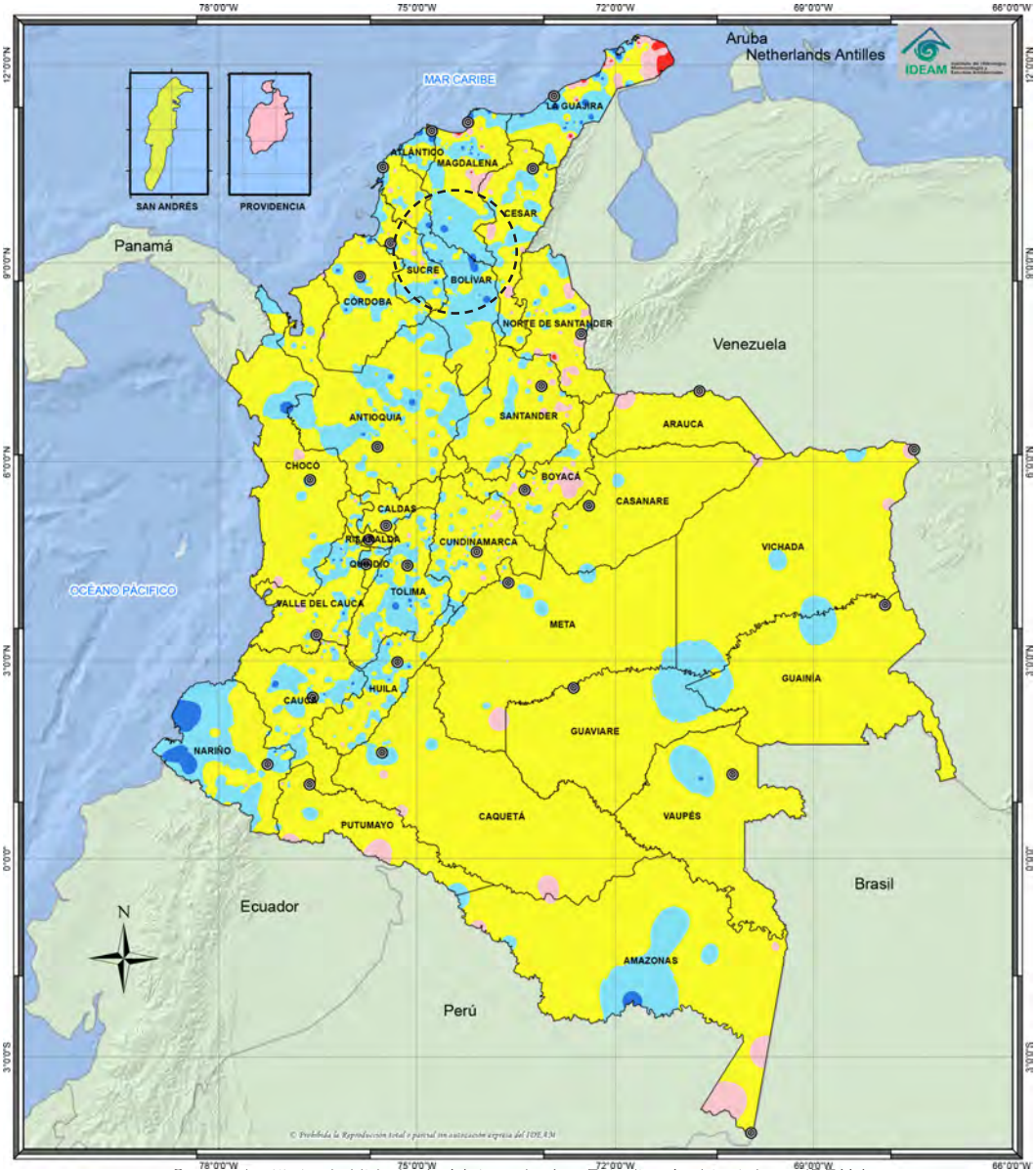
CLIMATE CHANGE: LA NIÑA PHENOMENON IN COLOMBIA PRECIPITATIONS

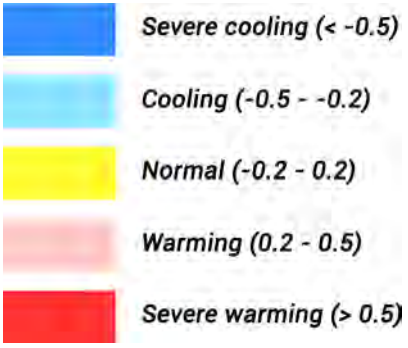


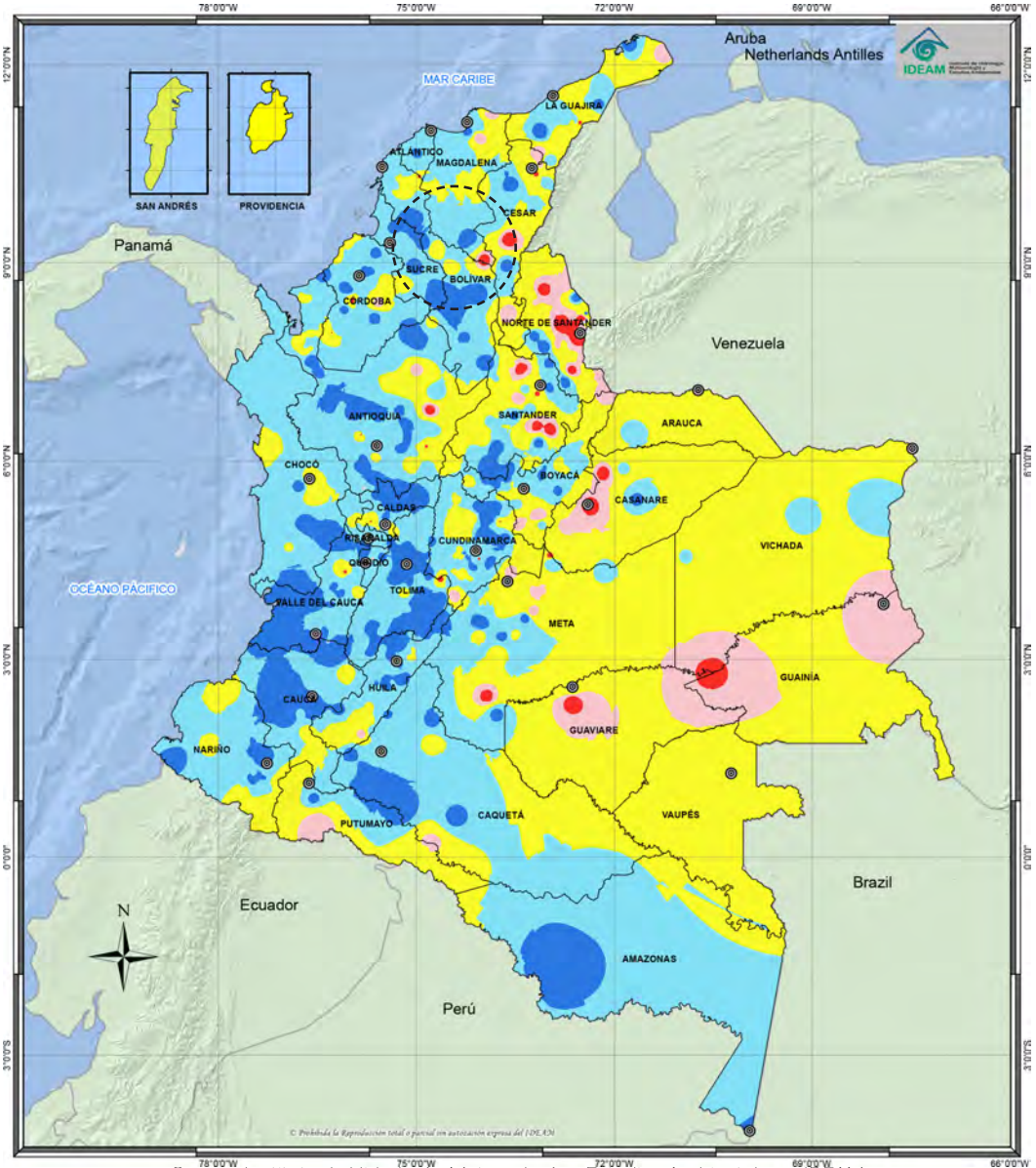


Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

CLIMATE CHANGE: LA NIÑA PHENOMENON IN COLOMBIA
AIR TEMPERATURE

Probable alterations in the air temperature (°C)





Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

A brief history of Santa Cruz de Mompox

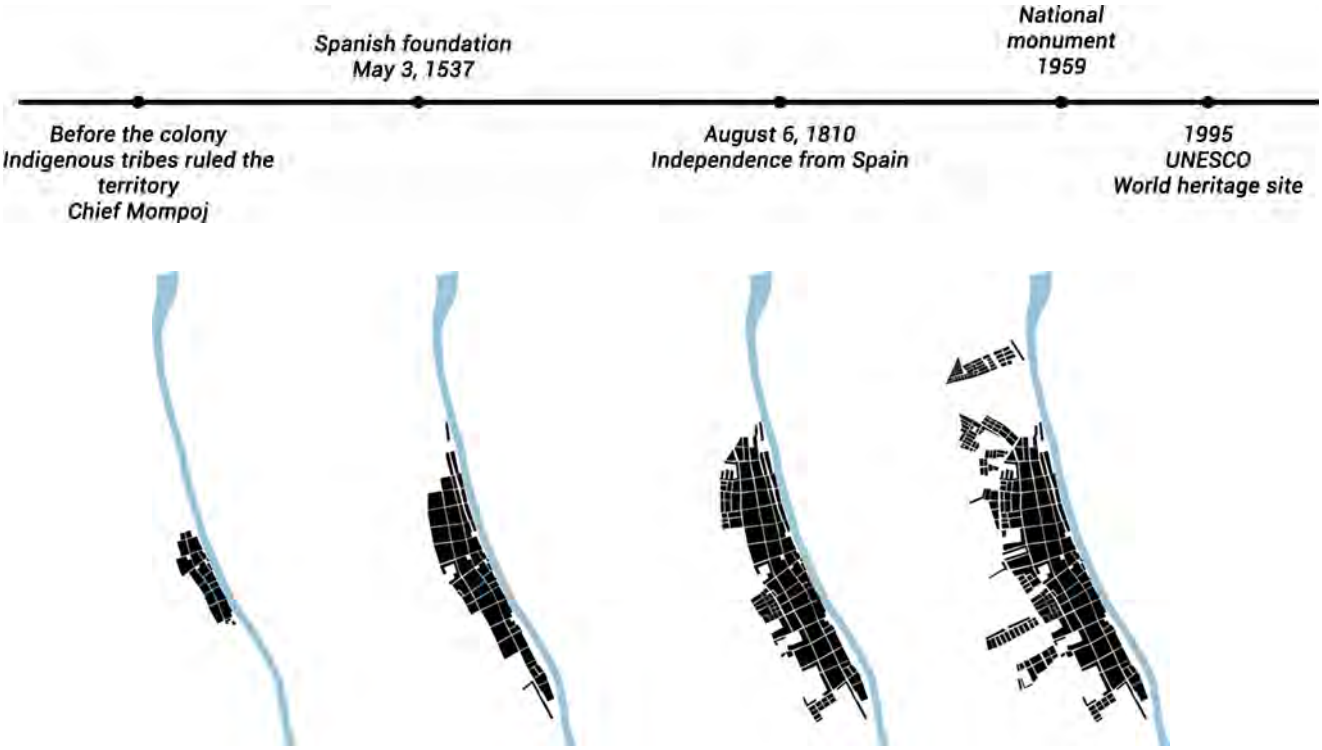
Mark, E. W. (1845).
Iglesia de Santa Bárbara. Mompox.

The Santa Cruz de Mompox village was founded by Don Alonso de Heredía on May 3, 1537, after a wild and bloody battle against the Kimbay tribe, defeating them and the indigenous chief "Mompoj".

The name Mompox comes from a great indigenous chief called Mompoj, which had his tribe's settlements where nowadays the city stands. The tribes were formed by alliances, allied vassals and families that had as leader the chief Mompoj. It is known that he ruled over fifty little tribes such as Güitacas, Chilloas, Chimíes, Chicaguas, Jaguas, Maibúes, Kates, Kimbayes, Mechiquejos, Talahiguas, etc. The inhabitants of the city of Mompox are descendants from the tribe Malibú.

Mompox was the first city of the Nueva Granada reign (Spain) to proclaim absolute independency from Spain on August 6, 1810, under the motto "Being free or die". The brave city, also called the cult city, after their illustrious sons, is still waiting the historical day in which the country in act of gratitude, contributes with great works due its achievements and contribution to Colombia's patrimony and history.

(Sitio oficial de Santa Cruz de Mompós en Bolívar, Colombia, s.f.)



Since its foundation, the city has been growing alongside the river, using it for transportation, fishing, and all sort of functions the river could provide. With the years, the city has evolved and grown, without a planning losing the "colonial" style and evolving into a "self-help construction style" that means do whatever you want or do what the neighbour did. This has led the city to a total disruption of its architecture and urbanism creating also new problems such as natural disasters, that in this case are floods.

Although, its urbanism has been keeping the principal axis of the city, the new urbanizations and housing are changing the tissue and evolving in a sort of organic growing without a rational development, leading to problems like lack of infrastructure, public services, lighting, etc. If there is an organic growing there must be a proposal for it, so the communities can access to the public services, have quality housing and manage their own growth according to their needs and own social, cultural and economic development.

Socio-economics

It is important to know that due to the war crisis in the country most of the people have been leaving the countryside to look for a new and safer future in the city. This led to an increasing urban population and a fast and uncontrolled urban growth.

Population

Urban: 25.441
Rural: 18.364
Total: 43.805

1 to 4: 12%
5 to 14: 21%
15 to 44: 45%
45 to 59: 13%
>60: 10%

Public services (urban coverage)

Clean water and sewage system: 80%
Electric power: 100%
Natural gas 68%

Public services (total coverage)

Clean water and sewage system: 46%
Electric power: 58%
Natural gas 39%

Socio- economic

Productive age population (18 to 65 years): 30.7% = 13.260

Unemployment rate: over 38%

UBN (Unsatisfied Basic Needs)

UBN: Needs defined as basic for subsist in the society. These needs are the folowing:

- Inadequate house.
- Inadequate public services (water, electricity, gas).
- Overcrowd (more than three people by room).
- High economic dependence (more than 3 people depending on one person's income)
- Scholastic absence
- Misery (more than 2 UBN)

(Sitio oficial de Santa Cruz de Mompós en Bolivar, Colombia, s.f.)

Economy

The economic activities are conditioned by the hydrological variations, being farmers in the dry season and anglers in the rain season.

Agriculture
The principal crops are corn, yucca, citrus fruits, tobacco and vegetables. There are also little crops of plantain and sugar cane. The flat lands suffer from flooding up to three months.

Animal breeding
The production is around the 70.000 cows. The flooded lands are adequate with resistant grass.

Fishing
One of the bases for the economical sustenance of the city. The fishing occurs mostly in the Cauca, Magdalena, Chicagua and caño del Violo rivers, rich in fish (bagre, dorada, bocacico, etc.) and in the cienagas (swamps or wetlands), rich in turtles, capybaras, mojarras (fish), babillas (little alligators) and iguanas.

Goldsmithing
Is very famous since remote times. Mompox has produced very valued jewellery, being specialist in the art of filigree, considered unique in the world. It is important to say that Mompox does not has goldmines, but in the colony times this work was done in the city and the people has learned how to work the gold.

Ceramics and pottery
It is one of the most important handcrafts, but sadly is vanishing due to a lack of opportunities for the potters; there are only two potters in the region. This art needs to be rescued.

Woodworking
It is very important in the city because of its renamed "mecedora (rocking chair) momposina".

Commerce
After the animal breeding and agriculture, commerce is one of the principal economical activities in the city. There are over a thousand commercial establishments in the city distributed in agencies, stores, drug stores, deposits, etc.

Domestic industries
It is the daily livelihood of many families; these activities can be considered as microenterprises for the elaboration of Cheeses, breads, rice, corn, meats, drinks, candies, etc.

(Sitio oficial de Santa Cruz de Mompós en Bolivar, Colombia, s.f.)

Ecology

The environmental richness of the Mompox's commune is also represented in its fauna and flora (fishes, birds and plants) that coexists with human beings. Despite the high contamination levels of the river, the aquatic fauna is still rich in species such as Bocachico, Bagre Pintao, Mojarra, Arenca etc. that not only are important for the ecological cycles but for the alimentation and community's economical livelihood.

Mompox, is also the habitat for several terrestrial fauna species, indicator of the existing symbiosis between the constructed space and natural environment. The possibility of watching and cohabit continuously with these animals is one of the special attractions of the urban area. It is common to observe monkeys, squirrels, iguanas, and lizards in different places in the city.

Other environmental attraction of the city is the pass and presence of an elevated quantity of birds that make the region a favourable place for the observation of Garza Ganadera, Martin pescador, Gallinazo, Guacamayo, etc. It is a significant touristic potential for the people who like this kind of activities.

(Sitio oficial de Santa Cruz de Mompós en Bolívar, Colombia, s.f.)

Source: http://2.bp.blogspot.com/-mvO5VcRqA_Q/VUT77JZ-7sI/AAAAAAAAAu4/3EIvwB80MY4/s1600/botanico3.jpg

Source: www.flickr.com/photos/fondoadaptacion/40474100774/in/album-72157695193063495

Social interest housing in Colombia

What is social interest housing

Before understanding what social interest housing in Colombia is, it is important to know the country's situation. The actual government has as a goal to reduce by a 5.5% the housing deficit in the country, going from 12.6% to 5.6% in the last couple of years. In addition, they were destined more than 2'085,714 € in subsidies so more Colombians can fulfil the dream of having a house on their own. The regions that receive more subsidies are Atlántico, Antioquia, Valle del Cauca, Magdalena, Córdoba, Cesar, Norte de Santander, Bolívar, Nariño, Sucre, Chocó and Cundinamarca. These investments not only gave a house to those in need but also generated 300.000 new jobs.

According to the national government (artículo 91 de la ley 388 de 1997), the social interest houses are those developed to guarantee the right of having a house to the families with the lowest income. In every Development National Plan (Plan Nacional de Desarrollo) the national government will stablish the type and peak price of the destined solutions for the families, taking into account the habitational shortfall, the credit access possibilities, the offer possibilities, the credit resources amount for the financial sector and the state's sum of funds destined to the housing programs.

Nonetheless, the destined resources in money or any kind by the national government, in legal obligations to promote the social interest housing, will be

Source: www.flickr.com/photos/fondoadaptacion/39376351760/in/album-72157695193063495

conducted primarily to attend the poorest population of the country, according to the unsatisfied basic needs indicators and the results of the incomes and outcomes studies.

In the actual government (Juan Manuel Santos 2014 – 2018), the value of the social interest house in Colombia must not exceed the sum of one hundred and thirty five (135) legal valid minimum monthly salaries. This year the legal valid minimum monthly salary is $781 242 COP, this means more or less 232 €.

Who can access to a social interest house

Today we can say that: the 34% of Colombians have a salary between 171 € and 285 €, the 29% makes between 285 € and 571 €, the 16% make less than 171 €, a 15% of the population receive between 571 € and 1,142 €, the 3% make between 1,142 € and 1,714 €, the 2% has a salary between 1,714 € and 2,857 € and the 1% makes more than 2,857 € in a month.

This said we can say that a social interest house in Colombia would have a value around 31 320 €. Nevertheless, there is also a Prioritized social interest house; this one has a top value of seventy (70) legal valid minimum monthly salaries, which can be translated in 13 240 €.

The appliance requisites for the housing subsidy (Ley 3 de 1991 y el Decreto 2190 de 2009 artículos 33 al 42) are the following:

a). Being older than 18 years.

b). Do not being in the impossibility to apply for it.

c). The applying family must not have a total monthly income superior than four (4) legal valid minimum monthly salaries.

d). Rely on complementary resources or savings, unless the family has an income lower than two (2) legal valid minimum monthly salaries.

e). Having a conformed family by two or more members.

f). Do not owning a house, except to request subsidy for the construction in the own site and housing improvement modalities.

g). Not having been beneficiary previously with a family housing subsidy.

The Fondo Nacional de Vivienda is able to subsidy from four (4) to twenty-two (22) legal valid minimum monthly salaries to the families in need.

What is going on with social interest housing in Colombia

There are three main programs done by the government to ensure a dignified house, from free houses to subsidies for the poorest and most affected population of the country.

100.000 free houses program

In the second administration of the Colombian president Juan Manuel Santos (2014 – 2018), there was created the "100.000 free houses program". This program was born as a response from the national government to the reality of thousands of families that live in the extreme poverty and thus they are not able to afford a credit to obtain their own house through the traditional mechanisms offered by the market. This program gave 100 thousand houses and had as central target to keep going with the accomplishment of the government's goal of creating job and reduce the poverty in Colombia. (Minvivienda Gobierno de Colombia, s.f.)

My house now (Mi casa ya)

This program is targeted for families with a monthly income lower than four (4) legal valid minimum monthly salaries. This program works by demand until exhaust of the government's capacity of leaning money. In order to apply for the my house now program the family has to:
- Not being owner of a house
- Not having being beneficiary of the familiar housing subsidy given by the national government or the familiar compensation funds.
- Not having been beneficiary of any title, of the coverage from interest rates.
- Having an approved credit.
- Wanting to buy a new urban house anywhere in the country.

Given benefits
Income: 2 LVMMS (legal valid minimum monthly salaries) -> Subsidy: 30 LVMMS
Income: 2 to 4 LVMMS -> Subsidy: 20 LVMMS
House value: from 70 to 135 LVMMS

(Minvivienda Gobierno de Colombia, s.f.)

Fondo Adaptación

"We are an agency under the Ministry of Finance and Public Credit of the Colombian government that was initially created to serve the construction, reconstruction, recovery and economic and social recovery of areas affected by events arising from the phenomenon of La Niña in 2010 and 2011 entity.

Since we began our work in late 2011 we have fulfilled our commitment, leading reconstruction efforts with transformation have contributed to sustainable development, economic and social well-being and improve the quality of life of thousands of Colombians in all regions of the country.

In 2015, with the enactment of Law 1753 of 2015 by which the Development Plan 2014-2018 "All for a new country" is adopted, the Fund was credited with the power to implement comprehensive project risk management and adaptation climate change with a multisectoral and regional focus, as well as those related to the phenomenon of La Niña.

That option will allow the Fondo Adaptación to use its experience and knowledge in implementing projects aimed at generating structural changes in the territorial development to reduce the risks associated with global environmental changes we are experiencing, so that the country is better adapted to climatic conditions.

This will strengthen the National System for Disaster Risk Management and environmental policies and climate change management."

(Fondo Adaptación, s.f.)

Source: www.flickr.com/photos/fondoadaptacion/27312941038/in/album-72157695193063495/lightbox

The Fondo Adaptación has done projects all over the country giving people a house to live in, giving hope and tranquillity to the most vulnerable communities in Colombia. However, despite of their effort of designing and giving houses that resist the climate change, they forgot all of the other aspects of what a community needs to grow around. These aspects will be mentioned further in this thesis.

Source: www.flickr.com/photos/fondoadaptacion/40474100774/in/album-72157695193063495

Perspectives of the social interest housing's architecture

We can rely on many aspects to explain the demand of social interest housing in Colombia, from the more than fifty years civil war leading to forced displacement, to corruption, poverty, poor economy models and so on. However, we are not thinking of these problems because for obvious reasons we are aware of them, in this thesis what is conceived as the problem is the actual construction of the house, its architecture, its urbanism, apparently not thought by people or made for other people. Roof, walls, window, and a doors are designed and constructed in the middle of nowhere (the placement of the projects is linked to the available plots, their risk zone and the magnitude of the projects) regardless the site, the climate conditions, the cultural and social aspects, the economy, the environment, etc.

The only thing that actually matters apparently is to give a house to the people and finish the work there. We cannot undervalue the work of the government with the National planning Department (Departamento Nacional de Planeacion) and the private associates such as Fondo Adaptación that are developing these houses, that in some occasions have done a really good job, but we can do better, with better professionals and with and interdisciplinary teams that, from holistic approach they can create a sustainable social interest housing.

Source: www.flickr.com/photos/fondoadaptacion/26511545408/in/album-72157691920978721

However, not everything is lost. There are entities (public and private) such as the ministries of ambient, housing, companies like Corona, the Colombian council of sustainable construction (CCCS), public and private universities, etc. These entities are concerned about the future of the country, its communities and its sustainable development, and more important they are committed to generate community (that in our case would be through architecture). Also students, professionals, thinkers, from every field of action, young people that are able to think and to dream a better tomorrow.

There are several projects and initiatives that we can take as an example of what could be better. The National Government has constructed in different regions of the country, with the same strategy, isolating the new inhabitant from the cities, with very similar architectural standards regardless the settlement's context.

Social interest housing in the Magdalena region. Source: www.flickr.com/photos/fondoadaptacion/26100401847/in/album-72157694811251505/

Social interest housing in the Magdalena region. Source: www.flickr.com/photos/fondoadaptacion/38985493560/in/album-72157693708937114/

Social interest housing in the La Guajira region. Source: www.flickr.com/photos/fondoadaptacion/41257362251/in/album-72157689547135270/

Social interest housing in the Tolima region. Source: www.flickr.com/photos/fondoadaptacion/38759605692/in/album-72157690425366745/

On the other hand there are projects developed by the communities ("nueva Venecia village") and by the National government (S.I.H in Riosucio and dispersed in the Bolívar region) that go beyond the simple fact of providing a house to the poor, starting to think about the settlements' resilience in different regions of the country with diverse environmental situations .

Social interest housing in the Bolívar region. Source: www.flickr.com/photos/fondoadaptacion/30273665382/in/album-72157673976062192/

Social interest housing dispersed Soin the Bolívar region. Source: www.flickr.com/photos/fondoadaptacion/8643028457/in/album-72157633227486463/

Social interest housing in Riosucio, Chocó region. Source: www.flickr.com/photos/fondoadaptacion/25125991048/in/album-72157663559739108/

"Nuneva Venecia" village. Source: www.eltiempo.com/colombia/otras-ciudades/como-se-vive-en-la-venecia-colombiana-105706

Source: http://ecogreeneu.org/en/economy/project/the_amsterdam_global_conference_on_sustainability_and_transparency

Sustainable architecture

What is sustainable architecture

There are different approaches and definitions about the relationship between architecture, sustainability, development and environment. To understand where we are now we have to go back and look for the definitions, concepts and approaches that have been written since us, as global population began to worry about the environment and our relationship with it.

The sustainability concept regards the construction in every aspect: design, construction, use, manage and disposal; and in every scale: materials, building, community, city, territory and planet. Otherwise are inherent the "living" aspects: psychological well-being, production, work, mobility, etc.

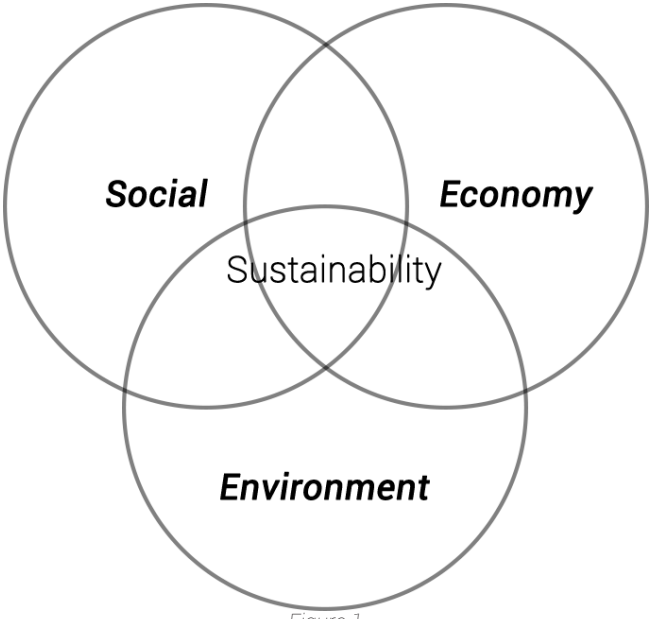


Figure 1

Definitions

Some of the following definitions can be perceived as the same but in fact, there are different aspects that differentiate them from each other.

Sustainable Development

The term has its origin from ecology where the sustainability of an ecosystem is understood as the capacity of maintain in the future biodiversity and productivity, using the natural resources in such a pace that those are capable to regenerate naturally. In 1987 the Brundtland commission (World Commission on Environment and Development – WCED) wrote the first definition of sustainable development: *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*.

(World Commission of Environment and Developement, 1987)

Sustainability

Given the previous definition is now possible to synthetize the relationship between economy, social equity and environment (Figure 1). This overlap is where we find sustainability.

The sustainability applied to building process considers:

- The material's choice, origin and it´s embodied energy (energy consumed by all of the processes associated with the production, from the mining and processing of natural resources to manufacturing, transport and product delivery).

- Constructive process of the building.

- The quality of the thermal performance.

- Maintenance processes.

- The durability of the whole: flexibility, adaptability.

- The construction and disposal techniques' suitability.

- The recycle and transformation possibilities.

- The possibility of clean energy use.

Sustainable building

After understanding what sustainability considers, it is possible to say that a sustainable building should be "a system, able to constantly maintain its own performances in time with a reduced energy and materials consume". The sustainability of a building involves aspects associated to the:
- Environment
- Energy efficiency
- Water consumption
- Life quality of the inhabitants
- Durability
- Relationship between costs and benefits
- Construction materials

Eco-architecture

(from Greek eco = oikos = environment)
Architecture responsible with the environment, ecological architecture. Considers mostly the social and economic aspects, where specifically:
- Air pollution
- Materials and components life cycle
- Energy performance
- Technological solutions
- Eco-economical assessment
- Environmental impacts
- Materials reuse and recycling
- Research of alternative solutions

Bioclimatic architecture

Study of typological and technological (systems performance) solutions (passive and active systems) to respond the environmental characteristics and climate condition allowing to achieve the inhabitants comfort inside the buildings with the minimum use of fosil fuels.

Biologic construction

Materials, processes and methods used in the construction sector that are respectful of the inhabitant's health, if possible from a natural source and with very low environmental impacts. It takes into consideration not only of the building, but the physical and psychological well-being of the people and their relationship with the building and the location (natural magnetic forces, harmful emissions, form and disposition of the spaces, natural lighting, colours, symbols and meanings).

Climate responsive and environmental sustainable design

Since the concern about environmental impacts was born, architects have been evolving their thinking and transforming it into a greener approach. Although this green design is one-step ahead, there is still a gap between the design goals and the environmental issues, we cannot take as a starting point the concept, we should begin from the very first matter of the place, its context, its climate and conceive the design in a more holistic way. The Royal Australian Institute of Architects has develop environmental principles; with them, we can have an idea about the climate responsive design.

- Maintain and, where it has been disturbed, restore biodiversity

- Minimize the consumption of resources, especially non-renewable resources. Within this principle the further considerations regarding the climate responsive design would be: the use of renewable resources in preference to finite resources and encourage the reduction of power consumption by, for example, maximizing passive thermal comfort and enabling users to make efficient use of building appliances

- Minimize pollution of soil, air and water

- Maximize de health, safety and comfort of building users

- Increase awareness of environmental issues

(Hyde, 2000)

For architects the job should be to implement these principles within a framework that considers the following aspects.

- Holistic consideration of negative environmental impacts that arise in the construction of the building and its infrastructure
- Make design recommendations, which minimize the negative environmental effects of buildings

The climate responsive design is focused on the synthesis and the selection of climate responsive strategies to meet design objectives (Figure 2).

(Hyde, 2000)

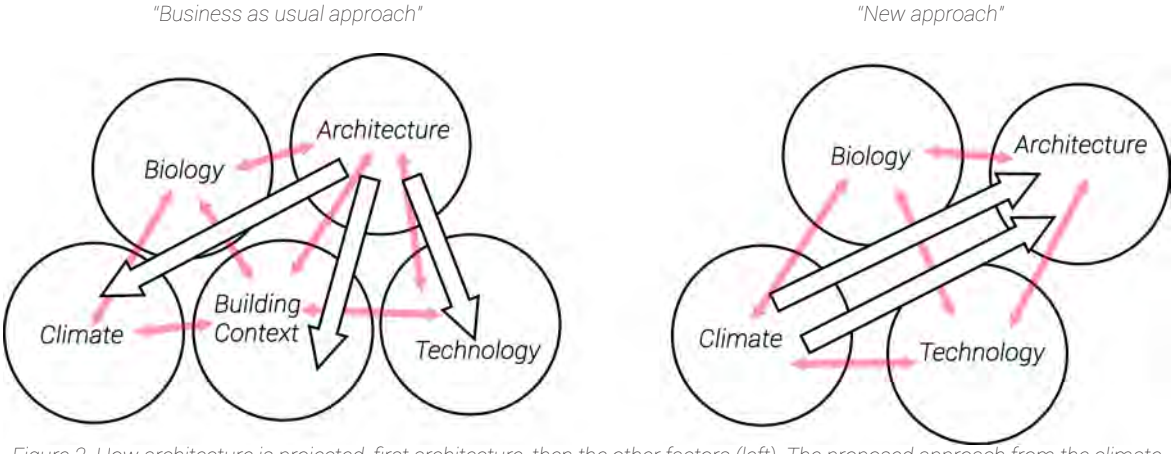


Figure 2. How architecture is projected, first architecture, then the other factors (left). The proposed approach from the climate to the architecture (right). Source: (Hyde, 2000.) Adapted by author

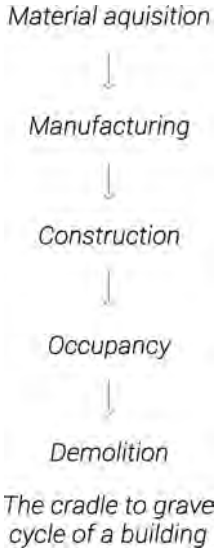


Figure 3. Source: (Bergman, 2013.) Adapted by author

Approaches

"What do we actually mean when we talk about green design, sustainable design, or eco-design? Generally speaking. We can apply these terms interchangeably. While there may be nuanced differences between them, I find it more helpful to think in terms of what we are trying to achieve".
(Bergman, 2013)

Reuse, Reduce, Recycle

Since the 1960s, we have been using these three R's, and it has been extremely helpful to increase the awareness of the environmental impacts that we as a species are producing. However, sadly some people think that by recycling some plastic bottles and newspaper they have done their part. It also takes part among the designers, using this approach makes them think that their sustainability jobs are done, but this thinking makes us look at the problems in an isolated way, limiting our goals and blinding us from an holistic approach.

Cradle to grave

To go beyond this little starting point we can consider as the following step something called Life Cycle Analysis (LCA) or Life cycle assessment. This analysis has been applied mostly to products, but the same principle can be applied to buildings. The life of the building is examined from cradle to grave, from the origin of its raw materials, to its transformation or manipulation, to the transportation, its embodied energy, to the energy consumed during its useful life, to the impact of its end of life. At every step of the Life cycle, there are inputs in terms of energy and materials that correspond also to environmental impacts (Figure 3).

The LCA attempts to quantify these inputs, convert them into values and be able to represent their impacts. This analysis enables the designers to take decisions and improve or modify their designs and construction processes to minimize the impacts of the building.

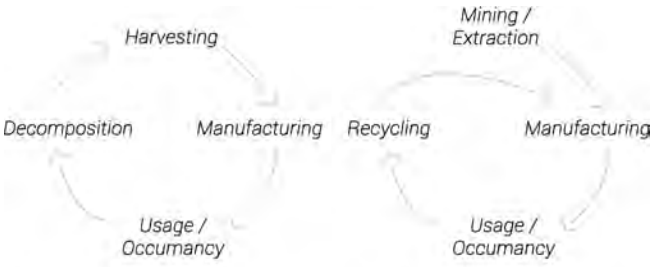
While this approach is more encompassing and conscious, still has its limitations. The very use of the word grave implies that the materials have an end, a disposal, in other words, they are a potential waste. This cradle to grave approach enables us to see and reduce the impacts of what we build, but as the authors of the "Cradle to cradle: remaking the way we make things" book Bill McDonough and Michael Braungart say, "being less bad" does not help us to achieve the goal of sustainability.

Cradle to cradle

This concept was popularized by McDonough and Braungart, it teaches us about the cycles of the ecosystem and how we can take advantage of them without harming our planet. It is a revolutionary way of thinking that even nowadays some university professors have told me "that´s a little bit utopic".
"Our materials (iron, coal, oil, agricultural nutrients, etc.), as well as the air and water we require for life, do not get replenished from outside the Earth's closed system, floating through the universe. Everything we have and ever will have is, in one form or another, on the planet now. (Given the tremendous cost and energy requirements of spaceflight, we are unlikely ever to bring back useful quantities of materials from other planets.) Therefore, to be truly sustainable, we must never use up resources faster than the Earth's ecosystems can replenish them." (Bergman, 2013)

However, we can rely on a critical exception called the Sun. This galactic neighbour showers us every day with its sunrays, allowing us to transforming them into electrical and thermal energies and use them without the fear of running out. This also includes related renewable energies such as wind and biofuels that would not exist without the sun, and tidal and geothermal energies that somehow make part of this interconnected energy system.

Through millions of years earth has developed a system in which nothing is ever discarded, in other words the earth does not produces "waste". This concept was recently explained as "waste equals food", referring to all kinds of waste that have the potential of becoming an input for another use. McDonough and Braungart divided everything considered as a waste into two categories: biological nutrients and technical nutrients. Biological nutrients are materials that, after their use we can easily return them to earth to be part of a new cycle. Technical nutrients are those materials that are quite hard to break down to their raw materials so become part of the usage cycle, where they can be recycled and used again as an input to create another product.



All materials should be considered to exist either in a biological nutrient cycle (left) or a technical nutrient cycle (right).

Figure 3. Source: (Bergman, 2013.) *Adapted by author*

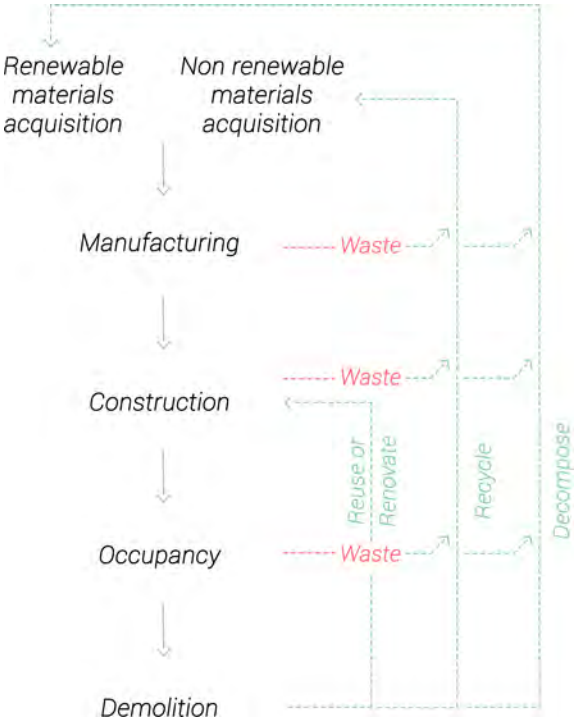


*Figure 4. Source: (*Bergman, 2013*.) Adapted by author*

Triple bottom line

This approach can be taken in a more philosophical way. We already know that sustainability can be found in the overlapped relationship between people, planet and profit, or economy, social equity and environment. However, is sustainability really the goal? What do we want to achieve as a human species, or as a single individuals? Where is creativity, self-flourishment, love, etc.? Taking the Maslow's pyramid scheme (Figure 5) we ca rely on aspect from the bottom to the top, from surviving to living, working as part of a system bigger than ourselves, in harmony with the environment without relying just on the economical profit thinking that this is just good for the people. We cannot let aside our dream and goals of becoming better in any sense.

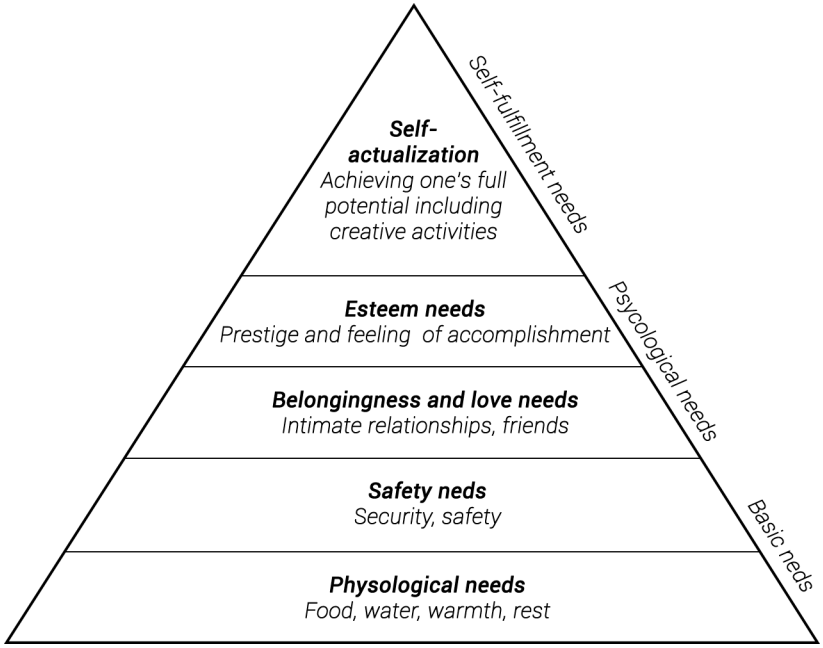


Figure 5. Maslow pyramide. Adapted by author

Certifications

There are multiple certification for sustainable buildings in the world. These certifications (some voluntary) were created to measure the impacts and benefits that the building has generated. They can be measured in the phases of construction, usage and the disposal, separately or altogether. Some of these certifications are:

- LEED (Leadership in Energy and Environmental Design): United States but has spread worldwide.

- BREEAM (British Research Establishment Environmental Assessment Method): England.

- HQE (Haute Qualité Environnementale): France.

- Eco-Bau: Switzerland.

- LBC (Living Building Challenge): International.

- CASBEE (Comprehensive Assessment System for Built Environment Efficiency): Japan

- Protocollo ITACA (Istituto per l'Innovazione e la Trasparenza degli Appalti e la Compatibilità Ambientale): Italy.

- CASA Colombia: Colombia.

Figure 6.

Figure 7.

Figure 8.

Figure 9.

Figure 10.

Figure 11.

Figure 12.

Figure 13.

Sources
Figure 6: www.buildup.eu/en/explore/links/leadership-energy-and-environmental-design-leed-0
Figure 7: https://greenbuildconsult.co.uk/the-benefits-of-breeam
Figure 8: http://www.phosphoris.fr/en/project/phosphoris-is-a-certivea-hqe-certifier-in-france
Figure 9: www.fixit.ch/fr/Home/Service/News/Certification-eco-bau
Figure 10: www.dialogdesign.ca/open-dialog/two-petals-closer-living-building-challenge
Figure 11: www.measurabl.com/blog/top-ten-building-certifications/
Figure 12: www.buildingblog.bticino.it/archivio-post/itaca-il-protocollo-delle-regioni/
Figure 13: www.cccs.org.co/wp/niveles-de-certificacion

Source:https://www.jtp.co.uk/projects/the-home-for-all-seasons

Resilience and climate change issue

Resilience

According to the Webster's dictionary, the definition of resilience is *"an ability to recover from or adjust easily to misfortune or change"*. In this way, we can apply this definition to the project, since it will recover or adjust from the natural changes (Rainy and dry seasons).

"Architecture plays a critical role in mitigating flood risk and improving communities' health and well-being during flooding. Good design can help reduce the vulnerability of the built environment to flooding- both protecting against the risk of flooding and ensuring that buildings are better able to deal with water if flooding cannot be prevented.

With the risk flooding set to increase significantly due to climate change, the UK needs to consider how best to deal with flooding risk and examine whether new approaches could help minimise the damage to communities and infrastructure. To better manage and respond to flooding risks, the Government will need to work with construction industry to adopt a ne approach to decision making and regulation. This should include:

1. Improving decision-making process to address a broader range of factors and potential solutions to water management issues

2. Piloting "Licence for innovation" to examine the effectiveness of new approaches to managing flood risk in new developments to flooding and ensuring all new buildings incorporate appropriate measures

3. Examining the potential for regulations of flood resilience to be linked to Flood Zone Designations through Building Regulations and planning policy

4. Regulation to ensure that all new developments in flood risk areas demonstrate reduced exposure and vulnerability to flood damage as well as broader benefits to resilience of the local area

5. Encouraging grater uptake of flood-resilient design by home and building owners exposed to flood risk."

(RIBA, 2018)

Note: the word "UK" can be replaced with the word "Colombia" to bring into context the subject)

The awareness of the irreversibility of environmental changes induced by the economic development both to the resources, increasingly scarce, and to the climate, increasingly characterized by the phenomena intensity, have induced a different attitude towards the sustainability concept. The mutations in the relationship with the natural environment impose new conditions to the different scales, both local and global, to which it is necessary to react.

It is, therefore, not possible trying to rebalance the relationships with the natural environment in order not to jeopardize it, it is necessary to implement concrete strategies and immediate actions to cohabit with climate changes avoiding the occurrence of the most catastrophic scenarios. The goal therefore becomes to mitigate the climate change and its consequences in a global scale. To the implemented actions, and to their effects, can correspond different scenarios. The mitigation is necessarily accompanied by the adaptation.

These two elements, the climate changes' mitigation and the adaptation, identify the resilience concept. The slogan of resilience characterises the actions and programs at international level. To the local level, the resilience concept has produced plans and means allowing the individual territorial realities to react to the adverse events derived from the climate change.

The elaboration and use of plans allow the local administrations and governments to evaluate the solutions and investments in order to increase the resilience of urban centres. For their development, it is necessary to know at a local level, the entity of climate changes, the definition of possible impacts, the fragility analysis, and vulnerability definition of the components that characterize the city structure. This leads to a regionalization of the climate change projections identifying the indicators at a local scale such as maximum and minimum temperatures, precipitations, days with temperatures above the threshold, the so called heat waves with maximum daily temperatures over 33°C.

The keyword of these interventions is adaptation, as define by the IPCC (Intergovernmental Panel on Climate Change) referring "to the transformations in the natural and artificial systems in response to the current or expected stimulus induced by the climate or its effects In order to moderate the damage or exploit positive opportunities offered by the change". Different types of adaptation can be identified, including the preventive one, the autonomous one and the planned one. (IPCC, 2007).

The meaning of the term adaptation consists in making the territory less vulnerable by climate change, through measures that reduce its impacts or through the response capacities of the productive subjects and the natural environment or transformed by men, cultivated.

The adaptation modalities must be defined according to the territory's vulnerability, the geographical factors and the infrastructures and must take into account the specific vulnerabilities of all the present subjects in the territory and of the stakeholders. This analysis requires a particular sensibility and evaluation of the possible scenarios. This approach appears to be absolutely appropriate to the climate

changes in progress and their exceptional speed. At planetary level, there are generalized increases in the air and sea temperatures, melting of perennial ice, rising sea levels, the ever-increasing frequency of extreme natural events, droughts and floods. The responsibility of the greenhouse effect induce by the human activity and the large quantities of carbon dioxide release into the atmosphere are identified as now certain, cause of the rising temperatures.

(Pollo, 2015)

The authorities should focus their policies enabling the communities to manage and mitigate their own risks. In this way, people can learn to live with water and be prepared for eventual floods, speeding their recovery if necessary.

The flood resilient architecture is helping communities all around the world, allowing to reduce the chance of losing their lives and livelihoods because of flooding. There is anyways a need to raise the awareness about flooding, this can change the general idea about what does it mean to live with the water and what resilient design means.

"*The expected impacts of global warming, such as flooding in low land areas with damages on infrastructure and buildings, underline that we will have to build for resistance and resilience. Rising sea levels are likely to become an important aspect of water management and are particularly significant for the many European cities that are located near the sea and other water bodies*". (P. Thörn, U. Moback, K. Buhr, & G. M. Morrison)

There are three different strategies to meet rising sea levels in urban areas. These concepts were originally developed by the Royal Institute of British Architects, Building Futures and Institution of Civil Engineers (RIBA, Building Futures and ICE, 2010).

Three strategies for climate change adaptation

The three strategies visualise each strategy in its extreme form, in order to provoke creative thinking on ways to meet the climate change challenge. The three strategies can be summarised as follows: (illustrations by SWECO Architects)

1. Retreat

A retreat strategy means that infrastructure and buildings gradually, i.e. through a long term planned and managed process, are moved to safer ground. The city is in essence gradually reallocated, i.e. it retreats, in order to avoid flooding.

1. Retreat. Source: Climate Change Adaptation of Frihamnen: Visualising Retreat, Defend and Attack. P. Thörn, U. Moback, K. Buhr, & G. M. Morrison.

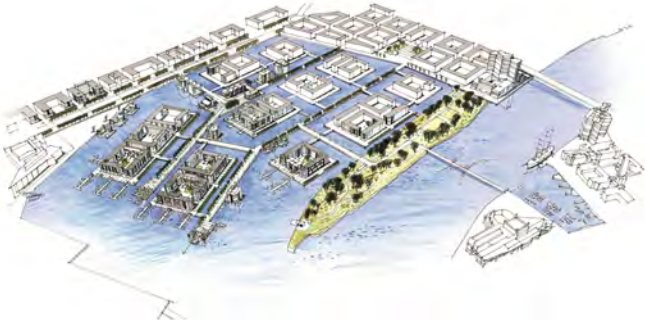
2. Defend

A traditional way to protect an urban district from flooding via flood defences, e.g. walls or other "hard" measures. A defence strategy saves the city from reallocation and protects existing infrastructure, but can be extremely costly depending on how much protection is needed and the level of risk.

2. Defend. Source: Climate Change Adaptation of Frihamnen: Visualising Retreat, Defend and Attack. P. Thörn, U. Moback, K. Buhr, & G. M. Morrison.

3. Attack

The attack strategy means that the city advances and builds out onto the water. Using modern technology but also traditional construction methods and designs that are adapted to flood risks and are made flexible to handle rising sea levels.



3. Attack. Source: Climate Change Adaptation of Frihamnen: Visualising Retreat, Defend and Attack. P. Thörn, U. Moback, K. Buhr, & G. M. Morrison.

(P. Thörn, U. Moback, K. Buhr, & G. M. Morrison)

The "retreat" strategy could have several social, economic and environmental impacts not only for the inhabitants but also for the old and new location zones if is not well developed. As an example, we have the project "Villa Mompox" in Colombia (Figure 17), where the houses were built away from the city, leaving the new population isolated from the rest of the city. It is very important to take into account every variable to execute a project like this.

The "defend" option is highly diffused worldwide (sea waterfronts and rivers) due to its architectural, economical, and urban advantage as seen in the "Liverpool waters" masterplan (Figure 18). However, these actions could unleash a certain number of environmental impacts, such as more floods or interfere whit the natural cycle of water bodies; furthermore, the economical balances are very important to develop projects with this approach.

The "attack" strategy is to adapt the architecture and the urban or rural landscape to the natural cycles, understanding that these phenomena will continue happening and raising rapidly due to the climate change. These resilience way can be understood as floating spaces, elevated paces, flooded spaces, so people can have a direct relationship with water, understand it and take advantage of it. The "Waterbuurt development" (Figure 19) is a great example of resilient architecture in the XXI century.

Figure 17: Mompox neighbourhuud moved away from flood risk areas. Project developed by Fondo Adaptación. Source: sitio.fondoadaptacion.gov.co/index.php/prensa/comunicados-de-prensa/comunicados-prensa-2018/1102-comunicado-015-18

Figure 19: Waterbuurt development by Marlies Rohmer Architecst & Urbanists (Photo: Roos Aldershoff) Source: RIBA, 2018

Figure 18: Liverpool Waters. Masterplan developed by Chapman Taylor Architects; Water Spaces Strategy developed by BACA Architects (Photo: Champman Taylor Architects) Source: RIBA, 2018

Climate change issue

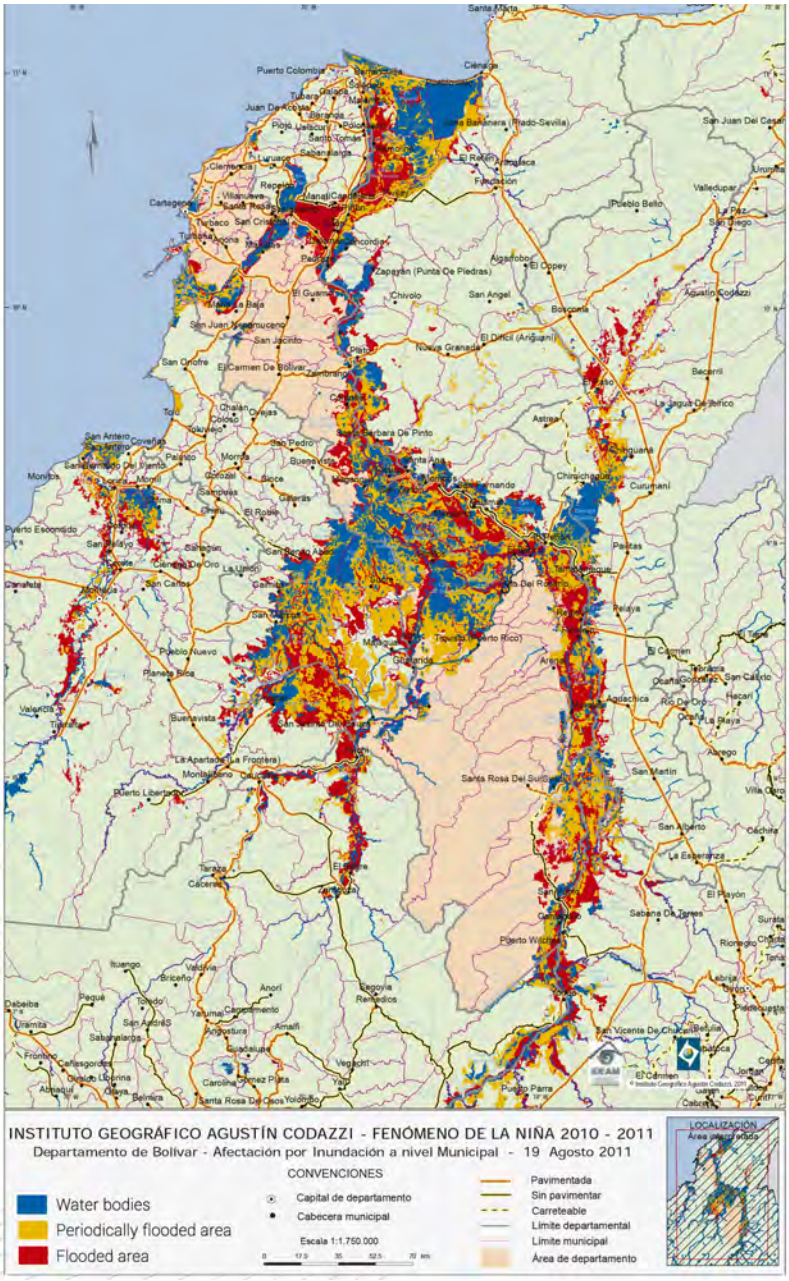
Water bodies in Mompox are the 32.1% of the municipality's surface. According to the data from the "Memoria técnica: Evaluación, análisis y seguimiento de las afectaciones por inundaciones asociadas al fenómeno de la niña" the periodically affected areas by floods are the 38.5%, this is equivalent to 24.662 ha.

The last flood by "La niña" phenomenon in 2011 affected the 29% of the municipality's surfaces, about 18.888 ha. leaving 92.376 homes (331.046 people) affected and 20.544 homes (74.558 people) highly affected , leaving more than the 60 % of the population affected. From 2006 to 2014, 45 people have lost their lives, and around 1.509.730 people were affected. 80.710 houses, 42.310 farms, 1.820 stores, 114 fabrics, 114 warehouses, 3.715 plots and 4.489 with other uses were affected by floods in the region. Additionally 3.212.452 Ha. of cultivable soil, 15.489 Ha. of forest areas, 678.638 Ha. of grass areas, 769.649 birds, 42.587 other species, 1.917.213 fishes and 483.246 livestock were lost.

On the other hand, the historical centre of Mompox was design and built by the Spanish with the awareness that every certain amount of time, the city could be flooded. This lets us know that this phenomenon in the city is nothing new, but due to global warming, has significantly increased over the years. Unfortunately these natural events are mostly unknown by the new generations.

Peripheral neighbourhood of Mompox under the flood. Source: www.eluniversal.com.co/cartagena/bol%C3%ADvar/patrimonio-de-mompox-en-vilo-por-inundaciones

Historical centre of neighbourhood of Mompox under the flood. Source: www.eluniversal.com.co/cartagena/bolivar/mompox-inundado



Bolivar region flood affectation. Source: Memoria técnica: Evaluación, análisis y seguimiento de las afectaciones por inundaciones asociadas al fenómeno de la niña

Kogi house construction. Sierra nevada de Santa Marta, Colombia. Source: www.flickr.com/photos/arquitectura_en_equilibrio/37960393984/in/dateposted

Sustainable housing in Colombia

Sustainable housing policies

There have been many efforts in the country by a reduced group of people besides the housing and environmental ministries to bring sustainable practices to Colombia. Private sector that brought LEED had helped with the CCCS (Colombian Council of Sustainable Construction) to impulse these practices. Nowadays we have a certification system and law that constrain the construction sector to evolve toward a more sustainable tomorrow.

There is one resolution that involves the sustainable construction in Colombia. This is the resolution number 0549 of 2015, related to the water and energy savings, the buildings must include the following aspects:

1. Compulsory percentages of water and energy savings, according the climate and building type.

2. Gradual application system for the territory of inhabitants' number conformity.

3. Certification procedure of the measures application.

4. Control of procedure and tool of the measures application.

5. Incentive promotion at a local level for the sustainable construction.

The percentages and the benchmarks to develop new houses can be found in the Sustainable construction guide for the water and energy savings in buildings (Guía de contrucción sostenible para el ahorro de agua y energía en edificaciones).

What is going on with sustainable housing in Colombia

Ministry of ambient

According to the decree 3571 of the year 2011 the ministry has as main goal to achieve, formulate, adopt, direct, coordinate and execute the public policy, plans and projects related to the territorial and urban development planned for the country, the consolidation of cities with efficient and sustainable use patterns of the soil, taking into account the access and financing housing conditions and public service allowance of potable water and basic sanitation.

The ministry beside organizations such as CAR (Corporación Autonoma Regional), urban environmental entities, territorial entities, etc. had published and publish the Sustainable construction guide for the water and energy savings in buildings, through workshops and work table to spread the sustainable practices all over the country.

CCCS (Colombian Council of Sustainable Construction)

Public policies, incentives and strategies.

1. The CCCS and its members and allies' network will continue supporting actively the public policies, incentives and strategies development at every government level; with the purpose of elevate the buildings' sustainability level. The goal is to achieve a market for sustainable social interest housing, sustainable communities and, generally, the materialization of green, productive, equal, and healthy cities.

2. As a country, Colombia supports the green growth strategies and the low carbon development. Therefore, the CCCS its members and allies' network will support the government to take actions in order to accomplish the assumed compromises in the country's accord and the goals of reducing by a 20% the greenhouse gases for the year 2030, related to the levels observed in the year 2010. The CCCS will continue supporting the housing, city and territory ministry, and every involved actors in this productive transformation agenda in favour of a low carbon development, in the gradual application and with viability criteria of its sustainable construction policy.

3. The CCCS will continue supporting the Colombian government with technical knowledge. There will be looking forward to counting with an information system that allows developing a monitoring of the efficiency in water and energy improvements' impact, compulsory for the new buildings since 2016 in Barranquilla, Bogotá, Cali and Medellín (Res.549/15 of the housing, city and territory ministry). The CCCS will continue committed with the spreading of this initiative for its application and acceptation by the private sector.

4. The CCCS will promote additional and central dispositions to the concept of sustainable construction in substantial areas such as waste management and health.

5. The CCCS will work alongside the local governments to make viable the normative implementation and the voluntary measurements implementation that can overcome the normative requirements through incentive schemes for the different involved actors during the life cycle of the building.

(CCCS, Consejo Colombiano de Construcción Sostenible, s.f.)

Figure 14. Source: www.cccs.org.co/wp/niveles-de-certificacion

CASA Colombia

It is an initiative by the CCCS to impulse the transformation of the housing construction in the country towards the sustainability, alongside the national politics of green growth. The main goal is to facilitate the structuration of efficient cost for new housing buildings, promote the concept of integrated sustainability, which includes resources efficiency, social and health responsibility and wellbeing of the users, and contribute with market solutions for the accomplishment of the new normative associated to the sustainable construction.

(CCCS, Consejo Colombiano de Construcción Sostenible, s.f.)

The realised studies allowed the developing of new reachable guidelines for any housing project type, including those that have budget limitations like the "social interest housing" and "priority interest housing".

In fact, the needs and realities of these segments were contemplated in the line guides' development. Considering the potential cost impact of some measures and guidelines' implementation, and with the purpose of encourage the generation of sustainable social and priority interest houses in the country, the referential "CASA Colombia" stablishes a different score for these project type. In this way, it is allowed obtaining the recognition fulfilling a lower number of optional guidelines, which the project developers

will choose according their capacities. Therefore, in CASA Colombia the social and priority interest housing projects will have to accomplish with the guidelines in the same way as the other projects do (Figure 16).

(CCCS, Consejo Colombiano de Construcción Sostenible, s.f.)

Figure 15. Source: www.cccs.org.co/wp/categorias

Figure 16. Source: www.cccs.org.co/wp/niveles-de-certificacion

SAC (Sello Ambiental Colombiano) Environmental Colombian label

This ecological label, is a distinctive or label, that is voluntarily obtained, granted by an independent institution called "organismo de certificación". The use of the SAC is voluntary, which means that the interested parts that want their good or services to have this label, can request it. To bear the SAC must be considered as a commercial strategy by the service producers and the providers and a competitive advantage; and by the consumers as a value added compared to other goods or services that do not have this label.

To ensure the credibility, independence and economical sustainability of the label, the program works supported by a structure that responses to the national subsystem of quality and norms ISO 1402 dispositions, relative to the labels and ecological declarations. (Minambiente Gobierno de Colombia, s.f.)

The label has 23 material categories for its application, such as prefabricated concretes, bricks, paper, cleaning products, bamboo, clay tiles, etc.

Figure 17. Source: www.minambiente.gov.co/index.php/component/content/article?id=366:plantilla-asuntos-ambientales-y-sectorial-y-urbana-19#4%C2%BFcu%C3%A1les-son-las-categor%C3%ADas-de-producto-disponibles-para-optar-por-el-sac

Certification methods used in Colombia

The sustainability has become a topic of interest in the Colombian constructions sector, not only for the encouragement of becoming more sustainable but also for the economic benefits that these practices can give. Private consultancy agencies are offering the service to construction companies "on going LEED" for their economic benefit. LEED is the most powerful international certification going on in Colombia, but also there are certifications such as CASA Colombia, LBC, that are on the raising.

Although we have seen all the initiatives that are going on in the country by the government and the private sector, we still see the same houses, the same design applied repeatedly without a second though. However as I said it before, not everything is lost.

Renewable fonts in Colombia

On February 26 of this year, was released the CREG 030 de 2018 resolution by the Energy and Mines Ministry, this text regulates the auto generation activities at little scale and the distributed generation into the National Interconnected System (SIN). The renewable energy auto generator (user) that decides to sell its surplus to the network will always have a buyer whose price will be close to the network operator buying value. However, it is still in action the electric infrastructure development needed and the digital platform to the respective procedures.

This year was adjudicated the wind generation project of 1.360 MV in the La Guajira Region, north of the country with a value of $174 million USD. This project makes part of the first phase of the wind energy project in La Guajira by the Mining Energetic Planning Unit (UPME), which wants to guarantee the reliability of the supply and diversify the generation sources through non-conventional renewable energy systems. It is the first project of great scale in Colombia with connection to the National Interconnected System (SIN), which should start its work by November of 2022. There are 45 more projects in development by 10 network operators in different country's regions.

(Consejo Colombiano de Construcción Sostenible , 2018)

Source: http://www.portafolio.co/innovacion/energias-renovables-en-colombia-502061

The self-construction also brings together the comunity. Kogi house construction. Sierra nevada de Santa Marta, Colombia. Source: www.flickr.com/photos/arquitectura_en_equilibrio/38678519371/in/dateposted/

Self-help construction

Self-help construction in Colombia

There are different reasons for the developing of the self-constructed houses in Colombia. From the self-sustainable way of living some people is trying to achieve, to the need of a shelter for people in extreme poverty and forced displaced communities.

Since the 90's, there are clearly two types of informal housing; the first one, the informal city, generated because of constructive processes developed around other buildings already constructed, they are not necessarily in the periphery of the city. The second one, are entirely new neighbourhoods, created by displaced people escaping from the armed conflict.

(Torres Tovar, 2009)

Kogi house construction. Sierra nevada de Santa Marta, Colombia. Source: www.flickr.com/photos/arquitectura_en_equilibrio/37960393984/in/dateposted

Since the 75% of the country's population lives in cities and raising, it is a very important issue in the country. It is possible to think in two main categories: rural self-helped constructions and urban self-helped constructions.

Rural

In the rural part of the country is where we can find the most of the self-constructed houses. Although most of the people ignore it, this kind of houses have been constructed more than 50 years ago (some of them hundreds of years in the case of the indigenous constructions), and have been able to resist earthquakes, heavy rains, strong winds etc. Made with earth, wood, adobe, stone and a lot of effort, these houses prove that it is possible to have a self-constructed house without the fear of them falling apart.

Urban

In the other side, we have the urban self-constructed houses. These houses can be divided into two models: Pirate urbanization and Invasion. The pirate urbanization is when a person owns a piece of land and sells little pieces of that land to the people so they can construct their own houses. This is about the 60% of the cases in the marginal sector of the country's cities.

As not everyone in the country can afford an apartment and much less an architect, they decide to choose the most suitable option: the foreman. Even though the foreman or "first man" has a lot of experience in the field, these actors do not have the professional formation to design a house within the normative (civil engineering) and much less to design a sustainable house.

The invasion happens when people cannot even afford to pay a foreman, you construct your house however and wherever you can to provide shelter for yourself and your family, this is about the 30% of the cases. These constructions are illegal for the government and because of that; you cannot have access to public services such as water and electricity until you land is legalized (this process can last years).

Self-construction house. Bogotá, Colombia.

What is going on with self-help construction in Colombia

There is a lot of prejudge about the self-construction and its low-tech techniques, often it is seem as poor people's architecture, that is not for the XXI century, that is going back in time, etc. Other factors are the fear that the house will simply fall apart, the conception of illegality of the self-construction and that it takes more time and care that globalized construction techniques. We cannot deny that almost all of the self-constructed houses In the cities are in danger and we have to bring this knowledge to the, to avoid loses because of an irresponsible architecture.

Self-constructed neighbourhood. Bogotá, Colombia

One thing for sure is that inside a reality as overwhelming as this is not fair to just sit and relax knowing that you can do something about it. For example, there are studies that support the construction with earth and adobe, with their correspondent structural and anti-seismic systems (structural wood) that enables the house construction within the legality and safety measures established by the government.

In the other hand, the consciousness about it is growing, that this way of living is possible, with hard work and love for the nature. We as architects (or people who care about the environment), have the responsibility of showing the world that a harmless way of living is possible without compromising the comfort that this century has given us.

Vernacular architecture and Ancient knowledge in Colombia: Architectural heritage

As mentioned before, there are low-tech techniques that have been used since the indigenous tribes stablished in the region. Vernacular architecture stands for native techniques, born in the place and developed by its people through hundreds of years, failing and succeeding, experimenting, always in harmony with nature.

We have a huge heritage about the man's relationship with nature, the indigenous people in Colombia have develop such a bond with nature that they have learned to use it for their benefit, to ensure their safety and comfort inside of a house.

On the other hand, we have the colonial architecture, the techniques brought by the Spanish could actually be a technique elaborated in the Middle East thousands of year ago. So the use of earth and materials such as wood, straw, and clay is nothing new, is not something "alternative" we have always used it, now is the time to appreciate what a precious give our ancestor have done to us.

The self-construction also brings together the comunity. Kogi house construction. Sienrra nevada de Santa Marta, Colombia. Source: www.flickr.com/photos/arquitectura_en_equilibrio/38678519371/in/date-posted/

Why Mompox

Three years ago, I was traveling the country in my bicycle with some other friends. One of the stops was in Mompox, I knew nothing about the city, only what I saw in architecture´s history class some years before that. Its landscapes, the river, its architecture, its people was remarkable. We didn´t sleep in some fancy hotel, we went to the "1 de mayo" neighbourhood, to sleep and to live with the locals.

As we moved away from the historical centre of the city, the architecture transformed itself; we arrived to a very different place. No roads, cracked sidewalks, no infrastructure, garbage everywhere, animals eating that garbage, but people smiling at us, children playing, and ladies waving goodbyes. The house was inhabitable during the day and extremely hot during the night. Build by some foreman friend of the family. This is the reality have to live millions of people every day. I´m am completely sure that we can do better, so people like them can enjoy their houses without thinking of the economic lose, they just have to see the bigger picture.

Mompox is also an important reference point to the region and the north part of the country. Its importance in the country can activate the housing model in the region that can be adequate to the similar social, environmental and economic contexts.

Historical center. Mompox, Colombia

Periphery neighbourhood. Mompox, Colombia. Source: https://www.google.com/maps/@9.2340509,-74.4276437,3a,75y,318.5h,89.62t/data=!3m6!1e1!3m4!1sjyeY-3_W2AY2ROIdKWOKRA!2e0!7i13312!8i6656

Urban analysis

Urban systems

MOBILITY NETWORK

The streets system in Colombia works wit streets (calles) and Courses (carreras). The Streets go in east - west sense, and the courses in north - south sense. The streets are named after famouse historical characters, their location or their name given by the comunity. For an easier understanding of the city, they have also numbers and people refer to them after their number.

The mobility system is not organized, there is not public transportation inside the city, and the public mobility relies in the "mototaxi", and the taxis for locals and tourists.

Being a colonial city and with no planned growth there is a lack of sidewalks and cycle lanes, knowing that most of the people moves in bycicle, motorcycle or by foot.

PUBLIC SPACE

The public space is conformed by streets, plazas, parks and the river. As the city grows and because of the colombian migration history and the lack of planning; the concept of public spaces has been vanishing leadig to the creation of little spaces made in the non constructed spaces such as pocket parks, this means that the park is created in a residual space betwen the buildings, not planned at all.

The concept of the plaza and park is desappearing, the only reason to go to these spaces is because they have to go to church and the spend a little time before or after the ceremony. The role as catalizers for the social, cultural and economical interaction has gone somewhere else, the streets, the private spaces, and some other unusual places.

HISTORICAL CENTER

Since the city is a colonial city, a national monument and and UNESCO world heritage site, the historical center has to be limited in order to control what is being restored, constructed, demolished and if there are the required permissions for the interventions.

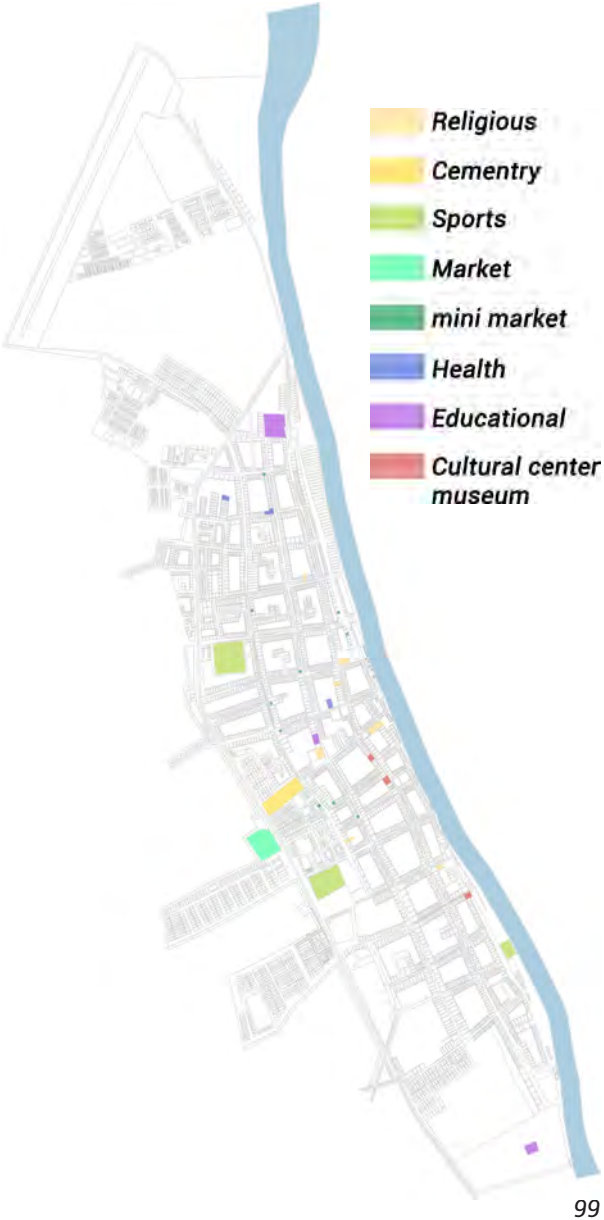
Crosing the border line of the historical city, the architectural landscape changes drastically, the houses begin to be more and more "self-constructed" and the public space begins to desappear and transform.

FACILITIES

Being a very religious city the plazas and the more frequented facilities are the churches, these are the principal meeting spaces of the people. This is and advantage because most of the churces have their own plaza, so through religion the people is able to create comunity.

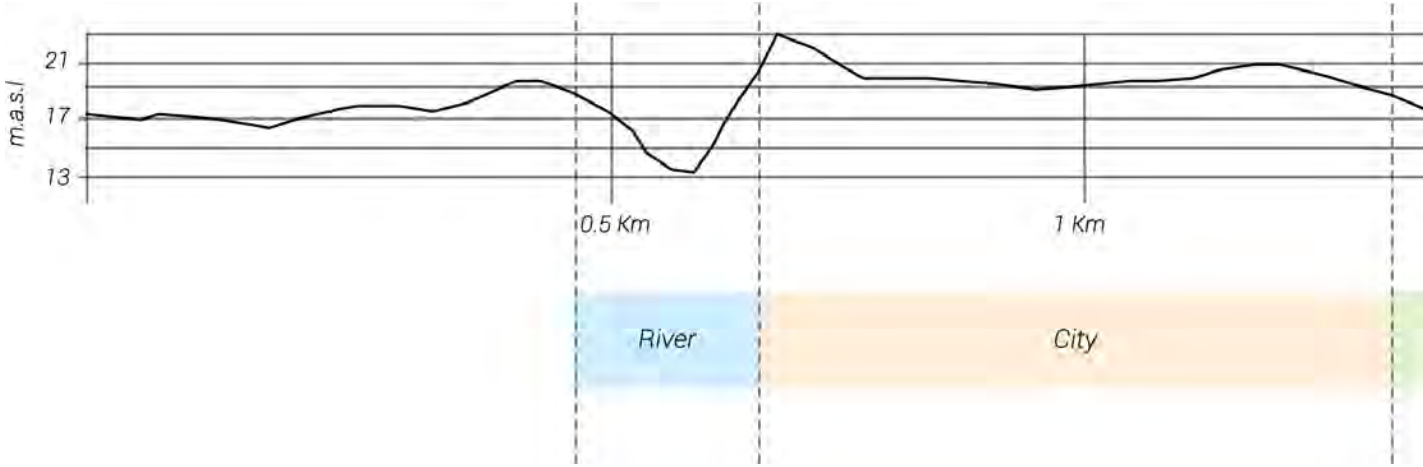
Rich in culture and history Mompox itself is a museum, with its festivals and holydays celebrations is one of the most visited towns in Colombia during these events.

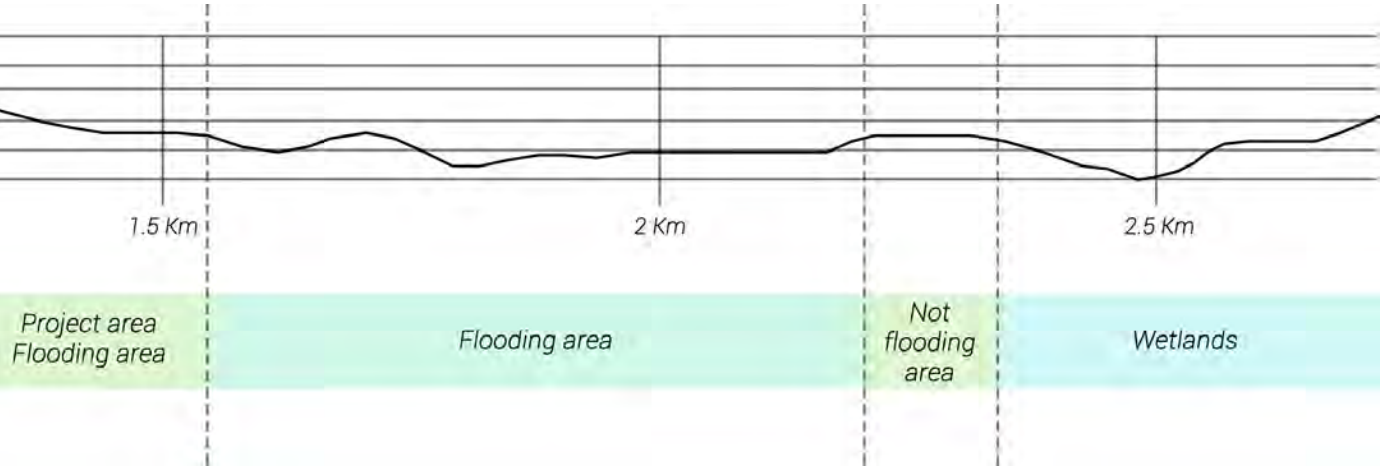
Despite of having a big market, as not everyone is willing to make the journey (since their transportation is mainly motorcycle or bycicle) there are a lot of mini markets or "tienda de barrio" all over the city, these little spaces have being created inside some of the houses to provide not only an easy food and supply access for the neighbours but to provide an income to the families.



TERRITORIAL SECTION

The city is located in the highest part alongside the river. Naturally, the urban areas suffer less from floods than the rest of the city. Since the project is located in a flood, area it is important to control its future growth and respect the natural cycles of the water.




1.5 Km
2 Km
2.5 Km
Project area
Flooding area
Flooding area
Not
flooding
area
Wetlands

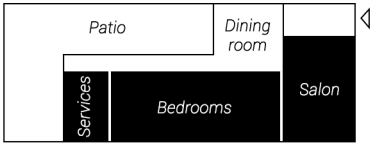
House typologies

COLONIAL HOUSE

In between

1 - one floor

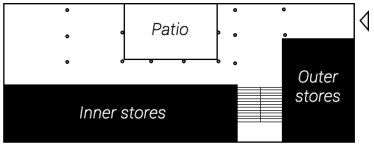
2 - one floor



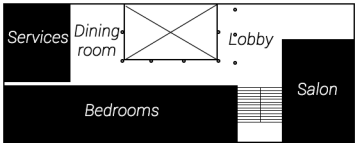
3 - one floor

4 - one floor

5 - first floor

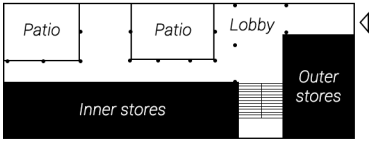


5 - second floor

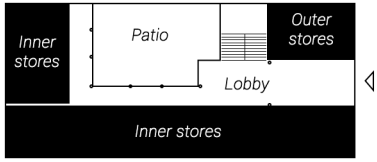


Corner

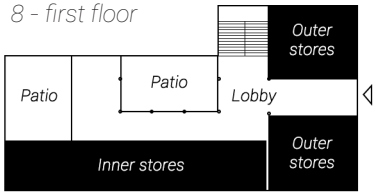
6 - first floor



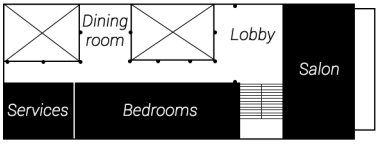
7 - first floor



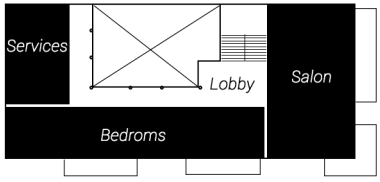
8 - first floor



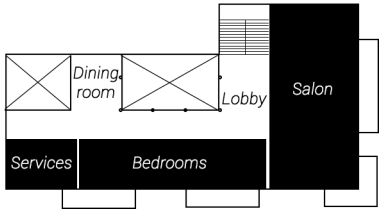
6 - second floor



7 - second floor

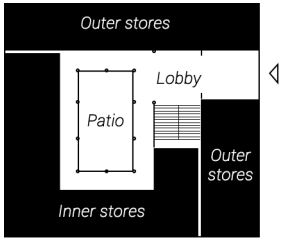


8 - second floor

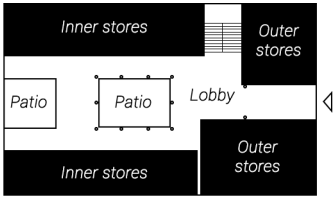


Complete

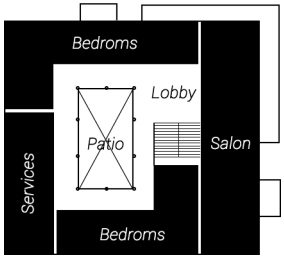
9 - first floor



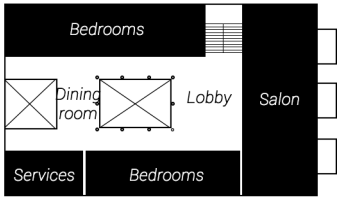
10 - first floor



9 - second floor

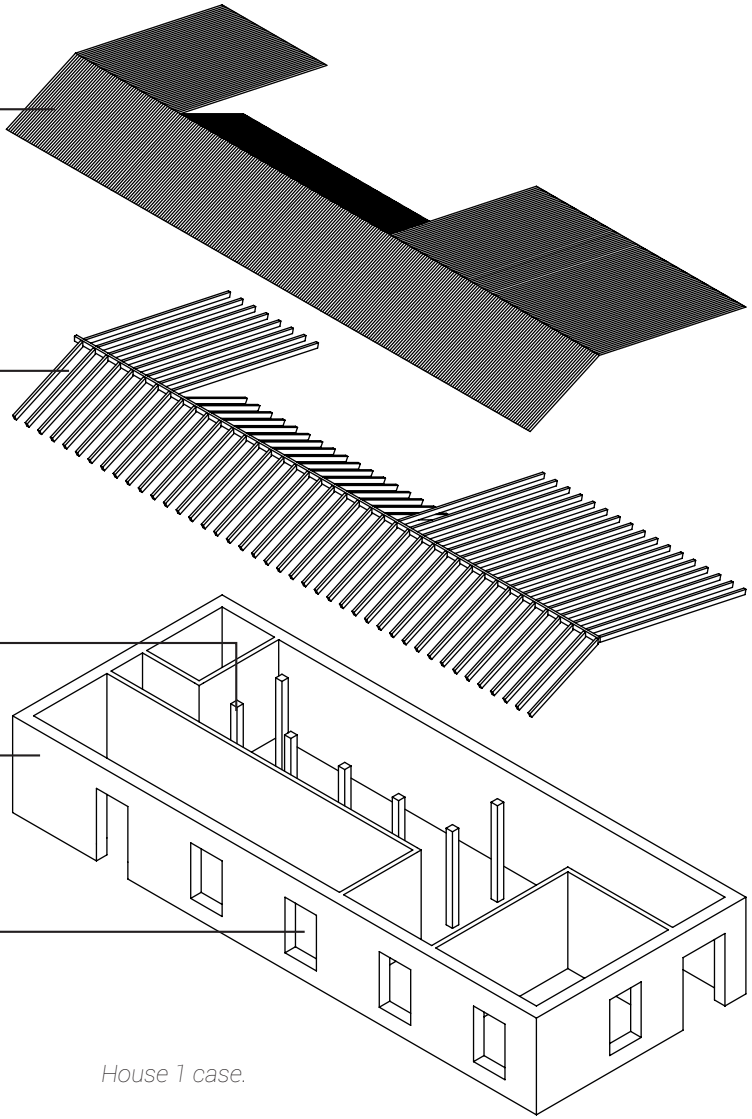


10 - second floor



1 to 10 source: (Angulo Guerra, 2008).
Images adapted by author.

In order to understand what can be done and what should not be done it is important to analyse the different house typologies in the city. This typologies are very different between them, evolving and changing thank to social, environmental and economic factors. The typologies analysed were: the colonial house, the 20th century house and self-helped constructed.


Roof: *Clay tiles*
Roof structure: *wood*
Columns:
Wooden structure to support the roof.
Walls:
Rammed earth / adobe reinforced with wood or concrete.
Average height: 4 m.
Average thickness: 50 cm.
Doors and windows:
Wood. Metalic grill (for security).

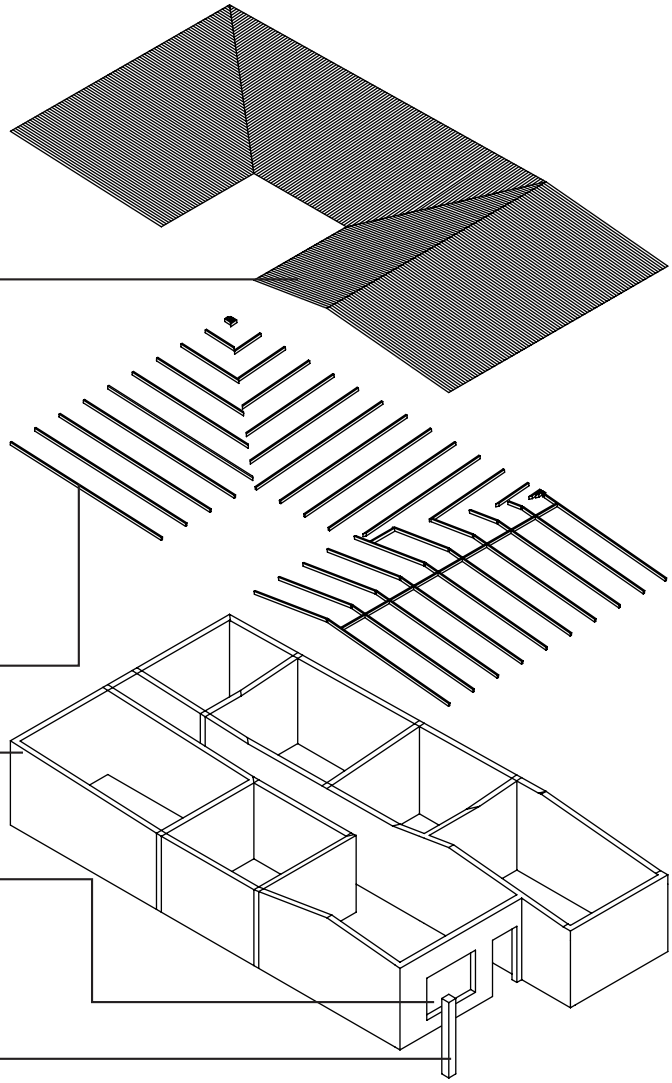
House 1 case.

The colonial architecture always closes itself from the exterior, developing the inhabitant's life into the interior, where the garden or "patio" is the protagonist. Leaving a little sidewalk and the street, no interaction with the neighbour in the public space.

20TH CENTURY HOUSE

It is quite hard to define a typology for these houses since the designs were made for different families and types of persons. Nevertheless, it is possible to stablish a generic typology of a house for a family. It is importatn to say that not all the cases are the same, most of the houses are in fact self-constructed, some better, some worse.

1 - generic typology



Roof:
Galvanized steel
Clay tiles
Adbestocement

Roof structure:
Wood

Walls: *structural masonry*
Average height: 2.7 m.

Doors and windows:
Wood. Metalic bars (for security).
Use of glass.

Columns:
Wooden or reinforced concrete structure to support the roof.

20th centuary house. Mompox, Colombia. Source: https://www.google.it/maps/@9.2379918,-74.4236386,3a,60y,119.6h,82.7t/data=!3m6!1e1!3m4!1s-fV-YNIRzauobv1zKpW9kA!2e0!7i13312!8i6656

SELF-HELP CONSTRUCTED HOUSE

This typology balances between the 20th century house and a very random design adapted to immediate needs. The houses can be constructed with materials from bricks, to wood, basically anything people can afford or find.

Photo 1: Self-constructed house. Mompox, Colombia.

Photo 3: Self-constructed house. Mompox, Colombia.

Photo 2: Self-constructed house. Mompox, Colombia.

Photo 4: Self-constructed house. Mompox, Colombia.

Sources:
Photo 1: https://www.google.it/maps/@9.2327938,-74.4296591,3a,75y,25.53h,83.68t/data=!3m6!1e1!3m4!1sYFsF0Go7b4uDH7Bp7Eilb-Q!2e0!7i13312!8i6656
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Photo 3: https://www.google.it/maps/@9.2331835,-74.429317,3a,75y,49.81h,85.15t/data=!3m6!1e1!3m4!1sTVxSEFWsHGez-sqYT-qAsXA!2e0!7i13312!8i6656
Photo 4: https://www.google.it/maps/@9.2339065,-74.4293147,3a,75y,333.52h,77.62t/data=!3m6!1e1!3m4!1sKyD9n5bLFwITmu6fWuiK-nA!2e0!7i13312!8i6656

Source: https://images.adsttc.com/media/images/581a/b41c/e58e/ce7a/4b00/02ee/large_jpg/JTP_EdBarsley-Ahomeforallseasons_lead_image.jpg?1478145044

Reference projects

Casa color caribe

Juan Mario Pradilla Duarte, Andrés Cabal Dominguez, Edgar Chamorro and Verónica Posada Thorsberg. Cartagenta, Colombia. 2017

"Our proposal is born from a reflexion about the today's city in Colombia, the encounter space of millions of people that abandon the countryside every day in pursuit of opportunities in the urban mean, a demography explosion that is determining the contemporary human being's lifestyle. Thereby each intervention in the city is a piece that defines its new nature, today conditioned by a housing deficit of the socioeconomic classes with the lowest income that the country is facing. This implies quicker interventions to solve quantity problems (approximately one million houses) as the "ciudad Bicentenario" case in Cartagena, however, leaving the housing in the market's hands the reflexions around the human's habitat forms pass to another plane (quality) and the house becomes into a commercial product (quantity) that meets the profitability margin for those who produce it.

Facing this panorama, we found an opportunity to re-think the Cartagena's development from the housing construction that understand the habitat as a resilient object that grows with those who inhabit it, adapts and transforms itself with the years. For it, we propose a progressive develop concept that born from the diversity of its inhabitants: a house that expresses truly the Caribbean colour.

As architects we deliver a package and design parameters, those who live the space will be able to fill this package, producing a contemporary city image that expresses cultural conditions with thousands possibilities, results and variables: "the package and its content"."

(Juan Mario Pradilla Duarte, Andrés Cabal Dominguez, Edgar Chamorro and Verónica Posada Thorsberg. 2017. Text originally in spanish. translated by author)

Source: https://images.adsttc.com/media/images/5988/e025/b22e/38da/c600/0160/large_jpg/09a_Alzado_Fugado_DEF.jpg?1502142475

Source: https://images.adsttc.com/media/images/5988/e283/b22e/3893/9200/0283/large_jpg/URBA-NO_Alzado_y_Corte_Long_1-250.jpg?1502143090

Source: https://images.adsttc.com/media/images/5988/e0c8/b22e/38da/c600/0163/large_jpg/04a_Propuesta_Diversidad.jpg?1502142646

The home for all seasons

JTP and The Environmental Design Studio (TEDS) United Kingdom. 2016

The 'Home for All Seasons' is designed to take extreme weather in its stride - a place to live in comfort throughout the year. Whether torrential rain causes flooding, blazing sun causes a heatwave or it's so cold that there's a big freeze, the 'Home for All Seasons' will keep you safe and sound.

This future-proof design provides protection, comfort and independence to residents through an approach of resilience, rather than resistance, to the very real issue of extreme weather conditions. It works inline with the principles of good place-making and rather than seeing 'resilience' as a compromise uses it as a feature to enhance the way in which residents live in and enjoy their homes. As a result those living in the 'Home for All Seasons' have peace of mind in the knowledge that their home can be quickly and easily adjusted to cope with the wide range of challenges the future holds.

The 10 Principles of the 'Home for All Seasons'

1. Habitable zones are positioned on the first floor level and above to ensure a future proof, high flood datum design. This strategy avoids reliance on temporary add on measures for flood protection.

2. The ground floor 'garden room' zone is a flood resilient, multi-use space that can be quickly adapted and cleaned post flood.

3. The elevated 'causeway' at first floor level provides safe access and egress during a flood event and reduces the demand on emergency services.

4. Water and power utilities are elevated to first floor level to enable continuity of services during a flood event.

5. The buildings' minimal hardstanding 'footprint' provides space for the integration of SuDs / swales and avoids displacing water to surrounding developments.

6. House design is suited to compact plot with reduced back-to-back distances. This means a density of 60 dwellings per hectare can be achieved.

7. The building form is designed to encourage passive stack ventilation effect with air drawn in through the high thermal mass ground floor zone

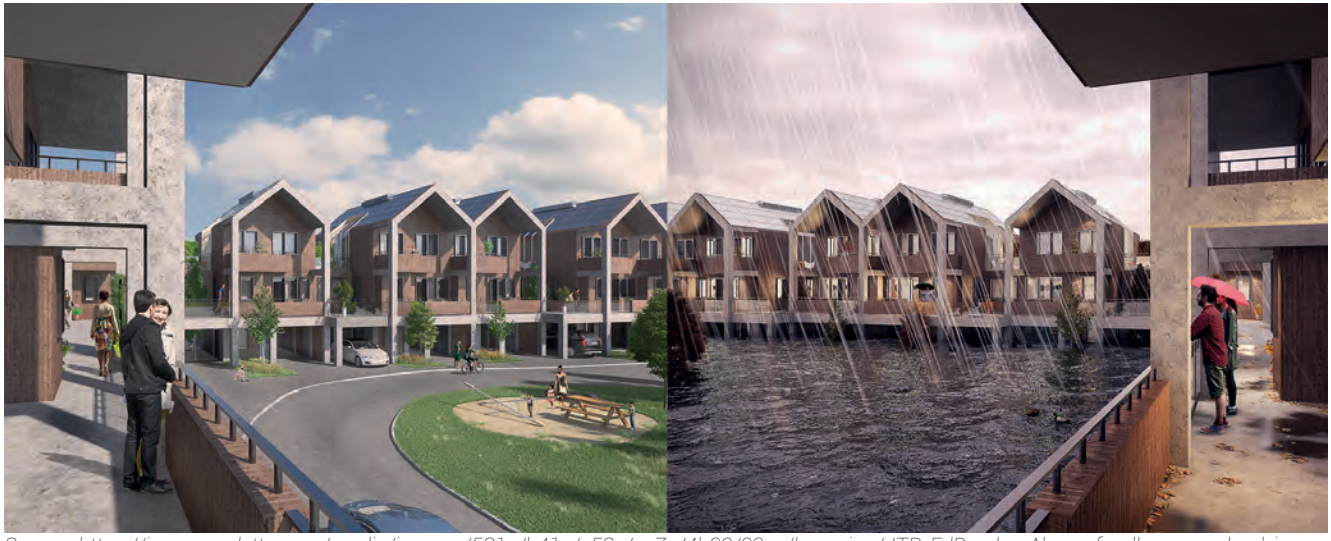
8. Thick and continuous super insulated envelope – ensures comfort in extreme cold.

9. Roof orientation designed to support on-site energy generation

10. The core house plan can be adapted to suit the changing needs of the homeowner and works for a range of different house types and layouts.

(JTP & The Environmental Design Studio (TEDS), 2016)

Source: https://images.adsttc.com/media/images/581a/b2b0/e58e/ce97/9100/01df/large_jpg/'JTP_EdBarsley-Ahomeforallseasons_003.jpg?1478144592



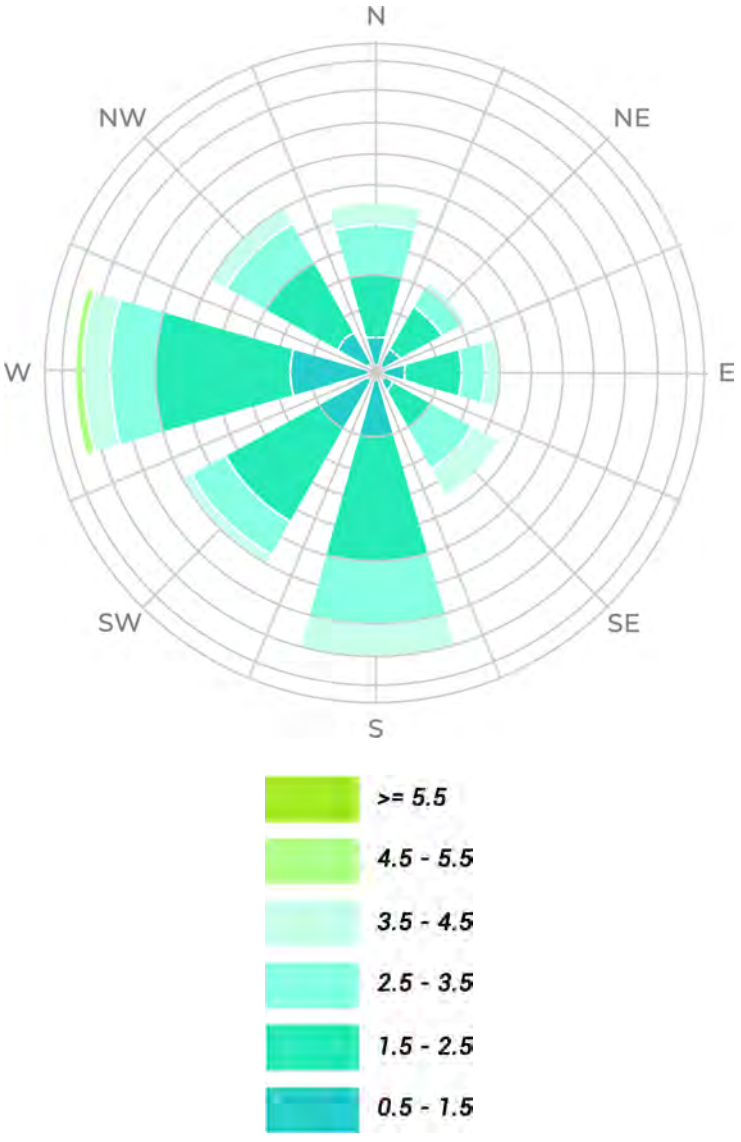
Source: https://images.adsttc.com/media/images/581a/b41c/e58e/ce7a/4b00/02ee/large_jpg/JTP_EdBarsley-Ahomeforallseasons_lead_image.jpg?1478145044

Source: https://medium.com/@elcarromato/la-ci%C3%A9naga-perdida-the-lost-swamp-f70aae46b384

Environmental analysis

Local Climate & Weather

AVERAGE ANNUAL WINDS IN MOMPOX
M/S



SYNOPSIS

Maximum temperature: 40.5 °C

Minimum temperature: 23 °C

Precipitations: It is very important because it has a direct relationship with human activities, animal breeding, agriculture and specially fishing.
Dry period: From last days of November to last days of March.
Rainy period: Mid april to October, when most of the raining occurs.

Annual avergage precipitation: 2.812,6 mm.

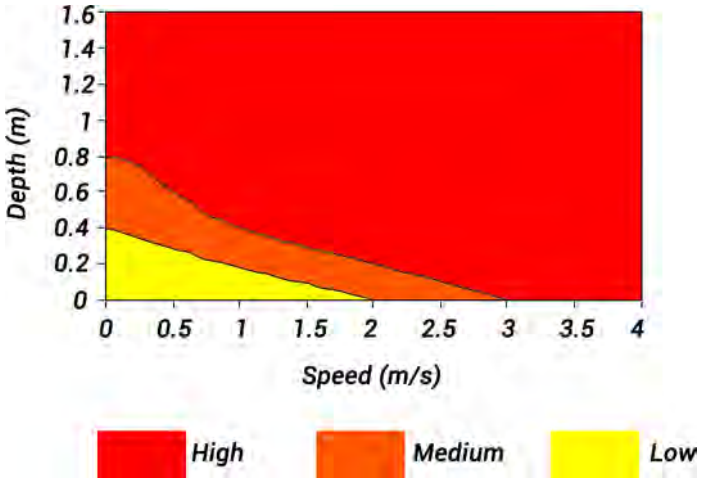
Average wind speed: 11.27 Km/h = 3.13 m/s

Average RH (Relative Humidity): 89.9 %

Climate: Warm semi-dry

FLOODING RISK IN MOMPOX TR 2.3 YEARS

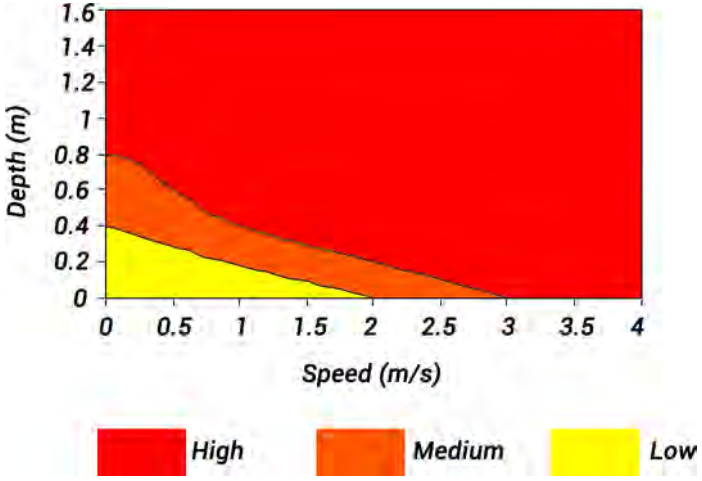
Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

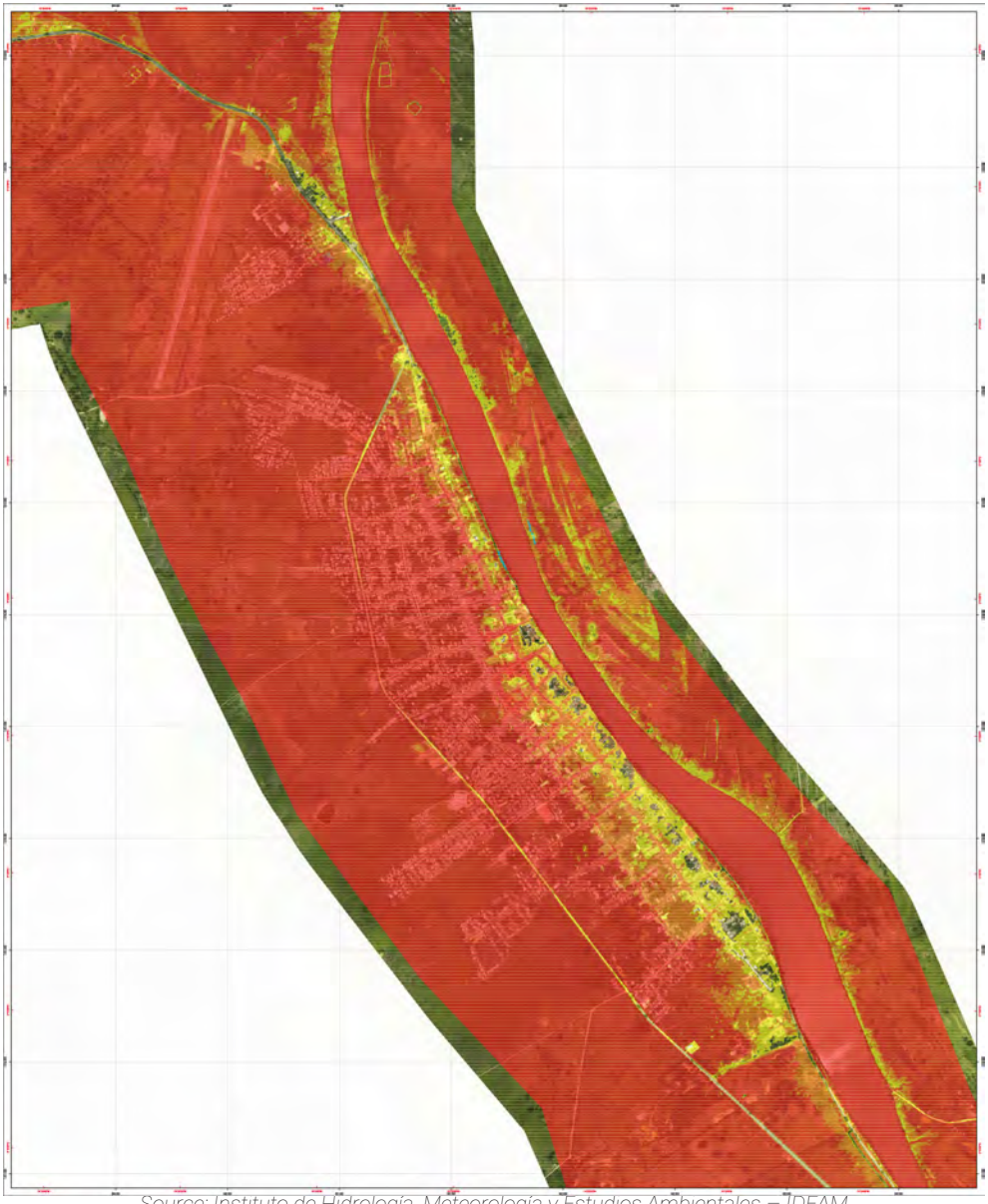


Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

FLOODING RISK IN MOMPOX TR. 100 YEARS

Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM





Source: Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM

Construction resources

In order to build the house with the lowest environmental impact, the purpose of this analysis is to find the nearest materials, to reduce every additional cost and energy use.

Earth

The earth is available everywhere, is a healthy material, has a very good thermal inertia, it is very simple to use, very low energy consumption and it is 100% reusable. However, not all the earth is adequate to constructions, it is important to know its composition and where to find good earth. The earth is a natural concrete and it is composed by gravel, sand, silt and clay. The proportions are very important for the correct use of earth construction methods such as rammed earth, adobe bricks, compressed earth bricks, cob (bahareque), etc.

Wood

The Bolivar region is also very rich in wood species, it is also important to know which species can be used as structure and which ones for other uses such as floors, windows, doors, tables, chairs, etc.

Structural woods

- Caimito
- Guacharaco
- Guayabo
- Níspero de monte
- Olla de mono
- Puercoespín

Non structural woods

- Bollo limpio
- Canalete
- Caracolí
- Colorado
- Corozo
- Guáimaro
- Palma amarga
- Palma vino
- Resbalamono

Water

The water (for construction) is obtained from the Magdalena river, and it could also be recovered in the wetlands (in rain season) and through water collection systems.

Construction materials

There is just one big shop in the city to get these construction materials, besides of this business there are little store for constructions materials but they are more expensive than the big shops. Bricks, concrete, steel, cables, lightbulbs, etc. It is possible to get anything related to construction in this place. But then again the costs increase because none of these materials are extracted or produced near the city, so the sum of the other costs add up to the price.

Diagnosis

There is a growing demand of housing in the region, not only in the city. The people need an affordable house that with work and solidarity the government is providing. But we cannot stay at this level, it is very important to say that the government is making a great effort to give a decent house to the poor people, but as I said before we can do better, we must do better. Seeing the unemployment rates, the lack of work opportunities it is time to turn and look for a more self-sustainable future, where people is able to build and fix their own houses, plant and their own food, live alongside the natural cycles, reconnect with nature and live for it.

The project made by the government is a big step forward, for a family is a huge jump to go from living in inhuman conditions to have a roof above their heads, it is a dream of thousands of Colombians that for many reasons (war, flooding, money, etc.) ended up with nothing. I am not trying to tear apart this project but as I discussed with colleagues, professors and people who does not know a lot about architecture they were impressed about these kind of projects, and not in a good way. Words like henhouse or even concentration camp came to the conversations, amazed of the magnitude of these projects. It is very hard to move an entire population away from their roots.

On the other hand, the people who can afford a house do not even considered of looking for an architect or an engineer, the call their trusted foreman. I had the opportunity to talk with María Álvarez, a local, about the construction of her house, and this is what she told me: "look when I built my house (also in the primero de mayo neighbourhood), I myself designed it, more or less how I wanted it, after that I looked for a friend of mine to build it, he began to do the walls as I raised money to pay to him for the job, sometimes I even went to the river to take sand to help building the house". The people had sometimes to leave the house because of the excessive heat inside; they call it "take fresh air" (vamo' a coje' fresco). They choose the new way (structural masonry and zinc roofing) because is faster, the maintenance is lower and everyone does it, but the heat is unbearable, the costs increase and sadly for society poor people are the ones that live in earth houses.

The matter that most people ignore is that the nature has its own cycles; this means that at some points there will be rainy and dry periods. It is very important to be aware of this because of the flooding periods that can be also related to climate change, meaning that the floods will be higher and longer. They have to be prepared to live with this phenomenon and adapt their life to them.

The need of a different way of seeing the housing and the relationship with the environment is real and is time for a new way of thinking, from the place, from the people. To live as one with nature. Of course is a process and it will not happen in a matter of days or even months, but is a beginning, is the beginning of the change.

The actual house design

Within the National Government's 100.000 free houses program, there were constructed 665 housing units in the city of Mompox called "villa Mompox". This project helped over 2.900 people from the city and its surroundings giving them a dignified house adapted to climate change.

There are different factors to take into consideration to understand the failures of the design. From the government's proposal of two housing typologies (one for the rural and one for the urban context) to the social and cultural relationship with the city. Since the proposal is a flexible and resilient urban-rural house as an alternative proposal, we will take into consideration the house's design to understand in clearer way what can be better, taking into account that both of the design are very similar.
As said before we cannot ignore the huge effort of the government of giving houses to the poor, but this project goes further, and tries to understand in a holistic way the mere fact of building a house.

Urbanism

The project Fondo Adaptación's project is located in the north part of the city, this location was selected because of its easy purchase procedure and because of it elevations, this particular plot is elevated and therefore is not going to flood. Since the aim was to construct houses adapted to climate change, it was the best location for the construction. The problem here is that in architecture is very important to analyse the factor, in a holistic way to produce something with more value than a simple house. Lack of important public spaces, stores, entertainment, and some other aspects make this project sink in the fast and not analysed solutions. In this way the already built project becomes the antithesis of the proposal made in this thesis.

Its relationship with the city is very distant; it has become a weak suburb of the city creating connectivity problems with the city centre where most of the life and activities happen (church, market, school, work, etc.). Aspects like sense of ownership, resilience and flexibility, connectivity (physical, social, cultural and environmental) were thrown away and let the inhabitant to realize about these problems with time all alone by their selves. In other words, it is not a part of the city.

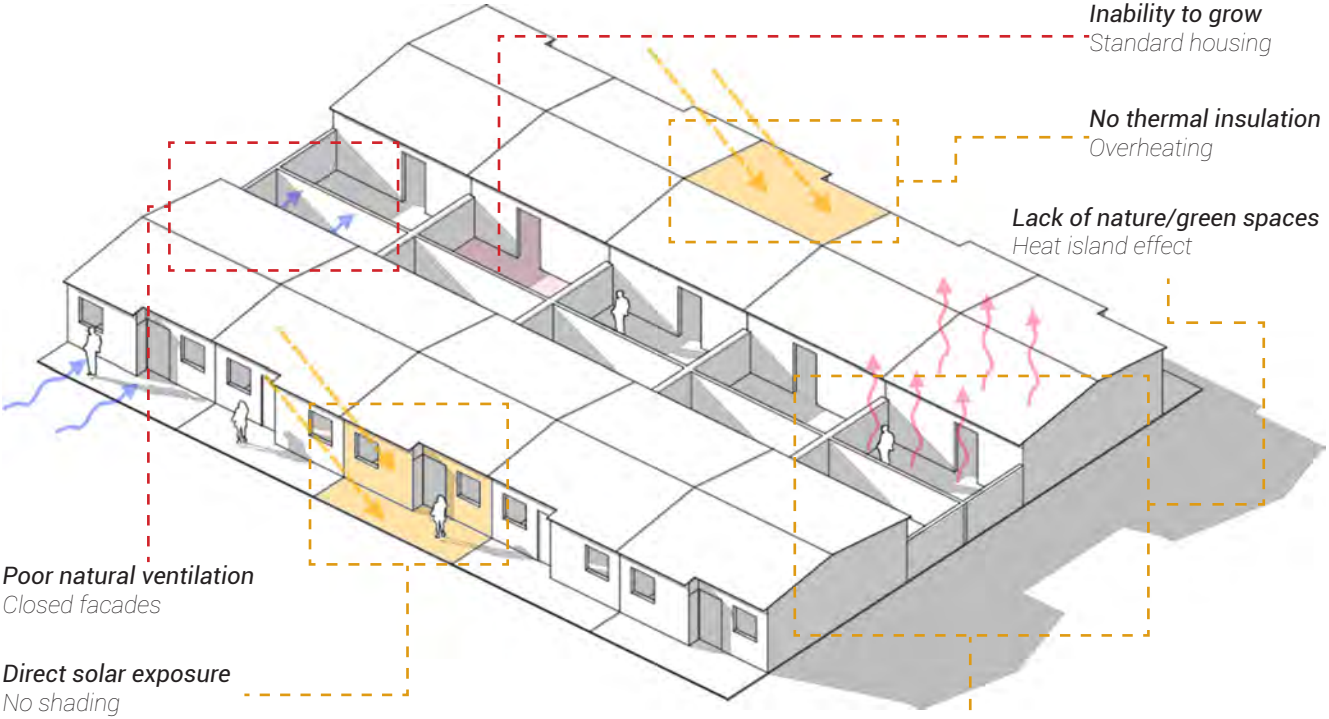
Source: www.flickr.com/photos/fondoadaptacion/39486115165/in/album-72157691920978721

Aereal view of the Villa mompóx, in the distance is possible to see the swamps. Source: sitio.fondoadaptacion.gov.co/index.php/prensa/comunicados-de-prensa/comunicados-prensa-2018/1102-comunicado-015-18

Aereal view of the Villa mompóx. Source: wwww.flickr.com/photos/fondoadaptacion/26511545408/in/album-72157691920978721/

City of Mompóx, Colombia. Source: Google Earth.

ARCHITECTURE

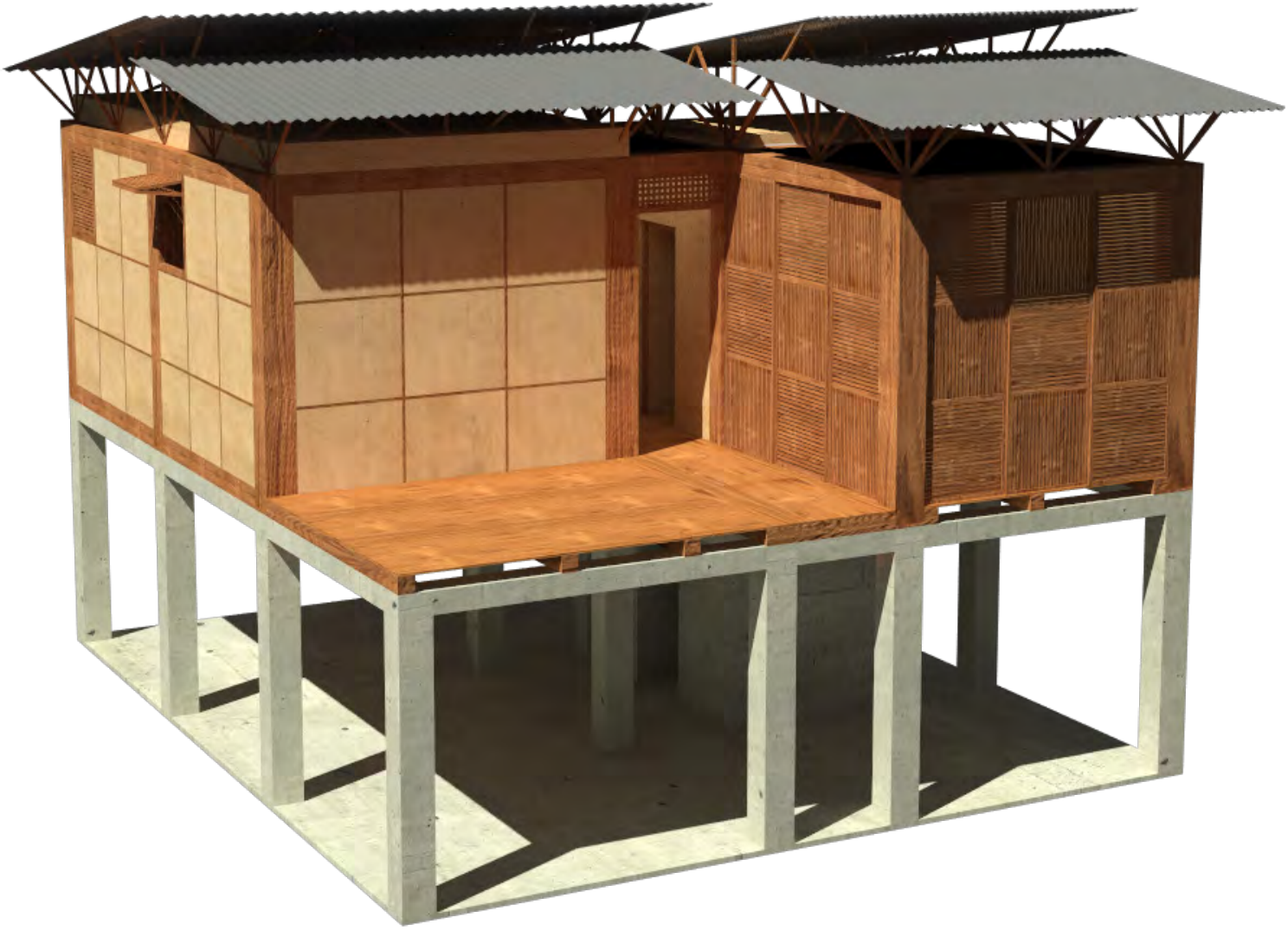


Lack of flexibility / Resilence
Inability to transform spaces

43 m² house program
- Two bedrooms
- Living-room / Dining-room
- Kitchen
- Toilet
- Backyard

CONSTRUCTION COSTS

1. Preliminary works	153.97	€
2. Foundations	1 839.75	€
3. Structure	331.41	€
4. Walls	697.24	€
5. Roof	1,286.43	€
6. Wooden carpentry	249.17	€
7. Metalic carpentry	379 €	
8. Finishes	1,861.94	€
9. Sewage water treatment system	223.07	€
10. On site training	157.14	
Total direct costs:	7,021.98	€



Proposed design

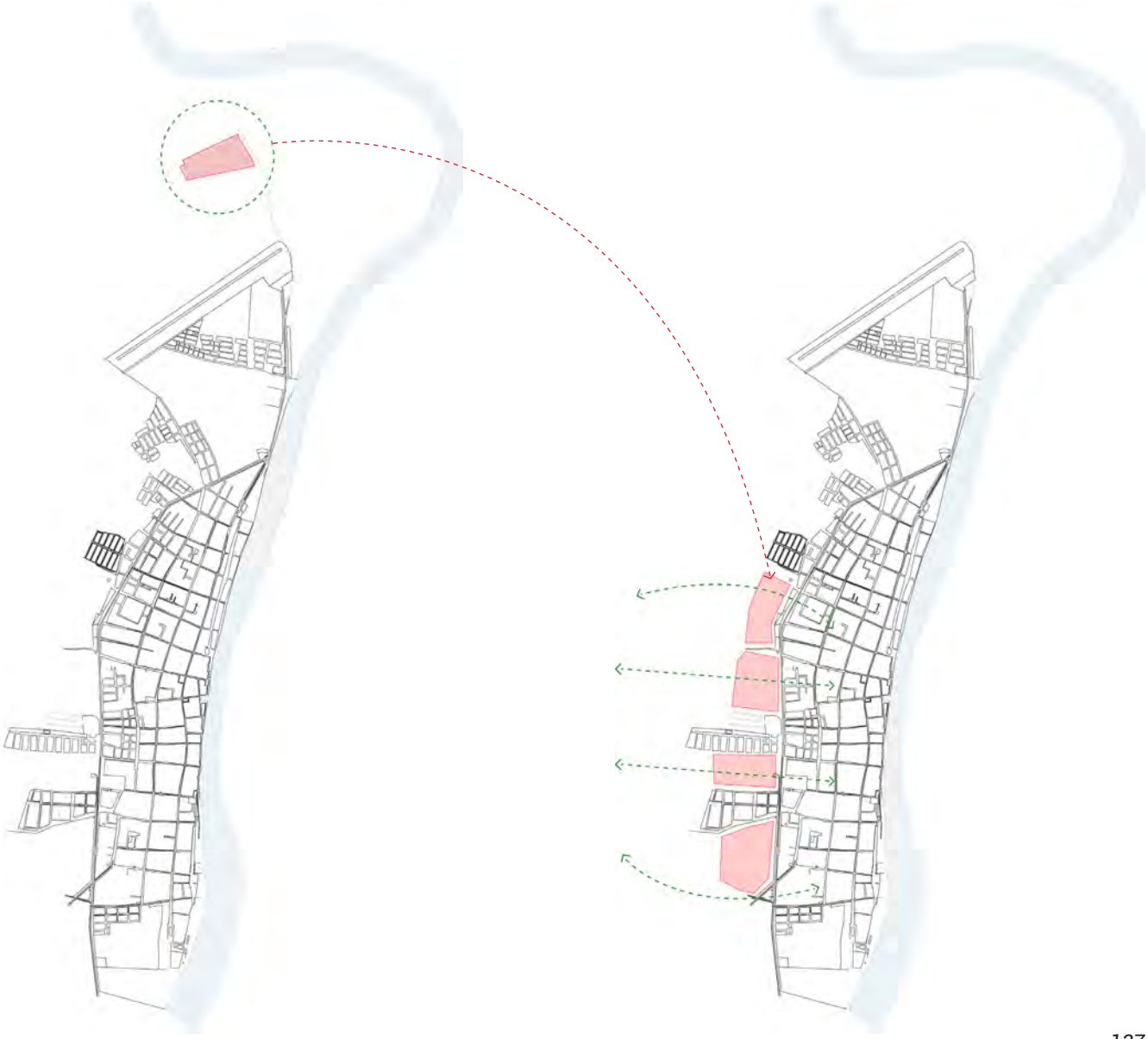
Re-re-location

To re-locate the people far away from the city is to steal their **identity**, it is important to mantain this bond with the city because it is their culture, their social relationships, their life develops arround the city. It is importatn to know that the re-location made by the government was decided because of the flooding, the chosed land was considerably higher than the rest of the possible locations. But then again this was the easiest and fastest desicion, not the better one.

Creating a self-sustainable neighbourhood will ensure a **sense of ownership**, where the people will take care of their own spaces, houses and develop a network of helping each other.

The **relationship with the city** is crucial, buecause is the expansion of the culture, the good practices and the history will prevail in the people. Also it is very important to the life quiality of the inhabitants, their homes will be near the city where they will be able to work or to get supplies for their local business.

The proposal expands the city, creating a permeable barrier in which the **city becomes countryside**, and the contryside becomes city.



Neighbourhood growth proposal

The plot was chosen because of its potential location. Due to its proximity to the market, the city centre and the city's growing arms (self-help constructions settlements), the project will allow the city to grow in a controlled and planned way, taking the old settlements and making them part of the new proposal.

1st phase

2nd phase

3rd phase

The urban project is divided in three phases:

The first one will improve also the local market to strength the local economy. This phase will be carried out with professional help, giving knowledge to people and providing education so in the future the community will be able to build their own hoses.

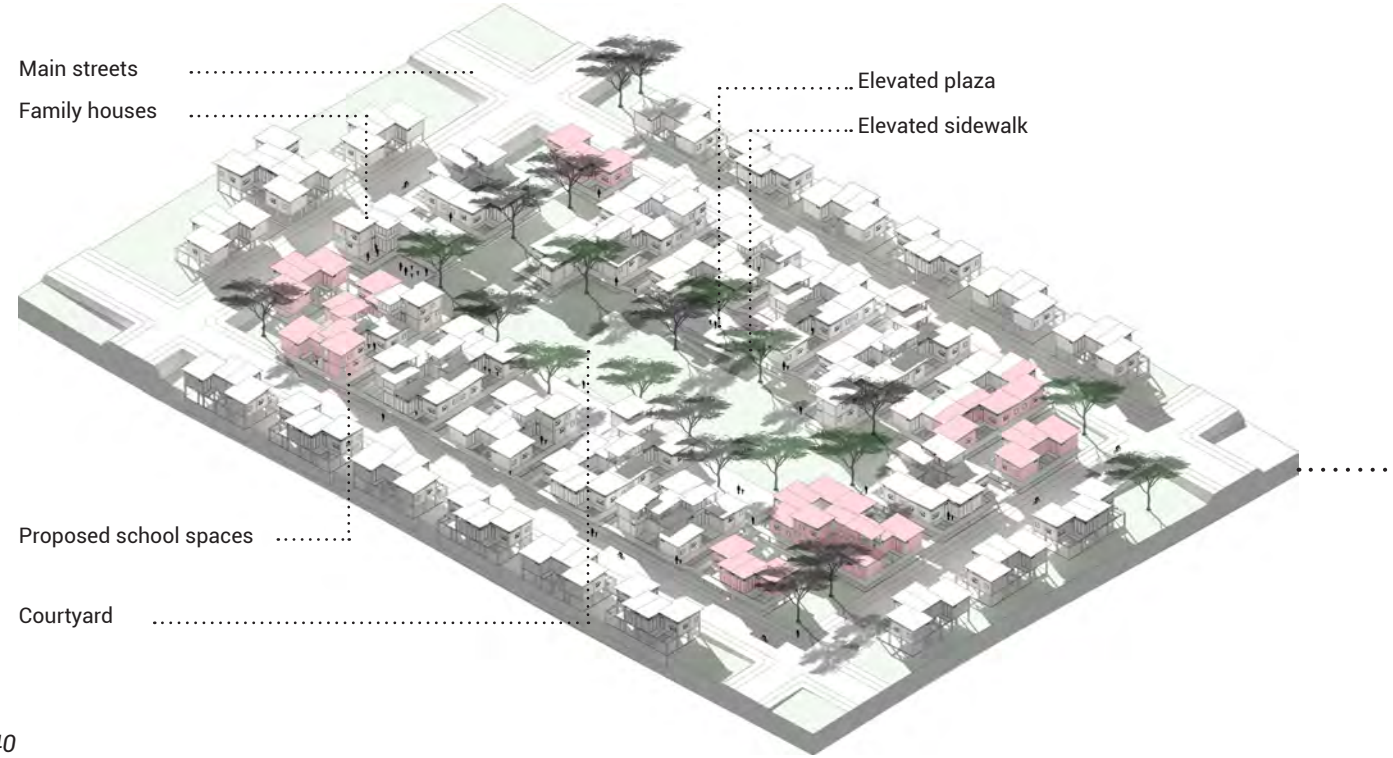
The second and third phases are the growing neighbourhood that with time will be completed by the community. Inside these phases were place the craft and technical schools, so the community can learn how to develop in a self-sustainable way.

In this way, the construction itself can become a way to develop new professional skills through a support approach giving technical assistance (design, construction, management, maintenance, etc.) by skilled professionals in architecture, engineering, always inside the resilience and self-helped construction.

Block identity

The blocks are able to develop their own identity like agriculture, fishing, breeding and construction. The central shared courtyard allows people to develop their productive activities, to share or to spend free time with neighbour. With this collective production chain, the inhabitant are able to sell their fresh products in the local market. The craft and technical school proposed, will allow people to learn and be able to use their knowledge for their own and do not depend on others for their economic, environmental and social stability.

For the streets the term shared space will be applied, in which the pedestrian the cyclist and the car will share the space. The hierarchy will depend on the transit ours, allowing everyone to move peacefully. However the main hierarchy will always be from most important to less important: pedestrian, bicycle and finally car. Anyhow, there will be a shred parking space in an elevated zone near the market



for the rainy seasons.
The proposed program will contain important aspects such as:

- Multifunctionality/hybrid: Housing, work, facilities, agriculture, fishing, construction, etc.

- Resilience: Adaptability to the natural weather cycles. Resilience againt water and floods.

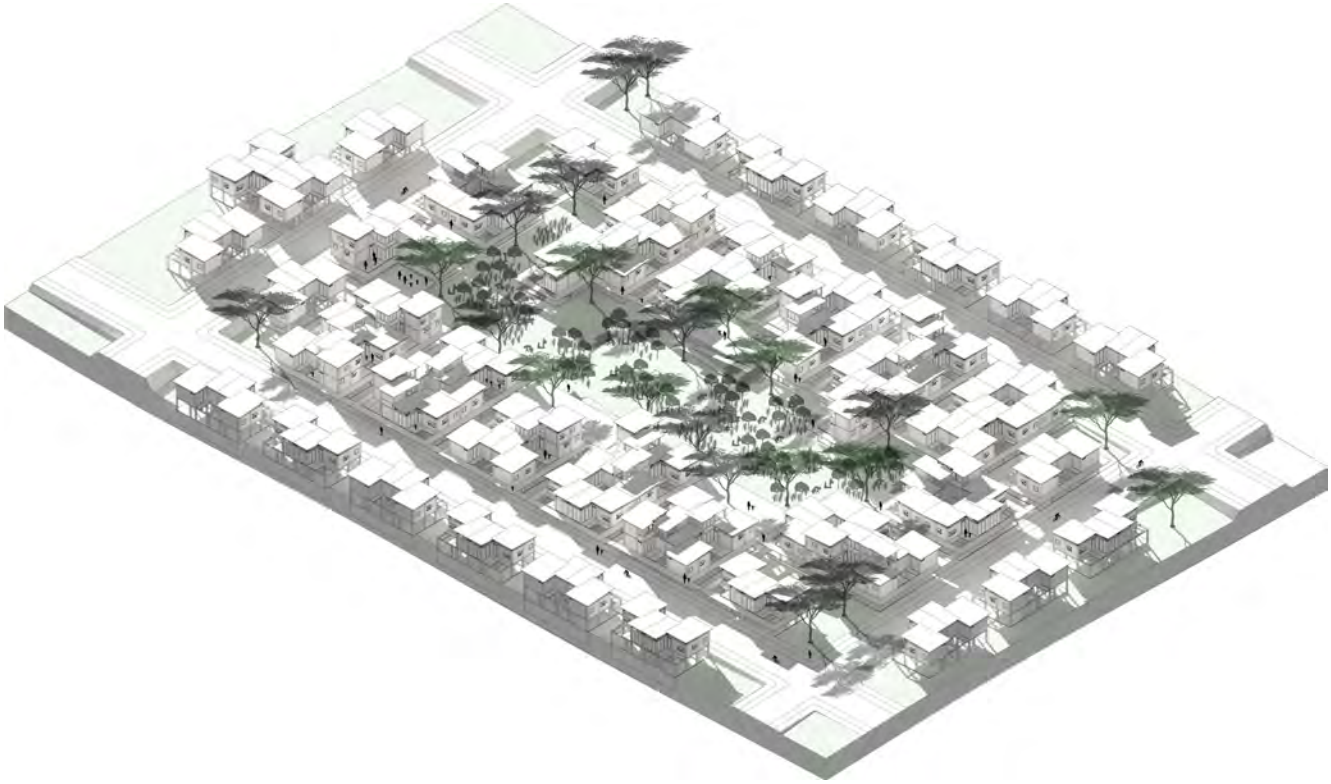
- Sustainable architecture: Low-cost materials, minimum environmental impact, positive cultura and social impact.

Block appropriation models

AGRICULTURE

For the agriculture it is proposed a permaculture approach, in which the people is more connected to the ground, leaving aside the machines, the oil dependency and the chemicals. Farming an edible forest, where the plants, animal, bacteria, etc., create an ecosystem in which every being contributes for its welfare.

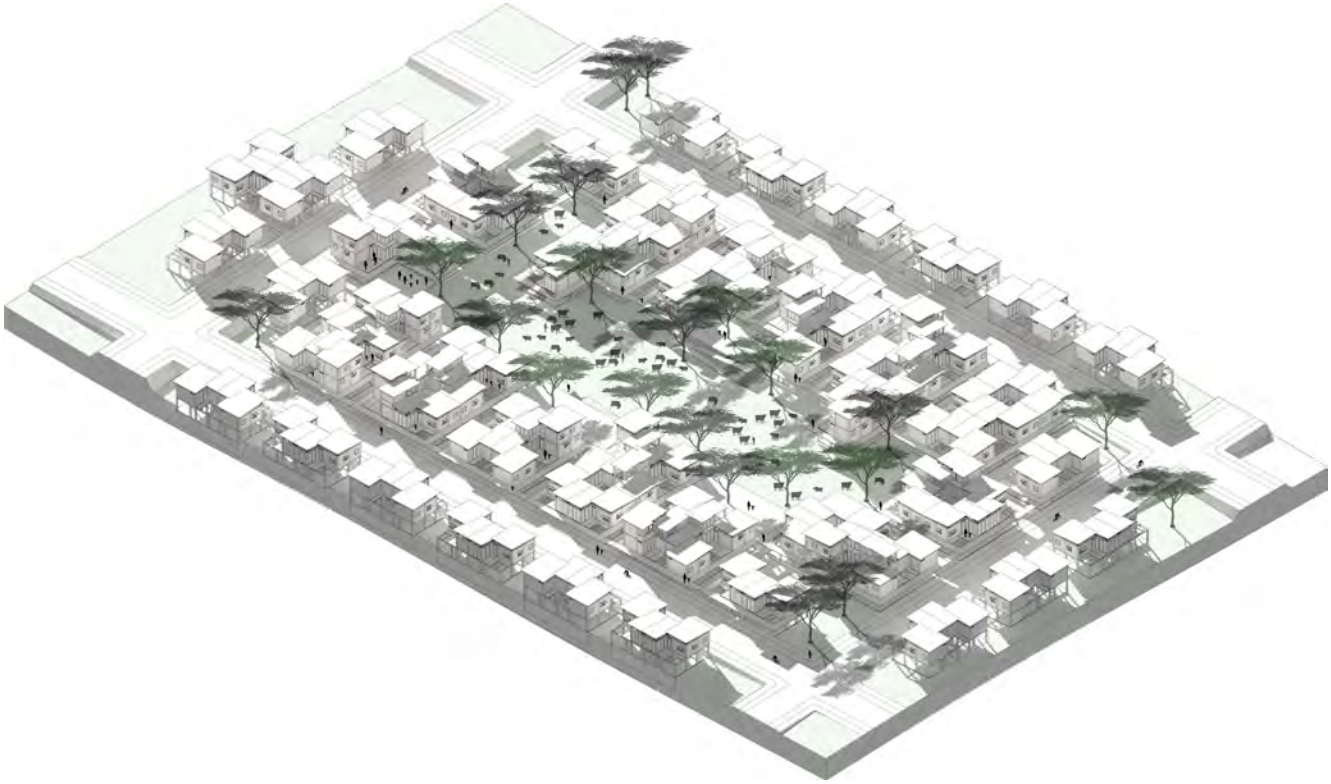
The products will be consumed by the community, and the surplus will be sold at the local market, fresh and organic. This activity will take place in the dry seasons.



ANIMAL BREEDING

The animal breeding is also related to agriculture to fertilize the earth with manure. The animal will be breed to provide food, in a sustainable and human way.

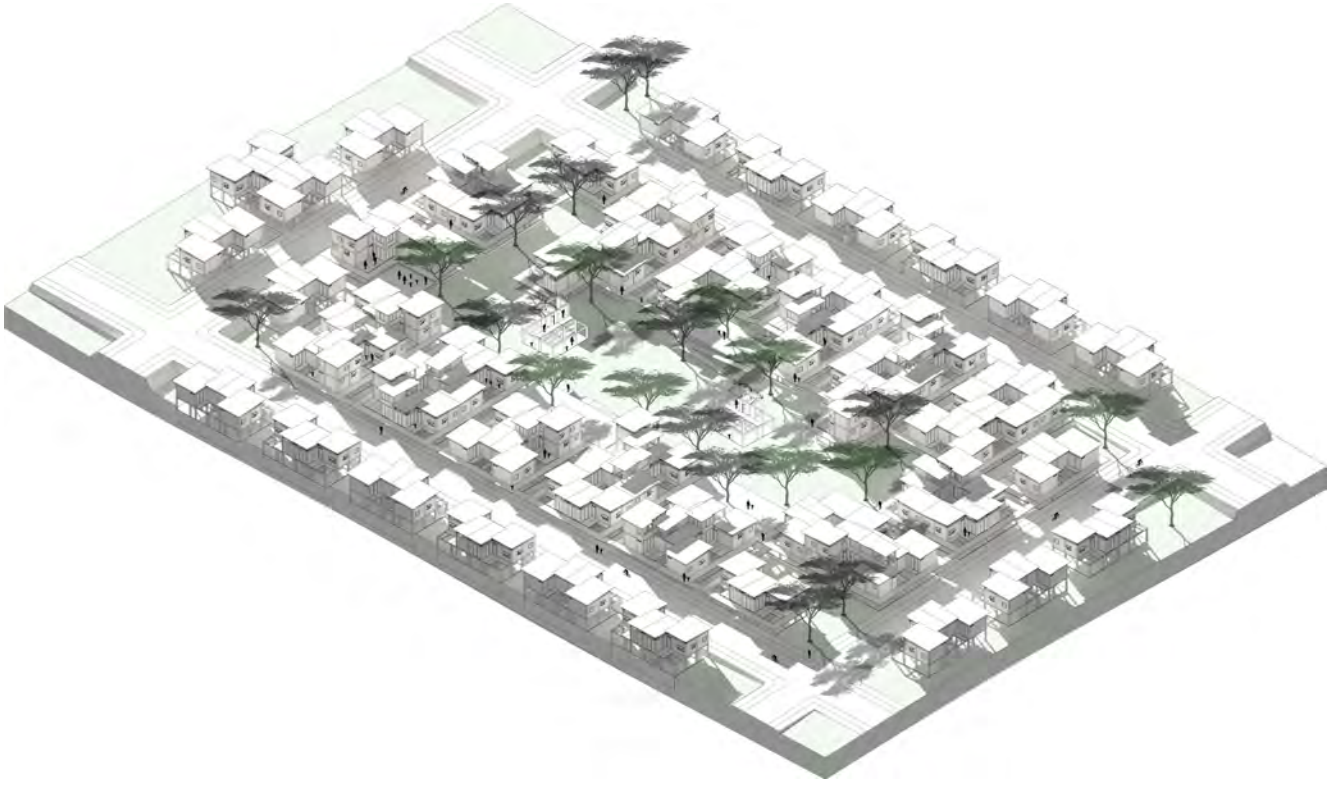
Breeding theme in open spaces, where every species can interact and have a normal life until they are needed to feed the population when it is necessary. This activity will take place in the dry seasons.



CONSTRUCTION

The construction space will be destined for the community, to repair broken pieces, make maintenance. In addition, it will be a space to study and practice new, better and more sustainable construction techniques.

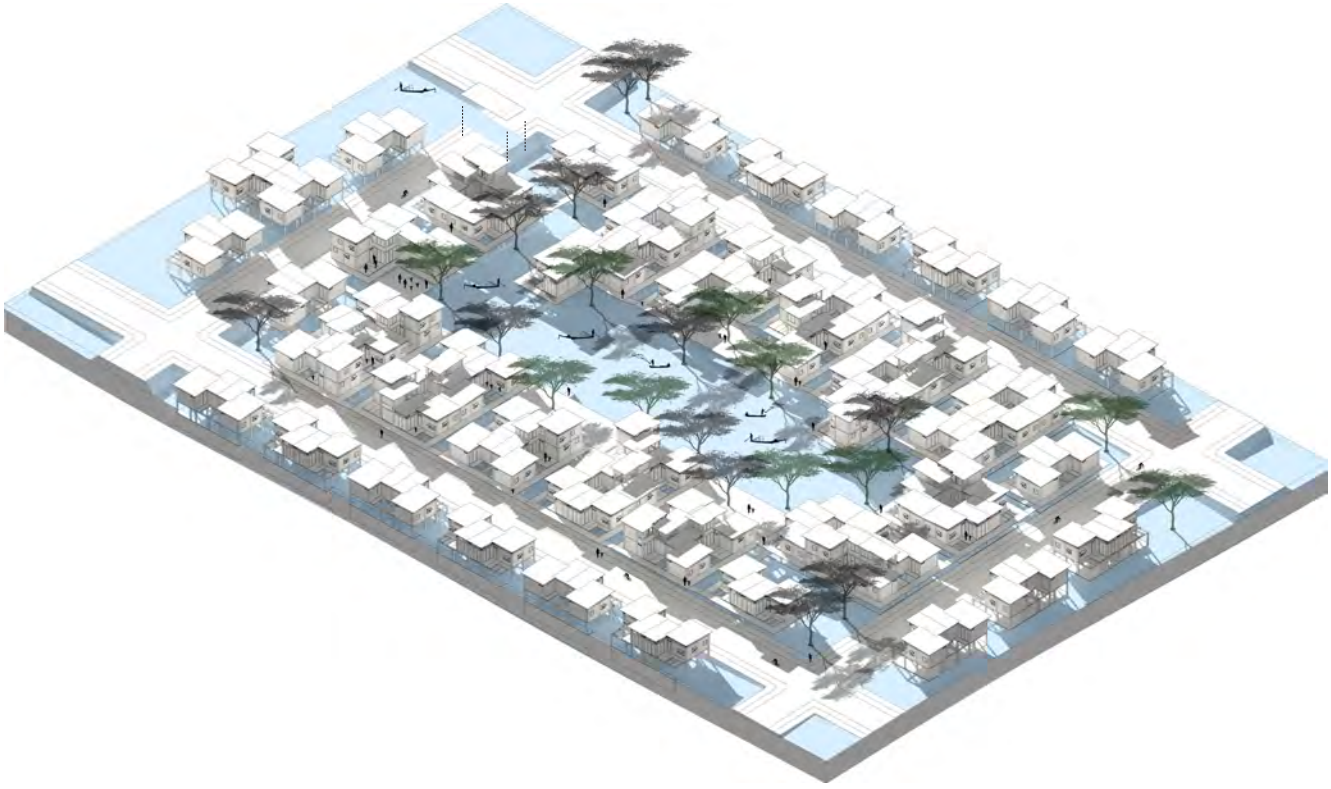
Alongside the schools, it will be a space teach, to learn and to share practical knowledge. These spaces will be used during the dry seasons.



FISHING

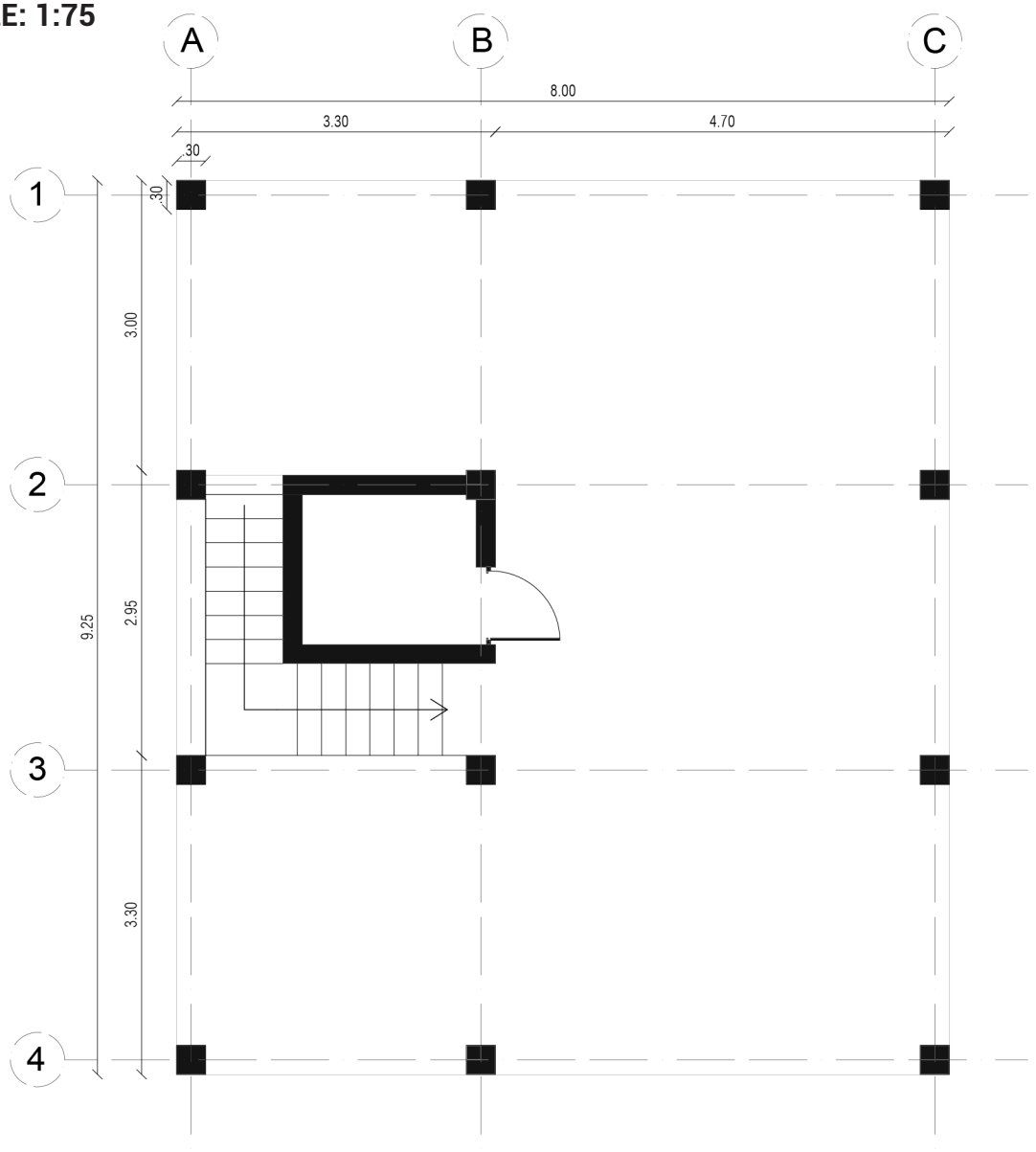
This is the main activity during the flooding seasons. The community´s economy will depend on this activity during these periods. It is also a space to learn, practice, and to keep the fishes fresh and together.

As the agricultural products, the fishes will be consumed by the community in a sustainable way, and the surplus will be sold at the local market as fresh as possible.

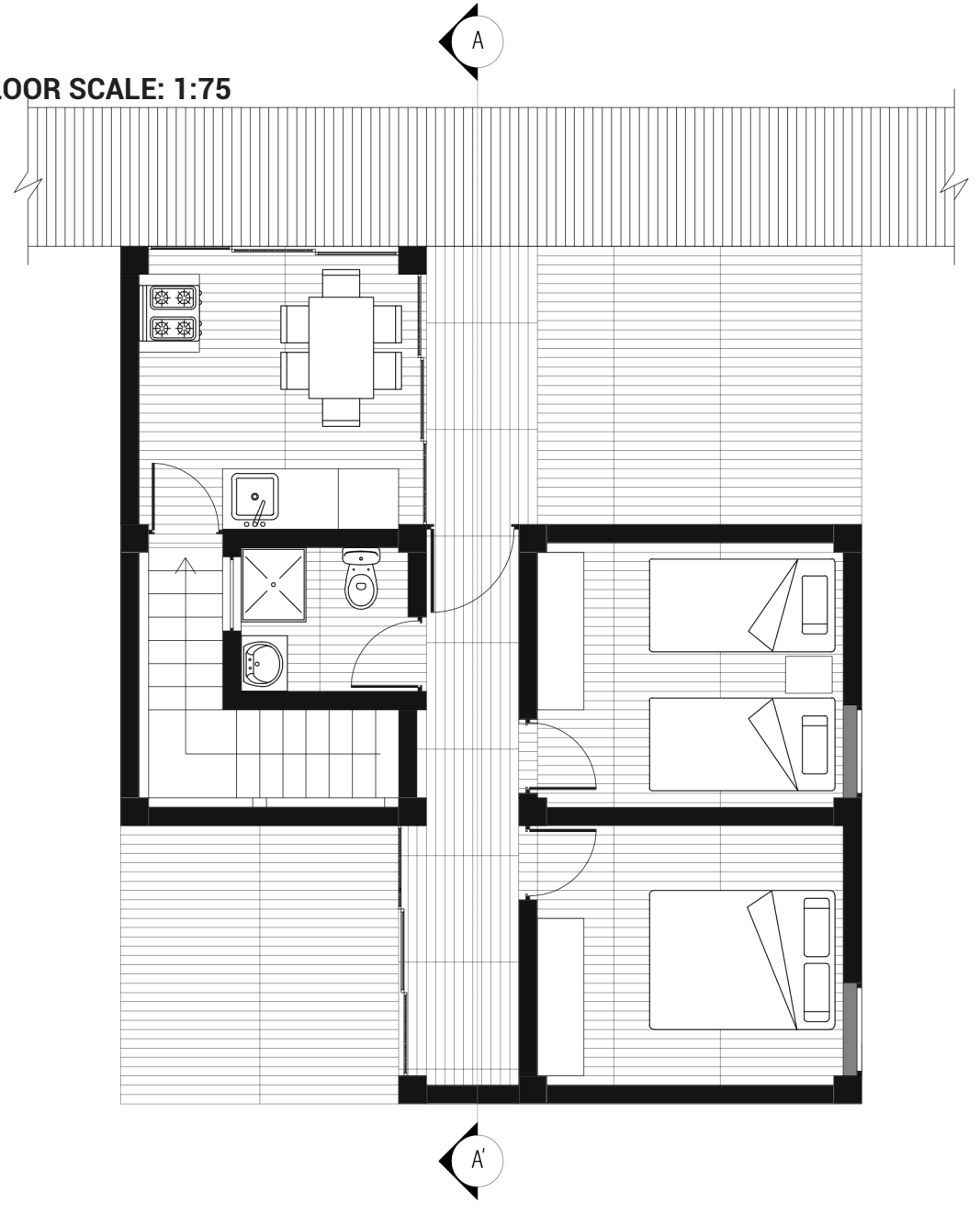


House design

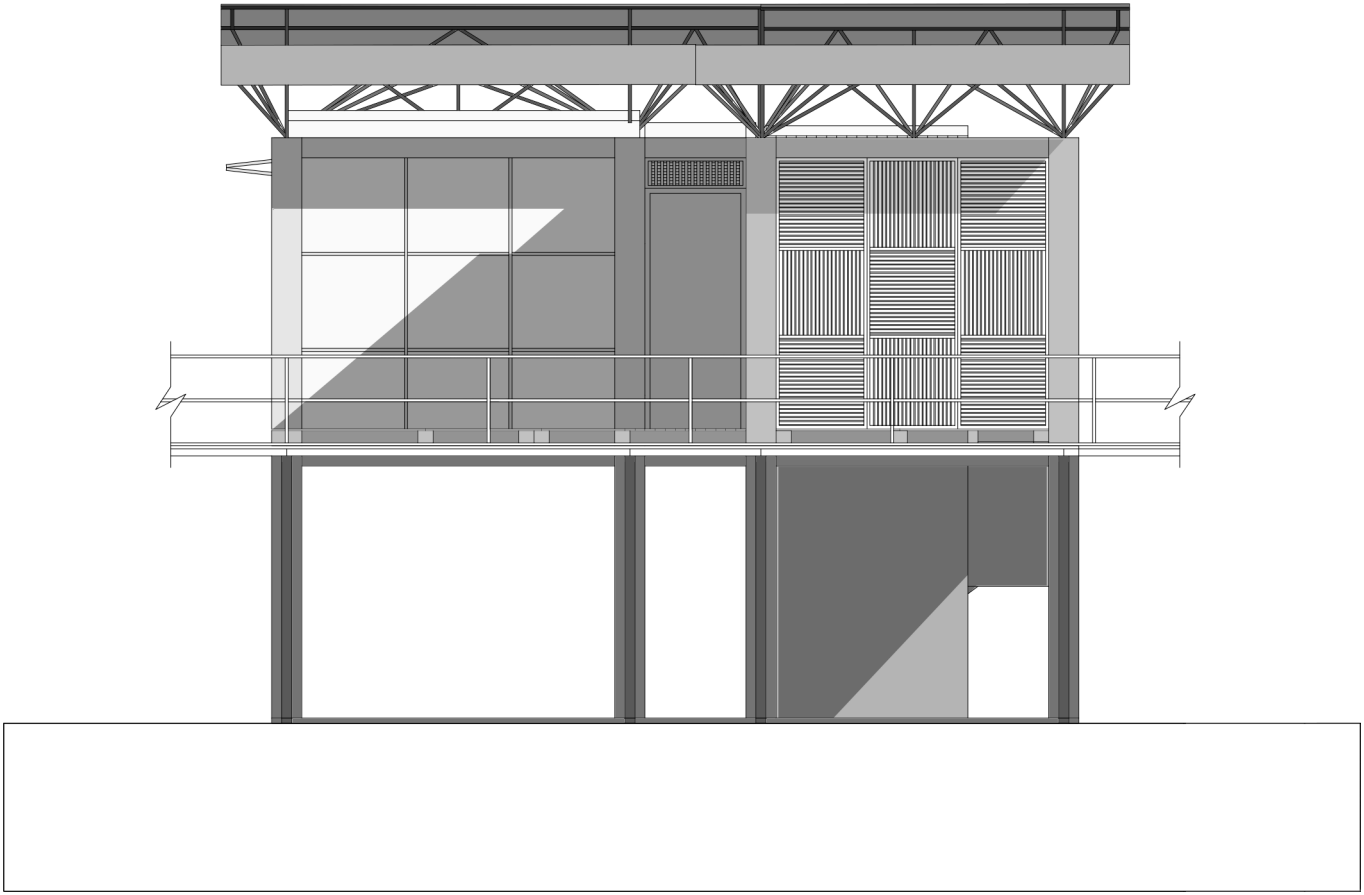
BASEMENT SCALE: 1:75



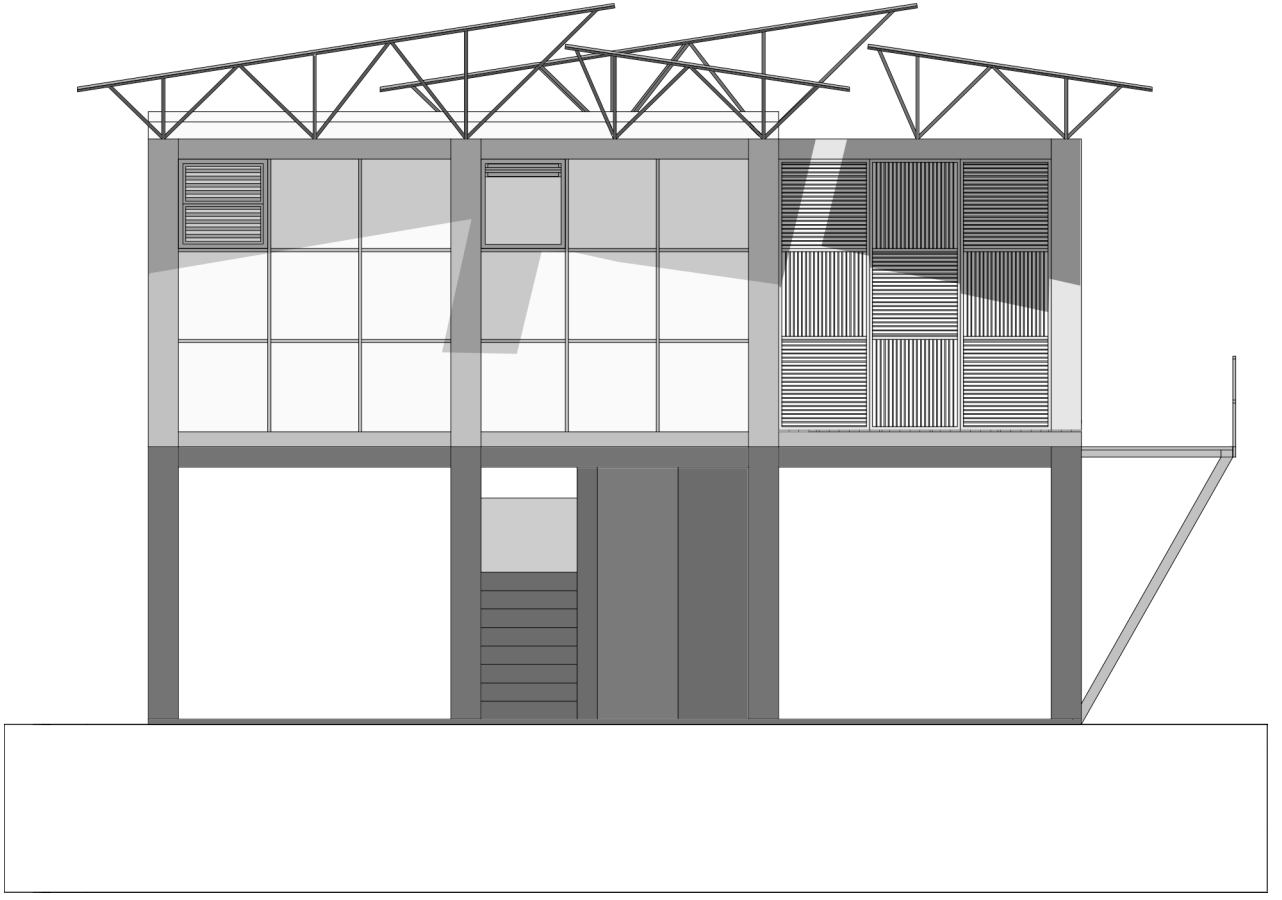
FIRST FLOOR SCALE: 1:75



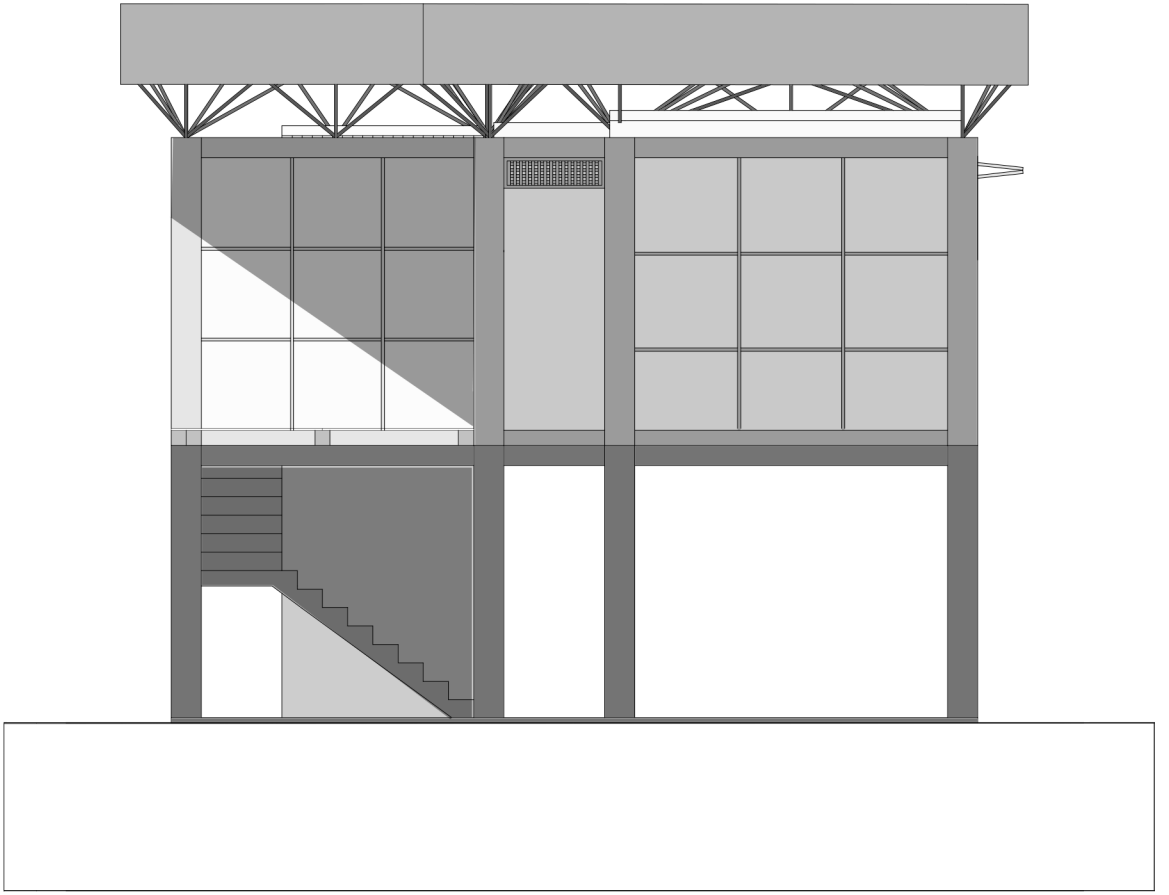
FRONT FACADE SCALE: 1:75



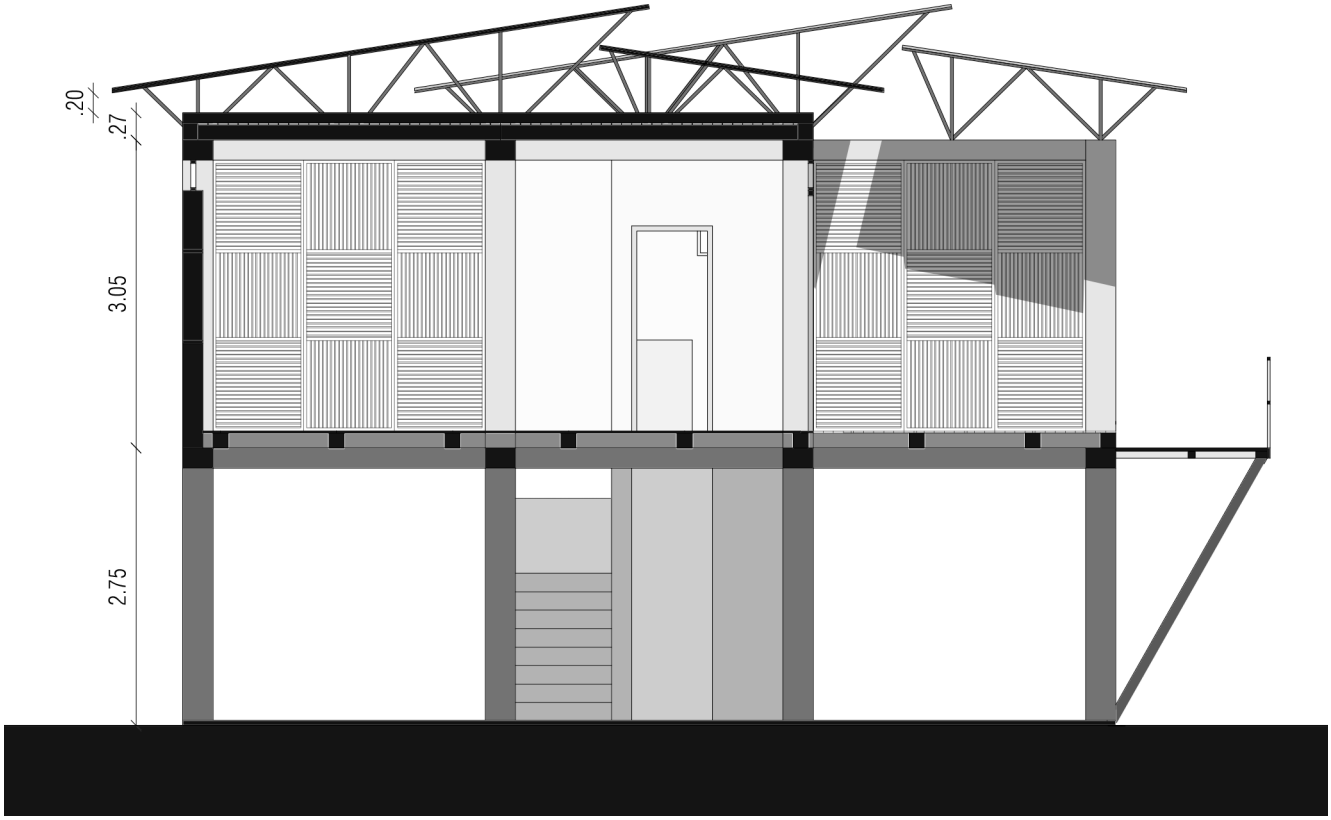
LEFT FACADE SCALE: 1:75

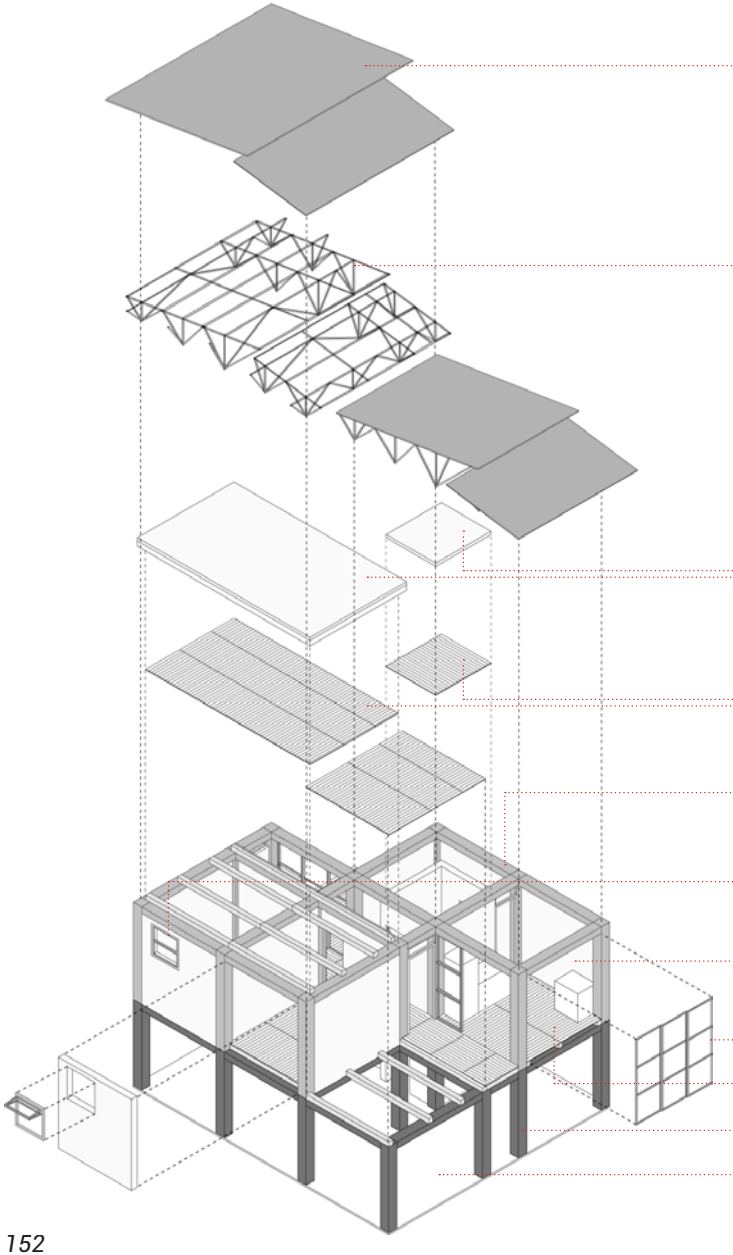


BACK FACADE SCALE: 1:75



SECTION A - A SCALE: 1:75

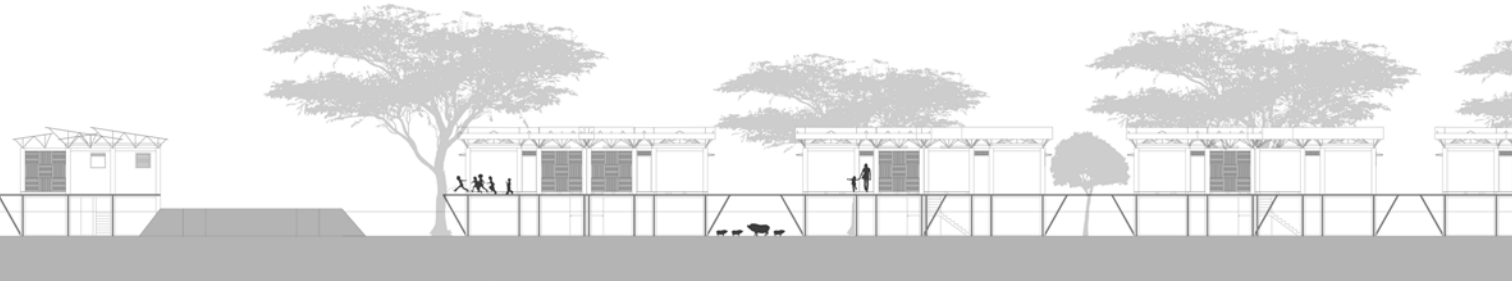


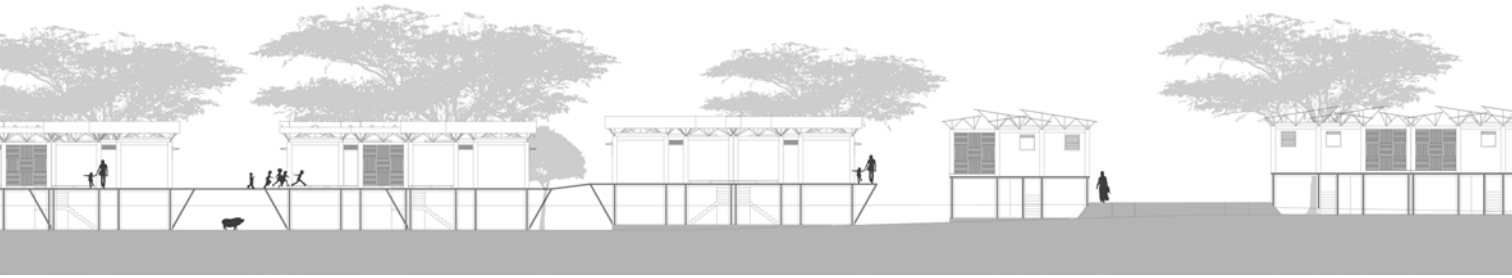

Roof: reused galvanized steel
Roof structure: galvanized steel
Roof insulation: earth + straw
Roof insulation: wood
Structure: wood
Windows: wood
Walls: adobe / Compressed Earth Blocks 20 - 40 cm thickness
Movable wall: wood
Floor: wood
Structure: reinforced waterproof concrete
Groundfloor: reinforced waterproof concrete

Construction costs

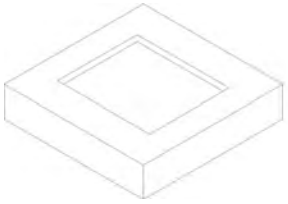
1. Preliminary works	616.91	€
2, Foundations	2.322.45	€
3. Structure	1.811.99	€
4. Walls		
5. Roof	826.86	€
6. Wooden carpentry	204.21	€
7. Finishes	43.65	€
8. Sewage water treatment system	223.07	€
9. On site training	157.14	€
Total direct costs:	6,049.14	€

BLOCK SECTION SCALE: 1:500

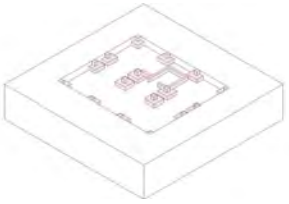




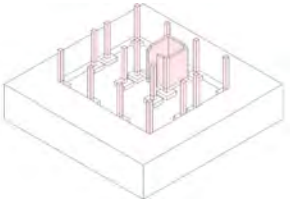
Constructive process



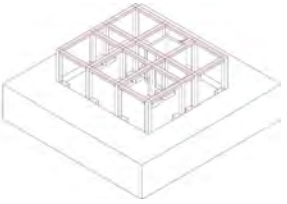
1. Terrain excavation



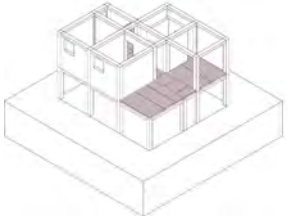
2. Foundations.
Reinforced concrete



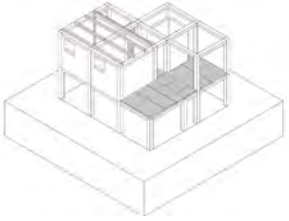
3. Colums.
Reinforced concrete



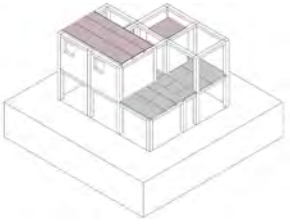
4. Beams.
Reinforced concrete



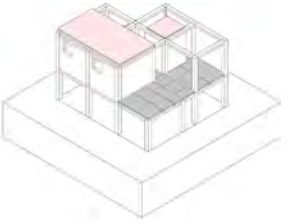
9. Floor.
Wood



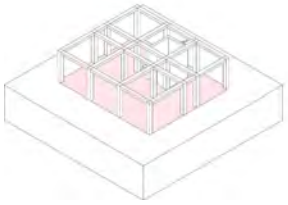
10. Roof beams.
Structural wood



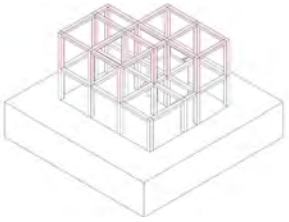
11. Roof.
Wood



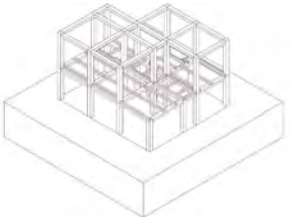
12. Roof.
Adobe / C.E.B



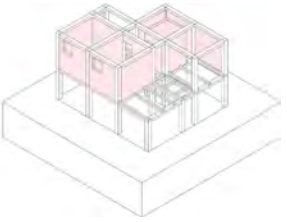
5. Groundfloor.
Reinforced permeable concrete



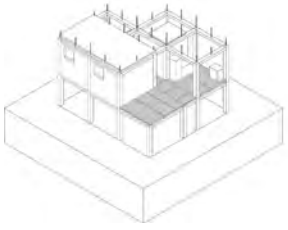
6. Columns.
Structural wood



7. Beams.
Structural wood

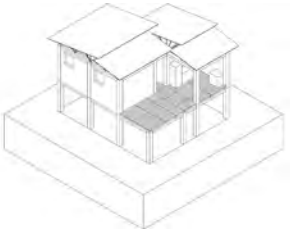


8. Walls.
Adobe / Compressed Earth Block (C.E.B)

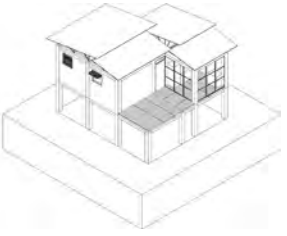


13. Roof structure.
Galvanized steel

14. Roof.
Reused galvanized steel



15. Roof structure.
Structural wood



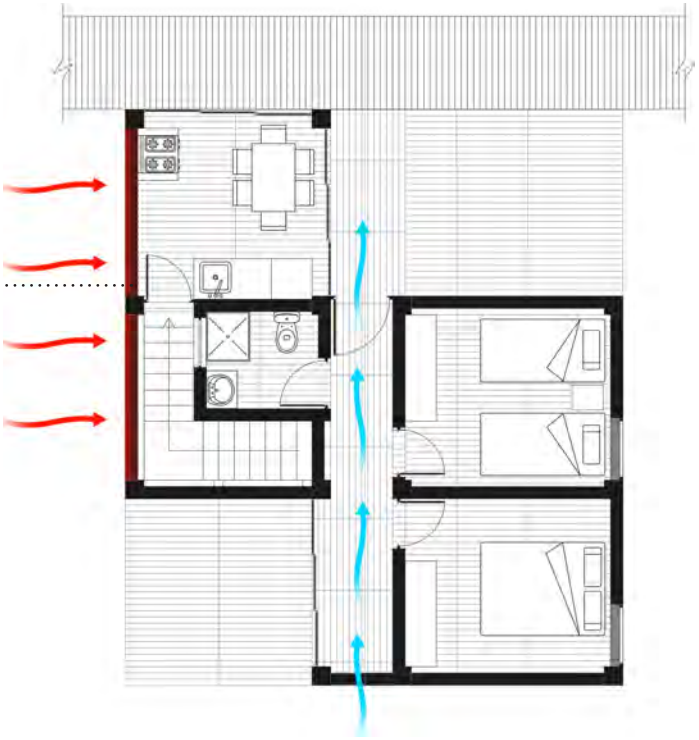
16. Movable walls / windows / doors.
Wood

Bioclimatics: Passive techniques

Considerations

Located in a warm semi-dry climate, it is very important to take into consideration the mass and the ventilation in the building. The mass, given by the earth walls (adobe or compressed earth bricks or C.E.B), allows the house to absorb the heat from the outside and capture it to maintain the inside temperature constant during the day to eventually release it by the night. In this process is very important to block as much as possible the direct sunlight from the walls, by doing this with overhangs, the wall is able to capture heat for more time, allowing the house to be cooler longer. The material selection can improve or not the thermal isolation:
adobe: λ= 0,45-0,8 W/mK
C.E.B: λ=1.13 W/mK

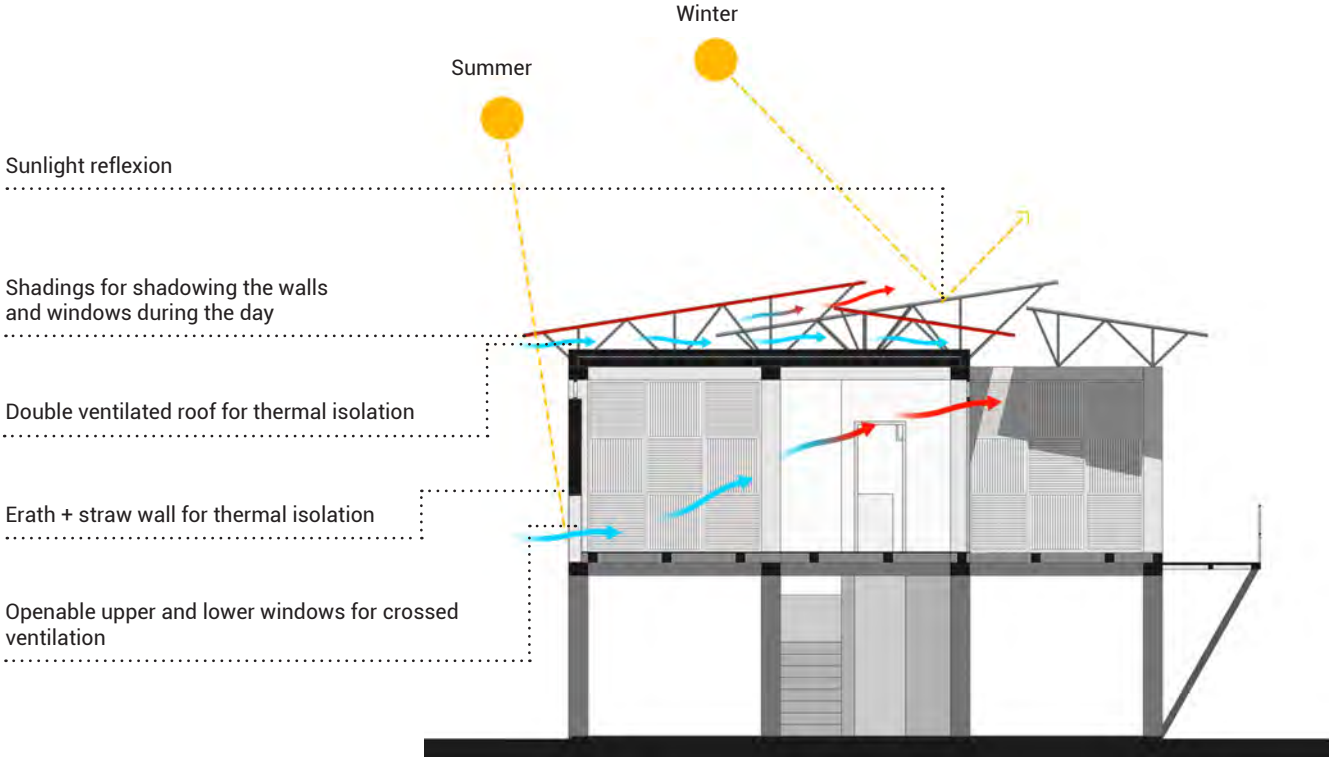
For the ventilation is very important to have a crossed ventilation from south to north and from west to east, where the prevalent winds come from. It is



Thick earth + straw walls for thermal isolation, this allows the house to have a constant and lower internal air temperature

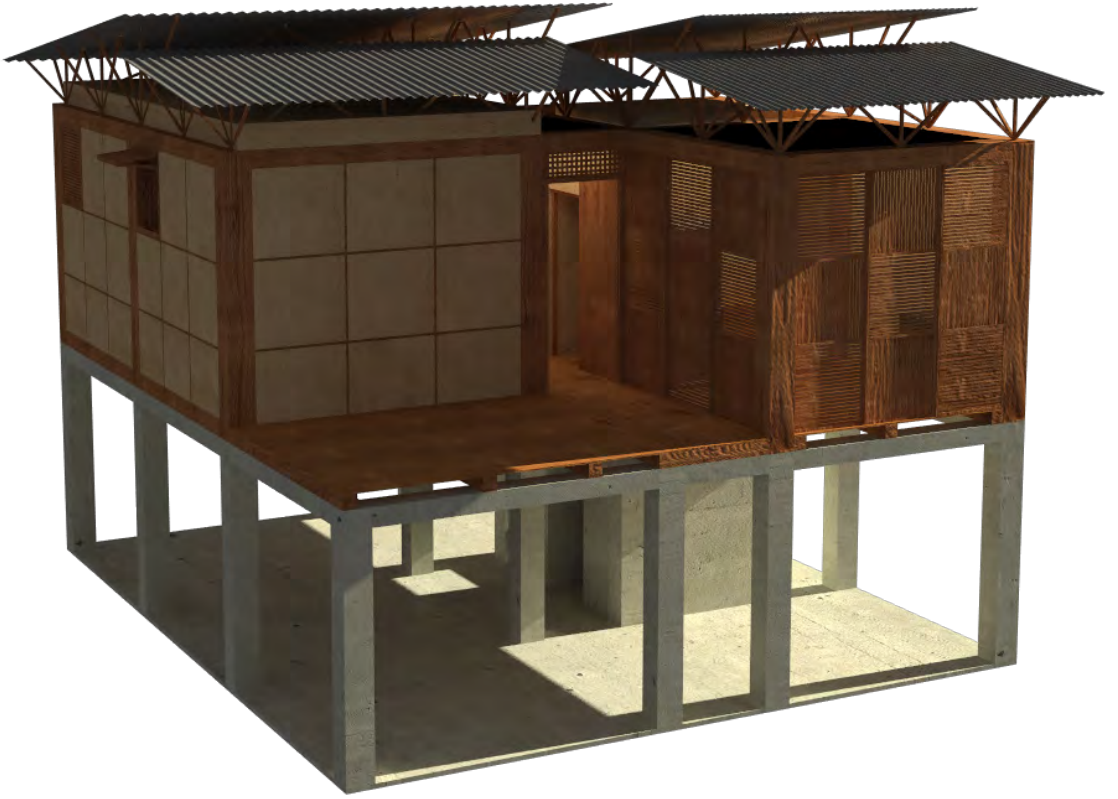
necessary to be careful with the windows design, it is needed natural light and ventilation, but if the windows are too big, the hot air will easily enter the house, and if they are too small fresh air will not be able to flow. Keeping the windows closed during the day and opening them during the night will allow the house to stay fresh in every moment.

A double ventilated roof will allow the house to stay ventilated and fresh. The inner part will work as a thermal isolator, meanwhile the outer part will reflect as much as possible the sunlight, leaving in between the enough space for air to flow.

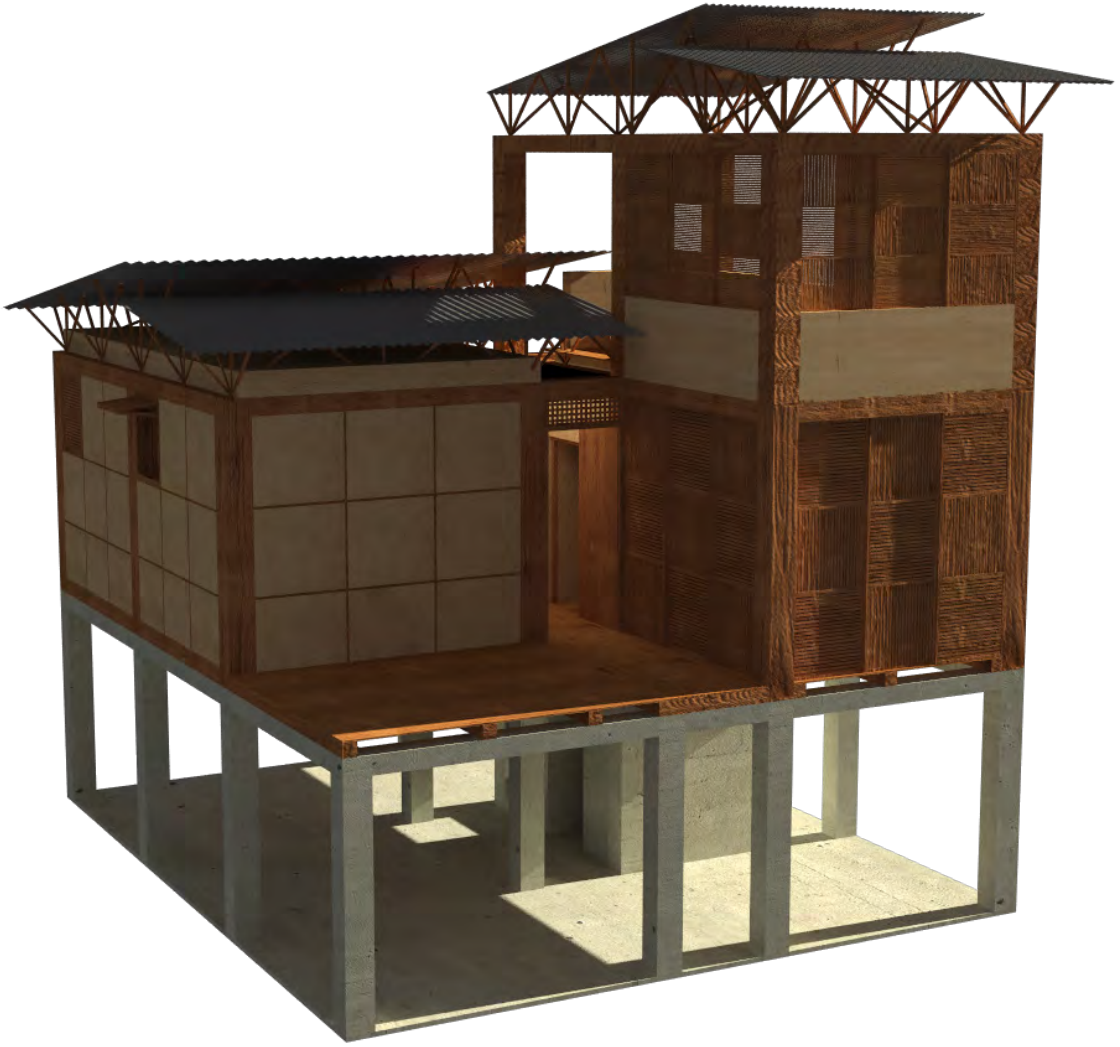


Growth process

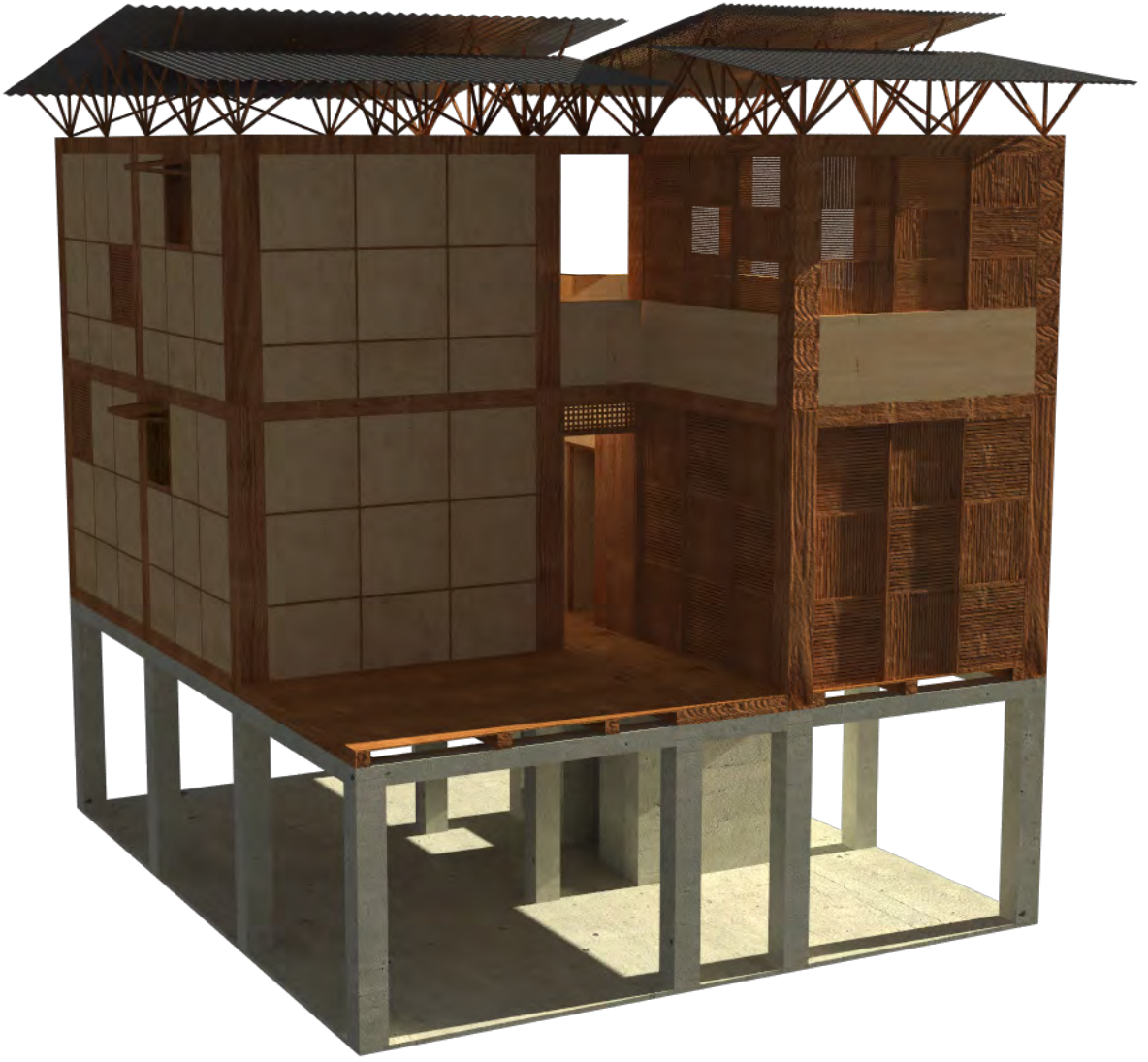
There are two main reasons for a growth proposal: the first one is that the families grow and want to stay together so they build a second floor, an extra room to give their relatives a place to stay. As a second reason it is also normal to create a little business at home and let one of the spaces for the store, this proposal enables the family to grow and to stay together as a family.



House base design: 4 to 6 people.



Growth proposal No. 1 design: 6 to 10 people.



Growth proposal No. 2 design: +10 people.

Appropiation models

DRY SEASON

RAINY SEASON

ELEVATED GARDEN / TERRACE

BUSINESS

Conclusion

Given the acquired knowledge about architecture, sustainability, social housing, resiliency, natural cycles and climate change, it is possible now to propose something not new, but useful, different and intelligent that goes further than the simple architectural project. With this project, it is now possible to rethink, recreate and reactivate the social and cultural relationships, bonding them with the most important topic: nature. The communities will be able to understand and to take advantage (in the best possible way) of nature, to live and to work with it.

The social interest housing becomes an excuse and an example for the people that is actually possible to live with low environmental impacts and low cost construction techniques, to self-sustain without leaving behind the commodities that XXI century has given us. With this approaches not only the environment will receive and thank the benefits, but the community itself, reactivating a lost but not gone network of co-dependence and collaboration between human beings. Where the people works for the people, for the profit, not only economical but also social, cultural and environmental.

The proposal is able to rethink the city, to adapt it to the different changes through the years and to improve with new technologies, new studies and better understanding of the relationship between the human being and the natural environment.

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POLITECNICO DI TORINO
1859
1906