ZERO CARBON

NATIONAL PARK "ARCHIPIELAGO LOS ROQUES"

LODGE

(BED AND BREAKFAST)

IED Torino ISTITUTO EUROPEO DI DESIGN

PRESENTED BY:

ARCHITECT_ NOHEMAR CASTILLO MADRID

PROJECT: ZERO CARBON LODGE

PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_VENEZUELA

TESIS PROJECT

MASTER IN SUSTAINABLE ARCHITECTURE

SHEET: 0

OFF GRID

LODGE

(BED AND BREAKFAST)

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SHEET: 1

ACTUAL SITUATION

Venezuela has a mixed economy dominated by the petroleum sector, around 80% of exports and more than half of government revenues. It has the least expensive petrol in the world because the consumer price of petrol is so heavily subsidised.

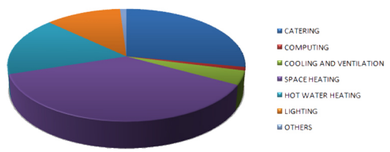
THE PROPOSAL

Venezuela is not only known for the cheap oil and beautiful women, but also for the most amazing natural places scattered all over the territory. Tourism is an activity that can be exploded as an alternative to an economy based on oil trade, for that reason it's necessary to offer good quality infrastructure, without causing a negative impact in nature.

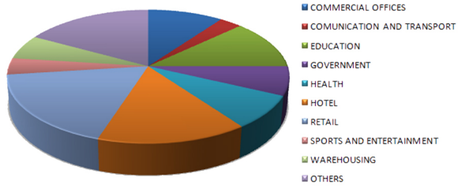
THE PROBLEM

Although tourism is an activity that brings economic benefits is very invasive, causing pollution and over-use of resources.

HOTELS CO2 EMISSIONS



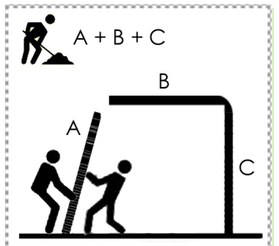
ANNUAL CARBON EMISSIONS



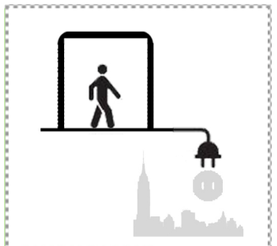
THE PROBLEM

A green ALTERNATIVE...

CHARACTERISTICS



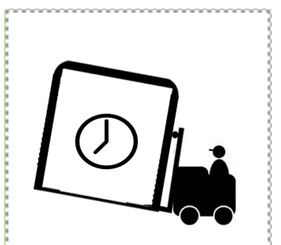
EASY TO BUILD/DISMANTLE



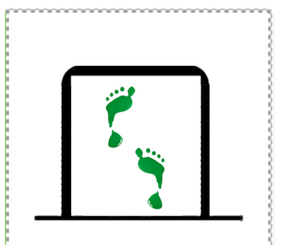
AUTONOMOUS

ADAPTABLE

LOW COST



TEMPORARY



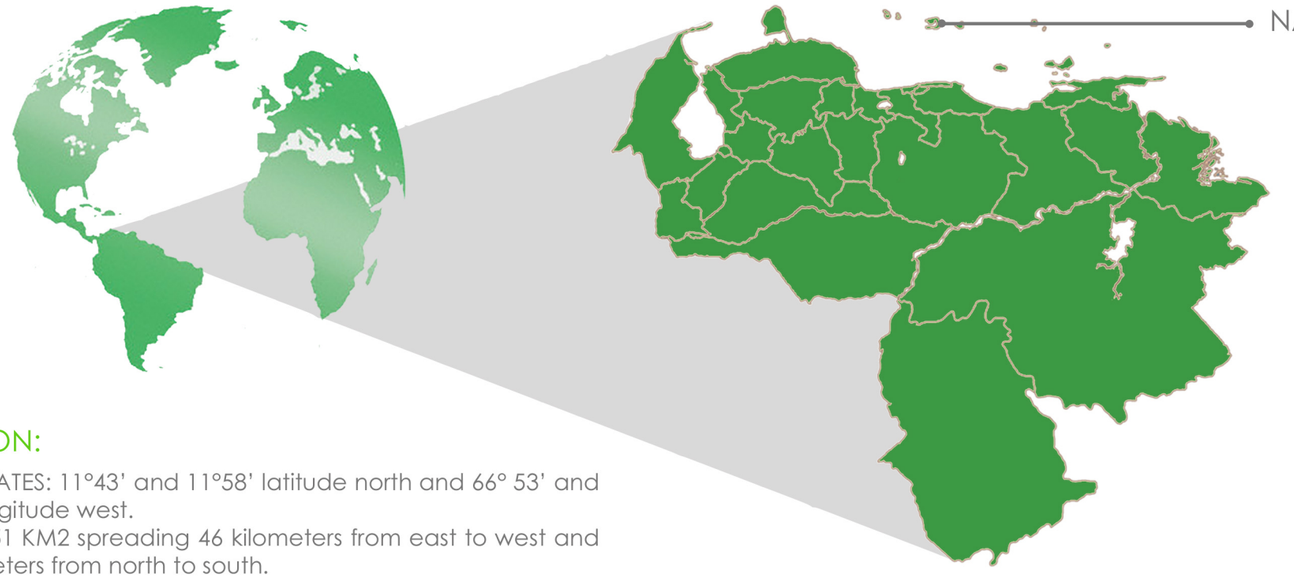
LOW IMPACT

OFF GRID

LODGE

(BED AND BREAKFAST)

THE SITE



NATIONAL PARK "ARCHIPIELAGO LOS ROQUES"

LOCATION:

COORDINATES: 11°43' and 11°58' latitude north and 66° 53' and 66° 57' longitude west.
AREA: 2.251 KM2 spreading 46 kilometers from east to west and 26.6 kilometers from north to south.

ECONOMIC ACTIVITIES

- Tourism is the most important economic activity, it generates direct employment for almost 40% of the active population.
- Lobster and botuto fishing, 90% of the lobster selled in Venezuela comes from Los Roques.

TRANSPORTATION

There is only two ways to reach island, by boat, or by plane from Caracas, Margarita or Maracaibo. The airport is located in the island of Gran Roque. Tranportation between islands is made by boats
Cars are not alowed in the island.

ARCHITECTURE

The houses and lodges have an influence from colonial architecture.
The use of natural materials and traditional techniques are the main characteristics of this type of architecture.
There are very specific laws that regulate the construction of houses and all kind of infrastructure.

POPULATION

In the Island of Gran Roques lives around a 1500 people permanent, spread around a 110 families, it receives approximately 70,000 visitors a year

LOCAL PROBLEMS

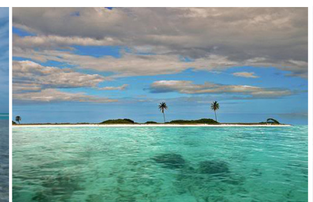
Population growth and the increase of visitors have produced a greater demand for basic services:

- **Water.**
- **Electricity.**
- **Removal of solid waste.**
- **Water treatment.**







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MASTER IN SUSTAINABLE ARCHITECTURE

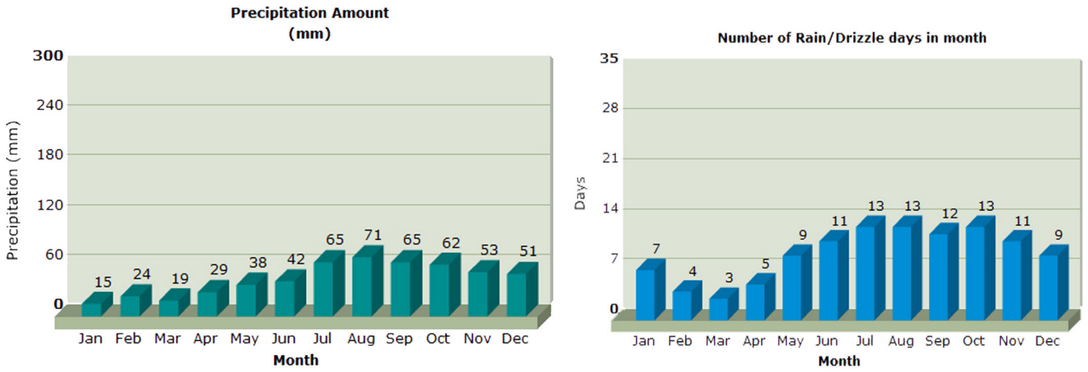
SHEET: 2

OFF GRID LODGE

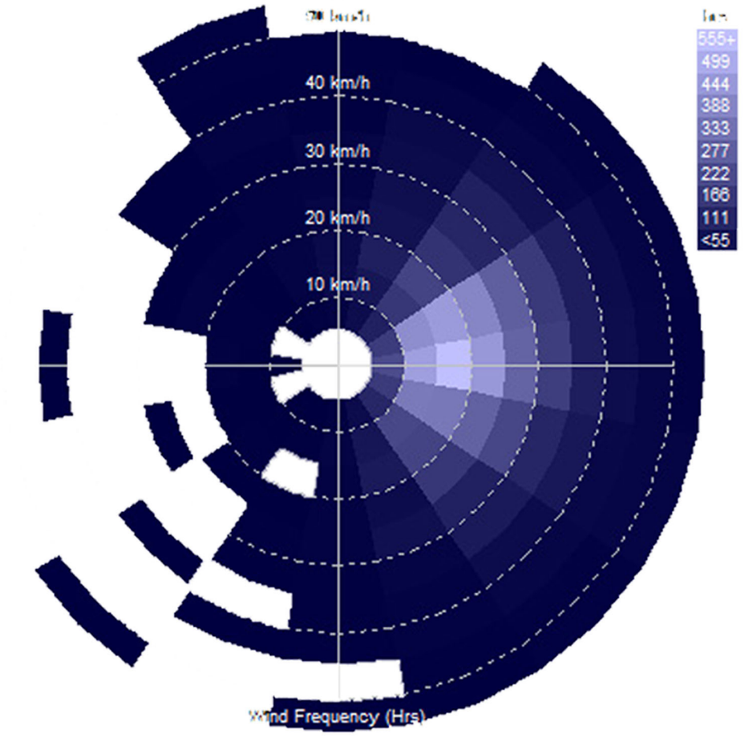
(BED AND BREAKFAST)

CLIMATE

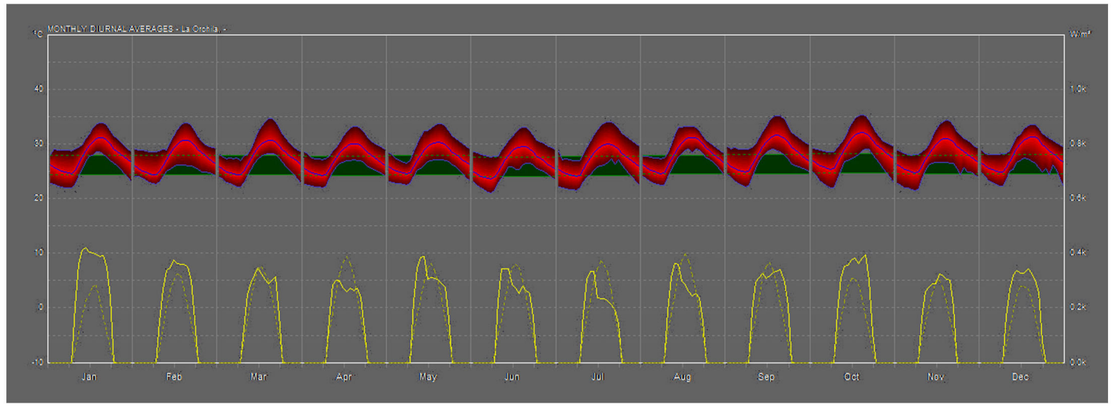
RAINFALL



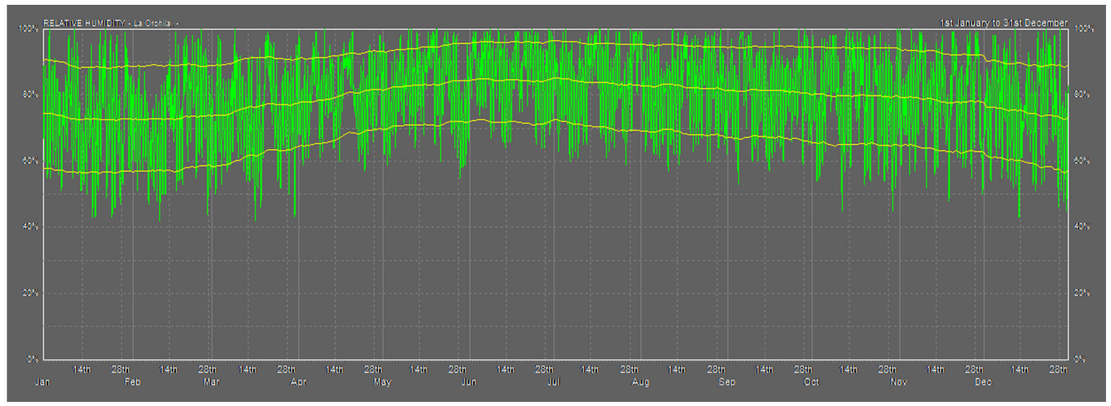
PREVAILING WINDS



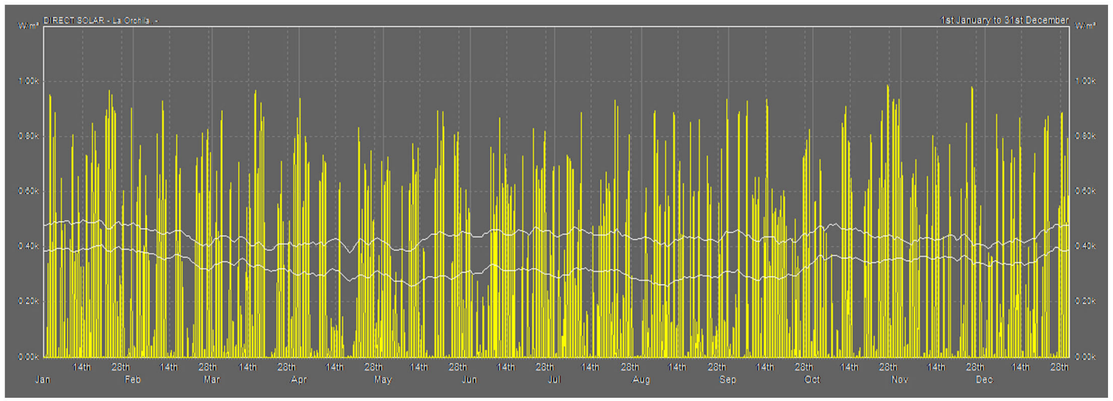
MONTHLY / DAILY AVERAGES



RELATIVE HUMIDITY



DIRECT RADIATION



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SHEET: 4

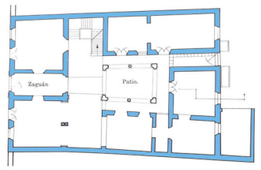
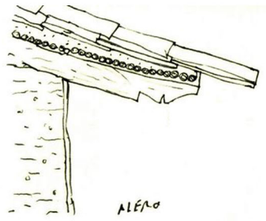
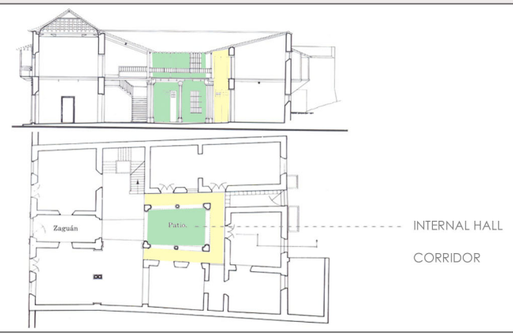
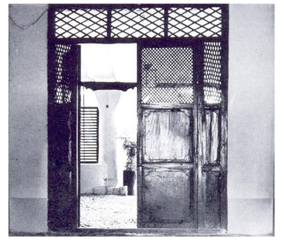
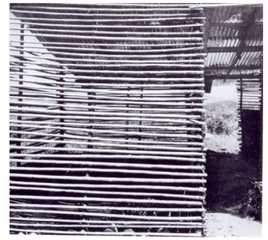
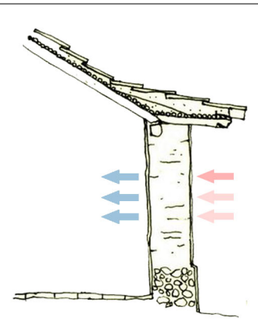
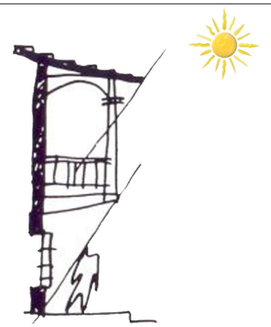
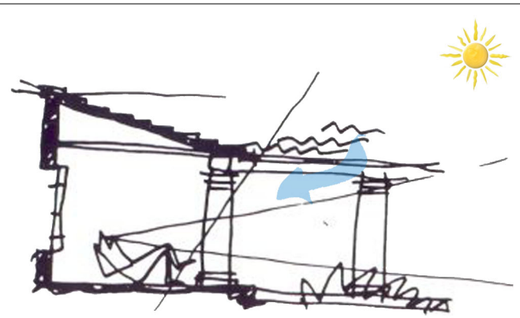
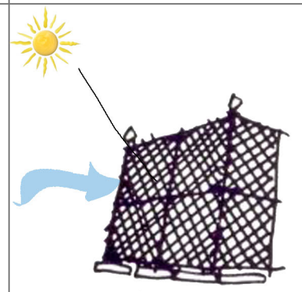
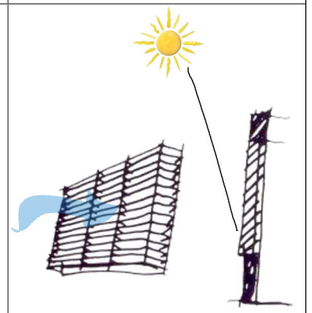
OFF GRID

LOCAL ARCHITECTURE

LODGE

(BED AND BREAKFAST)

ANALYSIS OF THE ELEMENTS ON COLONIAL ARCHITECTURE

ELEMENTS	WALLS	ROOF	BALCONIES	CORRIDORS & INTERNAL HALL	LATTICE	LOUVERS
						
DESCRIPTION	In combination with isolated columns that helped to define the space occupied by the internal halls of homes, also played the role of support elements, forming part of the primary components of the building. The adobe walls of the reported cases have thickness between 0.55 m and 0.70 m, with heights varying between 4.50 m and 4.70 m, were placed on them usually sill beams of 0.20 mx 0.20 m , that supported a pair of wooden decks.	With slopes varying between 33% and 73% coverage on colonial tiles, over a net roofs of cana brava, with structural wood beams. There may also be in the eaves wooden ornamental pieces.	The wooden balconies not only met a decorative function but were also elements used for protection against the sun and the rain.	Note the main courtyard as the most important space in the building. Comes from the ancient influence of Andalusian architecture adapted to the tropical climate of the New World, the internal corridors revolves around the main courtyard. There can also be a backyard or second courtyard, adjacent to the area of services. Major corridors around the courtyard were made to create shadow areas and thermal comfort catching the cool breeze of the night, through the courtyard, you get a diffuse lighting in the spaces, avoiding direct sun on the house walls. The use of fountains or vegetation for this spaces was very common.	Inspired in arabic lattices, this elements were placed on the top of the doors and windows, in order to search the intimacy and difused light, also to allow the air circulation.	Interior and exterior openings of ventilation to allow continuous flow using the thermal effect of air circulation for the benefit of maintaining a proper temperature inside the building.
MATERIALS	- ADOBE - WOOD - CANA AMARGA	- COLONIAL TILES - WOOD - CANA AMARGA	- WOOD	- CERAMIC TILES (FOR THE FLOORS) - WOOD (FOR THE RAILWAYS OF CORRIDORS IN UPPER FLOORS) - ORNAMENTAL COLUMNS.	- WOOD	- WOOD - CANA AMARGA
BIOCLIMATIC SECTION						

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SHEET: 4

OFF GRID

LODGE

(BED AND BREAKFAST)

CONCEPT

NEEDS

- SLEEPING
- FOOD AND DRINKS
- WC / HAND WASHING/ SHOWER
- ADMINISTRATION
- GARBAGE
- CLEANING

RESOURCES

- NATURAL MATERIALS
- RENEWABLE ENERGY
- WATER CONSUMPTION
- WASTE MANAGMENT

MATERIALS

CANA AMARGA

WOOD FROM OLD BOATS

WOODEN PALLETES

ENERGY

PV PANELS

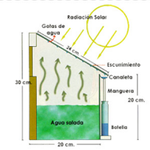
SOLAR PANEL
MADE FROM PVC PIPES

SOLAR PANEL

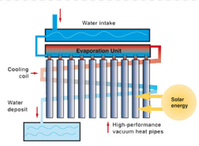
SOLAR PANEL
MADE FROM GLASS BOTTLES

EOLIC ENERGY

WATER

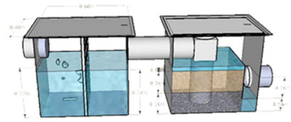


HOME MADE
WATER DESALINATION SYSTEM



WATER DESALINATION SYSTEM

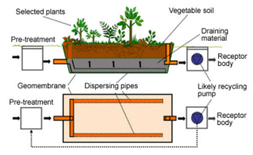
WATER REUSE



RAINWATER COLLECTION

SOLAR WATER PURIFICATION
SODIS

WASTE



PHYTODEPURATION

COMPOSTING

RECYCLING

SOLAR LATRINE

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SHEET: 5

OFF GRID

LODGE

(BED AND BREAKFAST)

REFERENCES

REFUGE

SHELTER

COVER

RETREAT

TENT

COVERTURE

PROJECT: ZERO CARBON LODGE
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SHEET: 6

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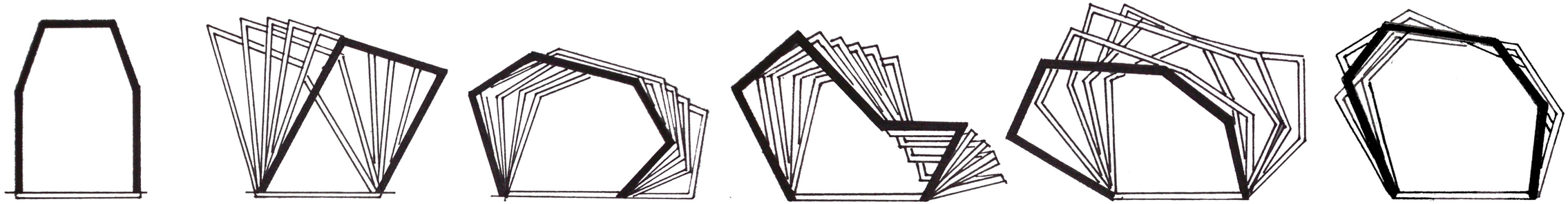
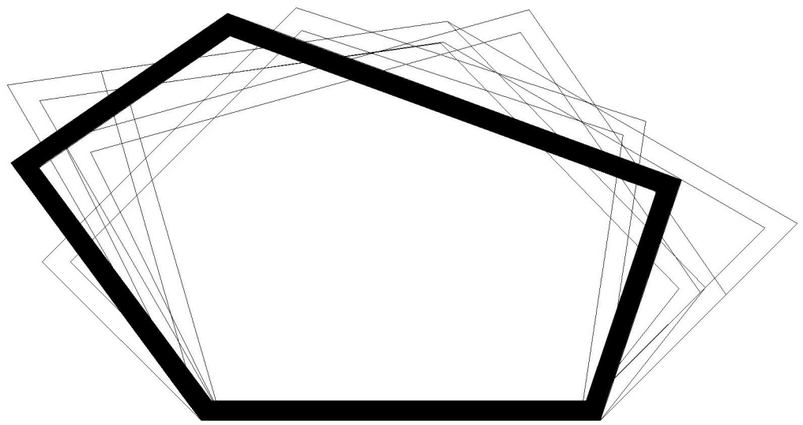
OFF GRID LODGE

(BED AND BREAKFAST)

THE CONTAINER

EVOLUTION OF THE SHAPE





CONCEPTUAL MODEL

PROJECT: ZERO CARBON LODGE

PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_VENEZUELA

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SHEET: 7

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OFF GRID

LODGE

(BED AND BREAKFAST)

THE CONTAINER

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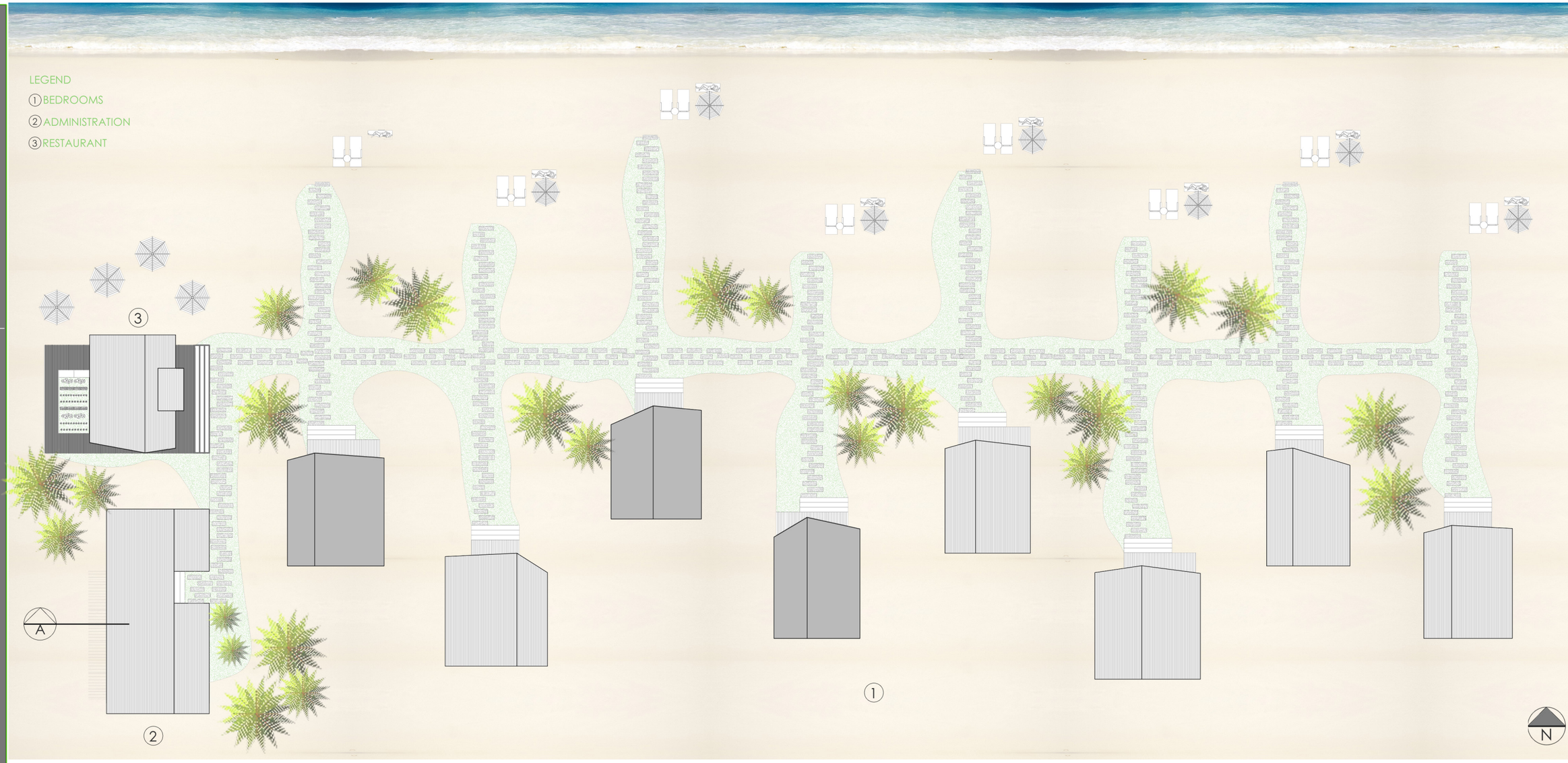
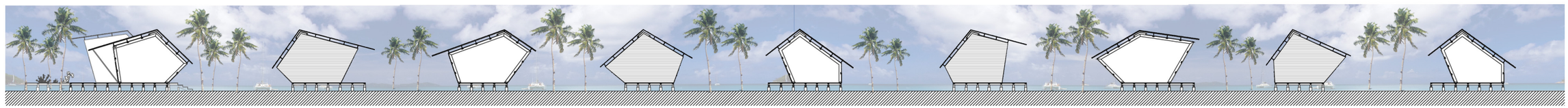
MASTER IN SUSTAINABLE ARCHITECTURE

SHEET: 9

LEGEND
① BEDROOMS
② ADMINISTRATION
③ RESTAURANT



GENERAL LAYOUT



SECTION A

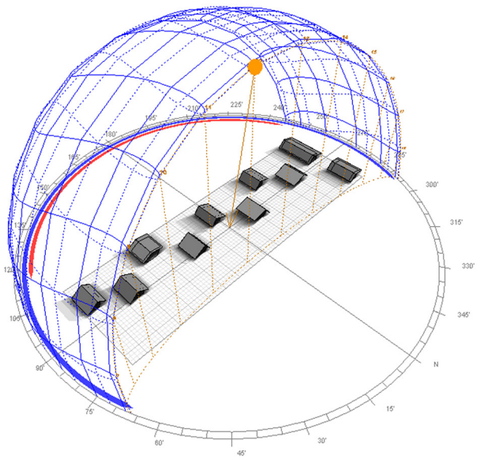
OFF GRID

LODGE

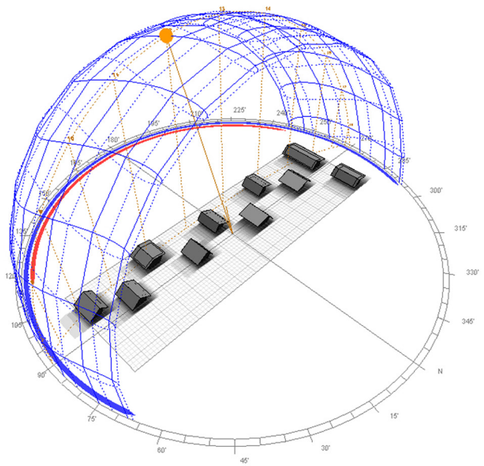
(BED AND BREAKFAST)

SHADOWS AND SOLAR ANALYSIS

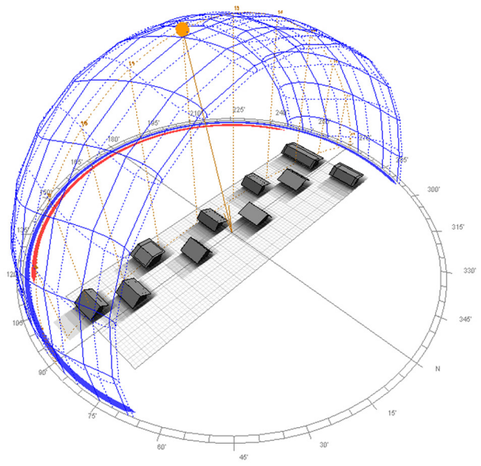
SHADOW RANGE



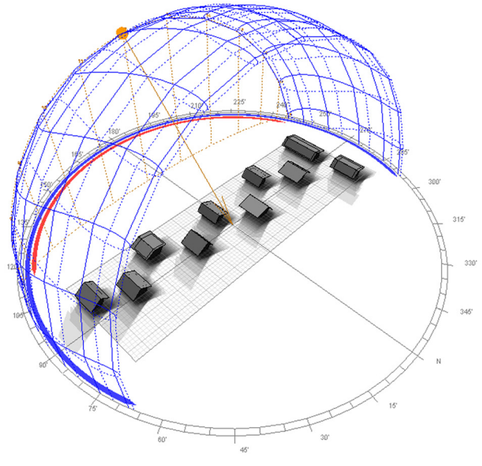
SUMMER



SPRING



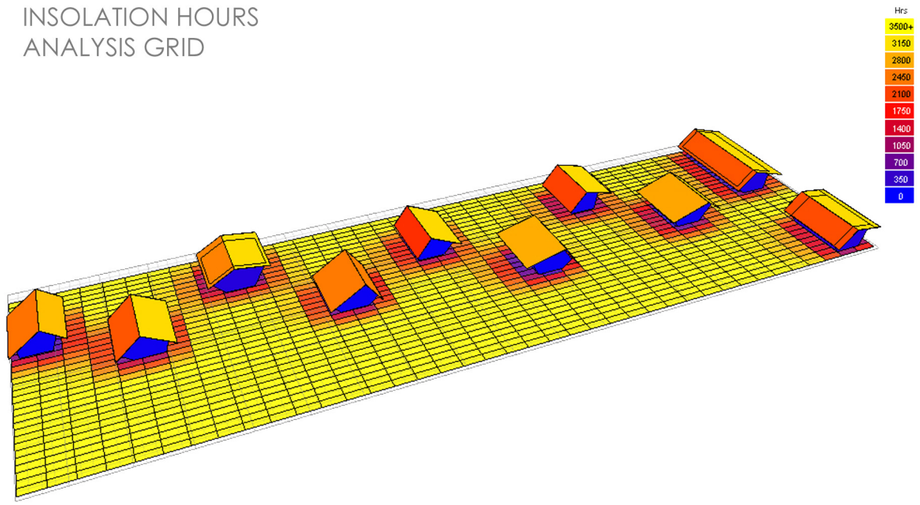
AUTUMN



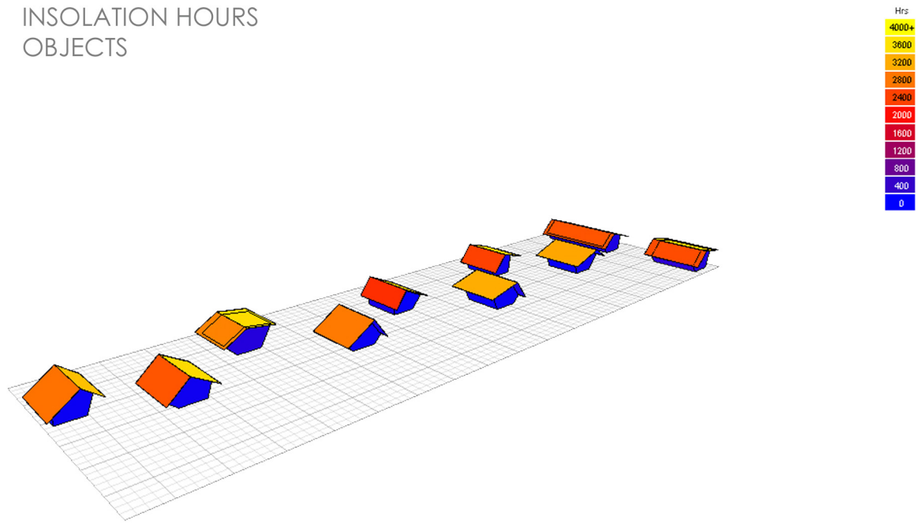
WINTER

SOLAR ACCESS ANALYSIS

INSOLATION HOURS
ANALYSIS GRID



INSOLATION HOURS
OBJECTS



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MASTER IN SUSTAINABLE ARCHITECTURE

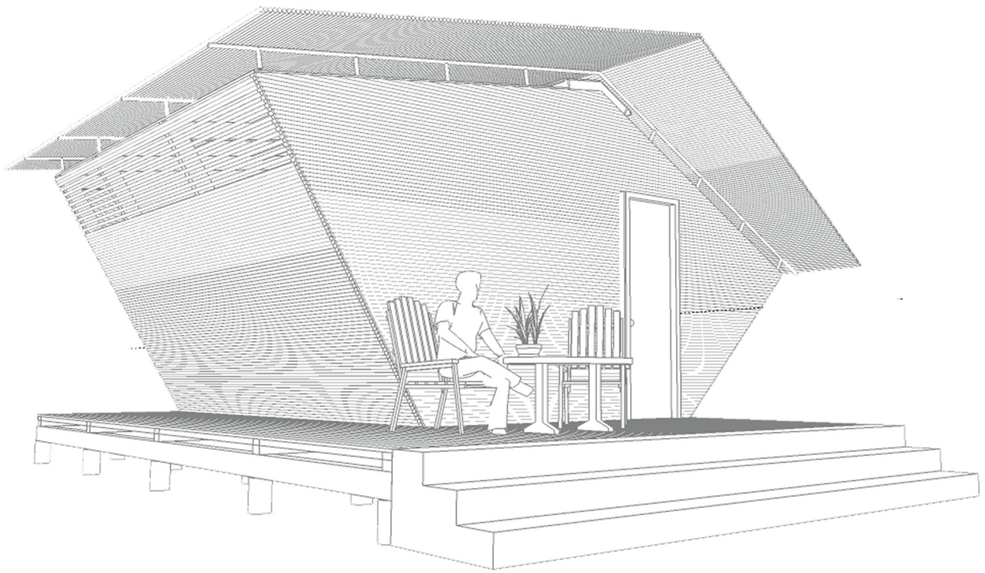
SHEET:
8

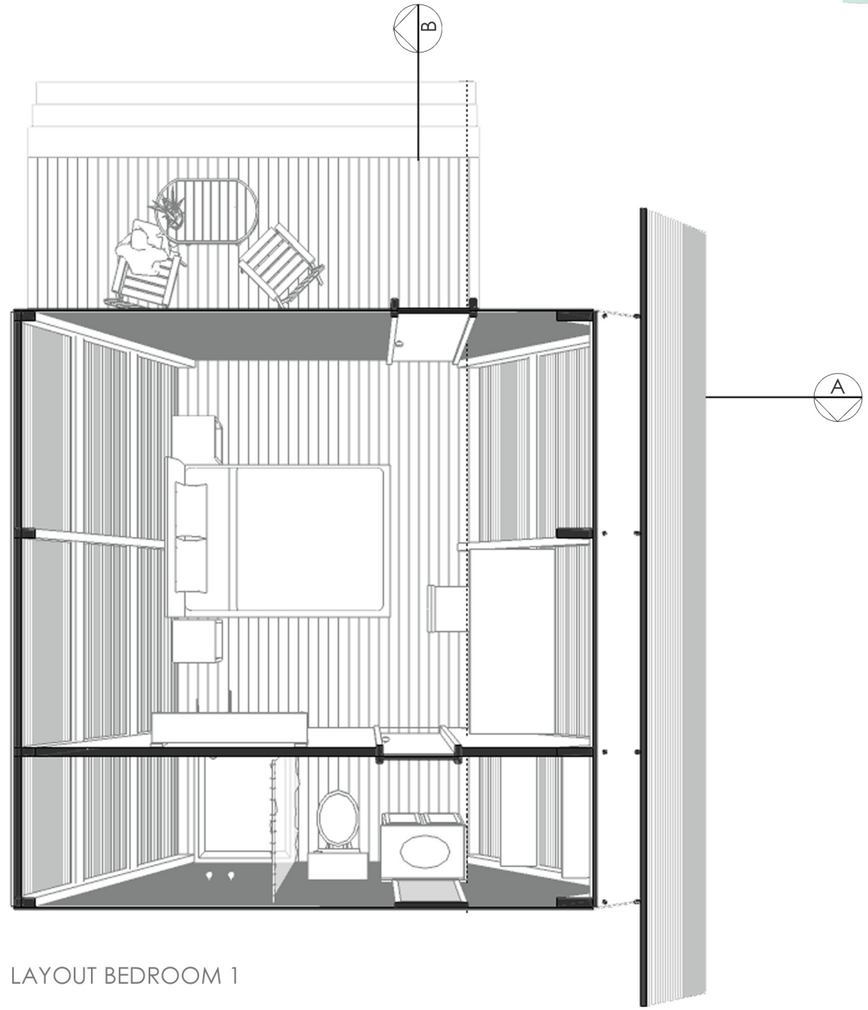
OFF GRID

LODGE

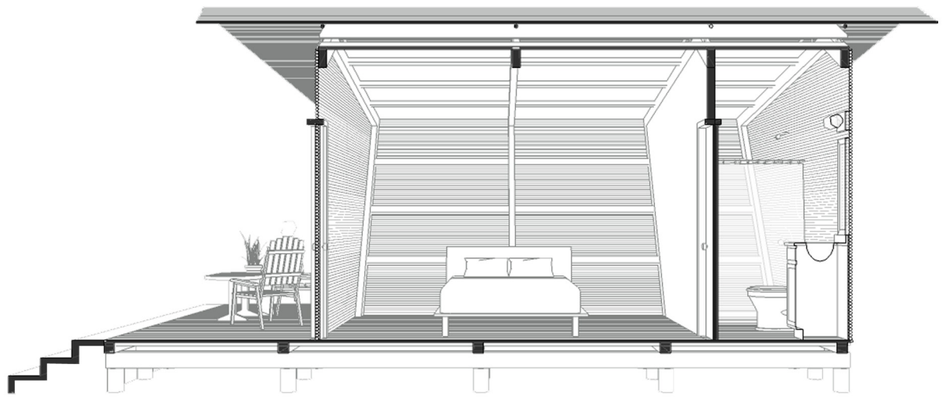
(BED AND BREAKFAST)

THE LODGE

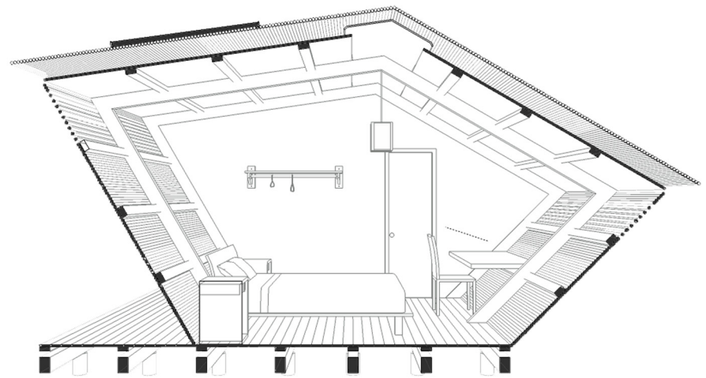




LAYOUT BEDROOM 1



SECTION B



SECTION A

PROJECT: ZERO CARBON LODGE

PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_VENEZUELA

TESIS PROJECT

MASTER IN SUSTAINABLE ARCHITECTURE

IED Torino ISTITUTO EUROPEO DI DESIGN

PRESENTED BY:
ARCHITECT_ NOHEMAR CASTILLO MADRID

SHEET:
11

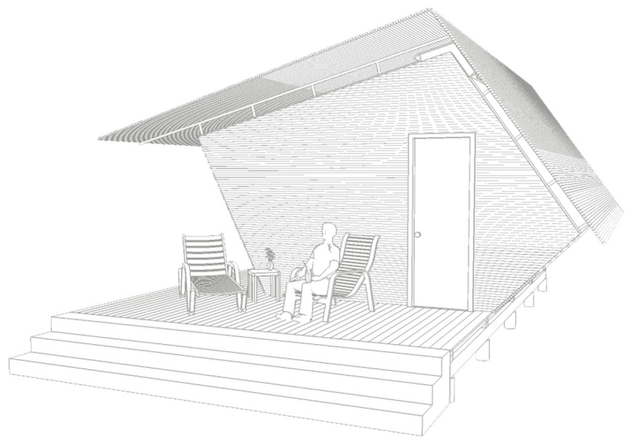
OFF GRID

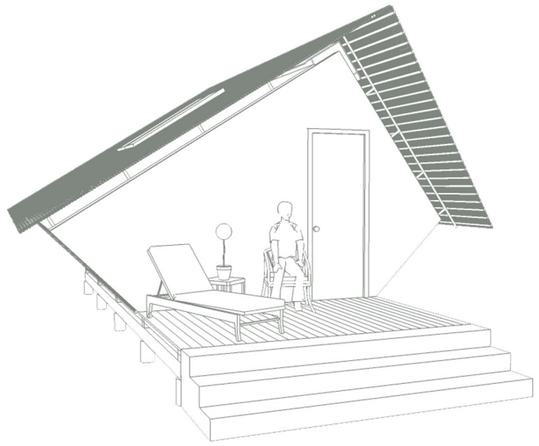
LODGE

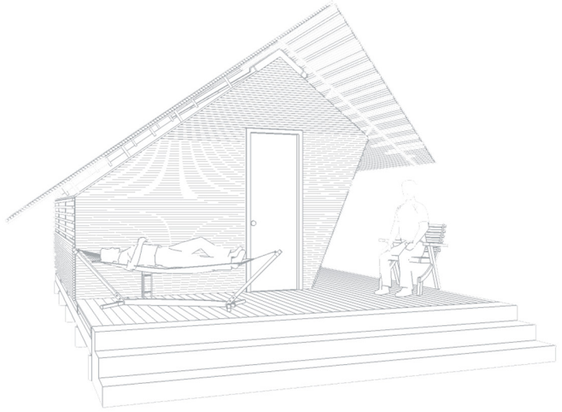
(BED AND BREAKFAST)

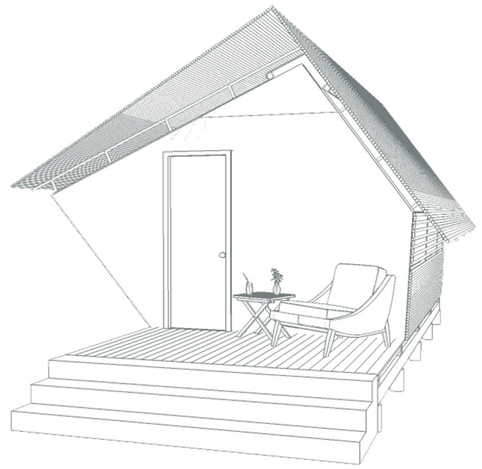
THE CONTAINER

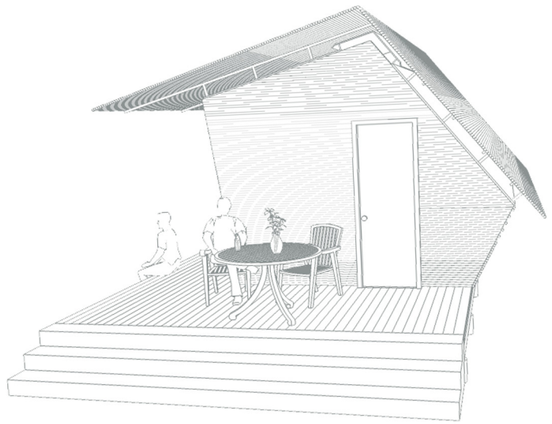
MODULE 1_BEDROOMS

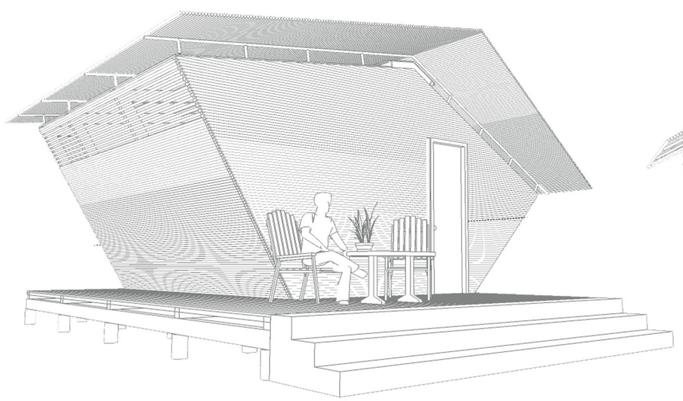


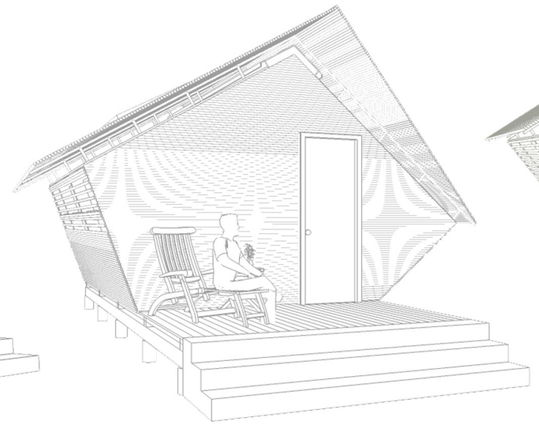


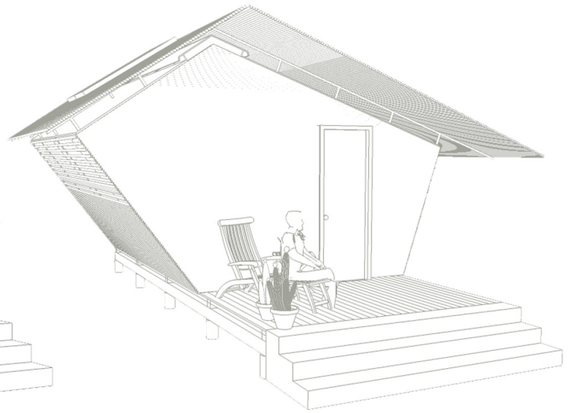












PROJECT: ZERO CARBON LODGE

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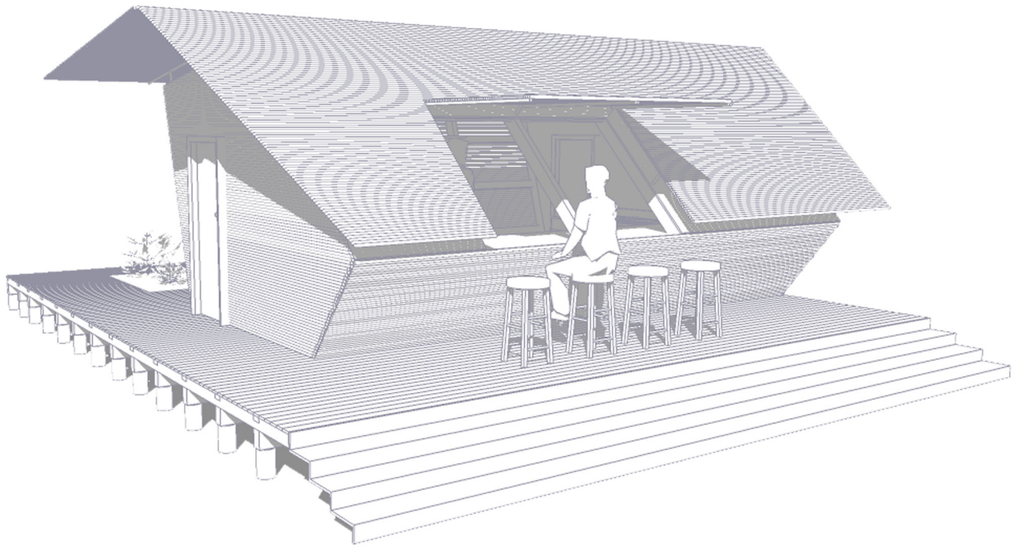
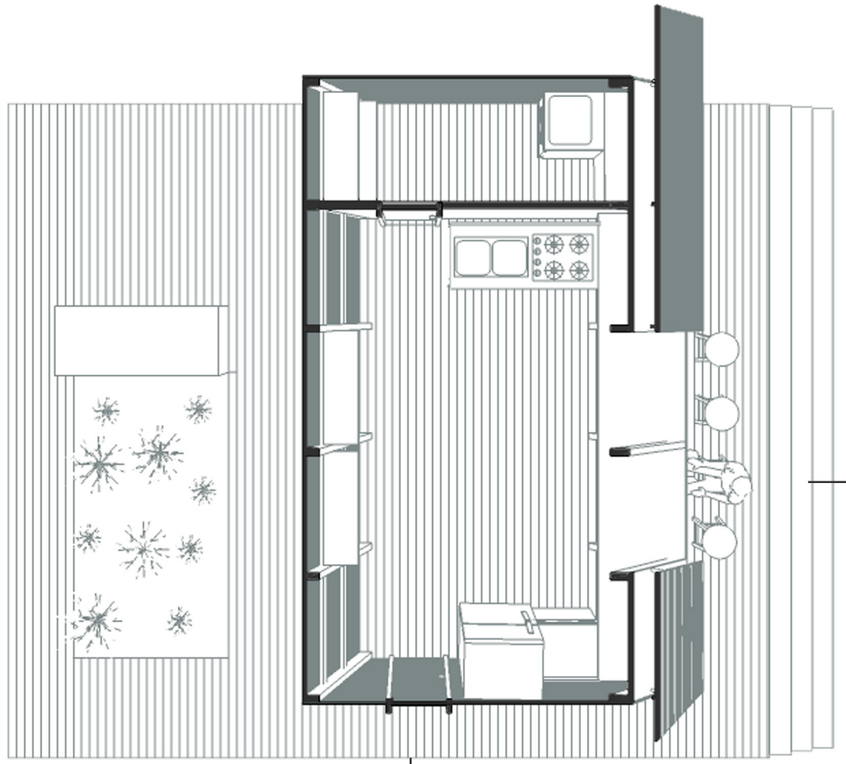
OFF GRID

LODGE

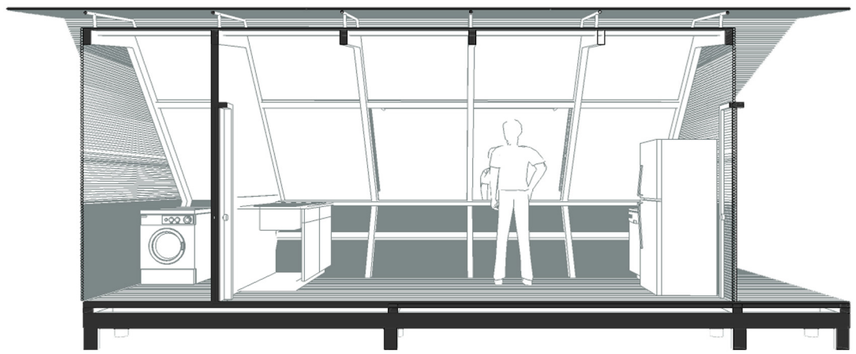
(BED AND BREAKFAST)

THE LODGE





LAYOUT KITCHEN



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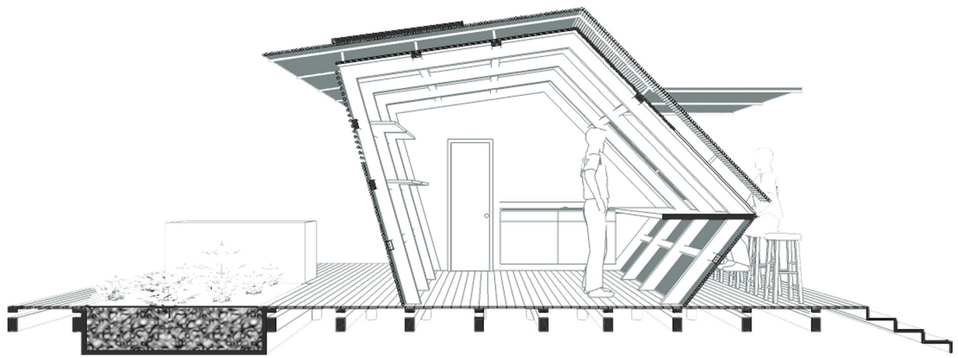

SECTION A

N

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PROJECT: ZERO CARBON LODGE

PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_ VENEZUELA

TESIS PROJECT

MASTER IN SUSTAINABLE ARCHITECTURE

SHEET:

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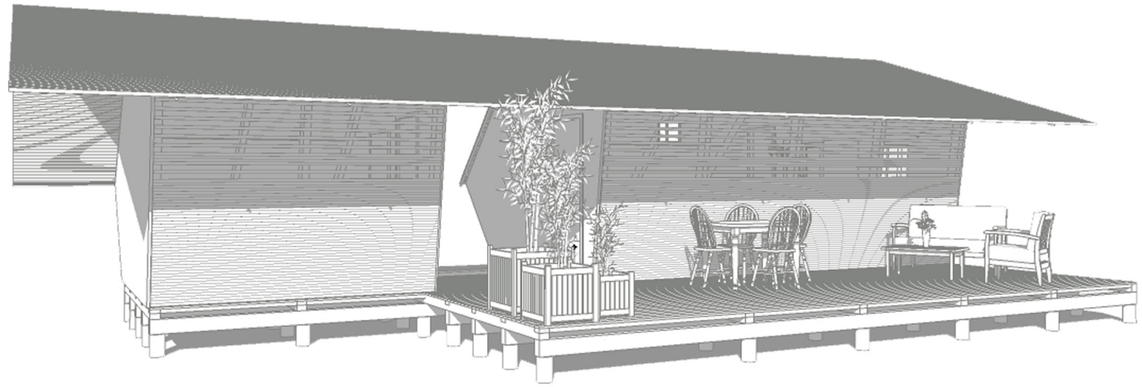
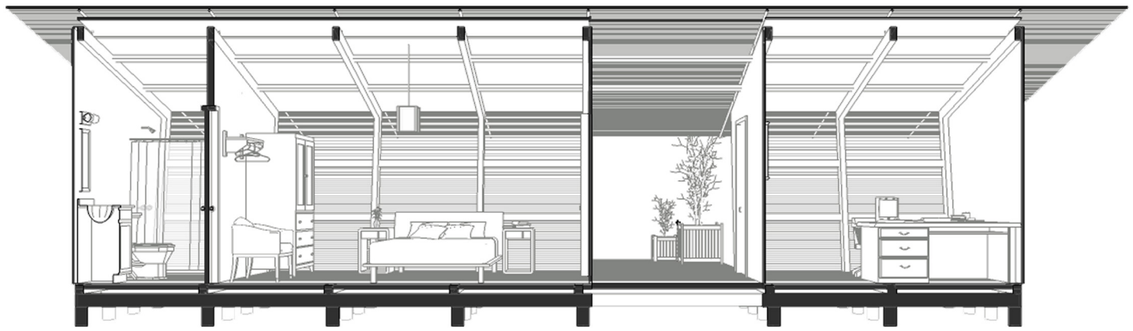
OFF GRID

LODGE

(BED AND BREAKFAST)





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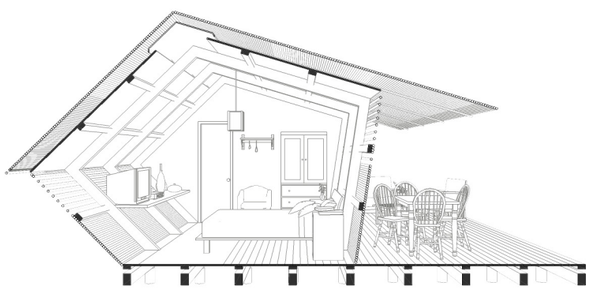
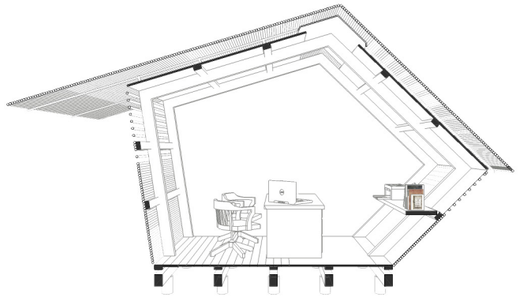
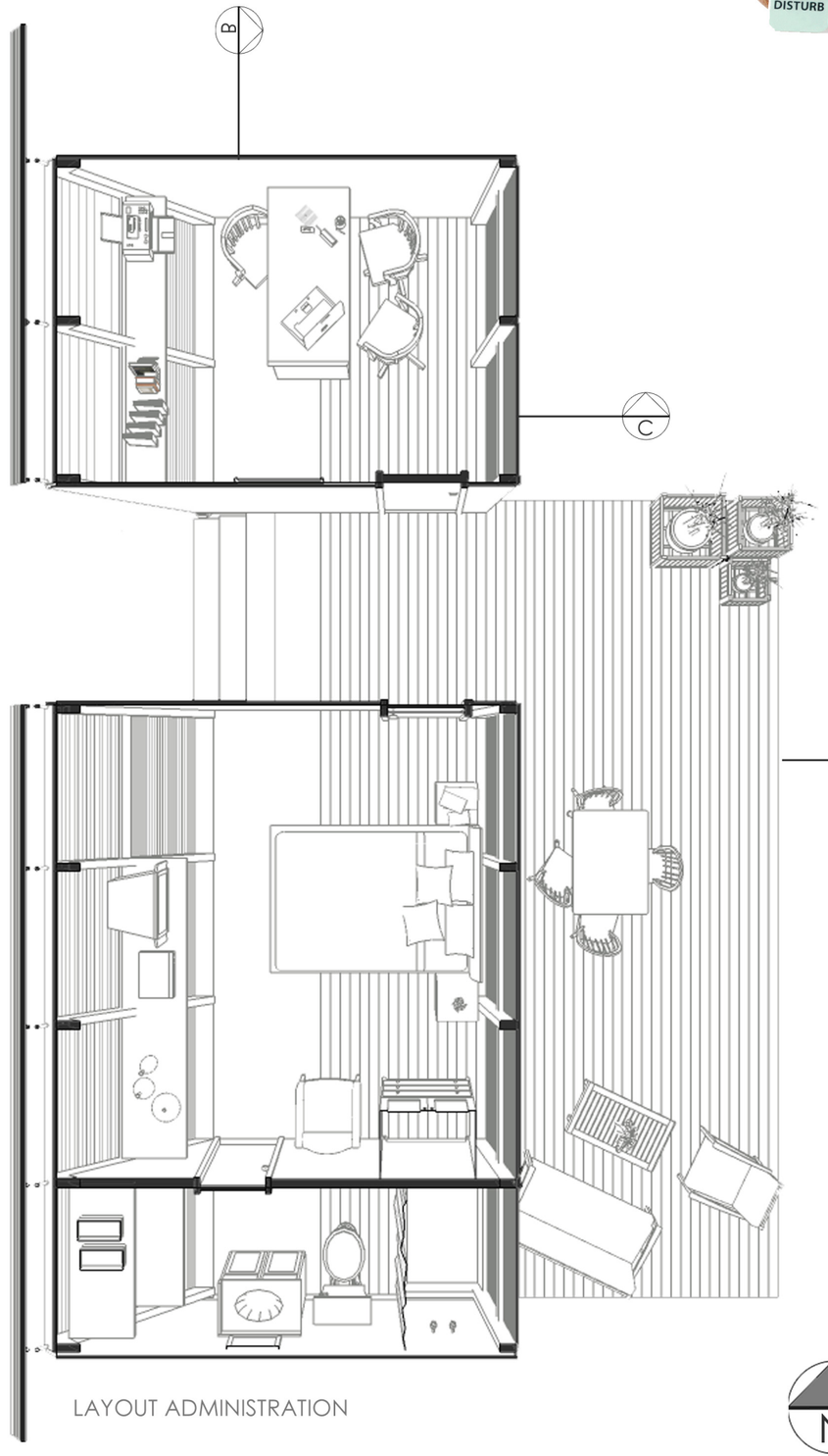


SECTION A



SECTION C

THE LODGE



LAYOUT ADMINISTRATION

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PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_ VENEZUELA

TESIS PROJECT

MASTER IN SUSTAINABLE ARCHITECTURE

SHEET:

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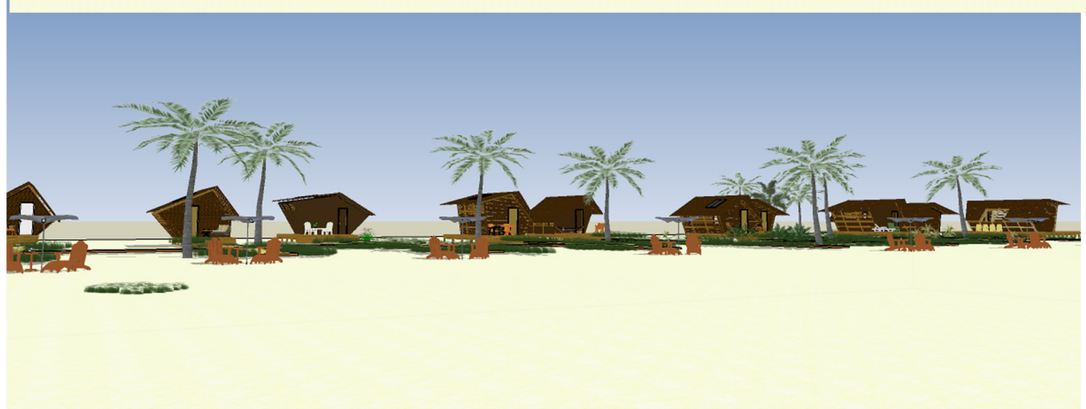
OFF GRID

LODGE

(BED AND BREAKFAST)

THE CONTAINER



PROJECT: ZERO CARBON LODGE

PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_VENEZUELA

TESIS PROJECT

MASTER IN SUSTAINABLE ARCHITECTURE

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IED Torino ISTITUTO EUROPEO DI DESIGN

SHEET:

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OFF GRID

BIOCLIMATIC STRATEGIES

LODGE

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PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_VENEZUELA

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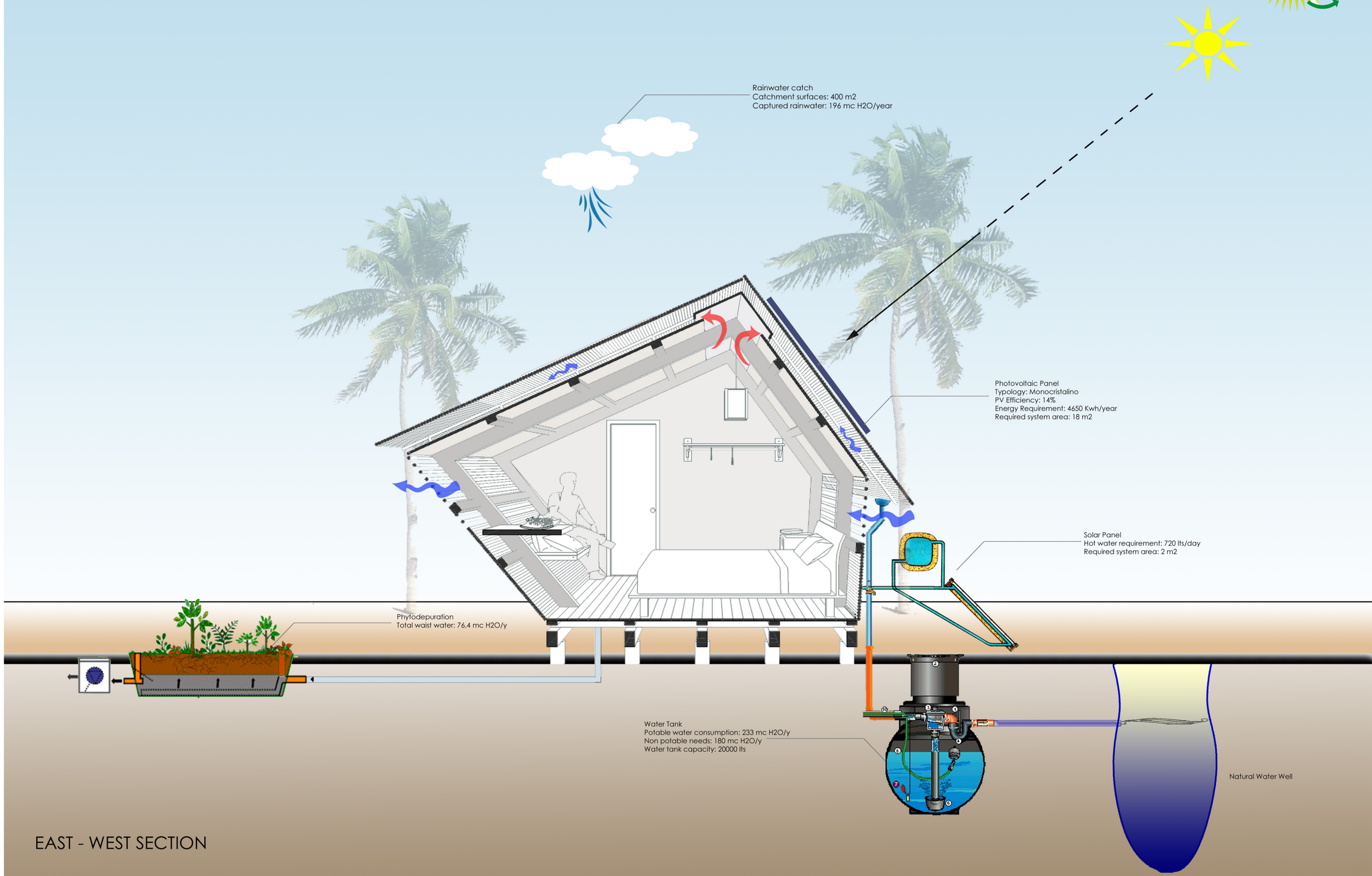
MASTER IN SUSTAINABLE ARCHITECTURE

SHEET: 15



EAST - WEST SECTION

OFF GRID LODGE

(BED AND BREAKFAST)

MATERIALS

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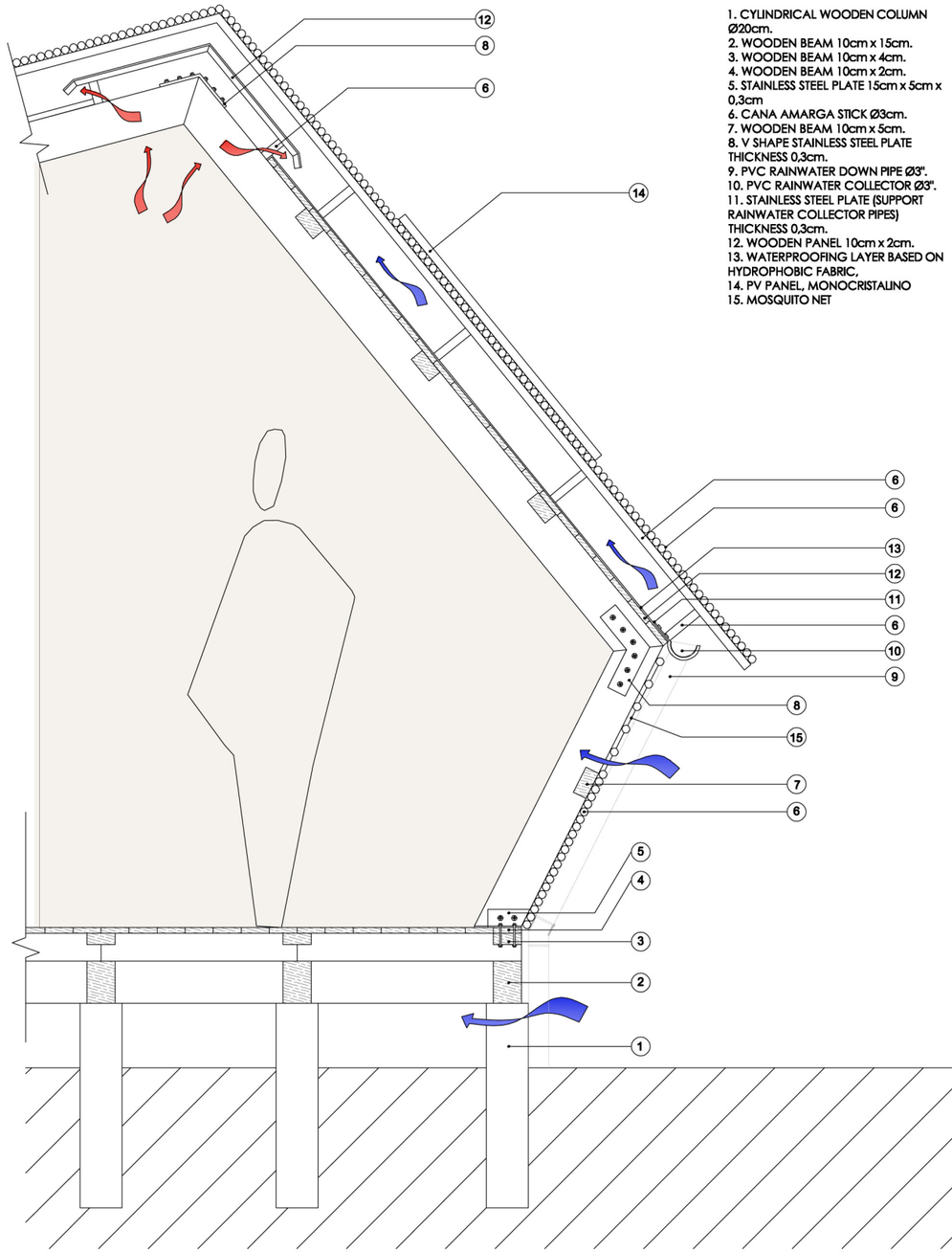
PROJECT: ZERO CARBON LODGE

PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_VENEZUELA

TESIS PROJECT

MASTER IN SUSTAINABLE ARCHITECTURE

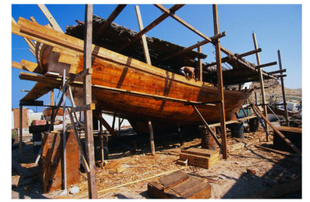
SHEET: 16



1. CYLINDRICAL WOODEN COLUMN Ø20cm.
2. WOODEN BEAM 10cm x 15cm.
3. WOODEN BEAM 10cm x 4cm.
4. WOODEN BEAM 10cm x 2cm.
5. STAINLESS STEEL PLATE 15cm x 5cm x 0,3cm
6. CANA AMARGA STICK Ø3cm.
7. WOODEN BEAM 10cm x 5cm.
8. V SHAPE STAINLESS STEEL PLATE THICKNESS 0,3cm.
9. PVC RAINWATER DOWN PIPE Ø3".
10. PVC RAINWATER COLLECTOR Ø3".
11. STAINLESS STEEL PLATE (SUPPORT RAINWATER COLLECTOR PIPES) THICKNESS 0,3cm.
12. WOODEN PANEL 10cm x 2cm.
13. WATERPROOFING LAYER BASED ON HYDROPHOBIC FABRIC,
14. PV PANEL, MONOCRISTALINO
15. MOSQUITO NET

DETAILED SECTION

MATERIALS

Foundations Wooden pallets, usually used in transportation companies.	
Structure Recycled Wood coming from old boats or pallets.	
Walls Cana Amarga.	
Waterproof Layer based on hydrophobic fabric Smart nanoparticles waterproof coating from smart nanoparticles of the lotus flower leaves structure, which repel water molecules from the surface.	
Joints, plates, and screws. Made with stainless steel, to prevent corrosion and oxidation.	
Pipes, gutters. PVC pipes.	

OFF GRID

WATER CONSUMPTION

LODGE

(BED AND BREAKFAST)

GENERAL DATA

AREA: 152 m2
USERS: 20
YEARLY OCCUPANCY DAYS: 195

RAINFALL

WET SEASON: JANUARY - JUNE
RAINY SEASON: JULY - DECEMBER
TOTAL YEARLY RAINFALL: 606 mm/y

CATCHING SURFACES

CATCHMENT SURFACES: 400m2
(ROOFS, TERRACES)
CAPTURED
RAINWATER: 196,34 mc H2O/y

IRRIGATION DEMAND

GARDEN (SHRUBS): 100 m2
GARDEN (VEGETABLES): 10 m2
TOTAL GREEN AREAS: 110 m2

TANK CAPACITY

RAINWATER TANK: 20000 LTS
APROX. DIMENSIONS: 2,80m x 3,83m
HOTWATER TANK: 1000 LTS
APROX. DIMENSIONS: 1,20m x 1,00m

WATER PURIFICATION

SODIS METHOD OF DESINFECTION
THE SUN'S ULTRAVIOLET RAYS DESINFECT WATER.CONSIST IN LEAVING A BOTTLE OF WATER UNDER THE SUN FOR 5 OR 6 HOURS.

CHOOSEN SCENARIO

FROM WATER WELL
233,03 mc H2O/y

DRINKING
7,8 mc H2O/y

PERSONAL HYGIENE
COOKING WATER
195 mc H2O/y

70%

DISHWASHING
14,6 mc H2O/y

70%

CAPTURED RAINWATER
196,34 mc H2O/y

WATER TANK
CAP. 20000 LTS
DIM. 2,80m x 3,83m

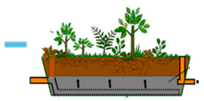
CLEANING
0,73 mc H2O/y

70%

CLEANING WC
58,5 mc H2O/y

70%

IRRIGATION
118,8 mc H2O/y



PHYTODEPURATION
WASTE WATER
76,44 mc H2O/y

TO THE SEA

PROJECT: ZERO CARBON LODGE
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SHEET: 17

OFF GRID

ENERGY CONSUMPTION

LODGE

(BED AND BREAKFAST)

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SHEET: 18

ELECTRIC APPLIANCES

RESTAURANT

TOTAL DAY: 21,7 Kwh/day
TOTAL YEAR: 4235,7 Kwh/y

ADMINISTRATION

TOTAL DAY: 5,17 Kwh/day
TOTAL YEAR: 1009,12 Kwh/y

BEDROOMS

TOTAL DAY: 7,48 Kwh/day
TOTAL YEAR: 1458,6 Kwh/y

TOTAL ENERGY

	Kwhel/year
RESTAURANT	4235,70
ADMINISTRATION	1009,13
BEDROOMS	1458,60
HEATING	0,00
COOLING	0.00
	6703,43/152 x 100
TOTAL ENERGY	**4410,15**

SAVINGS ON ENERGY BILLS: 1014,33 e
(according to Venezuelan electric energy price)

CO2 SAVINGS: 2425,58 kgCO2/year

PHOTOVOLTAIC PANELS

CHARACTERISTICS:

TYPOLOGY: MONOCRISTALINO
PV MODULE EFFICIENCY (%): 14
SYSTEM EFFICIENCY (%): 80
POWER (W/m2): 140
INCLINATION: 10°

Caratteristiche dell'impianto :		
Tipologia Celle:	monocristalino	
Efficienza del Modulo PV, [%]:	14,00	
Efficienza Sistema di Conversione, [%]:	80,00	
Potenza unitaria, [W/m²]	140	
Calcolo Area teorica:		
Fabbisogno, [KWh]:	% copertura:	A_c teorica, [m²]:
- annuale: 4410,15	100	17,1
Caratteristiche del sistema solare fotovoltaico scelto:		
Area Effettiva, [m²]:	18	
Potenza Sistema PV, [KW]	2,52	

	Produzione Energetica, [KWh]:	Fabbisogno coperto, [%]:
gennaio	386,11	100,0
febbraio	372,73	100,0
marzo	422,21	100,0
aprile	410,81	100,0
maggio	404,38	100,0
giugno	376,16	100,0
luglio	356,21	100,0
agosto	384,32	100,0
settembre	397,60	100,0
ottobre	403,43	100,0
novembre	360,91	100,0
dicembre	362,53	100,0
TOTALE:	4637,41	100,0

Determinazione dei costi del sistema solare e dei risparmi ottenuti:			
Dettaglio Costi:	area - unità	importo, [e/m² - e/u]:	subtotale, [e]:
Impianto del sistema solare:			
moduli PV:	18	1000,00	18000,00
messa in opera e accessori:	15	100,00	1500,00
varie:			0,00
IVA, [%]:	10		1950,00
Contributi a fondo perduto, [%]:			0,00
Detrazione Irpef, [%]:			0,00
		Totale, [e]:	21450,00
Gestione del sistema solare:			
manutenzione annuale:	18	5,00	90,00
varie:			0,00
		Totale, [e]:	90,00
Dettaglio Benefici:	En, [KWh]:	importo unitario, [e/u]:	subtotale, [e]:
Energia risparmiata:	4637,41		
-elettricità	4637,41	0,23	1066,60
		Totale, [e]:	1066,60
Valutazione della convenienza economica:			
tasso interesse, [%]:	3	durata imp., [anni]:	25
VAN, [e]:	-4444,24	periodo rit., [anni]:	37
L'investimento non è economicamente conveniente!			
Quantificazione della riduzione di emissioni di CO_2 in ambiente:			
Conversione dell'energia non utilizzata in energia primaria, [KWh]:			12381,89
Quantità di CO_2 non emessa in ambiente ogni anno, [Kg]:			3714,57

Comparing to the cost of the grid electricity the pv system is very expensive, so in this case the approach is not economic, the main savings are in CO2 emissions, and the avoidance of using fossil fuels.

SOLAR PANELS

Descrizione delle modalità di gestione e di utilizzo dell'impianto:			
Fattore di utilizzo:			
gennaio	0,53	Caratteristiche:	
febbraio	0,53		
marzo	0,53	destinazione d'uso:	*COMMERCIALE*
aprile	0,53		
maggio	0,53	n° utenti [p]:	20
giugno	0,53		
luglio	0,53	consumo acqua calda [l/g-p]:	36
agosto	0,53		
settembre	0,53	temp. acqua da rete, [°C]:	27,03
ottobre	0,53		
novembre	0,53	temp. media utilizzo, [°C]:	45,00
dicembre	0,53		

Calcolo:			
Fabbisogno Termico giornaliero [MJ/g]:	54,18		
Calcolo del Fabbisogno Energetico:			
	Acqua Sanitaria	Aria Ventilazione	Dispersioni
gennaio	890,10	0,00	0,00
febbraio	803,96	0,00	0,00
marzo	890,10	0,00	0,00
aprile	861,39	0,00	0,00
maggio	890,10	0,00	0,00
giugno	861,39	0,00	0,00
luglio	890,10	0,00	0,00
agosto	890,10	0,00	0,00
settembre	861,39	0,00	0,00
ottobre	890,10	0,00	0,00
novembre	861,39	0,00	0,00
dicembre	890,10	0,00	0,00
Subtotale:	10480,19	0,00	0,00
TOTALE FABBISOGNO ANNUO [MJ]:			**10480,19**
TOTALE FABBISOGNO ANNUO [kWh]:			**2911,17**

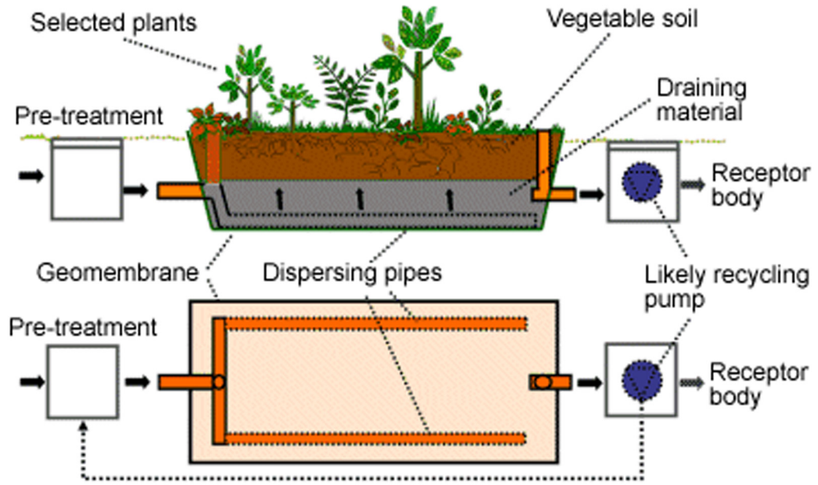
Caratteristiche dell'impianto:			
Tipologia collettori:	ACQUA	Eff. Collettori, [-]:	0,55
Eff. Distribuzione, [-]:	0,75	Eff. Scambiatore, [-]:	0,90
Eff. sistema, [-]	0,37		
Calcolo Area teorica:			
Produzione Acqua Calda Sanitaria:			
Fabbisogno, [MJ]:		% copertura:	A_c teorica, [m²]:
- annuale:	10480,19	50	1,7
- luglio:	890,10	100	3,8
Determinazione dei costi del sistema solare e dei risparmi ottenuti:			
Dettaglio Costi:	area / unità	importo, [e/m² - e/u]:	subtotale, [e]:
Impianto del sistema solare:			
collettori:	2	600,00	1200,00
messa in opera e accessori:	2	50,00	100,00
varie:			0,00
IVA, [%]:	10		130,00
Contributi a fondo perduto, [%]:			0,00
Detrazione Irpef, [%]:			0,00
		Totale, [e]:	1430,00
Gestione del sistema solare:			
manutenzione annuale:	2	12,00	24,00
varie:			0,00
		Totale, [e]:	24,00
Valutazione della convenienza economica:			
tasso interesse, [%]:	5	durata imp., [anni]:	15
VAN, [e]:	5270,79	periodo rit., [anni]:	3
L'investimento è economicamente conveniente!			
Quantificazione della riduzione di emissioni di CO_2 in ambiente:			
Conversione dell'energia non utilizzata in energia primaria, [KWh]:			7772,82
Quantità di CO_2 equivente non emessa in ambiente ogni anno, [Kg]:			2331,85

OFF GRID LODGE

(BED AND BREAKFAST)

WASTE MANAGMENT

PHYTODEPURATION



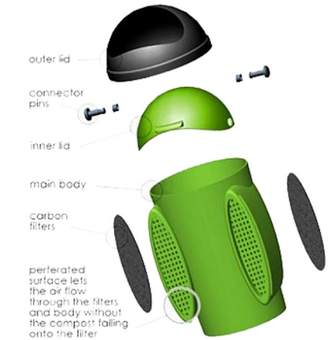
Subsurface Flow systems (SSF)

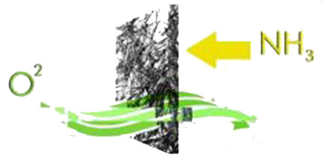
Inert filling material is put in the basin to support the growth of macrophytes roots. Its depth is generally between 0.2 and 0.8 m depending on type of macrophytes.
Wastewater is pre-treated by grid filtration and primary sedimentation to remove the largest particles and reduce the concentration of suspended solid particles.The frequency of vegetable mass substitution is low, thus avoiding a high biomass disposal.

The average efficiency is about 82% for BOD5, 72% for COD, 43% for nitrogen, 38% for ammoniac nitrogen, and 35% for phosphorous. H-SSF proved to be very efficient for suspended solids removal, reaching the 80%, and for microorganisms' removal, reaching values higher than 90%.

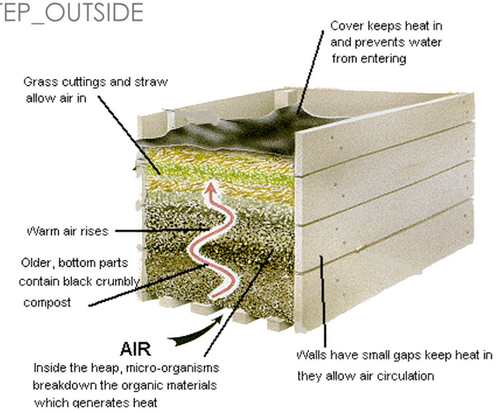
COMPOSTING

FIRST STEP_INSIDE





SECON STEP_OUTSIDE



THIRD STEP_FERTILIZER FOR GARDEN

PROJECT: ZERO CARBON LODGE
PARQUE NACIONAL ARCHIPIELAGO LOS ROQUES_VENEZUELA
TESIS PROJECT
MASTER IN SUSTAINABLE ARCHITECTURE
PRESENTED BY:
ARCHITECT_ NOHEMAR CASTILLO MADRID
IED Torino ISTITUTO EUROPEO DI DESIGN

SHEET: 19