
FUNNEL
HOUSE

U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

FUNNEL HOUSE

UNIVERSIDAD INDOAMERICA

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J3M ciudadanía - ambiente - energía

INSTITUTO **DE INVESTIGACIÓN GEOLÓGICO Y ENERGÉTICO**

E n . T e

TORREFUERTE ingeniería estructural

CONTENT

LOCATION

AMAZON REGION

● ECUADOR ● NAPO ● TENA ● FUNNEL HOUSE

COST-TARGET MARKET

TENA CANTON: 7 PARISHES

POPULATION CHARACTERISTICS TENA CANTON

- INHABITANTS: 60.880
- POPULATION DENSITY: 234 hab / sq mi
- SURFACE: 1507 sq mi

TENA CITY AND NAPO RIVER

POPULATION SETTLEMENT

SCATTERED

HOUSING TYPOLOFY

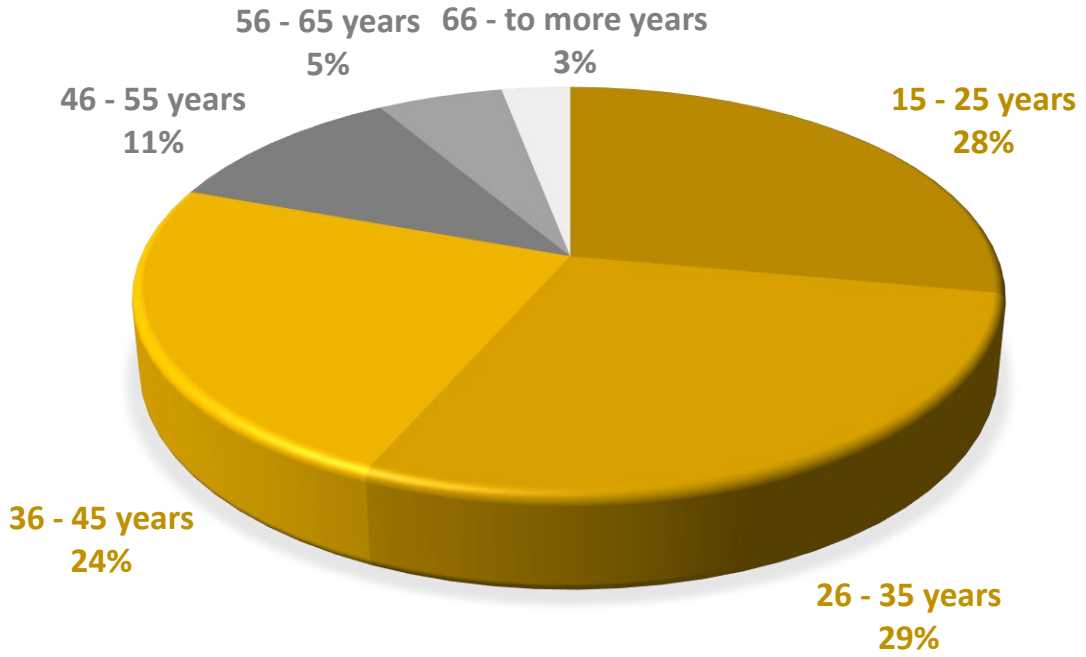
OWN HOUSING

ECONOMIC DEVELOPMENT

AGRICULTURE

POTENTIAL CLIENT

Young population between 15 and 35 years of age, with medium-high economic potential.

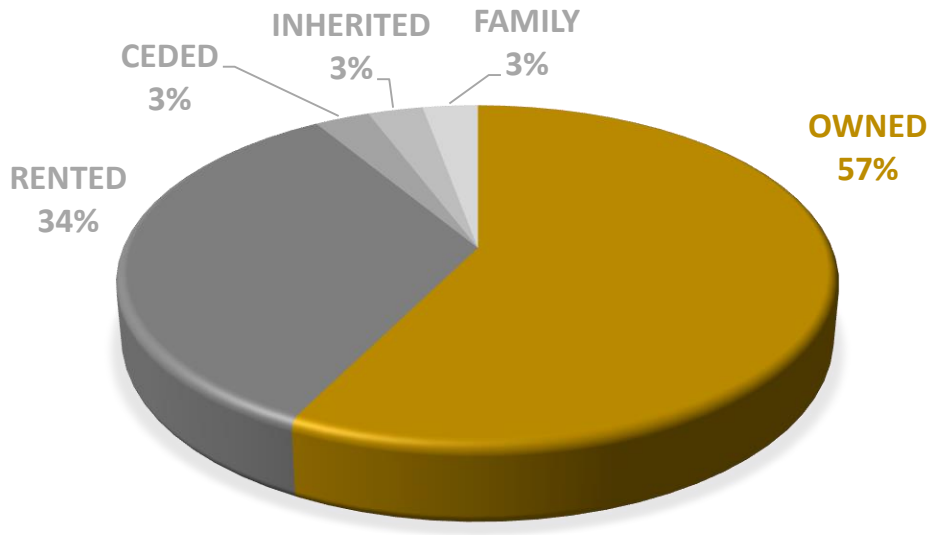


KICHWA FAMILIES

Residence is patrilocal: the wife moves to live in the house of the parents of the husband and is considered part of that family.

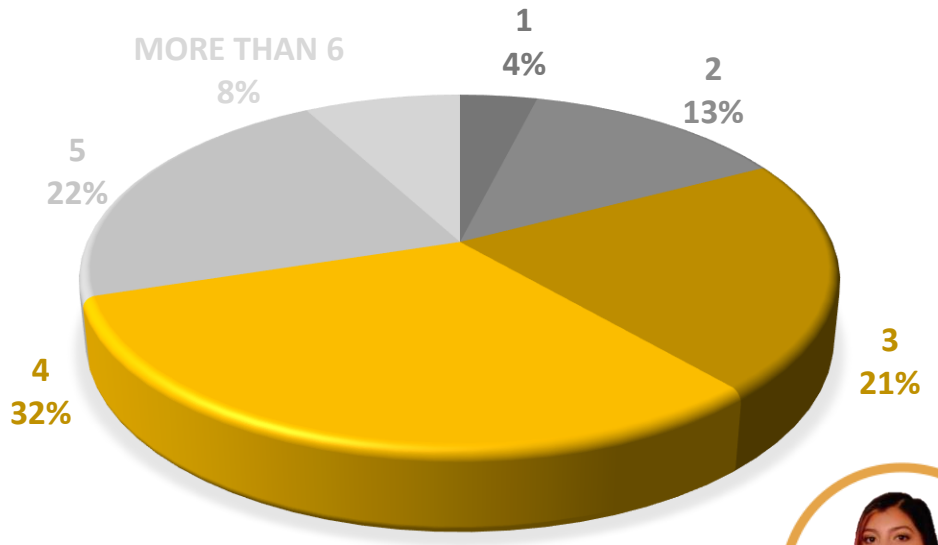
HOUSING

57% Owned house market potential



NUMBER OF PEOPLE PER HOUSE

53% 3-4 inhabitants market potential



AVERAGE HOUSING IN PANO

AVERAGE MATERIALS

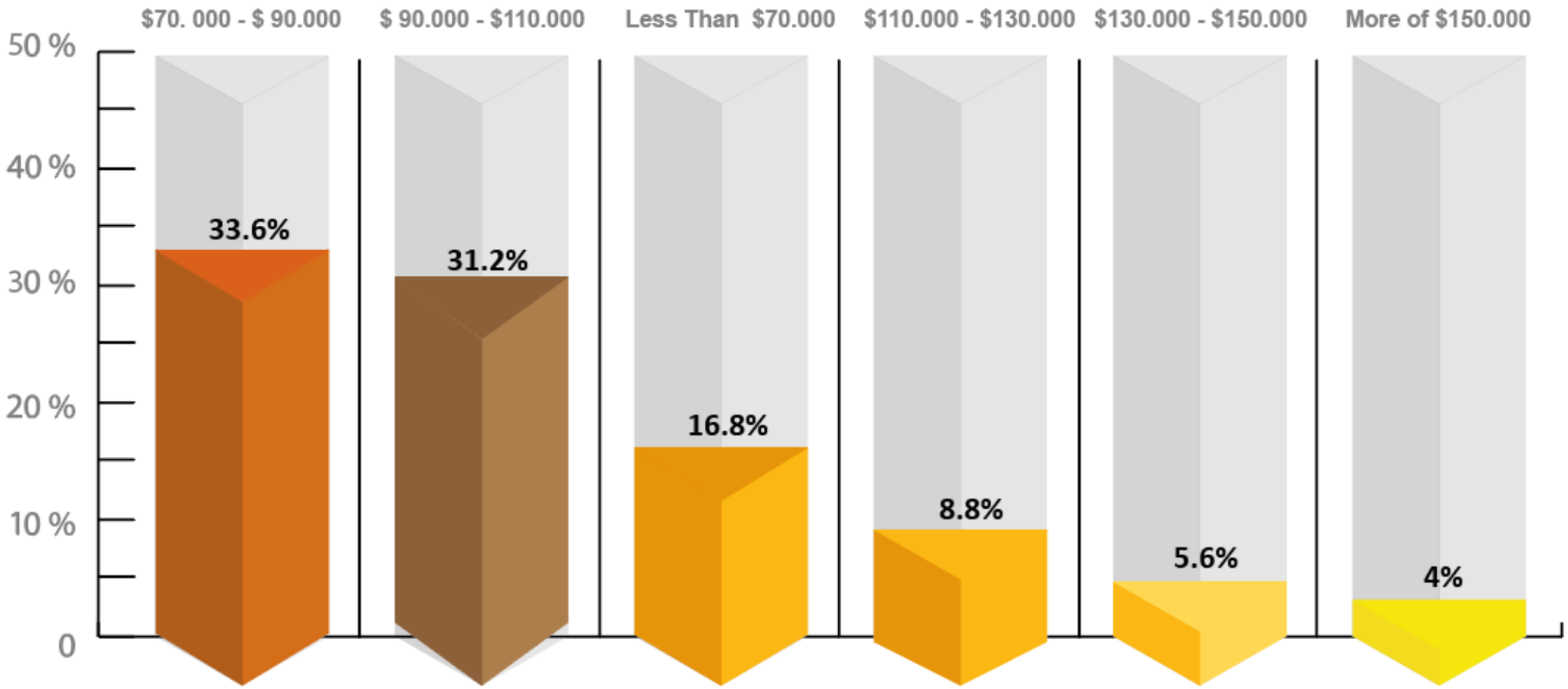
Zinc = 81%

Wood = 78%

AVERAGE PRICE

$30- $40
PER SQUARE
FEET- FT²

House Price - 1200 sq ft
$36 000 - $48 000


$70. 000 - $ 90.000
$ 90.000 - $110.000
Less Than $70.000
$110.000 - $130.000
$130.000 - $150.000
More of $150.000
50 %
40 %
30 %
20 %
10 %
0
33.6%
31.2%
16.8%
8.8%
5.6%
4%

COST-BENEFIT

FUNNEL HOUSE $62.811 / $37,2 PER SQ FEET

COSTRUCTION COST

01 LOT- SITE
Lot size of 10,000.00 m²
Cost: $20.000

02 LABOR
Corresponds to 25% of the budget.
Cost: $16.968

03 MACHINERY
Corresponds to 11.6% of the budget.
Cost: $7.000

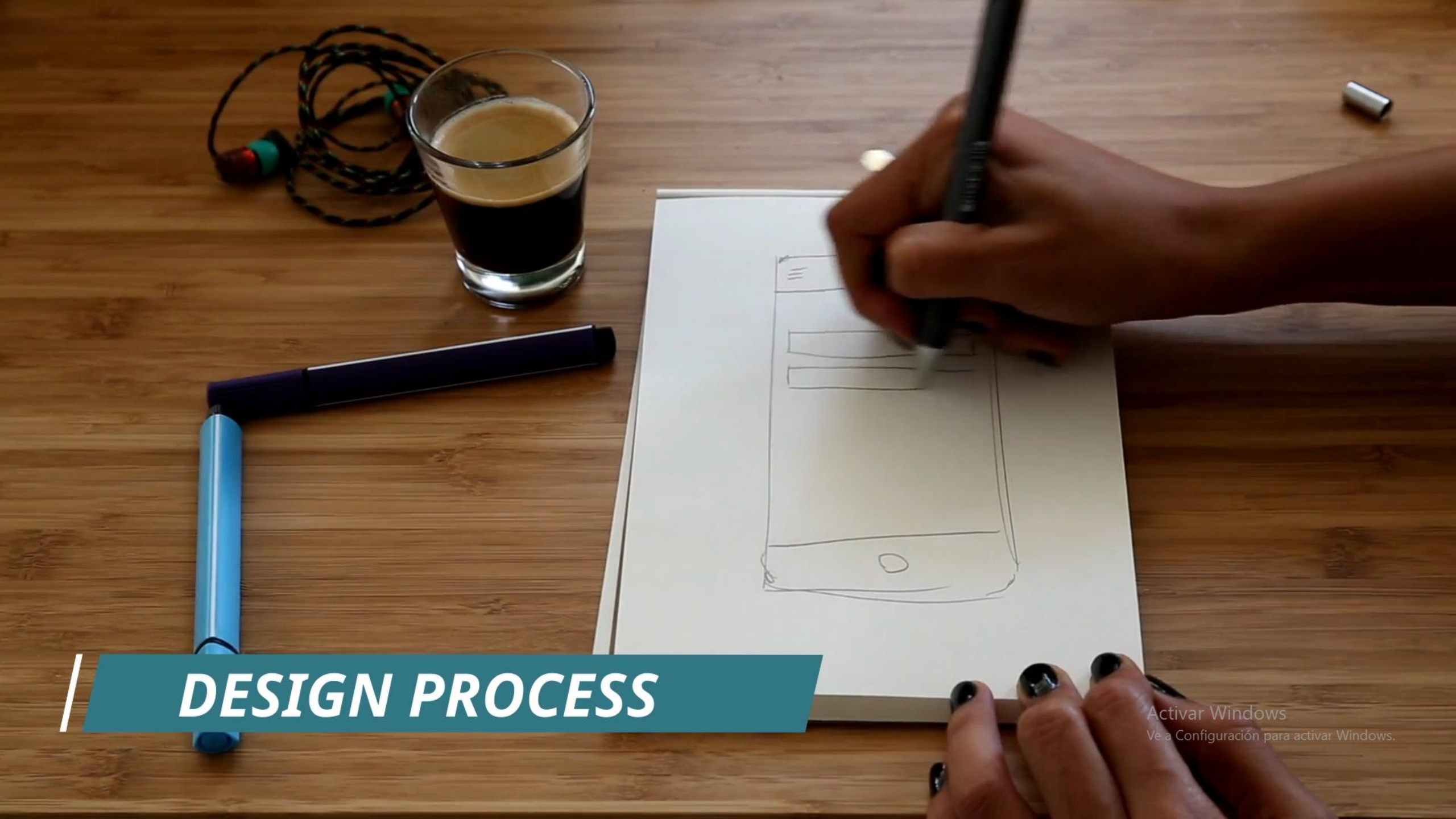
04 HOME APPLIANCES
Corresponds to 3.95.6% of the budget.
Cost: $2.484

05 MATERIALS
Corresponds to 58% of the budget.
Cost: $38.832

06 TOTAL COST OF THE DWELLING
Cost: $62.811

A MAINTENANCE COST
Corresponding to 3% of the total cost.
Cost: $1.804

B CONSTRUCTION TIME
The time to carry out the project is 51 days.



ENVIRONMENTAL CONDITIONS

Maximum temperature: 89,60°F
Minimum temperature: 57,20°F

Humidity: 81%-92%

Maximum precipitation: 38553.1 mm

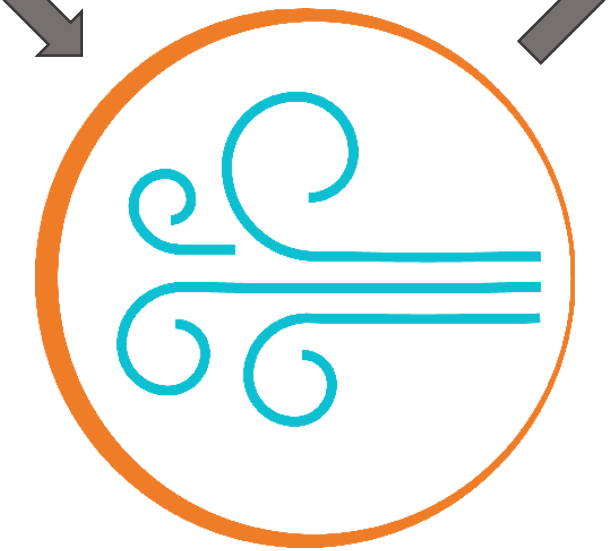
Months with high cloudiness: February and July.

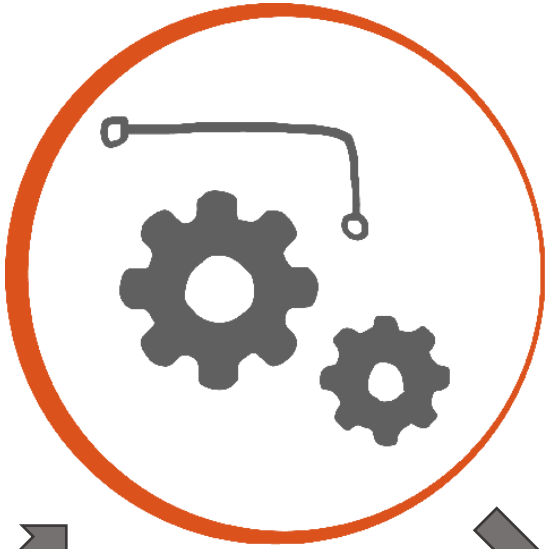
Months with the most hours of sunshine per day: tropical: July and August.

¨ The building needs to be cooled down, and the relative humidity needs be lowered ¨

Analyzes the environmental and user's conditions

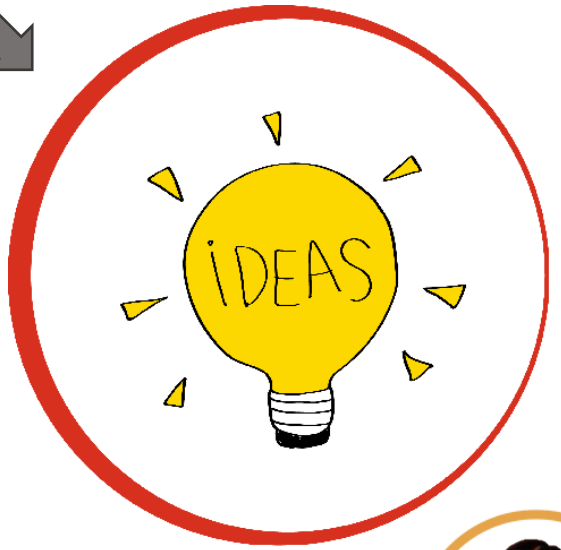
Passive strategies

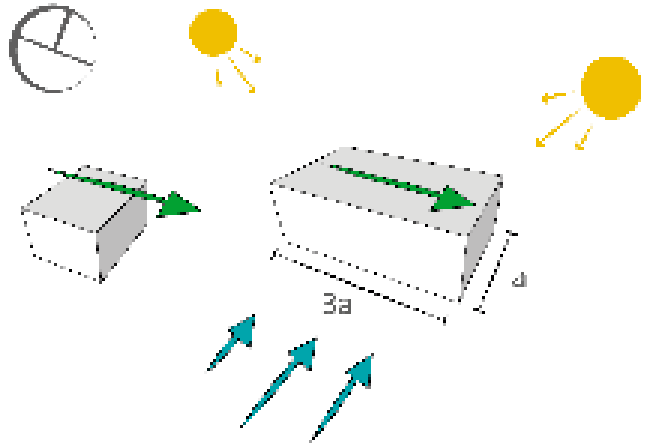




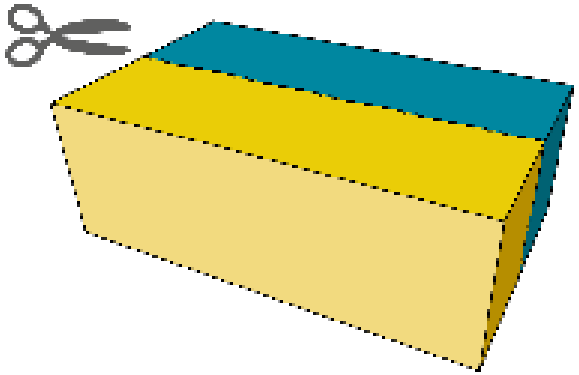
Technologies

Design



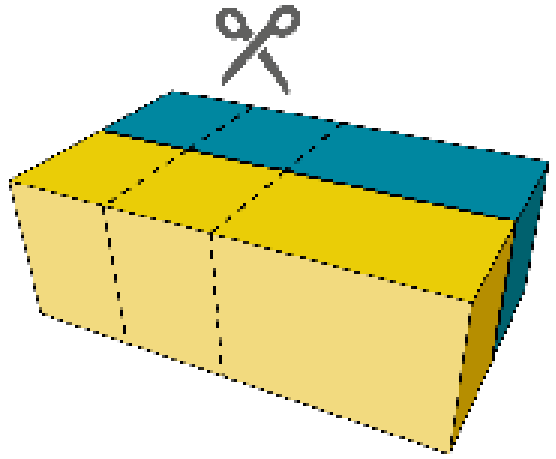


1 Elongated form:
Minimize solar exposure
Maximize South ventilation

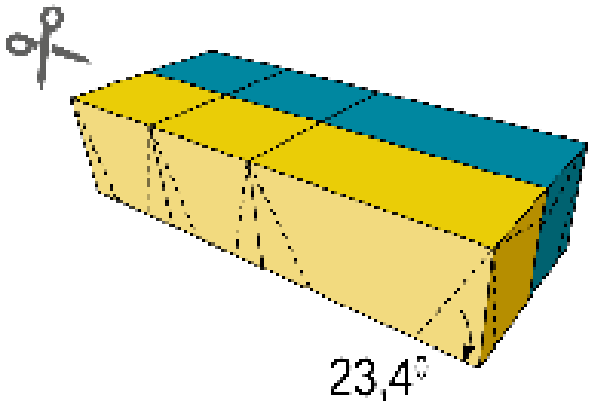


2 Open-social spaces:
Natural ventilation

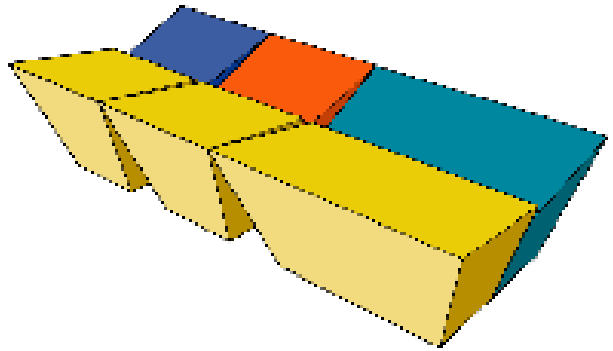
Closed-private spaces:
Improved comfort



3 Modularity=Progressive growth

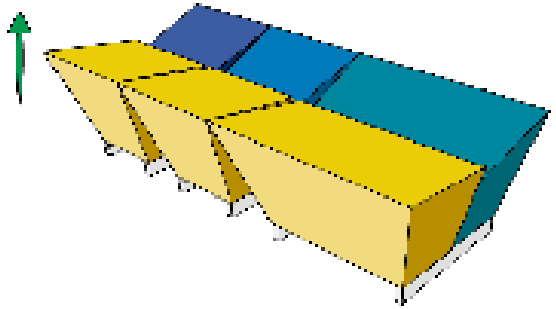


4 23,4° wall inclination to avoid the Sun



5 Unify, separate and ventilate hot spots

- Dining room
- Kitchen - Bathroom - cellars.
- Bedrooms.



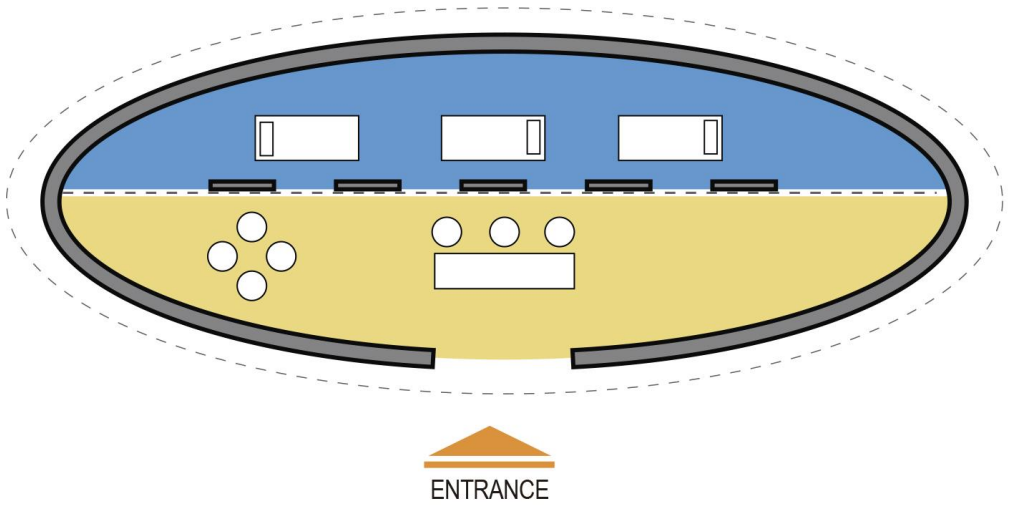
6 The building is raised from the ground, to:
- Allow air circulation under it.

ARCHITECTURE

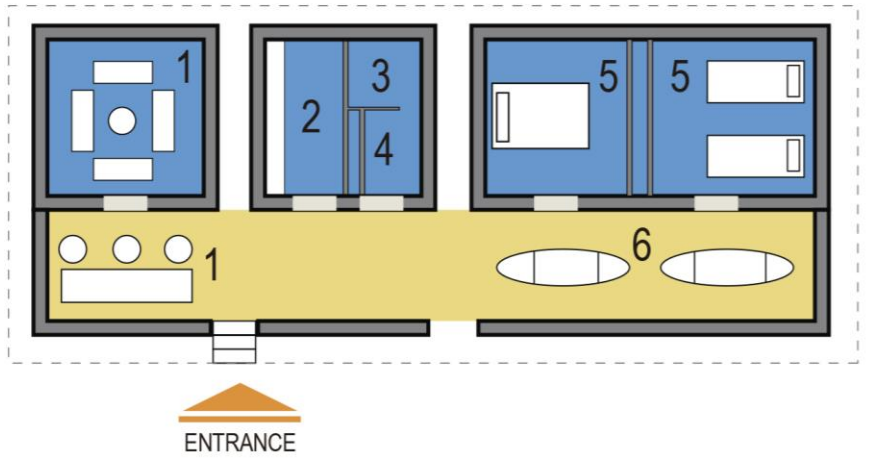
Settlers Residence

Vernacular Residence

Vernacular Housing



Funnel House



1.- Living room, dinning room
2.- Kitchen
3.- Bathroom
4.- Cellars, ducts
5.- Bedrooms
6.- Hammock room

"Ekent"
Private Space

"Tankamash"
Social Space


Bedrooms
Kitchen- Bath room
Leaving Room
Social Spaces


FUNNEL
HOUSE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HOUSE

MATERIALITY IN INTERIOR DESIGN

OSB Or Oriented Fiber Boards

Bamboo

Ecological stucco of cal

Narrow Slatted toasted bamboo board -VT


CONFORT

Air quality

water

Thermal comfort

Physical health

Acoustic comfort

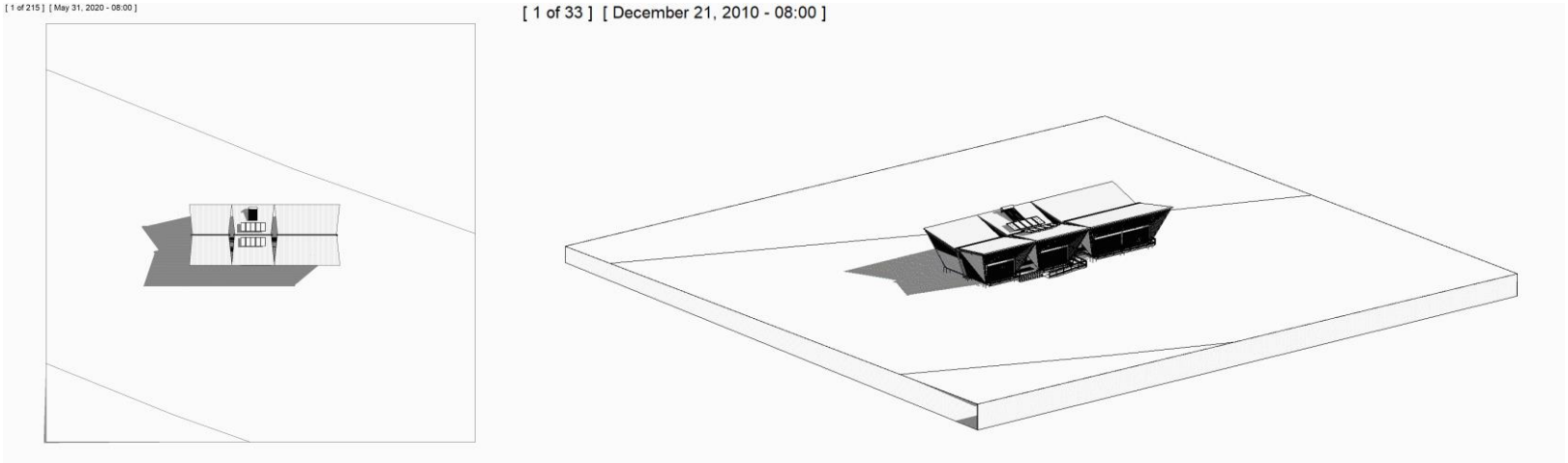
food nourishment

Community

Materials

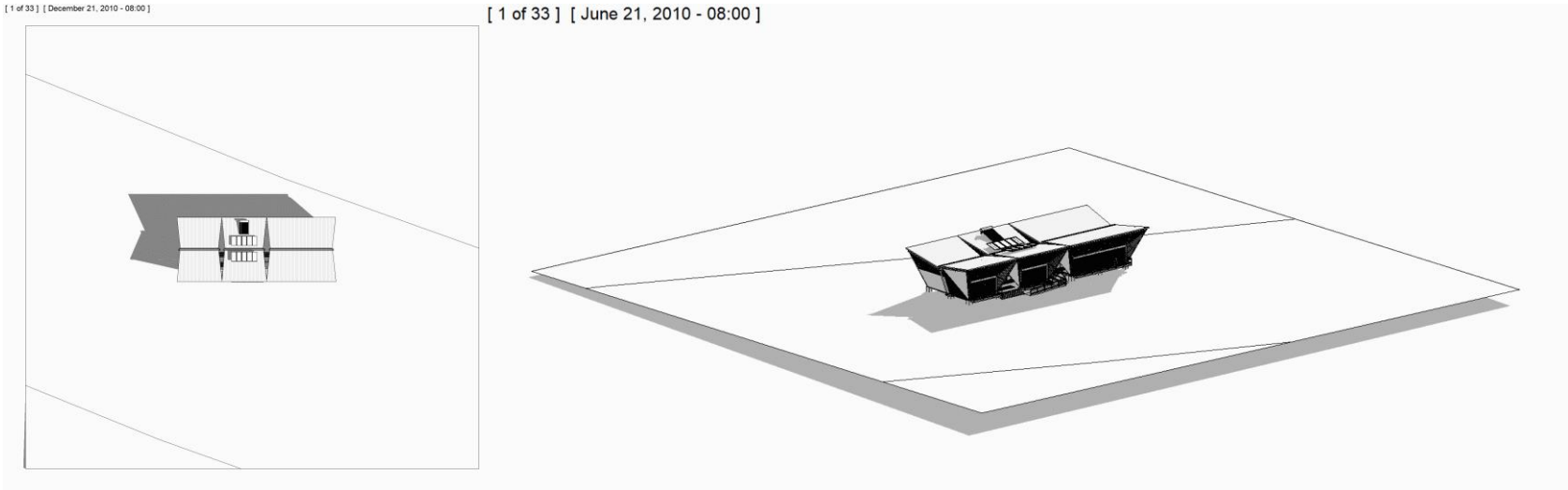
illumination

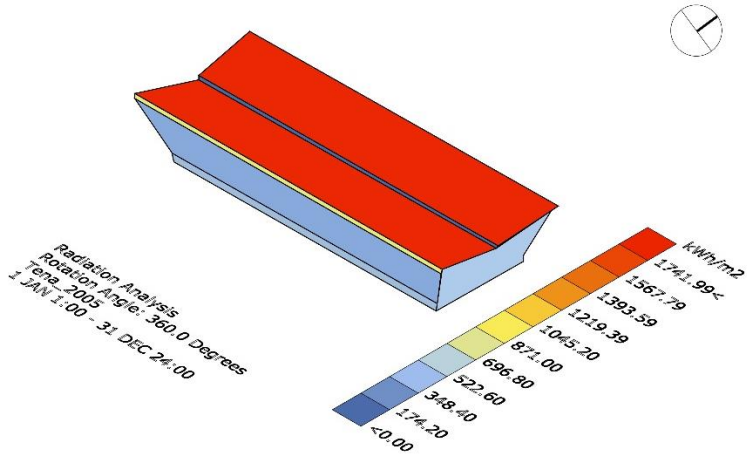
Innovation



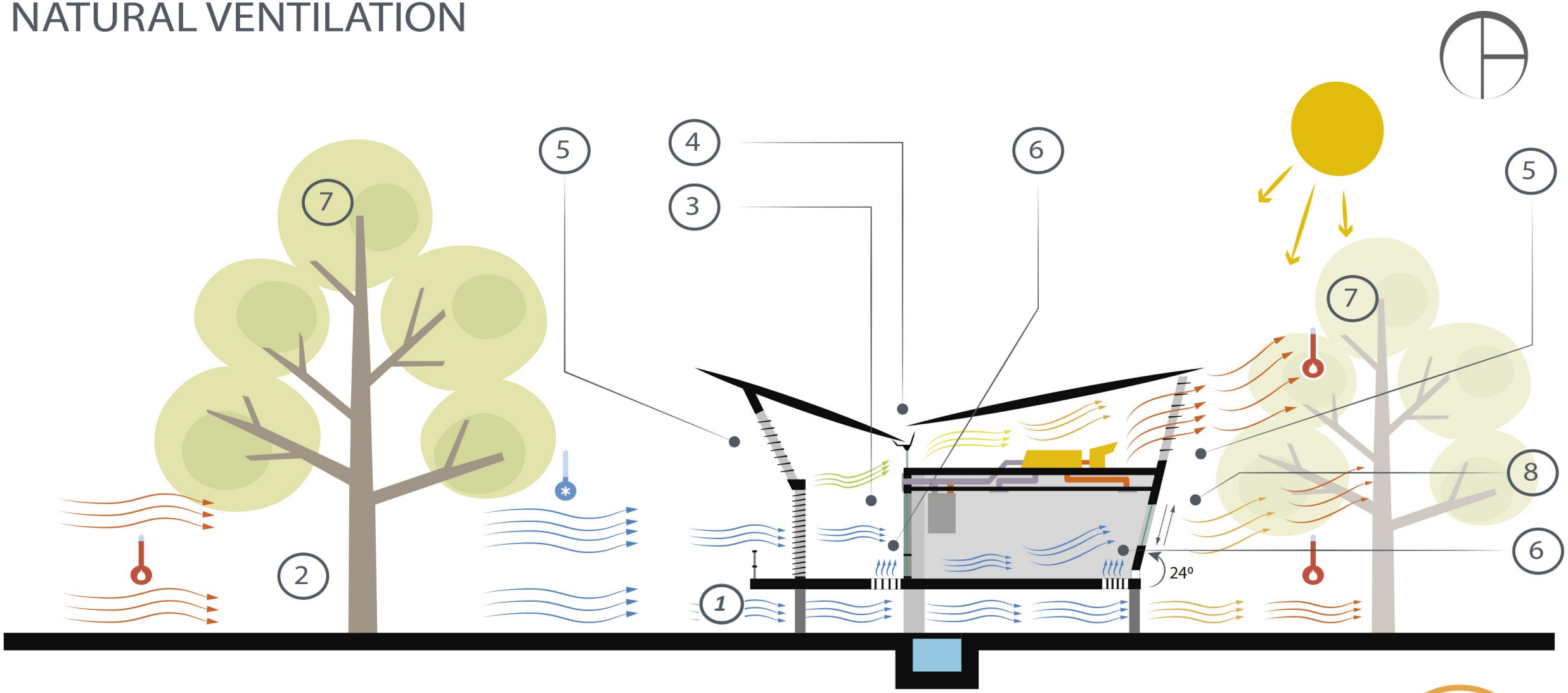
Natural Light Analysis

Natural Light
Best Orientation
Best Radiation

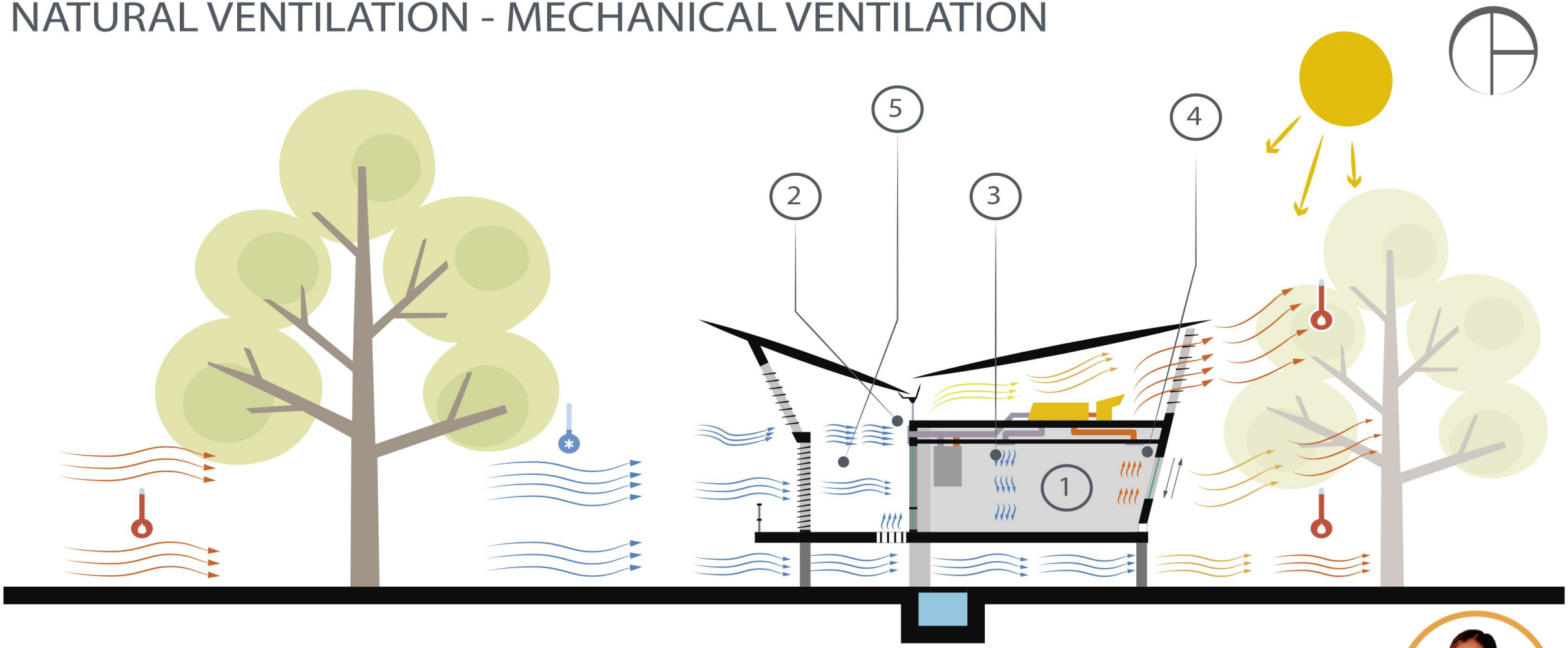




NATURAL VENTILATION



NATURAL VENTILATION - MECHANICAL VENTILATION



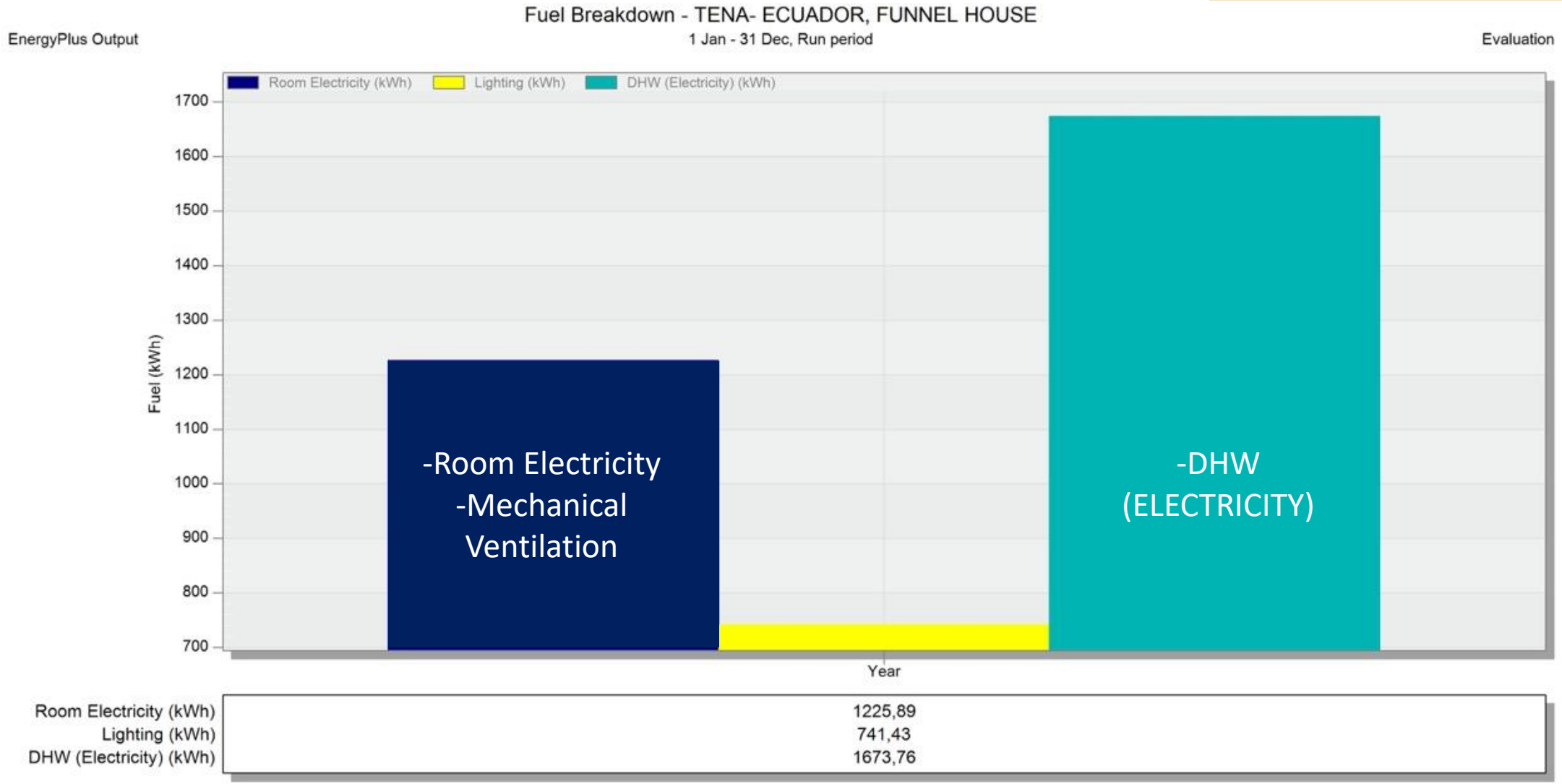

ENERGY PLUS HOUSE

Latitude 0°
High solar irradiation

FV energy production		House´s energy consumption		Excess returned to grid
5807 kWh/year	-	**4338** kWh/year	=	**1469** kWh/year

J3M
ciudadania - ambiente - energia
KEY PARTNER

FUNNEL HOUSE

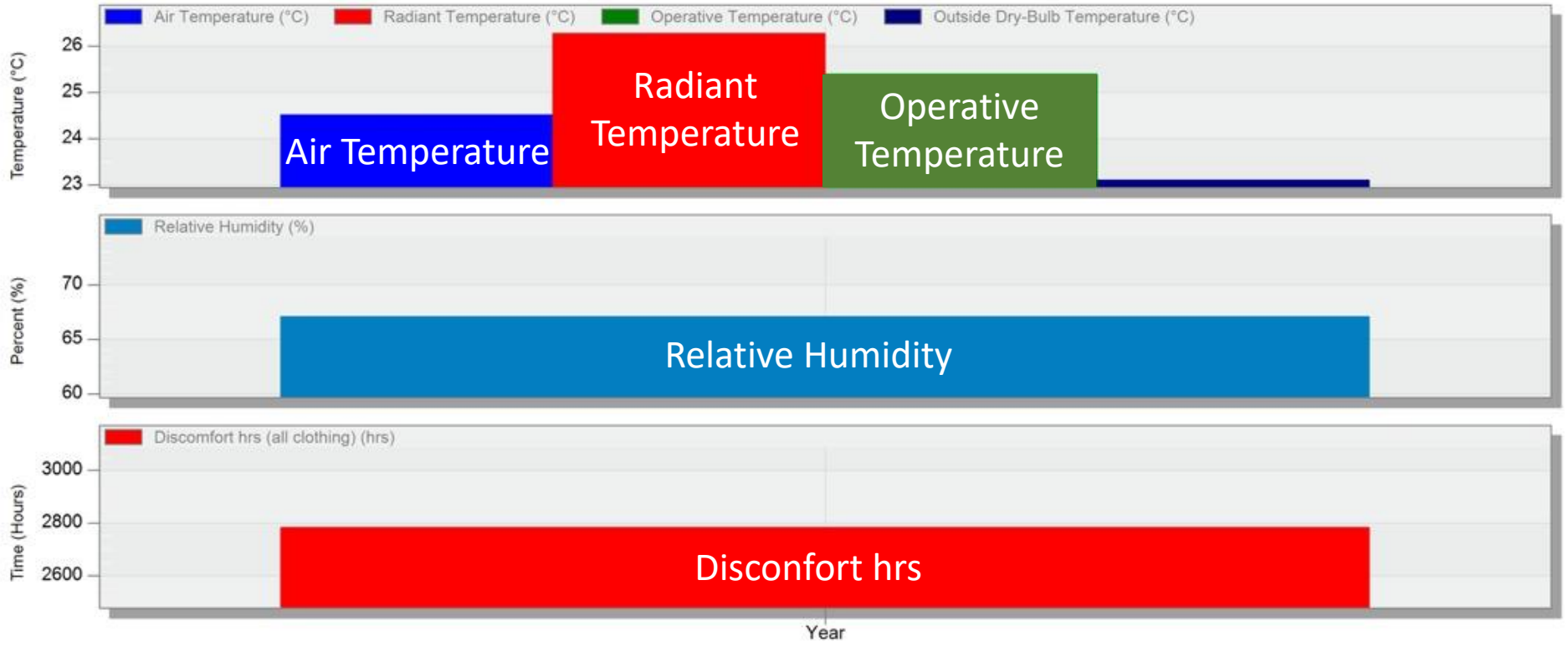

Fuel Breakdown - TENA- ECUADOR, FUNNEL HOUSE
1 Jan - 31 Dec, Run period
EnergyPlus Output
Evaluation
Room Electricity (kWh)
Lighting (kWh)
DHW (Electricity) (kWh)
Fuel (kWh)
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
-Room Electricity
-Mechanical
Ventilation
-DHW
(ELECTRICITY)
Year
Room Electricity (kWh) 1225,89
Lighting (kWh) 741,43
DHW (Electricity) (kWh) 1673,76

Comfort - TENA- ECUADOR, FUNNEL HOUSE

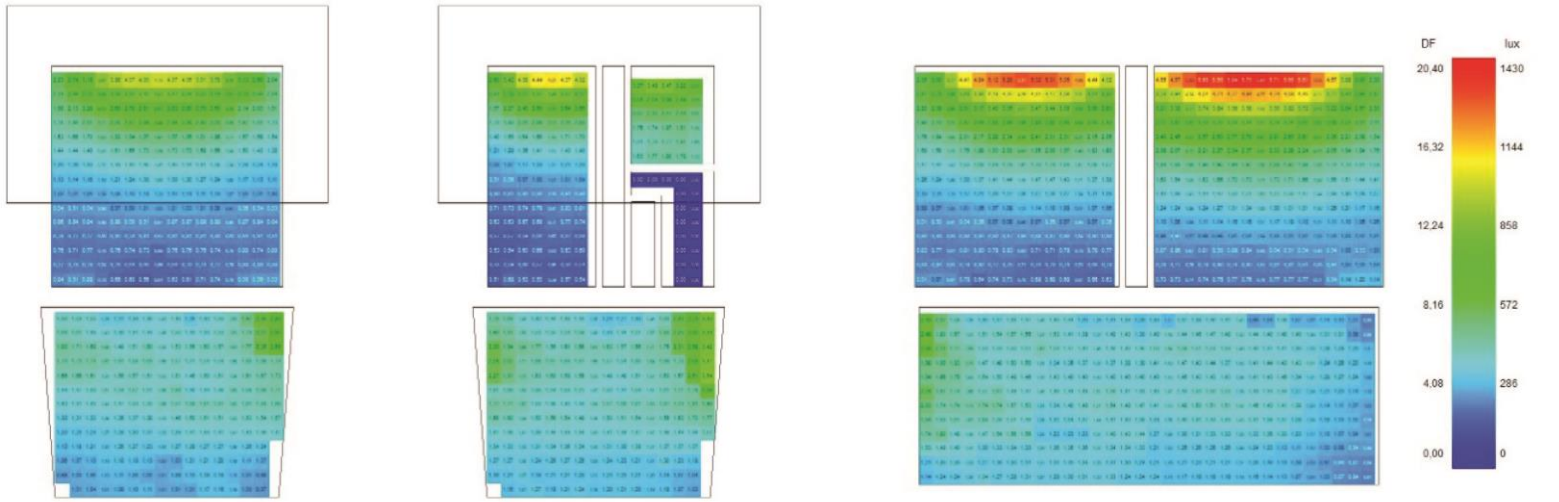
EnergyPlus Output

1 Jan - 31 Dec, Run period

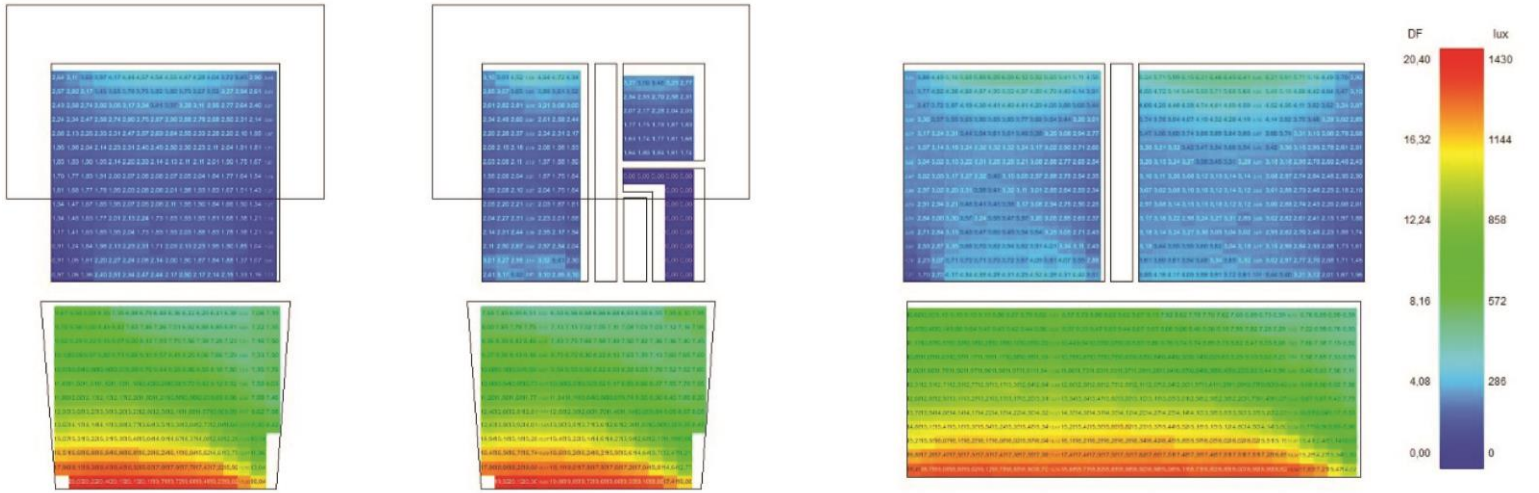
Evaluation



Air Temperature (°C)	24,51
Radiant Temperature (°C)	26,26
Operative Temperature (°C)	25,39
Outside Dry-Bulb Temperature (°C)	23,11
Relative Humidity (%)	67,04
Discomfort hrs (all clothing) (hrs)	2783,07



Daylight



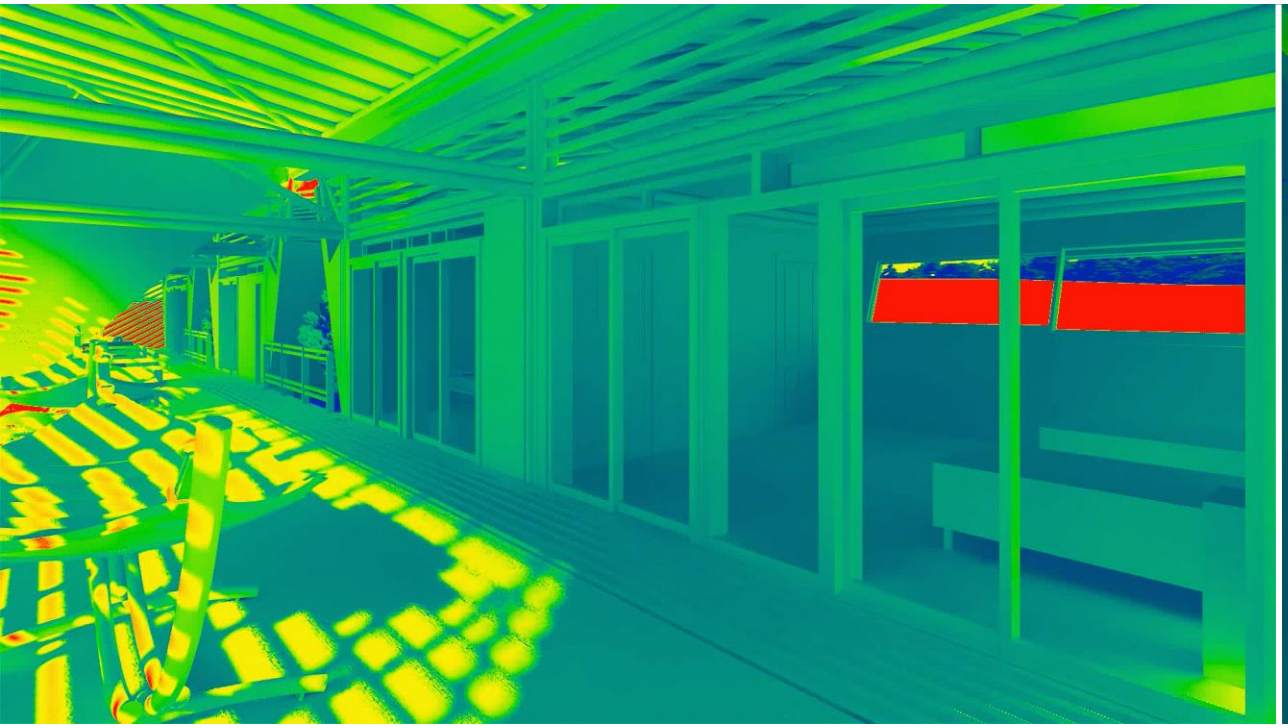
AfternoonLight

Lighting Analysis

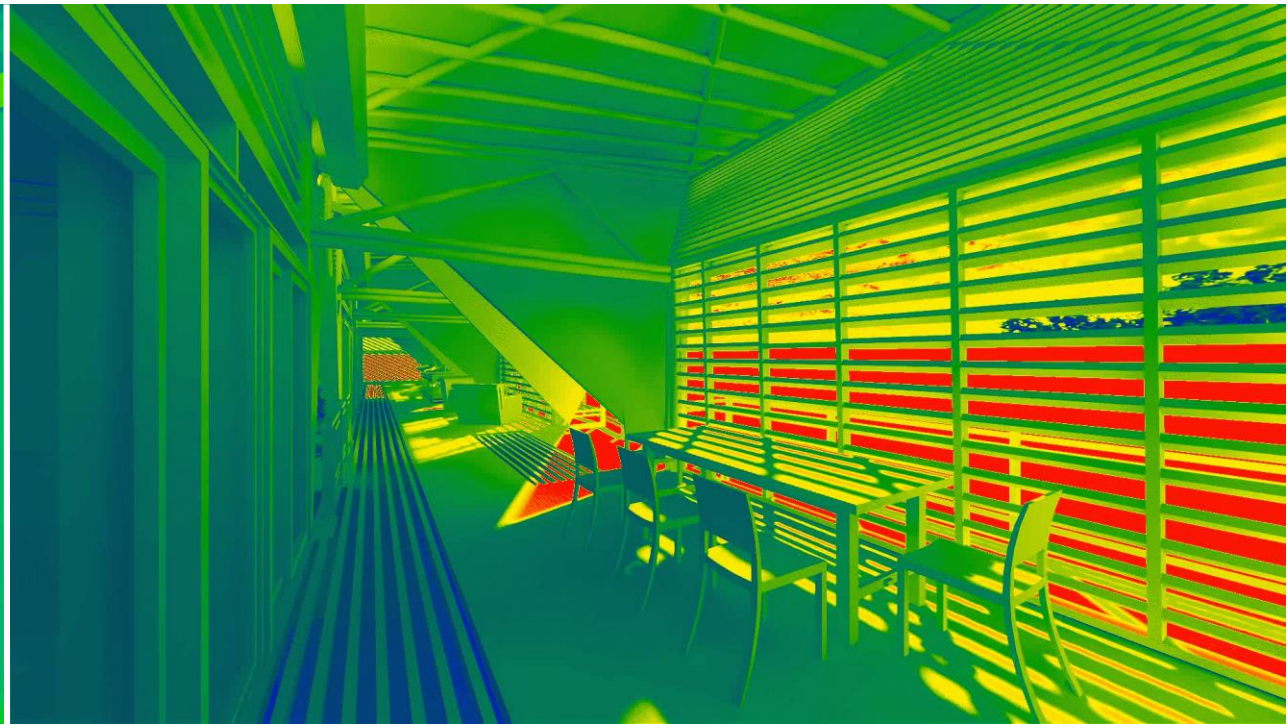
Interior Light
Natural Light

Housing area	lux min	lux recom.	lux optimal
Living Room	200	300	500
Kitchen	100	150	200
Bedroom	100	150	200
Studying room	300	500	750
Circulation	50	100	150
Badroom	100	150	200

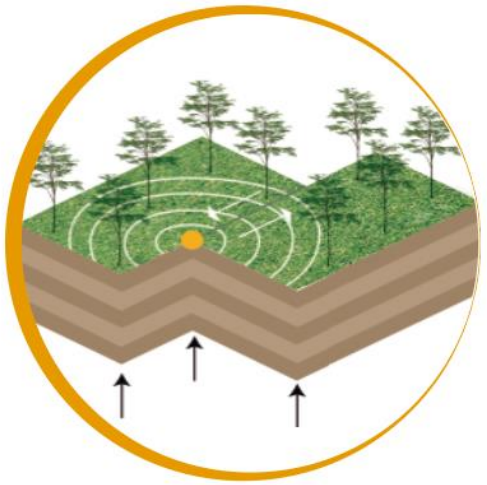
Lighting Analysis



VIDEO DAYLIGHT



VIDEO AFTERNOONLIGHT



Earthquake

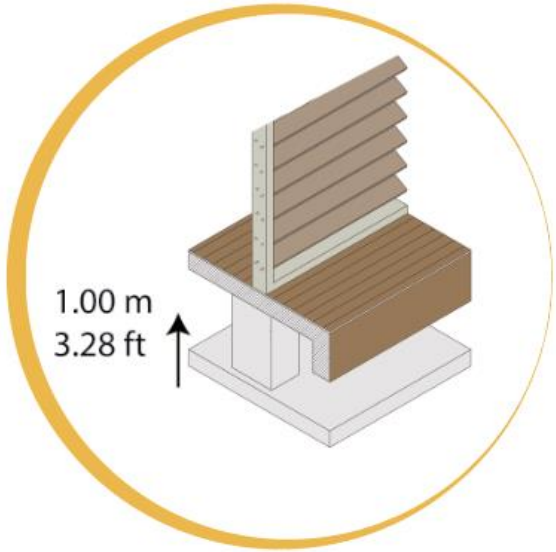
Structure

Isolation

Recreational Spaces
+
Local food producction
+
Internet Connection

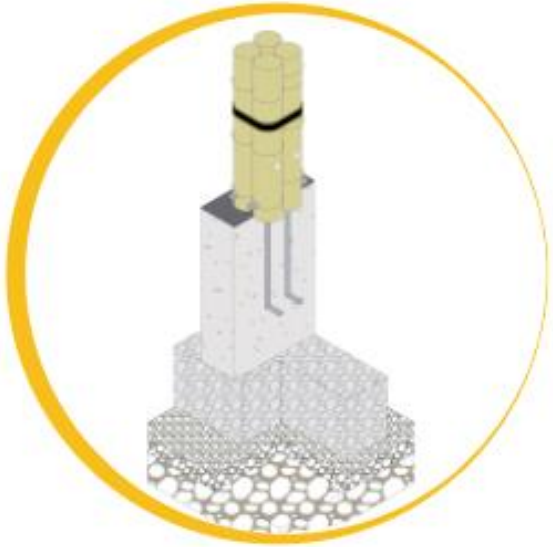
Floods

Raise a terme

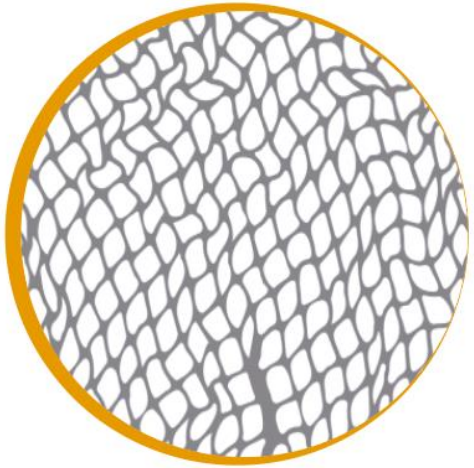


Land Sliding

Soil Improvement



Insects



AntiBug Layer

Deforestation

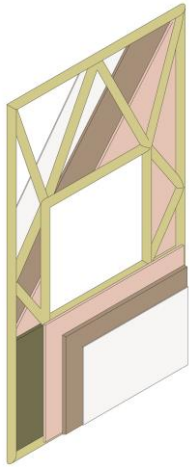
Certified Wood


STRUCTURE

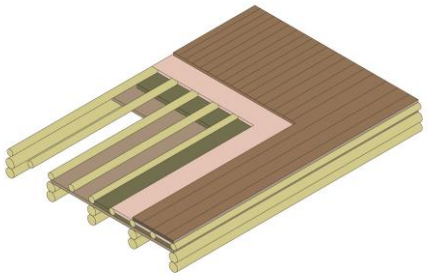
Exo - Structure

Concrete Foundation
Bamboo Structure

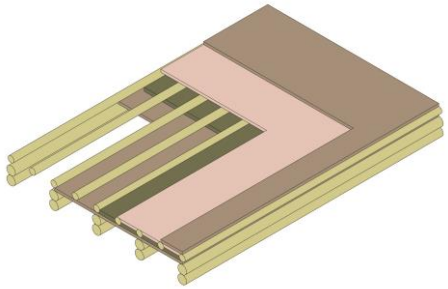
Wall System



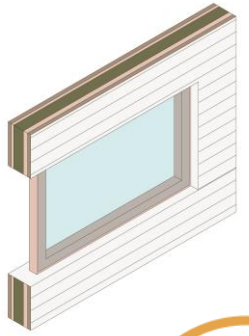
Floor System



Roof System



Window System



BAMBOO -GUADUA ANGUSTIFOLIA

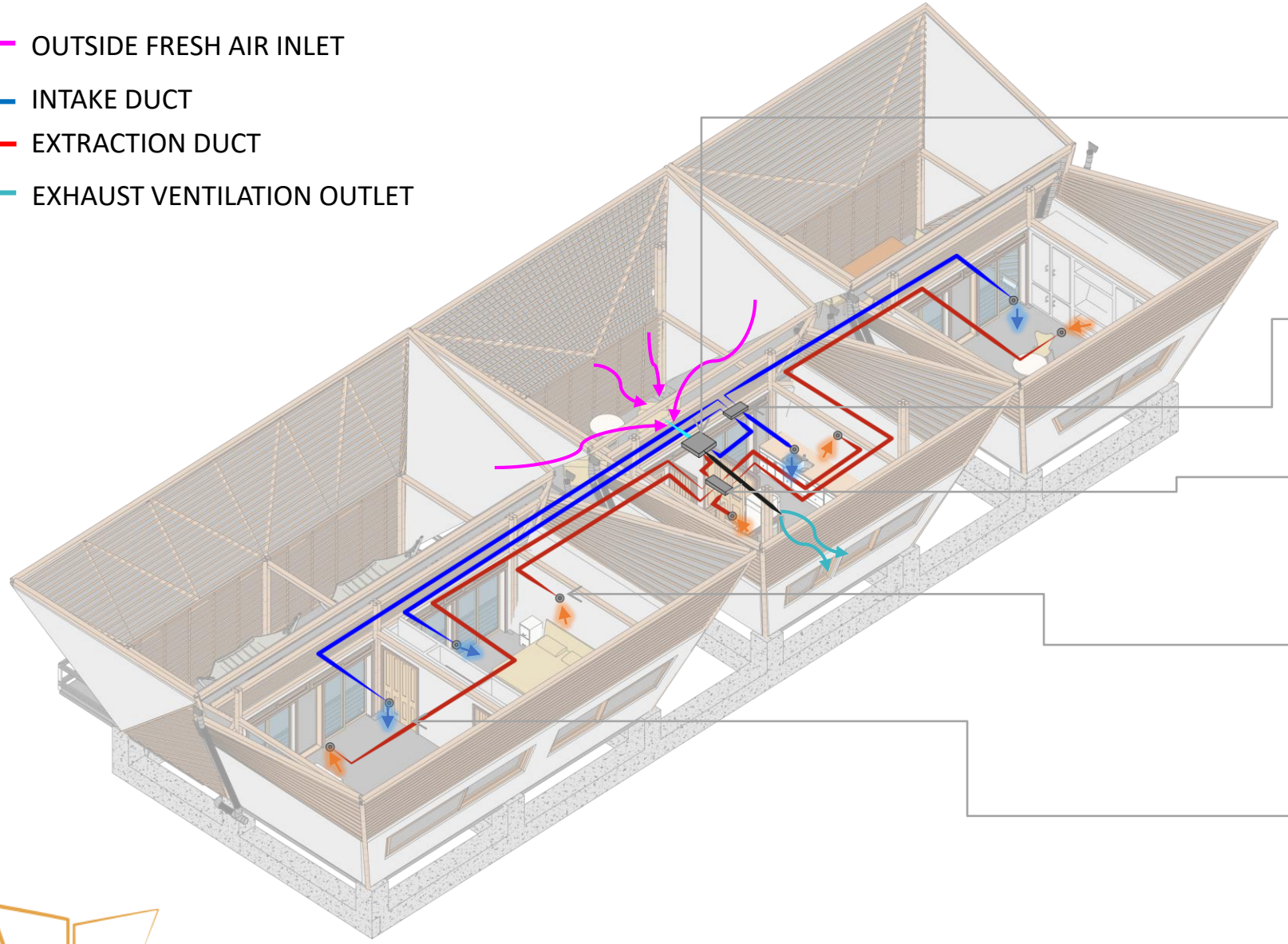
Lifetime	Stem Height	Diameter Radius	Compressive strength	Compression elasticity module	Felxural modulus
50 years	91.86 ft	0.49 ft	37.76	14.35 Gpa	12.16 Gpa

bambú ecuador

Ministerio de Desarrollo Urbano y Vivienda
NEC NORMA ECUATORIANA DE LA CONSTRUCCIÓN

ENGINEERING SYSTEMS

- OUTSIDE FRESH AIR INLET
- INTAKE DUCT
- EXTRACTION DUCT
- EXHAUST VENTILATION OUTLET



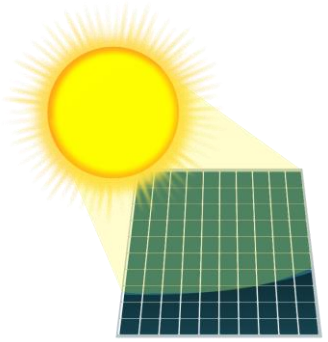
IDEO2
HIGH FLOW BACKFLOW
HEAT RECOVERY

DRIVE PLENUM

EXTRACTION PLENUM

BARJ / BARP SELF-REGULATING
EXTRACTION NOZZLE

PVC OR RECTANGULAR PLASTIC
DUCTS.

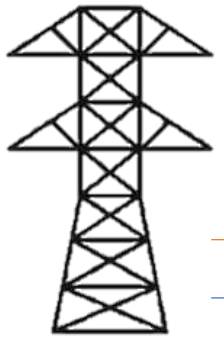


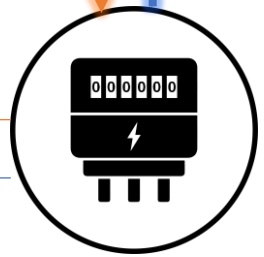
PHOTOVOLTAIC PANELS
CHEETAH HC 72M

INVESTOR FRONIUS
PRIMO 3.8-1

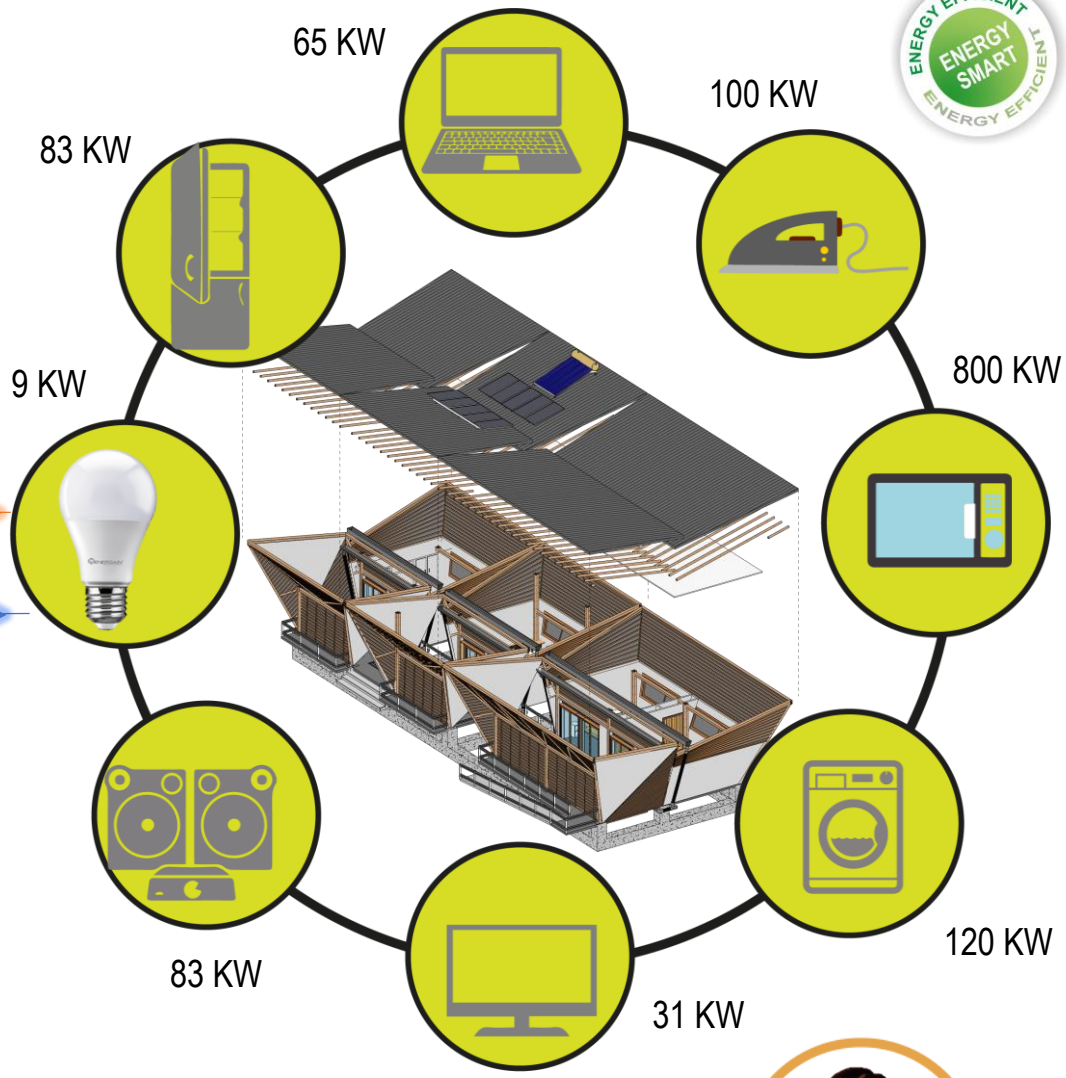
CONTROL PANEL
55 X 36 INCH

ELECTRIC GRID





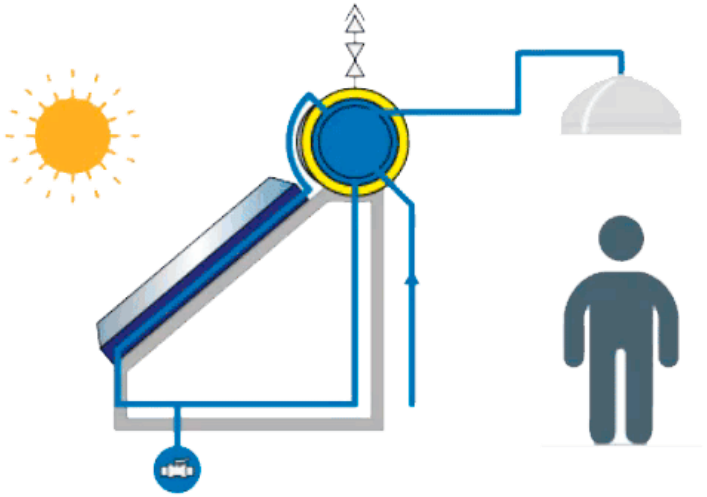
ELECTRIC POWER
METER

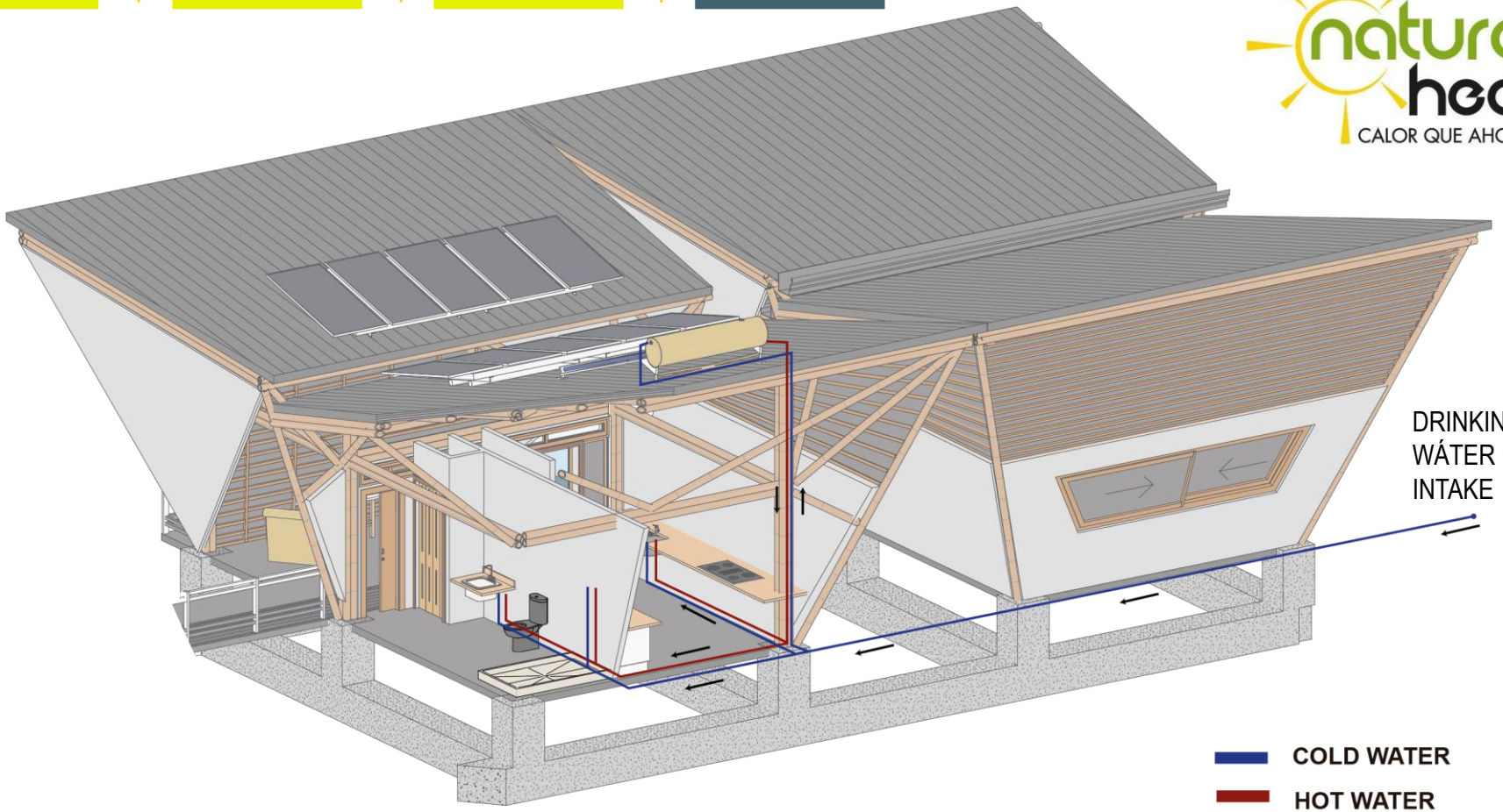


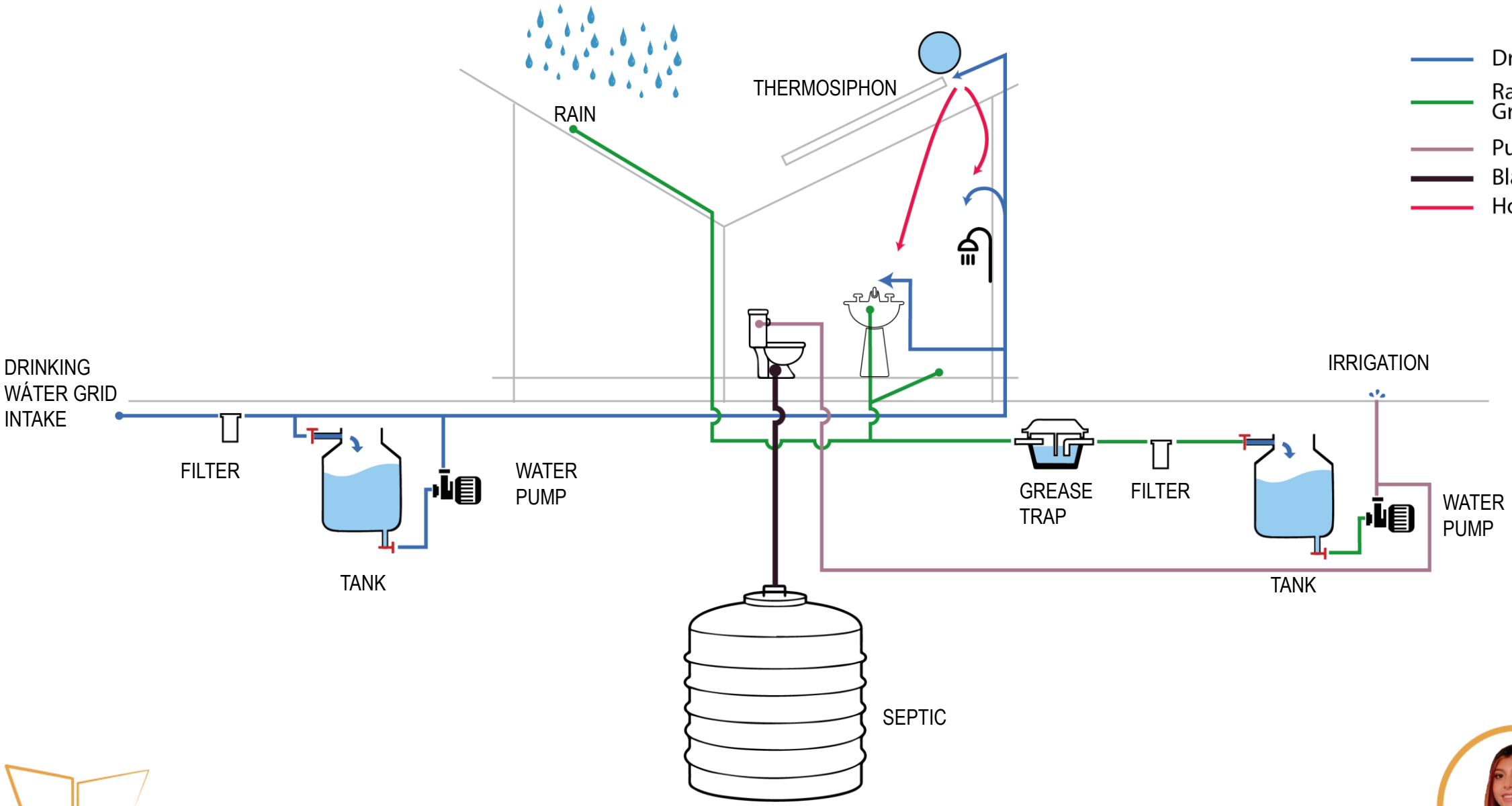
HOUSE ELECTRIC CHARGE

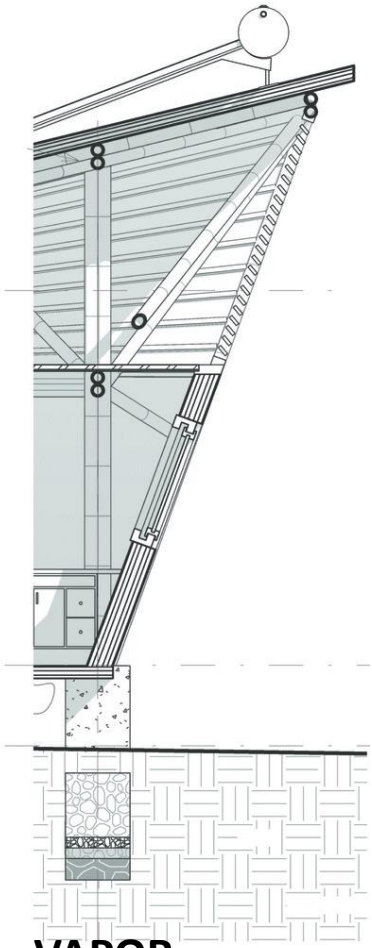
- BST THERMOSIPHON

CAPTUR → TRANSFORMATION → EXCHANGE → ACCUMULATE → HOT WATER

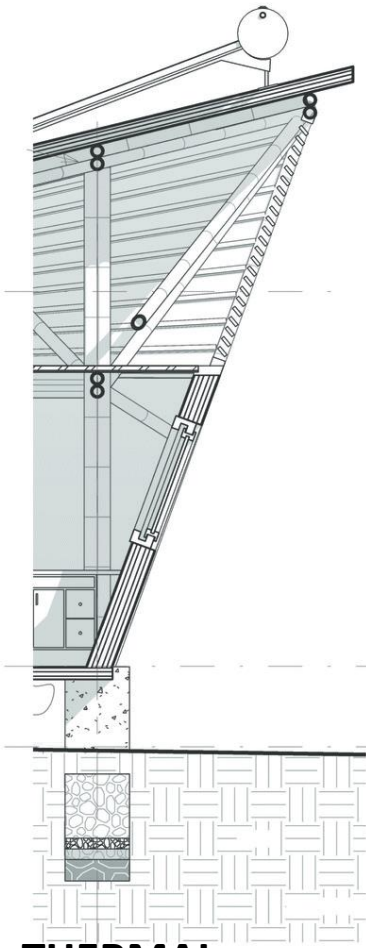




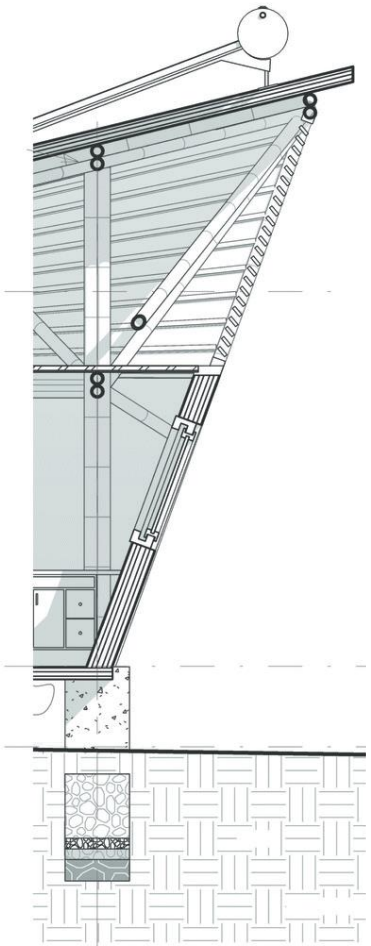

Drinking wáter
Rain Water
Grey waters
Purified water
Black waters
Hot waters
RAIN
THERMOSIPHON
DRINKING
WÁTER GRID
INTAKE
FILTER
TANK
WATER
PUMP
GREASE
TRAP
FILTER
IRRIGATION
TANK
WATER
PUMP
SEPTIC



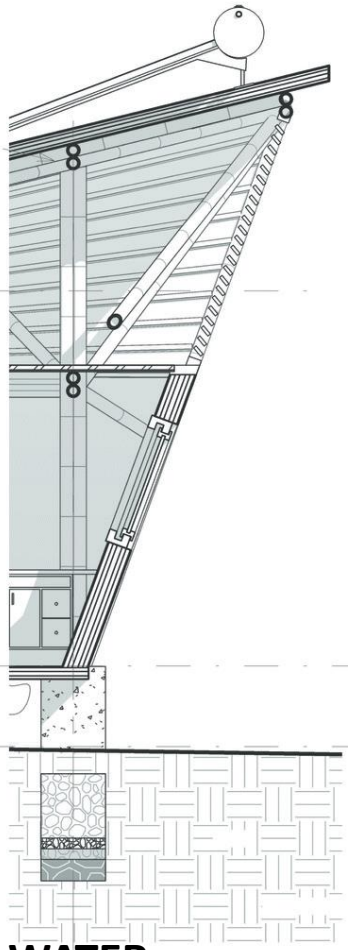
VAPOR



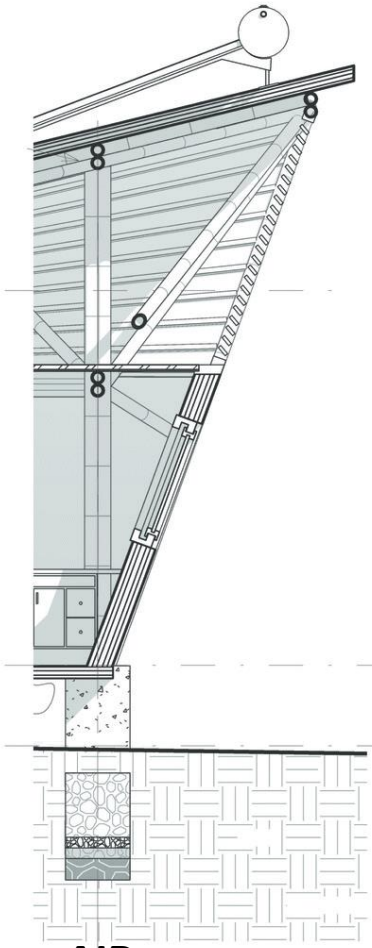
THERMAL



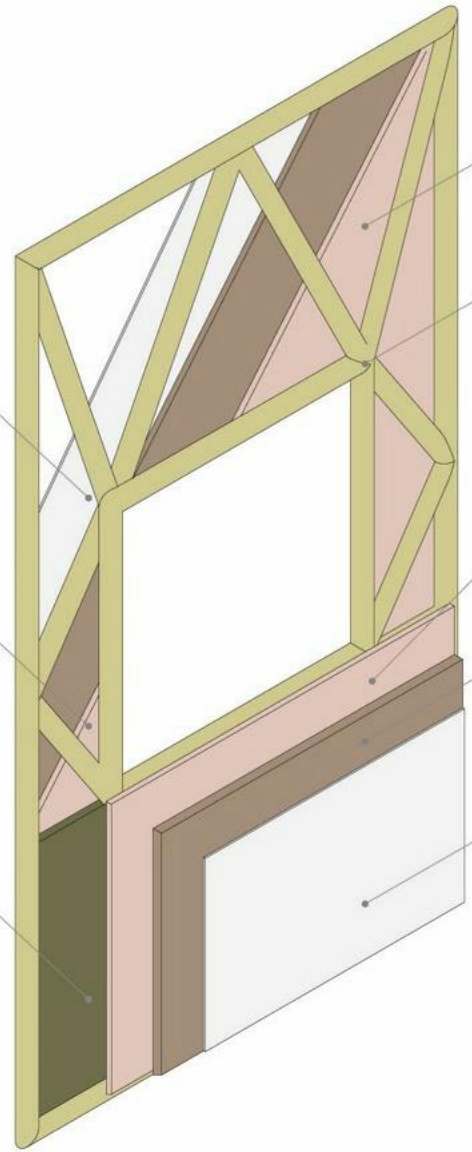
ACOUSTICS

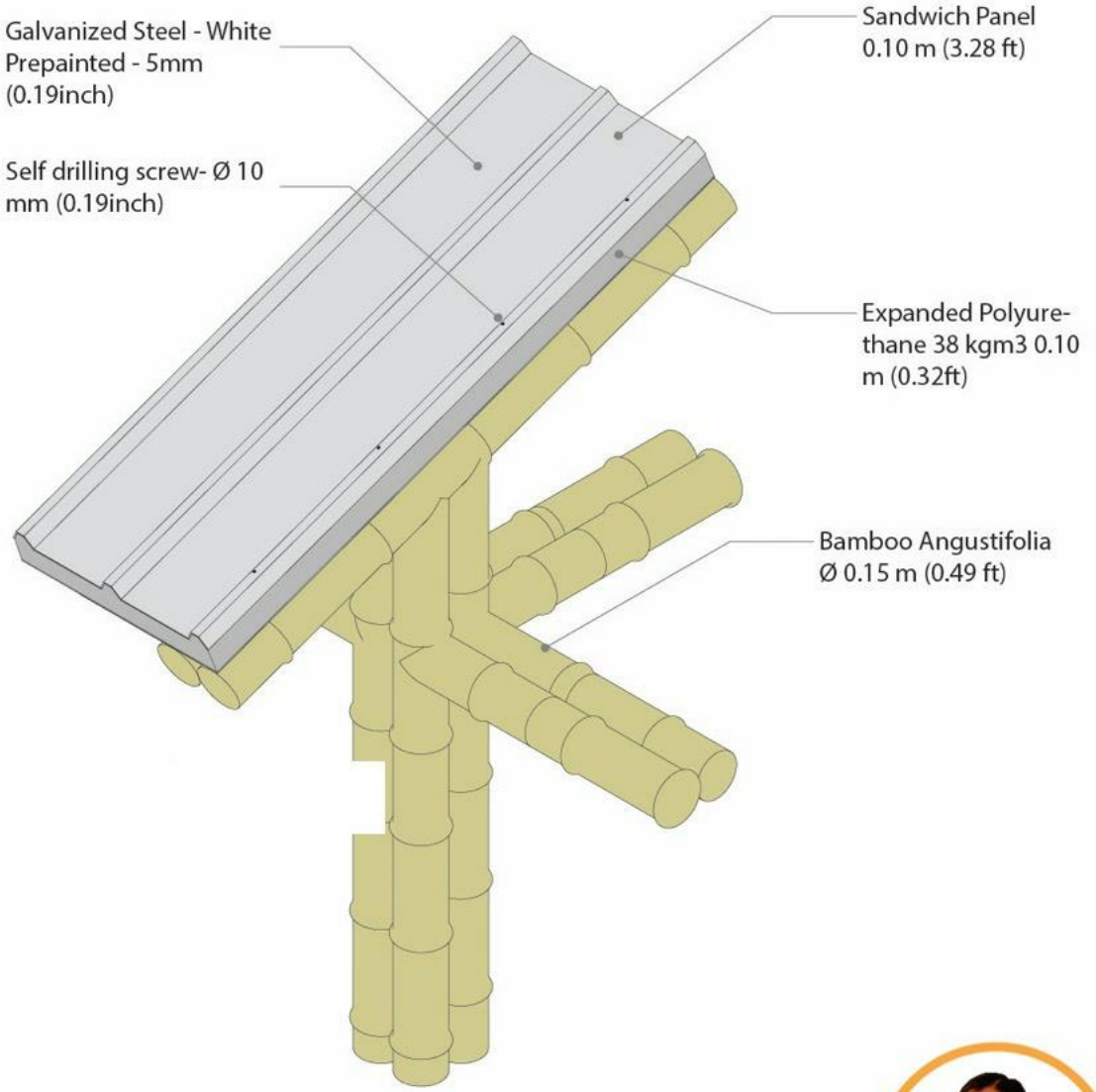


WATER



AIR





LOCAL MATERIAL, LABOR AND RESEARCH

Pintuco CONSTRUCCIÓN

Stuco

NOVOPAN PANELES DE MADERA

OSB panels

EcuaPoliuretanos

Vapor resistant foam

bambú ecuador

Certified wood

ESPE University
Universidad de las Fuerzas
Armadas de Ecuador

Palm fiber insulation research

PALM FIBER

Natural fiber used as insulation for temperature, research by ESPE University

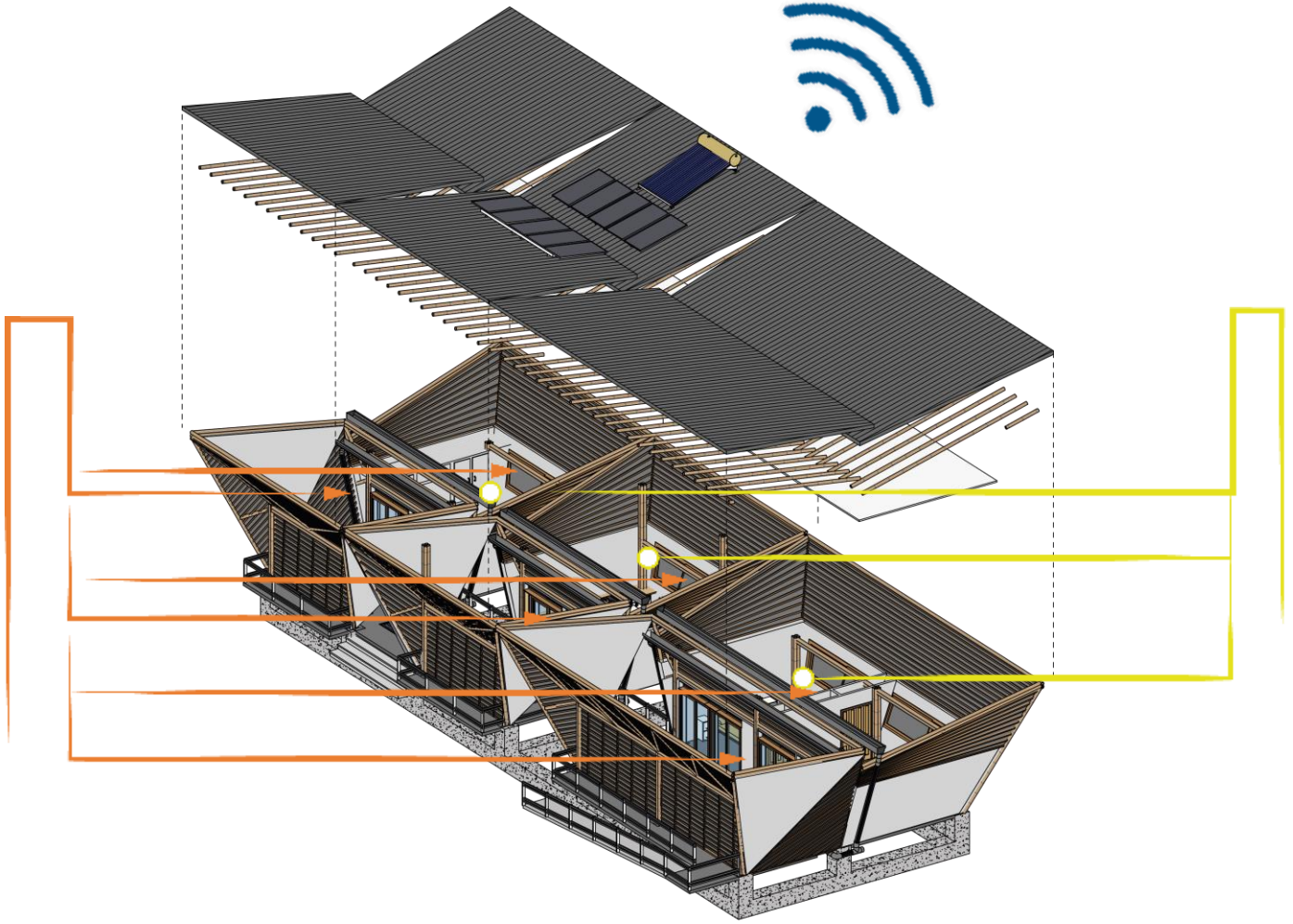
FIBER	Density (g/m3)	(W/K.m)
Glass Wool	0.011	0.045
NATURAL FIBER		
Palm Fiber	0.078	0.032


SMART BUILDING

Magnetic Contac Device

Motion sensor

Camera



Smart Thermostat

Control

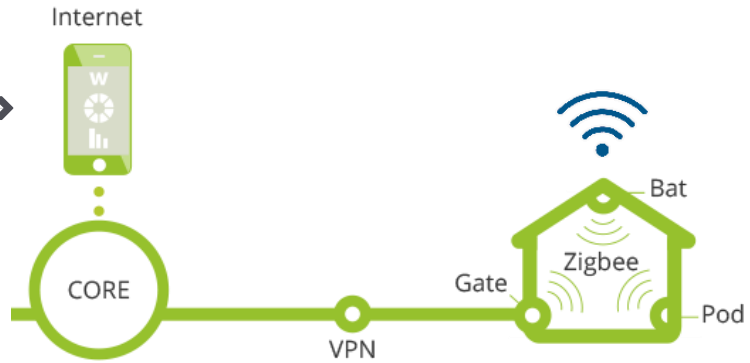
Intelligent plug

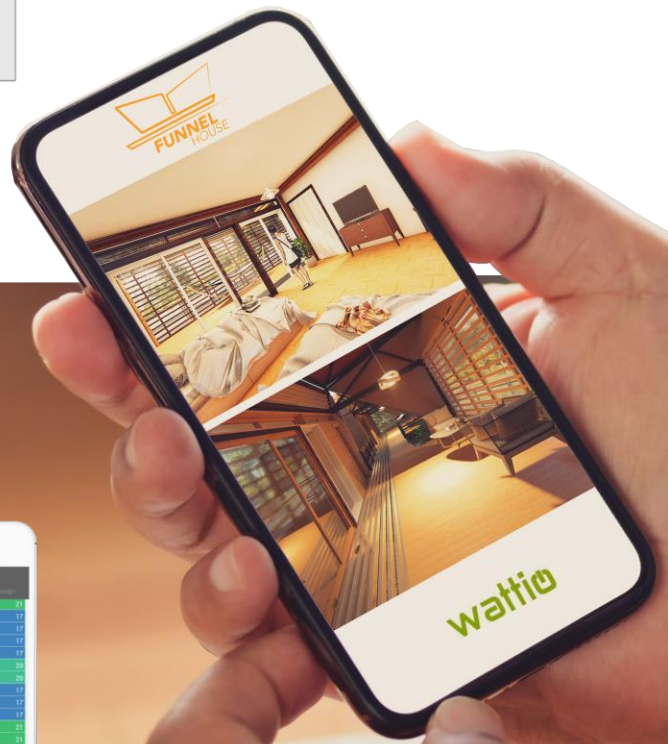
FUNNEL HOUSE

TOPIC: HOME AUTOMATION

integrates with all devices

SAAS (Software as a service)



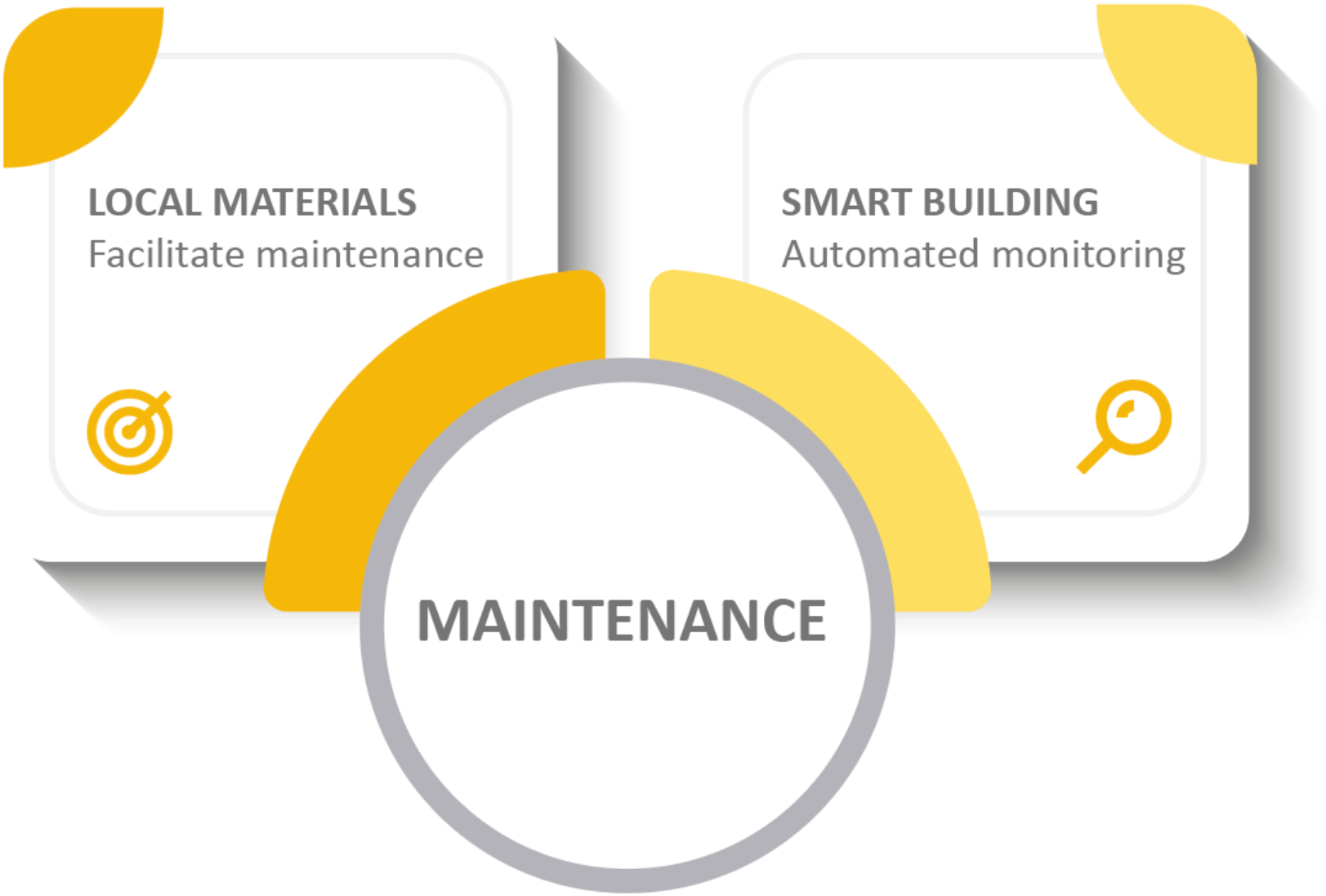


FUNNEL HOUSE

UNIVERSIDAD TECNOLOGICA **INDOAMERICA**

SPEAKER: CLAUDIA TOLEDO

MAINTENANCE


LOCAL MATERIALS
Facilitate maintenance
SMART BUILDING
Automated monitoring
MAINTENANCE

TREATED BAMBOO

Palm oil + **Zinc or Titanium** + **Wax finish**

Water proofing **UV protection** **Dust protection**

WATER RESISTANT STUCCO

3mm (0,1 inch) layer

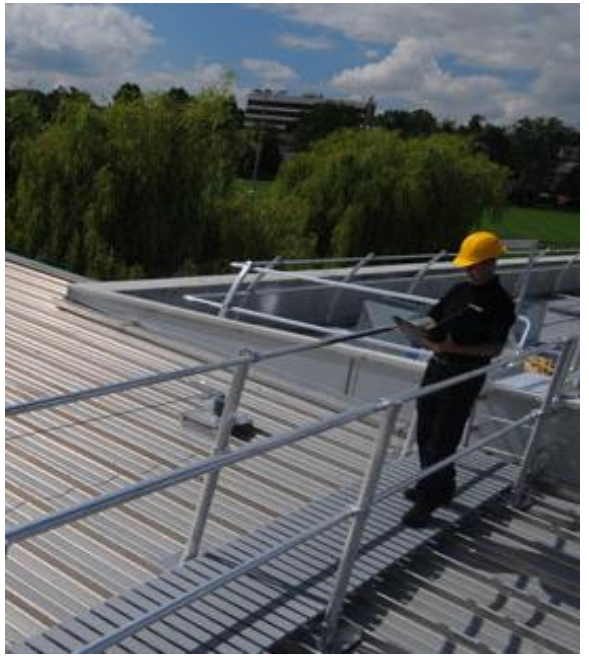
Maintenance every 2 years

40 years lifetime

ROOF PROTECTION

Protective Paint

Reflects radiation
Improves thermal and acoustic insulation
Moisture control

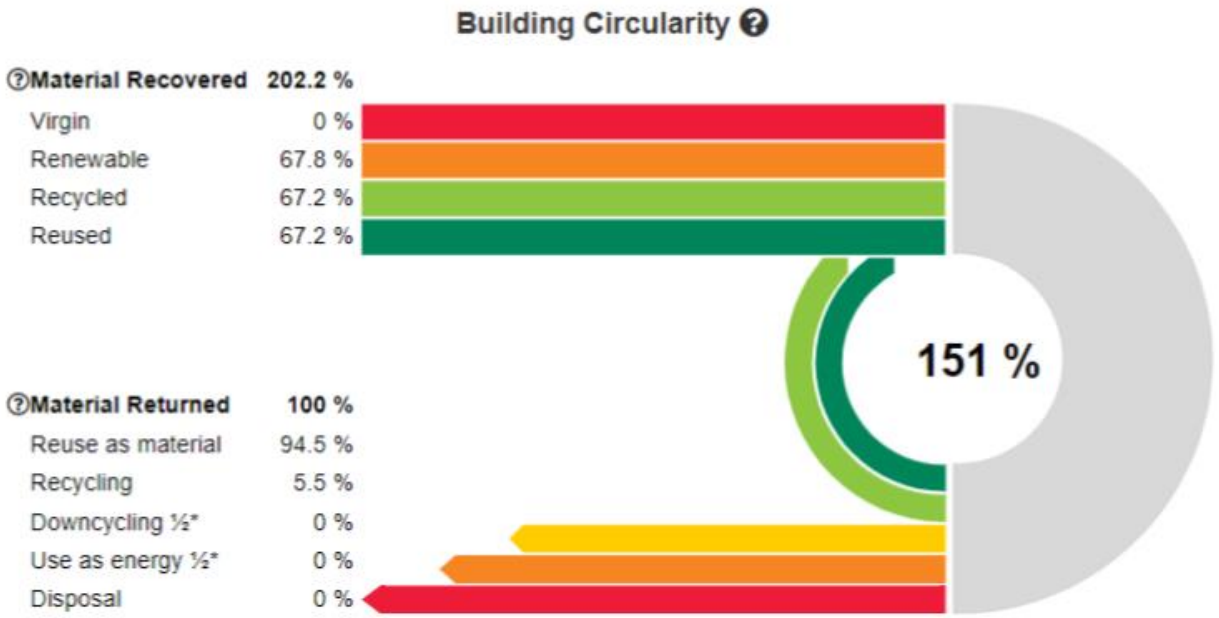


Service ladder

Gutter net

MATERIALS	USE	LIFETIME	MAINTENANCE TIME
BAMBOO	STRUCTURE	50 YEARS	EVERY 2 YEARS
PANLES OSB	WALLS - FLOORS	40 YEARS	EVERY 2 YEARS
SANWICH TYPE METALLIC PANEL	ROOF	25 YEARS	EVERY 2 YEARS

LIFE CYCLE ASSESMENT

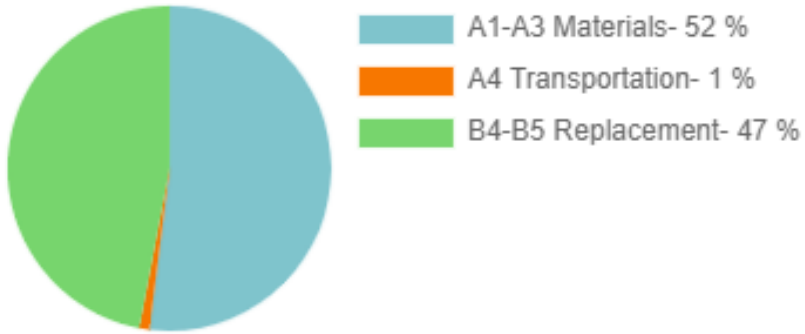


Renew / Reuse / Process for new material

EMBODIED CARBON BENCHMARK

Cradle to grave (A1-A4, B4-B5, C1-C4)	kg CO_2e/m^2
(< 140) A (140-270) B (270-400) C (400-530) D (530-660) E (660-790) F (> 790) G	211

EMBODIED CARBON BY LIFE-CYCLE STAGE



EMBODIED CARBON BY STRUCTURE - A1-A3