TEAM: INDOAMÉRICA
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Architecture

FACULTY LEADER
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Architecture
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Architecture
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Architecture

Daniel Poaño
Architecture
Viviana Sinailin
Architecture
Claudia Toledo
Architecture
Rodrigo Erazo
Industrial Engineering
TEAM INFORMATION

FACULTY ADVISORS

FACULTY LEADER
- Arq. Sebastián Alvarado

ARCHITECTURE
- Arq. Teresa Pascual
- Arq. Daniela Ortiz
- Arq. Jóse Leyva

INDUSTRIAL INGENIERING
- Ing. Wilson Chancusig
- Ing. Pablo Ron
- Ing. Paúl Remache

LANGUAGE CENTER
- MSc. Roilys Suarez
- MSc. Lorena Espinosa
- MSc. Samary Guillén
- MSc. Rocío Patiño

BUSINESS MANAGEMENT
- Ing. Alcibar Pila

PARTNERSHIPS

INSTITUTO DE INVESTIGACIÓN GEOLÓGICO Y ENERGÉTICO

UNIVERSIDAD TECNOLOGICA INDOAMERICA

SPEAKER: CLAUDIA TOLEDO
COST-TARGET MARKET
TENA CANTON: 7 PARISHES

- INHABITANTS: 60,880
- POPULATION DENSITY: 234 hab / sq mi
- SURFACE: 1507 sq mi

POPULATION SETTLEMENT
- SCATTERED

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

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SPEAKER: CLAUDIA TOLEDO
FUNNEL HOUSE $62,811 / $37,2 PER SQ FEET

**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 11.5% 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.

**TOPIC: CONSTRUCTION COST**

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SPEAKER: ASDASDFAS DFSDDFDGFDFGDF
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."
DESIGN PROCESS

Analyzes the environmental and user's conditions

Passive strategies

Technologies

Design

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SPEAKER: CLAUDIA TOLEDO
Elongated form: Minimize solar exposure, Maximize South ventilation

Open-social spaces: Natural ventilation
Closed-private spaces: Improved comfort

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
MATERIALITY IN INTERIOR DESIGN

- OSB Or Oriented Fiber Boards
- Bamboo
- Ecological stucco of cal
- Narrow Slatted toasted bamboo board -VT

SPEAKER: CLAUDIA TOLEDO

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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
PASSIVE – ACTIVE STRATEGIES

NATURAL VENTILATION - MECHANICAL VENTILATION

1. House
2. Trees
3. Sun
4. Wind
5. Airflow
ENERGY PLUS HOUSE
FV energy production: 5807 kWh/year
House’s energy consumption: 4338 kWh/year
Excess returned to grid: 1469 kWh/year

Latitude 0°
High solar irradiation
Fuel Breakdown - TENA- ECUADOR, FUNNEL HOUSE
1 Jan - 31 Dec, Run period

- Room Electricity
- Mechanical Ventilation
- DHW (ELECTRICITY)

<table>
<thead>
<tr>
<th>Year</th>
<th>Room Electricity (kWh)</th>
<th>Lighting (kWh)</th>
<th>DHW (Electricity) (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1225.89</td>
<td>741.43</td>
<td>1673.76</td>
</tr>
</tbody>
</table>

TOPIC: THERMAL COMFORT

SPEAKER: CLAUDIA TOLEDO
THERMAL COMFORT

Operative Temperature

Relative Humidity

Discomfort hrs

<table>
<thead>
<tr>
<th>Year</th>
<th>Air Temperature (°C)</th>
<th>Radiant Temperature (°C)</th>
<th>Operative Temperature (°C)</th>
<th>Outside Dry-Bulb Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24,51</td>
<td>26,26</td>
<td>25,39</td>
<td>23,11</td>
</tr>
<tr>
<td></td>
<td>67,04</td>
<td>2783,07</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SPEAKER: CLAUDIA TOLEDO
Lighting Analysis

Interior Light
Natural Light

<table>
<thead>
<tr>
<th>Housing area</th>
<th>lux min</th>
<th>lux recom.</th>
<th>lux optimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living Room</td>
<td>200</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Kitchen</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Bedroom</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Studying room</td>
<td>300</td>
<td>500</td>
<td>750</td>
</tr>
<tr>
<td>Circulation</td>
<td>50</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Badroom</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
</tbody>
</table>
Lighting Analysis

VIDEO DAYLIGHT

VIDEO AFTERNOONLIGHT

SPEAKER: CLAUDIA TOLEDO
RESILIENCE
RESILIENCE

Earthquake

Structure

Isolation

Recreational Spaces
+ Local food production
+ Internet Connection

TOPIC: RESILIENCE

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SPEAKER: CLAUDIA TOLEDO
TOPIC: RESILIENCE

- Floods
- Raise a term
- Land Sliding
- Soil Improvement
RESILIENCE

Insects → AntiBug Layer → Material

Deforestation → Certified Wood → Sustainable Material
STRUCTURE
Exo - Structure

Concrete Foundation
Bamboo Structure
**BAMBOO - GUADUA ANGUSTIFOLIA**

<table>
<thead>
<tr>
<th>Lifetime</th>
<th>Stem Height</th>
<th>Diameter Radius</th>
<th>Compressive strength</th>
<th>Compression elasticity module</th>
<th>Flexural modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 years</td>
<td>91.86 ft</td>
<td>0.49 ft</td>
<td>37.76</td>
<td>14.35 Gpa</td>
<td>12.16 Gpa</td>
</tr>
</tbody>
</table>

**CLAUDIA TOLEDO**
ENGINEERING SYSTEMS
MECHANICAL DESIGN

IDE02
HIGH FLOW BACKFLOW
HEAT RECOVERY

DRIVE PLENUM

EXTRACTION PLENUM

BARJ / BARP SELF-REGULATING
EXTRACTION NOZZLE

PVC OR RECTANGULAR PLASTIC
DUCTS.

OUTSIDE FRESH AIR INLET
INTAKE DUCT
EXTRACTION DUCT
EXHAUST VENTILATION OUTLET
• BST THERMOSIPHON

CAPTURE ➔ TRANSFORMATION ➔ EXCHANGE ➔ ACCUMULATE ➔ HOT WATER

DRINKING WATER GRID INTAKE

COLD WATER

HOT WATER

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SPEAKER: CLAUDIA TOLEDO
LOCAL MATERIAL, LABOR AND RESEARCH

- **Stuco**
- **OSB panels**
- **Vapor resistant foam**
- **Certified wood**
- **Palm fiber insulation research**

**ESPE University**
Universidad de las Fuerzas Armadas de Ecuador

**FUNNEL HOUSE**
UNIVERSIDAD TECNOLÓGICA INDOAMÉRICA

**SPEAKER:** CLAUDIA TOLEDO
PALM FIBER

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

<table>
<thead>
<tr>
<th>FIBER</th>
<th>Density (g/m3)</th>
<th>(W/K.m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Wool</td>
<td>0.011</td>
<td>0.045</td>
</tr>
<tr>
<td><strong>NATURAL FIBER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm Fiber</td>
<td>0.078</td>
<td>0.032</td>
</tr>
</tbody>
</table>
SMART BUILDING
SAAS (Software as a service) integrates with all devices.
MAINTENANCE
MAINTENANCE

LOCAL MATERIALS
Facilitate maintenance

SMART BUILDING
Automated monitoring

TOPIC: OPERATION (USE AND MAINTENANCE)

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SPEAKER: CLAUDIA TOLEDO
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

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SPEAKER: CLAUDIA TOLEDO
<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>USE</th>
<th>LIFETIME</th>
<th>MAINTENANCE TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAMBOO</td>
<td>STRUCTURE</td>
<td>50 YEARS</td>
<td>EVERY 2 YEARS</td>
</tr>
<tr>
<td>PANLES OSB</td>
<td>WALLS - FLOORS</td>
<td>40 YEARS</td>
<td>EVERY 2 YEARS</td>
</tr>
<tr>
<td>SANWICH TYPE METALLIC PANEL</td>
<td>ROOF</td>
<td>25 YEARS</td>
<td>EVERY 2 YEARS</td>
</tr>
</tbody>
</table>
LIFE CYCLE ASSESSMENT
**Building Circularity**

- Material Recovered: 202.2%
  - Virgin: 0%
  - Renewable: 67.8%
  - Recycled: 67.2%
  - Reused: 67.2%

- Material Returned: 100%
  - Reuse as material: 94.5%
  - Recycling: 5.5%
  - Downcycling 1/2*: 0%
  - Use as energy 1/2*: 0%
  - Disposal: 0%

**151%**

Renew / Reuse / Process for new material
EMBODIED CARBON BENCHMARK

EMBODIED CARBON BY LIFE-CYCLE STAGE

EMBODIED CARBON BY STRUCTURE - A1-A3

Cradle to grave (A1-A4, B4-B5, C1-C4) kg CO2e/m²

<table>
<thead>
<tr>
<th>Range</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt; 140)</td>
<td>A</td>
</tr>
<tr>
<td>(140-270)</td>
<td>B</td>
</tr>
<tr>
<td>(270-400)</td>
<td>C</td>
</tr>
<tr>
<td>(400-530)</td>
<td>D</td>
</tr>
<tr>
<td>(530-660)</td>
<td>E</td>
</tr>
<tr>
<td>(660-790)</td>
<td>F</td>
</tr>
<tr>
<td>(&gt; 790)</td>
<td>G</td>
</tr>
</tbody>
</table>

- A1-A3 Materials: 52%
- A4 Transportation: 1%
- B4-B5 Replacement: 47%

Vertical structures and facade: 18%
Horizontal structures: beams, floors and roofs: 77%
Other structures and materials: 4%