Favelas are informal settlements, often located in areas less habitable for formal development to take place. In the case of Rio, 1.3 million people live in the over 900 favelas located in the steep rock outcrops of the city.
CHALLENGES IN SANTA MARTA

1. Lack of Space

2. Infrastructure

3. Sanitation

4. Tension

GOALS

1. Provide equitable public space distribution through the entire favela.

2. Preserve and expand design strategies that facilitated construction for the residents.

3. Retain building density while improving quality of living.

Image sources: The Washington Post, La Gente, Fabio Telkeira, and Upsiste-Housing.com

Information Source: Livia Minoja

People Per Building

- 164
- 199
- 269
- 228
- 176
- 135
Model and Site Analysis through VR Headsets

Architecture and Landscape Architecture Students utilizing virtual reality headsets to view a model of the existing Santa Marta favela, built with 360° photographs. Milled Model was created by students during analysis phase based on computer model of the existing favela.
Part of the analysis was to find patterns between building density and ecological conditions. The project studied the location and density of buildings of different stories, to understand which topographic and hydrologic conditions are most favorable for which building types.
Analysing the Favela’s Context

Distance between Santa Marta and basic services

The team analysed the accessibility of different services outside of the favela, to determine which ones are most needed within a possible favela expansion.
Design Process:

Define Blocks

Choose Design Strategy for individual blocks based on Density/Slope Correlation

Define housing based on architecture rules for individual buildings.

Density/Slope Correlation:

Density/Slope correlation dictates that areas with less than 10% slope have the highest building density (90%). Areas of 10%-20% slope have medium building density (75%), and areas with 21%-35% slope have low building density (50%).
The first step of the design was to define housing blocks through the delineation of horizontal and vertical circulation. These blocks are then assigned a design strategy based on their slope-located on the next page.

**Defining Blocks - Process**

1. **Define Site Boundary and exclude areas within site beyond the buildable slope found on Santa Marta (40%).**
2. **Define Connection points to existing favela (Funicular Stops).**
3. **Define Primary horizontal circulation paths (Rule: paths follow contour lines for easy construction).**
4. **Identify main hydrology lines as base for primary vertical circulation.**
5. **Identify areas of gentle slopes (8% or less) and connect them through vertical circulation.**
6. **Final Blocks formed.**
Areas with high density (10% slope or less) implement strategies for widening primary circulation and introducing green strips. Areas with low building density (20% slope or more) implement terracing systems for community gardening and easier navigation of the topography.
Define Housing Based on Architecture Rules for Individual Buildings.

Shape Grammar Rules:

1. Plot Size will be adjusted to fit topographical conditions. Each plot should have minimum and maximum dimensions.

   \[ w = 4.00 \text{m} \text{ to } 8.00 \text{m} \]
   \[ l = 4.00 \text{m} \text{ to } 8.00 \text{m} \]

2. Each plot should have access to natural light and ventilation from at least two sides.

3. Each plot will be divided into 3 main spaces for program application.

   \[ a = 2.20 \text{m} \text{ to } 3.00 \text{m} \]
   \[ b = 1.60 \text{m} \text{ to } 2.00 \text{m} \]
   \[ c = 2.20 \text{m} \text{ to } 3.00 \text{m} \]

4. If only one side of the plot has access to natural light, the placement of a courtyard is necessary.

If this condition happens, place a courtyard

Place a courtyard in either section c and/or b

Areas to place a courtyard within plot

Rules regarding minimum space requirements and access to ventilation/natural light for each individual building. These rules are combined with the favela’s existing shape grammar to preserve the organic character of the development, while establishing a standard for each house.
Example of a single building design following shape grammar rules.
Master Plan of the Generated Favela Expansion

1,072 buildings in 76,000 sq. m in the original favela vs. 1,023 buildings in 55,000 sq. m in the expansion

Master plan following the new housing density and public space designation rules. The new area achieves an almost equal amount of buildings in a comparatively smaller area, while providing more designated public spaces than the original favela.
To address the lack of services close to the favela, part of the strategy was to maximize the services available on site. The team researched native plants with medicinal/food/construction material uses, to add community gardens as part of public spaces.
Renderings of favela expansion design that can be viewed as 360° images through a virtual reality headset. The team presented their research, design strategy and final expansion design to professors and community members in the University of Rio de Janeiro.
## Native Plants List

*Research Source: “Frutíferas e Plantas Uteis na Vida Amazonica”*

<table>
<thead>
<tr>
<th>Local Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andiroba</td>
<td><em>Carapa guianensis</em></td>
</tr>
<tr>
<td>Bacuri</td>
<td><em>Platonia insignis</em></td>
</tr>
<tr>
<td>Boldo</td>
<td><em>Plectranthus barbatus</em></td>
</tr>
<tr>
<td>Cancerina</td>
<td><em>Semialarium mexicanum</em></td>
</tr>
<tr>
<td>Caoba, mogno</td>
<td><em>Swietenia macrophylla</em></td>
</tr>
<tr>
<td>Chanca Piedra</td>
<td><em>Phyllanthus niruri</em></td>
</tr>
<tr>
<td>Coa</td>
<td><em>Fabiana imbricata</em></td>
</tr>
<tr>
<td>Copaiba</td>
<td><em>Copaifera spp.</em></td>
</tr>
<tr>
<td>Cuachalalate</td>
<td><em>Amphipterygium adstringens</em></td>
</tr>
<tr>
<td>Cuasia</td>
<td><em>Quassia amara</em></td>
</tr>
<tr>
<td>Curcuma</td>
<td><em>Curcuma longa</em></td>
</tr>
<tr>
<td>Doradilla</td>
<td><em>Selaginella lepidophylla</em></td>
</tr>
<tr>
<td>Ipê Roxo</td>
<td><em>Tabebuia impetiginosa</em></td>
</tr>
<tr>
<td>Manzanilla</td>
<td><em>Matricaria chamomilla</em></td>
</tr>
<tr>
<td>Pinguica</td>
<td><em>Ehretia tinifolia</em></td>
</tr>
<tr>
<td>Punarnava</td>
<td><em>Boerhaavia diffusa</em></td>
</tr>
<tr>
<td>Taray</td>
<td><em>Eysenhardtia spp.</em></td>
</tr>
<tr>
<td>Titica</td>
<td><em>Heteropsis spp.</em></td>
</tr>
<tr>
<td>Zarzaparrilla</td>
<td><em>Smilax aristrolochiifolia</em></td>
</tr>
</tbody>
</table>