“One In Seven”

By

James Browning

A 120-point thesis
submitted to the Victoria University of Wellington
in partial fulfillment of the requirements for the
degree of Master of Architecture (Professional)

Victoria University of Wellington

School of Architecture

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Abstract

Like many cities across South America, Caracas is a city of widespread informal settlements, with over a third of the city's population living in slums. South America's urban slums are expected to continue their rapid expansion, with an estimated 113 million people across the continent living in sprawling slums beyond the reach of official planning and regulation. These communities develop for many reasons; lack of affordable housing; large urban migration; or high levels of poverty. As people become frustrated with their situation they begin to build on empty areas in the city, continuously expanding and adding to the urban sprawl. However, South American cities are already highly developed, urban space is at a premium, and there's limited space for new construction. How can we improve the conditions within these informal communities rather than following the usual approach of force relocations into, often insufficient in number and inadequate in design, social housing? Forced relocations split communities apart and move inhabitants away from work and amenities, and often does nothing to slow the growth of informal settlements due to the limited number of social housing available.

This research proposes to form a self-sustainable architectural framework that integrates into the existing informal settlements without unnecessary harm or relocation of the city's urban poor, to improve their quality of life. The research argues that new strategies of regeneration that seek to promote a collaborative construction of the physical environment, would boost neighbourhood development and improve existing conditions without undue harm to the people it attempts to help. The regeneration strategy would be a system which works on 3 scales to solve basic problems, such as water, power, and community spaces through sustainable means. This system would be the starting point of a revitalization process, helping to improve the permanence and resilience of these communities.

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“Across the globe, one billion people live in slums: that is, one in seven human beings.”

– Paul Mason –

(Mason, 198)

[REDACTED]

1.0 Introduction

Fig. 1.1.
Hills of Petare

[REDACTED]

“One In Seven”

Epigraph

“Across the globe, one billion people live in slums:
that is, one in seven human beings.”

Paul Mason, 2012, *Why It's Still Kicking Off Everywhere: The New Global Revolutions* (198)

Preface

The title of this thesis ‘One In Seven’, taken from a quote by Paul Mason, clearly outlines the scale that is the problem of global informal housing. ‘One In Seven’ will slowly shift to ‘one in six’ or even ‘one in five’ during the next century showing the significant need for informal housing solutions.

Research Question

South America’s urban slums are set for exponential expansion over the next century. Can an architectural framework be created to regenerate Caracas’ largest urban slum in-situ, to improve the lives of the cities urban poor as well as the infrastructure deficiency’s they face?

Research Problem

Over the next 30 years, the world's population is projected to increase dramatically, with most growth expected to take place in urban centres within the developing world ("The Rise of Modern Cities"), largely through informal communities such as slums. Caracas represents one such city faced by large-scale informal settlements. Currently over a third of the population lives in slums (Brillembourg, Klumpner, 11) (Silva, 37). This city is just one of many which will become home to 80 percent of the world's future population growth.

The 20th Century witnessed Caracas' urban structure undertake an enormous transformation due to the accelerated growth of its population, caused by the discovery of oil in Venezuela and the shift away from an agricultural economy (Myers, 229). This new oil-based economy for the country moved the balance of jobs from rural to urban, creating a high demand for workers in Caracas and a rural exodus from the countryside (Myers, 229). In 1935 the city's population was 160,000 inhabitants, but by the end of the 1980's it had exceeded 4.2 million. Despite this, Caracas' housing stock did not increase at the same rate as demand, and new migrants to the city were forced to occupy the undeveloped periphery of the city in informal settlements creating the city's first slums. Caracas has two identities segregated from each other, that of the formalized city, and informal city (beyond the reach of official planning and regulation). The development of these informal communities is caused by many reasons, including; rapid urbanization (exasperated by the lack of affordable housing), inadequate planning from the government (unable to meet demand through social housing or regulation), and high levels of economic inequality. As people become frustrated with these factors they simply began to self-construct settlements in the empty areas found in the periphery of the city. Beginning with temporary timber shacks built from scavenged materials, which were later replaced by concrete and brick dwellings

(Vargas). As time passed, these scattered houses developed into dense informal neighbourhoods as more and more people flocked to the city. Without government support, however, access to municipal services was almost nonexistent, and development happened densely without provision for open spaces.

Currently, these settlements lack government recognition, legal protection, or access to basic infrastructure. The government's approach thus far has been to periodically and inconsistently clear informal areas to forcibly evict residents. Another more common approach by the government is to tolerate and treat the slums with apathy, as it is too hard or expensive to deal with them. This approach has been often used to justify the marginalization of these communities and cause their lack of access to basic resources, such as water and electricity. These communities, as a consequence of poor construction and hazardous locations, are also the most affected by natural disasters such as floods, landslides, and earthquakes.

Informal settlements continue to grow in Caracas today, as the social and economic issues that caused their initial creation have continued and increased, amplifying the existing structure of inequality and segregation within the city (Silva, 39). How can we improve the conditions found in these settlements and provide basic needs for the inhabitants, when the past modes of dealing with these situations have proved insufficient, costly, and alienate the people involved? Designers need to work out how to retroactively improve the inadequate conditions faced by these informal settlements. Therefore, the aim of this research and design proposal is to improve the physical conditions of the existing informal city in-situ without displacing these people, by means of providing access to needed services and basic infrastructure such as fresh water, and electricity.

[REDACTED]

Fig. 1.3. Petare Housing

[REDACTED]

Fig. 1.4. Petare from Above

Thesis Position

This research centres on the informal settlement of Petare in Caracas, Venezuela, the largest informal settlement per capita in South America (Brillembourg, Klumpner, 11). The thesis proposes new methodologies for intervention in informal settlements in South American cities, which (under intense economic, political and social pressures) need conditions to be improved in-situ without forced relocations. Faced with incomplete social housing schemes that ignore the existing and disregard the needs of the population. Caracas is just one of many cities which will become home to 80 percent of the world's future population growth (Mason, 196). These informal neighbourhoods or "Barrios" have a compact and climate-efficient urban fabric, Where the construction occurs iteratively in a way closely linked to the patterns of use of its inhabitants and to the spaces that collective life develops. However, even with the resident's inventiveness and perseverance, they suffer serious infrastructural deficiencies and the absence of vegetation or community services.

This thesis proposes to form a self-sustainable architectural framework that integrates into the existing informal settlements without unnecessary harm or relocation of the city's urban poor, to improve their quality of life. The research proposes regeneration strategies that seek to promote a collaborative construction of the physical environment in order to boost neighbourhood development. I propose a system that works on 3 scales to solve basic problems such as water, power, and community spaces. This system would be the starting point of a revitalization process, helping to improve the permanence and resilience of these communities.

Fig. 1.6. Caracas

Fig. 1.5. Petare Borders

Fig. 1.7. Petare Confin

Site Significance

Caracas is a city of large-scale informal settlements, with over a third of the city's population living in informal settlements (Silva, 37). Petare is the largest of these settlements, residing within the world's most violent city. Caracas represents an ideal testing ground for investigating different ways of approaching informal communities due to Venezuela's constitution which prioritizes social property over private property. The Venezuelan constitution states "everyone has the right to adequate, safe, and hygienic housing" (Brillembourg, Klumpner, 94), making the occupation of informal settlements partially legal and allows local government to work with inhabitants to improve conditions. This confirms that an important aspect to improve slum conditions is giving people stability in their homes and some right to the land they live on; "legalization of squatter areas, allows people to be interested in upgrading their neighbourhood (Schmidt, Kallert, 119).

Approach

Petare was selected as a location for this design-led exegesis in response to the city having the highest per capita ratio of informal to formal settlements in South America, as well as a response to the government's approach of ignoring their existence or forcibly relocating families from informal settlements. The research begins by examining the site and its people, then examines how similar settlements have been approached. The thesis title - One in Seven - derives from a quote by Paul Mason who clearly outlines the scale that is the problem of global informal housing. 'One in seven' will slowly shift to 'one in six' or even 'one in five' during the next century showing the significant need for informal settlement solutions.

Fig. 1.8. Caracas informal settlements.

Aims

- To investigate ways in which architectural design can be used to improve quality of life within urban slums, through a criteria of minimum forced relocation or demolition of existing houses.
- To investigate affordable ways for these communities to improve their infrastructural deficiencies.
- To investigate how important infrastructure can be provided into already established informal settlements.
- To investigate how to maintain or strengthen the occupants social and community ties.
- To investigate ways to improve access to green spaces and community services.

Objectives

- Critically explore through design the needs of urban slum dwellers.
- Critically explore through design the development of sustainable infrastructure to give communities permanence and stability.

Fig. 1.9. Petare Density

Methodology

1. Analysis of existing vernacular architecture (within the site and within rural settlements) - including building materials, construction techniques, and cost of current dwellings within the site.
2. Analyzing existing interviews of people with insight into life within my site, such as inhabitants, government workers, humanitarian workers, architects, journalists, and other potential stakeholders.
3. Diagramming and critical analysis of the programmatic needs of informal settlements at multiple scales, from individual dwellings to the larger city scale.
4. Diagramming and critical analysis of past precedents towards improving informal communities.
5. Use of conventional tools such as, drawing, and modeling both physical and digital to rapidly prototype.

Fig. 1.10. Formal and Informal boundary

Rules of Engagement

1. Minimum forced relocation of occupants or demolition of existing houses.
2. Interventions must be affordable and scalable.
3. Interventions are aimed at improving communities permanence and stability.
4. Interventions must be build-able.
5. Community engagement during all phases should be encouraged.

“Architecture is a political act,
by nature. It has to do with the
relationships between people and
how they decide to change their
conditions of living.”

- Lebbeus Woods -

(Woods)

[REDACTED]

2.0 Site Analysis

Fig. 2.1.
Petare hills at dusk.

Equator

Caracas- Venezuela
15 km from the coast of the
Caribbean Sea
Urban population
3.275.000 million
Metropolitan population
5.350.000 million

Caracas

Equator

Petare

Fig. 2.2. Caracas Scales

Site Analysis

Fig. 2.4. Historical Caracas Map

Timeline

Founded in 1567 and later becoming the capital of Venezuela in 1577, Caracas managed to meet its housing needs until the discovery of oil forever changed its economy. This created a high demand for workers and increased urban migration to the city. During this time the first slums began to appear as formal construction failed to meet this higher demand.

Data for this graphic was sourced from: (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Fig. 2.5. Climate Analysis

Climate Analysis

Data for this graphic was sourced from: ("Sunrise, sunset, dawn") ("Debris-flow and flooding")
("Weather and Climate") ("Weatheronline")

Fig. 2.6. Informal vs Formal

Informal vs Formal

Petare is roughly 2km by 1.5km with a population of approximately 400,000 (CABA, 68). Petare is the largest slum in Caracas, and the largest slum per-capita in South America.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Fig. 2.8. Petare Staircases

Access Arteries

Internal mobility within Petare is difficult. Access is provided by a hierarchy of access routes.

- (Blue) Exterior formalized routes providing relatively easy access around the edge of the settlement.
- (Orange) Routes are informal which follow the topography of the land and are often difficult to navigate.
- (Grey) Smaller access ways which are difficult to move through, consisting of staircases (which have crumbled in places) and small alleyways with barriers often impeding egress.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Fig. 2.9. Expansion Eras

Expansion Eras

This info-graphic shows the expansion eras of Petare. The initial founding of the settlement 1956 (green) onwards, and then the explosive growth of the settlement during the oil boom from 1984 (blue). As space became limited a slowing of growth can be seen following 2000 (orange). Urban migration and informal settlement hasn't slowed in Caracas (as they have within Petare) meaning new settlers are forced to settle in more dangerous conditions, further increasing the city limits of Caracas.

Data for this graphic was sourced from: ("ArcGIS.") ("OpenStreetMap") (Rosario, and Pérez, 17) (Silva, 11)

“As long as poverty, injustice
and gross inequality persist
in our world, none of us can
truly rest.”

– Nelson Mandela –

(Mandela)

[REDACTED]

3.0 Disparity Mapping

Fig. 3.1.
Petare's Boundary

CARACAS

Key Indicators

Fig. 3.2. Key Indicators

Key Indicators

Data for this graphic was sourced from: ("Unit, Venezuela Investigative.") ("SOCIALES.") (Glickhouse) ("Venezuela Inflation Rate ") ("Venezuela Unemployment Rate") (Edslr) ("El Ascenso De La Escasez.")

Fig. 3.3. Caracas Informal Settlements

Disparity Mapping

Data for this graphic was sourced from: ("ArcGIS.") (Silva, 11)

Fig. 3.4. Work Commute

Commute

This graphic shows the difference in commute between residents of the formal city and the informal city. With transport for the residents of the informal taking on average 90% longer than their formal city counterparts.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Fig. 3.5. Transport Interchange

Fig. 3.6. Transport Interchange

Public Transport

Public transport in Caracas is lacking and inefficient. Various informal bus routes have sprung up to attempt to fill this gap. This results in a journey from within Petare to the formal city involving multiple transfers and extended journey times.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Fig. 3.7. Public Space distribution

Public Space

Public space is incredibly scarce within the informal areas of the city. Access to these spaces is difficult due to the arduous internal mobility of the slum. Residents are also excluded from accessing the public spaces elsewhere due to the highway acting as a barrier.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Fig. 3.8. Education Distribution

Education Facilities

Access to education is difficult for informal city residents. Education centers are limited within the settlement and often difficult to get to.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Medical Facilities

Access to medical treatment is a problem for informal city residents. Medical centers are limited within the settlement and often difficult to get to. Response times are lengthy due to the difficult internal mobility of the slum.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Fig. 3.10. Cultural Distribution

Cultural Facilities

Cultural amenities are almost none existent within Petare Norte, restricting social interactions and opportunities to form a community for the residents.

Data for this graphic was sourced from: ("ArcGIS.") ("Google Maps") ("OpenStreetMap") (Rosario, and Pérez, 17) (Covarrubia, 14) (Silva, 11)

Access

1. Connectivity to the formal city is deficient.
2. Internal mobility is arduous.
3. Transportation of building materials is difficult and must be carried by hand.
4. Entrances are ill-defined unformalized or lacking entirely.
5. Public transport is lacking and inefficient.
6. Highway acts as a barrier to the formal city and therefore amenities.

Amenities

1. Lack of Public Space.
2. Lack of access to medical treatment.
3. Lack of access to education.
4. Lack of access to cultural amenities.

Utilities

1. Electricity is often limited, often stolen, with blackouts common.
2. Access to drinking water is also spotty, often having to be carried in.
3. Sewers are almost none existing.

Landslide

1. Heavy rain has caused large landslides in the past
2. Buildings often have inferior foundations causing them to slip.
3. Venezuela is subject to earthquakes

Issue Summary

Chapter Conclusion

This chapter has explored the major issues that exist within Petare such as inaccessibility and scarcity, with the site analysis providing a basis for design investigation. Accessibility problems prevent residents from, utilizing amenities available in the formal city or accessing what little amenities exist within the settlement. These access problems also limit the quality housing can achieve as all materials must be carried in and therefore low weight. Petare's residents also face scarcity at multiple levels from their basic needs such as water and electricity to an inadequate provision of public amenities or utilities. Also critically due to the precarious nature of construction and the hills on which they sit, residents are also impacted more by natural disasters such as earthquakes and landslide. All of these issues further contribute to the marginality and lower quality of life for Petare's residents.

“ It is insufficient for architecture today to directly implement an existing building typology; it instead requires architects to carefully examine the whole area with new interventions and programmatic typologies ”

- Dame Zaha Hadid -

(Hadid)

[REDACTED]

4.0 Typologies

Fig. 4.1.
Petare Housing

Second Floor

Fourth Floor

[REDACTED]

Third Floor

Ground Floor

Graphic scale

1m

Fig. 4.2. (Vargas)

Fig. 4.3. (Vargas)

Fig. 4.4. (Vargas)

Fig. 4.5. (Vargas)

Fig. 4.6. (Vargas)

Home of Mrs. Nieves

Antonio Jose de Sucre, Sector La Rinconada. Petare, Caracas

Mrs. Nieves' home, constructed of orange clay block, was built over a period of 45 years (Vargas). It was expanded in an incremental way as they were able to save the funds or as needs required, and now houses 3 generations of the family. It began life as a timber hut, which cost 500 bolivars (470.05 NZD today however with the rampant inflation in Venezuela at this stage these figures may be drastically different). The timber hut was then replaced with a blockhouse, taking about 5 years (Vargas). They used weekends to carry construction materials from the bottom of the slum to their house. This space later became the ground floor which consists of; two bedrooms, bathroom, kitchen, and dining room (Vargas). As the family expanded, three additional floors were built. The second floor contains the water tank and compost area with a large terrace. The third floor has two bedrooms a bathroom, and a lounge. The fourth floor is a rooftop; it has a single room (Vargas).

[REDACTED]

Fig. 4.7. (Vargas)

Fig. 4.8. (Vargas)

Fig. 4.9. (Vargas)

Fig. 4.10. (Vargas)

Fig. 4.11. (Vargas)

Home of Julia & Bonifacio

Petare, Caracas

Julia & Bonifacio began constructing their home with a small wooden house, which they later replaced with orange clay block (Vargas). They incrementally expanded the house as their family grew. The area that was originally the wooden house is now the kitchen and the entrance hall. “On their land there are now three additional houses connected by stairs where the rest of the family lives” (Vargas).

[REDACTED]

House of Mrs. Carmen 2015

Fig. 4.12. (Vargas)

Fig. 4.14. (Vargas)

Fig. 4.15. (Vargas)

Fig. 4.16. (Vargas)

Fig. 4.13. (Vargas)

Home of Mrs. Carmen

Juan Moreno, Municipality Revenga. State Aragua, Venezuela.

The expansion of Mrs. Carmen's home is equivalent to the growth of her family. They incrementally expanded, as funds became available, room by room to later fill the site that their house currently sits on. The house now has an extra 20 additional linear meters from its original size. "Today the house has five bedrooms, two bathrooms, kitchen, dining room, living room, two patios and an annex for one of their grandchildren: (Vargas).

[REDACTED]

Graphic scale

1m

Fig. 4.17. (Vargas)

Fig. 4.18. (Vargas)

Fig. 4.20. (Vargas)

Fig. 4.21. (Vargas)

Fig. 4.19. (Vargas)

Home of Neyi and Ismael

Juan Moreno, Municipality Revenga. State Aragua, Venezuela.

Neyi and Ismael describe their home as being built “little by little” (Vargas). They began with a small wooden house with wood they bought from relatives. They later began to replace the wooden house with block work, buying the materials they could afford week by week (Vargas).

Conclusion

Petare Analysis

Through these typology investigations, it became apparent that the people of Petare did not want their houses to be reconstructed or improved. From an outsiders perspective how the plans above seem inefficient and could be greatly improved, such as the diversity of space division, overuse the space, and the lack of privacy to name a few. However, The inhabitants believe their homes to be suited to their needs. Their homes are their most valuable possession, due to the time and resources they have expended creating them. The residents speak about their housing in high regard, but also discuss other deficiency's they face on a daily basis such as lack of basic resources, the safety of their neighbourhood, or access to education. Because of this any intervention towards changing the housing of these people would cause them undue stress and would not be the best approach to improving their lives.

“There’s a billion people on the planet that will be needing housing. Unless we ... tackle scarcity of means, we won’t solve this problem.”

- Alejandro Aravena -

(Elemental)

[REDACTED]

5.0 Precedents

Fig. 5.1.
Petare Streets

Fig. 5.3. (Elemental)

Fig. 5.2. Community Modifications

Fig. 5.4. (Elemental)

Fig. 5.5. (Elemental)

Quinta Monroy

Iquique, Chile

Elemental - Alejandro Aravena

Quinta Monroy development by Elemental architects, is an exemplary example of in-situ self help social housing. Due to budgetary constraints the architects where potentially faced with providing units which were too small or too few. Instead the architects came up with the solution of providing half a house, which would provide the program - that a family at the poverty line - would struggle to achieve, such as structural elements , and service cores (kitchens, bathrooms, and stairs). This approach would also enable residents to dictate their own needs as funds became available or needs changed. (Quinta Monroy)

Vertical dispersal of amenities
and public Space

[REDACTED]

Fig. 5.6. (Brillembourg, Klumpner)

Fig. 5.8. (Brillembourg, Klumpner)

Fig. 5.7. (Brillembourg, Klumpner)

Torre David

Caracas, Venezuela

Elemental - Alejandro Aravena

A key precedent in Caracas is the Torre David, An abandoned office tower transformed by squatters into an improvised home more than 700 families (Brillembourg, Klumpner, 274). Torre David is a unique representation of informal housing, representing a high-rise means with which to transplant these communities. With the residents resourcefulness proving a crucial resource for architects in creating sustainable solutions to this exceedingly complex problem, retrofitting infrastructure and providing crucial social services.

Fig. 5.9. Kowloon Walled City
Informal Growth

Fig. 5.10. (Lambot, Girard)

Fig. 5.11. (Lambot, Girard)

Kowloon Walled City

Hong Kong, China

Elemental - Alejandro Aravena

Kowloon Walled City once the “most densely populated place on the planet” (Popham, 10). The city expanded building on top of building, becoming an interwoven labyrinth of ad hoc infrastructure. Limited only by the confines of the old fort, residents were therefore forced to build upwards and incredibly densely, incessantly building to fill in the cracks and empty spaces. Developers would enter deals with residents to expand single floor dwellings into multistory buildings, giving the original owner the floors they began with at a much higher quality. The buildings would then be attached to one another for support, often sharing staircases with multiple buildings. Another interesting aspect of the walled city is how services were retrofitted into the ad-hoc structure of buildings.

[REDACTED]

Before

Fig. 5.12. Paraisópolis, São Paulo, Brazil

[REDACTED]

After

Fig. 5.13. Grotão Community Center

Fig. 5.14.
Grotão Community Center

Fig. 5.15. Site Plan

Grotão Community Center

Paraisópolis, São Paulo, Brazil

Urban Think Tank - Architects

Paraisópolis is a dense informal settlement located in São Paulo Brazil, with a population of 80,000 people living within a square kilometre. The settlement due to periods of heavy rainfall and challenging topography is often subject to dangerous mudslides which can cause mass destruction and displacement of residents.

Urban Think Tank (U-TT) sought to implement positive change in the settlement, developing a proposal that would transform an inaccessible void within the dense fabric, which had been cleared of homes after a severe mudslide, into a productive and dynamic community hub. The project they proposed provides green space to stabilize the precarious terrain and prevent further erosion, while also providing social infrastructure in the form of a community centre. The development of this project also encouraged the government to implement social housing projects nearby, to improve the living conditions of those living precariously near the edges of the site. This project shows the potential of architectural interventions in these communities to act as a catalyst for regeneration and to improve the lives of urban slum dwellers.

[REDACTED]

Before

Fig. 5.16. Praça Cantão - Rio

[REDACTED]

After

Fig. 5.17. Praça Cantão - Rio

Fig. 5.18. Praça Cantão – Rio

Fig. 5.19. Vila Cruzeiro – Rio

Haas & hahn

Favela Painting

Artists - Jeroen Koolhaas & Dre Urhahn

Artists Jeroen Koolhaas and Dre Urhahn (known as Haas&Hahn) founded the Favela Painting Project. Working in informal settlements, they involve the local community to reinvent their neighbourhoods through art. The projects train the local community in preparation and painting, as a catalyst to empower the people towards the self-improvement of their housing and neighbourhoods.

This collective effort improves the esteem of the communities. The relevance of Haas&Hahn's work to this research is that of community engagement and acceptance. Their projects show that by improving small aspects of these communities everyday lives can have a big impact, through instilling pride in their neighbourhoods. The individuals then work collectively to improve their dwellings and their neighbourhoods.

Water Scarcity

Conclusion

Petare Analysis

At the beginning of this exegesis, the initial assumption was that a housing solution was needed to improve conditions for South America's urban poor. However, after the context analysis of Petare and its people, it became evident that was not the approach wanted by the residents.

Due to conducting the site analysis in a way that attempted to understand these people to the highest degree possible, rather than simply focusing on areas that would simply inform my prior assumptions. The deep connection the inhabitants had to their homes became apparent, due to the self-built iterative construction. Therefore their homes are suited to their needs and have become their most valuable possession. Instead, the issues important to these people were the other deficiencies of Petare such as their lack of access to infrastructure, essential services, access, and safety.

Consequently, this helped to change the focus and approach to Petare from housing to one focused on the larger issues affecting the people, with an emphasis on improving access to water. For the inhabitants to prosper within these informal settlements, architecture must not enforce itself through the clearing of the existing, but instead respond and adapt to accommodate the organic makeup of the site.

In summary, the design response should address the following issues:

- Ability to adapt to the organic nature of the site context.
- Ability for the community to engage with the implementation.
- Provide potable drinking water, and generate electricity on site
- Provide access to essential amenities.
- Provide a means of improving the resilience of the community.

“If I have seen further
it is by standing on the
shoulders of Giants”

– Sir Isaac Newton –

(Newton)

[REDACTED]

6.0 Literature Review

Fig. 6.1.
The informal
edge of caracas

Fig. 6.2. Concept Investigation 01

Fig. 6.3. Concept Investigation 02

Fig. 6.4. Concept Investigation 03

Fig. 6.5. Concept Investigation 04

Literature Review

Introduction

Due to exponential population rise, Lebbeus Woods states that the 21st century will be one marked by instant cities, a term Woods re-purposes from Archigram to describe informal settlements (Slow Manifesto). A century where dramatic population increase, urban migration, and displaced people will be increasingly forced into the peripheries of cities, and poor conditions within informal settlements such as slums. As these factors cause increased demand within cities, these instant cities will continue to come into existence or expand, faster than they can be planned for. Designers are faced with how to retroactively improve conditions within these informal settlements to provide for the basic needs of those who live there. Architects, through confronting political and social issues, have the potential to act as a catalyst to affect social change to improve the lives of those neglected by society (such as slum dwellers). Even though small interventions that tackle basic deficiencies within informal communities, architects can have big impacts on their lives by freeing them of time and stress intensive burdens. Slum improvement can instigate political change, to break down the socio-territorial barriers that have been erected between the formal and informal preventing societal change.

This literature review will seek to establish a theoretical framework for the research, with which to integrate and build upon through the design process. To create a sympathetic design response to the complex issues facing the informal settlements in Caracas, examples of architectural design and theory as activism will be investigated. The conclusions arrived at will be used as drivers to create design experiments aimed at creating regeneration strategies that seek to improve the lives of Caracas' urban poor.

Fig. 6.6. Concept Investigation 05

Fig. 6.7. Concept Investigation 06

Fig. 6.8. Concept Investigation 07

Fig. 6.9. Concept Investigation 08

Fig. 6.10.
Maslow's Pyramid

Abraham H. Maslow, in his book “Motivation and Personality”, discusses his theory that human needs follow a hierarchy, where he states that an individual must satisfy their most basic and fundamental needs, before striving to fulfil intangible ones (Maslow, 36). At the lowest level of Maslow’s hierarchy resides physiological needs, imperative to human survival, such as air, water, sustenance, shelter, and sleep. After fulfilling these basic needs people can shift focus to next level of Maslow’s hierarchy which he describes as safety which includes the need for an individual to fulfil their want for the security of self, health, employment, property, and access to resources (Maslow, 39). After safety, the next echelon of the hierarchy focuses on the need for a sense of belonging and intimacy through friendship and family (Maslow, 67). Following achieving a sense of belonging, a person then seeks to boost their esteem and confidence through achievement and gaining the respect of their peers (Maslow, 45). Maslow then states that only after surmounting the other levels of the hierarchy, can an individual attempt to achieve self-actualization through education, activism, and creativity, to improve their social standing (Maslow, 54).

I propose to apply Maslow’s theories towards architecture, specifically the urban poor living within informal cities, to create a more humanist holistic approach to design within informal settlements. By using the hierarchy of needs within this context, it can be understood that the emotional stress experienced by the inhabitants, caused by fundamental

Fig. 6.11. Concept Investigation 09

Fig. 6.12. Concept Investigation 10

Fig. 6.13. Concept Investigation 11

Fig. 6.14. Concept Investigation 12

deficiencies within informal communities, can prevent communities from improving their circumstances and affect social change. A holistic approach to design would involve an analysis of informal settlements through Maslow's hierarchy, which outlines the fundamental needs of a community, to create a design framework with which to meet the aims and objectives of this research. This framework would then be used as a design driver, through which to evaluate deficiencies within informal settlements and propose methods to inform the design process.

The framework proposed follows Maslow's hierarchy of physiological, safety, belonging, esteem, and self-actualization:

Physiological

Physiological needs are perhaps the most important needs to address within informal settlements. The lack of these needs becomes the focus of an individual's existence, as without them the situation cannot improve (Maslow, 36). From Maslow's writing, and agreed by Lebbeus Woods, people in extreme poverty can be paralleled to those coming out of times of war with similar psychological trauma, needs, and wants. However, unlike people in extreme poverty where these conditions are the status quo, victims of war can expect a return to normalcy (Slow Manifesto). As according to Lebbeus Woods these are the most pressing needs:

"Living in the slums means living without many beneficial, even necessary, things ... Everything is now, today, and each day is a new struggle for survival. The gains made yesterday were maybe enough, but they were consumed yesterday. Nothing carries over, except the needs." (Slow Manifesto)

When designing within informal communities, architects must consider the capacity of the urban form to meet the fundamental needs of the community, as needs such as food, water, employment, shelter, and services, have the potential to affect the most change and improvement in the lives of the urban poor. Any intervention that helps meet these needs must be accessible within these dense neighbourhoods to everyone while not becoming a burden on the community. Even if only the physiological needs of Maslow's hierarchy was attained for the urban poor, a marked improvement of their quality of life would happen, freeing them of time and stress intensive burdens, potentially allowing them to seek to fulfil their higher needs with Maslow's hierarchy.

Fig. 6.15. Concept Investigation 13

Fig. 6.16. Concept Investigation 14

Fig. 6.17. Concept Investigation 15

Fig. 6.18. Concept Investigation 16

Safety

After fulfilling their basic needs, the focus can then shift to the next level of Maslow's hierarchy, which he describes as the need for safety (Maslow, 39). Safety, when applied to urban conditions, means a lack of fear when moving through or residing in a space, which within informal settlements can mean threats to personal safety from, people, natural disasters, or the surrounding environment. Designers must then create or improve spaces within slums to be safe to traverse through, live, and work. Jane Jacobs, in her book *The Death and Life of Great American Cities*, advocates for safety in urban street design. Her views provide actionable design parameters for translating Maslow's theory into architecture and urban design. Jacobs outlines the three main aspects that can promote safety in a community through urbanism. Firstly, Jacobs discusses providing clarity between public and private space to prevent the easy movement of strangers between the two. Secondly, she advocates for buildings to orient towards the street, to provide the opportunity for residents to look out into the neighbourhood. This provides a means to discourage bad behaviour through people nearby being able to render aid or sound alarm. Thirdly, Jacobs states there must be healthy levels of street activity to encourage residents to watch the street by providing interesting subject matter (Jacobs, 35). To achieve Jane Jacobs three qualities within informal settlements, designers will need to improve the dense, damaged, or inaccessible access-ways already present. By improving access-ways and making them easily traversable this will improve street traffic, and potentially encourage residents to occupy these spaces as community space adding to "eyes upon the street" (Jacobs, 35). As another benefit of improving the communities feeling of safety, they will be encouraged to invest more in their homes and communities by reducing threats to investment.

Fig. 6.19. Concept Investigation 17

Fig. 6.20. Concept Investigation 18

Fig. 6.21. Concept Investigation 19

Fig. 6.22. Concept Investigation 20

Belonging

Following safety, Maslow discusses an individuals' need for belonging and intimacy through friendship, family, and community (Maslow, 67). Urban design can support belonging by bonding a community together by creating a feeling of identity, pride, and ownership. An example of this can be seen in the Favela Painting Project by Haas&Hahn (page 67) who worked to raise the pride the community had in their homes and neighbourhood through the simple act of providing a unique identity for the community through art. When an urban form is a source of identity and pride, a community will work collectively to maintain, improve, and protect it, strengthening their ties to each other. These social ties strengthen through opportunities to communicate and cooperate together. Urban design, therefore, needs to provide spaces for chance meetings and congregating such as parks, schools, places of worship, or even bump spaces like streets and access-ways, areas which are vital for forming friendships and creating community ties.

Belonging can also already be found to some extent within informal settlements, as John F.C. Turner states that rural communities or extended family often transplanting their social ties with them by setting up neighbourhoods together within slums. Turner also states that these settlements often have "far healthier social environments" (Turner, 14) compared to social housing imposed by governments. When slums populations are forcibly relocated these ties can be broken, disenfranchising the people and destroying their sense of belonging.

Esteem

Once a community has achieved belonging they will seek esteem through external recognition (Maslow, 45). Robert Putnam (in *Bowling Alone: The Collapse and Revival of American Community*) interprets as "bridging social capital" (Putnam 8) defines this as the social ties which retain a community's identity within the external urban context. Informal settlements are largely ignored by governments, decreasing their esteem with their perceived value. This can be changed by showing the community that it is valued through aid and investment by outside parties. Furthermore, the communities esteem can be increased through the creation of facilities such as schools, cultural activities, and places of worship which benefit the community and are a point of pride worth celebrating. Through increasing the communities esteem through these methods they will be more prepared to face adversity together and advocate for the community's importance and share their knowledge with other informal settlements.

Fig. 6.23. Concept Investigation 21

Fig. 6.24. Concept Investigation 22

Fig. 6.25. Concept Investigation 23

Fig. 6.26. Concept Investigation 24

Self-Actualization

After the levels of Maslow's hierarchy have been satisfied, to parallel those already living in the formal city, Maslow states that people will be free to seek self-actualization and social change through education, activism, and creativity (Maslow, 54). To achieve this as a collective a community informal settlements must respond to their current values and surrounding built form, by doing this they can strengthen their stability at the other levels of the hierarchy. However as Clayton P. Alderfer's discusses his frustration-regression principle, as part of his ERG theory (which builds on Maslow's hierarchy), satisfaction at a lower levels will lead to progression upwards, although frustration with being unable to satisfy needs at higher level cause a regression downwards towards needs that appear easier to satisfy (Alderfer 151). Future urban designs must then be flexible to change while still being sympathetic to the communities values. This can be achieved through continuous community engagement and participation, ensuring their needs will be fulfilled in the future and the community remains stable at the higher levels of the hierarchy.

Conclusion

This literature review investigates a way to translate Maslow's Hierarchy of Needs towards architecture, and specifically the urban poor living within developing countries. Maslow's theories can be used to prioritize intervention within informal communities into stages, helping designers to locate the most urgent needs, and provide the community with the means to ascend the Maslow's hierarchy. Through approaching slum improvement through this process designers will be able to expand the scope benefit a great number of people and responding to the social challenges of the next century. This project will seek to integrate and build upon these views in design experiments aimed at creating regeneration strategies that seek to promote a collaborative construction of the physical environment, in order to boost neighbourhood development.

“These marginalized communities are missing from maps ... The government doesn’t recognize the area, or it’s not economically interesting for companies to map”

– Primož Kovačič –

(Blakemore)

[REDACTED]

7.0 Site Model

Fig. 7.1.
Petare Housing

Fig. 7.4. Petare

Fig. 7.5. Petare

Digital Site Model

In an attempt to improve my understanding of Petare’s scale, density and spontaneous growth, as well as to combat my inability to visit Venezuela due to the country’s current unrest. I created a digital simulation of the site within a video game engine, through the use of digital model created from extensive site mapping.

Data for this graphic was sourced from: (“ArcGIS.”) (“Google Maps”) (“OpenStreetMap”) (Rosario, and Pérez, 17) (Silva, 11)

“Every block of stone has
a statue inside it and it is
the task of the sculptor to
discover it.”

- Michelangelo -

("Michelangelo")

[REDACTED]

8.0 Preliminary Design

Fig. 8.1.
Petare Streets

Fig. 8.2. Concept 03

Fig. 8.3. Concept 02

Fig. 8.4. Concept 05

Fig. 8.5. Concept 01

Fig. 8.6. Concept Sketch

Fig. 8.7. Concept Sketch

Fig. 8.8. Concept Sketch

Concept Investigations

I created a variety of initial concepts, however many were discarded due to the need for the creation of space through demolition, the reliance on existing unstable structures, or the need for large structural materials which could not be carried through the narrow access ways of Petare.

Fig. 8.9. Concept 01

Fig. 8.10. Concept Sketch

Photovoltaics

Food Production

Water Capture

Water Tank

Concept 01

Positives

- Provides large amounts of community space
- Provides Rainwater capture: including large tank for storage.
- Photo-voltaic panels, provides sustainable electricity generation.
- Provides areas for urban farming: creating a community activity and strengthening community ownership.
- Creates areas of shade below the rainwater harvesting parasol.

Negatives

- Requires heavy materials be transported in for the structure: this limits the areas in which the intervention can be placed as materials can not be carried through cramped access ways by hand.
- Requires a large footprint / ground area: Meaning either community space must be taken up or current dwellings must be demolished.
- Requires conventional foundations: meaning a large ground area, the need for invasive groundwork - which may-destabilize other buildings.

Fig. 8.11. Concept 02

Fig. 8.12. Concept Sketch

Photovoltaics

Food Production

Water Tank

Steel Structure

Concept 02

Positives

- Provides some capacity for community space
- Provides Rainwater capture: including large tank for storage.
- Photo-voltaic panels, provides sustainable electricity generation.
- Provides areas for urban farming: creating a community activity and strengthening community ownership.
- Creates areas of shade below the rainwater harvesting parasol.
- Provides increased structural support to any dwelling its paired with.

Negatives

- Requires heavy materials be transported in for the structure: this limits the areas in which the intervention can be placed as materials can not be carried through cramped access ways by hand.
- Impedes the ability of the inhabitants below to expand their dwelling.
- The interventions structure may prove less adaptable to the irregular dwellings and access-ways of Petare.
- Access to the community space and farm area may become intrusive to those living below.

Fig. 8.13. Concept 03

Fig. 8.14. Concept Sketch

Photovoltaics

Food Production

Water Capture

Water Tank

Concept 03

Positives

- Does not require the use of large / heavy structural materials.
- Provides Rainwater capture: including a small tank for storage.
- Photo-voltaic panels, provides sustainable electricity generation.
- Provides areas for urban farming: creating a community activity and strengthening community ownership.
- Creates areas of shade below the rainwater harvesting parasol.
- Attaches to already existing structures requiring little to no footprint of its own.

Negatives

- Relies on existing structures: which may not be structurally stable or uniform in size and shape requiring each intervention be bespoke.
- Impedes the ability of the inhabitants below to expand their dwelling.
- Requires the water tank be placed on the ground near the intervention, both limiting the tanks capacity and requiring the use of ground space that is already at a premium.
- Provides no capacity for community space.
- Access to the community space and farm area may become intrusive to those living below.

Fig. 8.15. Concept 04

Fig. 8.16. Concept Sketch

Water Capture

Park Space

Concrete Structure

Photovoltaics

Concept 04

Positives

- Provides Rainwater capture: including a small tanks for storage.
- Photo-voltaic panels, provides sustainable electricity generation.
- Provides areas for urban farming: creating a community activity and strengthening community ownership.
- Creates areas of shade below the rainwater harvesting parasol.
- Has a small ground area allowing it to be placed into the tight access ways of Petare.
- Provides much needed green space to the informal settlement
- Connected walkways improve access through Petare.

Negatives

- Requires heavy materials be transported in for the structure: this limits the areas in which the intervention can be placed as materials can not be carried through cramped access ways by hand.
- Small interventions could be scalable and adaptable to different locations in Petare.
- May negatively affect the area below as it would affectively cut off sunlight to any dwellings it is placed above
- Access to the community space and farm area may become intrusive to those living below.

Fig. 8.17. Concept 05

Fig. 8.18. Concept Sketch

Photovoltaics

Food Production

Food Production

Water Collection

Concept 05

Positives

- Does not require the use of large / heavy structural materials.
- Provides Rainwater capture: including a small tank for storage.
- Photo-voltaic panels, provides sustainable electricity generation.
- Provides areas for urban farming: creating a community activity and strengthening community ownership.
- Creates areas of shade below the rainwater harvesting parasol.
- Has a small ground area allowing it to be placed into the tight access ways of Petare.
- Small interventions could be scalable and adaptable to different locations in Petare.

Negatives

- Smaller water capture area, and small water storage capacity: therefore has a smaller area of affect and lower number of people it can provide for.
- Small interventions could be scalable and adaptable to different locations in Petare.
- Provides no capacity for community space.
- Access to the community space and farm area may become intrusive to those living below.

Fig. 8.19. Concept 06

Fig. 8.20. Concept Sketch

Photovoltaics

Food Production

Food Production

raised Walkways

Concept 06

Positives

- Does not require the use of large / heavy structural materials.
- Provides Rainwater capture: including a small tank for storage.
- Photo-voltaic panels, provides sustainable electricity generation.
- Provides areas for urban farming: creating a community activity and strengthening community ownership.
- Creates areas of shade below the rainwater harvesting parasol.
- Has a small ground area allowing it to be placed into the tight access ways of Petare.
- Multiple interventions expand the area of effect and increases the amount of people they can benefit.
- Connected walkways improve access through Petare.

Negatives

- Smaller water capture area, and small water storage capacity: therefore has a smaller area of affect and lower number of people it can provide for.
- Small interventions could be scalable and adaptable to different locations in Petare.
- Provides no capacity for community space.
- Access to the community space and farm area may become intrusive to those living below.

Fig. 8.21. Development 01

Fig. 8.23. Concept Sketch

Photovoltaics

Food Production

Food Production

Water Collection

Fig. 8.22. Model Iteration 01

Concept Developments

Concept 05 was selected to develop further as it met the design criteria to provide, water, power, and food production (as a community activity), without the need for removal of the existing. This concept has some advantages over the others, including its use of light materials which can be carried to site - this will maximize the locations in which interventions can be placed. Other positives include the designs verticality and small ground cover, which will reduce the potential impact on residents. Also, this design does not rely on already insisting structures allowing the design to maximize the number of people it can help rather than just the dwelling it is attached to.

This concept will need further development to reduce its shortcomings and maximize its potential. However, unlike the other concepts, this designs shortcomings may prove drivers for design rather than a burden to the final design.

Fig. 8.24. Development 02

Fig. 8.25. Concept Sketch

Photovoltaics

Food Production

Buried Water Tank

Adjustable Legs

Fig. 8.26. Model Iteration 02

Concept Developments

The primary purpose of these interventions is to provide potable water, and currently the amount of water captured may be insufficient due to the small scale of the interventions. To improve the capacity of the design for rainwater capture the area of the farm area was increased and a larger water tank was buried below the tower (while not tanking up valuable ground space). This variation of the design uses timber legs attached to concrete piles to distribute gravity loads into the nonuniform spaces below the towers.

Changes:

- Adjustable Legs.
- Larger Buried Water Tank.
- Extra Height.
- Increased Diameter.

Fig. 8.27. Development 03

Fig. 8.28. Concept Sketch

Food Production

Buried Water Tank

Compression Ring

Adjustable Legs

Fig. 8.29. Model Iteration 03

Concept Developments

In the previous iteration - Fig.8.23 - it became clear that the leg design once placed into the site model was intrusive to the walkways they were placed into, the design also had structural instability in the timber sections of the leg. Therefore in Fig.8.26 the design was amended to be less intrusive and more structurally stable transferring gravity loads in a linear line to the ground.

Changes:

- Adjustable legs developed to be less intrusive.
- New legs increase height.
- Standard photovoltaic panels used to reduce cost.
- Water travels along pipes inlaid into the legs to the water tank

Fig. 8.30. Development 04

Fig. 8.31. Concept Sketch

Water Filter

Cast In-Situ Tank

Compression Ring

Adjustable Legs

Fig. 8.32. Model Iteration 04

Concept Developments

Due to the levels of pollution in Caracas, a water filter was needed to purify water to make it potable. In this iteration, an activated carbon water filter was added to met this need. The water tank also became a cast in-situ concrete tank, this allows the tank to become dual purpose that of a water tank, and foundations for the tower above.

Changes:

- Activated charcoal filter added
- Water tank becomes cast in-situ concrete, dual functionality of foundations & water tank.

Fig. 8.35. Alt Truss A

Fig. 8.36. Alt Truss A

Fig. 8.33. Alt Truss B

Fig. 8.34. Alt Truss B

Timber Truss

Steel Connections

Timber Truss

Embedded Light

Fig. 8.37.
Fink Truss:
Truss investigations
use variations on the
Fink truss which allows
cantilevers to have a
central support.

Structural Investigations

At this point of the design process, it became clear that the previous level of the structure was insufficient. This led to various structural experiments, consisting of improving the structure's ability to support the large span needed for rainwater harvesting without drastically altering the silhouette of the design. With the current hourglass silhouette where the structure tapers in the center from the legs and the cantilever above to a compression ring in the center, this allows the towers to be placed in more irregular sites through Petare - such as in conditions where above the ground floors dwellings cantilever outwards. Whether that be larger floor plates, balconies, or the overhang off roofs. This shaping of the towers allows these outward projections not to interfere with the towers thus increasing their adaptability.

Fig. 8.38. Alt Truss C

Fig. 8.39. Alt Truss C

Fig. 8.40. Alt Truss D

Fig. 8.41. Alt Truss D

Timber Truss

Structural Investigations

Structural changes shared by Fig. 8.8 & Fig. 8.6, where inspired by Buckminster Fullers Lightful Houses investigations - which eventually lead to his Dymaxion House design. Buckminster Fuller's design consisted of tension cables connected to a central mast to support a floor plate. This allows for there to be a large floor plate with a small ground occupation.

This translated to my design would allow for a larger area with which to capture rainwater. A hybrid system of timber trusses and tension cables allows for lighter materials such as timber instead of steel, allowing the timber trusses to be less substantial, and for the towers to have an hourglass shape with the structure tapering in the center this allows them to be placed into areas of Petare where the second story of a building cantilevers above the street.

Fig. 8.43. Development 06

Fig. 8.45. Concept Sketch

Timber Truss

Tension Structure

Compression Ring

Adjustable Legs

Fig. 8.44. Model Iteration 06

Concept Developments

The Alt truss D - Fig.8.39 - structural system was chosen as it was structurally sufficient and required less material than the alternatives. Another benefit of this system is its reduced visual mass, and corresponding visual impact. To improve the towers structural stability the legs of the tower were increased from 4 to 6 and thickened to a squarer profile. These structural changes better help distribute loads from the structure into the non-uniform spaces found in Petare - where a uniform structure isn't possible. At this point in the design process, the interventions were tested in different areas of Petare to gauge their adaptability.

Changes:

- Truss and tension structure implemented.
- Legs increased from 4 to 6.
- Flag added for Way-finding

Concept Developments

At this point, it became clear to maximize the amount of positive impact, the architectural intervention that the design needed to meet both the basic needs and the social needs of these people. To get them to truly accept the design, more needed to be done to promote the communities sense of ownership. Otherwise, the architecture may be perceived by the community as being imposed on them.

The first set of experiments in this direction attempted to adapt the current design of the infrastructure towers to add community space. Ultimately these experiments were discarded due to a number of reasons, some including, structural instability or the limited amount of space actually created. However, this experimentation helped to inform the later developed into a second larger topology to fill the amenity needs of the community.

Fig. 8.46. Second Topology 01

Fig. 8.48. Concept Sketch

Food Production

Water Capture

Water Tank

Road Clearance

Fig. 8.47. Sketch

Concept Developments

An alternate topology was created to fill the amenity needs of the community. This topology was designed to be placed along the major access arteries of Petare. These arteries would be areas where larger interventions could be placed due, materials being able to be brought to the site by vehicles rather than carried in by hand (such as in other places within the settlement). Another benefit to this placement of the towers where the larger space available if the design occupied the space above the roads.

Changes:

- New topology created to augment smaller infrastructure towers.
- New topology includes raised public space.
- Inhabitants to be consulted on public space use.

Fig. 8.49. Second Topology 02

Fig. 8.50. Concept Sketch

Photovoltaics

Water Tank

Timber Structure

Road Clearance

Fig. 8.51. Model Iteration 01

Concept Developments

The development of these community hubs looked at how to reduce the cost of the larger towers. This was done through the reuse of elements from the smaller towers, this would allow the parts to be mass produced and construction knowledge of the builders to be reapplied to increase efficiency. Another benefit of reusing elements of the smaller towers was to strengthen the visual connection between the two typologies.

Changes:

- Photovoltaics added for power generation.
- Photovoltaics and farm area mimic smaller towers.
- Interlocking timber structural system created.

Fig. 8.52. Second Topology 03

Fig. 8.53. Concept Sketch

Photovoltaics

Water Tank

Timber Structure

Road Clearance

Fig. 8.54. Model
Iteration 02

Concept Developments

Changes:

- Water Tank added: dual purpose tank and foundations.
- Activated carbon water filter added.
- Corrugated pvc paneling added for protection from the elements.

Fig. 8.55. Second Topology 04

Fig. 8.56. Enclosed Community Space

Tension Structure

Timber Truss

Water Tank

Fig. 8.57. Model Iteration 03

Concept Developments

To further reduce costs and improve the visual connection of the design, the larger hubs design was amended to act like nesting dolls. With the smaller towers placed within the larger ones, and the added community space added around them. This both improved structural stability and allowed for the higher reuse of materials, so parts can be mass produced and therefore costs reduced. These similar parts also allow laborers to build up their construction knowledge on the smaller towers to be applied to the larger towers. The visual connection between the typologies also helps build trust and ownership of the larger owners by building of the goodwill already established.

Changes:

- Structure altered to include smaller towers within: allowing parts and construction knowledge to be reapplied.
- Trusses added below cantilevered floor plates.
- Tension cable structure included from smaller towers.

Fig. 8.58. System Breakdown

Micro: Infrastructure Towers

Rain water harvesting towers with photovoltaic panels.

Macro: Collective Amenities

Community hubs to provide amenities for the community.

Conclusion

Preliminary Design

At this point in the research, the system I was creating was still vague and not fully realized. The larger community spaces were limited by their location, therefore only a low amount of people could be accessed and used by, due to its large concrete base. The base of these towers also created a large impact on the space below, due to the required girth of the concrete using valuable road space below.

Moving forward the connection between all the elements of the system needs strengthening, the water filter simplified, and the larger community hub design developed to reduce their impact and increase their adaptability. Other aspects that need attention include the power generation output, rainwater harvesting levels, and costing of the towers.

Areas the design response should improve upon are:

- Cohesiveness of the system.
- Adaptability of Community Hubs to different areas in Petare.
- Simplify water filtering.
- Provide basic costing.

Fig. 8.59. Site Test 01

Fig. 8.60. Site Test 02

“Lightning makes no
sound until it strikes”

– Martin Luther King Jr. –

(Luther King)

[REDACTED]

9.0 Developed Design

Fig. 9.1.
Petare Birdseye

Fig. 9.4. Reservoir Concept

① Compression Ring

② Water Tank

③ Adjustable Legs

Fig. 9.5. Petare Staircase

[REDACTED]

Adjustable Structure

Each tower has a system of adjustable legs to allow them to fit into tight nonuniform spaces throughout the slum. The legs allow the main mass of the towers to be placed above the neighboring buildings so as not to occupy the valuable space below.

Further improvements include the water tanks which have become staircases and access-ways. The purpose of the tanks then became threefold, as a water reservoir, foundations for the towers, and a method of improving access through Petare. This change created a connection between the multiple towers and to the larger community hubs. As well as expanding the area of effect of the towers as excess water can be stored, flow away from the tower so more people can access it.

Fig. 9.6. Community Water Capture

Fig. 9.7. Sketch

Fig. 9.9. Sketch

Tarps: Collective Investment

Pre-Installed Gutter Connection

Fig. 9.8. Model
Iteration 07

Community Engagement

Community engagement is encouraged throughout the construction of the system. Firstly the towers will be built with the help of the inhabitants (which would give them construction experience with the smaller towers - which can be applied to large ones). The initial towers would be used as a proof of concept for the fully connected developed system to help convince the community to trust and take ownership of the system.

The towers work in conjunction with the collective engagement of the community, who are encouraged to participate in rainwater harvesting through roof-mounted tarps, giving each dwelling a direct connection to the system, which will maximize the amount of water that can be collected. Also, the towers help with way-finding acting as landmarks able to be seen from a distance, and provide lighting at night to improve the feeling of safety.

Fig. 9.10. Development08

Fig. 9.11. Model Iteration 08

Concept Developments

Changes:

- Larger span for Increased water capture.
- Larger photovoltaic panels for increased power generation.
- Truss amended to allow for a larger span.

Food Production

Food Production

Food Production

Food Production

Fig. 9.12. Development 09

1086 L/D

583.67 GJ/Y

111.25m²

Food Production

100kWh Battery

Compression Ring

Adjustable Legs

Fig. 9.13. Model Iteration 09

Infrastructure Section

A problem that arose from allowing the residents to contribute to the water capture was that every rooftop then needed an individual filter. Beyond the logistic problem of providing and installing a water filter for each dwelling, there also becomes the problem of maintenance with filter materials needing to be replaced every few months. If even one filter was not maintained the water supply could become contaminated. To this end, the water filters were changed to be point-of-access to reduce the number of filters needed and to reduce potential points of failure.

Changes:

- Changed the water filter system to be point-of-access rather than point-of-capture to reduce the amount of filters needed.
- Access to farm level added, with adjustable staircase.
- Larger battery added increased from 50kWh to 100kWh battery.

Fig. 9.14.

Development09

LS:MK9.0

Costing: Infrastructure Tower

Costing Small Towers (all prices \$USD)

PV Panels = \$13,500 (Matasci)

100Kwh Battery = \$13,900 - With Tesla's Gigafactory beginning production this could drop to \$10,000 in the next three years - (Miller)

Reverse Osmosis Water Filter = \$2,837.74

("Commercial-Ro-Systems")

Timber Brazilian Pine \$USD per m3 = \$204

("Lumber and Timber Prices")

$20.54\text{m}^3 * 204 = \$4,190.16$

Steel per USD\$/tonne = \$684 ("Latin American Steel Prices")

$0.377\text{t} = \$257.868$

Cement (USD\$ per 50kg bag = \$9.08) (Molinari)

$4,320\text{kg} = 86.4 \text{ bags}$

$86.4 * 9.08 = \$784.512$

Total = \$35,470.28 (25/10/17)

30K to 40k depending on availability of material.

(Venezuela's Inflation at the moment may drastically increase this costing)

Food Production

100kWh Battery

Compression Ring

Adjustable Legs

Fig. 9.15. TowerAxonometric

1086 L/D

583.67 GJ/Y

111.25m²

Fig. 9.16. Development09

Infrastructure Towers

Solar Panel Power Output

$$E=A*r*H*PR$$

(Energy KWH) = (Solar Panel Area m2)*(Solar Panel Yield Efficiency %)*(Annual Average Solar Radiation on Tilted Panels KWH/m2/Year)*(Performance ratio coefficient loss - range between 0.5 and 0.9 -) ("calculate the annual solar energy")

$$E = 71.76m2*15\%*200.83KWH/m2/Year*0.75$$

$$E = 162,130.059KWH/Year$$

Average Household Usage Venezuela = 6.5GJ/Year - mostly for cooking - (Figuroa et al.)

$$162,130.059KWH/year = 583.67GJ/Year$$

$$583.67 / 6.5 = 89.8 \text{ (Amount of households the towers can supply power to)}$$

Rainwater Harvesting – Small Towers

Roof Area (m2) * Annual Rainfall (mm) * 0.9 (Percent of rainfall captured)
= Rainwater Harvested ml ("Rain Water Harvesting Formula.")

$$236.6m2 * 510mm * 0.9 = 1,085,994ml$$

$$1086L$$

$$1086L / 20L - UN Water Guidelines Per person per day ("Clean Water") \\ = \text{Water provided for 54.3 people}$$

However with Caracas having dry periods in February and March, water captured would be much higher in the wetter months Also water captured would increase as residents provide their roofs for water capture.

(A low of 59.14mm in February 2016 ("Weather and Climate") I could capture 125.9L enough too sustain 6.3 people)

(A high of 880.3mm in November 2016 ("Weather and Climate") I could capture 1,874.5L enough too sustain 93.7 people)

Fig. 9.17. Tower Final Model

Fig. 9.19. Sketch Model 02

Fig. 9.18. Sketch Model 01

Physical Modeling

Physical model testing structural rigidity and 3-dimensional relationship of components

Fig. 9.20. Development 09

Fig. 9.21. Development 09

Fig. 9.22. Development 09

1086 L/D

583.67 GJ/Y

111.25m²

Infrastructure Towers

Fig. 9.23. Second Topology 05

Fig. 9.24. Sketch

Timber Truss

Tension Structure

Compression Ring

Adjustable Legs

Fig. 9.25.
Iteration 05

Model

Community Hubs

Extra span of water capture added in tandem to the smaller towers
span also increasing

Changes:

- Larger span for Increased water capture.
- Larger photovoltaic panels for increased power generation.
- Truss amended to allow for a larger span.

Fig. 9.26. Second Topology 06

Fig. 9.27.
Iteration 06

Model

Concept Developments

Adjustable legs added to allow the towers to fit into denser spaces, and into less flat spaces, also gives the lower portion of the towers a more connected design language to the smaller towers.

Changes:

- A series of 8 adjustable legs added in place of the concrete pedestal.-
- Access to farm level added, with adjustable staircase.
- Larger battery added increased from 50kWh to 100kWh battery.

Food Production

Water Filter

Ball Joints

Adjustable Legs

Fig. 9.28. Second Topology 07

Fig. 9.29. Facade Sketch Design 01

Fig. 9.31. Facade Sketch Design 02

Cable System

Tension Cable

Fig. 9.30. Model Iteration 07

Openable Facade

An open-able facade was created to allow airflow through the structure in the hot climate. The facade also facilitates extra rainwater harvesting by opening outwards and increasing the area the tower can capture water with.

Changes:

- The facade was modified to be open-able.
- Facade panels open outward to increase rainwater harvesting.
- Each facade panel has a hidden gutter to transfer water to the tank.

Fig. 9.32. Second Topology 08

Fig. 9.33. Model Iteration 08

Hub Section

The leg system of the towers and hubs allows them to occupy space previously unusable by the community as they can occupy the space above the roadways without disrupting them. Community areas inside the hubs are self-determined by the community to allow the spaces to fulfill the needs the community needs and to encourage the community to take ownership. Due to the hubs being located in areas vehicles can reach, larger materials can be driven to the site and architectural interventions can thus be bigger.

Openable Facade

Adjustable Legs

Fig. 9.34. Second Topology 08

Food Production

1702.89 L/D

583.67 GJ/Y

111.25m²

Community Amenities

466m²

Fig. 9.36. Second Topology 08

Community Hubs

Photovoltaics Electricity Output

$E=A*r*H*PR$

(Energy KWH) = (Solar Panel Area m2)*(Solar Panel Yield Efficiency %)*(Annual Average Solar Radiation on Tilted Panels KWH/m2/Year)*(Performance ratio coefficient loss - range between 0.5 and 0.9 -) ("calculate the annual solar energy")

$E = 71.76m2*15\%*200.83KWH/m2/Year*0.75$

$E = 162,130.059KWH/Year$

Average Household Usage Venezuela = 6.5GJ/Year - mostly for cooking - (Figueroa et al.)

$162,130.059KWH/year = 583.67GJ/Year$

$583.67 / 6.5 = 89.8$ (Amount of households the towers can supply power to)

Rainwater Harvesting - Community Hubs

Roof Area (m2) * Annual Rainfall (mm) * 0.9 (Percent of rainfall captured)
= Rainwater Harvested ml ("Rain Water Harvesting Formula.")

$236.6m2 * 510mm * 0.9 = 1,702,890ml$

$1702.89L$

1702.89L for the Hub with the expandable surface area through the facade

$1702.89L / 20L$ - UN Water Guidelines Per person per day ("Clean Water")
= Water provided for 85.1445 people

Fig. 9.37. Hub Final Model

Fig. 9.38. Sketch Model

Fig. 9.39. Hub Final Model

Physical Modeling

Physical model testing structural rigidity and 3-dimensional relationship of components

Fig. 9.40. Development 08

Fig. 9.41. Development 08

BB:MK8.0

1702.89 L/D

583.67 GJ/Y

111.25m²

Community Amenities

466m²

Community Hubs

Micro: Infrastructure Towers

Rain water harvesting towers with photovoltaic panels.

Meso: Collective Investment

Community engagement and ownership, tarps increases water capture.

Fig. 9.42. System Scales

Macro: Collective Amenities

Community hubs to provide amenities for the community.

System Scales

My design outcome works on 3 scales that of the smaller infrastructure towers, community engagement, and larger community hubs.

Fig. 9.43. System Axi

Community Hubs

Roof Mounted Tarps

Water Tanks / Access

System Axonometric

The design outcome consists regeneration strategies that seek to promote a collaborative construction of the physical environment, in order to boost neighborhood development, I propose a system that works on 3 scales, to solve basic problems, such as water, power, and community space. The 3 scales consist of the smaller infrastructure towers, community engagement through roof mounted tarps, and larger community hubs. This system would be the starting point of a revitalization process, helping to improve the permanence and resilience of these communities.

Fig. 9.45. System Design

Fig. 9.46. Tower Density

Intervention Density

Each of the smaller towers services a 35m radius from its center, with seven being able to service a 100m radius. The larger community hubs are placed along larger roads with a distance of 75m between them. However the more that the community participates in collecting rainwater, the less the towers will be needed.

Fig. 9.47. Implementation

Phase One: Small Interventions

Phase Two: Collective Investment

Phase Three: Collective Amenities

Macro

Community hubs are installed to provide amenities needed in the community.

Phases of Implementation

The phases encourage community engagement throughout. In the first phase community members will be used to construct the towers and water tanks. In the second phase collective engagement is encouraged through individuals participating in rainwater harvesting through roof mounted tarps. In the last phase the community is encouraged to self determine the uses of the spaces.

Community Engagement

The system has been created to promote the communities engagement from construction through to maintenance as a means to promote the communities sense of ownership of the system. The various stages of the systems implementation also are a means to help the community ascend Maslow's hierarchy.

1. To begin with, individual towers are built with the aid of the inhabitants (this both helps to foster the community's perception of ownership towards the system and to give them construction experience - which can be applied the construction of more towers). Initially, the towers help convince the community to trust the system, proving that the larger system is beneficial to the community by immediately showing some of its benefits such as water and power.

The towers also work as a proof of concept to other communities to convince them to allow further towers to be built, and the system to be expanded. The community can see the benefits of the system reasonably quickly helping to build trust, such as the main purposes of the towers (rainwater harvesting, and power generation). Other benefits of them include a small provision for food cultivation (as a community activity to foster social connections), lighting the access-ways at night to improve the feeling of safety, and they also act as landmarks able to be seen from a distance and help with way-finding.

2. Next, the access-ways are cleared of trash and debris and the construction of the staircase/water tanks begins. The implementation of the staircases improves access through the dense neighbourhoods and acts as a reservoir supplying water through the community.

3. Further community engagement is encouraged as people connect their roofs to the system, increasing the amount of rainwater capture and giving each dwelling a direct connection to the system. The community decides plants that are grown in the farm areas and maintains them as a community activity.

4. The community is also encouraged to decorate the system, to give the areas an identity and to promote the esteem of the community. They build and decorate the access-ways, and staircases, giving their local community an identity and further ownership of the system. Staircase treads are painted simply by colour or have painted murals (decided by community). Larger platforms are created where possible to provide recreational spaces i.e. basketball courts. As well as the community getting to decide how colourful the tarps/roofs are.

5. The construction knowledge gained from building the smaller towers to help construct the larger community hubs (the community is consulted on their end use such as medical, educational, community hall, food market, community kitchens, churches, etc) government or charities help fit them out for their new use. Further kits of the smaller towers are provided which can be built by the community with the construction knowledge gained and modified to communities' preference such as decorating, or added utility, etc.

Maslow's Hierarchy

Physiological

Through implementing the smaller infrastructure towers first, the system works to meet the residents physiological needs as the most important needs to address for the residents of Petare. These towers provide access to the residents basic needs such as water, electricity, food improving residents quality of life. The system also seeks not cause any undue burden on the community while providing these basics, through not occupying valuable space and instead the system resides above the usable space with a small ground occupation. The improved access-ways also provide easier access to amenities within the greater urban context.

Security

To improve residents feelings of safety, the system provides safe spaces for the community to reside and sources of lighting within access-ways at night. The better access provided also means more foot-traffic and therefore more eyes on the street. Increased safety for the community will also encourages them to further invest in their homes as an extra benefit to this system.

Belonging

The system promotes belonging by bonding a community together through creating a feelings of identity, pride, and ownership. Through community engagement the system begins to create an identity for the community through their collective decoration of the system, with the towers acting as crux for the identity to spread into the community. The Farms in towers provide shared responsibility promote community engagement and therefore belonging. These shared amenities also act as bump spaces for chance conversations. The larger hubs provide spaces for the community to gather and discuss means to face shared adversity or improvements.

Esteem

Firstly through simply implementing the system the community esteem will increase as they will feel valued by outside parties due to the due to this investment. Furthermore, the community hubs can also be fitted out to act as schools, places of worship, medical facilities or institutions decided by the community, and allow the community to rally around and be proud of increasing their esteem.

Self-Actualization

To achieve a collective Self-Actualization as a community informal settlements must respond to their current values and surrounding built form and seek self improvement. To promote the community to achieve this the larger towers provide easier access to education and skills training. as well as encouraging communities to apply construction techniques gained in implementing the system in their own neighbourhoods into helping educate other communities to implement the system in their own neighbourhoods.

In conclusion, the full system provides better community engagement, while also providing water, power, food, community amenities, community space, access to needed services, and security. Allowing the people to focus less on these basic needs (reducing stress) so they can have more time to improve other aspects of their lives.

Conclusion

In summary, this is an important issue for architects to address due to the large and ever-growing percentage of humanity's population living in slums. These slums have poor conditions and little access to basics such as, food, water, electricity, as well as barely any institutions to build community or improve themselves through education. The problems faced by these communities will only be exasperated further as population increases cause these settlements to swell, making improving the conditions within an important undertaking for architects to overcome.

This exegesis has tested approaches to improving conditions and access to resources within Petare without displacing the inhabitants through demolitions or forced relocations. Rather, the design outcome creates a scalable system that can be implemented collectively by residents in order to boost neighbourhood development and community ties. This helped to achieve the aims of this research and design proposal to improve the quality of life for the residents, where the ultimate iteration of the design outcome creates a greater access to opportunities and promotes social inclusion. During the design process, it was important to develop and test solutions for the dense and compact conditions within the site, and therefore important not to occupy valuable public space to provide sources of fresh water, renewable energy, and spaces for community gathering without causing the community undue harm.

The proposed solution is one of ascending goals, similar to Maslow's hierarchy of needs, with a scale-able plan for improving conditions the urban poor living in slums within developing countries. Maslow's theory has been used to create an expandable system beginning by providing for the communities basic needs and expanding over time to provide for the higher levels of Maslow's hierarchy. This approach allowed for the interventions to meet the most important needs of the community such as access to basic resources, and then expand as their needs changed focus, for example, providing residents with a sense of value and belonging through institutions and spaces to gather, all the way up to providing them with a means for self-improvement through better access to

education, all as means to reduce inequality and marginalization.

Given more time if the scope of this investigation were to be extended, there are opportunities to develop similar systems within other informal settlements in Caracas and to a larger extent within other developing countries around the world. Through expanding the number of settlements, the system would be placed into the design of the system could be further refined and adapted to be easier and cheaper to mass produce and assemble, allowing the system to be used to help a greater number of people. I would have also liked to explore how to add further utility to the system such as wastewater treatment, or how the towers could be modified by users to be unique or meet unforeseen needs. Also, the scope of the project could further be expanded through considering how the developed design could be used for other applications, such as in cases of disaster relief (such as Puerto Rico being without power or water after hurricane Irma and Maria) or as a means to provide services within refugee camps. The developed design also presents opportunities for integration into western countries providing renewable resources for better resiliency in the case of disaster through decentralized backups, which could also be beneficial for island nations.

A major constraint I encountered was the inability visit the site due to the volatile situation in Venezuela during my research. This prevented the ability to get residents to contribute to the research through participatory design which could have potentially strengthened the final output as the design would have gotten critiqued and improved by residents. Not being able to visit the site also limited my experience to one from a distance, experienced through satellite images, photographs, documentaries, articles, and books. In a process to combat this deficiency, I consumed as much content on Venezuela as I could access, and created extensive mapping and site analysis which I used to digital model the site and place into a video game engine to better understand the scale and density of the site. However, these approaches have improved my understanding they cannot act as a perfect substitute to the real experience of the people and their culture.

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“One In Seven”

By

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