FLOAT CITY

Makoko : (re)development of an aquatic home

by Shawn Duke

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FLOAT CITY

Fig 1.0 Aerial image of Makoko showing its water routes, canoes, and diverse architecture.
Photograph by **Iwan Baan**

Abstract

Float City

Modernism's endeavors to improve the living standards of slum dwellers in developing countries in the last decades, while well-intentioned, have resulted in few success stories. In many cases these good intentions have been compromised from the start due to the approach taken whereby residents are "temporarily" relocated without their consent and thus subsequently forced to try to create a new life that is challenging and difficult to adapt to. Makoko, an informal settlement located in a lagoon off the coast of Lagos, Nigeria, is recognized as the world's largest floating slum. Over the years, this shantytown has grown into what is now seen by government officials as an obstruction of "proper" development and a visual nuisance; not coincidentally, the waterfront site is being labeled as prime real estate by developers. There have been efforts facilitated by the government to evacuate the slum that are ending with disastrous results for residents of the slum. The proposal pursued in the following research and design for Float **City** hopes to serve as a precedent for a form of affordable housing with a more community-oriented approach. Using D.I.Y (do-it-yourself) principles as its foundation, in conjunction with a combination of high-tech and low-tech infrastructure and architecture, this proposal hopes to create templates for the slum dwellers to follow to help in the revitalization of their own homes and community.

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Float City

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Fig 2.0 Map of Nigeria Locating Lagos

02

Introduction

Float City

Slum redevelopment via new, humane housing has been the primary focus of modern architecture's ideals since the start of the twentieth century. However, though modernism's intention of improving lives through the urban and architectural betterment of living conditions is of course well-intentioned, most approaches that have been taken by architects, even when they have received the cooperation of governments and developers, have had extremely uneven results.

Slum redevelopment plans historically involve a three-step process: the temporary relocation of residents, the total clearing out of the site, and the construction of "better" architecture. The shortfall of this approach lies within the initial relocation of the residents whereby they are being taken away, usually unwillingly, from the lives and means of support to which they are accustomed and/or are moved to altogether different locations where they have no sense of place. This latter strategy, though generally assumed to be temporary, completely disrupts peoples' lifestyles and leaves them with little or no access to goods and community services they would regularly need and receive. It is no wonder that stories of slum dwellers frequently "escaping" back to their old homes are often told.

The proposal pursued in *Float City*, which examines the slum of Makoko, a settlement with a population of approximately one-hundred-thousand that straddles the coast of Lagos, Nigeria (Fig. 2.0), questions this top-down approach. This thesis strives to investigate a process for the improvement of a vast slum area applying a method of architectural thinking and making that does not aim for a gleaming, new architectural reality provided top-down from an architect; this research focuses upon the ability, known skill-sets, and ingenuity of the slum dwellers to help themselves.

This study of *Float City* begins by seeking to understand the living conditions of Makoko's residents assessing what existing conditions of local life and economics, even if problematic in many respects, are nonetheless the most crucial to be preserved for the maintenance of community. This research takes cues from case-studies of constructed interventions in other recent African slum improvement initiatives as well as unbuilt theoretical projects, both as examples of what to do and what not to do.

The end goal of this thesis is to determine if significant housing and community improvements can be achieved in Makoko if the architectural work is left primarily in the hands of its inhabitants with the architect merely a "catalyst" to help locals re-frame aspects of individual and community building.

Fig 3.0 Map of Lagos locating Makoko and other coastal settlements, and showing the urban growth of Lagos from the 1900's till the 2000's

03

Slums in Lagos

Lagos Nigeria

Lagos, Nigeria's economic, and social capital, is home to approximately twenty-million people, and with an urbanization rate of 5% per annum and a 70% poverty level, its urban population is the largest of any low-income country second to India.¹ Lagos is considered a megacity, and with the highest GDP in Africa, it is remarkable that it survives for decades on end without what the western world currently recognizes as standard infrastructural benefits. A significant lack of an electrical supply and poor sanitation are two of the critical issues faced by its residents. With such infrastructural problems and its ever-expanding population, Lagos is a city that continues to grow rife with informal settlements.

Lagos started off as a port city, originating on a group of smaller islands separated by creeks, which form the mouth of the Lagos Lagoon. Bordered on the North by Ogun State and on the south by the Atlantic Ocean, the majority of the city is enclosed by water. Lagos is a city that is simultaneously growing and decaying – its metropolitan area has been developed independently of city planning efforts, which has been defined by urbanist Matthew Gandy as “amorphous urbanism”.²

¹ Davis, Mike. *Planet Of Slums*. New York, NY, Verso, 2006.

² Gandy, Matthew. “Learning From Lagos.” *New Left Review*, no. 33, 2005.

In response to the rapid population growth, and in addition to the slums scattered through it, the city began seeing the rise of coastal settlements (Fig. 3.0). These settlements, though seemingly disorganized in nature, nearly always do in fact have logic and order to them as over the centuries they have established, and to some extent perfected, a system of development that aids in the survival of their communities.

In 2005, the Lagos state government established the Lagos State Economic Empowerment and Development Strategy (LASEEDS). This was aimed at redeveloping the city to a point where there are lower levels of poverty, more employment and wealth, and reorienting value systems.³ The intentions of this project, while good, have led to the government paying more attention to informal settlements, but not necessarily in a positive way. Rather than attempting to redevelop these shantytowns, the government has decided to get rid of them altogether, as most of their locations have been labeled as prime real estate.

The Lagos state government's attempt to make the city a cleaner and safer place, even if only superficially, means that the visual presence of slums throughout the city is an affront to the government's public image. With the Nigerian urban housing market primarily targeting high-income earners, actual slum redevelopment is not a government focus and instead mere slum clearance prevails. In the current socio-political situation of Lagos, enormous sectors of the Nigerian population are excluded from any formal housing provision.

³ Filani, Michael. *The Changing Face Of Lagos: From Vision To Reform And Transformation*. Ibadan, Oyo State, Nigeria, Cities Alliance, 2012.,

Fig 4.0 Aerial map of Makoko showing the slum adjacent to the 10km long Third Mainland Bridge
Image sourced from Makoko research document, **NLE Architects**, 2012

04

The Site

Makoko: The worlds largest floating slum

Makoko is a slum that has grown due to the housing shortage in Lagos. It is called, perhaps with cruel irony, the “African Venice” because all its structures sit on stilts above the Lagos Lagoon. The location of the slum (The Lagos lagoon) instantly sets it apart from most other slums as it provides a unique aquatic quality. Fishing is the major vocation in the community. Generally, husbands and teenage sons would go out into the lagoon during the day to fish.¹ At the end of the day, whatever was caught would be brought back home for the wives and daughters to cook and/or sell, within and outside the community. Lumber sale is the secondary vocation of the slum dwellers. Logs are sawn and laid out on the water along the southern area of the community.² The area has an abundance of Akoko trees (*Newbouldia Laevis*), its surrounding water was initially named “Omi Akoko” meaning “Akoko water”, but was later shortened to Makoko.³

Newbouldia Laevis: 7 to 8m in height in West Africa
Up to 20m in Nigeria
Glossy dark green leaves/ purple flowers
Evergreen plant

¹ Architects, NLE. Makoko Research Document. Heinrich Böll Stiftung, 2012.,

² Ibid.

³ Ogunlesi, Tolu. “Inside Makoko: Danger And Ingenuity In The World’s Biggest Floating Slum.” The Guardian, 2016.,

Most Lagos slums are owned by a private landowner, usually a family. Makoko is owned by the Olaiya family. The family are residents of the slum who rule and oversee all the activities in the community. Seeing as the government is not involved in the community, police have no obligation to intervene in the activities of the slum.⁴ Protection is provided by local thugs known as “area boys”, who control everything from security to drug trade. With the lack of government involvement, there is a major lack of basic amenities, which has led to the current unsanitary state of the site.

General Site information:

The Makoko community is governed by traditional chiefs with three on the land side and nine on the waterside, with the main chief (Baale) of Makoko being Chief Kunle Olaiya. Usually, construction in the community would not be done by private companies, but rather by friends and family members of those who are building. The construction process starts by acquiring “land”, which is bought only by talking to the chief. Money is not used as a means of acquiring property, but rather bribing the chief with basic commodities (buying him lunch for example) and showing him the plot of land in question. Many homes are not occupied by landowners as it can get expensive for the average Makoko resident – most occupants usually pay an annual rent.⁵ Only 7% of residents actually have a “legal” title of land ownership, because of high registration costs and residents feel the process is too time consuming and unimportant as the quality of the buildings is not up to a certain standard.⁶

⁴ Agbola, Tunde, and Elijah M. Agunbiade. “Urbanization, slum development and security of tenure: The challenges of meeting Millennium Development Goal 7 in metropolitan Lagos, Nigeria.” A. de Sherbiniin, A. Rahman, A. Barbieri, JC Fotso, and Y. Zhu (eds.), 2009.

⁵ Ibid.

⁶ Ibid.

In addition to that, insecurity of tenure is one of the most important issues with slum dwellers and it is a major reason for the residents to refuse to purchase property.⁷

Current Site Conditions:

In 2012 the Lagos government came up with a plan to clear out Makoko to make room for possible developments on what is prime land. This has generally been unsuccessful as most of Makoko's residents do not want to move elsewhere – fishing is their way of life and they all live there due to existing family ties. This is a problem for the government as other reasons for clearance of the slum included; The slums continued growth towards a high-tension power line that supplies electricity to Victoria Island (One of the wealthiest neighborhoods in Lagos). Concerns about the shrinking of the Lagos Lagoon due to the piling of sawdust, waste and sand filling occurring in the community. The surrounding water is not drinkable because of the waste dumped in it, so locals rely on boreholes or buy kegs of water from hawkers for about N20 Naira (\$0.08 CAD).⁸ Some residents must travel as far as 3km to get to boreholes which pump fresh water but are charged by the bucket, while some collect rainwater and all water is recycled for cleaning and bathing.

⁷ Agbola, Tunde, and Elijah M. Agunbiade. "Urbanization, slum development and security of tenure: The challenges of meeting Millennium Development Goal 7 in metropolitan Lagos, Nigeria." A. de Sherbiniin, A. Rahman, A. Barbieri, JC Fotso, and Y. Zhu (eds.), 2009,.

⁸ Architects, NLE. Makoko Research Document. Heinrich Böll Stiftung, 2012,.

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Fig 4.5 Village Outlines Speculatively Determined From Water Routes. The High-Tension Power Line on the right, and The Coastline on the left are both shown in Red

Low-Tech methods of existing building construction:

Makoko is a self-sustaining community, its buildings consist of residential, commercial, hostels, schools, churches and more programs. Whayinna Nursery and Primary School is the only school in Makoko with an English curriculum, but is just one of many located in buildings with structures that are not up to modern standards.⁹ Other than tattered shacks and canoes, the community is filled with clusters of sand filled “blocks” that have been thought to be part of the cause of flooding in other parts of Lagos. Major flooding occurs three to four times annually and they can last up to four days. Three different building typologies can be found in the Makoko Community:

1. Plank/ Bamboo structures, **2.** In fills, **3.** Brick structures, with 52% of residents living in the plank/ bamboo structures.¹⁰ Generally stilts sit four to six feet above water the level to prevent flooding. Some areas are landfilled to allow for more stable construction. Sawdust is poured in first to mask the smell of the waste in the area then it is covered with sand.¹¹

Materials for construction usually include thatch, bamboo, hessian sacks, plastic, rubber and zinc. Wood, bamboo and fabrics are locally sourced or recycled. With the lumber industry being the secondary vocation in the community, the wood produced is used to build houses, canoes and used for other things such as smoking fish. Roofs are usually made from thatch but more recent buildings use tin, with walls made of zinc coated corrugated steel. Dominant housing type is wooden shacks (35%), followed by single storey concrete bungalows (22%).¹² With standard residential construction in Nigeria primarily involving the use of concrete masonry

⁹ Architects, NLE. Makoko Research Document. Heinrich Böll Stiftung, 2012.,

¹⁰ Yadua, Omoayena. “Determinants Of Urban Poor Housing Types In Makoko Area, Lagos.” *Journal Of Sustainable Development In Africa*, vol 14, no. 6, 2012.,

¹¹ Ibid.

¹² Makoko Research Document.

units for construction, the buildings in the Makoko community are below standard as they are constructed without the use of a building code. Each building is built individually but designed to allow canoes to move through the waterways. Through years of trial and error, the buildings have developed to be built with a system of low energy consumption. The East- West orientation reduces solar heat gain and at the same time captures the southwest wind. Terraces face the North for maximum shade. The water provides free cooling as most of the houses have no electricity for air conditioning. Most houses (50%) have between four to six people.¹³ Electricity is a problem in Lagos Nigeria and blackouts are very common. Power is supplied to Makoko through cables looped over the roofs. About 5% of the community is supplied electricity by paying those on land to draw electricity from the main power grid. 19% use generators, while the remaining population uses candles and lanterns.¹⁴

¹³ Yadua, Omoayena. "Determinants Of Urban Poor Housing Types In Makoko Area, Lagos." *Journal Of Sustainable Development In Africa*, vol 14, no. 6, 2012,.

¹⁴ Architects, NLE. Makoko Research Document. Heinrich Böll Stiftung, 2012,.

Fig 4.6 Typical Plank and Bamboo Construction, commonly found on the water

Fig 4.7 Typical Brick Construction, commonly found closer to the shore and on the land

Demographic Information:

- 1.** Approximately 91 hectares, extends 0.5 miles into lagoon.¹⁵
- 2.** No official figures for the population as Makoko is not included in official census figures. Estimated population by multiple sources; between 100,000 and 300,000 residents.¹⁶
- 3.** Approximately 40,000 canoes.¹⁷
- 4.** Density – 713 people per hectare.¹⁸
- 5.** Approximately 20,000 houses.¹⁹ With 4 to 6 people per home in 50% of homes.²⁰
- 7.** Average monthly income is \$171 CAD.²¹
- 8.** Residential Status: Owner 10% Tenant 80% Squatter 10%.²²
- 9.** Occupation: Fishermen 30% Trader 25% Artisan 15% Civil servant 12% Government workers (street cleaners) 8% Wharf workers 10%
- 10.** Employment Status: Informal 32% Unemployed 20% Formal 19% Student 19% Retired 10%
- 11.** Original settlers were migrant fishermen from Egun and Ilaje stock. Incoming migrants to the community are mostly from Badagri or Egun state in Nigeria. There are also immigrant settlers from West African countries; Benin, Ghana, Togo and Niger Delta.²³
- 12.** Source of land procurement: Government 7.1%, Community (major ethnic group) 9.5%, Family owner (Olaiya) 57.1%, Transfer from previous occupants 7.1%, Self acquisition 11.9%, Purchased from vendor 7.1%.²⁴
- 13.** Reasons for not having a legal title: Not interested 16.7%, Will soon relocate 2.4%, Not aware of the implications 14.3%, Too expensive and laborious 66.7%.²⁵

¹⁵ Architects, NLE. Makoko Research Document. Heinrich Böll Stiftung, 2012..

^{16 - 21} Ibid.

²² Adelekan, Ibidun O. "Vulnerability Of Poor Urban Coastal Communities To Flooding In Lagos, Nigeria." *Environment And Urbanization*, vol 22, no. 2, 2010, pp. 433-450.

²³ Ibid.

²⁴ Agbola, Tunde, and Elijah M. Agunbiade. "Urbanization, slum development and security of tenure: The challenges of meeting Millennium Development Goal 7 in metropolitan Lagos, Nigeria." A. de Sherbiniin, A. Rahman, A. Barbieri, JC Fotso, and Y. Zhu (eds.), 2009.,

²⁵ Ibid.

Geographic Information

Approximate Area: **91** Hectares
Extends **0.5** miles into Lagoon

Major Urban Challenges

Building
technology

Water
supply

Sanitation and
waste disposal

Electricity

Major Social Challenges

Education

Health & Safety

Population Information

±100,000

~ 20,000

4 - 6 per house

~ 40,000

Occupation

_____	30% Fisherman
_____	10% Wharf workers
_____	25% Trader
_____	15% Artisan
_____	12% Civil Servant
_____	8% Government Workers (Street Cleaners)

Building Information

Housing Types

_____ 35% Wooden Shack

_____ 22% One storey Concrete Houses

Residential Status

Owner 10%

Tenant 80%

Squatter 10%

Source of Land Procurement

—	7.1% Government
—	9.5% Community (major ethnic group)
_____	57.1% Family Owner (Olaiya)
—	7.1% Transfer from previous occupants
—	11.9% Self acquisition
—	7.1% Purchased from vendor

Reasons For Not Having a Legal Title

—	16.7% Not Interested
—	2.4% Will soon relocate
—	14.3% Not aware of the implications
_____	66.7% Too expensive and laborious

Fig 4.8 Aerial image of Makoko. Photograph by **Iwan Baan**

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The Situation: Eviction

Foreigners coming into Lagos for business would arrive at the Murtala Mohammed International airport. They would then travel about thirty minutes into the city to get to Victoria Island, which is the upper-class area of Lagos, where most international business interactions occur. The route from the airport includes a small journey on the ten kilometer-long Third Mainland Bridge and with squalid Makoko being directly adjacent, the Lagos state government fears a bad impression would be given. In addition to Makoko's unappealing visual presence, the community gives off a particularly unpleasant smell, likely because of the poor sanitation and the constant smoking of fresh fish.

With the Lagos state government coming up with plans to make the city a new, clean mega-city, Makoko is one of the many things that stands in the way of their goals. With this at hand, the Makoko community faces impending eviction and evidence of this has already been seen. In July 2012 the Lagos state government gave residents of the settlement seventy-two hours' notice to leave their homes, after which many were destroyed rendering three-thousand residents homeless.²⁶ The reasons given for this abrupt eviction were mainly focused on the claim that the slum was expanding and getting too close to the high-tension power line that supplies electricity to Victoria Island (Fig. 4.15). Although this was the official reason, speculation around the settlement was that the government was trying to clear out the slum to sell the land to developers for profit.

²⁶ Ogunlesi, Tolu. "Inside Makoko: Danger And Ingenuity In The World's Biggest Floating Slum." *The Guardian*, 2016,.

The proposal pursued in the research and development for Float **City** hopes to provide an alternate solution for the government – one that takes the slum’s residents into consideration while simultaneously attempting to solve the sanitation issues. To try to understand the situation happening in Makoko, the next chapter will examine several case studies that have either dealt with similar issues or have a similar context to that of Makoko.

Fig 4.15 Image of the edge of Makoko depicting the high tension power lines
Photograph by **Isaac D. Pacheco**

Fig 5.0 Map of Ibadan: Ibadan, Nigeria. Showing the border of the city in red, major highways in black, and bodies of water in grey

*Ibadan's Inner City: Ibadan, Nigeria**Case Studies*

Ibadan is the capital of Oyo State and is the most populous city in the state as it has over three million residents. Ibadan's inner city has been subject to overcrowding and deterioration over the last few decades, which has consequently turned the city into a slum. Half of the city's core area was considered to be slum dwelling in 1963, this number then grew to 70% of the town's total number of derelict housing by 1985.¹ Fueled by the lack of financial capability and political will, slum redevelopment is a subject that all government eyes are closed to and due to this lack of interest, problems with illegal squatting and slum dwelling continue to rise. In addition, slum dwellers have been known to oppose the idea of resettlement because of their ties to their ancestral lands.² The United Nations Human Settlements Programme has classified the slums in Ibadan into three different categories:³

1. Inner city slums: These consist of the oldest (nineteenth century) and lowest quality residences and are characterized by severe deterioration, the city's highest population density and no identifiable sanitation facilities. They house a very high percentage of indigenous Yoruba people.

¹ Un-Habitat. "The challenge of slums: global report on human settlements 2003." *Management of Environmental Quality: An International Journal* 15.3 (2004),.

² Ibid.

³ Ibid.

2. Squatting areas: The low and medium income residential districts of the first half of the twentieth-century – although better controlled by the planning authorities – have attracted some illegal squatting by migrants from the 1970s and 1980s onwards. Squatting is highly organized and cannot be considered as spontaneous.

3. Unplanned outskirts: from the 1970s to the 1990s, land along the major traffic arteries has attracted slums in the north, the east and the south of the city. Here, at the outskirts of the city, thirty percent of the derelict houses in Ibadan are found. Most of them have developed because a new labor market gave opportunities for employment, but without housing provision. Some spontaneous slums also exist in other parts of the city; but few data are available.

What was successful?

Due to a lack of any apparent intervention within any of the slums in Ibadan, there isn't much to be analyzed, but with a lack of intervention, the slum dwellers have no fear of being displaced or their homes being destroyed.

What was unsuccessful?

From the 1950's, the Nigerian government has been separated into three different levels based on their involvement and responsibilities relative to the population they serve: Federal, State and Local government.⁴ The local government saw slums as inevitable and an issue that cannot be dealt with at the local level. According to *The Challenge of Slums*, "Conflicts of jurisdiction and competence, the absence of effective coordination between levels of government, frequent bureaucratic changes, low priority for urban planning, and the commensurate lack of funding have caused delays and confusion in the execution of urban policies".⁵

⁴Un-Habitat. "The challenge of slums: global report on human settlements 2003." *Management of Environmental Quality: An International Journal* 15.3 (2004).
⁵Ibid.

The constant “blame game” that the different levels of government in Nigeria keep playing with regards to taking responsibility for slum redevelopment in the country is what is leading to the increase in slum settlements.

What can be used?

The involvement of the government in any major redevelopment project is imperative. Float **City** would need to include a plan that gets the government, whether federal, state or local, fully involved in all or at least some parts of the project, by providing some incentive that would be beneficial to both the government and the residents of Makoko.

Images on the next page depicting *typical living conditions* in the Inner City slums of Ibadan.

Photographs by Olusubomi Cole

Fig 5.1 Map of Kibera: Kenya, Nairobi. Showing the border of the slum in red, major roads in black, and bodies of water in grey

Kibera Slum Upgrading Project: Nairobi, Kenya

Case Studies

Kibera is recognized as the largest slum in Kenya and the largest urban slum in Africa. The Kibera slum upgrading project stems from a program jointly managed by Kenya's Ministry of Roads, Public Works and Housing and UN-HABITAT called KENSUP (Kenya Slum Upgrading Project).⁶ KENSUP consists of many phases across the country, in which Kibera is one. It specifically deals with the temporary relocation of residents to adjacent "decanting sites" to allow for an in-situ construction of permanent housing. In September of 2009 the first decanting site went under construction and by early 2010, the first families had been moved.⁷ These temporary residences provided electricity and lower rent, but they were lacking adequate water supply and were far from many essential services in the area, like nursing homes, schools, health clinics, pharmacies, water sources and access to transportation.⁸

With this knowledge at hand, Kenyan architect Martin Tairo performed an analysis of the project, which resulted in an article titled, "Why slum upgrading in Kenya has failed".⁹

⁶ Vieira, Luiz. Slum Upgrading In Kibera, Nairobi. TUFTS University, Fletcher School, 2012, http://sites.tufts.edu/gis/files/2013/11/Vieira_Luiz.pdf.

⁷ Ibid.

⁸ "Voice Of Kibera." Voiceofkibera.Org, 2017, <http://voiceofkibera.org/>.

⁹ Tairo, Martin. "Why Slum Upgrading In Kenya Has Failed | Buildesign." Buildesign, 2013, <http://buildesign.co.ke/slum-upgrading-kenya-failed/>.

In this, Martin talks about how the beneficiaries of slum upgrading projects usually end up renting out their new homes to find their way back into the slums. Here they have already established a certain lifestyle for themselves, one that the new relocation sites cannot provide. Martin then goes on to state, “I carried out a survey in Soweto, Kibera, for a similar proposal back in 2008 where I asked the residents what they thought should be done to improve their lives. Out of the respondents I picked, only 15% that thought better houses were the solution. The government’s approach focusing on housing is therefore worrying”. The main concerns for most of the residents included things like improved roads, proper drainage systems, good sanitation, improved security and better incomes.¹⁰ They have a simple reasoning for the whole situation, which is that they live in the slum because they cannot afford to live elsewhere, if their economic status could improve, they would move out.

What was successful?

The Kenya slum upgrading project has relocated hundreds of families to these decanting sites, therefore allowing for an easier clearance of the old and dilapidating parts of the slum. The system, while possibly immoral in the sense that the slum dwellers were most likely forced out, was successful in relocating them.

What was unsuccessful?

In as much as the relocation of the slum dwellers has been a successful operation, it is the very reason the whole project failed. The plan was to move the residents to a completely new location with the intention of redeveloping their homes and moving them back, but what would happen to these decanting sites after the residents are hypothetically moved

¹⁰ Tairo, Martin. “Why Slum Upgrading In Kenya Has Failed | Buildesign.” Buildesign, 2013, <http://buildesign.co.ke/slum-upgrading-kenya-failed/>.

back home? The development of new buildings to temporarily house the slum dwellers has proven to not only be a waste of time, but a major waste of resources.

What can be used?

This project can be used as an antithesis – a template for what not to do with Float **City**. Temporary relocation is the initial idea that any developer with an in-situ redevelopment plan will come up with – to clear out the existing site and rebuild. The problem with this method of redevelopment is, the slum dwellers do not want to move from their homes due to existing ties and an already established lifestyle. Float **City** will need to develop a plan that involves the community in all parts of the project in a way that would allow for a redevelopment that doesn't unwillingly displace all the residents.

Image on the top of next page showing *typical living conditions* in Kibera. Image on the bottom showing an aerial view of Kibera with one of the “*decanting sites*” for temporary relocation on the far right.

Photographs by **Alison Robinson** and **Daniel Losada Casanova**

Fig 5.2 Map of Kibera, showing the Nairobi river below it : Kenya, Nairobi. The border of the river in red, major roads in black, and bodies of water in grey

Nairobi River Clean Up Project: Nairobi, Kenya

Case Studies

The rehabilitation of the Nairobi River has been a topic of discussion for over the last twenty years. The project comprised of three separate phases that were to take place over ten years.

Phase 1: (1999-2001) Work started in 1999 and lasted 2 years. This phase was supported by the United Nations Environment Programme (UNEP) and focused on water quality assessment, public awareness and capacity-building.¹¹

Phase 2: (2001-2003) This phase was designed as a pilot and focused on one of the tributaries of the Nairobi River (Mutuine-Ngong). The main point of this phase was to monitor pollution and included community education.¹²

Phase 3: (2004-2008) Focused on 5 activities that would lead to the restoration of the rivers ecosystem to provide clean water for the city and a healthier environment for the people.¹³

¹¹ “Nairobi River Basin Rehabilitation and Restoration: Succeeding By Building On Lessons From Past Failure | Pambazuka News.” Pambazuka.Org, 2017, <https://www.pambazuka.org/land-environment/nairobi-river-basin-rehabilitation-and-restoration-succeeding-building-lessons-past>.

¹² Ibid.

¹³ Ibid.

At the initial stages of the programme, donors, partners, NGO's and the Kenyan Government were all supportive and enthusiastic about it, but as time went on interests died down.¹⁴ In 2009 the Minister of Environment and Natural Resources began to see this program as a problem, as most of the activities planned and the recommendations that stemmed from some of the studies were never brought into fruition.¹⁵ Today the Ministry of Water and Irrigation believes that the major cause for failure of the three-step programme was due to budgetary constraints. Other than budgetary constraints, there are a few other challenges this program is facing: Poor involvement of the residents because they feel there is no incentive for them, scarcity of and highly technical nature of data, lack of enforcement, corruption, lack of interest of turning waste into opportunity.¹⁶

In 2016 the Ministry of Water and Irrigation launched a new master-plan known as the Nairobi River Basin Rehabilitation Program (NRBP) for the restoration of the river and in contrast to the original three phase plan, they hoped for this new plan to be more “people-centered”, by focusing on changing the behaviors of those who contribute to the pollution of the river.

What was successful?

The project has not seen any success yet as it is still in progress.

What was unsuccessful?

As stated above, the main cause for failure, as understood by the Ministry of Water and Irrigation, was due to budgetary constraints as funds were lacking and whatever funds they had available were pocketed by corrupt government officials.

¹⁴“Nairobi River Basin Rehabilitation and Restoration: Succeeding By Building On Lessons From Past Failure | Pambazuka News.” Pambazuka.Org, 2017, <https://www.pambazuka.org/land-environment/nairobi-river-basin-rehabilitation-and-restoration-succeeding-building-lessons-past>.

¹⁵ Ibid.

¹⁶ Ibid.

In addition to those stated above, an ever-increasing lack of interest on the part of the Kenyan government seemed to be a major driver for the failure of the first three phases.

What can be used?

The Nairobi River Basin Rehabilitation Program has come up with ten steps which will guide their rehabilitation program for the river, which include;

1. Creating an awareness and assessing social impacts
2. Survey and delineation of the Riparian reserve
3. Stopping illegal discharges
4. Completing work of 2.5 km Demo stretch
5. Relocating economic activities and informal settlements
6. Developing and implementing an integrated solid waste management system
7. Rehabilitation of Nairobi dam
8. Repairing and installing sewerage and associated infrastructure
9. Developing a Master Plan for economic utilization of riparian zone
10. Landscaping and beautification of the riparian zone.

Float **City** could take cues from these steps and possibly use some of them, including steps one, six and eight. Others are more specific to the Nairobi river, so this proposal could rework them to fit the scale of Makoko, as cleaning up the water will be an essential part of the project.

Images on the next page depicting ***typical conditions*** of the Nairobi River in certain locations showing the large amount of waste it carries.

Photographs by **GRID Arendal**

Fig 5.3 Map of Koh Panyi: Koh Panyi, Thailand. Showing the border of the village in red, major walkways in black, and the water in grey

Koh Panyi Fishing Village: Koh Panyi, Thailand

Case Studies

The Koh Panyi fishing village in Thailand was established in the 19th century by nomadic Malay fishermen. During this time, a law passed that only allowed those of Thai national origin, the right to land ownership, so the Malay fishermen had to move off the land and onto the water, therefore the majority of the Koh Panyi settlement is built on stilts.¹⁷ Over the years, the island has grown to be one of Thailand's frequented tourist spots, as the aquatic lifestyle of its residents has an astounding aesthetic quality to it. Much of the islands population is of Muslim religion, and with the community's increasing income due mostly to tourism, structures of relevance like a mosque were built. Despite the increase in tourism, fishing remains the villages primary means of income, as tourist only visit during the dry seasons.¹⁸ Other than its stilted structures, the village is known for its floating soccer pitch which was built from recycled wood and fishing rafts by the children in the community in 1986. This lead to the creation of the villages youth soccer team, and after making it to the semi-finals of the inland tournament, a brand-new pitch was built.¹⁹

¹⁷ Meijer, Chris. "Panyee FC: The True Story Of The 'Impossible Football Club'." | Sports Of The Day." Sports Of The Day, 2017, <http://sportsoftheday.com/panyee-fc-the-true-story-of-the-impossible-football-club/>.

¹⁸ Ibid.

¹⁹ Ibid.

What was successful?

Over the centuries, Koh Panyi has thrived as an aquatic home for a fishing community. This is primarily due to its successful tourism industry. Waste management and sanitation in the community are kept up, through proper infrastructural means, to create a conducive environment for living and visiting. This cleanliness aids in the beautification of site, enhancing its natural features and making a more attractive destination for tourists. In addition to its beauty, Koh Panyis floating soccer fields play a major role in its success.

What was unsuccessful?

N.A.

What can be used?

The tourism industry that Koh Panyi has built up is what has lead to its continued success as a community. Through the implementation of new sanitation habits, Float City would allow the residents of Makoko to provide a suitable place for living, tourism could later be a possibility as the aquatic nature of the site would make it a destination point in Lagos. New recreational facilities like a soccer pitch could also be beneficial for Makoko as it would give the children an extra curricular activity as well as aid in attracting tourists.

Images on the next page depicting ***typical conditions*** of the Koh Panyi fishing village, showing its ***stilted structures and walkways***. The ***village mosque*** can be seen in he back of the bottom image.

Photographs by Baptiste L and Grzegorz Mielczarek

Strategy 1: (*Relocate*)

Strategy 2: (*Compromise*)

Strategy 3: (*Reclaim*)

Strategy 4: (*Reconstruct*)

Fig 6.0 Possible site strategies

06

The Proposal

Float City

Possible Site strategies

After exploring the various strategies taken by other architects and developers seeking to improve the lives of slum dwellers, four completely different strategies were considered. These approaches range both in scale and how drastic they are with regards to immediate physical change, and the displacement of residents.

Strategy 1: (***Relocate***) This option would involve the total clear out of the slum, relocation of residents and development of social housing in a mixed income neighborhood. This strategy would be extremely expensive and would require resources to find a site and build new houses, completely relocate all the residents, then clear out and clean up the current site.

Strategy 2: (***Compromise***) The expansion (shift) of the slum into the Lagos lagoon to pull away from the shore would be the main challenge of this option. Wealthier developments would then be developed on the land, prompting the redesign of slum units. This strategy is less drastic than the last but would still require immense resources to physically uproot and move existing buildings further into the lagoon. While this would allow for development on the land, it will also

mean the houses will be closer to the high-tension power line, which is one of the current issues on site.

Strategy 3: (***Reclaim***) This would involve the process of artificially landfilling on southern side of Makoko and developing homes for wealthier clients. The total clean up of the surrounding water would be important and existing shacks would be untouched, but maintenance would need to be implemented into the lives of the slum dwellers. There are currently two major land reclamation projects in Lagos today, one completed and the other under construction (Banana Island and Eko Atlantic, respectively). The issue with this strategy is that land reclamation involves massive costs, so the current projects house the wealthiest people in Lagos, and Makoko might not be the most appealing site for that target demographic.

Strategy 4: (***Reconstruct***) This would create the opportunity to provide the most basic infrastructure for water, power, sewage, and aid in the initial cleaning up of the site. The next stage would be an overall design for a new building typology template that allows for flexibility based on personal income but maintains a safe and sanitary minimal standard. This would allow the residents to rebuild on their own without the need for much external help. The template could be used for the slow but eventual redevelopment of entire site.

All four options have been considered in whole and in part in relation to cues taken from both international and local projects. Ultimately, the fourth strategy, ***Reconstruct***, has been chosen as the basis for improvements to Makoko.

Reconstruct

The Reconstruct strategy pursued in the Float City proposal is one that focuses more on the cultural stability of the local people, rather than attempting to implement western ideals on them. After a careful study of Makoko and the lifestyle of its residents, considering the major urban and social challenges of the site, the Reconstruct strategy has been divided into three stages, with each phase focusing on a major issue:

1. Site Clean Up
2. Urban Infrastructural Implementations
3. Architectural Template Design

1.Site Clean Up:

Makoko is made up of six separate villages divided between land and water:¹ Oko Agbon, Adogbo, Migbewhe, Yanshiwhe – These four are known as “Makoko on Water”, and Sogunro, and Apollo are recognized as Makoko on the land. Separation of site cleaning up can be done based on these six locations. Each community can take responsibility for their own village, reducing the amount of area that each group needs to worry about.

The first question to be asked would be, what is the problem?

- 1.*** Bad waste management systems in and around Makoko
- 2.*** Bad sanitation habits of residents due to a lack of awareness and infrastructure

These situations will be dealt with using methods discussed in a later chapter. The next question would then be, what can be done with the garbage after it has been collected?

- 1.*** Rather than sending garbage collected from the lagoon to the three major and two temporary landfill sites used by

¹ Ogunlesi, Tolu. “Inside Makoko: Danger And Ingenuity In The World’s Biggest Floating Slum.” The Guardian, 2016, <https://www.theguardian.com/cities/2016/feb/23/makoko-lagos-danger-ingenuity-floating-slum>.

the Lagos Waste and Management Authority (LAWMA),² the waste can be reused in a more passive way to aid in the revitalization of Makoko

2. Recyclable material can be reused, and this can be done in a way that creates public awareness
3. Compost can be used for possible on-site farming (This can be introduced in Urban stage)

Major steps for cleaning up would involve:

1. Creating awareness for Makoko's residents
2. Dividing the clean up according to villages to reduce the amount of work for residents
3. Use site cleaning to create job opportunities for Makoko residents

2. Urban Infrastructural Implementations:

The urban implementations include the design of new infrastructural facilities, and the integration of these facilities with Makoko's architecture. The surrounding water generally ranges between one and five meters deep so implementing infrastructure below the buildings would prove to be difficult, therefore overhead infrastructure would be an appropriate solution. This would include electricity supply, Clean water supply and return, and sewage. Taking cues from the overhead water pipes in Berlin, the new infrastructure would need to be enclosed in a series of horizontal and vertical channels for protection and would need a structural system for support.

1. Government involvement may be necessary to supply electricity, water, sewage access etc.
2. Pipes will need to be channeled vertically from an overhead position, to positions below the buildings to integrate them with the architecture.

² "Landfill – Lagos Waste Management Authority:Lawma." Lawma.Gov.Ng, 2017, <http://www.lawma.gov.ng/inside-lawma/departments/landfill/>.

3. Overhead infrastructure would need to sit at a height between ten meters and fifteen meters above the water to accommodate for various heights of buildings on the site

4. Supports to be constructed out of accessible materials; Bamboo, Planks, Metal etc.

The supports for the infrastructure are going to be fundamental in its success as a system. Two categories of these supports will be designed; Primary supports which will act as vertical chases to redirect the infrastructure. These supports are designed to simultaneously hold up and enclose the channels. Secondary supports will be simple posts that add extra structure for the channels that span longer distances between primary supports. Seeing as the primary supports are designed to be multi-functional and could possibly be eventually integrated into the architectural template in a way that they could be interacted with, they have been appropriately named Social infrastructural anchors.

3. Architectural Template Design:

The architectural template is to be the main proposal for Float City. It would be designed based on the living habits of residents in each of the six villages, depending on if their divisions lead to the allocation of various land uses. The template will be flexible and incremental, it will serve as a structural framework that Makoko's residents could use to construct new buildings, using materials that are available to them. Float City's new architectural template will be designed using the following options and issues as guidelines:

1. DIY (do-it-yourself) architecture

2. Materials currently available for use in Makoko:

- Wood sourced from the local sawmill (Eki-Iron Wood, Akun, Bamboo)
- Corrugated steel
- Aluminum plates

³ Architects, NLE. Makoko Floating School Research Report. NLE Architects, 2012.

- Plastic

3. Problems on site that could be solved through architecture

- Clean water supply (Rainwater collection and filtration)
- Recycling plastic (Possible new material for construction)
- Electricity supply
- Recycling compost
- Flooding

4. Building typologies to be considered include: Houses for families of four to eight people, Schools, Churches and other religious institutions, and General commercial services

5. Template should include options for these 4 typologies

6. To deal with flooding and the destruction of buildings by heavy rains, a system which incorporates both stilts for anchorage and some flotation device for the change in water levels, could be developed

Fig 6.1 Image of the edge of Makoko depicting men cutting down stilts formerly used to support houses. In the background; the now destroyed Makoko floating school by NLE Architects
Photograph by **Iwan Baan**

07

Site Clean Up

Float City

The first stage of the Float **City** proposal involves the cleaning up of Makoko and the implementation of new sanitation habits for its residents. In accordance with the autonomous principles the project is aiming for, the residents would play a major role in this stage. Creating awareness would be the catalyst, and this could be achieved through advertising. Posters would be put up all over Makoko and its surrounding areas, and the idea could be discussed at various community meetings to inform the residents of how they could participate. Makoko is divided into six villages, four on the water and two on the land, residents of each village would be responsible for the maintenance of their surroundings, so the area allotted to each family to take care of is fair and equal. The major issues with regards to the current state of the site are due to inefficient waste management systems, and sanitation habits that are significantly below average. New waste management systems will be discussed in a later chapter focusing on the urban implementations of the Float **City** proposal. Sanitation habits of the residents could be improved by providing the opportunity for them to learn about recycling and how it would create a better environment for them to live in. Recycling centers would be set up throughout the site, with an incentive program that rewards residents for every kilogram of recyclable material returned.

In addition to that, a new outrigger set up would be designed (Fig. 7.1) – this could be attached to the average canoe used in Makoko, which would give it the ability to hold nets or platforms. This new outrigger canoe could then go through the site collecting garbage and recyclables for a fee, reducing the amount of work for the residents while simultaneously providing new job opportunities for those willing to paddle them.

Fig 7.0 Posters designed to create awareness for the residents of Makoko to clean up their surroundings. Posters written in both English and Yoruba, the common language spoken in Lagos.

Fig 7.1 New Outrigger Garbage boats. Bamboo outrigger attaches to existing canoe.

08

*Urban Infrastructural **Implementations***

Float City

The urban infrastructural implementations stage of the Float **City** proposal includes the design and strategic placement of ten meter to fifteen-meter-high bamboo space frames throughout Makoko's six villages. The surrounding water generally ranges between one and five meters deep and implementing infrastructure below the buildings would prove to be difficult, therefore overhead infrastructure would be a fitting solution. Appropriately named Social Infrastructural Anchors (Fig. 8.1), these space frames would primarily be responsible for redirecting the overhead infrastructural channels vertically to bring them below the buildings and spread them to a select group of units. In addition to acting as vertical chases, the anchors would double as pavilions designed to aid in solving major urban challenges faced in the site. The new infrastructure in Makoko has been divided into two levels; primary and secondary, with the primary level serving the wider neighborhoods. This level would deal with the supply of clean water and production of electricity, as well as an automated system for cleaning up the surrounding water. The major urban challenges faced in Makoko include; a severe lack of adequate building technology, water supply, sanitation and waste disposal, and electricity. The secondary level of infrastructure will be discussed in a later chapter focusing on building technology, while the following paragraphs will elaborate on how Float **City** could deal with

the remaining urban challenges on site.

Electricity:

One of the biggest challenges faced in Nigeria is a lack of constant electricity supply. With the largest population in Africa, only forty percent of the country is connected to the energy grid and even then, sixty percent of the time there are difficulties with the supply. Makoko, being a community that is not officially considered as part of Lagos State by the government, is one of numerous locations in the country with no legal power supply. The Float **City** proposal hopes to tackle this problem with the first of the Infrastructural anchors. The pavilion designed to solve the electricity problem would use a two by three meter space frame constructed from bamboo that would enclose water supply and return, and electricity ducts as they are taken from an overhead position to below the buildings they are supplying. To produce energy, this pavilion would take cues from wave energy harnessing buoys. Wave energy harnessing buoys produce electrical energy by converting the vertical motion of the buoy through the means of electromagnetic induction. The system consists of three major parts; The float assembly, spar, and heave plate. As surrounding waves create an oscillation, the float assembly moves vertically along the spar – this vertical motion is then converted into a rotational motion which is used to generate a current. The electricity produced can then be transferred to whatever ends necessary. The problem with commercially produced wave energy harnessing buoys is their size. The water surrounding Makoko is shallow, usually ranging between 1.5m and 5m deep, so these buoys would have to be re-engineered and scaled down to be operable in Makoko (Fig. 8.0).

¹Aliyu, Abubakar Sadiq et al. "Nigeria Electricity Crisis: Power Generation Capacity Expansion And Environmental Ramifications." *Energy*, vol 61, 2013, pp. 354-367. Elsevier BV, doi:10.1016/j.energy.2013.09.011.

²"Powerbuoy Technology." *Ocean Power Technologies*, 2017, <http://www.oceanpowertechnologies.com/powerbuoy-technology/>.

Fig 8.0 Sketches depicting initial designs for the electricity anchor

Fig 8.1 Bamboo space frame for social infrastructural anchors, and the re-engineered wave energy harnessing buoy.

Sanitation and Waste Disposal:

Waste management in Makoko is a major topic that needs to be addressed, as most of the water is covered in trash, both organic and recyclable. The first step to changing this will be to create an awareness for the residents of the community and urge them to begin an initial manual clean up of the water. To move forward, the pavilion designed to handle waste management will likely have the same structural elements as the previous iteration (the electricity pavilion) but instead of producing electricity, it will be used to passively collect waste.

This anchor would take cues from a floating debris interception project known as the Seabin. Designed to be deployed in areas with calm waters like ports, the Seabin uses a submersible water pump that can be connected to either a 110V or a 220V supply.³ The Seabin can catch up to 1.5kg of debris daily and with a 12kg net attached to it, maintenance would only need to be done on a weekly basis.⁴ Seeing as the existing design has a diameter of only a few centimeters, the device could be scaled up to work for Makoko. The sanitation and waste disposal anchor for the Float City proposal hopes to use the Seabin project as inspiration and adapt it to fit the needs of the Makoko residents (Fig. 8.1).

³Ceglinski, Pete. "Seabin Project." Seabinproject.Com, 2017, <http://seabinproject.com/>.

⁴Ibid.

Steel frame to connect
 garbage interceptors to
 bamboo space frame

Sanitation & waste disposal
 anchor equipped with
 submersible water pump to
 create flow and pull debris
 in.

Fig 8.3 Aerial view showing the social infrastructural anchors and how they would interact with Makoko's existing architecture, and the re-engineered floating debris interceptor.

Water Supply:

Despite the slums location, clean water supply is a problem that the residents of Makoko have had to deal with for a very long time. The surrounding water is not drinkable because of the waste dumped in it, so locals rely on boreholes or buy kegs of water from hawkers for about N20 Naira (\$0.08 CAD). Some residents travel as far as 3km out of Makoko to get to boreholes which pump fresh water but are charged by the bucket.⁵ The Water supply anchor would not use the same space frame as the previous two as it differs completely in its size and functions. It will consist of a six-meter high by five-meter diameter water tank, held up by a light frame structure (Fig. 8.2). A borehole drill would be attached to the water tank, which would dig till it hits ground water – this would then be pumped up to the water tank, where it could be filtered, processed, stored and then distributed to the Makoko community. Given the size of this anchor, the need for numerous iterations would not be necessary so it would be cut down to only two per village, giving Makoko a total of eight water anchors on the lagoon.

Fig 8.4 Sketches depicting initial designs for the water supply anchor

⁵Architects, NLE. Makoko Research Document. Heinrich Böll Stiftung, 2012.,

Fig 8.5 Drawings depicting the water supply anchor.

Floating Landscapes:

All three of these anchors are to assist with urban challenges in various ways, but they are also designed to be neighborhood hot spots where various activities could occur. In 2016 a news article was written about the design of irregular soccer pitches in Bangkok. Developer AP Thailand designed and built four soccer pitches in the densely populated capital of Thailand as a response to the lack of appropriate space for parks and recreational areas.⁶ According to the designers, the concept was to transform irregularly shaped areas into practical soccer fields that still allow fair play.⁷ The idea allowed them to fit in functioning pitches into whatever space they could find, resulting in asymmetrical, yet beautiful and functional spatial designs (Fig. 8.3). This idea has been translated to fit into the context of Makoko for the Float **City** proposal and has been termed “Floating Landscapes”. The social infrastructural anchors would be located appropriately according to the needs of the community, and these would then be enclosed with asymmetrical floating platforms that fit into whatever the surrounding context is (Fig. 8.7). These floating landscapes would be built up using compost and could be used for a variety of activities, ranging from community farming to impromptu games of pick up soccer. Flashing beacons would be added to the tops of the anchors and could be used to notify residents when certain activities occur. These will be dispersed throughout the site enclosing the anchors, as long as they do not interrupt the flow of canoe traffic.

⁶Holmes, Oliver. “A Different Ball Game: Bangkok’s Crooked Football Pitches”. The Guardian, 2016, <https://www.theguardian.com/world/2016/sep/30/a-different-ball-game-bangkoks-crooked-football-pitches>. Accessed 20 Mar 2018.

⁷Ibid.

Fig 8.6 Aerial images of Bangkok, showing how the irregular soccer pitches fit into available space.
Images sourced from **Dezeen**.

Fig 8.7 Drawings depicting the floating landscapes and how they would interact with Makoko's architecture and new infrastructure.

Speculative cluster mapping strategy model:

The urban strategies pursued in the Float **City** proposal require a large amount of planning and detailing – as multiple aspects come into play while attempting to strategically figure out various locations and dimensions of several parts. All these ideas were initially to be mapped out as solids on a large scale physical model. As the project progressed it became obvious that this method would not work as the various parts were constantly changing and evolving. With this, the model needed to be something that allows for flexibility and at the same time could be used to represent the project accurately. The speculative cluster mapping strategy model was then developed. This is a 2.25m² (1.5m x 1.5m) physical contour model of the Makoko area at a 1:1000 scale for maximum clarity, accompanied by two mini projectors on tripods. The physical model itself is just a representation of the contours of the surrounding area, milled from high density foam on a CNC router and painted white. The two mini projectors are the main source of information as they project the actual map along with all the various layers of urban strategies onto the model. Lining up the virtual map on the physical model allows for viewers to not only understand various aspects of the project visually, but also provides the ability for a spatial understanding as well. Projecting maps with multiple layers, and allowing users to toggle between these layers, provides the option of having “several models”, each with a unique level of information, all in one. This model has helped with both planning and visually representing strategies, not only as a presentation model but as a working tool as well.

Fig 8.8 Speculative cluster mapping strategy model.

Fig 8.9 Speculative cluster mapping strategy model. Image from Colloquium II.

Fig 8.10 Speculative cluster mapping strategy model. Image from Colloquium II.

Urban Strategy Mapping:

As mentioned earlier, Makoko is divided into six villages, none of which have been recorded in any online sources. These villages have been speculatively mapped out based on the major water routes within the site and were used to locate the social infrastructural anchors (Fig. 8.11). The anchors are designed to act as channels for the overhead infrastructure to bring them below the buildings, but each building cannot have its own anchor, so they have been grouped together for the optimum distribution of pipes. The buildings have been grouped into clusters according to their proximity to one another and based on what grouping affects the water routes the least – this is represented by the green organic outlines with grey fills. The exact locations of the various anchors could then be determined by the outline of the building groups and other factors that affect their functions. For example, the electricity anchors (red) would need motion in the water to operate, so an optimum location would be along the borders of the villages, near or within the main water routes where canoe traffic would produce enough motion throughout the day. The waste management anchors (yellow) could be in areas with high pollution rates and calmer waters – their locations could be more flexible as they will most likely be needed everywhere. The water anchors (blue) would be less frequent as their size is sufficient enough to supply clean water to numerous buildings. They have been cut down to only two per village, giving Makoko a total of eight water anchors on the lagoon, located far enough from each other to serve as many buildings as possible.

Fig 8.11 Speculative cluster mapping locating the Electricity (red), Waste management (yellow), and Water (blue) anchors.

Fig 8.12 Speculative cluster mapping showing the connections between infrastructural anchors, green spaces and the new infrastructure.

09

Architectural Template

Float City

An eminent lack of adequate building technology is one of the major issues faced in Makoko today. Rickety stilted structures clad in a variety of materials, and solid brick buildings are the most common architectural typologies. With the implementation of the Float **City** proposal, the development of a new architectural template will be pursued. This template is to be incremental and flexible to adapt to whatever context it is situated in, and it will be designed to allow for vertical growth as expanding further into the Lagos lagoon has been prohibited by the government. The Image on the next page focuses on 3 of the clusters of Makoko's existing buildings that have been explored. With each home housing about **4 to 6 people**, Cluster 1 on the left with **13 houses** will hold approximately **52 to 78 people**, Cluster 2 in the middle with **24 houses** will hold approximately **96 to 144 people**, and Cluster 3 with **18 houses** will hold approximately **72 to 108 people**. These clusters have been grouped together according to their proximity to one another to make room for an infrastructural path that does not interfere with the everyday life of the residents. Based on the numbers gotten from the 3 examples above, each cluster is home to an **average of 90 residents**. This can be translated into the design for the residential template and even further, a new (*possibly vertical*) cluster with **at least 18 units per cluster**.

Fig 9.0 Image of clusters determined by proximity of buildings to each other

According to the United Nations Population Division, the average floor area per person for living in Africa is ***less than 20 square meters***.¹ With that in mind and the average home in Makoko housing 4 to 6 people, the new residential templates would need to be between 80m² and 120m² depending on the size of the household. From this we should have a 100m² average unit size to host a family of 5, but with the space currently allotted to each house, the footprint of individual units will have to be averagely ***8m by 4m***. These footprints will be used as a base for the ***frame*** which will house new architectural units. This frame would be constructed from materials readily available to the Makoko community, most likely ***dimensional lumber*** as its proportions and strengths are adequate for this purpose. Using traditional tying techniques, nails and screws, the framework hopes to be put together with ease and minimum training. It is to be designed in modular units that allow for ***expansion, stacking, and interconnectivity***, creating both vertical and horizontal clusters depending on the site conditions and needs of the residents.

¹ “Un.Org, 2017, <http://www.un.org/esa/population/pubsarchive/chart/14.pdf>.

Initial iterations of the architectural frame consisted of multiple organizations for the units, including that of a tri-star formation. This arrangement involved the alignment of three units in a circular plan that could be stacked and rotated to whatever heights necessary. This staggered arrangement provided room for expansion on all four sides of each unit, but after much consideration, it was determined that this would be inefficient as there would be no shared walls and therefore an excess amount of building material would be needed. After this circular organization was discarded, the decision was made to move in a more *organic* direction, which led to the exploration of the *Metabolist movement*.

Metabolism is an architectural movement which emerged in the 1960's. Spearheaded by a group of architects heavily influenced by the works of Kenzo Tange, it is primarily focused on the belief that buildings and cities should be designed organically in the same manner as life itself.² This idea of *organic growth* is one that is seen throughout Makoko's fabric. All its buildings are organized in a *seemingly chaotic, yet orderly fashion*, growing out from the shore into the Lagos lagoon. It is this concept that the Float **City** proposal will use to suggest possible organizations for the proposed architectural template. As part of the Tokyo World Design Conference in 1960, a group of architects including Kisho Kurokawa wrote the Metabolism Manifesto which was a series of four essays concentrating on designs that used the movement as their driving force.³ Kurokawa's essay; "Ocean City", is the first in the manifesto, and it focused on the Metabolist ideas of *artificial land*, and *major and minor structures*.⁴ These design strategies were developed as a response to the scarcity of land in growing cities. Initially the three ideas were to be used as a general guideline for designing Makoko's new vertical architectural clusters.

²Mori Art Museum. Metabolism, The City Of The Future. 2011. Accessed 17 Mar 2018.

³Kikutake, Kiyonori, et al. "Metabolism: The Proposals for New Urbanism." Bijutsu shūpansha, Tokyo (1960).

⁴Ibid.

They were to be anchored to the earth below with a centralized “major” structure, grouped together by a surrounding floating platform (artificial land), and each unit was to have its own “minor” structure, connecting it back to the main anchor. The problem with this approach was its similarity to the initial architectural frame, so rather than combining all three design strategies, the decision was made to spread them throughout the site.

Makoko is a community that has developed over hundreds of years, and in that time, its people have learned to survive through centuries of trial and error. They have developed an architectural system which primarily involves the use of stilts to support its structures. This system, although flawed, has worked for them – which is why other architectural typologies that have been tested out on the site often fail. Take NLE Architects prototypical floating school project for example, it was designed as a solid A-frame structure which sat on plastic barrels for flotation. The design, while innovative, could not survive the heavy rainfall that Lagos faces annually, and collapsed three years after its construction.⁵ With this in mind, the architectural template for Float City was pushed in a direction that considered both Makoko’s existing architectural language and the design strategies from the Metabolist movement.

Fig 9.1 Sketch depicting initial iteration of vertical cluster using Metabolist ideas.

⁵Okoroafor, Cynthia. “Does Makoko Floating School’s Collapse Threaten The Whole Slum’s Future?”. The Guardian, 2016, <https://www.theguardian.com/cities/2016/jun/10/makoko-floating-school-collapse-lagos-nigeria-slum-water>.

The Vertical Stack:

The design chosen to be explored is one that focuses on individually stacking a few units, rather than grouping a large number in vertical clusters. The template will be a ***five storey frame***, constructed from dimensional lumber, with individual storeys having a specific role to play to service those that live or work in the stack. Each storey will be ***about 3m high***, giving maximum ceiling height for infrastructure while still providing a comfortable environment for living. ***The first storey will be left completely empty***, set three meters above water level, it will give room for the constant change in tide and eliminate the fear of the units flooding. This semi-public space would also give enough room for canoe traffic, eventually increasing the number of secondary water routes within the site, while simultaneously creating space for docking. ***The second through fourth storeys will be occupiable***, giving room for a maximum of ***three small single storey units*** or a minimum of ***one large three storey unit***. The frame is designed to have the second and fourth floors occupied first, leaving the third empty for either unit to expand into if necessary – however this project recognizes that its design is only a framework that the users can develop to their own preference. ***The fifth storey is not intended to be occupied*** but rather to act as a space for utilities, including a water tank that will serve the rest of the stack. This is then capped with a corrugated metal butterfly roof that would aid in rainwater harvesting and be host to solar panels.

Fig 9.2 Axonometric drawing of the new vertical stack.

Fig 9.3 Axonometric drawing of the new vertical stack showing its basic structural assembly.

The infrastructural stage of the Float **City** proposal has been divided into two levels; *primary and secondary*, with the primary level serving the wider neighborhoods, and the secondary level serving individual stacks of units. This secondary level deals with the supply, return and filtration of gray water, as well as the harvesting of solar energy for electricity. As mentioned earlier, the fifth storey of the new architectural template will be left unoccupied to house a *two-meter diameter water tank for rainwater collection*. This will then be supplied to each unit in the stack and used for flushing toilets. Gray water from showers and sinks will be collected and sent to a septic tank, submerged directly below each stack – this will then be filtered, processed and pumped back up to the water tank on the fifth storey and reused. The larger section of the butterfly roof will host a series of solar panels – these will supply the units in the stack with enough electricity to power light bulbs, fans, and other small amenities.

Fig 9.4 Sketch showing the secondary infrastructure associated with each vertical stack

Fig 9.5 Axonometric drawing of the new vertical stack showing the secondary infrastructure.

Architecture in Context:

The Makoko community covers roughly ninety-one hectares of land and water and extends roughly half a mile into the Lagos lagoon. Given this much area to cover, it would be impossible to figure out how the new architectural template would fit in to every part of Makoko. Therefore, the site has been divided into four different conditions with varying contexts; the open water edge, the shoreline, the main water routes, and the dense inner site conditions.

The open water edge condition is, as the name implies, along the existing perimeter of Makoko on the water. This would be the first place to test how the new template would fit into the context of the site as the limitations from surrounding structures are very minimal. The Lagos state government has prevented the community of Makoko from expanding further into the lagoon, so the stacks erected in this area would serve as a barrier to prevent the community from growing outwards, but rather promote the idea of growing upwards. In addition to the residential units, each of the four conditions would have some public aspect associated with it, as the community has always been self sufficient and has everything it needs within its borders. With the open water edge condition housing being at the boundary of Makoko, the public feature of this cluster could be associated with fishing and recreation. For example, a new floating soccer pitch could be accessible through this cluster, and commercial outlets that primarily deal with fishing nets and bait would be located on some of the lower units of the stacks. The floating soccer pitch would be constructed using either the bamboo outriggers for the garbage boats discussed in the site clean up section, or plastic barrels with a rolling barge for flotation, which would then be covered with wooden planks to make a platform.

Fig 9.6 Aerial view of the edge of Makoko showing the Open Water Edge condition.

The shoreline condition is the only situation in which Makoko on land, and Makoko on water meet. With these two different contexts, the architectural template would have to be adjusted to satisfy both situations. The template would remain the same for Makoko on water (units set three-meters above water level), but as the cluster moves towards the land, the need for that three-meter height begins to drop, and the units could therefore be built closer to the ground. The stacks located in Makoko on land would be constructed using a standard slab on grade foundation, but still have the same stilted structure for the units above. This would provide a more stable structure that could possibly hold more units than proposed. Makoko is a self-sufficient fishing community, with a majority of its population involved in the industry – but it does not just serve itself. People come from all over the city to buy fish from the community and having to go into Makoko on water could prove to be a challenge for some. With that, the public aspect proposed for the shoreline condition could be commercial services that serve both Makoko on land and Makoko on water, like fish markets. This way people would not have to travel far into the site to get what they need.

Fig 9.7 Sketch showing the change in height of the new vertical stacks as they move towards the shore.

Fig 9.8 Aerial view of the shoreline of Makoko showing the Shoreline condition.

Transportation in Makoko is primarily achieved using canoes, so it has major and minor water routes weaved throughout its urban fabric. *The main water routes condition* is one that will have to be implemented with more caution, to not interrupt the flow of vehicular traffic in the community. The stacks being constructed near these “highways” could be set back from the informal borders by at least two-meters, to ensure that no disruption occurs as well as create opportunities for the eventual expansion of these routes. All four conditions would have a network of walkways connected with ladders to create accessibility for the units, but in the main water routes condition, the walkways would be located behind at least one row of housing to keep them separated from the canoe traffic. The public aspect for this condition would be something that needs easy access but does not need to be commonly found throughout the site. Religious institutions like churches and mosques, as well as educational institutions could be in these clusters as they are programs that are commonly used but only need a limited number of locations.

Fig 9.9 Sketch showing how the new vertical stacks would be located near and around main water routes.

Fig 9.10 Aerial view showing the Main water routes condition.

The dense inner site condition is one that would commonly occur throughout the area. Makoko is heavily populated with existing fabric, so this condition deals with the interaction between its current architecture and the new template – the stacks would have to fit into the given context in ways that least affect the current lifestyles of its inhabitants. Rather than being set at three-meters above water level, the first unit of most stacks would be perched half a meter above the roofs of existing buildings, at a perpendicular angle to their orientation to be structurally stable. This condition is the most site specific of the four and therefore cannot have as many rules dictating the locations and orientations of the buildings. The public aspect for this situation could be one that is needed in every household and could be spread all over Makoko without becoming excessive. For example, floating platforms could be dispersed throughout the community and anchored to the inner site clusters, providing the opportunity for on-site farming and other agricultural activities.

Fig 9.11 Sketch showing interaction between new Float City proposals and Makoko's existing architecture in dense inner site conditions.

Fig 9.12 Aerial view of the dense inner site conditions showing how the vertical stacks would interact with Makoko's fabric.

10

Conclusion

Float City

Float **City** began as an exploration into informal settlements and how new architecture could affect the lives of their inhabitants. Slum redevelopment is not an unfamiliar topic within the architectural community, but the methods through which it is approached have proved problematic over the years. So, as a response, the end goal of this thesis was to determine if significant housing and community improvements can be achieved in slums if the architectural work is left primarily in the hands of its inhabitants with the architect merely a “catalyst” to help locals re frame aspects of individual and community building?

Makoko is recognized as the world’s largest floating slum, and with that comes a whole range of alternative-lifestyle adoptions. When choosing a site to explore methods for autonomous informal architecture, it seemed appropriate to go with one that presented challenges that applied to the present world as well, and given the current issues with climate change, aquatic architecture is a direction that seems inevitable. Makoko’s architecture on stilts is a typology that is recognized for its use in situations of an aquatic nature as elevating buildings is the standard solution within this context. Initially, the architectural proposal for Float **City** was to be used as a prototypical design that would attempt to solve slum redevelopment issues as well as spearhead new ideas for aquatic architecture – but as the thesis developed,

it became clear that attempting to solve Makoko's problems with a "one size fits all" solution was misguided.

Architecture is a subject that is highly dependent on context and should always be designed by taking its surroundings into consideration. Therefore, the architectural template designed for the site draws inspiration from Makoko's existing fabric and uses methods of construction that its people are familiar with to push their architecture forward without completely disassociating them from the lives to which they have adapted. In addition to architectural interventions, Makoko is in need of infrastructural rehabilitation and this challenge was taken on as well. The proposal pursues this aspect to a certain degree with interventions that attempt to combine high-tech methods of problem solving with low-tech methods of building construction. Given more time, this aspect could be developed further and pushed in a direction that better integrates the infrastructure with the architecture.

The Float **City** proposal has served as both a learning experience and a design opportunity – one that faced the challenge of developing an architectural typology while aspiring to propose change without being problematically invasive. With all the interventions developed for the residents of Makoko, the intention was not to design a solution per se to their problems, but rather a template that they could use as a framework and develop to their own needs.

Fig 10.0 Panoramic view of the edge of Makoko showing the new Float City proposals interacting with Makoko's existing fabric.

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Float City

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Float **City**

Makoko : (re)development of an aquatic home

by Shawn Duke