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BAMBOO STADIUM. THE ARCHITECTURAL REHABILITATION OF THE FORMER OLUSOSUN LANDFILL, LAGOS (NIGERIA)

Iulia Dorobanțu [1,2,*] and Lucas Monnereau [1]

[1] *École Nationale Supérieure Paris - Belleville, 60 Boulevard de la Villette, Paris, France*
[2] *University of Architecture and Urban Planning "Ion Mincu", Academiei Street 18-20, Bucharest, Romania*

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ABSTRACT

With an ongoing growing population of around 21 million people, Lagos, the capital of Nigeria, struggles not only with how to deal with its waste but with garbage sent illegally mostly from the United States and Europe. The former Olusosun landfill, the largest waste dump in Africa and one of the largest in the world, used to receive about 3,000 to 5,000 tons of trash per day, filling the dumpsite almost to its near capacity. After the local government decided to close the landfill, the city has started to search for solutions to rehabilitate the site. In an effort to include an anchor program, the stadium becomes the natural meeting point for the neighborhood: an evolutive, flexible and transformable infinite bamboo based-unit structure. In response to new much-needed regards towards waste, bamboo resources seeded on the site become the local building material. A mix of social spaces, dedicated to enjoying the sport on game days, as well as dwellings and local public programs to be occupied all year by the local community, blend in a small-scale system. Finally, the aggregation can grow in each direction to meet all needs of various situations, with potential multiplication of the system at the scale of the neighborhood or city.

1. INTRODUCTION

"By 2025, […], the waste produced by cities around the globe will be enough to fill a line of rubbish trucks 3,100 miles long every day."

The World Bank, 2019

Today, all urban areas have one big thing in common: the global issue of waste. Every year, our world produces more than a billion tons of garbage, which it incinerates, buries, exports and, not enough, recycles (Sieff, 2017). While the major cities continue to expand at a preposterous rate, so must their capacity and ability to reverse wasteful habits and begin adopting a more efficient and sustainable lifestyle. It is expected that approximately 70% of the world population will live in cities by 2050 (The World Bank, 2019). As a result, we all need to start taking into consideration alternative design and development models to allow the emergence of sustainable programs and, in effect, cities, and territories.

Lagos, the Nigerian megalopolis, is estimated by some to represent the fastest-growing metropolis in the world, with a rate of enlargement from a population of 7 million to over 21 million in the past decades. Until recently, there was a seemingly easy fix and Lagos handled its waste by relocation, being simple enough to drive waste outside of town to the 100-acre Olusosun dump site, beginning in 1992. Though the landfill was once far from any urban activity and direct human interaction, the site has somehow become the heart of the neighborhood, raising numerous issues, while starting to become a lifestyle for the local community (England, 2017; The World Bank, 2018). Educational, residential, industrial, medical institutions and religious buildings now circle the site (Sieff, 2017).

Earlier last year, the Olusosun landfill was finally shut down by the local government, after a fire has broken out in March 2018 (Ugbodaga, 2018), and the site was assigned for redevelopment as a public park and urban green area.

In this phase, the approach of the project should encompass an anchor program that merges new attitudes relating to waste. Waste is not defined only by its presence inside landfills or hidden alleyways. Instead, it penetrates the urban environment and its core, creating broken and unprecedented urban landscapes. Imminent architecture gestures need to be reflected in an open-minded attitude, in the development of open structures, with a mix of uses, and in facilitating a strong interdisciplinary design process (van Lohuizen, 2017).

The project proposes a novel compositional organization that reconsiders the place of the stadium and transforms the entire site into the local supply of fast-growing

* Corresponding author:
Iulia Dorobanțu
email: iuliadorobantu@yahoo.com

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easy-to-use building material: the bamboo. Plans to rehabilitate the site include the stadium as the main anchor program – this massive structure, known only to be wasteful in its resources, with a limited lifespan, and so inconsistent in usage, which has confronted numerous critical issues.

Working at the small human scale, to the larger scale of the city, the project Bamboo Stadium searches to become a part of the community, a porous entity, serving both as a world-class sporting facility and the local community.

2. INTEGRATING DESIGN. NATURE, MATERIAL & STANDARDIZATION

2.1 Lagos and the Olusosun landfill

Although having different perspectives, most developing countries have huge issues when it comes to waste management, finding it hard to achieve a sustainable implementation of the various human activities and life cycles of the resulted products. The megalopolis of Lagos, Nigeria, has been continuously exporting trash in the last decades to the 100-acred Olusosun landfill (Sieff, 2017).

2.1.1 Urban growth

As the city's port continued to grow, its slums and skyline continued to spread along the muddy coastline and inside the territory. Now, the city is well expanded beyond Olusosun, and the dump now finds itself in the center of the city, surrounded by a fully-formed neighborhood, with hospitals, schools, churches, restaurants or dwellings just over its precipices. The former landfill is directly connected to the main highway, the city's standing traffic jams becoming the first witnesses to the overcrowding stashes of trash (Figure 1).

Being the center of a global conversation, the continuous growing urban population has come to outnumber that of rural areas, in the hopes of a better life. Lagos remains one of the most representative cases. "Population corridors" have derived, merging crowded cities into new forms of human settlements. As Africa's largest metropolis, its population is growing at a rate of 600,000 people per year, with an average density percentage reaching 6,900 people per square kilometer. Infrastructure, housing, working wages, and social programs struggle and often fail to meet the overpowering expectations.

Moreover, unlike its Chinese or Brazilian megacity counterparts, Lagos is faced with drastic social segregation, still concentrating wealth in the hands of a tiny minority of the population. About 80% of the workforce is part of an informal economy where individuals are trading products and services without any supervision or aid. Hence, the landfills have become a lifestyle and source of a minimum living wage where people are scavenging garbage and doing business in informal means, like in kiosks on the side of the road and local markets (Howden, 2010; Sieff, 2017).

Rapid waste is one of the results of rapid urbanization. Lagos produces 0.3% of the total waste of the world's cities, meaning 11,000 tons out of a total of 3,5 million tons. Adding to that the migration of individuals from rural areas, slums run out of usable land, causing an overflow of trash into the swampy areas and even the use of garbage as livable land and construction materials.

2.1.2 Former status of the Olusosun landfill

Before its closure, the former Olusosun was by far the biggest of the city's landfills. With towers of garbage 10 stories tall and an endless cue of trucks arriving to unload, Olusosun used to shelter over 4,000 people living or working inside its premises.

Though everything may look like a total eyesore, the landfill managed to create inside a local community, with people living in tentlike structures on top of the trash, surrounded by daily social activities. However, as the stack of waste has grown, its area has become associated with the city's darker side. But this didn't stop people coming from all over the country to work there.

The recycling became an increasingly profitable business, in the 1990s and early 2000s, and thousands were drowned to the industry, despite the working conditions, in a continue hope to eliminate at least some of the trash, and welcome foreign investors (Sieff, 2017).

After its closure, as the site has been subject to many fires, the landfill became a source of the potential development of the entire area, as well as a chance to a more sustainable approach to waste. Local plans to rehabilitate the landfill include not only the park but also infrastructure beneath to harness methane emissions from the waste and transform it into energy (Cocks, 2013), improving the country's electricity deficit.

2.2 Designing with nature. Bamboo

In light of the current situation, the project tries to reveal how architecture can be shaped by and is responding to ecological thinking at the present moment. With a preference for resource and building materials, infrastructure over typology, landform over building form, the system prevails over individual objects. The approach seeks to reflect a broad reconceptualization of building materials in a blunt relation with nature, as opposed to only structural attributes.

There is a local leading effort to start using the bamboo areas and turn them into a reliable source of building material (Mussau, 2016). By transforming the site into a local supply, the project proposes an evolutive system – from a bamboo forest and stadium to a checker-board infinite pattern, composed of built blocks and yards, alternating between each other.

2.2.1 Bamboo resources in Nigeria

About 80% of the Nigerian population depends for their livelihood on the resources of flora and fauna that can be found on the territory of Nigeria. About 20% of its forest resources fall into the tropical rainforest area, out of which bamboo is one of the non-wood resources that remains untapped. In the past decade, a growing awareness has been noticed, due to the current socio-economic context, with an increase of the natural resource depletion, worsening economic climate and an inability to afford imports. The recent attention highlights the benefits of bamboo especially in developing areas (Ogunwusi & Onwualu, 2011). Despite

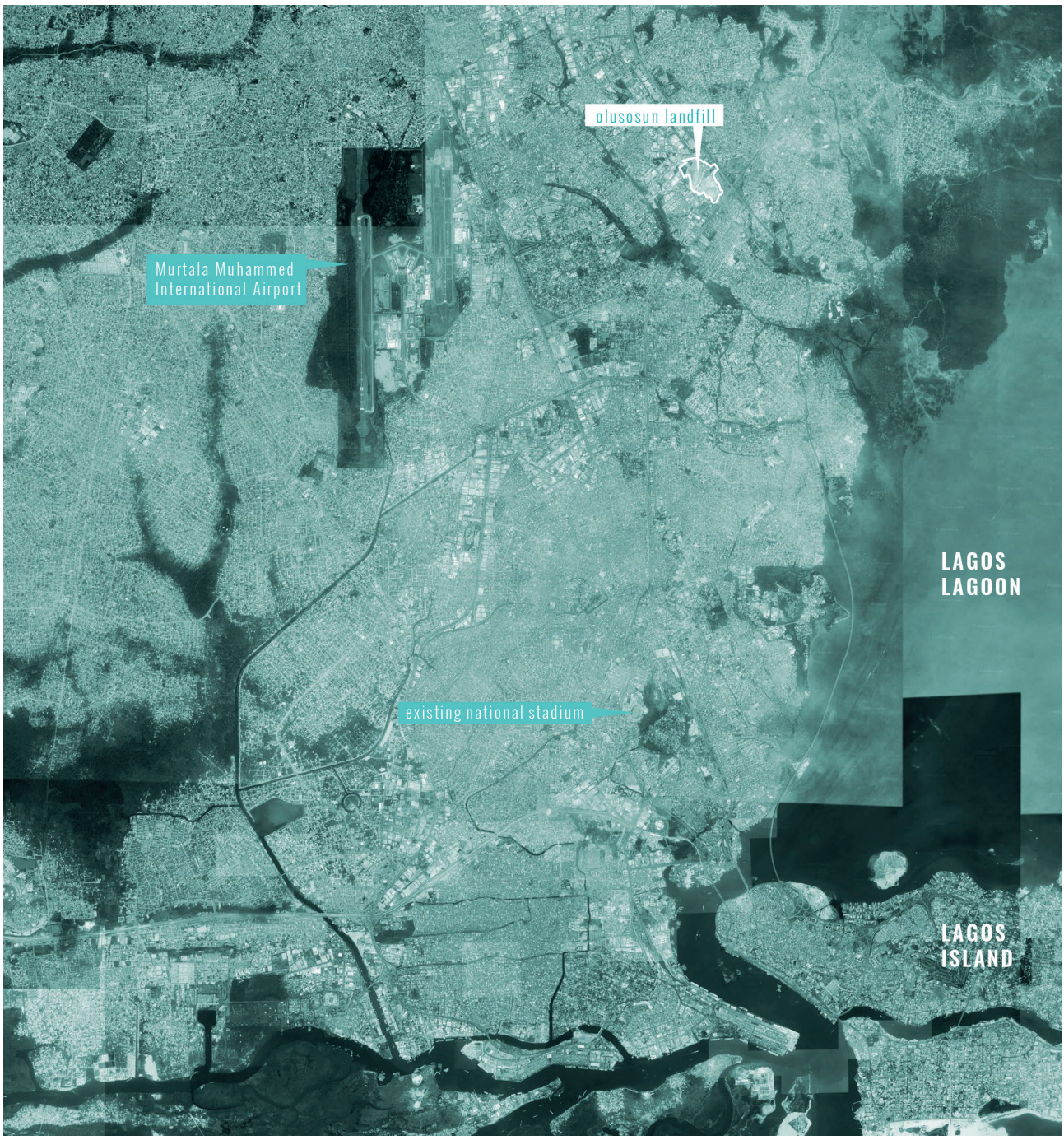


FIGURE 1: Position of the site inside the Lagos urban area (Source: https://www.archoutloud.com/uploads/4/8/0/4/48046731/waste_competition_brief_180907.pdf).

a lack of acknowledgment in the protective and productive aspects of bamboo, exploitation, and utilization have yielded directly, having an impact at a micro level, benefiting to the economical disadvantages of rural communities in Nigeria. We believe that bamboo has a real capacity to impact urban context, especially particular cases where ecosystems have been already altered.

The Nigerian economy has been traditionally dominated by crude oil resources. However, the presence of bamboo – a highly versatile resource that can grow almost in any kind of climate and thrive in worst soils – can become a real solution. Moreover, in the context of Olusosun, it can provide both a clean and renewable energy alternative in the form of charcoal briquettes and wood for domestic and industrial use, while mitigating the effects of former usage through rapid reforestation, slowing soil erosion and repairing the damaged ecosystem. Also, bamboo acts as a large-scale carbon sink, each plant being able to have a double intake of carbon dioxide than a tree. Moreover, it offers an immediate and fast-growing building material that can directly include the direct participation of the local community on the construction site.

Currently, Nigeria hosts multiple varieties of bamboo. The species can attain a height between 14-20 meters at maturity with a girth of about 20 cm. Processing native bamboo can provide a secure business in terms of construction materials. While facing a decrease in terms of total forest estates, from 10% in 1996 to 6% in 2010, a quickly growing resource would solve the imminent wood shortage in the next years. Besides, some species of bamboo can attain maturity in only 3-4 years, which makes it incredibly accessible in comparison with other available resources (Ogunwusi & Onwualu, 2011).

Also, it is said that the bamboo industry could earn Nigeria $22bn annually, making the scheme not only viable for the Olusosun site but for the entire city and country (Ffan, 2003).

The Bamboo Stadium inserts itself at the interior of the site not only in terms of programs and activities but arises from a primordial gesture of planting the bamboo forest. In this way, the site becomes its resource, while taking the time to mend the consequence of the last decades. With a fast growth speed, the structure of the stadium and its surroundings consist of bamboo canes weaved together, forming highly resistant repetitive structures.

2.3 Material & standardization

Bamboo grown on the entire site becomes the dominant building material: transformed into standardized arches that will bear the platforms and roof-structures, between yeards and bridges (Figure 2). Patterned units make the construction process extremely efficient and cost-effective. The building act becomes possible in-situ, offering the flexibility to change the form, add or retain pieces on short notice. Looking forward, a local grow and support of the direct participation of dwellers in the design work can raise awareness and repel the soil, reduce carbon emissions or heat in the process.

The design is an assembly of modular building-blocks, that contain different functions of the site. Each block can connect to its neighbors or develop onto multiple modules, offering a continuous space inside and out, varying between interior and exterior space.

With the appearance of the stadium, the area can rapidly grow in popularity as a recreational area for Lagos citizens, an international sports center for tourists and fans, as well as local work and meeting space for the local community. Bamboo Stadium sets up to promote a healthy and ecological co-existence of the neighborhood with the natural environment (Figure 3).

With all parts standardized and with the possibility of an in-situ fabrication, the construction process becomes extremely efficient and cost-effective. It also makes the construction on-site flexible to add certain areas or alter the programs on short notice, and it offers job opportunities for the dwellers and local inhabitants.

2.3.1 Phasing / Development

Starting from the current state of the former Olusosun landfill, the project proposes multiple phases of development. We took the bamboo cane as a starting point and developed an entire forest to cover the site and mend the consequences of the past activities which took place on its perimeter. When the first lot touches maturity, a modular system is developed around the main unit: four bamboo arches organized on the perimeter sides of a square. Adding further units, the bamboo structure grows in each direction, offering a great amount of flexibility to react to different situations (Figure 4).

The entire structure sits on the existent soil. The units work as normal walk-paths inside the forest, gardens, special yards and to create interior spaces for the program.

While reacting both in scale and functions to the activities happening inside, the project addresses the critical issues of stadiums caused by inconsistent usage and limited lifespan. While not being used for sports events, the massive structure of the Bamboo Stadium remains a lived space, acting like a porous entity, incorporating all kinds of different programs inside its perimeter. The architectural gesture acts against the disruptive size and limited shelf-life of stadiums, maintaining an endless hum at the interior. With an interweaving of architecture and landscape, the structure can expand or withdraw depending on the event taking place inside.

2.3.2 Multi-purpose & flexibility

Stadiums are an icon for a community and business enterprise, soccer remaining the No. 1 sport in the world, with the largest international fan base. The local populations find pride in attending matches but, moreover, often within 10-20 years, the infrastructures become almost impossible to reuse. If not well maintained and with an offer larger than the traditional stadium program, the infrastructure risks abandonment, becoming unsafe for the events.

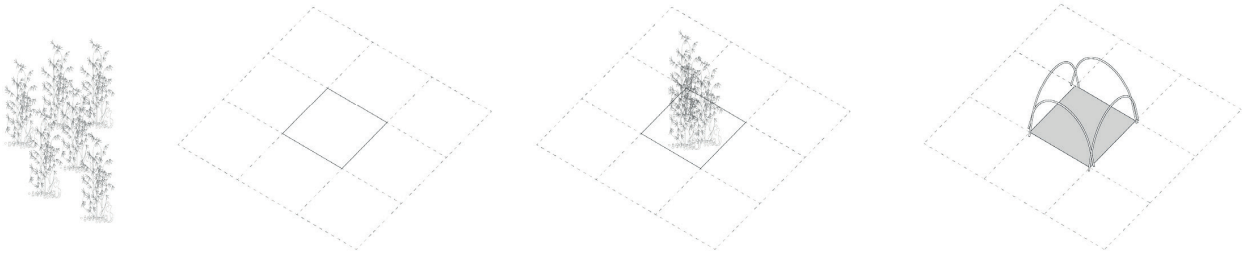


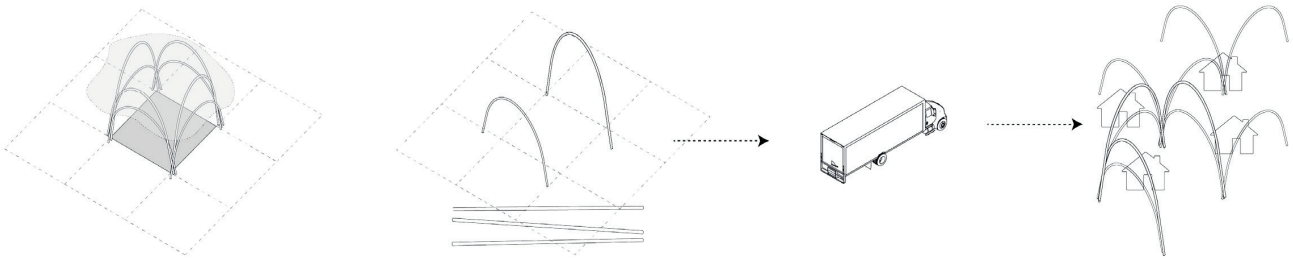
FIGURE 2: Method and options diagrams (continues in the next page).

FIGURE 3: Aerial view.

Generally, stadiums are used for only a couple of hours a day, for a few events a year, becoming a strain especially developing countries, such as Nigeria. So, the purpose became the implementation of supplementary permanent programs, that could accommodate activities and events year-round. The former Olusosun dump becomes a city center within the local neighborhood (Figure 5).

Bamboo Stadium gathers inside a mix of the stadium typology and a park, mixed with various other functions. Like a checker-board, the building-blocks and yards alternate with one another, hiding in-between gardens and different functions. Each module is filled with various functions, from dwellings, educational programs, public programs (cinemas, theaters, workshops, restaurants, etc.), sports courts, to playgrounds and markets with local shops (Figure 6).

We took the traditional form of market and introduced it at the interior of the stadium, exactly around the soccer field, in the stadium gallery. The structure is thought to make the entire intervention an area where the public and visitors can spend their time, no matter their background. The diversity of activities and programs happening inside opens the site to an infinite of situations and needs, making the proposal also viable for implementation in different



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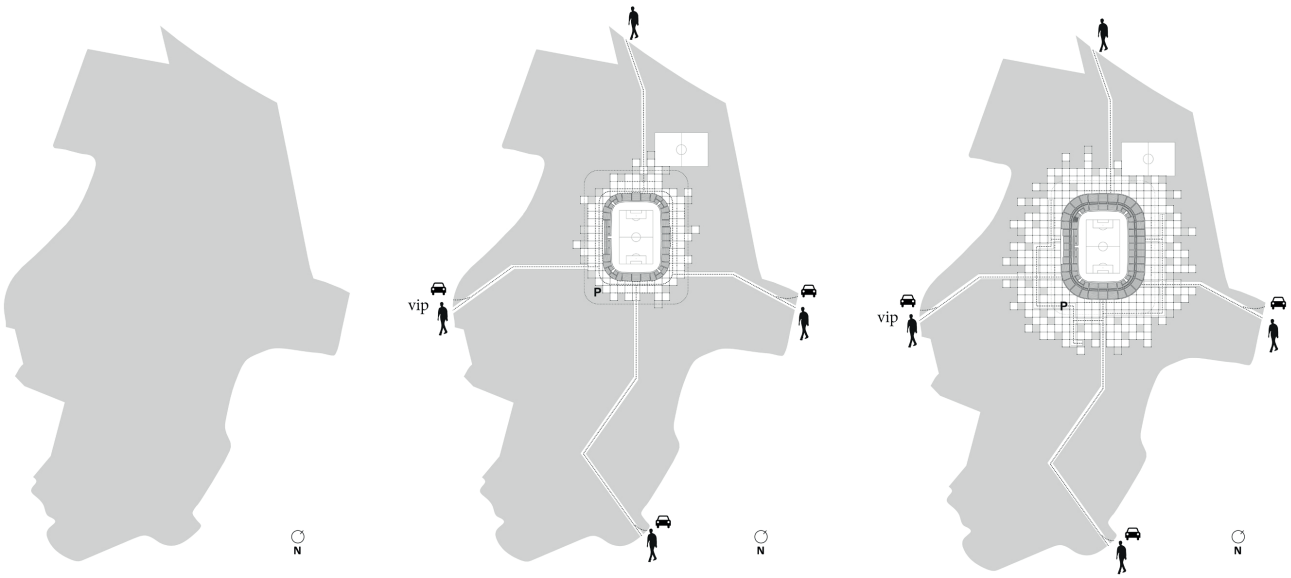
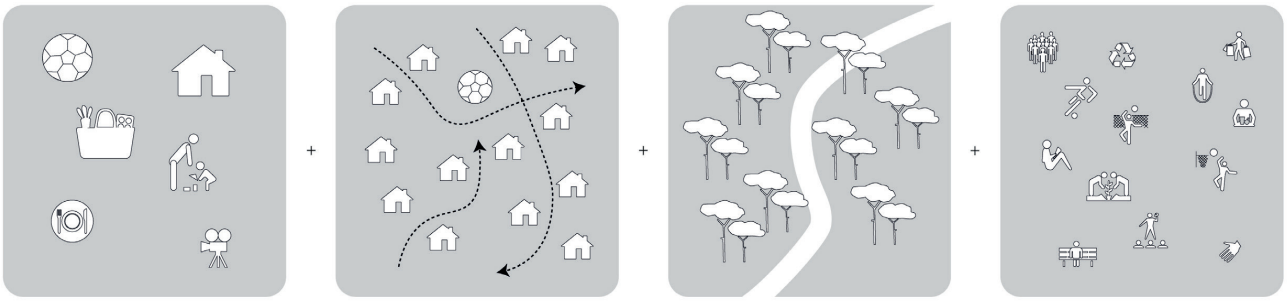


Step 1 : *the Bamboo Forest*

Step 2 : *the Stadium & Bamboo Forest*

Step 3 : *the Stadium & Bamboo Forest*
Housing & Public Programs

FIGURE 4: Phasing diagrams.



functions

stadium-village typology

landscape
the urban forest

activities/visits/participation

FIGURE 5: Conceptual diagrams.

locations. Bamboo Stadium becomes a model and methodology of intervention on similar sites.

2.3.3 Participation and Curiosity

After the fire and closure of the former landfill (Ugbodaga, 2018), many people remained without a job and minimum wage to live and provide for their families. By seeding plants on the site, the site not only creates an ecological environment for future structures and local building material sources but it gives inhabitants the possibility to become the main designer of the buildings. With an infinite potential of growth, bamboo construction sites offer an endless possibility of teaching dwellers ways to build, creating workshops and offering much-needed jobs. In a search for a balance between architecture and nature, such a system could directly address the issues of urban growth and fast development, finding a viable alternative to provide for a growing population.

2.4 Stadium-village typology

Given the looming transformation of the former landfill, the proposal seeks to return the football game to its roots as a natural meeting place for the local community, without forgetting the worldwide public. While avoiding an iconic and monumental structure, the ensemble presents itself as a network of small-scale units that create diversity and unexpected connections. Taking into account the dwelling issue Lagos is facing, the village typology offers the possibility to introduce flexible and easily-erected housing units, together with public facilities: market, school, cinema, sports courts, local shops, restaurants or workshops.

The perimeter of the stadium becomes a blend of social spaces, dedicated to the fans for enjoying the sport on game days, as well as to the local community, extending the urban fabric with programs to be enjoyed 365 days a year (Figure 7).

Architecture needs to be explored. The landscape and surprising connections between the modules create a special and personal bond to the place, leaving space for all kinds of possibilities. With a deep understanding of the local culture, a core responsibility of the project represents the creation of specific functions and activities that are familiar for the local community and demanded by it. In any possible scenario, the stadium and its infrastructure tackle with its identity and the temporal aspect of multi-usage and a phased approach of the site.

The infinite grow and mix of spaces offer an example of sustainable and conscientious development of a former landfill, the site embodies the organization of a village and a tool for social change. Its specificities and typology can play a huge role in the psyche of the local community.

The day-to-day needs of the bustling neighborhood become part of the proposal, becoming a familiar experience for the inhabitants and a unique one for the visitors. The common routines of everyday life are introduced in a cycle that includes recycling, housing, public needs, and leisure. Informal markets and kiosks, dwellings, workshops, teaching classes, cinemas, traditional restaurants and bars, sports courts, all meet inside in personalized spaces, in the unique context of an already build the local bamboo structure (Figure 8).

3. MODULAR SYSTEM. TRANSFORMATION & AFTER-USE

The stadium generates the plan of the system, in terms of economics or urban thoughts of orientation, zoning, and infrastructure. The aggregation can grow in any direction by adding further units, to meet all needs and demands of various situations.

By creating a blank canvas, the system opens up to the influence and speculations resulted from the needs and self-organizing gestures of the community, leaving a simple-to-use material to be interpreted in any way possible.

3.1 Modular system

With prescribed dimensions, the aggregation of modules can evolve in any aspect. The weaved bamboo arches follow the geometric rectangular design, covering the given soil and determining individual structures or components that can be connected. At the interior of each structure, spaces can occupy a single unit or expand into a bigger space and cover a greater surface, depending on the specific needs. The alternation between the outdoors and interior universes creates hidden spaces, and particular atmospheres depending on the positioning inside the system (Figure 9).

The beauty of this modular architecture consists of the liberty of the inhabitant, who decides which component can be built, replaced or added without affecting the rest of the system. The human hand is directly involved in the architectural gesture of building and creating this stadium and its surrounding components. As much as the bamboo stands as the main actor of the proposal, the human presence stands at the same level of importance.

This bamboo system is characterized by functional partitioning into discrete scalable and reusable modules. The functions stand at the interior of each module

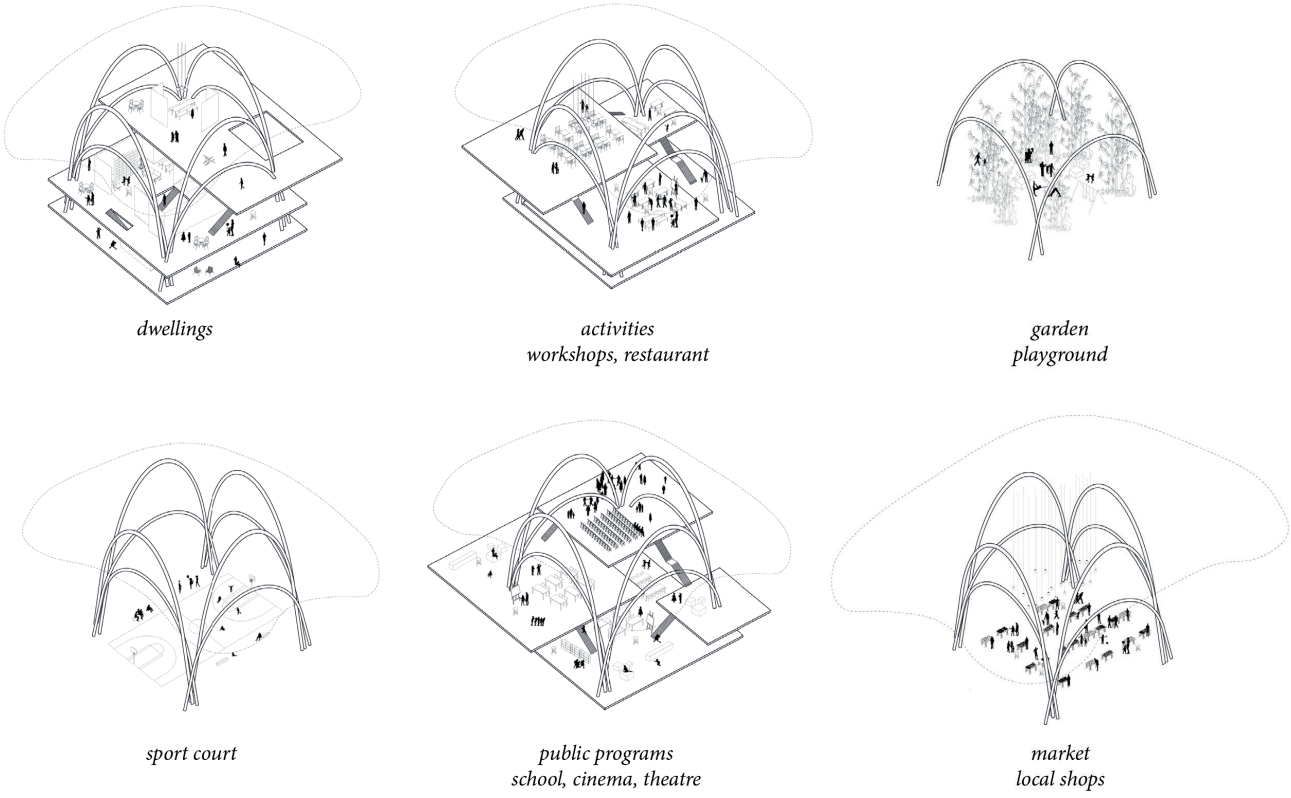


FIGURE 6: Programmatic diagrams.

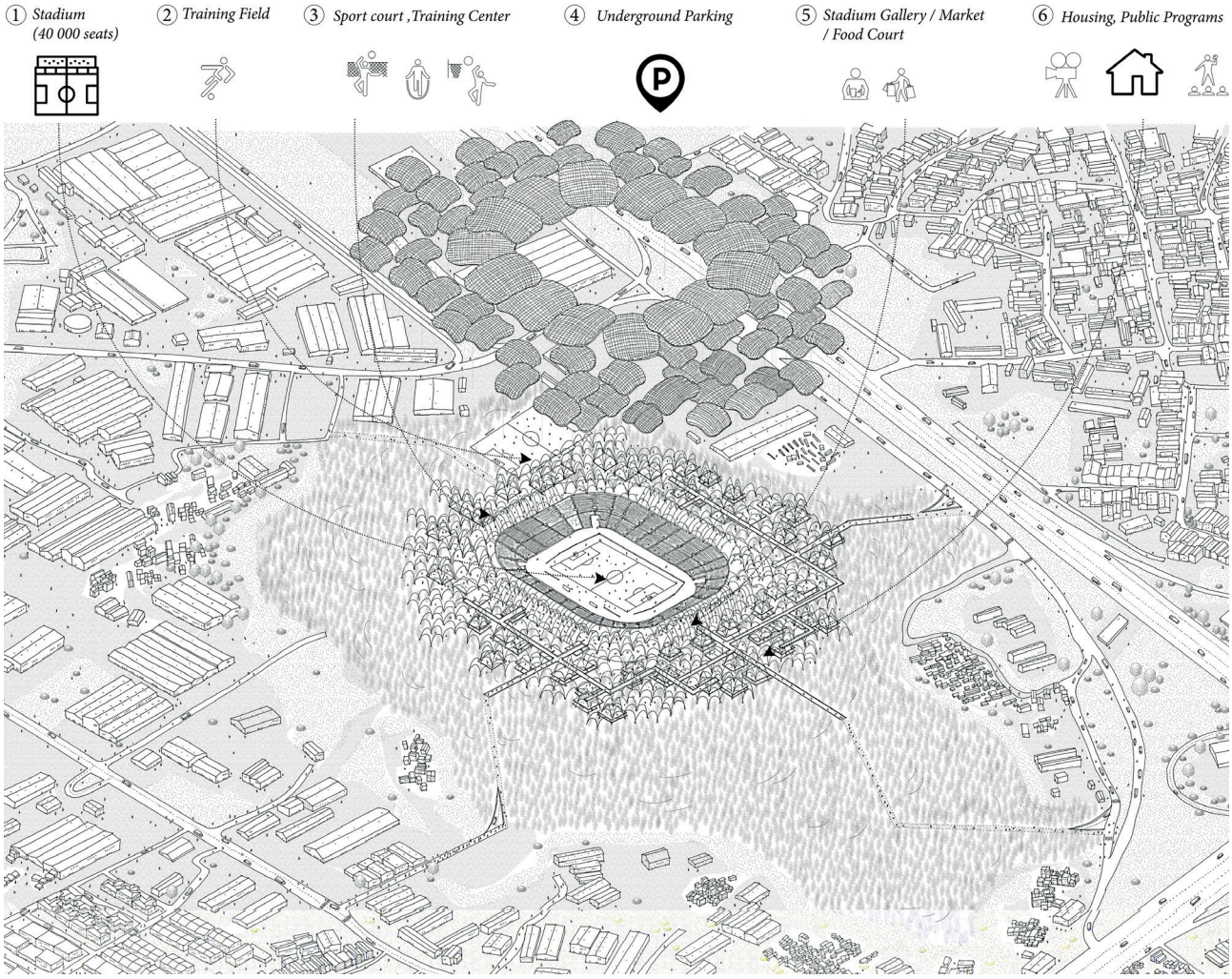


FIGURE 7: General axonometric.

on a succession of platforms made out of the same raw material. Being a very versatile material, bamboo makes as a base for many interventions, such as structural elements, platforms, pathways, bridges or even walls. The flexibility of the proposal offers dwellers the possibility to integrate bamboo into their own daily lives and adapt it to each need and use. Bridges pass on top of the gardens connecting platforms and functions between them, new contexts waiting to be discovered at every corner. Bamboo pathways also pass through the thick bamboo forest, connecting the stadium to the surrounding circulations and areas.

Passing from the public to semi-public and even private areas, the Bamboo Stadium follows the gestures and customs of its users.

3.2 Transformation and after-use

Visitors and dwellers strolling through the park and between the structures are constantly surrounded by nature and home-grown resources. The system addresses an important topic of fast-developing countries, and it creates a path where nature, architecture, and people live in an ecological coexistence.

In the aftermath of a local or international football match, the structure will transform into a communitarian ensemble of programs. Its capacity and already designed modules' dimensions pass easily back and forth between the needed functions. The sequel can be continued, if desired, by its expansions at the scale of the neighborhood or the city. From dwelling to sports courts or public programs, Bamboo Stadium can represent a starting point to start thinking architecture as a process and not as a fixed form (Figure 10).

The proposal should help to populate and develop other areas of Lagos and not only, in a mindful and sustainably way. Due to the specificities of bamboo, structures remain easily transformable and movable, while they offer an infinite number of possibilities of usage. Combining units, the system can envelop different sizes and typologies of programs, temporary or permanent, with a structural behavior strongly dependent on the current fashions and needs.

The modules are transportable and can become a model for differing contexts, being not only a response to Olusosun's specificity but one that could also envision ways for architecture to evolve in different ways to gain rele-

FIGURE 8: Stadium gallery | Market.

FIGURE 9: Sport court and training center.

vance in facing the world's growing toxicity and its crossing relationship with inequality.

4. CONCLUSIONS

There is no doubt that the consequences of waste go far beyond our immediate imagination. Through our proposal, we believe that architecture should become more of a process, than only a final object. Until recently, the approach towards waste has been somehow neglected but the sector is becoming an increasingly significant player in terms of urgency, especially in the context of the ecological crisis we found ourselves in.

The sustainable approach of the Bamboo Stadium explores transforming the Olusosun brownfield into a bamboo forest that would provide the raw material for building a future stadium and community gathering space on-site. Despite the traditional presence of stadiums at the interior of communities and cities, we call for much bigger social values. The environmental impact of bamboo and its benefits as raw material, its positioning in-situ and the possibilities of recycling are completed by the benefits of social interaction, cultural cohesion, and rehabilitation of the community.

Providing direct access to resources, promoting a direct dialogue between architecture, inhabitants and an ecological and sustainable environment, Bamboo Stadium forges the possibility of long-time maintenance of one of the biggest symbols – soccer – by integrating it as a polarizing program for a new village-typology development, where both formal and informal functions can occur as it continues to grow into an infinite sea of possibilites.

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FIGURE 10: Public programs.

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