

# Architecture, Infrastructure, and Technological Leapfrogging

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## CITIES ARE BECOMING MORE INFORMAL

From a fourth floor room in the Southern Sun Hotel in Dar es Salaam, one can see the silhouettes of several partially constructed, multi-story concrete frames rising in the center of the city. Like many developing places, this commercial capitol of Tanzania is adding “Class A” office space capacity in an effort to respond to the increasing globalization of the country’s economy. Within the confines of the corrugated metal fence that encircles its site, the construction of a twenty story office tower appears orderly, efficient, and consistent with standard building practice in places like Houston. Meanwhile, the city pressed to the outside of the corrugated metal construction fence appears chaotic and disorderly; most daily exchange between residents—the so-called life of the city—dwells within this milieu of dense, irregularly sited low buildings constructed of varied concrete casting, sheet, block, plank and tarpaulin. It is a condition that characterizes what has come to be known as the informal city, a term that implicates political, social, cultural and built environments. In this case, the construction fence delineates informal settlement from the modern urban form of the office tower, inviting a comparison between these two contrasting morphological processes of building the city. One might be inclined to speculate that the Global South, alternatively known as the Third World, will increasingly follow the formalizing path forged by large capital improvement projects and exemplified by the office tower, however, most researchers agree that the growth of informal settlement will continue to outpace formal development in cities like Dar es Salaam.<sup>1</sup> That is to say, cities of the Global South will likely become more informal.



Figure 1. View of Manila, Philippines with informal settlement in the foreground. Image ©UNHabitat, 2002.

While the historical, geographic, economic and political conditions that sponsor informal settlement globally are multiple and varied, most pre-colonial African cities have always been informal settlements with growth governed locally by unwritten but well understood rules.<sup>2</sup> Here, indigenous practice often favors localized negotiation between neighbors and construction planning is usually administered through the collective consent of those directly affected by the proposed project, as opposed to a top-down process imposed by a centralized authority. Thus, planning and development mechanisms in these informal settlements are similar to traditional building crafts in that both are diffuse and perpetuated by oral tradition.

While traditional practices explain typical patterns of informal settlement, informal economies are what sustain existing informal settlements and sponsor the growth of new ones. Informal economies are the result of demand for autonomous, unregulated small-scale jobs. In a report from 1972, the International Labor Organization characterized informal sector activities according to their "ease of entry, reliance on indigenous resources, family ownership of enterprises, small scale of operation, labor-intensive and adapted technology, skills acquired outside the formal school system, and unregulated and competitive markets."<sup>3</sup> This characterization still holds true almost forty years later and not only describes economic conditions in the informal sector, but also serves to define material practices prevalent in informal settlements as well. John F.C. Turner offered a similar assessment of building practices in informal settlements:

"Personal and local resources are imagination, initiative, commitment and responsibility, skill and muscle-power; the capability for using specific and often irregular areas of land and locally available materials and tools; the ability to organize enterprises and local institutions; constructive competitiveness and the capacity to co-operate."<sup>4</sup>

Informality often operates outside the realm of public and private institutions in order to evade taxation or political control and, as a result, tends to resist the forces of formal development, yet initiatives to formalize informal settlements, which may be traced back to the colonial period, persist through the present day.

### INFORMALIZING INFRASTRUCTURE

The slab buildings of Michenzani define the cross axis of Karume Road and Mandege Road in Ng'ambo; from above, they are the most clearly identifiable urban forms one encounters when viewing Zanzibar from the air on the approach into Zanzibar International Airport. On the ground, the scale of these roads and the flanking buildings of Michenzani evoke images of a grand boulevard like Karl-Marx-Allee in Berlin. The comparison of the two is not casual given the fact the Michenzani's multi-story housing blocks were developed with the support of the German Democratic Republic and imagined as both a means of constructing the urban armature for a new socialist city and, more importantly, as a statement of political power.<sup>5</sup>

Michenzani's massive buildings follow the plattenbau formula pioneered in post-World War II Europe, employing frame and panel systems of concrete and block construction that utilize the efficiencies of prefabrication and are built at the scale of a megablock. In some instances, these buildings extend one thousand feet, uninterrupted along the street, and seventy feet into the air. The effect is impressive and conceals an extensive mat of informal settlement located behind the monolithic buildings. Here, one- and two-story houses built against the back face of Michenzani's housing blocks produce a clear contrast between the two types. The pretext for constructing Michenzani was to provide improved access to public resources and create a spatial order consistent with the political ideology of Zanzibar's Revolutionary Council. In 1968, German Democratic Republic planners presented a monumental plan based on Soviet planning principles that was ultimately realized in the 1970's with the building's completion. Despite the idealized form of the project and the improved access to services it provided, Michenzani residents were compelled to transform their new habitat to compensate for its deficiencies.<sup>6</sup>



Figure 2. Aerial view of Ng'ambo, Zanzibar featuring the cross axis of Michenzani housing blocks. Image by author, 2011.

The residents' adaptation of Michenzani serves to illustrate the principle that formal conditions are becoming increasingly informalized in many parts of the Global South. Some adaptations in Michenzani are related inadequate spatial conditions. Because

units are regarded as too small for most family types and there is no provision within the rigidity of the multi-story precast construction for the expansion of dwelling units as families grow, the population of Michenzani's flats primarily comprise bachelors, newlyweds and the elderly.<sup>7</sup> Other adaptation efforts provide supporting programs—in the form of shops and kiosks at the base of the buildings—in an attempt to imbue the buildings with a life similar to that of the adjacent informal settlements. Ineffective building infrastructures necessitate additional forms of adaptation. Access to water is difficult in the buildings; water pressure is inadequate and often unavailable so residents are forced to source water elsewhere. Meanwhile, access to electricity is excellent as Michenzani shares transmission lines with Zanzibar's government buildings. The result of this imbalance is a sort of infrastructural barter in which members of surrounding informal settlements provide water in exchange for access to electricity. These exchanges are readily observed in the form of an electrical extension cord draped across an alley or in the figure of someone entering Michenzani carrying water with one hand and a cell phone and charger with the other.

In other cities of the Global South, like the Rocina Favela in Rio, the disparity between physical geography and the overlaid infrastructural order creates a sort of informal fall-off where neighborhoods become gradually more informal as one climbs further uphill, away from services like electricity and water. This condition has led to the common practice of illegally connecting public sources of water and electricity.<sup>8</sup> In Michenzani and elsewhere, efforts to formalize settlement typify the modern ideal of improved access to public resources like water, electricity and sanitation through homogenous planning practices. These planning practices promote ubiquitous standardized infrastructural grids that, in theory, produce social, environmental and economic parity for those whom they serve.<sup>9</sup> Often, however, they become examples of adaptive reappropriation of the very infrastructural services they attempt to consolidate. Whether due to lack of maintenance, shifting political ideologies or disinvestment, monolithic infrastructures are increasingly transformed into self-organized infrastructures by the residents of informal settlements.<sup>10</sup>

Just as water and electricity are bartered as commodities, so too is data bandwidth. Mobile phone subscribers in Tanzania represent over half the population and their numbers continue to grow.<sup>11 12</sup> While mobile phones are a liberated version of the wire-based telephone line, they also represent new means of exchange. In a place where consumer credit is unavailable, mobile minutes are a method of payment that operates similarly to a debit card but, unlike bank cards and other consumer credit instruments, mobile phones don't require an address, an obvious advantage for residents in informal settlements. As a result of these advantages, mobile phone use continues to rise, cellular coverage grows and, conversely, wired communication grids remain incomplete and inaccessible to most of the population.

### ALTERNATIVE MATERIAL STRATEGIES

Attempts to formalize settlements have historically brought new methods of construction and material technologies that are in turn co-opted according to indigenous practice. With the construction of Michenzani in the 1970's, Zanzibari construction workers gained hands-on knowledge of both the manufacture of, and construction with, pressed earth blocks. As a result, small industry has grown around this material and its application as a more permanent form of construction in Zanzibar's informal settlements. By some estimations, 50 percent of the illegal squatter settlements presently situated around Michenzani are constructed from earthen blocks whereas, at the time of Michenzani's construction, fewer than 1 in 7 buildings utilized these types of permanent building materials.<sup>13</sup> Like the introduction of corrugated metal sheets in Global South during the nineteenth century, cementitious blocks have become part of a new standard of vernacular construction adapted from the twentieth century building practices of the Global North.

In the Global South, where urbanism increasingly reflects the growth of informal settlement, the built environment is an improvised collage of repurposed materials, techniques and infrastructures. Set within this autonomous and unregulated economic framework, residents build according to available resources. Though seldom on the grid—both infrastructurally and politically speaking—informal settlements are nonetheless teaming with construction activities characterized by entrepreneurship, imagination and

self-reliance. Efforts to formalize informal settlements rarely deliver the type of order and social equality that proponents espouse during the planning stage<sup>14</sup>, however, adaptations of these efforts produce multivalent and pluralistic effects that suggest alternative modes for material practice in the Global South.

In *Supports*, John Habraken imagines the independent dwelling, with its capacity for variation, as an alternative to mass housing. According to Habraken, the independent dwelling sponsors domestic environments that are a direct result of the occupants' needs, and fixed support structures supply necessary services and enable greater density. In Habraken's approach, and many other models of self-help housing, the self-organized dwelling is possible only to the extent that people have access to public services like water and electricity through formal support structures as these public services are usually predicated on monolithic distribution networks.<sup>15</sup> Turning to lessons deployed in informal settlements, however, provides alternative examples of support where the global force of advancing technology means greater flexibility and diffusion of technology based on real versus idealized social conscience. That is to say that, given infrastructural adaptations found in informal settlements, it is possible to imagine alternative means of effectively collecting and distributing public resources that allow people flexibility to organize their built environment independent of their proximity to a fixed support structure.

Advances in the way electricity is generated, communicated, stored and consumed have led to numerous ideas that have found traction in the Global South. For example, electro-luminous material like the light emitting diode (LED) offer the multiple advantages of being efficient, robust, and long lasting when compared to other lamping technologies. In many parts of the Global South, LED bulbs have come to replace incandescent bulbs in standard light fixtures; their efficacy provides significant benefit in terms of reduced energy consumption. Meanwhile, a number of recent initiatives demonstrate entirely new strategies for providing urban and domestic light that leverage other unique properties of the LED. Projects like the "Starsight" streetlight project by Kolam Partnership imagine new modes of urban lighting where streetlamps are off-the-grid low demand LEDs with form factors adapted to their urban settings. Unlike the ubiquitous "cobra-head" lamp

found in the United States, these fixtures, which are currently being tested in Cameroon, are not dependant on the electrified grid but collect and store their own energy and are tailored to their particular environment rather than uniformly sized. Flexible, adaptable and tailored electric light is found in both the home and field in the Portable Light Project by Kennedy Voilich Architecture. The designers worked collaboratively with a population of semi-nomadic farmers in Mexico to develop a set of luminous components that would integrate into traditional hand-woven articles; thus shawls and bags become luminous bodies at night and provide light for reading. Here, again, the durability of new technology makes adaptation possible in a heavy use item such as an article of clothing. With durability comes longevity; light emitting diodes can last up to 50 years according to manufacturer claims. Thus the life cycle of building material and the life cycle of the light fixture become more synchronized and illumination may be imagined as integral or even embedded in building materials in ways that are impossible with the conventional socket-based bulb. Such materials have been adapted for use in places like Darfur in the form of luminous clay fired blocks that may be built directly into traditional clay block assemblies.

Beyond light, the ethic of scrupulous energy consumption found in the Global South results in a number of efficient practices for heating and cooling as exemplified in solar ovens that collect and concentrate the sun's heat to cook food and warm the home, and pot-in-pot porous clay vessels that secrete water to provide evaporative cooling.

Reduced dependence on electricity means that electrical production can be diffused and small-scale. Power lines and easements that connect and divide communities are transformed into localized cooperative networks. Several techniques figure in to micro-power generation; the dominant technology in this category is the photovoltaic cell. Like the light emitting diode, this semiconductor continues to grow more efficient and durable while its cost continues to decline. Photovoltaic collectors can be scaled to the individual dwelling or the individual and, unlike the intensive power plants of the 20<sup>th</sup> century, the efficiency of photovoltaic cells is not predicated on their scale. In applications like the Portable Light Project, individually scaled photovoltaic systems provide individually scaled servings of electricity which can be collected and then



Figure 3. Interior view of a house in Stone Town, Zanzibar featuring LED light fixture and improvised electrical wiring connected to PV collection cells. Image by author, 2011.

stored in batteries at the point of use. In buildings, photovoltaic assemblies are being re-imagined as high performing alternatives to the standard corrugated tin roof found on many houses in the Global South. Meanwhile, other communities are defining alternative cooperative approaches to generating electricity, as in Nepal, where waterwheels are being retrofitted with generators to provide power to small clusters of houses. In these instances, the absence of a monolithic power grid opens up the possibility for efficient and adaptable schemes for the production of electrical power.

Access to clean water is imperative to the health of settlements and certainly the most important tangible resource in a community. The model distributing potable water and collecting waste water via large scale systems is effective; however, in informal settlement, imbalance and lack of maintenance often produce unequal access to water and sanitation. Several recent projects imagine water

distribution and water quality as it relates to architecture and the individual. One such project is the Solar Water Disinfecting Tarpaulin. The tarpaulin project takes the form factor of a common item in the Global South—namely, the tarp—and embeds into it the technology for disinfecting water. As a result, the tarpaulin may be incorporated into building roofs to provide water storage and solar activated water disinfection, and also used as a carrying device for communicating water from the well to the point of end use. Rain water harvesting, cistern storage, human powered pumps and other water-moving devices provide additional alternative means of water collection and distribution. Likewise, waste water may also follow soft-path strategies through devices that compost, diffuse and filter at the point where the water is consumed. These localized strategies for distributing and treating water facilitate greater individual control of the resource and are appropriate for the varied conditions of the informal settlement.



Figure 4. View a Solar Water Disinfecting Tarpaulin on the roof of a Samburu house in Kenya. Image by author, 2007.

## LEAPFROGGING

Programs to aid in the Global South often reflect the development strategies of the Global North. Prosperity, according to this doctrine, depends on a developing nation's ability to enact the economic models of a developed nation; however, in the context of new technologies and technological adaptations, this model loses currency. Benefitting from a lack of extensive investment in heavy infrastructure, much of the Global South is free to move beyond outmoded models of serving public resources through monolithic networks and to leapfrog ahead, toward infrastructures that are increasingly distributed, architectural and personal in scale. This leapfrogging process yields possibilities that are more readily adapted by populations in informal settlements and enables design to address real rather than idealized needs.

In the face of emerging technology, the efficiency of consolidated infrastructural systems as the dominant connection between people and the public resources they consume is questionable. Developing countries of the Global South offer alternative examples of building infrastructures and technologies that proliferate, in part, because these countries are less burdened by the Global North's model of idealized efficiency, a model of standardization where the performative features of architecture are scripted by the systems and elements that allow buildings to participate in a common standard. As an alternative to the utopia of standardization, technological leapfrogging allows design to skip generations of innovation—due to lack of resources or interest—and launch design research forward into a future liberated from the genealogy of earlier, moribund intelligences. Just as the Industrial Revolution introduced a Fordist ethic to building technologies, so too might the current revolutions in information, energy, and materials be understood in terms of their transformative effects on architecture. The built environment of the Global South, less burdened by a Modern legacy, proffers adaptations in building technology that do not necessarily retrofit existing systems but rather, leapfrog them. Within this paradigm of technological leapfrogging lies the potential for a South-to-North exchange of architectural ideals.

## ENDNOTES

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5 Garth Andrew Myers, *Verandahs of Power: Colonialism and Space in Urban Africa* (Syracuse: Syracuse University Press, 2003), 132.

6 *ibid.*, p. 106-117.

7 *ibid.*, p. 120.

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