



ENVIRONMENTS OF CHANGE: AN OPEN BUILDING APPROACH TOWARDS A DESIGN SOLUTION FOR AN INFORMAL SETTLEMENT IN MAMELODI, SOUTH AFRICA

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Abstract

Poor living conditions in informal settlements may be attributed mostly, though not exclusively, to the lack of basic services. Informal settlements, which also go by the name of squatter camps, are volatile by nature. Even within relatively fixed settlement boundaries, change in urban fabric continually manifests through altering dwelling configurations. Deemed unstable and unsafe by formal criteria, these environments disclose schizophrenic characteristics: beyond the dirt, grime and smog, exist relatively functional societies capable of survival and self-regulation.

Public and private sector investment within informal settlements is restricted as a result of their illegal status. Inhabitants have no incentive to invest their own resources where they have no formal tenure over the land. Due to a rather backward approach to informality in South Africa, innovation in dealing with these settlements has been limited. Despite the fact that the rhetoric has sometimes changed from eradication to upgrading, little has been done with regards to alternative forms of settlement development that has relevance in terms of improving the lives of informal settlement dwellers.

With rising anger in poverty-stricken areas and on the peripheries of cities, what is needed is improved service delivery through immediate solutions. This article suggests a service delivery core, an architectural catalyst, rooted to the 'energy' of the public realm, stimulating growth of infrastructure networks. This catalyst core aims to instigate the amelioration of the surrounding environment.

The concept presented is that of a dynamic service core – universal in principle – while also being contextually-driven by responding to a specific environment and needs of a specific community. A generic architectural solution is thus presented to providing basic services and infrastructure within informal settlements, with focussed consideration for the unique situation of an informal settlement in Mamelodi, Tshwane (Pretoria), South Africa. It is important to realise that there is no final product, but rather an organic architecture that adapts in a process of continuous and progressive change.

Keywords: South Africa, informal settlements, progressive change, service delivery, architectural catalyst interven-

INTRODUCTION OF CONCEPTS: ARCHITECTURE OF CHANGE

Hamdi (2004) explains how 'small' interventions grow and guide development and how the role of the professional becomes one of creating conditions for emergence and searching for catalysts. This approach generates a process of 'negotiated reactions' (Dewar & Uitenbogaardt, 1991), whereby continuous transformation is achieved within a

stable environment. This approach acknowledges that the built environment is not static: it is a complex relationship between stability and transformation (Habraken, 1998)(Osman & Konigk, 2008).

This study is therefore based on some fundamental design principles including the need to promote and extend architectural catalyst interventions in informal contexts. These structures provide various services (thus the term "servant core") so that they successfully reach and serve the majority

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of people within an informal settlement. It is important initially for the catalyst intervention to address the basic needs of the inhabitants, and only at a later date, to stem off and provide several other platforms allowing for diverse interpretation and use.

It is understood that while projects need to have a bigger vision, in a context such as Mamelodi they need to start small, by identifying where existing energy is and latching on to that spatially, physically and functionally (Osman, Sebake, 2010). The resultant public space, which is thus shaped by the architectural intervention, is critical as a socio-economic stimulus inviting private informally-run micro-enterprises to operate within certain parameters. In this way, the intervention offers opportunity and provides place for social activity. It was therefore seen as key to couple the design intervention with an existing public arena, such as the sandy football field in the particular site of an informal area within Mamelodi. The servant core thus directly imparts some beneficial service onto the public realm, such as lighting and water points to mention a few. This strategic selection of site also establishes a symbiotic relationship, whereby the public are more likely to accept such an intervention and possibly take ownership of it.

The proposed construction method of these catalysts acts to showcase technologies, materials and methods relevant to context. The technology encourages communication with users through visual observation and tactile interaction. In addition to that, the structures are designed in such a way as to have the potential to be disassembled and relocated elsewhere and may possibly relocate once they have served their purpose on a particular site. However, depending on the changing needs of a specific environment, the structures could also be absorbed within an expanding urban fabric giving direction to the future development of the township and adopting new programmes.

The design of these catalysts is conceived to make provision for the informal sector, in terms of economical activities and environmental forms, as informality is considered a legitimate energy and form of expression. This is done, firstly, in the construction process and secondly in the way that the facilities will be used after completion.

A BUILDING SYSTEM SUITABLE FOR ENVIRONMENTS IN CONSTANT FLUX

Due to the fact that “slums change too fast to render any criterion valid for a reasonably long period of time” (UN-Habitat, 2003:11), the design solution presented here also has impermanent qualities. The built system is capable of learning and evolving in time; the capacity for change is integrated within it. It is necessary to design for future scenarios by “devising an ‘adaptive’ strategy that is exceptionally alert to changing events and can adjust quickly” (Brand, 1995:183). Designing for change within the built configuration should encompass both principles of adaptability: “capable of different social uses” (Groak, 1992:15) and flexibility: “capable of different physical changes” (Groak, 1992:15) in order to best respond to the ever-changing, ever-informing urban environment. This approach to the built environment is advocated by many practitioners, albeit under different names and banners: Time-Based Architecture (TBA), 4 Dimensional Design (4D design), Open Building etc. Time-Based Architecture has been defined as: “... a design attitude to conceive ‘objects’ from a long term vision, therefore integrating the fourth dimension, i.e. time, in the initial design phase.” (Paduart et al, 2009: 2). When this is achieved, time becomes a design catalyst where built environments are treated as living systems (Luketz, 2009:5).

INFORMALITY

“In developing countries, the term ‘slum’...simply refers to lower-quality or informal housing. Large, visible tracts of squatter or informal housing have become intimately connected with perceptions of poverty, lack of access to basic services and insecurity. Terms such as slum, shanty town, squatter settlement, informal housing and low income community are used somewhat interchangeably by agencies and authorities” (UN-Habitat, 2003:9).

There is a growing epidemic of informal settlements, albeit by different names, occurring throughout the world with no sign of a “cure”. South Africa has shown little innovation when it comes to dealing with informality. The intelligence

of the poor in identifying and occupying well-located land is dismissed as an illegal process rather than appreciating some of the benefits of the process, learning from it and supporting it through expert involvement. Adopting a “first-world approach” of eradication and “clean-up” is disadvantaging many communities who are unable to enter the, many times unaffordable, formal sector.

Most often these informal settlements are located on the outer periphery of cities and industrial areas – in this way, the informal dwellers are near enough to serve the city (they are therefore close to job opportunities) but they are not close enough to be served by the facilities available in the city. South African cities, despite political change since the end of Apartheid, stubbornly maintain patterns of segregation. The proliferation of informality is in many ways attributed to past spatial injustice, a process that generated some of the most inequitable cities in the world. Anger against the state has intensified in many forms. Numerous social and political problems such as violence, crime, service delivery protests and xenophobia might be a result of these spatial inequities. It is generally agreed that the problems facing these areas need to be urgently addressed if political stability is to be achieved.

Existence of an informal area is treated as temporary by authorities; however, the reality is that many informal areas continue to be in existence for long periods of time and are therefore quite well established. The inhabitants of informal settlements are generally resourceful and innovative in devising systems of habitation that are well-located (close to work opportunities), that are affordable, that can be constructed speedily and dismantled just as easily.

While upgrading and integrating informal areas into cities is the accepted approach, it is also acknowledged that mass-regularisation might also be problematic where it might prove to be impossible to formalise at a large scale given the extent of informality that exists in the country. Many scholars have called for an incremental approach where there is no strict distinction between formal and informal. Some have asked for investigating different forms of tenure security. There is a call to investigate the domain between strictly formal and informal, the “in-between” zone, in terms of physical structures, finance models and forms of ownership,

that might include group ownership as opposed to a western system of individual ownership.

Some attempts have been made at an area-based approach to upgrading as opposed to focussing on the individual houses. In all cases, what is important is that addressing informality needs to be done in an innovative manner that is unique to context and that benefits the inhabitants. This is what this project set out to investigate, as well as to address the negative connotations of informal settlements.

There is a deeper intrinsic quality to an informal setting. “Emergence” of informal settlements within South Africa is both instant and gradual, determined by the intensity of energy at a particular time: need, economy, opportunities, politics, etc. A form of street grid is established, organic by nature and true to the energy which shaped it. The scale and layout is often more suited to a pedestrian scale as it is determined by the main “mode of transport” within the settlement, walking on foot.

The ubiquitous ‘tin’ shack, reminiscent of many informal settlements throughout the world is pragmatic, functional, affordable, but inadequate. While it functions well as a rain-screening shelter, the South African method predominantly uses a timber structure, usually with a recycled steel sheet clad exterior offering the user only the bare essentials of a shelter.

Informal settlements are in constant flux. Even when settlement boundaries have been defined by existing formal settlements, infrastructure or natural edges, such as steep slopes or rivers, within these boundaries, change in built fabric continually manifests through altering dwelling configurations. The disassembly and recycling of structures, together with new informal additions and extensions to older structures, creates an environment that is constantly being remodelled as dwelling units are adapted for increased practicality and density.

In order to remove demeaning overtones, it is essential for an architectural intervention not to be condescending, but rather uplifting and empowering, initiating a change in the outsiders’ perception of informal settlements and their inhabitants while stimulating the self-help strategies of the inhabitants. Architects have a special role to play in this process: “New imaginations are needed, both

robust and nuanced, on how these chasms [between the rich and the poor] can be bridged... It would be disrespectful of the dignity of those who had been shut out in the past to say that they should now be satisfied with having access to shoddy and styleless buildings based on the principle of bare necessities only. Elegance, accomplishment and suitability for purpose are factors appreciated by all, whether in dress, dance, music, speech-making, or sport or building... [there is therefore] no inherent incompatibility between a building being friendly to the public, on the one hand, and pleasingly, coherently and efficiently designed on the other." (SAIA awards report, 2010)

Based on the above principles, the proposed design for a specific case study area in Mamelodi, South Africa strives to act as both a symbol of hope and progressive change.

THE INFORMAL SECTOR IN MAMELODI, TSHWANE

Mamelodi is a residential suburb approximately 25km² in area and was originally established in the 1940s as a township for black workers near the train station at Eerste Fabrieken. In time Mamelodi expanded to the East beyond the Pienaars Rivier, locally known as the Moretela River. Mamelodi is divided into two sectors by the Pienaars Rivier, Mamelodi West and Mamelodi East. Mamelodi West shares a distinct border with the established township of Eersterust to the West and the industrialised area of Silverton to the South-West. The Magaliesberg mountain range defines the northern perimeter of the greater Mamelodi. Mamelodi East is bound by the North-South lying branch of the Magaliesberg mountains and commercial and residential development to the South in the Willows. Mamelodi East contains a great deal of informal dwellings, particularly in the extreme East where there is significantly less formal housing and limited infrastructure.

Mamelodi still shows traces of its numerous growth patterns, both from its pre-apartheid and post-apartheid eras. It displays evidence of the diverse urban planning typologies practised during the changing years of government and the fusion of incongruent road grids as well as contrasting forms

of housing typologies. Unconstrained growth of informal shacks is depicted by the smaller informal grid patterns.

In Tshwane, South Africa, as in other places, there exists a certain order within the apparent chaos of informal settlements. Internal policing, construction and trading are all resolved and carried out on a scale suited to context, available resources and paying power. Informal settlements establish cultural, social and individual roots which in turn support the greater structure of the settlement and the community.

The area of Mamelodi is rapidly expanding and swallowing up auxiliary informal settlements on the peripheries, and at the same rate giving rise to new informal "offspring" as informal residents located on the erratic edges would either move into the new formal housing or, together with newer immigrants, would again relocate to the shifting outskirts of the township. These informal settlements have been continuously uprooted and displaced by the expanding formal urban fabric of the township. The informal settlements in the extreme East and South-East of Mamelodi (informally known as Lusaka and Phumolong) were identified as areas in urgent need of basic services with high fire risks and poor sanitary conditions.

The informal sector of Mamelodi east consists predominantly of wards 10, 16 and 17. Collectively these wards comprise more than one third of the area of Mamelodi served by 1 clinic in ward 17. Sanitation is inadequate with poor health circumstances as result. Much of the material used to construct the shacks is obtained from the surrounding industries, mostly from the Ford manufacturing plant in Silverton. Many informal dwellings encroach upon the Magaliesberg on the eastern front. The threat of shack fires exists due to the high combustion rate of the building material and the high densities.

Much of the current formalised township of Mamelodi East is composed of consolidated informal settlements, in which land previously subdivided without approval is sold or leased to the informal residents and has overtime been recognised as part of the township. Improved infrastructural networks are thus provided and these informal settlements are merged within the recognised township. However, and in contrast, in some cases squatters

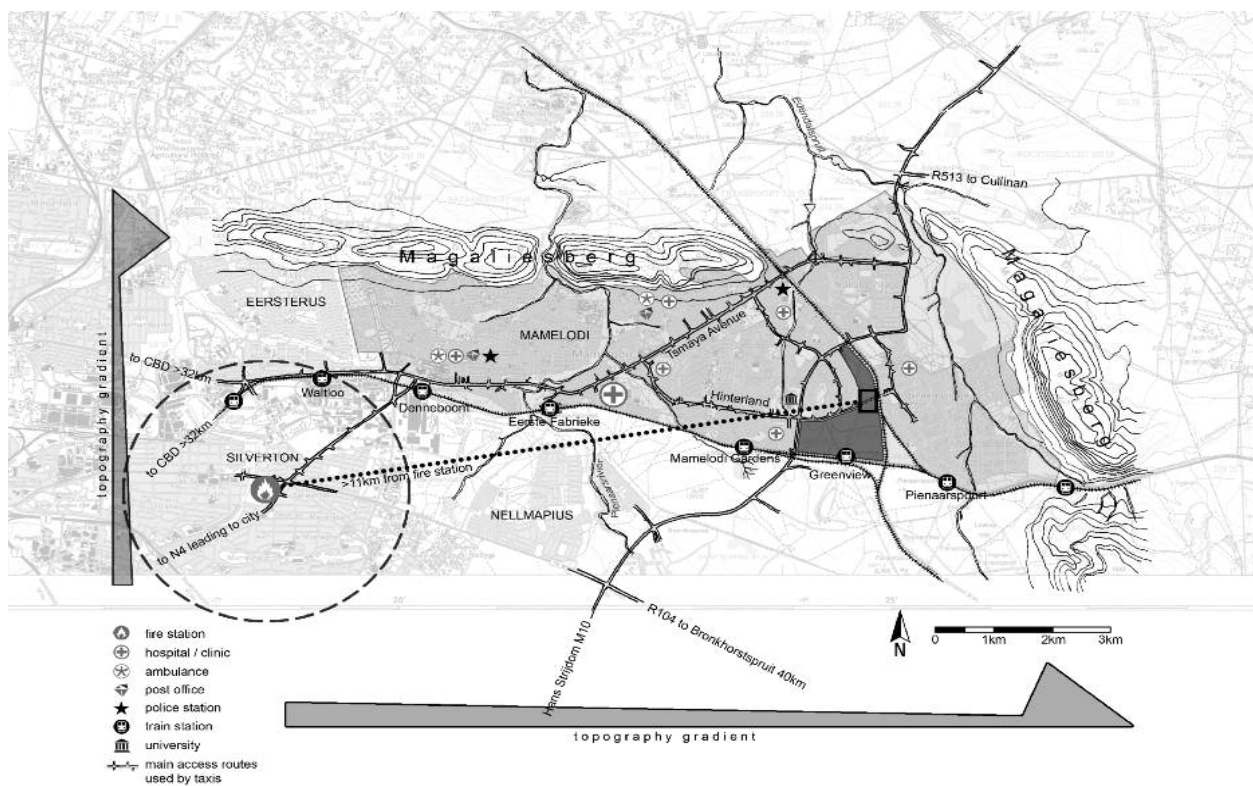


Figure 1. Location of Phumolong informal settlement within Mamelodi and distances from critical services.

have been relocated and the land developed for new government-subsidised housing – also referred to as RDP houses (from the Reconstruction Development Programme) or “give-away” houses (alluding to the fact that owners do not have to pay or pay a minimal amount). Currently, the South African government aims to provide formalised housing and services to these informal communities. However priority is given to the informal settlements “of the most vulnerable and disadvantaged groups” (UN-Habitat, 2003:129) and those established during the apartheid regime and pre-1994 (Metroplan, 2006), thus excluding the specific site under investigation due to its recent establishment, after 2003.

THE SITE: PHUMOLONG

Phumolong is located in ward 16, extension 6, Mamelodi, Tshwane, South Africa at coordinates 25° 44'00" S 28° 25'00" E. It is almost completely surrounded by the township of Mamelodi (Figure 1) except to its south where the municipal boundaries of the City of Tshwane and Metsweding meet (both situated in the province of Gauteng).

‘Phumolong’, Sotho for ‘resting place’, is the local name for this land which is occupied entirely by informal settlers’ shacks with almost no municipal services provided. The area of Phumolong is located along the curved main road of Hans Strijdom (M10) defining both its Northern and Western boundary while two converging railway tracks demarcate its Eastern and Southern limits (Figure 1). This area is locally referred to as ‘bridge to bridge’, referring to the proximate infrastructure, and is managed by a community elected ward leader and committee. The older neighbouring community to the North-West, known as Marabastad by the locals, also belongs to Mamelodi Extension 6 and boasts RDP housing together with the necessary infrastructure. Electricity is extended from neighbours by means of illegal ‘izinyoga’ (Sotho for ‘snake’) connections. Hose pipes are connected to garden taps within the neighbouring Marabastad and transverse the dividing asphalt roads. Hose pipes meander down the gravel roads serving the community of Phumolong, sometimes unseen but mostly overlooked by the municipality.

Mamelodi does not have a fire station despite high rates of fire. Apparently, Mamelodi has

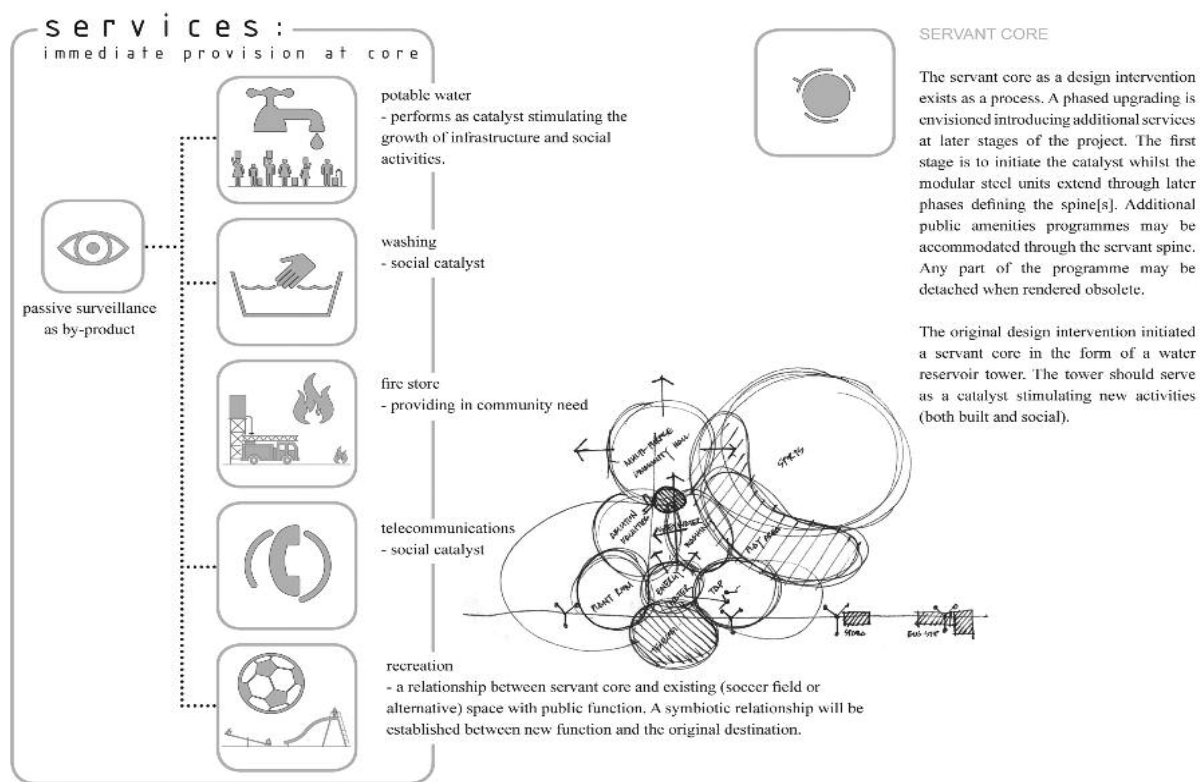


Figure 2. Services to be accommodated during first phase of catalyst

the highest rate of fire among any other wards in Tshwane for the year's 2007 and 2008 (City of Tshwane Disaster Management Services 2008). A fire station is a necessity (Chief Fire Warden of the Pretoria Central Fire Station, J Pieterse 2009, 25th May). A central location would offer greatest access to fires within Mamelodi and the neighbouring areas of Nellmapius, Eersterust, Waltloo and the area of the Willows.

Inadequate vehicular access and the absence of fire hydrants within Mamelodi and its informal sectors delay the process of extinguishing fires. This gives fires time to spread, many times having deadly consequences. The provision of a water reservoir, sorely needed by the informal residents for human consumption, could also co-function as a 'fire filling station', operating as fire hydrant in times of fire. This idea gave rise to the concept of a servant core with its primary activities based around the provision of water (Figure 2).

The location is suggested along the edge of a well-used football pitch (Figure 3). This allows for easy access to water in times of fire and also guarantees a constant presence of people and aims to create a sense of pride and ownership in the structure.

THE PROJECT BRIEF

This design intervention aims to improve service delivery as well as social well-being within the informal settlement of Phumolong. The scheme acts as catalyst for social growth as well as system and services growth thus responding to both individual and community needs.

The intervention is to be the generator for service delivery and an ordering structure within the urban fabric by acting as basis for urban societal life – thus linking improved infrastructure and services, a sense of community pride and participation is to be achieved by giving emphasis to the importance of positive public space. Through this process, lack of public amenities and services is addressed. Also, in the process, architecture is investigated as a responsive system. As a changing relationship of form and programme, the architecture investigates the potential to achieve a higher degree of independency through the integrating of energy inclusive systems and infrastructure that do not rely on the municipal grids or systems. In other words infrastructure as architecture is explored resulting in an adaptable and flexible architectural plug-in system.



Figure 3. View of the informal settlement showing the football pitch along which the intervention is proposed.

The design intervention also serves as a symbol of renewed hope and support. It establishes an improved identity within the settlements and informal sector. The service core provides place and opportunity for the local business owners and surrounding residents and is capable of expanding according to future needs, allowing new and changing programmes to be attached to the system. The intervention is a public services building integrating public space with public services and amenities. The users are the informal occupants, business owners and the community as a whole. The phased growth of the design intervention (Figures 4 and 8) incorporates various clients at different stages. The first client[s] will be responsible for construction of the primary structure and necessary infrastructure and would be the government and its relevant departments such as; the Department of Human Settlements, Department of Energy and the Department of Rural Development and Land Reform.

The secondary clients are responsible for construction of buildings having civic importance and serving as public amenities. Such programmes and clients may change depending on need of the community but may typically be healthcare, educational facilities or even a post office or place of worship. The lifespan of such programmes depends on the needs and position of the community at a given time. Other clients such as small, medium and micro-enterprises will be responsible for their own

building construction and attachment to the servant spine. They too influence the growth of the servant spine. Advertisements and branding attached to the building structure may generate further capital needed for maintenance and systems growth. A local entity would have to be elected to manage these processes.

Possible funding and material can also be obtained from sponsors such as steel manufacturer Arcelor Mittal. This company has partnered with the South African Department of Education to build ten schools throughout the country using new steel technology, one of which is in Mamelodi.

THE SUGGESTED CONSTRUCTION METHOD

It is important to note that the proposed structural configuration is not a “one size fits all” but rather an assembly of easily attained, transported, manipulated and fastened parts. With this in mind construction materials and methodologies were considered which allowed for an ease of disassembly and compatibility. ““Design for Disassembly” (DfD) is the detailing of connections between a building’s different components; DfD means designing buildings that can be disassembled and reassembled part per part (Durmisevic, 2006), it assures that connections can be undone. “Design for Compatibility” (DfC), on the other hand, ensures

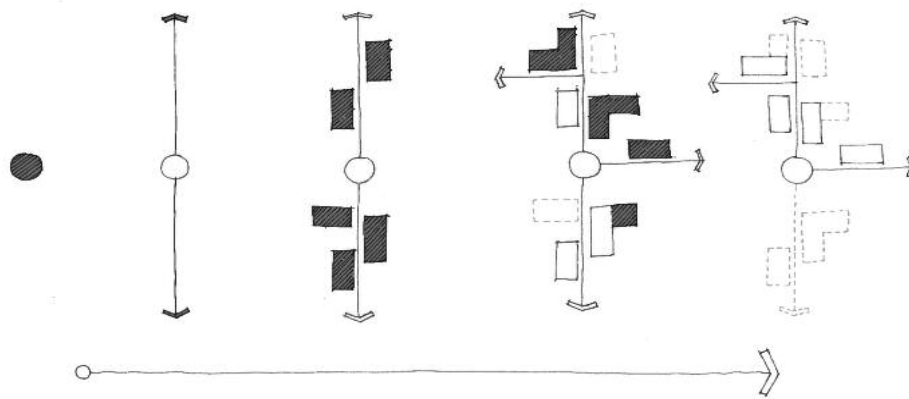


Figure 4. Phased growth of service core to servant spine

that elements can be connected to each other, because their measurements are all based on the same sequence.” (Osman & Herthogs, 2010).

The Hendrickx-Vanwalleghem Design Approach (HVDA) integrates both DfD and “Design for Compatibility” (DfC) into a design strategy based on process analysis and control (Debacker et al., 2006). It presents a set of guidelines to design multiple adaptable and reusable constructional components which are compatible with each other. Thus, these components can be used to design a variety of adaptable and reusable constructional sub-assemblies. The result is a “generating system” where a limited number of basic elements and a set of combination rules allow more complex entities to be “generated”. This method therefore focuses on the life cycle of the building components (Osman & Herthogs, 2010).

Therefore, the proposed structure allows for future adaptations by attaching and fixing standard components to the primary structure. Thus the design is not limited to a specific kit of parts but is rather a structural configuration undergoing constant evolution according to best practice at a particular moment in time. Thus, these components can be used to design a variety of adaptable and reusable constructional sub-assemblies.

The common construction method in the townships is that of the block/brickwork house and the steel clad shacks. The former, mostly constructed through government subsidies, uses wet works construction and typically contributes to the establishment of more permanent settlements. In the more established wards of Mamelodi, this structure is very often manipulated by the land owners with

additions, extensions and alterations. Its counterpart, the ‘Zozo Hut’, is constructed in like fashion and has established itself amongst the informal business enterprises. It is also commonly erected on formal stands and is used as a rentable outbuilding. The Zozo Hut is often seen as a temporary solution to housing due to its ability to be relocated with the user. The existing construction culture gives rise to an opportunity to examine an architecture based on disassembly and re-assembly.

For this project, these two systems are taken into consideration with regards to achieving a degree of permanence with the option of changeability. Thus the criteria for material and construction demands ease of transport, on-site assembly using local labour, self-informing assembly by unskilled labour, labour-intensive operation, piece assembly and erection, skills transfer, low skills operation, economic viability, little or no heavy machinery to be used, limited need for electricity (thus requiring the majority of work to be done by manual labour with no welding). This has led to the consideration of a steel structure with predrilled holes at determined increments to be fixed with nuts and bolts (Figures 5 and 6), assembled on site with the ability to reuse the components upon disassembly, relocation or manipulation of the structure.

Lightweight cold-formed steel sections are ideal as a building material. The advantages are that this form of structure is lightweight, has a high strength-to-weight ratio, high stiffness and comes in various shapes and sections which can allow for additions and alterations with minimal wastage. The material is non-combustible and allows for pre-fabrication of parts, compact packaging and accu-

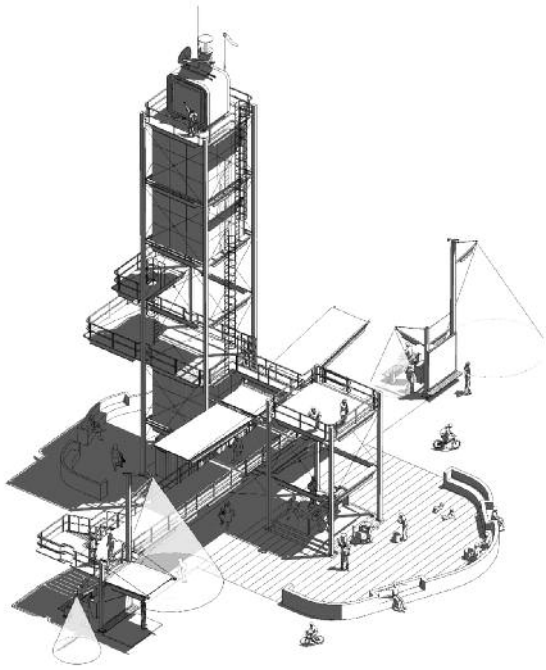
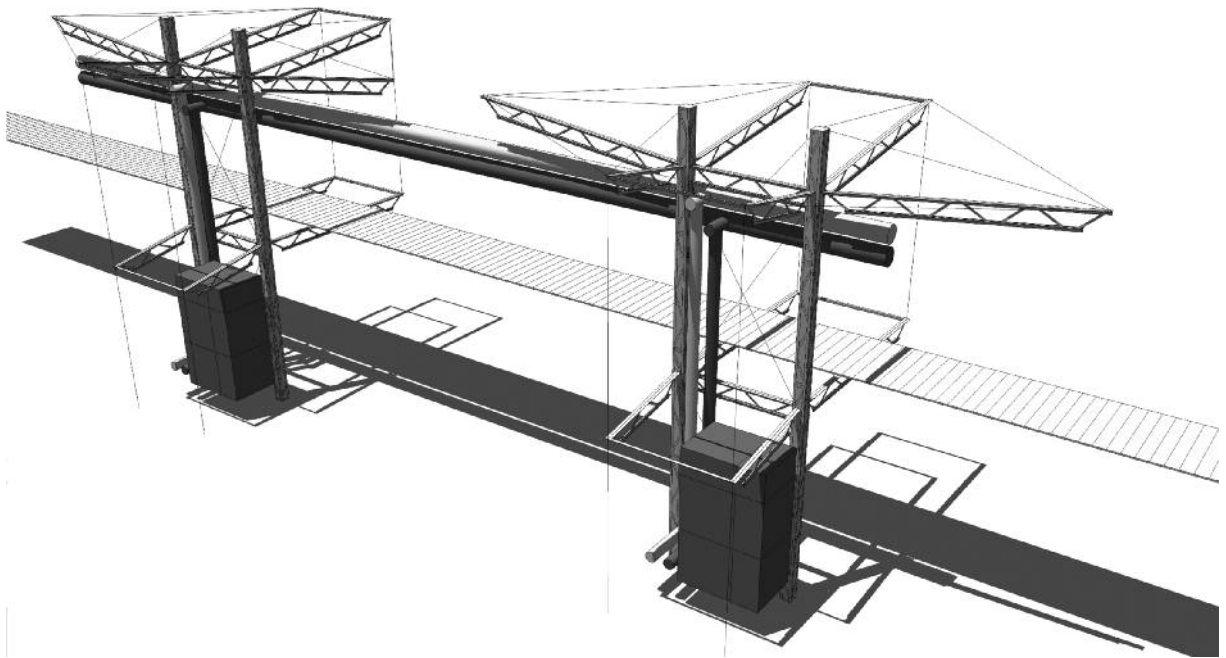


Figure 5&6. Adaptable steel structures composed of modular parts



rate assembly.

Hydraform dry-stacking blocks have the following dimensions 120-240mm long x 220 or 140mm wide x 115mm high with typical strength values of 4-7MPa. This method is considered as infill in this project as these blocks are ideal for remote regions as they are produced on-site by means of a mobile or stationary block-making machine. The interlocking dry-stacking blocks require minimal mortar and are produced from Laterite (building sand/sub soil) and 5-10% cement. Hydraform uses soil cement Compressed Earth Block (CEB) technology. Blocks do not need

to be burnt and need a minimum of 7 days curing. Hydraform equipment is made locally and the franchise provides full training and support. Mobile block making machines need low-skilled operation with little or no dependence on higher skills. Thus it is labour intensive with almost all of the production and construction process occurring on-site. It is thus cost-effective and fast to use.

Finnbuilder box shuttering dimensions are 480 mm (length) x 220, 150 or 110 mm (wall thickness) x 240 mm high and allow for straight as well as circular walls. Finnbuilder is a slip form shuttering system whereby a shuttering mechanism is

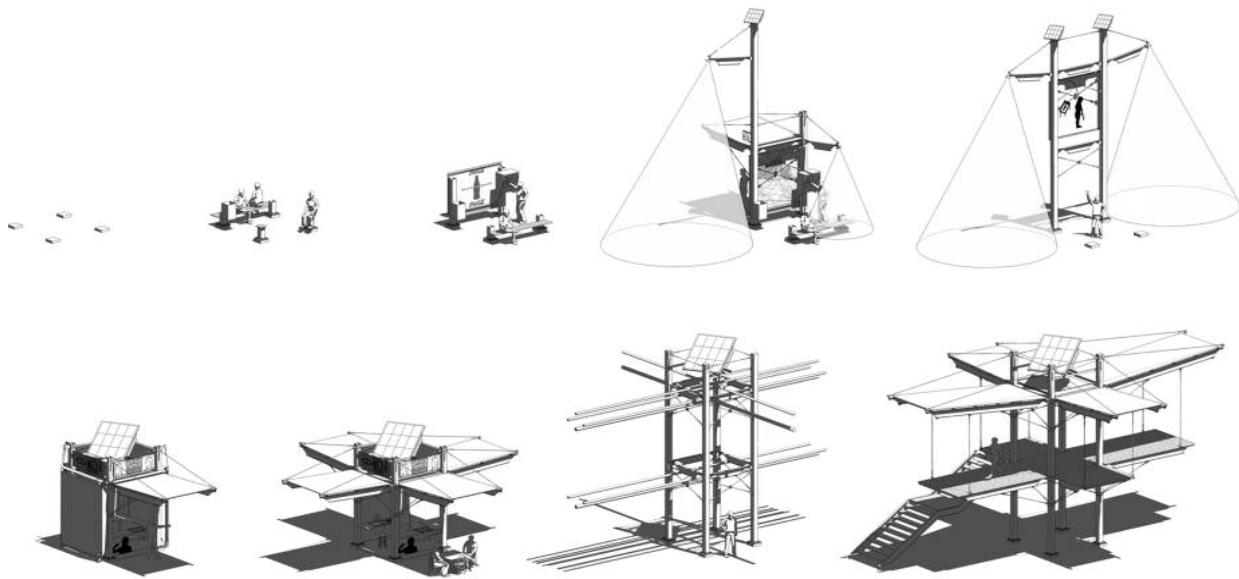


Figure 7. Evolution of modular steel structure

filled with the necessary cement, sand and aggregate mix and upon compaction is slid to the next area along the length or height of the wall/column. The main advantages are that it is produced on site, is labour-intensive, on-site soil may be used, low skills necessary, with the option of skills transfer. This is a low cost-high strength option.

Brownbult is used as roofing or cladding material. The interlocking steel profile together with its clip-fixing requires no fixing holes for screws or nails, thus eliminating the damage incurred to the sheeting by such holes and allowing it to be reused. Produced in widths of 406mm, the lengths are specified by the client and are only limited by transport constraints (usually 18,6 m). Brownbult can be used in conjunction with other sheeting profiles by using the relevant flashings, and it is easy to install.

Abeco hot-dipped galvanised lightweight pressed steel tanks are composed of prefabricated modular panels. These are used to erect the tanks for water storage as they are ideal for remote areas where access is limited. Their small modular size and robustness allows for easy access and undemanding transport. Panel sizes are 1220 mm x 1220 mm or 610 mm x 1220 mm half panels produced in 3 mm, 4.5 mm and 6 mm thicknesses. The maximum depth is restricted to 4 panels (4880 mm). It is planned that panels be painted by local

children and artists helping establish a sense of ownership through community pride so as to deter vandalism as well as aiding in corrosion resistance.

Only 3 types of fasteners, all 8 mm in diameter, are to be used on the steel structure reducing the need for a variety of fasteners and chances of error. These are specified as hot-dipped galvanised, high tensile grade nuts and bolts, easily accessible though fitted with a guard-nut tamper-proof fastening system to prevent vandalism and theft and galvanised gutter bolts.

By these materials, products and technologies, or similar alternatives, as the basis for the building parts, an adaptive system emerges. This system is thus capable of reacting, growing, shrinking and learning. The steel structure undergoes a structural and programmatic evolution (Figure 7), reacting to need and growth intensity. This prevents an initial high capital cost as well as allowing the layout to be tested by the users, who then respond appropriately.

CONCLUSION

For this proposed system to be successful, the community of Phumolong needs to be fully involved from the outset. The strategic site is crucial in establishing a service core as a catalyst, which will trig-

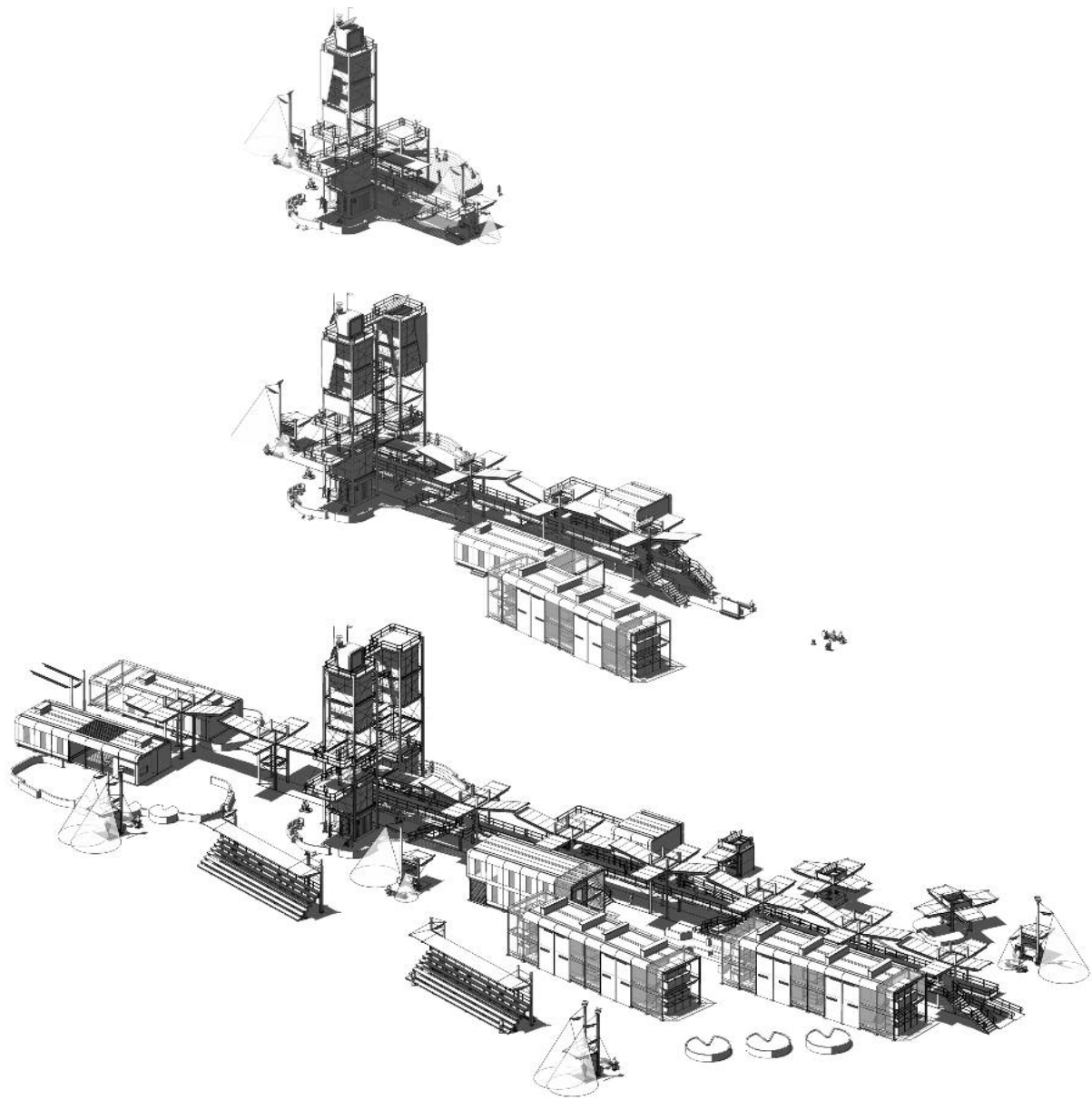


Figure 8. Phased growth of building system

ger off more activity and construction, either attached to the service core or in close proximity to it. By a unique approach to the project and the design conceptualised, it is hoped that there will be a willingness from the public and private sectors to invest in the area. However, as discussed above, the initial project need not be a large, capital-intensive intervention, but rather a seed that inspires and guides an ongoing process. Ultimately, the aim of the servant core is to serve the community by providing the necessary basic services while acting as catalyst for social upliftment. In conclusion, the architectural approach encourages the design intervention to serve as mediator through a process

of change. There is no final product, but rather architecture adapting constantly in response to the demand and energies of the surrounding context and its inhabitants.

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