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Connecting cities across infrastructural divides:

Case studies from self-build practices in Tshwane east

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Abstract

This paper investigates opportunities to connect divided cities by analysing ways in which occupation practices operate alongside, subvert and potentially transform historic, and presently developing urban infrastructure divisions in Tshwane's eastern urban region. Through a critical theory lens, existing and perpetuating conditions of infrastructural segregation are examined in order to understand scenarios through which built environments, as assemblages, maintain conditions of extreme inequality and power. In this respect, urban spatial research projects, analysing formal and informal settlement patterns are presented. The projects form part of an architecture design lead research studio that focuses on discovering alternative scenarios for urban environments by examining existing infrastructure barriers, and unpacking methods for the transformation of segregative systemic forms. Extracts of the projects are presented as case studies with a focus on areas around Mamelodi east and Moreleta Park in rapidly growing parts of Tshwane. These projects demonstrate conditions through which urban divisions of scarcity are established and constructed along infrastructure development zones in the region. They also raise key spatial questions pertaining to inequality and the role of capital investment in its perpetuation.

The second part of the project involves socio-spatial methods of mapping self-build situations occurring alongside hard infrastructure zones in the region. The studies focus on the composition of building fabrics that actively attempt to circumvent issues of scarcity and unequal access to material and social infrastructures. Through the establishment of physical interfaces, people form modes of operation despite extreme resource limitations. The project aims to identify alternative ways of reading territorialised urban infrastructure assemblages by examining critical zones of urban occupation. While the examples expose many of the volatile situations that the urban majority experience on a perpetual basis, the primary aim is to reveal - from the everyday – urban spatial emergence and methods of coding and mapping these emergences towards an adaptive, reparative and transformative approach to divided cities.

Keywords

assemblage; infrastructure space; interfaces; informality; urban networks

1. Background

The Sustainable Development Goals (SDGs) recognise a universal right to basic resources, to water and sanitation, and to safe, resilient, and sustainable cities (United Nations, 2015). Achieving these targets requires new ways of

responding to urban occupation in contexts marked by extreme wealth disparity and unequal access to infrastructure. The challenge of transforming urban environments is complex – not only does it raise key questions about citizenship and the right to the city, but it also highlights the urgent need for infrastructure that facilitates viable livelihoods for vulnerable inhabitants. In facing future city scenarios, in contexts of growing inequality, it is important for urban and architectural designers to examine systemic frameworks through which cities operate as they grow and perpetuate ingrained systems of infrastructural inequality.

These issues are made stark and legible in the many scars and divisions in urban landscapes in South Africa, the most unequal country in the world (World Bank, 2022). For the SDGs to be realised here there needs to be a rapid and substantial shift in how basic services and associated urban infrastructures are conceived and developed, and a re-evaluation of the mechanisms and methods by which people gain access to them. The growing body of research on this topic recognises that urban infrastructure is not simply a set of facile technical devices that control and regulate mechanical, electrical, informational, transportation, and/or other material flows, but rather a systemic network of interfaces that connect (or exclude) people, resources, services, capital and wealth. Thus, urban infrastructures act as assemblages that establish power over, and shape territories of material distribution and equality or inequality (Dovey, 2012, Lawhon et al., 2014; von Schnitzler, 2016; Wafer, 2020).

Colonial, apartheid, and modern planning practices have entrenched patterns of compartmentalization and systems of resource and labour extraction producing tight strictures of exclusion through which people must operate. South African apartheid-era urban development was implemented with specific intentions of racial segregation. This was achieved via tightly controlled land-use regulations and the rollout of built services and social infrastructures in ways that benefited the white minority (von Schnitzler, 2016; Mbembe, 2019; Judin, 2021; Mpofu-Walsh, 2021). Examples of this include regulated provisions for transport, water, electricity, education, work, recreation, and skills development – the legacies of these exclusions are still evident and in cases highly entrenched in the South African landscape. Today, public and private development patterns – both of which follow the dictates of neoliberalism – reinforce unequal urban systems, with built infrastructures continuing to perpetuate poverty and exclusion at multiple scales (Peres, 2015; Maharaj, 2020; Mpofu-Walsh, 2021).

These historic and unfolding territories of infrastructure operate as adaptive assemblages that interconnect through built environment spaces. From a critical theory paradigm, these spaces are understood as devices that maintain power over and facilitate the territorial marginalization of large majorities of inhabitants (Judin, 2021), particularly in cities of the global south. Conditions of control are partly reinforced by crime responses and more generally by systemic aspirations for exclusive and consumptive urban lifestyles. Formalised urban environments are structured to maximise barriers, surveillance, and private policing while not disrupting the circulation of material market economy consumables. In this respect, capital moves freely through infrastructures of freight warehousing, distribution, and ‘lifestyle’ offerings often segregated alongside conditions of extreme poverty, infrastructural decay, and violence.

The aim of the study is to identify methods of representation and coding of socio-spatial occupation scenarios that reveal potentialities for the transformation of divisive structures. Material separations between inhabitants of the Tshwane east region are analysed both in terms of characteristics and in terms of potentialities – that is by the relationships that exist between material and human urban assemblages and the opportunities that these relationalities present (Simone, 2004; Du Plessis, 2012; De Landa, 2016). Scenarios for the rescripting of infrastructure development strategies are identified through the observational drawing and documentation of existing occupations in marginalised spaces. Challenges are articulated alongside innovative modes of practice in the face of extreme resource scarcity. The reading of urban infrastructure from an adaptive territorial perspective helps us think about alternative modes of material and resource exchange. It demonstrates existing and emergent scenarios at play in our built environments operating through urban junctions at multiple scales over time.

The approach to scale follows the ontological positions set out by De Landa (2016) – micro-urban form emerges at the individual scale of people and the interactions they share with the material worlds surrounding them. The mezzo scale operates beyond the neighbourhood as regional territories, and in this investigation, the macro scale is set as

the whole urban form and its broader territorial network. This multiscale approach enables the visualisation of 'thick descriptions' as identified by van Aswegen (2021) which provide a qualitative lens through which the mapping processes are developed and articulated. It also helps us think about our infrastructure as both hard and soft, and as complex, adaptive assemblages. From a socio-spatial perspective, formal and informal material worlds are seen to operate through interfaces that can enable or disable dialogue and exchange. The distinction between the formal and the informal is developed after Dovey (2012) who acknowledges the complex spectrum that exists between these two terms and recognises that they generally operate in tandem as part of social structures and built environments where the formal and informal operate in a kind of symbiosis. Informal in the context of this paper is used to describe built environments that fall outside of formal building approval processes, that are generally made from the adjoining of Adhoc components and materials to fulfill basic built environment needs or opportunities. It is important to note here, that while the distinction between formal and informal is made in this paper, we recognise more generally the association of the informal building sectors with greater assemblages of other formal and informal processes.

Given the rapid population growth and densification expected in the Tshwane East region alongside historic and perpetuating conditions of urban inequality, it is important to consider the latent potentials at play between formal and informal, and static and kinetic actors within our built environments, to reconfigure existing boundaries of segregation as productive and sustainable sites for human habitation.

2. Theoretical Framework & Methodology

1. Assemblage Theory

The methodology is built from an assemblage perspective by examining the spaces between urban objects as a study of dispositions (Till, 2009), territories, and potentialities (De Landa, 2016). This approach facilitates an understanding of urban fabrics from the perspective of its spaces, seen as the gaps between urban actors and objects. In this way, the fields of architecture and urbanism can borrow and build on the pedagogy posited by Mushakavanhu in 'Reading Zimbabwe':

> How do we engage with archives as sites of erasure, how do we archive gaps and how can we translate these experiences in the form of critical knowledge production? (Mushakavanhu, 2021)

When considered in relation to urban landscapes, these questions challenge us to develop both new methods for mapping and understanding divisive infrastructures and new frameworks for repairing damaged cities. They also underscore the need to access and prioritise knowledge systems emerging out of informality and to consider how these might impact built environments. New urban arrangements emerge at multiple scales from both informally and formally developed built environments. To better understand this Pieterse (2009) after Long (2001) propose a method of reading and mapping that considers the urban occupant's 'lifeworld', which includes the various urban systems and built environment interfaces that people engage with in their everyday lives. Processes of observational drawing and mapping examine socio-spatial urban patterns of relation which reveals soft infrastructure scenarios. This approach informs the understanding of relationships between urban assemblages which serve as case studies. The case studies function as socio-spatial lenses that help us to understand emergent characteristics as well as territorialisation tendencies at play in Tshwane East..

The socio-spatial network and lifeworld mapping techniques are analysed through a structured assessment of conditions of territory and relationality (De Landa, 2016) and acknowledge limitations at play in terms of occupation tenure (Simone, 2004). The analysis aims to highlight emergent networks and built environment systems that are operating as workarounds to infrastructural exclusions. Understood from the perspective of Dovey & Ristic (2017) the drawing or mapping process involves interpretations and perspectives of the worlds around us. Maps represent aspects of existing space but also involve numerous biases in their coding of types and classifications, virtual characteristics, and in some cases, future scenarios. In this respect, maps are seen as forms of representation that present aspects of physical, perceived, and conceived worlds. Maps reveal points of novel intersection and

provide opportunities for the connection of seemingly separate urban forms, but they can also reinforce conditions of segregation and inequality.

An assemblage perspective involves a reading of urban environments as conglomerates of heterogeneous material and social parts operating as relational systems. The term is a translation from the French word agencement used by Deleuze & Guattari (1987) to describe the arrangements of social and material realities. This perspective facilitates the identification of conditions of relationships and territories which De Landa (2016) expands on by emphasising the significance of potentialities that exist within such assemblages. By analysing the various scenarios that are possible within a system and exploring ways of mapping and coding these relationalities and potentialities, we identify opportunities that may enable and transform segregated urban assemblages and territories.

2. Infrastructure Space & Life World Mapping

The concept of infrastructure space is understood from the perspectives of Easterling (2016) who argues that built-environment services operate as systemic entities through complex networks of spatial composition and connection. Viewed from this perspective we recognise that infrastructure systems function to regulate the flows of materials, resources, people, and ultimately wealth, capital, and power. It is important to note here that the infrastructural means and interfaces by which people are able to communicate and connect, access services, move around, maintain themselves, and generally operate viable livelihoods are often nested within macro systems and devices of political and economic surveillance and/or control. In this respect, they can be understood as operating systems that regulate power and wealth structures. Wafer offers a useful interpretation:

> Infrastructures include a complex network of material and institutional structures that underpins the functioning (and dysfunctioning) of modern cities. To the extent that infrastructures are understood as complex networks, they are also therefore implicated into systems of power and politics ... [they] coordinate, connect and distribute people, commodities, capital, and resources. (2020: 86)

Building on this concept, Easterling (2021) emphasises the importance of understanding architecture as suspended in thick, lumpy, material mediums and scenarios of operation. A useful distinction to make here is the relationship between ‘hard’ and ‘soft’ infrastructure as described by Winning (2010) and Matsipa (2017) – that is the physical services (hard elements) that operate through softer human and non-human interfaces and networks. In the same way that software facilitates interactions between components in a computer and hardware represents the electronic fabric of the device, we can think of our cities as a product of both the hard-built environments suspended in and operationalised through softer networks including social norms, customs, laws, relationships, politics, power structures, energy supplies, exchange contracts, etc. By thinking of the spaces that enable or exclude social or exchange arrangements we develop a view to uncover potentialities for recoding segregated worlds. Seen from this perspective we take a reading of space as a principal regulator of urban networks, often nested within territories of surveillance and power. Through the operating potential of space Easterling (2016) proposes a ‘hacking’ or infiltrating and subverting of the devices of power that can potentially reconfigure the internal operations of segregated city forms.

Building on the process of lifeworld representation, Casakin & Valera (2020) pair occupation patterns with actor networks to understand public space complexity through studies of relationality. The understanding of this relationality means that we can think about designing beyond objects, Till (2009) unpacks this by interrogating approaches to design that recognise the interdependencies of materials and making processes and the implications of time and disposition. Part of this argument means that we think about ways in which we adapt and reuse existing built environments, how we inhabit infrastructures and spaces in transformative regenerative ways (Du Plessis, 2012), and what the worlds we make today will enable in the future. As a means of accessing this, Frichot (2019) draws on ideas of gleaning, collecting, gathering, and quilting, Bhan (2019) makes an argument for occupying and repairing urban divide and Mehrotra & Vera (2018) recognises the synergy between static forms and kinetic actors as socio-spatial change enablers.

3. South Africa and Tshwane context: Historic and Perpetuating Inequalities

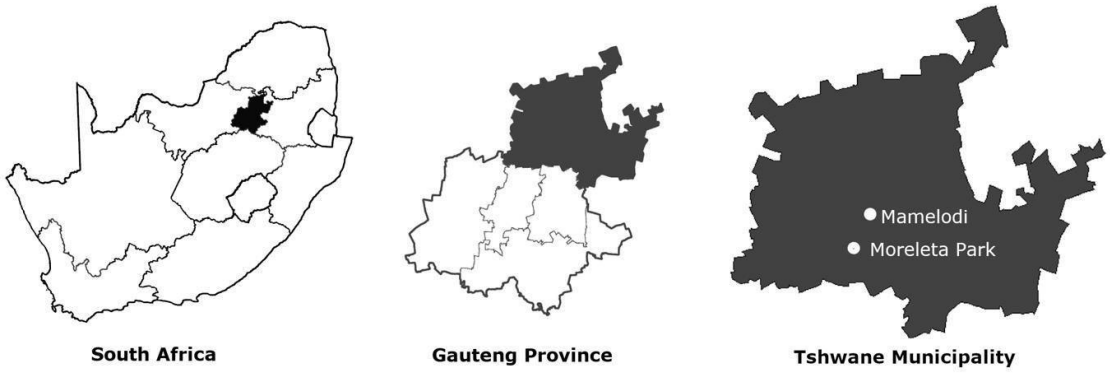

Figure 1. Maps showing location of case studies in South Africa, Gauteng and Tshwane contexts

The methods and themes identified from the theoretical framework above are used in the contextual analysis to better understand patterns of spatial emergence in highly segregated contexts. The case studies include self-build urban occupations in formally developed areas in Tshwane east. This region makes up the northern portion of the Gauteng province in South Africa and adjoins various other urbanised zones that make up the greater Gauteng city region (GCR) assemblage. As a seat of fiscal and national governance and as part of the largest urban economy in South Africa, the GCR exhibits significant capital investment alongside extreme spatial segregations and inequalities both historic and perpetuating (Ballard, et. al., 2021).

The specific case studies focus on two mezzo-scale settlements in Tshwane East (see Figure 1.). Case studies 1 and 2 are based in Moreleta Park and explore issues of informality, urban spatial emergence, constructed scarcity, and material assemblages. This area was designated under apartheid for low-density exclusive white occupation with existing black residences displaced. In its present-day Moreleta Park's development patterns are highly segregated and compartmentalised, with a number of established gated residential and commercial developments alongside informal self-build settlements. The second set of studies are located in Mamelodi and focus on social and recreational infrastructure. Mamelodi was established in 1945 and designated for the resettlement of displaced black persons under apartheid. Both areas exhibit characteristics of informal occupation and self-build adaptations alongside formal infrastructure segregations. The analysis of conditions of segregation and accessibility in these two historically distinct regions allows for a broader sampling of conditions through which infrastructural segregation perpetuates and provides varied insights into ways in which infrastructural interfaces are established, occupied, and potentially transformed.

3.1. Urban Infrastructure Segregations Under apartheid

Prior to apartheid, segregation was already common in South Africa – racial separation, settlement control and urban compartmentalisation characterised colonial occupation as seen in examples of legislation such as in the Natives Land Act of 1913. In this example we can see how the state sought to establish power and control over mining and agricultural capital in South Africa, by reserving the right to rent or own strategically located land to the white population. In addition, the act spatially secured exploitative access to black labour to support the production of capital at a much larger scale (Philip, 2014).

In 1948, South Africa saw the election of the Nationalist Party into government, whereby apartheid was formalised on an institutional level. The party's strong "religio-political" Afrikaner nationalist agenda, which sought to further secure the interests of the white minority in relation to land rights, was evident in the urban policies that followed (Janse van Rensburg, 2009). Apartheid-era built infrastructures adhered to a vision of racial segregation that was established under colonial rule but sought to formalise and further entrench aspects of this segregation in law, urban and regional settlement forms, and in labour and industry. Urban development in this period was characterised by strict regulation of land occupancy and use as well as by intentional decisions about the development of service infrastructure (transport, water, electrical, waste, data, etc.) and social infrastructure (courts, banks, education, health, recreation, etc.) (von Schnitzler, 2016; Mbembe, 2019; Judin, 2021; Mpofu-Walsh, 2021).

The apartheid city served not only as a place of racial and class segregation but also as a complex engine for promulgating labour exploitation and wealth extraction. Its carefully planned infrastructure served as a vehicle for entrenching white supremacy in all aspects of life. At the micro and mezzo urban scales, 'the Group Areas Act of 1951' saw the demolition of many neighbourhoods; the forced relocation of people based on racial, ethnic, and class segregation; and the establishment of infrastructural boundaries, with severe restrictions on the movement of non-white persons and on their access to resources, transportation and land tenure (Maharaj, 2020; Judin, 2021). At the macro scale, 'the Black Homelands Citizenship Act of 1970' included the formalisation of Bantustans as an attempt to denationalise black citizens from the country and enforce control over interregional movement.

3.2. Perpetuations of segregation after apartheid

The post-apartheid city continues to perpetuate unequal access to infrastructure. Formal urban development has tended to prioritise compartmentalised, privately managed, and serviced enclaves. Extractive industries operate under corporate industry ownership and social infrastructure such as healthcare, security, schooling, communication, etc. is frequently accessed privately by the wealthy. In the transition into democracy, we have seen racial segregation evolve into wealth-based infrastructural exclusion, though the latter continues to reflect historical racial divisions (Mpofu-Walsh, 2021).

Rapid urbanisation without adequate industrial growth and an existing infrastructural deficit is the dominant condition subjected to most post-colonial African cities, resulting in high unemployment and poverty (Pieterse, 2011). Despite displaying an inefficient urban form, Tshwane boasts a comparatively lower unemployment rate and a higher GDP per capita than the South African average (UN-Habitat, 2020). This is a major pull for economically strained citizens of peripheral rural areas, neighbouring provinces, and SADC countries such as Zimbabwe and Lesotho. However, the city faces high levels of inequality, represented by a high Gini coefficient (Gauteng Provincial Government, 2021). Levels of multidimensional poverty have seen an increase in peripheral areas (former black homelands), with affluence and capital investment projects remaining largely concentrated in previously advantaged white areas, on the opposite end of the city (Katumba et. al., 2019).

The combination of inaccessible private spaces and rapid population growth has however also resulted in the emergence of informal economy-based self-build settlements. As city regions such as Tshwane east expand and adjoin one another in the GCR it is notable that despite limited formal land tenure and poverty, these self-build settlements have established and continue forming alongside and in between capital investment areas in highly unequal spatial arrangement patterns. According to Maharaj (2020), self-build settlements in South Africa have tended to establish near inner-city areas, on the edges of former white suburbs, and growing alongside affluent development zones. Considering current legislative efforts such as the Spatial Planning and Land Use Management Act of 2013 (SPLUMA) a shift has occurred regarding the legal redressing of urban inequality and the protection of occupants of these settlements (Joscelyne, 2015). Despite this, Tshwane remains a deeply divided "dual city" with policy implementation limited in the face of continued uneven development served by the labour of inhabitants from marginalised areas (Horn, 2020; Peberdy, 2017).

A firm correlation has been drawn between the insecurity induced by segregation and scarcity, racial tension, and the subsequent socio-spatial division that prevails in South African cities. Similar conditions of segregation are

analysed in five other divided cities by Calame & Charlesworth (2012) - their analysis focuses on tendencies and patterns of spatial divisions, and the ways in which such divisions form and adapt in efforts to control issues of insecurity through segregation changes over time. From this, standard pattern codes emerge and assist in the reading of processes of reorganisation and compartmentalisation evident in a segregated urban context as illustrated in Figure 2 (Katranas, 2021 after Calame & Charlesworth, 2021). As a prerequisite for real spatial healing and reparation of the injustices of colonialism and apartheid, it is important to acknowledge the significance of socio-political territories as well as processes of deterritorialisation and reterritorialisation.

To design integrated cities, the perspectives of an emerging, marginalised, urban majority should be considered to address social, economic, and geographic exclusion (Harvey, 2007; Pieterse, 2011). The following section considers relationships between informal and formal built environments in order to understand the emergence of socio-spatial patterns from the perspective of everyday lived experiences.

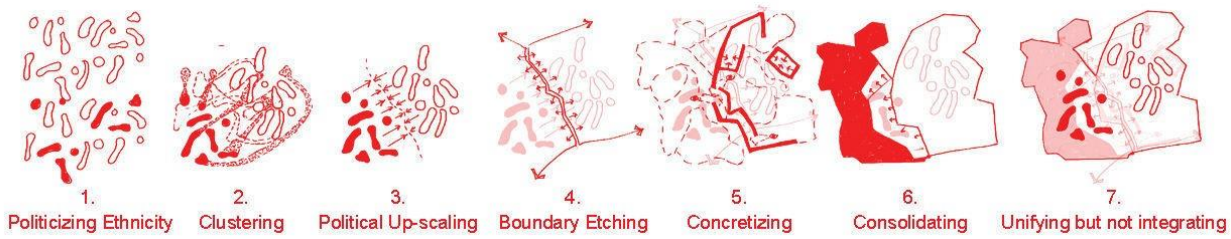

Figure 2. Segregated spatial patterns and scenarios of change over time

4. Moreleta Park and Plastic View

4.1. Urban fabric on an inter-neighbourhood scale, the emergence self-build settlements alongside gated communities in Moreleta Park

As the pace of local urbanisation intensifies in South Africa, the continual emergence of self-build urban settlements in areas of commercial and residential development will too (Neuwirth, 2008). Mehrotra & Vera (2018) maintain that spontaneous kinetic currents supersede and evade the norms of the static formal city, increasing their presence and effect as urbanisation intensifies. Reluctance to recognise and negotiate this inevitable kinetic urban future can result in an even more volatile urban landscape that further endorses exclusion.

Moreleta Park is analysed through this lens as a product of rapid sprawl since the early 1990s (Landman, 2004), the area is made up of a residential assemblage of gated communities and shopping centres on ecologically valuable land. Moreleta Park most evidently displays the many negative effects of sprawl on the urban environment - this suburban archipelago enforces further exclusion through rampart boundary conditions without planning for a spatially just urban future (Soja, 2010). The area also lacks the sensibility of scale and organisation necessary to secure resilience in its morphology (Peres, 2015; Katranas, 2021) - characteristic of a ‘floating city’ (Salat et al., 2011), large shopping malls and centralised amenities dominate the landscape yet remain monofunctional as static change averse urban islands.

Empty pockets of land (aiding in the increasing emergence of self-build settlements) create barriers between isolated developments and the only planned attempt at stitching these suburban islands together exists in the form of wide roadways (City of Tshwane, 2018). Solomon Mahlangu Drive is an important anchor in this respect; where urban sprawl and urbanisation meet; and where a number of self-build settlements, such as Plastic View, are identified in leftover spaces between developments and along urban infrastructure servitudes. The reasons behind the emergence of self-build settlements along this spine are a combination of inherited issues and situational influences. The exclusionary landscape of Moreleta Park is also characterised by a number of residual areas occurring between development, these spaces are classed as SLOAP (Spaces Left Over After Planning) and can be viewed as a hyper-densified trope of South Africa’s tense suburban state – and its possible future (Creswell, 2013).

SLOAP can also be associated with Junkspace (Koolhaas, 2014) which includes, conceptually, the disjunction of modern planning approaches where multiple ideas and agendas are often compartmentalised and their junctions left unresolved. SLOAP tends to be situated between up-market housing developments and malls, creating a perfect niche of opportunity for spontaneous settlers to build a livelihood (Du Plessis & Peres, 2013). As informal currents often do, these in-between spaces address a need for affordable living spaces close to work opportunities, in reaction to non-provisions thereof. As Soja (2010) argues, from these far-reaching implications one can affirm that justice or, for that matter, injustice is inextricably bound to a consequential geography.

Case study 1 includes the cataloguing of 18 new spontaneous urban settlements in the region (see Figure 3). In line with urbanisation trends traced in Gauteng, at least ninety other spontaneous settlements have emerged in Pretoria over the last five years (Du Plessis & Peres, 2013). The mapping process shown here forms part of a socio-spatial lexicon of patterns of development of emergent self-build settlements and are descriptive of soft and hard infrastructure interactions and entanglements. Through the cataloguing and coding of various individual socio-spatial attributes of the spontaneous urban settlements selected in the analysis, eight shared characteristics have been revealed as shown. These characteristics range from patterns of emergence to settlement configurations and when understood together, this list has the ability to determine the location probability of future spontaneous settlements. The record of attributes has proven applicable to countless other existing self-build settlements, tracked with a variety of GIS programming, all over South Africa. Since a kinetic neighbourhood located within a static suburb isn't an anomaly bound to Moreleta Park, the possibility of a prototypical architectural response to the urban and architectural issues, is revealed.

4.2. The Microscale of Emergent Self-Build Settlements

Despite policy reform during the post-apartheid period lingering social constructs prevent the active dismantling of divisive urban forms. Informal settlements are regarded as obstacles to be removed by formal development actors. Plastic View, identified in the previous section as a self-build settlement of Moreleta Park, is emblematic of this broader issue of continued exclusions and stands as a densified narrative of the post-apartheid South African urban condition. The reluctance of the Moreleta Park community and of practitioners to recognise and engage with the formalised settlement of Plastic View is emblematic of a broader reluctance to negotiate with this kinetic mode of urbanism (Mehrotra & Vera 2018).

The non-recognition of the permanence of Plastic View is further demonstrated by an open letter sent on the 14th of May 2021 to the Mayor of the City of Tshwane, Randall Williams, and other recipients. In this letter the Community Caring Forum (2021) reminds its readers of the seventeen court orders against Plastic View, leading up to a list of requests including "the removal and deportation of all undocumented occupants" and "the breaking down of the shacks to prohibit expansion at all costs" (Community Caring Forum 2021: 6).

Case study 2 aims to reveal the social spatial value of such self-build housing settlements and scenarios through which basic livelihood infrastructure is achieved despite very limited resources and basic rights. Figure 4 details a planned view of building fabrics and a scenario of typical use for a portion of Plastic View. The plan reveals characteristics of street interfaces with individual housing units defining the rhythm of street setbacks and entrances. Centrally located is a creche and 2 shops, a tavern, and community office that demarcate other edges of this communal area, and the play area and sports field are also situated within surveillance range of these shared, more public facilities.

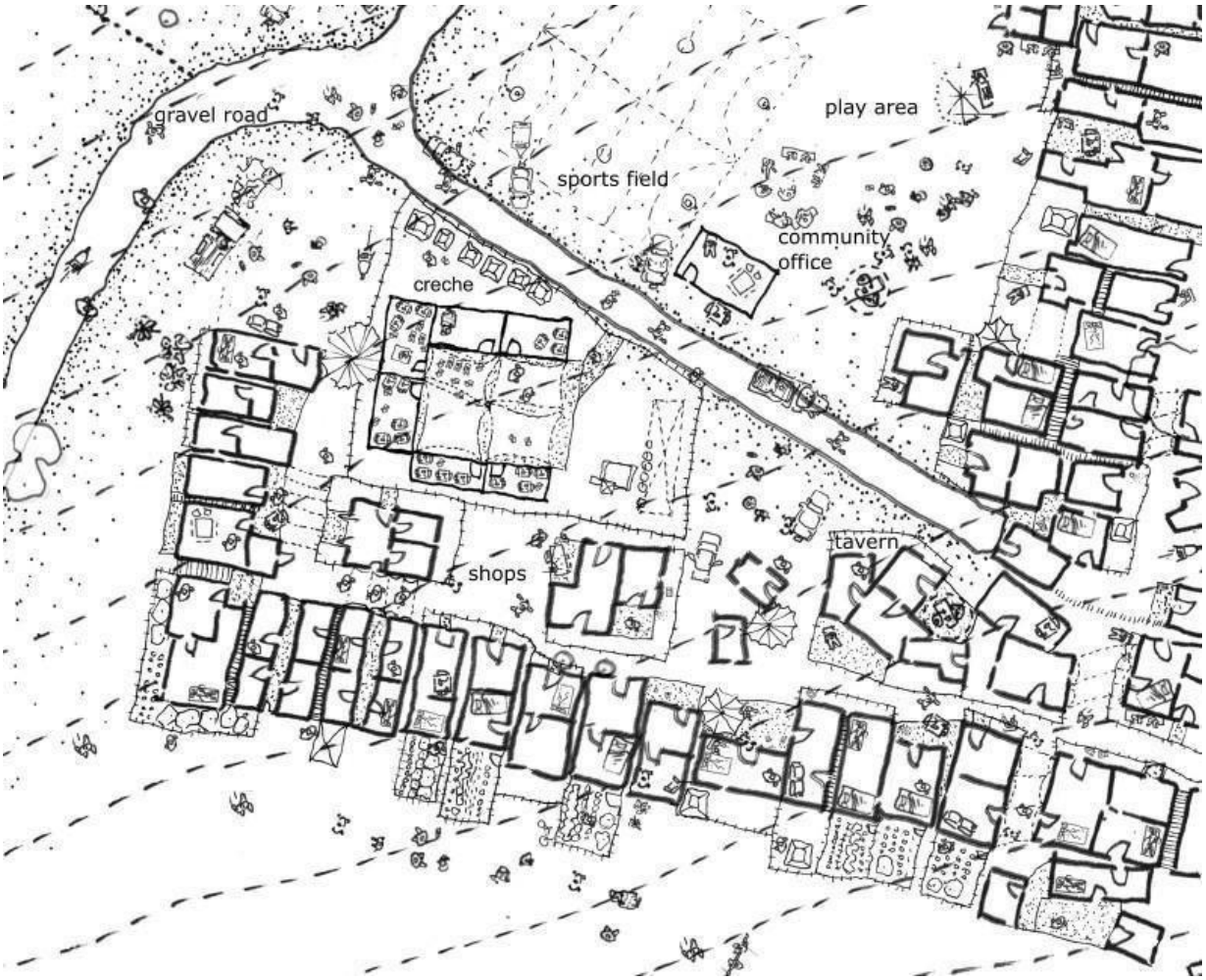

Figure 4. Occupancy plan of an area of Plastic View showing a scenario of Sunday morning activities and street interfaces (Katranas, 2021)

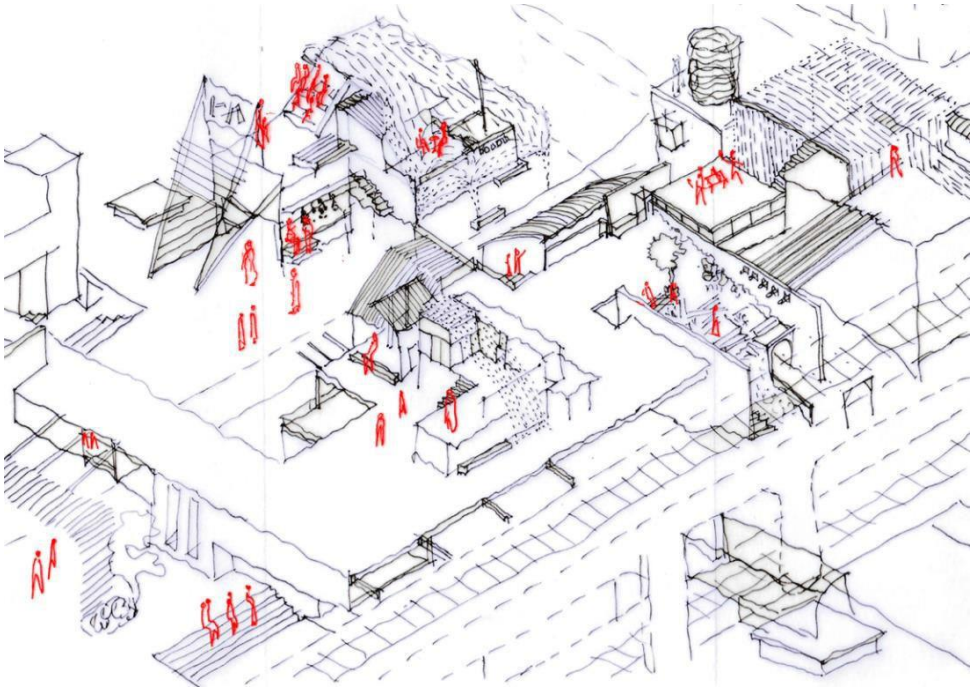

Figure 5. Illustration of design iterations exploring the connection of divisive urban infrastructure - hypothetical future scenarios based on field observations of building practices in Plastic View (Katranas, 2021)

Through the assemblage of self-built spaces, a marginalised community has established a number of interconnected social and economic infrastructures that operationalise a mutual support in the face of extreme conditions of scarcity and exclusion. Figure 5 builds on this and presents a speculative axonometric drawing considering scenarios of formalisation of the kinds of interfaces that are observed in Plastic View. This exercise functions as a speculative mapping process that allows us to consider developmental scenarios for transforming infrastructural divides in informal self-build settlements as productive and effective forms of housing and livelihood infrastructures. Case studies 1 and 2 reveal the emergence of urban processes at the mezzo and micro scales where people are operating through self-made and adaptive urban assemblages despite extreme resource limitations and poverty. Moreleta Park is in this respect a context possessive of both the challenges and opportunities through which the future city can be postulated; where within a 3km^2 area, infrastructural deficit meets excess. In the interrogation of these issues Kriek (2021) explores opportunities for repairing urban divisions, noting the urgent need for the static city to incorporate adaptive characteristics of kinetic occurrences in establishing urban resilience.

5. Social Infrastructure Interfaces in Mamelodi East

During the peak of apartheid, a number of displaced black populations were relocated to Mamelodi from the 1950s through to the late 1970s (Breed, 2012). Infrastructure development implemented during the period focused on the construction of housing, the regulation of transportation, and the limitation of access routes to 'white' areas of the city (Strauss, 2019). Here the scarcity of public open space and social infrastructure can be understood as a direct legacy of apartheid planning and as a means to control the gathering potential of non-white groups during the time (City of Tshwane, 2005). In the post-apartheid period, the housing shortfall in townships has seen a focus on subsidised state housing; the resultant limited focus on non-housing services has led to a lack of maintenance or development of public open spaces and recreation facilities (McConnachie & Shackleton, 2010; Denoon-Stevens & Ramaila, 2018). Where state or NGO-developed social infrastructures have been implemented they often stand as monofunctional giants following the established segregated grain of the region, disconnected from community dynamics. Therefore, as a response, many social infrastructures and services are developed through informal economy sectors and community organisations (Urban Studio, 2020). This spontaneous dynamism often relies on taking inspiration from existing elements (directly linked to services or not) and bringing alterations, additions, different uses, activities, and meanings to objects and spaces to satisfy communal needs (Demba, 2021).

Case study 3 builds on the theme of kinetic potential (see Figure 6) and illustrates on an interpersonal scale, the socio-spatial scenarios and networks observed along a stormwater and access servitude in Mamelodi. Here Demba (2021) examines the accessibility of social infrastructure as well as methods by which people build alternative socio-spatial networks, nodes, and routes to facilitate the operations of their daily lives. These ad hoc inventive means are developed through informal economies, and community organisations (De Beer et al., 2020). Examples of social and recreational activities are observed as part of informal infrastructures of trade, gathering, playing, maintaining, exercising, etc., spatial material interventions are adaptive and straightforward in fulfilling needs and are developed through social practice. The occurrence of these activities along a stormwater channel can be attributed to the open space that it maintains which makes it a viable movement route. An important observation in this respect is the common space that these various activities share, this is part of the reason that recreational spaces are considered as they pair human practices with human needs to foster hybrid scenarios catering to social needs. Here, one can draw comparisons to the above scenarios in Moreleta Park where formal infrastructures are considered static elements while the informal and community-based activities represent the kinetic part of the township; where the varied collective actions, patterns of occupation, and the links established between them create systems capable of participating in the sustainable development of future urban schemes if understood correctly and contextually (Demba, 2021; Katranas, 2021; Kriek, 2021).

Just as Pieterse (2009) after Simone (2004) considers the important role that people play in providing infrastructure as collectives to benefit communities in developing contexts of cities of the global south, the study of everyday street interfaces and occupations aims to find ground-up solutions capable of reconciling and reintegrating isolated

or underused infrastructures. By recognising all the many human and non-human actors that make up the public realm as an assemblage, we establish new meanings and opportunities for the rescripting of divided spaces.

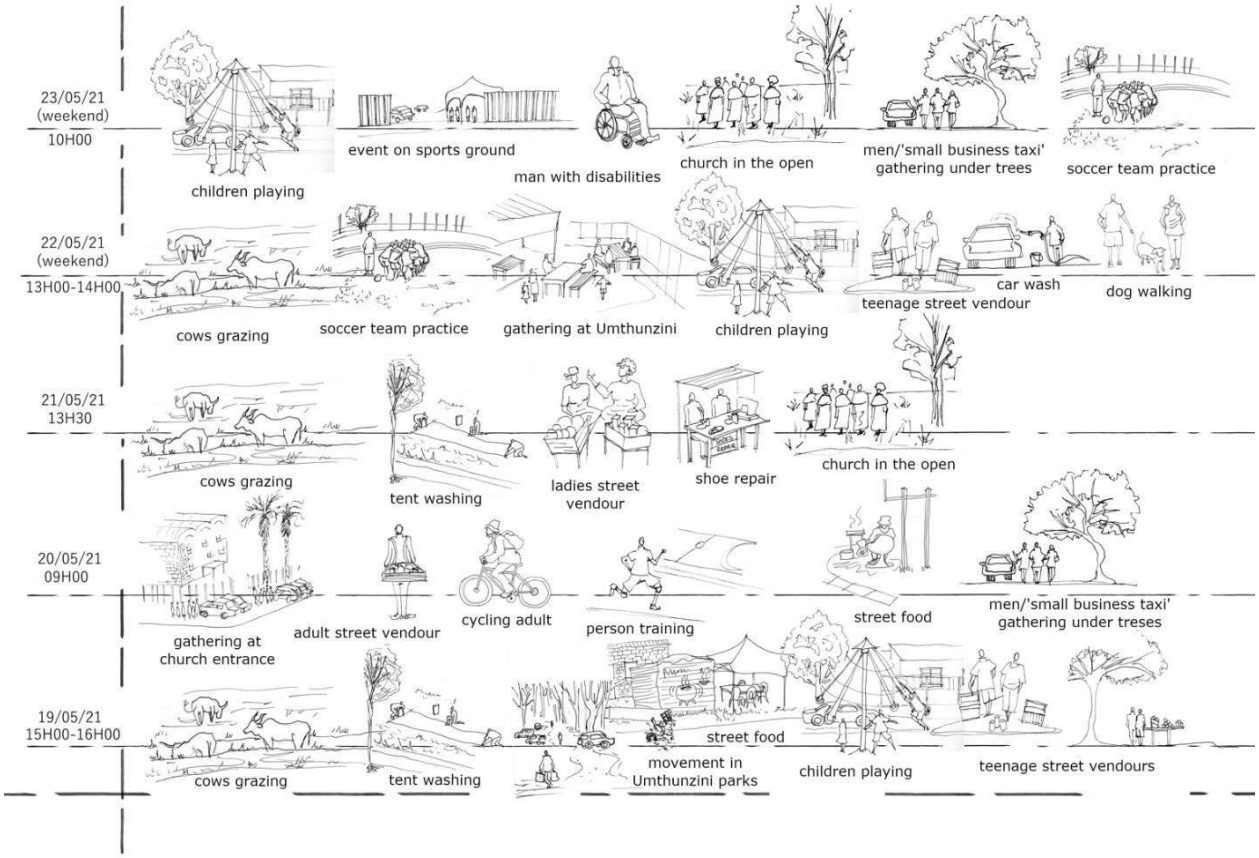

Figure 6. Activity mapping along open space network in Mamelodi east (Demba, 2021)

6. Outcomes and Conclusion

Through a process of life-world observations of urban occupations, the case studies attempt to reveal systems of socio-spatial networks and assess their operating potential in relation to infrastructural exclusions and needs. The case studies present a broad sample of ways in which urban infrastructures emerge through socio-spatial arrangements in Tshwane east – often operating to circumvent conditions of extreme inequality, scarcity, and exclusion.

Of particular interest is the observation of the concurrent evolution of informal self-build settlements alongside gated communities. Here conditions of territorialisation are seen to agglomerate around capital investment zones and projects. Both formal and informal built environments coevolve through processes of fortification, exclusions, and compartmental occupation. The relationality between occupants of informal economies and those of more formal areas is seen to overlap in many instances, people living in one sector may find themselves working or operating in another. In line with this idea, the contextual analysis reveals the inevitability of the coexistence of formal and informal residential settlements and economies in the region. Through a study of patterns of the assemblage of self-build settlements, the case study also reveals socio-economic relationality - an example of this is the emergence of settlements in congruity with building construction sites as a result of job opportunities. An important question that arises here is what role the funders of capital investment infrastructure projects play in the transformation or perpetuation of conditions of major urban inequality. Built environment projects are always a product of a collaboration between designers, builders, makers, and other stakeholders, and they always operate through relational flows within their contexts. By recognising and affirming these collaborations and partnerships

we can potentially transform the way we make our worlds. In facing the urgent need to redress issues of urban inequality it is imperative that built environment practitioners explore scenarios for the establishment of shared access to basic resources and acknowledge the inevitable coexistence of the static and kinetic, and the formal and informal forces that shape our cities.

By illustrating spatial settlement practices alongside divisive urban infrastructures the project identifies key occurrences in Tshwane that are attempting a repair and recalibration of divisive infrastructure. South Africa's urban fabric is constituted of vast networks of civil systems, stormwater services, roadways, parks, servitudes, railways and other publicly owned property. By examining scenarios that challenge infrastructural exclusion this project identifies and tests opportunities for reconceptualising urban forms to reimagine them as shared common elements that have multiple sides and potential functions that can connect rather than divide. The future development of Tshwane and possibly other regions of Gauteng can evolve by fully revealing, representing, analysing, and understanding the variables and relationships that make up the public realm.

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