VISUAL ASSESSMENT AS A RESEARCH TOOL FOR SOLVING SPATIAL PROBLEMS IN KHUTSONG SECTION INFORMAL SETTLEMENT

by Mbongiseni Emmanuel Nathi Nkambule
(23106876)

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Study Leader: Professor Karel A. Bakker
Co-Study Leader: Professor Roger C. Fisher

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GLOSSARY OF TERMS

**The following terms and phrases used
in this study are understood as follows:**

Acupuncture design: the design of spaces and forms with a considered deliberation of how they are integrated in and respond to a specific site in a manner that stimulates a chain-like effect of developmental activities.

Ad hoc: decisions and actions taken based on current conditions and urgent needs. Hence, adhocracy is a system of organising and governing society using an ad hoc style or philosophy.

African: a term used to refer to a people of African descent as well as the cultural practices, built environments, artefacts and intellectual properties related to them.

African space: a built environment created by African people or expressing an African motif in its physical manifestation.

Age of Access: refers to a period in human history whereby the economy depends on the availability, quantity, quality and accessibility of information and the information and communication technologies.

Agglomeration: the act of forming human relationships, friendships and community ties in urban areas, which often leads to socio-economic development.

Aggregation: the process by which people form social networks and establish means of circulating information, goods and services with the aim of creating a livelihood.

Archigram: a group founded by architect Peter Cook, formed in the 1960s and joined by avant-garde architects of the Architectural Association in London.

Architectural design: the spatial and structural planning, design and creation of architectural space and form through the formalised design alignment of the built form.

Cluster: a group of buildings arranged closely together.

Coherence: the perception of visual order in urban forms and spaces.

Collaborative design: the application of skills and site integration and interventions created through collaborative design processes to reflect cross-disciplinary design interpretations.

Community: the collective way of living of a group of people which balances the individual attributes and philosophy of each group member and the shared values that facilitate the survival and growth of the group.

Community engagement: the process by which community leaders, community members and other relevant stakeholders utilise means of communication so as to collaborate and co-operate for the purpose of applying a collective vision for the development of a community.

Complexity: the quality of a place that evokes visual richness as a result of the diversity and variety of urban physical elements and forms.

Complex system: a network consisting of numerous varied and self-sufficient but interdependent and interrelated components joined through many interconnections.

Consolidated design: a design solution which results from combining the positive aspects of a range of design solutions.

Context specific: architectural work generated from a broader understanding of relevant historic and contemporary practices, activities, cultural identity, economic standing, precedents, physical site and other related design informants.

Continuity: the visual and physical linkages between streets, buildings and spaces.

Densification: the process of creating an integrated urban environment in a manner that ensures better living conditions for a growing number of people.

Design: the process by which spaces and forms are articulated, analysed, extrapolated, resolved, systematised and visually represented towards an established purpose of function and aesthetics.

Design professionals: a term used in this study to refer to urban designers and architects whose visual-spatial skills can be utilised in visual research.

Diversity: refers to the conditions in and the ability of urban environments to support a variety of human activities that enrich the urban experience and improve the quality of living conditions.

Domestic activities: activities related to the household or the running of a home.

Enabling environments: interrelated physical and other infrastructures, built environments, culture, laws, policies, information and communication technologies and organisations that must be in place to facilitate the socio-economic development of people and communities living in informal settlements.

Enabling infrastructure: the physical and systematic facilities and structures that give societies or enterprises the means to operate, grow and thrive.

Enclosure: the level of perceived boundaries used to define public spaces and streets, using trees, buildings, walls and other elements.

Ethical capitalism: the view that a moral imperative for the betterment of humankind is an intrinsic attribute of capitalism, since it originated from providing good services and products. Honesty, trust and transparency are the fundamentals of establishing and growing business operations.

Euclidean geometry: a geometry with rectilinear and regular shapes as opposed to fractal and irregular geometry.

Fine-grained urban fabric: urban structures with small urban blocks and consequently with more streets.

Flows: the action of moving from one place to another to serve a specific purpose, as well as the circulation of people, objects, information and suchlike, necessary for the proper and efficient operation of society and the economy.

Fractal: organically shaped network of pedestrian and vehicular routes resulting from the *ad hoc* layout of an informal settlement.

Fragments: *ad hoc* and often irregularly shaped houses, *spaza* shops, buildings and the resulting open spaces in an informal settlement.

Fragmentation: the process by which people in informal settlements demarcate their land portions and define their spaces of habitation in an *ad hoc* manner.

Fourth world: the human settlements and their economies which are not regulated by a government of a country.

Globalisation: the process by which a community or an enterprise grows to the level of operating on an international scale.

Home-based enterprises: refers to businesses which are operated from the business owner's home.

Human scale: the sizing and proportioning of urban spaces, forms, features and elements to match and relate to the human body.

Information Age: a period in human history whereby the economy is centred on information and communication technologies rather than traditional industrialisation.

Informationalisation: the process by which an economy depends more and more on information as a resource rather than on industrialisation.

Informational capitalism: a political and economic system in which the state entrust for-profit organisations to utilise information as means, capital asset and item to operate and control a country's industry and trade.

Informal settlement: a human-made place for the habitation of people, created and expanded through adhocracy.

Kampung: an Indonesian word for a village or informal settlement.

Khutsong Section: an informal settlement used as a study area in this study to demonstrate the application of the visual research method by urban designers and architects in solving spatial problems in informal settlements.

Knowledge-based economy: an economy that depends on the communication, circulation, availability, accessibility, quantity and quality of information rather than on resources of production.

Legal: that which is regulated by and permitted by law of state.

Legibility: a sense of orientation that makes it easy for people to navigate an urban space.

Lekgotla: a Sesotho word for gathering space, usually located under a tree, for community meetings and court cases.

Lisangu: an Nguni word for a designated space near the main entrance to an Nguni homestead, where males gather around a fire in the evening while keeping a lookout for intruders.

Mabhalane: an Nguni word which can be translated as "secretary" whose role is to type letters and record and circulate minutes during council and community meetings.

Memorability: the condition of a place created by the attributes of physical spatial elements and their arrangement that make it recognisable and distinct.

Micro-scale: a very small scale as relates to size and measure of occurrence.

Modernism: a collective artistic and architectural approach to simplify forms to the essence of function, influenced by industrialisation in the 1900s.

Motif: a recurring or dominant architectural design concept, idea, intent, motive, theme and leitmotif that drives the creation of space and form.

Network: a structure or web or group of interconnected people or things.

Nguni: the group of people including AmaZulu, AmaXhosa, AmaSwazi, AmaNdebele, BaSotho, BaTswana, AmaTsonga, AmaShangaan, AmaVenda and BaPedi, also known as those who speak Bantu languages.

Node: an area that connects the flow of traffic, information, money and suchlike, resulting in a concentrated activity zone.

Pedestrianisation: the process of planning, designing and creating streets for the use of pedestrians only, or that prioritises the use of pedestrians over motor vehicles.

Pedestrian-oriented: urban spaces that are created to prioritise pedestrian traffic over motor vehicle traffic.

Place-making: the process of creating spaces with context inspired and informed characteristics, features and identity, with the aim of promoting the well-being of people.

Plug-in infrastructure: infrastructure which provides services, structures or facilities at strategic locations so as to be used for the operation and sustainability of communities and enterprises.

Precinct: a spatial zone or region known for a particular social or political or cultural or economic activity that gives a unique identity to an urban area.

Private activities: relationship-building activities which occur successfully or comfortably in private spaces.

Private space: a defined or enclosed space with walls or other forms of spatial boundaries, owned or controlled by an individual or household and not accessible for public use.

Public activities: relationship-building activities which occur best or comfortably in public spaces.

Public space: a space that is generally accessible and open to people, articulated to promote the interrelation of social and economic activities.

Relationship-building activities: day-to-day human actions and interactions that promote the formation of friendships, social relationships and community ties to ensure human survival.

Representation: the illustrative way of depicting, portraying and describing ideas and information.

Segmentation: the process by which people establish micro-scale enterprises that specialise in providing services and goods which are in demand in specific locations, and have the potential to grow.

Semi-private space: an open or enclosed space with access control and not accessible to the public, but accessible to residents in a cluster of buildings and associated people only.

Semi-public space: an open or enclosed space around private spaces with limited access to the public.

Scaling: the process by which people adjust the way they live, work and relax to suit the conditions or situations of their current physical context and socio-economic dynamics.

Shack: a place of habitation which is usually built as a temporary and rough-looking structure, using recycled and new materials.

Sikhulu: an Nguni word which may be translated as "chief",

used to refer to a ruler who is ruling on behalf of a king over a demarcated zone known as *sigodzi,* and who carries the responsibility of allocating land, resolving disputes, and supervising development in his territory.

Site-specific: architectural work generated from the unique attributes and features of a particular place, and which therefore exists symbiotically with that place.

Social Age: a period in human history whereby the economy and development of society is based on social relationships and the technologies which facilitate these relationships.

Social capital: refers to the economic and societal benefits of community ties, friendships and other human relationships.

Socio-economic activities: activities which are related to the interaction and integration of social and economic undertakings.

Socio-spatial: built environments and how they relate to the life, work and recreation of people.

Socio-technical: the integration of human activities or behaviour with the built environment, technology and infrastructure.

Socially responsive design: the integration of social relationships and historical and local neighbourhood identity references in the planning, design and creation of spaces and forms.

Spatial domain: a room or bounded/defined area controlled or owned by a particular individual, household, organisation, community or government.

Space of flows: the physical or virtual environment designed to enable and support the circulation of people, goods and information.

Space of places: the man-made environments suitable for people to live, work and relax on a daily basis.

Spaza: a South African vernacular neologism referring to small subsistence retailers informally established and operated in townships and informal settlements.

Spirit of place: the quality of a space that makes it distinct and memorable as a result of its natural setting and/or human-made spatial interventions.

Street: a circulation space used as a public pathway or road bordered by buildings and houses on one or both sides.

Support structure: an architectural system or interface which facilitates context-based re-use, reinvention and resilience for its users.

Sustainability: the ecologically-friendly process of creating and improving social, economic and environmental systems that encourage and enable human creativity, connections, communication, collaboration and cooperation towards an abundance of resources.

Sustainable urban neighbourhood: the social and economic well-being of a specific urban area inhabited by a well-networked group or community of people, whose relationship with the physical environment is symbiotic and harmonious.

Systems design: the process of interrelating and interconnecting urban and architectural elements and features to satisfy specified requirements and relate to a certain context in order to create holistic built environments.

Tertiarisation: the process by which an economy develops dependency on services rather than on manufacturing.

Threshold: the transitional space crossed when moving from one room to another or from one distinct space within perceived boundaries to another.

Tidiness: refers to a well maintained, orderly and clean urban space.

Tindvuna: an *Nguni* word which may be translated as "tribal councillors" or "headmen", whose responsibility it is to advise the chief on any community related matters.

Township: an urban environment predominantly inhabited by people of African descent in South Africa, historically designated to urban peripheries by the *Apartheid* government.

Transparency: the degree to which human activity beyond a public space or street edge can be seen or perceived by people.

Ubucub'obuhle buhamba ngabubili: an *Nguni* figure of speech which may be translated as "good waxbills go in pairs", expressing the idea that it is better to be helped by another person than to do things alone.

Ubuntu: an *Nguni* word for the expression of human respect, hospitality and kindness in social relationships, business dealings, artefacts and human-made space.

Umgijimi: an *Nguni* word which may be translated as "messenger", whose role is to circulate information as instructed by the chief and tribal councillors.

Umuntu ngumuntu ngabantu: an *Nguni* figure of speech which may be translated as "I am because you are", implying that a person gains his or her humanity from the help of others.

Upgrading: the process whereby the socio-economic potential of an informal settlement is realised through making spatial and infrastructural changes and improvements.

Urbanisation: the processes whereby people settle in very close proximity to each other as opposed to a rural settlement pattern, and the associated closely related built environment, infrastructure and technology.

Urban design: a process by which a context-based positioning of urban elements on a certain site is planned and designed to achieve cultural relevance, sustainability and design resonance.

Urban open space: refers to both the natural landscapes and the man-made open spaces around buildings used as circulation spaces as well as spaces for social and recreational activities.

Urban spatial strategy: a master plan or plan of action and its supplementary policy towards an established urban spatial development vision.

Urban structure: the physical layout and arrangement of urban forms and spaces for specific uses.

Visual assessment: the analysis and evaluation of spatial relationships using graphical illustrations.

Visual research: a systematic use of graphical illustrations to investigate spatial matters so as to reach new conclusions and establish new understanding.

Visual-spatial: that which is related to the ability of the human brain to perceive, articulate and express spatial relationships.

ABBREVIATIONS

Available as a fold-out page at the end of the document

ABET: Adult Basic Education and Training

BNG: Breaking New Ground Policy 2004

DHS: Department of Human Settlements

ICT: Information and Communication Technology

KIP: *Kampung* Improvement Programme

NBR: National Building Regulations

NDAO: National Delivery Agreement Outcomes

NDHS: National Department of Human Settlements

NDP: National Development Plan Vision 2030

NGI: National Geo-spatial Information

NUSP: National Upgrading Support Programme

PNC on ISAD: Presidential National Commission on Information Society and Development

RDP: Reconstruction and Development Programme

SABS: South African Bureau of Standards

SACN: South African Cities Network

SANS: South African National Standard

SLF: Sustainable Livelihoods Foundation

SMMEs: Small Medium and Micro Enterprises

SSA: Statistics South Africa

SUSS: Sustainable Upgrading Spatial Strategy

UISP: Upgrading of Informal Settlements Programme

ABSTRACT

In South Africa there are many informal settlements experiencing worsening socio-economic living conditions, along with associated environmental and urban open space degradation. These socio-spatial problems have increasingly attracted attention and responses from the South African government and researchers. Urban designers and architects as design professionals can make use of their visual-spatial skills to play a leading role towards developing sustainable and enabling urban open spaces in informal settlements. This study employed visual assessment as a tool for urban designers and architects to address socio-spatial problems in informal settlements. A visual research methodology was explored, using Khutsong Section informal settlement as a vehicle so as to formulate a generalised approach to the upgrading of informal settlements. The study area, Khutsong Section, is located in Ivory Park township within the City of Johannesburg.The visual-spatial design process gained from the context of the study, visual analysis and interpretation of precedents as well as the analysis and understanding of the study area. The context-informed and -driven urban open space design process resulted in an integrative and consolidated spatial solution for Khutsong Section. The understanding obtained of specific socio-economic activities imbedded in prevailing spatial elements and features in informal settlements has a broader applicability in the urban design and architecture professions. Therefore, the application of the visual research method in this study contributes towards positioning urban designers and architects to be visionaries and pioneers in the sustainable upgrading of informal settlements.

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3.037a–3.037g 3D drawings: The non-90° relationships in some compositions of buildings and clusters in Khutsong Section create spatial variations, complexity and elements of surprise. Individual buildings in a cluster which are arranged to have a 90° relationship are visually related through aligned edges. Overlapping building façades in a cluster with 90° relationships tend to create a stronger sense of spatial enclosure. At the block edges of the informal settlement (along Moagi Street, Hlanganani Street and the water channel) the composition is chaotic, the result of uncontrolled orientation which creates weak relations among buildings. Private front yards become focused open spaces in L-shaped and U-shaped building clusters which have strong orientation and direction to the open side. Building edges on streets and pathways (PP – public pathways) form a channelled linear space where the attention is drawn towards the ends of the street, if buildings are linearly arranged and their façades are aligned. Open corners in a cluster of buildings enclosing a central open space create a sense of weak spatial enclosure (SP – spatial leaks and PES – poorly enclosed spaces), whereas closed corners create a strong feeling of spatial enclosure (ES – enclosed space). An inward-oriented and self-centred arrangement of buildings in a cluster creates a central common semi-private open space whereby the buildings screen semi-public and public spaces. *Medium: AutoCAD and pen.* **184**

3.038 3D drawing: Different types of building clusters and the way they enclose private open spaces in relation to the street. *Medium: Pen.* **183**

3.039 3D drawing: The fractal or organic linear pathway system is a result of the arrangement of buildings, and is negotiated by moving pedestrians in order to access other places. These pathways create a high degree of linkages and transparency in Khutsong Section, because they physically and visually connect to all dwelling units within the informal settlement and the surrounding roadways. *Medium: Pen.* **183**

STREET-SCALE ANALYSIS

Moagi Street

3.040 Photograph used to study the urban forms and open spaces of the study area: Moagi Street – the edge of Khutsong Section on the right-hand side displays a lack of tidiness, continuity and legibility. Tidiness denotes the cleanliness and physical condition of an open urban space. *Medium: Colour photograph.* **186**

3.041 Photograph used to study the urban forms and open spaces of the study area: Moagi Street – a *spaza* shop is located along the boundary fence and washing lines, domestic activities and toilets are visually exposed to

open public spaces and the street because of the see-through street boundary fences. *Medium: Colour photograph.* **186**

3.042 Photograph: Moagi Street – poorly managed run-off water from dwellings and water collection points contributes towards the untidiness of the street. *Medium: Colour photograph used to study the urban forms and open spaces of the study area.* **186**

3.043 Photograph used to study the urban forms and open spaces of the study area: Moagi Street – this water collection point is located very close to the fenced dwelling in the background, which implies that when the people fetch water or do their laundry they may intrude on the privacy of the residents. *Medium: Colour photograph.* **186**

3.044 Photograph: Moagi Street – this L-shaped dwelling and the waterless toilet provide a strong enclosure for the front elevation open space which is used for washing lines and domestic and social activities. *Medium: Colour photograph.* **186**

3.045 Photograph: Moagi Street –an example of a *spaza* shop attached to the dwelling of the *spaza* owner and unfenced dwellings, whereby private and semi-private open spaces spill onto public spaces. The resulting spatial conditions carry the memory of the effects of poverty and how it strips human dignity. *Medium: Colour photograph.* **186**

3.046 Drawing: Moagi Street – poor definition of threshold space causes untidy and poorly enclosed open private spaces. *Medium: Pen and pencil drawings.* **187**

3.047 Drawing: Moagi Street – L-shaped and U-shaped building arrangements help define the boundaries of private open spaces. *Spaza* shops attached to dwellings work as transitional spaces that connect interior spaces to public outdoor spaces. *Medium: Pen and pencil drawings.* **187**

3.048 Drawing: Moagi Street –the *spaza* shop owner sits at the vehicle and pedestrian gate, away from the shop but close enough to see incoming customers. Locating *spaza* shops on the street boundary helps to partially screen private activities in front of dwellings from the street and open public spaces. *Medium: Pen drawings.* **187**

3.049 Drawing: Moagi Street – the need exists to introduce

spatial elements to strengthen the sense of enclosure of front -yard open spaces and draw a clear line between private open spaces and public open spaces. *Medium: Pen drawings.* **188**

3.050 Drawing: Moagi Street – a great need exists to define public spaces and integrate services and transportation networks in a manner that will produce good urban spaces. One way to achieve this would be by using *spaza* shops as filter layers (thresholds) between private and public domains to increase urban spatial legibility. *Medium: Pen drawings.* **188**

3.051 Drawing: Moagi Street – due to the poor insulation of roofs and walls, residents usually sit under trees and in shaded areas during the day. A need exists for open green spaces, good drainage of run-off water and storm water, and shaded spaces along streets and open public spaces so that more relationship-building activities could occur. *Medium: Pen drawings.* **188**

STREET-SCALE ANALYSIS
Hlanganani Street

3.052 Photograph: Hlanganani Street – residents use the private open spaces along front of dwellings for socialising and domestic activities. Waterless toilets and water taps were provided by Government for residents. This street is characterised by very green lawns because it receives high levels of water run-off due to the fact that the site slopes down from 22nd October Drive towards Hlanganani Street. *Medium: Colour photograph.* **189**

3.053 Photograph: Hlanganani Street – this view from Hlanganani Street shows buildings in the background which become a visual focus point because of their linear arrangement along this pathway. *Medium: Colour photograph.* **189**

3.054 Photograph: Hlanganani Street – an unpaved road and poorly managed run-off water and waste affect the tidiness of this street and adjacent open spaces. *Medium: Colour photograph.* **189**

3.055 Photograph: Hlanganani Street – dwellings are usually built with a timber frame and a collage of steel roof sheeting and other materials, with textures, sizes and articulation of physical elements that match human pro-

portions and size. The building forms also give the street a distinct, memorable and recognisable spatial quality. *Medium: Colour photograph.* **189**

3.056 Photograph: Hlanganani Street – on the opposite side of Khutsong Section there are formal houses which have decorative boundary walls and gates leading to a high degree of memorability, legibility, complexity, continuity, coherence, enclosure and tidiness. However, the levels of linkages and transparency are low along this street edge. *Medium: Colour photograph.* **189**

3.057 Photograph: Hlanganani Street – street vendors take advantage of high levels of pedestrian traffic by displaying food, vegetables and other products along the street. *Medium: Colour photograph.* **189**

3.058 Drawings: Hlanganani Street – this *spaza* shop is located next to a formal grocery shop and adds vibrancy to the street, as opposed to the solid fence of the grocery shop. *Medium: Pen.* **190**

3.059 Drawings: Hlanganani Street – these two L-shaped dwellings and toilet partly enclose a private open space that directly connects to the street. This open space can be improved by articulating the street boundary. *Medium: Pen and pencil.* **190**

3.060 Drawings: Hlanganani Street – here more fences are used to demarcate the semi-private open spaces in front of houses along this street, compared with houses deeper into the settlement. *Medium: Pen and pencil.* **190**

3.061 Drawings: Hlanganani Street – the thresholds of some of the houses are articulated by using covered entrances, seating and paved frontages. *Medium: Pen and pencil.* **190**

3.062 Drawings: Hlanganani Street – this organic linear pathway wraps around clusters of dwellings and connects to the main street. The walls of the buildings, toilets and solid and see-through fences define the edges of the pathway. *Medium: Pen and pencil.* **191**

3.063 Drawings: Hlanganani Street – the spatial arrangement and sizing of the building forms are related to pedestrian movement and human proportions. High levels of spatial transparency compromise the sense of spatial enclosure of private open spaces and affects spatial continuity and coherence. *Medium: Pen and pencil.* **191**

3.064 Drawings: Hlanganani Street – although there is high

degree of transparency and spatial linkages, this street edge has poor continuity because building edges were not aligned. *Medium: Pen and pencil.* 191

STREET-SCALE ANALYSIS

The Channel

3.065 Photograph: The channel – some of the houses are built with bricks, indicating a sense of permanence compared with the make-shift houses of timber and steel sheeting. *Medium: Colour photograph.* 192

3.066 Photograph: The channel – a poorly defined public spatial domain lacks the necessary architectural elements that support socialactivities. *Medium: Colour photograph.* 192

3.067 Photograph: The channel – the owner of this *spaza* shop lives in the L-shaped dwelling behind and keeps the open spaces clean and tidy. Usually open spaces that are not closely related to dwellings are littered and untidy. *Medium: Colour photograph.* 192

3.068 Photograph: The channel – the concrete channel directs run-off and storm water that flows through underground pipes penetrating into the informal settlement. *Medium: Colour photograph.* 192

3.069 Photograph: The channel – due to the lack of a backyard space, the front yard is used for domestic and social activities while functioning as a pathway that connects to adjacent dwellings and open spaces. *Medium: Colour photograph.* 192

3.070 Photograph: The channel – the existing deep channel running through the settlement transports grey water from kitchen and laundry activities towards a larger channel in 22nd October Drive. To prevent diseases, a submerged channel should be provided to convey this water to storage tanks, after which it can be pumped through a water purification system. This would ensure clean public spaces to encourage social activities. *Medium: Colour photograph.* 192

3.071 Drawings: The channel – washing lines in front yards clutter the open space and disrupt pedestrian movement. *Medium: Pen and pencil.* 193

3.072 Drawings: The channel – these buildings are arranged to have their front doors opening towards a linear private open space which is used for sitting and social activities. *Medium: Pen and pencil.* 193

3.073 Drawings: The channel – residents along existing deep channels running through the settlement use fences to define and demarcate their semi-private spatial domains. Adding a boundary fence and a *spaza* shop draws a clear line between the private open spaces and the street. A 90° relationship between the dwellings, *spaza* shop, boundary fence and street creates good visual order and a stronger sense of spatial enclosure. *Medium: Pen and pencil.* 193

3.074 Drawings: The channel – this dwelling has a private open space that is at a higher level than the street and a solid boundary fence, allowing residents to passively survey the streets, while making it difficult for pedestrians to see into the dwelling. *Medium: Pen and pencil.* 194

3.075 Drawings: The channel – this water collection point and the toilets could have been designed and arranged to better define the street edges and avoid health hazards. *Medium: Pen and pencil.* 194

3.076 Drawings: The channel – women with their children meet at this water collection point to fetch water and do their laundry, which affects the dwelling next to it. *Medium: Pen and pencil.* 194

3.077 Drawings: The channel – Residents along the existing deep channels running through the settlement use the spaces in front of their houses for domestic activities which are intertwined with social activities. The lack of a semi-public spatial domain between the semi-private and the public (the pathway along the channel) interrupts semi-private social activities. *Medium: Pen and pencil.* 195

3.078 Drawings: The channel – the open spaces in-between dwellings allow for a high level of spatial transparency and linkages between the street and the spaces behind the buildings. *Medium: Pen and pencil.* 195

3.079 Drawings: The channel – the arrangement of the L-shaped dwelling, *spaza* shop and toilet in relationship to the street defines transitional space that integrates social activities with micro-scale economic activities. *Medium: Pen and pencil.* 195

3.080 Drawings: The channel – these clusters of buildings have rear and side elevations facing towards the street, with front façades facing a central courtyard space with covered entrances, seating and trees. *Medium: Pen and pencil.* 195

3.081 Drawings: The channel – an analysis of the spatial structure of Khutsong Section, showing social interactions in spaces of places and spaces of flows (Author, 2013). These drawings were based on the understanding of African settlements and the observation of socio-spatial aspects of Khutsong Section. Spatial thresholds play an important role to demarcate private, semi-private, semi-public, and public spatial zones. *Medium: Pen.* 196

3.082 Drawings: The channel – the spatial profiles indicate different uses and articulation of front yards, street boundary edges and back yards of a cluster of buildings. *Medium: Pen.* 196

3.083 Drawings: The channel – residents close to existing deep channels running through the settlement enjoy the sunlight while watching people walk in front of their houses and greeting and chatting with friends. *Medium: Pen and pencil.* 197

3.084 Drawings: The channel – residents sit in private open spaces shaded by trees and surrounding houses. *Medium: Pen and pencil.* 197

3.085 Drawings: The channel – the lack of a semi-public spatial domain between the semi-private and the public (the pathway along the channel) interrupts semi-private social activities. *Medium: Pen and pencil.* 197

3.086 Drawings: The channel – open private spaces with a strong sense of enclosure. Seating and covered entrances attract social activities. *Medium: Pen and pencil.* 197

3.087 Drawing: The channel – the absence of orientating landmarks affects the legibility of the settlement. *Medium: Pen.* 197

STREET-SCALE ANALYSIS

Shlezi Street

3.088 Photograph: Shlezi Street – salvaged mattress steel frames, timber, sails and scrap metals were used to create this high street boundary wall. *Medium: Colour photograph.* 198

Part 2.4

A VISUAL-SPATIAL INVESTIGATION THROUGH DRAWINGS AND COMPUTER-GENERATED MODELS
URBAN SCALE EXPLORATION

Medium: Pen and pencil. 206

4.006 Drawing: Inserting a two-storey linear urban spatial spinal cord through the informal settlement as enabling infrastructure could allow the easy flow of pedestrians, goods and services while strengthening the spatial structure and legibility of the urban fabric. *Medium: Pen.* 206

4.007 Drawing: Vertical spatial growth could also allow more landscaping to be inserted into the open public spaces around existing houses. By adding trees, retention ponds, constructed wetlands and paving, open spaces may improve the quality of the urban space in general. *Medium: Pen.* 207

4.008 Drawing: High-density housing may be achieved along with high-quality urban spaces by articulating open spaces around buildings. *Medium: Pen.* 207

4.009 Drawing: This design intervention aims to create a fine-grained fabric for the informal settlement, while introducing spatial thresholds that define the change from public spatial domain in open public spaces and streets, to semi-public and semi-private spaces that lead to individual houses. *Medium: Pen.* 207

4.010 Drawing: The analysis of the spatial structure of Khutsong Section shows that there is a need to insert spatial thresholds in some areas to dignify the transition from one spatial domain to the next. *Medium: Pen.* 208

4.011a–4.011b Drawing: Developing densification and upgrading scheme for informal settlements with a site-specific building code for Khutsong Section could ensure sustainable urban regeneration. *Medium: Pen.* 208–9

4.012 Drawing: This layout highlights existing pathways, with inserted rectangular forms imitating the existing urban fabric of Khutsong Section informal settlement. The aim of this approach is to achieve a subtle urban spatial quality using the existing spatial structure. *Medium: AutoCAD, pen and pencil.* 210

4.013 Drawing: This layout shows the strong visual impact of inserting new buildings (coloured in red and orange) along the street edges of clusters. This solution is intrusive because the size of proposed buildings dominates the existing spatial structure and will require that some of the existing houses be demolished to make enough space for the intervention; therefore further design ex-

plorations will aim for more subtle design interventions. *Medium: AutoCAD, pen and pencil.* 211

4.014 Layout drawing: In this solution, double-storey buildings that accommodate educational and economic activities are inserted along the street at the centre of the settlement, after which small buildings are inserted at existing dumping sites. Trees are also inserted along existing streets to improve the quality of public spaces. *Medium: AutoCAD, pen and pencil.* 212

4.015 Drawings: This design option shows the spatial effect of adding a second fractal pathway above the existing urban fabric. This pathway is used for urban agriculture and the harvesting of solar power and rainwater, a solution which is also visually invasive in the existing urban fabric. *Medium: AutoCAD, pen and pencil.* 212

4.016 Drawings: In order to avoid invasive forms that visually dominate the existing urban form, a fragmental approach is used in this design option. Pockets of open spaces and new building forms proportional to the existing ones are inserted in a manner similar to the existing urban layout to achieve a subtle new development. Forms are juxtaposed by imitating the way residents add new houses within the informal settlement. The design focuses on improving mainly the open urban spaces. *Medium: AutoCAD, pen and pencil.* 213

4.017–4.018 Drawing: These drawings illustrate the visual and spatial impact of proposed forms and elements (rendered in grey) in relation to the existing building footprints (rendered in black). *Medium: AutoCAD rendered.* 214

4.019 Drawing: Trees and paving can be used to define the edges of open spaces around existing buildings so as to improve the spatial legibility, coherence and continuity of Khutsong Section's spatial structure. *Medium: AutoCAD and pen.* 214

4.020 Drawing: Allocating individual plots (coloured in yellow, blue and green) based on the existing public open spaces, pedestrian and vehicular routes (coloured in black), and open semi-private spaces (coloured in red) can help release the potential for self-improvement of houses and open spaces. *Medium: AutoCAD and pen.* 215

4.021 Drawing: This drawing shows the visual impact of

inserting new buildings (coloured in blue and yellow) along the street edges of clusters. This solution is invasive because the proposed linear buildings are larger than existing houses and will require some demolition and the removal of residents from some of the houses, thus disrupting some of the existing relationship-building activities; therefore further design explorations will aim for more subtle design interventions. *Medium: Pen and pencil.* 216

4.022 Drawing: Intervening only in existing open spaces so as to add public facilities, improve the quality of outdoor spaces, and define the edges of streets and public spaces can be achieved using and articulating minimally invasive urban forms and elements. *Medium: Pen.* 217

4.023 Drawing: This option aims to insert two-storey buildings as fragments in different open spaces and along busy streets, while also inserting gathering spaces and service systems in between existing structures in a more context specific manner. *Medium: Pen.* 218

4.024–4.027 Drawings for illustrating proposed spatial ideas and solutions: The added buildings and urban elements are responsive to site-specific conditions of the streets, open spaces and buildings of Khutsong Section. Further articulation of the proportions and sizing of the proposed forms can improve the legibility and coherence of the settlement. *Medium: AutoCAD.* 219

4.028–4.031 Drawings for illustrating proposed spatial ideas and solutions: Proposed urban elements and forms (rendered in grey) are related to existing buildings to strengthen the enclosure of open spaces, legibility, coherence, continuity, complexity, memorability, tidiness, linkages and transparency between buildings, open spaces and streets. *Medium: AutoCAD.* 220

4.032–4.033 Drawings for illustrating and generating spatial ideas and solutions: This design option shows the effect of adding a second fractal pathway above the existing urban fabric. This pathway can be used for urban agriculture and the harvesting of solar power and rainwater. This solution is also visually invasive but creates spatial linkages, coherence and continuity in the existing urban fabric. *Medium: AutoCAD and pen.* 221

4.034 Drawings: In this solution the double-storey build-

ings are inserted along the street located at the centre of the settlement and accommodate educational and economic activities. Small buildings are inserted on existing dumping sites. Trees are also inserted along existing streets to improve the quality of public spaces. *Medium: AutoCAD and pen.* **222**

4.035 Drawings: This design option shows the visual impact of the second storeys inserted over existing buildings. *Medium: SketchUp and pen.* **223**

STREET-SCALE SPATIAL EXPLORATION

4.036 Drawing: Activities like arts and crafts, storytelling, music, cooking, eco-learning, eco-entertainment and other cultural activities could be arranged in interconnecting spaces within the settlement. *Medium: Pen.* **224**

4.037 Drawing: Retail activities could also be arranged in interconnecting spaces within the settlement. *Medium: Pen.* **224**

4.038 Drawing: Urban agricultural activities could be arranged in interconnecting spaces within the settlement in a manner that improves urban spatial quality. *Medium: Pen.* **224**

4.039 Drawing: Sports and leisure activities could be arranged in interconnecting spaces within the settlement in a manner that improves the urban spatial quality of the settlement. *Medium: Pen.* **225**

4.040 Drawing: Vertical spatial planes, columns and trees could be used to create spaces where people can gather. Semi-enclosed spaces support semi-private and semi-public activities. Vertical spatial planes, columns and trees should be articulated by inserting openings, seating and finishes that serve as means to filter private and semi-private activities from public activities. *Medium: Pen.* **225**

4.041 Drawing: Open spaces in the settlement can be designed to integrate social activities with micro-scale economic activities. *Medium: Pen and pencil.* **226**

4.042 Drawing: Community gathering spaces can be created by manipulating vertical spatial elements and trees to provide enclosure. The horizontal spatial plane can

be articulated with seating, steps and platforms. *Medium: Pencil.* **226**

4.043–4.044 Drawing: Vertical spatial planes could be inserted between existing semi-private social gathering places in order to screen noise and provide a degree of privacy from adjacent busy streets and open public spaces. *Medium: Pen.* **227**

4.045–4.046 Drawing: Linearly arranged trees, walls and other vertical physical elements can be used to enclose pockets of green and agricultural open spaces. *Medium: Pencil.* **227**

4.047 Drawing: Adding first floor levels with balconies above existing dwellings in Khutsong Section can provide shaded spaces that can be used for social and micro-scale economic activities. *Medium: Pencil.* **227**

4.048–4.052 Drawing: Tidiness and memorability can be achieved by paving and adding seating, street furniture, vertical space-defining elements and trees in open spaces and streets of Khutsong Section informal settlement. *Medium: Pencil.* **228**

4.053–4.054 Drawing: New buildings can be articulated to enclose urban spaces and frame openings to act as gateways that connect open spaces. *Medium: Pen.* **229**

4.055–4.058 Drawing: In order to avoid invasive forms that visually dominate the existing urban form, a fragmental approach is used in this design option. Small buildings and partially enclosed open spaces that are proportional to existing building forms are inserted in a manner similar to the existing urban layout to achieve a subtle new development. Forms are juxtaposed by imitating the way residents add new houses within the informal settlement. A variety of thresholds are inserted to separate semi-private activities from public activities. *Medium: Pen.* **230–1**

4.059 Drawing: In order to maintain spatial transparency and linkages, vertical walls used to define spatial thresholds have openings that align with doors, windows, gates and front yards of existing dwellings. *Medium: Pencil.* **232**

4.060 Drawing: Simple vertical and horizontal spatial planes may be used to create thresholds between spatial domains used for a variety of activities within the settlement. *Medium: Pencil.* **232**

4.061 Drawing: Introducing vertical urban forms in the spatial structure of Khutsong Section can ease navigation and improve the spatial congnition of pedestrians. *Medium: Pen and pencil.* **232**

4.062–4.066 Drawing: Screen walls with seating and trees can be used to partially enclose pockets of spaces to attract social and micro-scale economic activities along streets, while screening semi-private activities in the front yards of dwellings and acting as firewalls to guard against the spread of fire. *Medium: Pen.* **233–4**

4.067–4.071 Drawings: Threshold and open space design principles to be applied in further spatial explorations. *Medium: Pen and pencil.* **235–6**

4.072–4.074 Drawings: Existing pedestrian and vehicular routes can be used for circulating services and providing minimally invasive amenities so as to enable self-improvement of houses and the growth of micro-scale economic activities. *Medium: Pen.* **237**

4.075 Drawing: Inserting pre-fabricated structural components to upgrade the existing fractal pathways within Khutsong Section may help to simplify the construction process, because there are few roads wide enough to give access to construction vehicles. *Medium: Pen and colour pencil.* **238**

4.076 Drawings: Minimally invasive spatial interventions could be achieved by elevating proposed structures by using columns so as to add new spatial layers without demolishing existing dwellings. *Medium: Pen and pencil.* **238**

4.077 Drawing: Minimally invasive spatial interventions could be achieved by proposing movable and lightweight space-defining elements that can be relocated and re-used as the informal settlement transforms and develops. *Medium: Pen.* **239**

4.078–4.080 Drawings: Lightweight structures can be used to create spaces, support solar panels for energy production, carry planters for food production, and to harvest rain water. Adding green roofs, seating, paved pathways, drainage and service channels, and creating a continuous block edge (indicated by red lines) along streets may help to beautify the public spaces of the informal settlement. Layers of vertical and horizontal spatial thresh-

olds can be used to densify and diversify activities occurring in the open spaces of Khutsong Section. Vertical green walls, raised walkways and roofs can be used to make streets more attractive and usable by accommodating social activities. *Medium: Pen.* 239

4.081 Drawing: Inserting trees and rainwater-harvesting systems around existing houses could result in a green and sustainable open urban space that helps to blend new buildings and urban elements with existing shacks. *Medium: Pen and pencil.* 240

4.082 Drawing: The use of a structure and infill system could help to simplify the construction process during the upgrade of the informal settlement. Lightweight structures equipped with solar panels and rainwater collection tanks could be prefabricated and then transported to Khutsong where they can be connected to existing houses. *Medium: Pen and pencil.* 240

4.083 Drawing: A lightweight steel structural system with pre-cast concrete components may ease the construction process. Steel components of the system may be transported and erected more easily and quickly than masonry construction. *Medium: Pen and pencil* . 241

4.084 Drawing: The insertion of a double-storey building and lightweight structures for micro-scale economic activities provides shaded spaces. Seating can be inserted to support social activities at ground level. *Medium: Pen and pencil.* 241

4.085–4.088 Drawings: A simple steel butterfly shed can be used for the parking of movable double-storey rooms while allowing a variety of activities when the containers have been removed. Lightweight steel stair systems could be connected and disconnected as required. *Medium: Pen and colour pencil.* 242

4.089 Drawing: By improving the edges of open spaces and streets using lightweight and demountable structures, the urban fabric and network of open urban spaces in Khutsong Section can enable social and economic activities. Medium: Pen and pencil. 243

4.090 Drawing: This structural system reduces the footprint of the new building while providing shaded space below which could be used for economic activities. Vegetation could be used to reduce the visual impact of the structural steel forms. *Medium: Pen.* 243

4.091–4.093 Drawings: Steel elevated walkway structures could be used for urban agriculture and the harvesting of solar power and rainwater, while providing walking and seating space above the existing houses in the informal settlement. *Medium: Pen and pencil.* 244

4.094–4.096 Drawings: These demountable and movable spatial elements can be used to strengthen the coherence, continuity, legibility, tidiness, memorability and complexity of the urban spatial structure of Khutsong Section. *Medium: AutoCAD.* 245

4.097–4.099 Drawings: Improved central spaces enclosed by clusters of buildings can be interconnected by paved pathways or roads and plantings, and though information and telecommunication network infrastructures. *Medium: Pen and pencil.* 246–7

4.100 Drawing: Vertical spatial growth could help achieve high densities (top image) (Author, 2013). Open urban spaces could be used for swimming pools, games areas and play areas for children (second image from top). Urban agricultural activities may play a vital role in achieving a sustainable informal settlement (image second from bottom). Amenities like small post offices and satellite government services could also be inserted into some of the open urban spaces within the settlement (bottom image). These spaces that support a variety of activities should be well connected through a series of thresholds (indicated with red arrows) that dignify and demarcate private, semi-private and public activities. *Medium: Pen.* 248

4.101–4.104 Drawings: Inserting two-storey buildings at the edges of the settlement could help to attract business and integrate Khutsong Section with the surrounding formal housing in Ivory Park. Local learning and production activities require a good flow of services, goods, people and knowledge to and from different parts of the settlement. *Medium: Pen and pencil.* 248–9

4.105–4.106 Drawings: Spatial and infrastructural interventions can serve the purpose of creating an integrative urban spatial structure. Inserting spatial thresholds by using low walls, seating, level changes and trees may help to create a spatial structure that supports and inte-grates social and economic activities in urban spaces of the settlement. *Medium: Pen and pencil.* 250

4.107 Drawing: Mobile steel seating structures could be used in integrated open public spaces for community and other social gatherings. This mobile structure can be easily integrated with urban open spaces. *Medium: Pen.* 251

4.108 Drawing: Open spaces can be improved for social gatherings, defined by using vertical spatial planes and vegetation to attract people to them. Semi-public communal space may need thresholds that separate it from public spaces in order to encourage semi-public relationship-building activities. *Medium: Pencil.* 251

4.109–4.112 Drawings: Prefabricated and demountable kitchen and bathroom units can be added to existing shacks so as to provide services and better define open spaces. Green infrastructure can be added to the existing streets and open spaces around existing dwellings. Vertical spatial growth would allow enough space at ground level for micro-scale economic activities which would promote social connections. Facilities for an education program can be located on the first floor, while economic activities can take place on the ground floor, where sellers can have a direct connection with buyers. *Medium: Pen and pencil.* 252–3

4.113–4.114 Drawings: Elevating proposed buildings for residential and public use above existing dwellings can make it easier to regenerate the informal settlement at ground level without relocating residents. Integrating grey-water recycling, greenery, and rainwater and solar harvesting systems within the form can produce an enriching urban environment. *Medium: Pen and pencil.* 254

4.115–4.117 Drawings: The spatial structure of Khutsong Section can be improved by providing lightweight and responsive site-specific infrastructure in open spaces and streets. The collection, sorting and packaging of solid waste can be done at recycling stations linked to paved pathways within the settlement. Rainwater can be harvested and used in urban agriculture to irrigate vegetable gardens. *Medium: Pencil.* 255–6

4.118–4.119 Drawings: Steel structures can be integrated

with constructed wetlands, water recycling facilities, and urban agriculture. Water recycling systems, rainwater harvesting, urban agriculture, and mobile tuck shops can be integrated to create a thriving and resilient informal settlement. *Medium: Pen and pencil.*   257

4.120 Drawing: The recycling of solid waste could be organised and managed by residents in order to generate income for the individuals participating in the recycling programme. *Medium: Pen.*   258

4.121–4.128 Drawings: After the network of pedestrian and vehicular routes has been paved, mobile street furniture, housing units and other elements can easily be transported to wherever they are needed within the settlement. Designing for better mobility can ensure better living conditions throughout the different phases of transformation and development in Khutsong Section. *Medium: Pen and pencil.*   258–61

Part 3.1

A VISUAL-SPATIAL REPRESENTATION OF THE DESIGN SOLUTION
FINAL RESPONSIVE OPEN SPACE DESIGN SOLUTION FOR KHUTSONG SECTION

5.001 Drawing: Paved fractal pedestrian and vehicular routes within Khutsong Section connect to the main roads: 22nd October Drive and Freedom Drive. *Medium: AutoCAD.*   262

5.002 Drawing: Individual plots are allocated and new buildings and trees are proposed based on existing spatial arrangements so as to increase spatial legibility, continuity, coherence, memorability, linkages, transparency, tidiness and integrated social and economic activities and enabling urban environments. *Medium: Pen and pencil.*   263

5.003 Drawing: Khutsong Section integrated and consolidated upgrading proposal: Layout drawings. Shops are coloured yellow and the spaces used for recycling and community gatherings are coloured red. These lines of shops serve as semi-public spatial domains separating semi-private spaces from public spaces. This responsive design approach strengthens the existing fractal pathway structure by integrating trees, seating, paved areas, water collection systems, food gardens, existing houses and shops, waste collection points, urban elements, and community and educational facilities into a holistic design intervention. The aim is to express the identity of place and community values of Khutsong Section by creating aesthetic appeal, utility and functionality, while increasing opportunities for relationship-building activities which are integrated with educational and economic activities. *Medium: AutoCAD, pen and colour pencil.*   264

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FURTHER URBAN LAYOUT PROPOSALS
FOR KHUTSONG SECTION

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PART 1
Context

1.1 INTRODUCTION

1.1.1 BACKGROUND

About half of the urban population of South Africa is located in townships and informal settlements (Statistics South Africa, 2012). Townships in South Africa were created by the apartheid system to be used as residential and industrial sites for the African working class (South African Cities Network (SACN). 2009: 5). As a result of the shortage of state-provided housing in townships, informal settlements mushroomed to accommodate the growing number of rural-urban immigrants and those from neighbouring countries. With green belts separating them from cities, these townships and informal settlements are usually located on urban peripheries, creating the inconvenience of long distances and high transport costs for their citizens (Gelderblom & Kok, 1994).

In developing countries like South Africa, the pressure of a growing urban population presents opportunities and challenges. Large numbers of people living in close proximity to each other present many social and economic benefits. In a world where a knowledge-based economy is growing faster than ever before, urban dwellers lacking education opportunities are excluded from urban benefits. Most of them are living in very poor conditions in places that are referred to as 'shanty towns', 'informal settlements' or the 'informal city'.

The UN-Habitat defines slums as … *settlements of the urban poor that have developed through unauthorised occupation of land* (UN-Habitat, 2005: 5). Informal settlements are usually characterised by unhealthy and unsafe living conditions due to overcrowding and lack of access to basic services. Access may be defined as the capacity to attain desired goods, services and activities (Litman, 2008). A squatter community is defined as a neighbourhood where people take possession of a parcel of land illegally and informally erect shacks on it, with no official rent or rate payments by those who live there (Gertenbach, 1997: 11). An estimated increase from 1 billion to 2 billion people living in slums or squatter settlements is expected between 2008 and 2030 (De Filippi, 2009:9). According to De Filippi (2009:9), the … *term slum refers to an informal or unplanned residential area, considered irregular or illegal due to the lack of deeds and registered property owners.* A conglomeration of slums is usually referred to as the *"informal city" – in contrast with the "formal city"* (Abiko, 2009: 24).

Balbo (2009: 8) calls … *slums "potential urban landscapes" or areas … of potential … starting point[s] in a quest for urban resilience, opportunities for creating nuclei of strength to shore up a system whose fragility is becoming too apparent … [W]e could think of the slum, not as a problem to be solved, but as a potential resource for the legally constituted city.*

The fourth world (informal settlements) has been described by Manuel Castells as a world where the unregulated flow of wealth occurs through global networking and criminal activities that stretch all the way to the formal legal economy and political systems at all levels of society (Susser, 2002). The sense of lawlessness and illegality can been seen as a response to inequality and social exclusion consequent to globalisation. This urban informality is defined as … *not formal, not planned, not taxed, not regulated …*, as urban settlements with an … *unregulated and untaxed economy* … . This is termed the informal economy (Huchzermeyer, 2011:70).

According to Huchzermeyer (2011:77), … *the process of informality responds to changing pressures, newcomers add structures, settlements 'densify' or expand, occupants change, a rental market may merge and expand, and may be reversed, leadership emerges and may be challenged, struggles for formal recognition and servicing may be waged, sections may be bulldozed and others may be consolidated.* However, social connections keep the community together amidst all these factors in informal settlements (Hamdi, 2004; Otter, 2007; Harber, 2011). The relationships that people in informal settlements have, keep the community together.

Faroa (2011:50–52), who lives in an informal settlement in Cape Town, puts it this way: *But we do the best we can. We are a close community. The understanding is there and so is the love for one another … we have learned to deal with many issues like drug issues, domestic vio-*

lence and teenage pregnancies ... We are all there to help each other in every way or to support in any way .... .

Ogbu (2009: 3) argues that the informal sector is a well-functioning system integrating social, economic and spatial aspects. Informality could be understood through multiple relationships and networks that are not dictated by a formal institution. The communities in informal settlements function through transportation networks that are anchored in space of places. Informal settlements fill the cracks left by what the formal sector fails to address (Deckler & Poulsen, 2010: 166).

One of the dominant phenomena in informal settlements is social exclusion. According to Roberts (2009), social exclusion implies that a segment of a population is ... *comprehensively outside mainstream society.* Ruth Levitas outlines three political discourses on social exclusion: (1) *a redistribution discourse,* where more resources (especially money) are channelled to the poor; (2) *a social integration discourse,* focusing on creating jobs for the poor; and (3) *a moral underclass discourse,* attributing *exclusion to the excluder's own moral deficit.* Exclusion can also be defined as ... *detached from the broader social and economic experiences of mainstream society* (Roberts, 2009). Fundamentally, addressing social exclusion involves solving income inequality and injustice (Byrne, 1999).

African workers are rated to be in the lowest educational and occupational categories (Statistics South Africa (SSA), 2012: 28). Inequality, social exclusion, poverty and misery are physically expressed by the continual growth of informal settlements in South Africa. Despite the thousands of Reconstruction and Development Programme (RDP) houses built by the South African government, their occupants continue to build backyard shacks as a way to *densify* townships (Department of Human Settlements, 2011: 31–5).

Socio-economic barriers created by historically state-driven segregation, present-day class divisions, and market-driven internal segregation in townships and informal settlements contribute to social inequality in South Africa (Haferburg, 2012: 267). Although townships comprise both middle- and lower-income classes, most people living in informal settlements are poor, and very high unemployment rates are prevalent. As a result some residents have started businesses – mostly grocery retail – to better their economic conditions.

In townships and informal settlements, there exist large, medium, small-medium and micro enterprises (SMMEs). Micro enterprises remain the most prominent survivalist business sector. These micro-scale businesses in townships are known as *spaza* shops (see next paragraph) and are usually enterprises related to food, beverages and hair salons (Sustainable Livelihoods Foundation (SLF), 2012: 2–3). *Spaza* shops are

micro-scale economic enterprises usually located along streets where there are high levels of pedestrian and vehicular movement. They benefit from these streets and from areas with high population densities (Dewar & Uytenbogaardt, 1991).

The term *spaza* is a Zulu term which means 'hidden', expressing the idea that these shops are nestled in homes surrounded by the organic and complex streets of townships and informal settlements.

Spaza shops are well known as micro-entrepreneurial initiatives which emerged during the era of apartheid in South Africa. They are usually small and sell predominantly groceries. Most of them operate on a subsistence level, and are run by the poor and unemployed. Their growth is very slow compared to businesses located in inner cities. Each business operates within a localised area, providing services and products to residents in its immediate vicinity. They are pervasive throughout townships and informal settlements in urban South Africa, constituting an important business sector in the informal economy (Charman, Petersen & Piper, 2012: 47).

The small business sector is an important contributor to job creation for residents of townships and informal settlements. ... *[T]he small business sector comprised 2 million small businesses representing 98% of the total number of firms. Collectively small enterprises em-*

ployed 55% of the country's labour force, contributing approximately 42% of the country's total wage bill. However, 87% of the small enterprises are survivalists and the great majority of these are owned by black people. Women owned 41 per cent of these (Njiro, Mazwai & Urban, 2010: 6).

The influx of foreign business owners into townships is challenging the *status quo* of businesses in these areas. Competition prevails between South African shopkeepers and foreign entrepreneurs, especially Zimbabweans, Somalis and Pakistanis, and is believed to be one of the reasons behind the xenophobic attacks on foreigners in 2008 and 2015. In some townships and informal settlements the rise of foreign shopkeepers has contributed towards the transformation of business practice in the home-based enterprise sector from subsistence to entrepreneurial modes (Charman *et al.*, 2012: 47).

These socio-economic activities are played out in urban open spaces and therefore are directly and indirectly affected by urban spatial strategies and policies (Bartels, Napolitano & Tissi, 2013: 526). During the 1950s, through the Prevention of Illegal Squatting Act of 1951, the occupation of land in informal settlements was declared illegal, and government laws and acts were passed in parliament to evict mostly African communities (Mogane, 1998: 6). The abolishment of the Group Areas Act, which instigated racial separation in the post-apartheid landscape, contributed to changes in social, demographic, economic, and rural-urban migration in townships (Shackleton, Hebinck, Kaoma, Chishaleshale, Chinyimba, Shackleton, Gambiza & Gumbo, 2014: 501).

In most informal settlements the street functions as the most important public realm that is used on a daily basis (Steyn, 2008: 158–60). According to Harber (2009: 33) *most settlements have this characteristic which provides legibility and open space to congregate and trade in … Throughout Africa the dominant street is a theatre of intense trading providing as many as possible with access to the economy as well as safety in numbers. Mixed uses and highly inventive recycling of materials are evident. Trade is directly onto the vibrant circulation spaces with a minimal distance between services, manufacture and selling*. Most of the organic pedestrian-oriented pathways which are a common feature in the urban structures of informal settlements have vibrant social and micro-scale economic activities. These socio-economic and socio-spatial characteristics and features of informal settlements have attracted interest from different disciplines.

Much work relating to informal settlements has been done by the disciplines of the human sciences discipline, ranging through literature, field work and experiments to historical studies (Manona, Bank & Higginbottom, 1996). Dlamini (2009) and other writers have opposed the glorification of poverty in African townships and settlements (Van Wyk, 2004; Harber, 2011). He argues that it is desirable that high standards of living be promoted in such areas. Recalling childhood experiences and comparing them to the current status of these areas, some African writers mention that the current government of South Africa has implemented the same old Apartheid housing models in townships.

There are other perspectives emerging in South Africa. Crankshaw (2003: 31–51) has researched the changing relationship between racial and class inequality due to squatting in urban areas. Crankshaw's research (2003) indicates that the gap between the financially wealthy and those with less material prosperity is widening. Physical, social, economic and political changes continually … *shape and either maintain or threaten … the existence of informal settlements* (Abbott, Martinez & Huchzermeyer, 20001: IV).

People who were born and brought up in such settlements have given us their own perspective through literature, music and film. In his book *Shirley, Goodness and Mercy*, Chris van Wyk (2004) tells true stories that took place in Riverlea. The work of these writers shows that there are strong social networks and a sense of community in informal settlements and townships. Another perspective is provided by people who never stayed in townships and squatter camps but have been there as visitors, like Anton Harber (2011) who wrote the book *Diepsloot.* The film industry has contributed to how we understand informal settlements and townships, like the well-known *Yizo Yizo* television programme founded and directed by Angus Gibson.

Saunders (1995: 15–16) researched Port Elizabeth's informal settlements, looking at how people obtain their income as well as measure of the poverty in the settlements. Nxumalo (2003) investigated the means available for obtaining financial help in order for people to have access to low-cost housing. Valuable work has also been done in other disciplines, for example by researchers from the agricultural sciences investigating agricultural products that meet … *the needs of low-income consumers in urbanised informal settlements* (Duvenage, 2010: 44); in geographical studies involving the mapping and measuring of existing informal settlements, together with contributions from the engineering discipline on the design and implementation of sanitation and other services or systems (Botes, Krige & Wessels, 1991).

In recent years more work has been done towards practically upgrading existing informal settlements (De Filippi, 2009). One example is the yearly *Global Studio* conference contributing to the development of informal settlements in different countries. In his book *Small Change*, Nabeel Hamdi (2004) discusses various small-scale community driven projects in informal settlements. Rural Studio is an American-based organisation (founded by Samuel Mockbee in 1993) which has done a variety of work in one of the poorest states of the USA (Cumberlidge & Musgrave, 2007).

In India, Slum Networking focuses on development in the line of basic needs like sewage, water supplies and roads in informal settlements (Cumberlidge & Musgrave, 2007). Indonesia has a programme called the *Kampung* Improvement Programme (KIP) which has played an important role in upgrading existing informal settlements in different parts of that country. Historically, most governments viewed informal settlements as an urban catastrophe and very little national effort has been invested in their development.

Population dynamics and urban development processes impact informal settlements at the macro level (Abbott, Martinez and Huchzermeyer (2001: IV). Urbanisation occurs at high rates due to the concentration of population growth in the poorest society sectors. Infrastructure provision is very costly and its release, along with formal land, occurs at a very slow rate.

The formal housing, infrastructure, and employment opportunities are not able to absorb the influx of rural-urban migrants in South Africa. The South African Department of Human Settlements(DHS) is making efforts towards the upgrading of informal settlements. The N2 Gateway pilot project in Cape Town is one example that demonstrates one such attempt by the government (Huchzermeyer & Karam, 2006: 5–6). Although bits and pieces of research have been done on informal settlements in South Africa, there is still a lack of appropriate, integrative, globally responsive, progressive, systematic, and concrete solutions to the problem of unsustainable urbanisation in informal settlements. There is, however, a shift from the eradication of informal settlements to upgrading them and acknowledgement of existing socio-economic networks.

Social cohesion and social capital – to a large extent housing delivery still negates the role of civil society and the citizens themselves, therefore undermining social capital and building dependency on the State while burdening the State and compromising its delivery capacity. Finance – despite the increase in the housing budget vote, the fiscus is not enough to effectively provide adequate shelter for the increasing number of households who are living in inadequate housing, given the new focus on delivering functioning human settlements that offer livelihood opportunities and building social cohesion. The strategic response for developing sustainable human settlements aims to ensure responsiveness to the objectives of Government's medium-term urban spatial strategy to expand social and economic infrastructure and build cohesive, caring and sustainable communities (Department of Human Settlements, 2011: 31).

Informal upgrading and sites-and-services were introduced by the World Bank in 1972. Informal settlement upgrading means the ... *improvement of the settlement without the total relocation of the existing population, and in such a way that a part of the population stay[s] on their existing sites ... Thus it may comprise an improvement in the infrastructure or the housing, or it may comprise the provision of security of tenure* (Abbott *et al.*, 2001: 11–12). The decision to upgrade or consider other options is controlled by cost comparisons (Ferguson, 1996). The attempt to regularise informal settlements by the state is made possible by rigorous environmental, geotechnical and hydrological studies (Huchzermeyer, 2011: 117).

Informal settlements usually grow organically without a town planning scheme, services, formal roads and allocated plots (Augustijn-Beckers, Flacke & Retsios, 2011: 94). This usually results to an urban spatial structure with poor vehicular access and good pedestrian circulation which promotes an effective and rich community life (Saeidi & Oktay, 2012:503–504). An urban spatial structure is defined as an array of concepts that relate to the arrangement of urban public spaces which influence accessibility, environmental sustainability, safety, social equity, social capital, cultural creativity and economics (Healey 2007: 171).

In many informal settlements protests related to South African service delivery are on the rise. There is also a shift in approach within the upgrading strategy of the Department of Human Settlements. Development frameworks for each settlement are required to follow an incremental approach, coupled with processes strong in community participation and engagement (National Department of Human Settlements (NDHS), 2013: 1). Spatial strategies for the 2 700 informal settlements around the country are shifting to socio-spatial and socio-technical approaches as encapsulated in the National Delivery Agreement Outcomes (NDAO) 8 (2010), National Upgrading Support Programme, National Develop-

ment Plan Vision 2030 (2012), Part 3 of the National Housing Code (2009), Urban National Strategies, and the Upgrading of Informal Settlements Programme (UISP).

In this study the term "socio-spatial" is defined as the relationships and interdependencies between socio-economic activities and the built and natural environments where they occur. The concept of upgrading of informal settlements for this study is defined as site-related and place-responsive spatial, service and system interventions in the public and private domains of the urban fabric of the informal settlement. These interventions are made to enhance the built and natural environments and add value to the urban spatial character, as well as to elevate the socio-economic status and cultural identity of a settlement through the use of a diverse range of urban, architectural and landscape forms, services, systems and design applications.

The national target stated in the National Upgrading Support Programme is … *to improve basic infrastructure, services and land tenure for 400 000 informal settlement households by 2014* (NDHS, 2013: 1). In addition to these objectives, the Cabinet required that informal settlement upgrading plans be prepared for 45 metropolitan and local municipalities to address … *provision of security of tenure, water, sanitation, public transport, area lighting, electrification, waste management, public open spaces and recreational facilities* (NDHS, 2013: 3).

Therefore, a great need exists for integrative and sustainable socio-spatial informal settlement upgrading solutions in South Africa. The concept of sustainability denotes the processes of social, economic and ecological reproduction and interrelated systems located within diverse spatial contexts (Pieterse, 2010: 12–14). These processes are non-linear, indeterminate,

contextually specific, and achievable through various means. They are flexible and continuous in nature rather than being rigid and having predictable outcomes. This concept supports the possibility of diversity, difference, and local contingency rather than the imposition of global homogeneity.

Dewar and Louw (2012) argue that the role of urban designers and architects is currently undermined and threatened by the state in South Africa. The position of this study is that urban designers and architects possess visually-based skills and tools that they can use to play a leading role in the realisation of social, economic and environmental sustainability through informal settlement upgrading projects.

1.1.2 THE AIMS OF THE STUDY

Main aim: The aim of this study is to use an existing informal settlement as a vehicle to demonstrate how a visual research methodology may be applied in solving urban open space problems in informal settlements. The research is not intended for just documenting Khutsong Section in the traditional sense. A visual research methodology is therefore applied towards an understanding of appropriate socio-spatial qualities of informal settlements, and the underlying liveability qualities of a specific informal settlement. Thereafter, context-appropriate and sustainable urban open space solutions are formulated using an existing informal settlement, with the aim of demonstrating how urban designers and architects can apply a visual research methodology. The sub-aims are outlined as follows:

Sub-aim 1 Apply a visual research methodology in analysing precedents and extrapolating meaning and generic socio-spatial design principles from a

historic and contemporary informal settlement.

Sub-aim 2 Apply a visual research methodology using an existing informal settlement as a vehicle to broaden an understanding of the site-specific socio-spatial conditions in informal settlements.

Sub-aim 3 Use an existing informal settlement as a vehicle to demonstrate how a visual research methodology in the urban design and architecture disciplines can be used to solve urban open space problems in informal settlements through iterative design processes.

1.2   THE CONTEXT OF THE STUDY

1.2.1   THE CONTEXT OF THE LITERATURE: GENERATING DESIGN MOTIFS

The term "research method" refers to … *ways of approaching design problems or investigating contexts within which to work* (Noble & Bestley, 2005: 46). As forms of visual research, architectural and urban design may be defined as entailing a thinking process that emerges from contexts with ideas of situations involving people and organisations in space, and how those situations work (Hertzberger, 2010: 28). The ideas that will follow have created a design theoretical context which inspired and informed the visual research process in Part 2 of this study. Spatial design motifs were also generated from the context of the literature and were explored through the visual research process. In this study the term "motif" refers to concepts, ideas, themes, intentions, motives, leitmotifs and elements that inform, drive and make urban design and architectural compositions distinct.

CULTURE IN SPACE

Culture is the moral value, ethical principles and a vision of the ideal society that binds people together (Mandela & Goldstein, 2004). The significance of spatial relationships depends upon the particular character of the social objects in question. Patterns of social organisation determine spatial structure. The spatial structure is an extension of the intangible social structure (Urry, 1995: 65–6); therefore, building and dwelling should follow the daily actions and activities of the occupants. Form and space should be shaped for the actual activities of the occupants concerned in ways that heighten meaningfulness and their sense of being.

Social behaviour and social values influence the way land is occupied, used, changed, developed, and treated (Eleb, Chatelet & Mandoul, 1988; Lapin, 2010). Aspects of community needs and wants tend to activate social behaviour, leading to many individual and group actions in occupying and improving land. Social behaviour may be defined as ... *the way in which people and groups conduct themselves, how they act in the context of the values and ideals they possess. These values and ideals, whether latent or manifest, are the product of human experiences in a specific cultural, economic, and physical setting, and consist of a kind of superstructure built around the basic drives of human life* (Priemus, Button & Nijkamp, 2007: 152). The response of the NDHS to the target of 400 000 informal settlement households is engineering focused with little regard for the socio-spatial realities in informal settlements.

Human needs refer to ... *values relating to the necessities of urban living* ... and human wants refer to social and economic desires which supplement the necessities of urban living (Priemus *et al.*, 2007: 152–153). Values are referred to as either the latent or the subconscious and manifest or the conscious logical constructs of an individual or group, with reference to desired ends (Priemus *et al.*, 2007: 155).

Studies of people and their surroundings have become common practice in research. In this regard, human action is defined by sets of social, cultural and individual human factors that are clearly interconnected to each other, to the physical fabric of the built environment, to the locality in which they occur and to the temporal context (Eleb, Chatelet & Mandoul, 1988). Architectural and sociological interpretations can evolve from large-scale and small-scale surveys of households and individuals, and include interpretations of people's aspirations, needs and lifestyles (Bernard, 1992).

Social interaction refers to the process in which people act toward or respond to others (Blumer, 1986). Human interaction is mediated by the use of symbols, by interpretation, and by ascertaining the meaning of one another's actions. These are defined as symbolic interactionism (Garfinkel, 1967; Robertson, 2002). An analysis of the rules people follow in everyday social interaction is called ethnomethodology, a term coined by Harold Garfinkel (1967).

Lumer (1986: 82–3) mentions that we act towards things and our environment in accordance with the meaning we give them. That meaning arises out of social interaction. In any situation we go through an internal process of interpretation in order to assign meaning to the situation and decide how to act. Place-making is the product of the process of communicating meaning, values, culture and the essence of being a human being.

Altman and Vinsel (1997:182–260) argue that there are contextual interactions among people in specific situations. Relationship-building activities occur in locations with differing levels of privacy, i.e. public, semi-public and private. There are spatial activity patterns that are consistently shared by members of a community during specific periods of time, which may occur in either public or semi-public spatial domains. Intimate relationships are appropriate in private spaces.

Social events (every day and more distinct and unique social events) are distributed in time-space. Any particular social entity (civil society, the state, relations of production) is built around a particular temporal and spatial structuring (space of place and space of flows) (Urry, 1995: 67). Social entities are temporally and spatially interrelated with each other.

Other spatial activity patterns are shared by an individual with a number of people who form a group, a household, an extended family etc. These result in particular buildings (interior) and public spaces (exterior), due to different relationship-building activities; therefore, the created spaces and objects or forms are informed by human relationships.

Whyte's (1980) project for public spaces provides hard facts on how seating, trees, the sun, wind, street vendors (food), the street, retail frontages, and the available population are factors that influence how well spaces are used by people. When people occupy a particular space, they tend to transform it, rearranging it by using the cultural references and values suitable for their needs. Such spaces are usually ergonomically appropriate, thermally comfortable, and economically accessible.

Studies in Western contexts have shown that social interaction occurs in a range of different places, including libraries, cafés, pubs, local parks, play areas and places of worship. However, the studies show that local shops are the most important places where

people within a neighbourhood can connect (Holland, Clark, Katz & Peace, 2007: 23).

CONCLUSION: DESIGN MOTIF

The existing arrangement and use of spaces in informal settlements reflect the cultural and social values and ideas of the people living there (Lawrence, 1987: 77). The built environment and human-made objects are the material expression of a matrix of human relationships. These are relationships between family members, friends, community members, colleagues, schoolmates, service providers, and suchlike. Spatial design interventions in informal settlements should respond to and enhance existing social and cultural identity of the people living in them.

SOCIAL NETWORKS

Rifkin (2000: 12) describes this Information Age as the Age of Access. Organisations and institutions are shifting from possessing physical assets and products to services by creating and maintaining relationships with customers, competitors and sub-contractors. The shift to services and networks has influenced capitalism and globalisation. Roberts (2009) refers to a *knowledge economy/knowledge society* whereby a country invests mainly in the education of its people rather than in material resources and financial capital to achieve its economic strength. According to Manuel Castells (1996), a network society (information society) is emerging from the globalisation of communications. Human interaction is at the centre of the flow of knowledge, ideas and resources. A network in this context becomes ... *any infrastructure allowing for the transport of matter, energy or information, which is carved out upon the territory characterized by the topology of their circles of transmission, their nodes of bifurcation or communication* (Santos & Marques, 2002: 262).

... *[O]bjects of contemporary science, technology, social and economic life are not physically concrete* ... and yet their effects are undeniable. Networks, brands, communities, media, groups, mathematical sets etc. are intangible but very present among us (Shields, 2011: xiv). These invisible realities have been hijacked by capitalism and power operators, overruling actual ... *presence and proximity* (Shields, 2011: xiv).

Inequality has been defined as the degree of difference in the distribution of income and assets by diverse social groups and different individuals, comparative to one another (Castells, 2000: 128)**.** A process whereby the top and the bottom of the magnitude of wealth appropriation increases faster than the middle, where the middle gets smaller and the social differences between two extreme segments of the population become very steep is called polarisation.

When the available resources are below a given minimum living standard at a given time ascribed by the defined currency, then we define the condition as poverty (Castells, 2000). If it gets worse than that, meaning that the distribution of wealth is at the bottom level, it is called misery or deprivation (Castells, 2000). In informational capitalism, these are categories used when explaining social differences.

According to Rifkin (2000: 85), the propertied material definition of wealth and inequality will soon be out-dated because of the growing focus on services and networks. Instead of measuring wealth in terms of digits of monetary gains, it should be measured by the quality and quantity of relationships that people have. Schumacher (1974: 16) argues that ... *The substance of man cannot be measured by Gross National Product. Perhaps it cannot be measured at all ... Statistics never prove anything*.

After mourning the delirious collapse of the system of statism, Castells introduces a new version of capitalism, i.e. *informational capitalism*. It is characterised by a unified economic system, with a strong sense of existence, and yet it is adaptable to changes, bolted onto innovation-induced efficiency and globalisation-oriented competiveness to generate and distribute income and resources (Castells, 2000: 161–5). In it, technology and culture evolve by conceiving knowledge and information as raw material which is converted into assets and resources by means of a globally networked form of communications and trade. This new global economy is advantageous to those who work by networking and also works in the Net, which negates distance and geographical locations.

Hall (1996: 17–22) discusses four factors that influenced urban growth at the end of the twentieth century: *tertiarization, the shift from manufacturing to service; informationalization, the increasing use of information as the basis of the economy; the resulting locational disarticulation whereby command-and-control functions are carried out in places different from production locations; and constant innovation in both manufacturing and, increasingly, the generation and exchange of information.* Global cities have emerged through the influence of these factors.

Urbanisation brings with it socio-economic problems and opportunities. *Migrants are more likely to be between the ages of 15 and 35 years than any other age category* (Gelderblom & Kok, 1994: 58). The term 'urbanisation' simply means ... *the growth in urban population in proportion to the growth in rural population* (Abbott, Martinez & Huchzermeyer, 2001: 2). The number of people who need houses grows as a result of natural growth and rural to urban migration (Ellis, 1977: 19–23). Population growth is a resource if there

are many opportunities for people to develop themselves so that they can contribute to the economy of the country, but it becomes a problem if governments hand out houses and social grants.

Migration usually distances migrants from their families and friends and involves transport costs, costs associated with political boundaries, information costs, housing costs, sustenance costs and psychological and social costs (Gelderblom & Kok, 1994: 60–63). The poorest tend to be trapped in rural settings, depending on relatives that have successfully migrated to urban areas for employment opportunities. These migrants connect with their distant relatives via Information and Communication Technologies (ICTs) and use postal and banking services to send money home.

Human communication may be defined as the … *fundamental life process through which we sense, make sense of, and transact with our environment and the people in it. Social communication is the process which gives life to and perpetuates multi-personal units. It is through social communication than norms, roles, standards, ethics, knowledge, and values are defined and transferred from individual to individual and from one generation to the next* (Rubin & Rubin, 1992: 61). These factors influence the way people configure and arrange spaces in their environment, communicating their meaning, values, culture and skills through the places thus created. Communication occurs in space. African traditionalists strongly use the power of dialogue. This is evident in the emphasis on oral history, especially the importance of communication with the elders. In the process of social connection, communication plays a central role – interpersonal communication, intrapersonal communication, small-group communication, public speaking and mass communication.

According to Fischer (1977: 3), *People are constantly choosing whom they will begin, continue, or cease to interact with, approaching these relations in an essentially rational manner. People seek and keep associates whom they find more rewarding than others. And they form relations that are exchanges of goods, services, and emotional support.* There are different communication settings according to the number of people involved in them and the degree to which they are able to interact during relationship-building activities. Communication helps to meet physical and psychological needs, establish and grow relationships, acquire and transfer information, and to make decisions and persuade others.

Latour (2005: 5) refers to the word 'social' as … *a trail of associations between heterogeneous elements.* Spaces of place and spaces of flows function as intermediaries that enable associations and connections between people, information, objects and services. The existence of people in a particular location (physical or virtual) has the tendency to invite the occurrence of events and other human activities in that particular space in time (Latour, 2005); therefore, places where social relations can continually occur until a large web or network is formed are necessary. There has to be an intermediary – an event, activity or occurrence – that becomes a node, thereby bringing people in contact with one another.

Public spaces, shops, workplaces, schools, community meetings, streets and so on are the common meeting spots. These activities cause people to meet and even collaborate with each other. An informal settlement is created because of a need to be closer to job and economic opportunities near cities. Therefore, a need can also function as the nucleus that attracts people to settle in a specific location. As residents of informal settlements develop skills and knowledge for meeting the specific needs and interests of other residents, complex social and economic relationships and networks can emerge. Needs and the means of meeting those needs facilitate human communications at various levels. The more needs and interests there are within a community, the more opportunities there are for a variety of businesses and social networks to be established.

A need may be defined as an unsatisfactory condition experienced by the individual consumer that leads to an action that will make the condition better (Sheth & Mittal, 2004: 17; Duvenage, 2010: 45). Income, availability, education, knowledge, attitudes, beliefs and skills, time, social class, culture, social context, and social setting are factors that determine the choices people make when selecting products and services (Duvenage, 2010: 22). The needs of the consumer are the … *basic goals and standards that consumers strive to fulfil, including adherence to attitudes and beliefs held, and are imbedded in the basic needs they strive to meet* (Lundahl, 2006: 28–89; Duvenage, 2010: 45).

The settings where communication occurs may be located in the public, semi-public and private realms. In studying social connections and the spaces where these occur, these realms are important. However, ICTs with wired or wireless infrastructural connections may be used to communicate without being in the space of place.

Relationship-building activities refer to the different human social and economic actions that increase the chances for friendships and communal bonds and ties to occur between people. Relationships are determined by the kind of … *resource or information exchanged* … through a particular network, *its direction*

(recipient and emitter), and strength (according to various indices of different types of social capital). They can also be classified as direct and indirect, considering that actors can be linked to others through third parties, in symmetric or asymmetric fashion (Pereira, 2011: 113). Integration, sustainability, empowerment, partnerships, participation, community, democracy, ethical capitalism etc., are terms that evoke the notion of networks.

Relationship-building activities provide emotional and psychological connections between people. Networks help facilitate everyday connections and contact (Santos & Marques, 2002). Social attributes determine the composition of relationships and ties. People of similar characteristics will mutually feel empathy towards each other. Space of places facilitates strong links within an individual's immediate community. Space of flows may be considered as the facilitator of weak links, between people in a local settlement and people far away from their neighbourhood. These links or ties help connect ... *actors in one or more relationships* (Pereira, 2011: 113). They vary in content according to the capital that drives the connection, direction and strength.

Complex systems theory has played a significant role in the creation of computer networks. Complex systems theory uses two types of links: weak links to create networks and strong links to expand existing networks. The 'network life' becomes complex as a result of the formation of spontaneous linkages through small daily relationships which grow larger and larger, defying borders and distance (Lévy, 1993). Social and technological networks engender the ... *flows of information and capital* stirring up *cognitive and social values* ... due to the conglomeration of global standards and local norms (Pereira, 2011: 110). Technological networks permitting information flows initiate the elegant organisation of informal locations, informal micro-economic activities, informal education, informal service and product flows, and informal social connections.

These concepts are developed from complex system theory, which points that it is through these weak links that an individual can expand his or her social network. Strong links refer to the ties and connections an individual has with local community members. Hence complex system theory supports both strong and weak links in order to maintain and grow an individual's social network and connectedness. *Actors who are considered strong ties are more representative of the motives and resources of the network itself, [which,] while considered weak, with less representation within a network, are useful for connecting the network to other social groups, because they generally span more than one sphere of relations* (Pereira, 2011: 113).

Zohar (1997: 50) writes of quantum systems which ... *have no fully fixed identity until they are in relationship. This gives the quantum system maximum flexibility to define itself as it goes along. It co-creates with its environment. All of nature's complex systems are at their most creative when they are delicately poised between fixedness and unfixedness – poised at the edge of chaos.*

The strong links and weak links may be equated to social bridges that help residents of informal settlements create and extend their social networks. The residents act as intermediaries, as social bridges and links between other people, information, goods and services. Multiple links are necessary to have a stable network; this phenomenon is termed design diversity. Design diversity involves creating multiple links, connections and bridges in order to maintain a stable and reliable network. If one link breaks, the connection will be carried by the next link.

These multiple links form a network that allows the flow of life in a community. *Individuals' social relations, both personal and intimate ones and impersonal and formal ones, can be thought of as strands in the webs of their "social networks". The networks radiate out from the individual to close associates and then to the society beyond. Conversely, society can be thought of as the complex mesh of all these social networks, an intricate lattice-work* (Fischer, 1977: 17).

This mesh may be achieved by creating a great variety of relationship-building activities at different levels and scales so as to increase connectivity in a community. Then there will be multiple strategies for keeping connections. Technological innovations functionalise the ... *connections between geographically dispersed elements organized into social, economic and political networks ... Networks form around various hubs, including cities, corporations, supermarkets, churches, banks, restaurants, social movements, and virtual personalities* (Pereira, 2011: 110).

Design diversity is also termed ... *multiplicity, which ... refers to the amount of wires that connect the actors within a network, according to the degree of interactivity (if there are many changes, many wires, for example). Multiple ties tend to be more intimate, voluntary and durable* (Pereira, 2011: 113).

Networks may be ... *considered as social (symbolic, economic, political) networks and as socio-technical networks (because they are organised on the Internet)* (Pereira, 2011: 108). The Internet and media help to link people and ideas, increasing connectivity of one to the next. Hence there are opportunities for people to be linked socially, in their social fabric, to concepts, resources, searchable linkages, and programmable virtual and real space.

Another concept that relates to the theory of networks is the 'six degrees of separation' (Zhang & Tu, 2009: 1). This refers to the idea that everyone is on average approximately six steps away, by way of introduction, from any other person on Earth, so that a chain of "a friend of a friend" statements can be made to, on average, connect any two people in six steps or fewer (Zhang & Tu, 2009: 1)**.** People are becoming more and more aware of how they are all linked.

Relationship-building activities are those which cement human connections and bonds. They require that people should find many ways to seek new friends, locating people in the heart of large populations that share common values, where they have the opportunity to begin making connections with other human beings. According to Habraken (1999: 24–25) ... *A relationship relies upon actions, and to dwell is to do something; it is the sum of human actions within a certain strategy, within the protective environment created by man*. The human act of dwelling is connected with building. It may also involve adopting technological developments that help humans to relate with one another. In African informal settlements, social relationships, family ties and religious connections form bonds that help inhabitants survive.

CONCLUSION: DESIGN MOTIF

The community has to have these links; they are what bind and connect people. In spatial terms, design diversity may help residents to have as many links as possible. Spatial design interventions in informal settlement should be done in manner that creates multiple ways of connecting, linking and communicating between places and people. Each person should be given an opportunity to increase his or her links using the multiple channels that are available in space of places and space of flows.

Through these diversified connections individuals may use different relationships to be socially connected, to raise capital to sponsor their businesses, and to improve their lives so that they can benefit the entire social network.

AFRICAN SOCIO-SPATIAL ISSUES

African values and culture emphasise hospitality, respect, negotiations, networking, the extended family, and social relationships. *Ubuntu* is a term that explains the concept of collectivism for survival in harsh and changing realities. It means to fulfil the role of being a human being in the form of showing compassion and seeking reconciliation (Van Niekerk, 1993: 13–14). This concept resonates in the fabric of African culture as expressed by the Xhosa proverb *umuntu ngumuntu ngabantu*, meaning one is *a person through others* (Teffo, 1999: 153), or a person is a person by people, or I am because we are (Mbigi, 1997: 10). Culturally, Africans understand that if they establish a community, they can increase the opportunities for and chances of sustaining themselves.

This sense of community and emphasis on relationships underlies how African informal trade, transport and settlements are operated (Royston, 2013: 52). Organic, invisible human networks and flows are given priority and importance above the places where social and economic activities occur. Once the social and economic networks have been improved, the physical space will also improve. Although the physical conditions may appear to outsiders as chaotic and dysfunctional, informal settlements are occupied by a well-organised community (Koolhaas, 2002).

The *Ubuntu* concept also plays an important role in how Africans trade in the informal sector. Although there are exceptions, it is common to negotiate your price offer down when purchasing goods or services from Africans. This approach emphasises hospitality above the monetary value of the goods or services offered. Mbigi (1997: 5) calls this business practice 'African Hospitality', which means the African trader prioritises the act of helping another by offering services or goods above the money paid for them. Mbigi (1997: 10) further argues that combining African Hospitality with knowledge about *process innovation* and *functional integration* will breed successful African entrepreneurs. However, when communities succumb to pressures of poor economic conditions, non-service delivery and harsh economic downturns, they sometimes abandon these practices as observed in recent (2008 and 2015) xenophobic attacks in South Africa. Perhaps, through education and community engagement the practice of *ubuntu* in the business arena may be effectively taught and promoted.

Sub-Saharan African people are not individualistic and show a strong sense of community, living in relationships and interdependence. According to Lutz (2009: 313) *the most striking features of the cultures of sub-Saharan Africa is their non-individualistic character*. Although a community spirit may be observed in this part of Africa, it should be taken into consideration that each African culture possesses its own unique traits.

Traditionally, subsistence farming was the main means of making a living for sub-Saharan African people (Martin, 1987: 31–47). Cattle, sheep, goats and the cultivation of the soil were part of their tradition. Hunting was also used as a supplement in the days when game was abundant. Women would do agriculture and men focused on the arduous tasks like clearing the ground and ploughing. Most of the work was done through group effort. Neighbours and

friends would assist with more laborious work in exchange for a bucket of maize or a bundle of pumpkins (West, 1976: 7; Hughes, 1994: 59–60).

Martin (1987: 20) mentions that the term Bantu was used to refer to the race, culture, and language of the southern African tribe which consisted of a common ancestral community of speakers: AmaZulu, AmaXhosas, AmaSwazi, AmaNdebele, BaSothos, BaTshwana, AmaTsonga, AmaShangaan, AmaVenda, BaPedi and so on. *The various members of the tribe were bound together by a strong social element, a kind of an unwritten law, a tradition which every member of the tribe was brought up to respect and uphold* (Molema, 1963: 114).

Family was the basic unit of African people and its reach would include numerous close relatives. Historic homesteads in African settlements were made of clustered huts around the cattle byre which was a symbol of economic strength (West, 1976: 7–9). The father would prefer that his sons build very close to him so as to maintain their relationship, looking after each other. The general settlement pattern was made of detached individual huts in close proximity to each other.

According to Molema (1963: 115) … *parents, their children, their grandchildren, and – it may be – their great-grandchildren, all formed one family – a joint-family. They all dwelt together in one part of the village, their houses being continuous, that is, uninterrupted by houses of other families, and disposed in simple geometric figures – circles, semicircles, and quadrilaterals*. A network of paths and open spaces around these fragmented homestead groups connected them, making it a system of enclosed and open spaces. Most of these social factors are still observable in African communities today (Mandela & Goldstein, 2003; Hughes, 1994).

Architect Peter Rich has conducted a study of what he terms 'African space'. He outlines the order and use of thresholds and space in African architecture without architects. His study shows how Africans occupy, organise and use space for social connections. According to Rich (2002: 157), African space possesses the following characteristics: a set of detached pavilions that define outdoor space; spaces between buildings are treated as important public space; changes of level define thresholds of entry and ritualise movement; and open-ended multi-use spaces contrast with specific intimate spaces.

The social and spatial construct of detached enclosed spaces with organic movement routes and open spaces around them is still practised in current urban African settlements. These are scattered and fragmented enclosed spaces, sometimes surrounded by rooms with no windows, and are still connected by organic, fractal transportation networks. The open spaces, which are used for social activities, are also found in informal settlements. The enclosed spaces seem to be reserved for more intimate activities while the thresholds are usually used for meeting guests, particularly if it is a warm day.

Although most activities took place outside, the houses were used mostly for sleeping, storage and as shelter from natural elements. The beehive house building type did not have windows. Some of the settlements were distinct villages that worked like towns. When in search of greener pastures and fertile soil, seasonally some would move away from their settlements into temporary shelters close to the fields. The Nguni people had both scattered homesteads and well-defined villages, usually around the ruler's homestead (West, 1976: 8–9). A homestead was usually located closer to rivers, wells, productive soil and other homesteads grouped in to a village.

The sizes of homesteads varied significantly, depending on the people who lived in them. The ruler or chief's homestead was in a central position while the rest of the homesteads were arranged around it. The human scale prevailed in the sizing, proportioning and arrangement of spaces. The concept of detached enclosed spaces goes way back in the history of African settlements. For each family, each wife had her own sleeping structure, a storage structure and a kitchen structure, each having open-air functions attached to them. Then there were the granary structures, older boys' and girls' structures and guest structures. The grandmother and grandfather would also have their own house structure located at the centre of the homestead, which was also used for family meetings.

These African villages were co-operative societies of members-whose inter-dependence played an important role. In the co-operative union of families and villages there was real bond ship and the nearest example of social and economic equality (Molema, 1963: 115). It was common for the rich to share their food with the needy, without humiliating the dignity of the unprivileged. Even though in theory all the property of the tribe belonged to the chief, individual families had the freedom to trade their possessions, except for land. Uncultivated lands were communally shared for grazing.

The social life of Bantus was usually interwoven with their economic, educational and political life. Each child belonged to the community and not just the family. A new-born child would travel around the homestead and community on his or her mother's back and people would interact with him or her, showing that

he or she is welcome in the community (West, 1976: 9). When the child had grown big enough, he or she would be left in the care of older children and the larger community. Rituals were carried out for a newly born child in the presence of the extended family. When the child reached puberty, initiation rites signified the change in status from child to adult. During the initiation process the child (boy or girl) was educated about African values and the forms of behaviour expected from a grown-up person.

Cooking areas were usually used as classrooms under the tutelage of the mother of the family and the girls received their education. The boys would sit around the fire in a semi-enclosed space called *lisangu*, with the head of the family teaching them important lessons about manhood. The community leaders used to address their people in public gathering spaces under a tree, sometimes with a podium or stage about the tree. Cattle byres were also used as public gathering spaces. Further education into adulthood occurred during initiation rites for both girls and boys. Before wedding ceremonies, the girl and the boy used to separately undergo another schooling to prepare them for starting a happy and fruitful family. African rituals involve the use of speech, actions, and symbols to communicate something of spiritual value, starting from pregnancy to birth, naming, teething, during puberty, circumcision, engagement, marriage, childbearing, elderly-hood, old age, death, and the after-life (Mbiti, 1991: 131).

Entertainment was also intertwined with education. Dancing, songs, poems, praise names and stories revealed much about the people's history, customs, military tactics and sexual morality (Frescura, 1981: 122). Traditional folk tales were used to hand down a people's history from one generation to the next. Most leisure activities were not attached to specific formalised architectural forms, although some occurred within semi-public spaces defined by low earth walls and kerbs and also within reed screens approximately 1.5m high.

African people have a rich artistic history. Art involves the design of meaning by using words and objects, organising musical sounds into patterns of pitch and rhythms, creating images through drawing, colouring and modelling, and dance which involves the poetic and meaningful movements of the human body. In southern Africa mural paintings among the AmaNdebele, BaPedi and BaSotho all express culture; In all southern African societies the design of clothes and beadwork, praise names, dances, oral traditions, songs, storytelling and poetry involve the refinement of words and sound (Ntuli, 1999: 194–5).

Guests were usually welcomed with warmth. If the sun set before a traveller had reached his or her destination, then a light indicating a home in the distance brought relief. The travelling stranger hoped that in that home he or she would find hospitality and kindness, and accommodation for the night. Hospitality was the thread that kept communities strong and prosperous, whilst wars split tribes and families apart, affecting the economy. Hospitality and kindness are always desired in African communities (Mandela & Goldstein, 2003: 37).

Some aspects of these socio-spatial practises still persist in contemporary African communities. Hospitality in Bantu social and cultural fabric still greatly influences the way they relate to others and their environment today. The informal, varied, and detached enclosed spaces and organic open spaces in informal settlements should not just be erased and replaced with a Euclidean geometry to force spatial formality onto African communities. Relationship-building activities occur best in organically evolved spaces. The seamless, endless and organic routes around dwellings provide opportunities for people to meet, greet, to trade, and to watch over each other. Dwellings scattered and fragmented on the landscape provide opportunities and chances for relationship-building activities to randomly occur.

According to Rich (2002: 157), African space consists of ... *defined outdoor spaces, spaces between buildings that are treated as important public spaces, changes of level that define thresholds of entry and ritualised movement, and open-ended, multi-use spaces that contrast with specific intimate spaces* ... Plant and earth materials were used for the finishing of primitive African buildings in South Africa, and were seasonally refinished by a group of women in the community. African culture plays a role in the way spaces, ranging from intimate, to personal, to social and public, are used and inhabited (Altman and Vinsel, 1997: 189–191).

CONCLUSION: DESIGN MOTIF

A consistent sense of human scale and socio-spatial interdependence can be observed in the spaces created for different relationship-building activities in African settlements. A variety of spatial thresholds are used to separate spaces of different functions by means of low walls, reed screens, and change in floor levels. The spatial structure consists of private, semi-private, semi-public, and public spatial zones which are closely related. When developing the design proposal for an informal settlement, this spatial thresholds and demarcated spatial zones will be applied to create a spatial structure that encourage a variety of relationship-building activities in the informal settlement.

AFRICAN RELATIONSHIP-BUILDING ACTIVITIES

A Zulu proverb says, *Ubucub' obuhle buhamba ngabubili* (Good waxbills go in pairs), meaning that two people are better than one, as they can support and help each other (Magubane, 2001: 11). The African proverb, *umuntu ngumuntu ngabantu* (a person as human being exists because other human beings exist), encapsulates the essence of an informal settlement. Covenants were a common practise in African communities in order to solidify ties between people. According to Kasomo (2009: 25):

> Notably, peace has always been a major need in a society. In all African societies, there were covenants drawn up to cement a wide range of human relations and interactions. These involved issues such as marriage agreements, settling of disputes, adoption of individuals, admission into societies, arrangements for buying land and trade. These operated more formally and served as preventive measures against the potential threat to peace and tranquillity. Their intention was to cultivate peace, good relations, mutuality, friendship, respect, love between people and nature and love between people and spiritual forces.

The elders in African communities play a vital role in promoting and maintaining peace and harmony (Kasomo, 2009: 25). They are respected and considered to be moral professionals in the community. They are involved in teaching, guiding and counselling on moral values and interpretation of dreams in the community. The leadership of those elders who lead an ethical life is more acceptable to and respected by the community. Since they are close to the living as well as the dead, especially the dead who wisely guided the people in the community and contributed to the good of others while they were alive, elders serve well as counsellors in African communities.

Traditional African relationship-building activities are still ... *an integral part of our daily life, often blending with each other and with modern elements to present a fascinating juxtaposition of old and new* (Nelson Mandela, quoted from Magubane, 1998: 7). These activities continue to cement Africans together in different ways. Urban spaces should be arranged in such a way that these relationship-building activities can continue to thrive and adapt to time and technological changes.

Marwick (1978: 52) sheds some light on the ... *changes in domestic organization that Africans undergo on moving from traditional subsistence activity to participation in modern urban industrial life ... patterns of domestic organization move in the direction of those normally found in modern industrial societies; and that marriage shows an interesting mixture of emerging new trends and surviving but changed traditional features.*

African community life offers a head-start in finding opportunities to become friendly with many people. This happens best in environments where people can win friends just for the sheer joy of forming and maintaining human relationships. Making many friends for the mere reason of benefitting from them is viewed as devious and manipulative. This is considered no way to form authentic and lasting relationships. On Sundays and during weekdays many people meet in the places of worship scattered throughout townships and informal settlements. Many more valuable commonalities could emerge among church members, especially if the members meet regularly enough for friendships to result. According to Latour (2005:37), relationship building is an on-going process that must be performed continuously.

Moreover, according to Magubane (1998: 8), ... *Indigenous African culture, in common with other cultures, has always been dynamic, adapting itself to external circumstances and events ... In the course of the 19th and 20th centuries, many changes have been wrought through the impact of Christianity on indigenous religious practices, the growth of the migrant labour system, the gradual transformation of rural to urban communities, as well as responses to the realities of modern consumerism.*

CONCLUSION: DESIGN MOTIF

Most urban African communities are filled with places of worship, including special spaces, mosques and churches. If one person visits, for instance, a church group of ten individuals, and each other person had a circle of ten other friends, then the visitor would have suddenly acquired access to 180 potential new friends. In conversations after services, that visitor would find something in common with at least one of the other people there. Perhaps the two people are in similar or complementary businesses or maybe someone there knows someone whom the visitor needs to meet.

Social gatherings usually provide an environment where people can make contacts in a manner that does not reveal self-interest. Civic service organisations such as Rotary Clubs, places of worship and similar organisations usually attract all kinds of people, including those who are already very successful, and provide regular opportunities for relationships to develop in an environment of caring for others. Any subsequent business benefits are secondary to those relationships. This may not be the case with professional breakfasts, as these may be mere opportunities for self-interested and ambitious people to advertise their businesses.

SPACE OF FLOWS *

There is a new spatial form, characteristic of social practices that dictates and embodies the network society. It is called 'the space of flows' (Castells, 2004: 369). It denotes the material establishment of time-sharing social practises that work through flows. Flows are the purposeful, repetitive, programmable sequences of exchange and interaction between physically disjointed positions held by social actors in the economic, political and urban environment, in dominant social structures (Castells, 2004: 181–2). Space of flows is constituted by a circuit of electronic exchange, transportation networks, and nodes and hubs for social and spatial organisation (Bell, 2007). Space of flows also facilitates the flow of services, people and information which flow from one space of place to another.

Informationalism has induced a rise of … *space of flows in opposition to the space of place* (Susser, 2002: 315). Urbanisation has become a manifestation of how knowledge and meaning moulds society and space (Castells, 1990). New information technologies are reducing the importance of place, since economic and social activities can occur without face-to-face interactions (Leadbetter, 1999). Whether a person lives in a shack or a palace, it does not make much difference as long as he or she has a network address and can be located online and via the phone.

Information systems in geographically dispersed networks ... may be considered as … *differential factors potentiating the practices, flow, and movement of information* (Pereira, 2011: 109). ICTs help to facilitate the flow of social networks, overcoming geographical distance and political territory. The global problems that were … *left unsolved by postmodern Enlightenment perspectives*

* Space flows in this study refers to circulation routes and cyberspace, allowing the movement of people, goods, services and information.

... like … *pollution, global warming, environmental destruction, uncontrolled urbanization, human rights issues and the massacre of indigenous populations ...* (Pereira, 2011: 109) may be addressed through the exchange of knowledge using ICTs.

Information and communication technologies are speedily shifting from … *wired, fixed networks, devices and human interfaces to widely available, wireless networks and mobile devices which are integrated into activities unmoored from specific points* (Shields, 2011:xv). Along with an increase in travel, there has been a rise of the mobile economy in network societies. A mobile economy is facilitated by the integration of the Internet, e-business, and the wireless world where customers can go online anytime and anywhere, and using any device (Kalakota & Robinson, 2002). Mobile commerce refers to business transactions conducted while on the move. Users can conduct business and communicate and share information while away from their desktop computers (Kalakota & Robinson, 2002).

Since African culture, due to strong family ties and communal spirit, is in certain instances comparable to Asian culture, it is worthwhile to mention how Asian countries have responded to the Information Age and globalisation. Many global cities have emerged in Asia, more specifically along the Western Pacific Rim. According to Yeung (1996: 4), these cities are well prepared for the functions of networking in helping to drive global and regional economies forward. These cities are Tokyo, Osaka, Nagoya, Seoul, Taipei, Hong Kong, Manila, Bangkok, Kuala Lumpur, Singapore, Jakarta, and Surabaya. They have invested a great deal in physical infrastructure. Highways, satellites, wired and wireless internet, bridges and airports effectively increase mobility along with investment in the automotive industry. The cities are also

network-dependent and technologically inclined. There is a trend towards a post-industrial society which is also termed an information society. Therefore, these cities have put in place the required infrastructures for information networks (Yeung, 1996: 25-31), resulting in social, educational and economic developments.

CONCLUSION: DESIGN MOTIF

Reconfiguring an informal settlement for the Information Age requires wireless and wired infrastructure to be in place (Flickinger, 2002: 125). South Africa is currently the leading country in Africa in general and digital infrastructure, with many people owning mobile phones even in informal settlements (Castells, 2000: 122). South Africa has reliable cell phone and Internet banking services, reliable electricity supply and infrastructure, a wide range of mobile network service providers, diversified industrial and economic activities, and a solid international connection. This means the country is at an advantage for improving and using the space of flows in solving social exclusion in informal settlements. The concept of space of flows allows for informality, temporality and fluidity of activities. Horan (2000: 33) mentions that the spatial fluidness of electronic communication can link activities traditionally separated by physical space.

IMAGINING INFORMAL SETTLEMENTS IN THE NETWORK AGE

Today, humankind lives in a world where knowledge and mobility are increasing at a faster rate than at any other time in history. A new global economy, driven by the establishment of a worldwide decentralized network which negates national boundaries, has redefined the way we live, work, play and pray (Steger, 2009). This globalisation is driven by networks and

connections (Rifkin, 2000). However, many are still left behind, swimming in the pool of poverty, social exclusion, and a global criminal economy in developing countries (Bigman, 2002).

A trend towards a much more urbanised world brings with it opportunities and potentials that are within reach of each and every individual living in an informal settlement. A high urban population growth is expected in less developed regions due to the influx of people from rural to urban areas and the conversion of rural settlements into urban spaces (United Nations, 2004). Regions that are more developed are those which are the most urbanised. Underdeveloped regions are known as economically, culturally and socially more remote than developed regions (Urry, 2007: 54). However, with the increasing use of communication tools, these regions may still connect to the necessary resources to create better living conditions. Town planners, urban designers and architects may play a very important role in enabling these connections through the way they design and arrange spaces.

Urbanised areas are becoming densely populated as people migrate to them. Social networks form as people live closer to each other and co-operate to explore cost-effective ways of producing and distributing products.

This presents a great opportunity for designers to tap into the energy and potential of urbanisation and direct that to effect development. Urbanisation is like petrol. If a person spills the petrol on the ground, allowing it flow without purpose and direction, it can become dangerous if someone drops a burning cigarette on it. However, if that petrol is directed into a car's petrol tank, that petrol will be used by the car to effect movement. Planners, urban designers and architects have the responsibility to give direction and purpose to urbanisation in the way they re-arrange spaces.

Azua (2010: 13) mentions that the real revolution taking place in the world now is social networking. Social networking tools are in abundance and more affordable than ever; this includes the low cost of transportation (wires, railroads, etc.) and communication (mobile devices, cellular phones, tablets, wikis, blogs, tags, interactive games, and online social tools like Facebook and MySpace). The cost of communication has decreased in each modern historical era, and an increase in communication technologies came with economic growth (Azua, 2010: 7).

The Internet and different means of transportation have thus introduced the possibility for freer choice. A resident of an informal settlement living in a shack may have access to people, products and services from any part of the world through the Internet. People can study online, buy and sell products and services online, do bank transactions online or through their cellular phones, and interact with anyone who is available online. Even though this may be dismissed as idealistic, it is a possibility that needs to be explored. Such freedom of choice could provide the most fundamental infrastructure for socio-economic prosperity in informal settlements.

The network society and economy has made *Small* to be the *New Big* and has replaced the scarcity economy with an abundance economy (Jarvis, 2009: 54). Networking has opened many avenues of creativity, production and distribution. In this study, these great opportunities of abundant knowledge, communication tools, and a growing urban population will be explored. The role of spatial design in increasing chances for people to connect to these opportunities will be investigated.

An intertwined globalised economic, social and ecological explosion is increasingly becoming a feature of the twenty-first century. However, city residents living in informal settlements are excluded from the formal economy and depend on poor public services and inhumane built environments (Pieterse, 2010: 12). In the creating of policy, political and institutional arrangements remain rigid, unable to respond to the unsustainable systems that currently socially and economically exclude residents of informal settlements.

With the rise of the Information Age and global capitalism, the poor are becoming poorer while the rich are becoming richer (Castells, 2000). The world has changed from the Industrial Age into the Information Age, thus encouraging wealth creation and social networking improvements for those who flow with the spirit of this era (Castells, 1990). However, many people in informal settlements lack the basic infrastructure through which to access the global flow of information and resources if they do not have access to Information and Communication Technologies (ICTs).

Among the poor, growth in technological capability is limited by a fragmented institutional environment and a lack of government support. Migration from rural to urban areas, urban poverty, the AIDS epidemic, unemployment, and poor education and health care are the current characteristics of informal settlements (Castells, 2000). Can the poor find an access point to the streams of wealth flow, global networking and quality education? The growth of squatter informal settlements in urban peripheries is one way people with limited resources try to connect to

the opportunities that can be found in cities around the world.

In this Information Age, the global economy is driven by developments in knowledge and technology. Therefore, the social and economic infrastructures require that people should continually learn new things and upgrade themselves. Information technology has not been well applied in the making of sustainable urban informal settlements. Politicians have not yet fully considered informal settlement projects as processes that take a lifetime to develop (Lawrence, 2003).

The need exists to investigate how quality living standards could be attained in the informal economic sector, long before costly infrastructure is implemented by the government. One could trade profitably with almost anybody in the world through the use of telecommuting and electronic commerce (wired and wireless communities) without being stymied by distance and geographical limitations.

The late Minister Sicelo Shiceka, former minister of Co-operative Governance and Traditional Affairs (CoGTA), once announced plans for a local system that would integrate with other Information and Communication Technology (ICT) systems and platforms across municipalities … *for standardisation, collaboration and to maximise service delivery* (Moodley, 2010: 62). The late Minister's major concern was the low level of Internet penetration and lack of computer literacy in townships and informal settlements.

CONCLUSION: DESIGN MOTIF
Urban areas and informal settlements are subject to growing mobility and the forces of the Information Age. People tend to hire, buy from, and do business with individuals whom they know, like and trust. Relationships lead to economic activities; relationships come first before the exchange of money for products or services. Therefore, urban spaces should be shaped and arranged to increase chances for people to have social connections which may lead to economic opportunities. These connections should be allowed to occur in both physical and virtual space. The necessary infrastructure should be provided to facilitate the connections of people to other people, and to knowledge, products, services and economic activities.

SPACE OF PLACES *
Castells (2000) describes the space of places as the historically rooted spatial organisation of our common experience, where face-to-face interaction occurs. Space is the material support of time-sharing social practises (Susser, 2002: 315). Norberg-Schulz (1980) defines the term 'place' using the Roman concept of *genius loci*, 'spirit of place', which is the fabric of the local character, everyday life and composition of a space, characterised by a sense of orientation and identification. African social and cultural constructs determine place-making and the resulting *genius loci* in human settlements (Osman, 2004: 91).

Lock (2003: 58) explains the urban neighbourhood on the basis of habitation and the networks of mutual help and personal contacts that are created in it. These networks and relationships occur through social interaction. The essence of a neighbourhood is human interaction. An urban neighbourhood can be viewed as the most important urban element that establishes the social and economic sustainability of an area, providing the ties which hold a community together and forms its relationship to surrounding areas (Lock, 2003: 58). Lock (2003) mentions that sustainable urban neighbourhoods could be expressed as eco-neighbourhoods, sociable-neighbourhoods and model-neighbourhoods. They contain the following characteristics: *adequate size; compact form; appropriate urban density; varied mix of uses and tenure; a range of employment, leisure and community facilities; ready access to public transport; and [a] pedestrian-friendly environment …* (Lock, 2003: 60-2).

According to Wright (2006), density, diversity and design play a role in determining land use patterns. Denser urban developments allow for closer physical proximity of amenities, goods, services and activities. It also reduces urban sprawl which is created by car-oriented city planning. Three historic patterns of urban growth which gave rise to different urban forms have been identified; these are categorised as *walking, transit and automobile cities* (Newman & Kenworthy, 1999).

Diversity is another factor in land use patterns (Wright, 2006). Human life consists of diverse activities, and accessibility demands that people live within close reach of amenities, local shops, schools, local government offices and hospitals. Design requires that people make space for the activities that they need to see occurring, and helps them to prioritise the various activities that take place on city streets.

The *pedestrianisation* of urban areas contributes to the improvement of the quality of cities. It allows for better social interaction and economic growth. Through design, the connectivity and interconnectivity of movement patterns are applied to the planning and use of functional components of the city (Cox, 2010).

Mitchell (2003: 71) argues that network/digital in-

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* Space of places in this study refers to buildings and open spaces around buildings which are not primarily used as circulation routes.

teractions in space of flows should not substitute face-to-face interactions in space of places, but should rather co-act to utilise small-scale, pedestrian-oriented, fine-grained, more humane and sustainable urban environments. According to Reinhard (1998: 6), ... *there is no substitute for personal relationships, meeting people, face-to-face discussions, eye contact and all that ...*

CONCLUSION: DESIGN MOTIF

Making and maintaining social relationships just by the click of a mouse may not be as satisfying as meeting people and communicating with them face-to-face. People living in informal settlements can take advantage of information and communication technologies (ICTs) to reduce trips out of the neighbourhood, so as to strengthen face-to-face connections and interactions within the neighbourhood. In this way the process of building honest global and local relationships opens doors for informal settlement dwellers to economic, political, educational, religious and cultural opportunities.

FRACTAL SPATIAL STRUCTURES IN AFRICAN INFORMAL SETTLEMENTS *

In 1924 Benoit Mandelbrot, a French-American mathematician, introduced the term 'fractal', which is a notion to describe irregular objects. It also means 'broken'. Mandelbrot used fractional dimensions to quantify and express the roughness and irregularity of an object (Thuan, 2006: 107). The word 'fractal' came from the Latin word *fractus* which means broken and irregular; thus the word 'fractal' evokes the word 'frac-

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*   Although the term 'fractal' is not the most accurate word for describing Khutsong Section's urban fabric, the author found it most useful when seeking to understand the organic and non-Euclidean urban form. This term has also been used by other academics like Eglash (1999), Salingaros (2005) and Barabasi (2002) as an attempt to describe the nature of irregular and organic urban fabrics similar to Khutsong's.

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tion'. 'Fraction' is defined as a ... *part of a whole ... a small part, piece ...* in the Oxford Advanced Learner's Dictionary (7th Ed.) (2005). Therefore, fractals carry with them the notion of the segmentation of a shape or geometry into small pieces.

In the context of informal settlements, a fragment may be defined as an individual land parcel, spatially demarcated and used by its occupant to create private, semi-private, semi-public and public spatial domains configured according to the human scale (1cm–2m). A land parcel is used for social and economic purposes. Value can be added to each parcel of land or fragment through land development, and by using it for agricultural purposes so that the land may produce income for its occupants (Priemus *et al.*, 2007: 131). These spatial domains could be completely enclosed or semi-enclosed and demarcated for a great variety of uses. Fragments are composed of the horizontal and vertical planes that freeze space into defined, finite perceptions.

Even though not all African settlements are fractal, fractal settlements are in abundance throughout Africa (Eglash, 1999). A repeated pattern of fractals of different types and shapes exists, ranging from rectangular fractals, circular fractals, and branching fractals (Eglash, 1999: 20–38). The central property that characterises a fractal is that it is made of a structure on a hierarchy of scales. A mathematical fractal possesses self-similar structures from a large scale down to an infinitesimal scale.

This pattern is repetitive at smaller and smaller magnifications, thus connecting the different scales into a whole with regard to the geometry and processes occurring in the settlement. It takes place in accordance with Alexander's (1977) "Mosaic of subcultures" (Pattern 8), "Subculture boundary" (Pattern 13),

and "Identifiable neighbourhood" (Pattern 14).

In some of the African communities, like for example in the Ba-ila settlement of southern Zambia, social status was conveyed by the size of the house in the settlement (Eglash, 1999: 114). At the centre of the village circle was an open sacred space used for making offerings to ancestral spirits (Smith & Dale, 1968: 113). The centre of each ring of each family was the altar of each family. The importance of family was always connected to religious practice (Eglash, 1999: 28).

In Euclidean geometry, symmetry means similarity in one scale, like bilateral symmetry (Eglash, 1999). However, fractal geometry is founded on scaling symmetry; thus the symmetry exists between different scales. Some of the circular African settlements may not have the centralised location, and yet they possess fractal properties. At different levels of scales, self-similarity prevails. A variety of spatial definitions and a fine-grained settlement fabric are common in African settlements (Eglash, 1999). Small to medium to large fragments are linked by fractal open spaces. The fractal property may even be observed in the paintings and decorations on walls, body ornaments, hair plaiting, beads, sculptures, art, baskets etc. (Eglash, 1999).

Similar to the bronchial passages of the human lungs and the veins in a leaf, the pathways that connect African fragments often have a branching form (Marshall, 2005: 66; Eglash, 1999). Transportation networks in these settlements have a fractal structure. In terms of hierarchy, the wide streets usually accommodate the market place, which is fed by medium sized paths which are in turn fed by smaller routes leading to residential fragments. Informal settlements in South Africa also have intrinsic fractal properties which are similar to living systems (Otter, 2007;

Harber, 2010). The urban fabric of these settlements simulates nature with its segmented and fractal geometry.

A fractal urban fabric may be created by adding fractal substructures on every scale, resulting in a folded, crinkled, textured fabric, and undulating urban boundaries, streets and edges (Alexander, 1977). A fractal may also be constructed by punching gaps at successively decreasing scales. Moving from a large to a small scale, the holes get smaller and smaller, resulting in a perforated urban membrane. Enlarging bits and pieces of a fractal will produce a pattern similar to the whole picture, and zooming out from the whole produces a pattern similar to its components (Eglash, 1999: 18).

These fragments and fractals form and functionalise centralised and decentralised networks, depending on the flow of communication. Networks of communication like the ones occurring in informal settlements may be categorised into small world networks and scale-free networks. *Small world networks tend to have high clustering coefficients and short distances between nodes* (Recuero, 2009: 56). This network model corresponds to strong links as expressed by the systems network theory (Ibid.). *This model demonstrates that through ties made randomly between close people, the distance between the people on the planet is reduced* (Recuero, 2009: 59–67). Weak links are the scale-free …*networks in which few nodes have more connections than others. This model describes the dispersal of ties along nodes (degrees of dispersal), with low clustering coefficients* (Pereira, 2011: 114).

The smaller the size of the fragments, the more fine-grained the urban fabric becomes and the higher the randomness, complexity, uncertainty, and possibili-

ties for connections that can occur at any given time (Thuan, 2006). At the subatomic level, particles of matter possess dual properties, requiring that a whole series of similar events, rather than just one event, can be observed to make a conclusion. Scientists resign to probability and time to make conclusions as far as the subatomic is concerned. The fine-grained informal settlement fabric allows micro-scale social and economic activities to thrive and multiply (Schumacher, 1974).

By splitting the fragments of a settlement into smaller and smaller pieces, creating a porous, very fine-grained settlement fabric, the levels of possibilities and opportunities for interactions to occur amongst fragments would increase at any given time (Marshall, 2005: 226–227; Thuan, 2006). This can be compared to the urban fabric of a modern city with large city blocks and fewer small-scale paths. The growth of the spatial fractal sub-structures is the backbone of a fractal informal settlement (Marshall, 2005: 4–6). This spans across social activities, economic activities, land ownership, land use zones, streets and pathways, transportation, and even ecological issues.

The geometry of the urban fabric helps to facilitate the support of linkages so that human interactions can occur. If an infinite number of very small elemental strips are taken in an area, say of a rectangular shape, the calculus integration yields are greater in number than when finite elements are taken. From this calculus observation it can be deduced that, the finer the grain, the greater the sum of the whole (Whitlow, 1995). If a … *thing gets too big, its nature and value is destroyed* (Richards, 2012: 179).

Fractal geometry is used for both structural and manipulative purposes. The fractal nature of pathways

in informal settlements may be observed in nature as well. Blood vessels in the human body form a network, from the aorta to the small capillaries distributing blood to every part of the body. The fractal structure of the blood vessels works more efficiently to fit their large surface area within the limited volume of the body. The fractal pathways of settlements also efficiently allow the flow of people, information, goods, services and human interactions. These fractal pathways have a hierarchy of scale (small-medium-large). Small pathways feed into medium pathways which feed into large pathways which feed into larger pathways (Thuan, 2006: 108–09).

Connections and bonds are the life and energy of an informal settlement. If the fragments remain separated then a settlement has no life. Each link exists to facilitate information exchange between two fragments. The fragment could be a house, a shop, a workshop, a market, a school, a garden, a park etc. The more fragments there are, the more links may be created. This is the opposite of the modern city, which enforces mega structures and monumentality (Sadler, 2005: 96).

Each parcel of land occupies a unique physical relationship with every other parcel of land. Because in every community there exist a variety of land uses, each parcel is the focus of a complex but singular set of space relationships with the social and economic activities that are centered on all other parcels. To each combination of space relationships, the market attaches a special evaluation, which largely determines the amount of the bid for that site which is the focus of the combination. Thus certain locations are more highly valued for residential use than other sites because of the greater convenience to shops, schools, centers of employment, and recreational facilities. Corner locations command a higher price for certain types of retail use because of

greater convenience to streams of pedestrian traffic (Priemus *et al.*, 2007: 132).

Consider two fragments: a house & a small-scale furniture workshop within an informal settlement. These two fragments will need a person to go from the house to the workshop; therefore the two fragments are a house and a workshop, and they need to be connected via a physical path structure.

An estimated number of links illustrates how a fractal network in an informal settlement works. Consider $ð$ fragments. Connecting the two fragments by one link will require $ð/2$ paths (Salingaros, 2005: 8). This implies that half the fragments are houses, and the other half are workshops if each house is connected to one workshop. A far larger number of paths may be achieved if the randomly linked fragments result in a giant net (Barabasi, 2002). According to Salingaros (2005: 8–10) this large number is given by:

$$(ð/2)\lin ð$$

A majority of the fragments are connected by intermediate fragments. By directly linking every fragment without going through intermediate fragments, complete connectivity may be achieved. This requires directly linking every fragment without going through intermediate fragments for a large number of links, which is given by:

$$ð^2/2$$

Linking the fragments either directly or indirectly facilitates human interaction and relations within the informal settlement. It is expected therefore that a fragmental and fractal informal settlement with ä fragments would have linking paths between:

$$(ð/2)\lin ð \text{ and } ð^2/2$$

In order to make these connections possible, the urban fabric should be sufficiently fine-grained, with multiple transportation networks giving many alternative choices. Through permutation, this will produce multiple alternative paths.

For example, an informal settlement that has about 400 shacks, including households, pre-schools and tuck shops. Therefore, $ð=400$, giving the following estimates for the relative number of connective paths:

A randomly linked settlement has $(ð/2)\lin ð = (400/2)\lin 400 = 1,198$ paths.

A modernist city of this size would have $ð/2 = 400/2 = 200$ paths (Salingaros, 2005: 8). Therefore, a randomly linked settlement is 6 times more connected compared to a modernist city. If the settlement is completely connected then there are:

$$ð^2/2 = 400^2/2 = 160,000/2 = 80,000 \text{ paths}.$$

This is 400 times that of a modernist city and 67 times that of a randomly linked settlement. In order to achieve a completely connected settlement, pedestrian paths should be used to allow direct connections among all fragments. Vehicle access and parking could be kept to the boundaries of the settlement. The settlement and each shack can be accessed from all directions. In the informal settlement, life becomes like a game that is subjected to chance, as depicted in Archigram's *Living City* exhibition (Sadler, 2005).

The aim is to establish informal settlement nodes with distinct and unique precincts, allowing growth to fill in the links between them (Neal, 2003). The more nodes, the more variety there is within a neighbourhood, with specialised economic activities of similar or complementing characteristics gravitating towards each other in each node (Priemus *et al.*, 2007: 142). This spatial organisation concept is referred to as the Multiple Nuclei Concept (Priemus *et al.*, 2007: 142), and may occur in very close proximity to an informal settlment, similar to the way fractal structures form. For example, one node may be an educational precinct, another production precinct, the next an entertainment precinct, and so on.

Kihato, Momoniat and Gavera (2010: 31) term these phenomena *agglomeration economics,* to explain why certain urban land activities and economic sectors tend to be in close proximity to one another. This allows them to … *gain certain efficiencies from networks and concentrations* (Kihato *et al.*, 2010: 31). Land uses approved by municipalities may either promote or discourage agglomeration, thus affecting the choices that businesses have to group together or not. Agglomeration may also be enriched by mixed land uses, which also allow social activities to be integrated with economic activities. There is a need for the appropriate infrastructure to facilitate the necessary flows to achieve this agglomeration.

The more negative (one fragment needing what the other supplies) and positive (the fragment supplying what the other needs), the greater the attraction (pull effect) that links the fragments. Thus, increasing the variety of fragments increases the magnitude of the forces that establish connections.

CONCLUSION: DESIGN MOTIF

Preserving the existing fractal pathways in an informal settlement may help harness spatial connectivity in the informal settlement. Graphical techniques can be used so as to generate ideas that will help release the full potential of an informal settlement's fractal and fragmental urban spatial structure to become a well-networked neighbourhood.

ENVISIONING PLUG-IN INFRASTRUCTURE
FOR IN INFORMAL SETTLEMENTS

Although the previous discussion preferred fractal spatial structures in informal settlements rather than modernist spatial structure, there are positive lessons that can be drawn from modernist urban design solutions. *The rhetoric of the 'motor age' has been replaced by the rhetoric of sustainability and neo-traditional urbanism. Compact, dense, mixed-use neighbourhoods are back in fashion ...* (Marshall, 2005: 9). Transportation infrastructure may be designed to assume a green infrastructural role in informal settlements. The network of pedestrian paths may be layered with service systems. According to Habraken (1999: 78), *To allow the development of natural relationships in the urban situation we must ... regard each dwelling as an independent one.*

Therefore, informal settlements may function as plug-in infrastructure for micro-social, educational and economic activities (Sadler, 2005). Through this plug-in infrastructure, individual dwellings and educational and economic units can connect to the flow of people, information, goods, services, and digital communication networks. The plug-in infrastructure exhibits many opportunities for individuals who would like to connect, just as people would travel to major cities to connect to urban opportunities.

Habraken (1999: 79) calls this plug-in infrastructure a *support structure* which is a construction which allows the provision of dwellings which can be built, altered and taken down independently of the others. A street could be considered a support structure which is connected to the individual dwellings in close proximity to it. Existing pathways, streets and public spaces in an informal settlement may be designed to become efficient support structures that enhance and support self-help initiatives, relationship-building activities, variety, and micro economic activities.

An efficient, accessible and effective support structure may become the backbone of development in the settlement, allowing variety. A neighbourhood should contain sufficient variety and *fractality* to become partially self-sufficient. For a healthy urban fabric every fragment should be linked to a complementary one. The informal settlement should have an enormous diversity of fragments in close proximity to each other.

Each fragment should have several alternative paths for linking to another fragment. For example, a person may have the option to walk, cycle or drive. Physical linear or curvilinear connectivity for each linking path from the physical shelter to each fragment is therefore required. A healthy urban fabric should consist of multiple connections which impose a flowing geometry throughout the settlement. These connections which could be designed as support structures in the informal settlement should have ... *the ability ... to grow, develop and change with what goes on inside* (Habraken, 1999: 106). The support structures of the informal settlement should allow the settlement to adapt to changes in time, events, technology, family needs, economic needs, and so on. These changes should be accommodated without losing the conti-

nuity of the historical benchmarks of the residents and their city.

There must be a high density and variety of fragments so that they can induce interactions amongst themselves. The street is not merely a ... *matter of distributing the land use labelled 'transport' here and there to fit within a patchwork of other urban spaces and places ... The 'movement space' constituted by streets forms the essential connective tissue of urban public space – from the micro scale of circulation within buildings to the macroscale of whole cities* (Marshall, 2005: 13).

According to Mitchell (1996) activities, information, events, production and distribution and services that traditionally occurred in fixed geographical spaces may now be accessed in and through digital communication networks. The need for large and costly infrastructure is being replaced by the need to be online. The street space of the informal settlement (Marshall, 2005: 13) may allow access to even invisible and intangible social, educational, governmental and economic resources without the need to travel.

A mixed-use settlement will have residential, commercial, small-scale light industrial, government and religious fragments in close proximity to each other (Krier, 1998). Similar fragments should not be concentrated in homogenous areas. Fences and barriers should be avoided, while wide sidewalks, street trees, seating, drinking taps, small scale economic activities, boulevards, and street furniture that can facilitate interaction between people should be provided (Whyte, 2000). The settlement needs to be compact and well-connected at all scales, with a hierarchy from large scale (wide roads), to intermediate capacity roads, to small scale pedestrian pathways.

In settlements where transportation networks are

not lacking, cyberspace may be used to facilitate connections between spaces that are far apart (Mitchell, 2003; Mitchell, 1996). The World Wide Web and mobile technology can easily be integrated with physical connections on the human scale. These mobile technologies are pedestrian-friendly. A car network requires more physical space than digital communication infrastructure (Salingaros, 2005). The space of flows (wired and wireless communications) facilitates long distance weak links at low cost. Weak links help local settlement inhabitants to expand their social network, bringing social, economic, and educational benefits. They work hand in hand with local strong links. Since weak links reduce the need for locals to travel long distances, more time becomes available for them to maintain their local links.

There is an opportunity for an *Archigram Plug-In* type city to emerge in informal settlements so as to facilitate the ever growing immigration and flow of knowledge. *Archigram* envisioned architecture ... *not as fixed form but as a set of provisional relationships between components* (Sadler, 2005: 98). Existing relationships and spatial layers may be connected to new ones, further enriching a settlement.

This type of architecture may be termed network architecture. Network architecture is the art and science of designing and making platforms on which people can socially network and distribute products and services to other people who are connected to the network. People can do what they do best and then link to the rest of the world by joining a network (Jarvis, 2009: 24–39). Habraken (1999: 7) describes ... *housing as a totality of events which cannot be looked at meaningfully in isolation from each other. We are dealing with mutually related forces arising from all sides of soci-ety and which, if all goes well, act in equilibrium. The action of these forces is the concept we call housing and the tangible results we call towns and dwellings.*

Similar to the *Plug-In City*, informal settlements may be envisaged as events that require the ... *active involvement of its inhabitants ...,* harnessing an unending process of change and development that functionally and artistically plug into resourceful infrastructures (Sandler, 2005: 16). Connections and disconnections between individual dwelling units and the supporting infrastructure should be allowed to occur, ... *like an endless syntax* (Sandler, 2005: 19). The infrastructure along the pathways takes on Khan's *servant* role while the dwelling units and other uses are the *served* spaces (Sadler, 2005: 23).

Open spaces in a settlement may be considered as platforms for different events; therefore, the street infrastructure provides support for all the different events that may occur in the open spaces. If there is a music event, a funeral, a wedding or a community gathering, they can be facilitated by the infrastructure.

The spaces of flows permit flexibility and the unending transformation of spaces of places to accommodate the needs of people. Circulation infrastructure offers choices, opportunities and access to the resources and networks flowing through it. Individual small changes occur much more easily than changing an entire settlement with a once-off costly state-driven development mechanism. The designer remains with the task of setting in place an elegant organisation to support already existing social networking and educational and economic activities using flows and processes (Jarvis, 2009).

Micro-scale individually driven transformations are therefore enabled by an efficient space of flows that promotes self-help efforts without destroying the overall network. Similar to the *Archigram* approach ... *[f]or a world undergoing such rapid transformations ...,* this research proposes … *organic change rather than total, sudden, centralized projects* (Sadler, 2005: 50). Mega structures are therefore replaced by fragments of smart, flexible micro-scale spaces and activities that connect to infrastructures of flows in order to form a big network. Three components emerge from this design approach: (a) asupport infrastructure, (b) infill micro-scale individual self-help initiatives, and (c) a constant growing flow of services, goods, information, and social networking opportunities (Habraken, 1998; Hamdi, 2004; Lapin, 2010).

The design of and intervention in the fractal street space of informal settlements is key to providing support, enablement, empowerment, and opportunities for micro-scale self-help initiatives. Intervening in the public spaces around dwellings in an informal settlement is key to the development and transformation of the informal city (Hamdi, 2004; Harber, 2009).

Fujimura (2011: 86) lists three principles that help to generate diversity in a city:

(1) Mix small and large elements
(2) Mix new and old elements
(3) Provide a physical structure promoting (1) and (2)

These are extracted from Jane Jacobs's (1961) ideas of mixed uses, small city blocks, aged elements and concentration in order to achieve city diversity. Compactness and connectedness is crucial for creating a living city. High densities will result so as to provide ... *viable and efficient public transportation ...* and *generate vibrant local markets, which are a precondition for the generation of small-scale economic activities* (Dewar & Louw, 2012: 54).

The street takes on the functions of the roots, stem and branches of a tree. Just as the tree's structure facilitates the flows of resources that are used by leaves to produce fruits, the street is the space of flows that facilitates the flow of resources (Marshall, 2005: 163). The success of this thought will be inspected through case studies. The most important question is, which conditions are to be satisfied by the informal settlement in order to fulfil its purpose?

Urban design is defined as ... *the art of arranging buildings to form unified compositions* (Moughtin & Mertens, 2003: 233). The buildings are arranged around transportation networks and open spaces. This definition needs to be rephrased when applied to urban design in informal settlements. There is a need to improve the public spatial environment in these settlements because most ... *poor people occupy small private spaces and carry out many of their daily activities in public spaces* (Correa, 1996; Dewar & Louw, 2012: 54). Intervening in public spaces in such places is vital for improving living conditions.

Design approaches sustainability if it welcomes uniqueness, informality, changeability, collaborations, and empowerment. *Archigram* considered it ... *simpler to hand the control levers of the environment straight over to society, and let people determine…spaces directly* (Sadler, 2005: 94).

In the informal settlement the art of *arranging buildings* is done by residents, and the formal unification of urban elements becomes threatened. Fractal circulation networks may be upgraded in informal settlements to be efficient plug-in or support structures (Habraken, 1998), where residents may in-fill and connect to opportunities and to other people. This introduces a new manner of unifying compositions

in the art of arranging spaces. Affordability and accessibility should be at the door fronts or within *walkable* reach of dwelling units in settlements. Economic activities should be integrated with social activities, and ecological practices should be intertwined with economic activities. However, formal interventions do play an important role, especially in addressing issues of tenure and services.

Once the plug-in infrastructure is in place, the dwelling units, small shops and other structures do not need to be permanent. This approach requires the re-arrangement of the six S's of Brand (1994): **site, structure, skin, services, space plan, and stuff.** The site may assume the role of a plug-in structure equipped with services, and the skin of the shacks may be flexible and able to be layered with green and productive horizontal and vertical layers. The space plan and stuff are left to occupants to change and control. In 1966 *Archigram* put it this way: *buildings with no capacity to change can only become slums or ancient monuments* (Sadler, 2005: 94).

Interventions in and urban designs for the plug-in infrastructure in settlements are aimed at stirring and supporting the growth of micro-scale 'market-based' approaches to the upgrading of settlements. Ngwabi (2009: 15) defines 'market-based' urban regeneration as ... *those initiatives that seek to influence the market so as to stimulate private sector investment and urban regeneration.*

In the context of informal settlements, design should be the intermediary between indigenous design solutions and highly advanced first world technologies (design solutions). Schumacher (1974) coined the term 'intermediate technology' which refers to a bridging-technology which is more ... *productive than indigenous technology ... but it would be immensely cheaper*

than the sophisticated, highly capital-intensive technology of modern industry (Schumacher, 1974: 50). Such intermediate technologies and design solutions are within reach of locals in terms of affordability, financing, education, social structure, organisational skills, maintenance, operation, aptitude and so on.

CONCLUSION: DESIGN MOTIF

Applying a pedestrian-oriented city development strategy for informal settlements will involve small design interventions that are interconnected by fractal pathways to create a holistic urban spatial structure. This can be achieved by providing the necessary support infrastructure and applying the appropriate technologies which can be used to connect and supply multiple fragments of development. The role of the State is to provide the infrastructure that can interconnect the different fragments of space of places in informal settlements and can be used by residents to connect to the flow of knowledge, skills, services, products, and people. The most important function of these support infrastructures is to facilitate relationship-building activities, while cultivating the potential of residents to lead, maintain and expand the development of their community. This can be possible if the infrastructure and State programmes recognise, enable and cultivate existing micro scale socio-economic activities. The next discussion will look at these small scale activities and how they can grow in urban environments.

POSSIBILITIES OF MICRO-SCALE SPATIAL INTERVENTIONS IN INFORMAL SETTLEMENTS

A major feature of informal settlements is the small scale: small-scale housing, small-scale trading, and small-scale gardens. The small-scale strategy has proved to be a solution to the forces of poverty and harshness faced by residents in informal settlements

(Rudofsky, 1972; Steyn, 2008: 158–59). In the absence of adequate jobs in the formal sector, the informal sector has fragmented into small-scaled enterprises that meet the need. Informal settlement upgrading strategies should aim at creating conditions conducive to the establishment and growth of very small-scale social, educational and economic activities. An undeniable presence of very small businesses in the informal settlement indicates solutions to poverty, social exclusion and lack of services. Supporting the very small economy along with very small-scale housing and other activities could open up new inventions in African settlements.

The control of movement, activities and places of residence in urban spaces was a central weapon of the apartheid regime in South Africa (Bénit-Gbaffou, 2009: 56). After the collapse of the apartheid regime, urban spaces were given back to the people, and people of all races were free to move around and be in them. Promoting and enhancing social relationships and a community spirit in public places, streets, semi-public places, and semi-private places is key to ensuring safety and economic vibrancy. It is not enough to just provide urban spaces; they need to be configured so that they are suitable and appropriate for the culture and needs of the people who use them.

In the book entitled *South African Cities: a manifesto for change*, Dewar & Uytenbogaardt (1991: 18–21) list urban qualities which can support small-scale activities in urban areas. The urban form and urban structure of the informal settlement should: accommodate, support and enable the urban activities and events; cultivate the potential and talents of many people in the development of the settlement; allow and increase easy access to the opportunities residents generate; promote specialisation, intensity, diversity and necessary complexity to generate urban opportunities through high levels of human interaction and population density; characterised by quality integration between different urban, architectural, and landscape elements of the informal settlement; and provide a sense of identity and belonging by the provision of well-connected and demarcated private, semi-private, semi-public, and public spaces.

Therefore, by designing for the very small in scale, life is made affordable in the informal settlement. Many micro-scaled activities, products and services may be observed in the day-to-day lifestyle of the inhabitants of informal settlements. The fragmentation, aggregation, segmentation and scaling of objects and activities are solutions developed by residents in informal settlements to meet needs. Current policies and town planning schemes need to address this small scale when upgrading informal settlements.

One small-scale activity may be to plug into digital communications. By connecting to the global information network and wealth flow, the small-scale housing system and economy could develop into small and smart systems that are part of the global decentralised network. A tiny company start-up could become an integral part that connects to existing big-scale manufacturing companies, using other people's factories and distribution networks while selling to a worldwide market that can locate its products on the Internet (Jarvis, 2009).

Therefore, multiple small-scale specialised enterprises could link to other small-scale and large-scale enterprises. Connection and linking could now happen much easier because of the abundance of affordable Information and Communication Technologies. If this were the case, informal settlement housing and economic systems could remain small in size but achieve big results by reaping the benefits of being connected to a network (Jarvis, 2009: 57).

According to Schumacher (1974:16-17), ... *in agriculture and horticulture, we can interest ourselves in the perfection of production methods which are biologically sound, build up soil fertility, and produce health, beauty and permanence ... In industry, we can interest ourselves in the evolution of small-scale technology, relatively non-violent technology, 'technology with a human face' ...* Adapting small-scale and affordable technologies for production may help many small-scale enterprises to be efficient in their endeavours.

Allowing and supporting very small-scale activities and providing connection platforms for them would enable residents of informal settlements to own and maintain sustainable initiatives on their own. People can program their own activities and spaces and then connect to the local and distant social and spatial networks. Programming activities and spaces in the settlements means that spaces are not static. There would be continuous innovation, changing the spatial domains and thresholds to accommodate a growing population with its ever-growing and changing needs. This is a dynamic function of creativity and innovation. Spaces are constantly changing and, whatever the status quo, they have to be changed by individuals exercising their free will.

Individuals should be given the opportunity to constantly programme their domains, thus becoming co-creators and co-designers of their activities and the spatial features in their physical and digital spatial domains (Hamdi, 1991). The designer's function then is to make available and accessible to residents the spatial design development codes which they can use

to create and re-arrange their domains in the way each individual requires them to be. Reprogramming means spaces can be modified and new links can be formed in order to create an environment with better opportunities for building relationships and economic growth.

Small-scale urban design interventions become a big intervention when combined. *While there is certainly value in big-picture planning, it's important to recognize how slight tweaks to our urban landscape – movable chairs, trash cans – can spark big changes in how we interact with public space* (Labuz, 2009).

The upgrading of informal settlements through spatial strategy should address the human scale by creating an urban fabric that supports variety, diversity, hierarchy and uniqueness. Once fragmentation has been achieved, there will be a need to create connections between people, spaces, information and objects. Informal settlements need not be erased and replaced by a non-responsive Euclidean urban geometry. Interfering with the city system created by human beings for human beings is messing with the laws of human survival. This settlement needs a spatial strategy for sustainable upgrading that integrates social activities with small scale economic activities. The integration of these activities could facilitate long-term sustainable development of the informal settlement.

Urban planning should consider ... *the pluralistic, spontaneous, market-driven, entrepreneurial and serendipitous dynamics which shape cities in practice. This will allow the benefits of city planning to reach the poor* ... (Ward, 2003: xii). The unsustainable high cost of management, administration and other scarce resources of the state's social housing programmes makes it imperative to support self-help initiatives.

The role of design and planning is shifting from providing people with houses to enabling and supporting self-help initiatives by the people for the people. The designer may provide a structure where individuals may find many opportunities for plugging into social, educational and economic capital.

According to Ward (2003: xiii), there is a ...*vast unofficial, invisible, and unrecorded economy of a multitude of tiny enterprises and occupations among the city's unrecorded population, whose shanty settlements can evolve over time, given the right circumstances, into fully serviced suburbs ... In 1996 George McRobbie and Fritz Schumacher instigated the formation of the Intermediate Technology Development Group ... [They explain] why they accumulated a series of maxims:*

> If you want to go places, start from where you are.
> If you are poor, start with something cheap.
> If you are uneducated, start with something simple.
> If you live in a poor environment, and poverty makes the market small start with something small.
> If you are unemployed, start with using your own labour power, because any productive use of it is better than letting it lie idle.

Micro-start-ups necessitate connections to people and organisations (social capital) so that resources may become accessible by building relationships with others. Informal activities may be hinged around formal resources, so that the two sectors co-exist for mutual benefit. Small business owners can build trust and relationships with customers through direct face-to-face communication. People tend to do transactions with people they like, know and trust. Therefore, the setting up of micro-economic activities encourages individual communication until a relationships has

been built between the seller and the buyer. Many small businesses in close proximity to one another encourage cooperation between many different small business owners.

Establishing a variety of precincts within informal settlements is very healthy for the growth of small entrepreneurs. Resources can be pooled and shared amongst business owners in a vegetable and fruits precinct, saloon precinct, clothing precinct, arts and crafts precinct, African history and culture precinct, hospitality precinct, music and media precinct, bakery precinct, grocery precinct, games and sports precinct, furniture precinct, car and electronic repair precinct, welding and building materials precinct, educational precinct, agriculture precinct, pre-school and child care precinct, transportation and delivery services precinct and so on.

In each of the precincts individuals and/or organisations may be involved in organising and facilitating small-scale economic activities. A person might let it be known that they have items such as shoes, kitchenware, used furniture, cosmetic products, grocery items, building materials, or children's books which they can sell to local residents. Some of the items may also be ordered online after interested buyers have paid a deposit, and then delivered to them at the stated date. By ordering online only what has already been requested by local residents, the need for warehouses and storage is reduced and the seller saves costs.

In African communities, caring for the needy is part of the culture. Clothes, shoes, toys and any items that are no longer used can be collected and administered to needy children and residents within the settlement. Some of the items, like books, computers, toys, and so on could be made available at local community fa-

cilities to be shared by needy people, who may also contribute a minimal sum to replenish the supply and keep the charity programme going. Wedding dresses, furniture, kitchenware and just about anything one can imagine can be made available in the charity precinct to cater for the neediest people. This is a way for neighbours to help each other.

Strong local social links within informal settlements are valuable, but residents need to also nurture distant weak social links in order to enlarge their territory. Partnerships, participation and social entrepreneurship are part and parcel of the process of the development of the informal settlement. Civic engagements need to be cooperative, shifting from provider to enabler (Hamdi, 2004: 107).

Micro-scale economic activities create stronger human connections because they allow one-to-one communication. Urban design spatial interventions should provide a structure to allow multiple small-scale social, educational and economic activities. This will promote ... *intimate contact with actual people, with individuals, families, small groups, rather than states and other anonymous abstractions* (Schumacher, 1974: 62).

The informal city may collaborate with the relevant local authority through settlement committees that represent streets, sections and the entire settlement. These committees should facilitate continuous meetings and public participation that are fashioned in such a way that individuals and groups may achieve growth within a market and yet communal environment. The role of design is thus to kick-start the process by which individuals, small organisations, products, services, information, events, and activities can connect and build relationships on a continuous basis. Sustainability comes into existence through this self-driving relationship-building program.

Today's peddler is potentially tomorrow's shopkeeper (Gratz, 1989: 133). Micro-scale changes in an informal settlement can create big differences in the future. Gratz (1989) writes about how small changes by individuals and small groups resulted in a big difference in Kelly Street, located in the heart of New York's South Bronx. Middle-income families developed their homes and bought cooperative apartments and brownstones with no loans, no financing arrangements, and no government commitment, only payments from their weekly salaries (Gratz, 1989: 101). Their action was followed by people moving in, new business coming in, new cottage industries springing up, vacant stores being rented, and a strong community spirit coming to life. As long as the residents of a neighbourhood possess a strong vision for a better urban environment, self-help initiatives will develop a life of their own. In the case of an informal settlement, there is a need for stirring and supporting even the smallest self-help development initiatives. If there is quality in the micro-scale, then the bigger scale will possess integrity and quality. It is the small world that makes the big world.

CONCLUSION: DESIGN MOTIF

Micro economic activities are intertwined with relationship-building activities because they involve human relationships in different ways. Design solutions should provide the relevant support structure and framework for these activities to thrive. Small design interventions should address the immediate and long-term needs of small start-ups in manner that encourage a variety of relationship-building activities. Harnessing existing social networks and cultivating existing micro scale enterprises is crucial in ensuring sustainable in situ upgrading. The following case studies will be used to draw lessons on designing support infrastructure that promotes relationship-building activities, incremental growth and better urban living conditions in informal settlements.

IMAGINING INFORMAL EDUCATION IN INFORMAL SETTLMENTS

The ... *key factor of all economic development* comes *out of the mind of man* (Schumacher, 1974: 64). Education is the most essential resource in any society. Ideas result in economic growth, and ideas require education in order to come to fruition. Education is the key opportunity for self-empowerment and the transfer of values and growth in the settlement.

Jarvis (2009: 210) asks the question, *who needs a university when we have Google? The entire world's digital knowledge is available at a search. We can connect those who want to know with those who know ...* . Jarvis is a professor at the City University of New York Graduate School of Journalism. He is not stirring up a movement for the eradication of educational institutions, but is challenging us to rethink the way we should learn and teach. The concern of the late former Minister of CoGTA, Sicelo Shiceka that internet and computer skills are lacking in South African communities could be addressed by providing social and educational platforms in informal settlements.

Existing social networks play an important role in the sharing of knowledge, information, ideas and skills. Socialisation, research, teaching and testing could be abstracted as the key roles of a university (Jarvis, 2009). Existing universities and colleges could establish satellite connection platforms in informal settlements in order to bridge the education gap in South Africa. Social funds like the Eskom Pension and Provident Fund and other private and public social

funds could be accessed to support this educational program. The economic gap in South Africa is directly related to the educational gap. People living in informal settlements could enrol for e-learning programmes with the support structure of existing institutions.

Students could be linked to the best teachers and experts with no need for textbooks, since information and discussions could be linked online. In this way the cost of education could become affordable to many people in these settlements. Considering the history of schooling in South Africa, whereby Africans were restricted from accessing quality education, this approach could spark many positive developments in informal settlements (Ellis, 1977: 7). The problem of poor connectedness could be addressed by investigating learning and networking platforms in an informal settlement in accordance with Jarvis' (2009: 210–17) concept of a Google University.

In the process of learning, study groups could be formed which would allow for social interaction, collectiveness and support (Hirsch, Deutsch & DuBois, 2011: 4). Since residents in informal settlements descend from an oral based knowledge culture, information services should make use of audio-visual materials (Mogane, 1998: 93). These groups could function in both space of flows and space of places, collaborating in research and learning. Online teaching and testing could connect and co-ordinate the socialisation/learning processes. Jarvis (2009: 210–220) suggests that, instead of measuring accreditation through certification, students could be required to present portfolios of what they have been doing; thus learning could become a life-time activity that supports individual small businesses.

Adult education like the Adult Basic Education and Training (ABET) programme can be found in some communities (Gartenbach, 1997: 124). Homework/study centres have been helpful in some communities, although some of them faded away due to lack of funds to compensate tutors. Educational games may also be integrated into the program. Informal education may be further strengthened by connecting to space of flows, allowing residents easy access to resources. When individuals engage with learning and training programs on a continual basis, it may lead to economic growth within the settlement (Lapin, 2010: 57–90). If an effective support infrastructure is laid down first, residents are provided with many opportunities to develop and grow the economy, and then they can build themselves houses.

Education should provide information that may be directly applicable to residents in the informal settlement, for example work or employment, finance, self-empowerment, personal needs, family life, health and safety, entrepreneurship, housing, agencies, and legal and civil rights.

CONCLUSION: DESIGN MOTIF

Building on Mugo's (1999: 228–231) proposal for education in African communities, the following may serve well to raise ideas towards contributing to education in informal settlements:

1. Education should suit the African oral tradition, combining oracy with literacy.
2. Technology should be used in education for Africans. Jarvis (2009: 210) indicates the possibilities of continual, networked, and certificate-less teaching and learning through the use of ICTs. Moreover, access to social, informational and economic capital may also be achieved through the same means. Telemedicine and various collaborative programs become possible through ICTs (Serote, 1999: 352-55).
3. Education combined with production would reward learners for putting information into practical, productive use for solving daily problems and advancing human development. On the job-training for micro-economic enterprises like agriculture, sewing, carpentry, drama and so on, has been effective in African communities.
4. Education should be collective to allow individuals to contribute and share information in a group. Study groups make learning collaborative, collective, social and oral. The curricula should be relevant to the immediate and long-term development of individuals and the community as a whole. Workshops and seminars that empower Africans to advance their small businesses and careers should take place on a continual basis.
5. Locals, especially young people, may participate in interactive eco-entertainment while also learning about green initiatives. Different educational games may also be introduced to challenge locals and expose them to new ideas. The informal settlement spatial strategies should identify and indicate strategic spaces that can be used for these educational activities. This can be done by integrating ICTs and education which can take place in proposed small community halls scattered throughout informal settlements.

1.2.2 THE PHYSICAL CONTEXT

The study area is the Khutsong Section informal settlement in Ivory Park, Midrand, an area that falls under the City of Johannesburg. It was established in 1990 on a stand that was reserved for community uses like a school or a clinic (see Addendum 3 for more details). Khutsong Section was selected as the study

area because it was easily accessible for the researcher. Secondly, there were existing surveys conducted by Hideki Katayama (2004), who mapped and documented the social and spatial characteristics of the settlement. The study area was therefore suitable to be used as a vehicle to explore a visual research method towards understanding and solving urban spatial problems in informal settlements.

The study area also presented an obvious socio-spatial design problem. Residents of Khutsong have put much effort in defining and arranging spaces according to the extent of their economic means and as their spatial requirements dictate. The resulting left-over open spaces present a spatial opportunity for introducing a structure into the more organic spatial urban fabric of the settlement.

Juxtaposed building forms and urban spatial elements intrigued the visual researcher, inspiring him to look for possible spatial connections and interventions that can create an enabling environment for the residents. These spatial qualities qualified Khutsong as a suitable study area for this visual research undertaking. Khutsong as a study area has a strong sense of place reflected in the layers of informal housing activities, water and toilet services provided by the City of Johannesburg municipality, layers of ad hoc spatial interventions by residents to extend spatial territory, and the layers of other socio-cultural and micro economic activities. The following discussion on the visual research method is an outcome of and reflection on the visual investigation undertaken for the study area.

1.2.3 THE CONTEXT OF THE METHODOLOGY
INTRODUCTION

Visual assessment is a relevant and valuable tool when communicating spatial problems and solutions because: 65% of the general population are visual learners; 93% of human communication is non-verbal; 90% of all information transmitted to the human brain is visual; and people remember 80% of what they see and 20% of what they read (Long, 2015). Gardner's multiple intelligences theory recognises spatial intelligence along with other forms of intelligence like: linguistic, logical-mathematical, musical, naturalistic, interpersonal, intrapersonal and bodily-kinaesthetic (Gardner & Hatch, 1989: 4–9). Roger Sperry concludes that, although the right hemisphere of the human brain is non-verbal, it still has the ability to will, show emotions, think, remember, reason and perceive (Gazzaniga, 1998: 51–55).

Linda Kreger Silverman's research (2002) suggests that 30% of the general population strongly uses visual or spatial thinking and are better at visual learning. These visual thinkers have both spatial-temporal reasoning and spatial visualising abilities (Sousa, 2006: 224). Spatial-temporal reasoning entails visualising spatial patterns and mentally manipulating them over a time-ordered sequence of spatial transformations (Peterson, Balzarini, Bodner, Jones, Phillips, Richardson & Shaw, 2004: 2–3). Spatial visualisation is the mental manipulation of two- and three-dimensional diagrams. For this reason, the use of visual assessment as a research tool is advantageous for visual thinkers when solving urban spatial problems. Visual or spatial thinking is a non-verbal reasoning method described as rationalising concepts and ideas using mental images. Other non-verbal thinking methods are to be found in the practice of mathematics, kinaesthetics and musical thinking.

In this study the term "visual assessment" describes a non-linear, systematic, graphical analysis and interpretation of the following: firstly, the historical and current spatial design practices and trends relevant to the site and brief under consideration; secondly, the site-specific spatial conditions and arrangements, and thirdly, a range of proposed spatial interventions aimed at investigating graphics through available means so as to moderate the effects of such proposed interventions prior to implementation (Hernández, García & Ayuga, 2003: 16). The output of the assessment is a narrative visual presentation that communicates a consolidated and integrative spatial solution or idea, effecting positive change in the envisaged appearance and use of the space in question (Wagan, 2009: 21). In the process of visual immersion in relevant spatial design trends and the selected site, a design resolution of a spatial problem can be defined and can act as stimulus for the generation of spatial ideas in the mind of a visual researcher.

Urban design and architectural design as forms of visual research utilise a variety of visual materials and techniques to solve design problems and generate new visual knowledge (Sanoff, 1991; Rose, 2013). Visual research is carried out so as to reach new conclusions that are graphically generated and communicated, and to establish graphically represented facts through a systematic graphic investigation into materials and sources (see Addendum 1 for more details). *Research is an intrinsic aspect of design and an essential part of the activity of problem solving* (Noble & Bestley, 2005: 18): When using "to design" as a verb, … *meanings include to connect something, to simulate, to draft, to sketch, to fashion, to have designs on something* (Noble & Bestley, 2005: 48).

Design … *interconnects three constituent activities: imaging, presenting, and testing. Information is used as a*

heuristic catalyst for imaging and as a body of knowledge for testing (Zeisel, 2006: 22). Design is a research activity defined as a critical application of a visual vocabulary to define a spatial problem, devise methods for solving the problem, devise solutions, and communicate a resolved solution. The fundamental function of design is to organise form and space towards a purpose. A design strategy can be defined as a collection of actions focused on achieving that purpose.

Approaching the design of spaces in the built environment involves complex processes, because the practice of urban design and architecture is complex in nature, consisting of design constraints, spatial opportunities and the abilities of the designer (Lorenz & Staub, 2011). The designer must be deeply immersed in all aspects of the research project. A designer has the responsibility to interpret, analyse and apply inputs from different stakeholders, using primarily, visual communication.

Design as a visual research method denotes a process of thinking visually about space, resulting in new, visually communicated spatial decisions and ideas. Visual thinking begins with defining a spatial design problem, followed by a non-linear repetitive and experimental imagination of spatial solutions to an established problem. It is a mind process involving the assimilation, processing, manipulation and filtration of visual information aimed at establishing a new structure and meaning (LaGro, 2013: 17). The mind of a visual researcher formulates observed images and then attempts to translate and interpret them through the action of image making and drawing; therefore, the ability to draw gives a visual researcher the capacity to express and communicate visual concepts.

Through the use of diagrams, architectural or spatial ideas are analysed and generated by designers. Therefore, a visual investigation requires that the designer learns to analyse why, what, and how people see, overlaid with the designer's innate understanding of spatial order in the comprehension and perception of the world (Balmer & Swisher, 2012: 1). The creation of diagrams facilitates design analysis of existing precedents and the generation of new, visually represented design and spatial ideas. Spatial ideas are defined as architectural intentions that manifest through re-arrangements of form in an activated search for meaningful human habitation.

Diagrams are defined as abstract spatial illustrations composed of symbols that simplify pictorial reality. They provide a visual technique for collecting and sorting spatial information, test spatial ideas and explore a range of spatial solutions, helping the visual researcher to self-reflect on place-making representations and processes (Yee, 2013: 3). All this is possible through using a very specific visual language having its own visual vocabulary, visual grammar and visual syntax. Moreover, the making of diagrams affords a visual researcher the ability to communicate and engage with other involved people and peers who might help to test the soundness of core spatial ideas.

Visual researchers use models, diagrams and conceptual sketches to generate, organise and formalise ideas so as to communicate geometries of form, structural arrangement, the behaviour of structural forces, and spatial atmospheres and moods (Lally, 2007: 1–5). A systematic design-thinking process provides clarity and a philosophical approach to spatial design problems. Throughout the visual research process, graphic diagramming is used to communicate a spatial strategy for and understanding of the overall conceptual theme. Therefore, the acts of drawing spatial diagrams assist to synthesise a range of spatial solutions to a defined spatial problem. Visual diagramming serves as a graphical representation of spatial solutions in their idealised and contextualised state, allowing the researcher to explore alternative spatial solutions. It also promotes visual thinking, visualising, and a metamorphic understanding of space and habitation.

During the early stages of the visual research process, preliminary schematic diagrams with two-dimensional and three-dimensional configurations are achieved by using a combination of a point, line and two-dimensional drawings to illustrate spatial ideas (Pohl, 2012: 4–5). Analytical diagrams are then used to identify and communicate spatial components and the relationships that exist between them. As the design process intensifies, formal and spatial diagrams are used to visually express interpretations and translations of site conditions and intended spatial interventions.

A designer requires a method of design thinking in order to make choices through the design process. The methodology selected should be suitable for the purpose of the type of urban design and architectural work in question. A pattern of thought and design development sequences is communicated through visual techniques. According to Balmer and Swisher (2012: 5), a design methodology describes basic root insights and procedures of design thinking. However, the relationship between form, space and human activities is open-ended, falling victim to endless analysis and interpretation. By drawing on a range of design practices, visual research data may be analysed, coded and developed into thematic categories.

The process of architectural visual research guided

by design-polemical theory is able to link intuition, imagination, visual materials, modelling and reality towards generating new visual-spatial knowledge (De Jong & Van der Voordt, 2002:41–42; Rose, 2013: 25–26). Groat and Wang (2002: 111–119) define a design-polemical theory as a speculative abstract thought a visual researcher employs to initiate, guide and conclude an architectural visual investigation.

Putting in place interpretative processes can help establish guiding speculations and a set of design criteria so as to be able to judge and measure the design product. Consequently, a design methodology defines … *a process of analysis, visualising possibilities and a path towards judging the potential design result* (Balmer *et al.*, 2012: 6). Precedent studies and native sensibility obtained by absorbing the order of forms and spaces can be used during the interpretative design process. The analytical focus of this research is on space activities: analysing how private spaces are used in contrast with public spaces (Kenney, 2009: 159). The design investigation in this study will entail analysing and generating spaces in order to create enabling urban environments.

Urban environments are constructions in space, subjected to constant transformation under different circumstances and for different people. Everything is experienced in relation to its surroundings, bringing together memories and meanings (Lynch, 1960: 1–2). The stationary physical elements of a human settlement have an impact on the moving elements, especially the people and their activities. Residents are observers and are also part of the different events in time and space. Therefore, people's perception of the human settlement can be understood as imagery, although this can be fragmentary, mingling with other

concerns. The making of images in visual research assists to represent this imagery either as fragments or as a system.

Lynch (1960: 8–13) discusses three components to be analysed in order to understand the image of a city: identity, structure, and meaning. The image of a human settlement requires that objects be identifiable, meaning that each object is distinct from other things. Structure refers to the fact that the object needs to have a pattern or spatial connection to the other objects and the observer. Consequently, the observer can attach some practical and/or emotional meaning to that object as a result of spatial interventions and improvements.

VISUAL-SPATIAL COMMUNICATION

The use of visual communication is known to be more effective in expressing and translating tacit knowledge (Chen & Xin, 2008: 624). The effectiveness of a visual language in visual assessment lies in enabling the generation of spatial knowledge. A visual language entails the use of images, words and diagrams to transmit spatial ideas and concepts to others (Horn, 2001: 1). Visual language is composed by applying and combining the following visual units: scale, proportion, dots, lines, shape, form, colour, pattern, direction, texture, orientation, angle, space and motion (Yee, 2013: 16). The representation of concepts and ideas in spatial contexts is achieved through image making, using conceptual illustrations and visual metaphors and symbolism. Visual communication enables visual analysis, interpretation and development in all the stages of visual research. The ultimate goal is for the images in the designer's mind to be communicated to others. Crysler (2003: 189) calls this phenomenon, *Writing Spaces and the Spaces of Writing*. The resulting image relies on the combination and interconnectedness of visual units so as to communicate the geometries of form, structure, structural forces, meaning, perception, atmosphere, mood, feeling and instructions.

Illiteracy is very high in African urban settlements, hence visual communication may be a more effective way to share spatial ideas and stimulate an exchange of spatial knowledge.

The practice of using hand drawings for presenting spatial ideas comes from the inventions of ancient illustrators. Schematic two-dimensional presentations were used on Mesopotamian clay tablets and Egyptian papyrus. Architectural drawings of the medieval era were accurate drafts used for the implementation of entire sections of buildings. They included drawings and sketches of figures, buildings, construction techniques and tools. The first post-medieval architectural drawings communicated spatial architectural theory rather than technical information (Jarzombek, 2012: 1–2).

This practice was taken further in the Modern era in which architectural drawings served the purpose of illustrating architectural theories, conveying architectural information, and gaining insight through survey drawings. Sketching was used as a means to generate ideas, and presentation drawings were used for decision making purposes (Pérez-Gómez, 2005: 217–219). Painter architects also used optical illusion when surveying architectural work to reproduce actual buildings – representations which became more informative and influential than even the portfolios of their built projects (Karet & Windows, 2012: 2–4).

Artistic depictions of spatial ideas were dominant during the eras of Classicism and Romanticism, later

to be replaced by highly technical drawings during the era of Realism (Van Uffelen, 2009: 9–11). Later in the era of photography these techniques were complemented by the use of this medium. Strongly linear drawing styles with simple and clear contours and surface decoration became common, especially during the Art Nouveau era.

This interchange of visual communication techniques continued into the 19th century, characterised by horizontal and vertical projections with clear lines and rational technical drawings, with the advantages of printed reproduction assimilated into presentation drawings (Smith, 1998: 31–33). The monumental style of the 1930s and 1940s introduced a variation of drawings: expressive and heroic sketches, presentation drawings and technical drafts and drawings (Fleming, 1980: 328–346). Architectural idealists of the 1960s and 1970s transformed schematic drawings and diagrams into decorative and expressive graphic elements through the use of collages, figures, colours, perspectives and isometrics.

Twentieth century architectural visual communication introduced the use of computer-aided drawings, characterised by three-dimensional, photographic and realistic presentations and animations (Van Uffelen, 2009: 13).

For the purposes of this research, the spontaneity of hand drawings will be combined with the precision and perfection created by computer-aided drawings.

Using both visual media will help achieve a more precise representation of surveyed spaces and forms, whilst presenting the passionate spatial mood of the site and proposed spatial interventions. Consequently, visual investigation of precedents and the site will form a visual assessment framework for the generation of spatial ideas towards solving a design problem.

A variety of representational skills is required to survey, analyse, imagine and resolve spatial ideas. A design concept results from an idea. This concept can be abstracted and developed by using freehand intuitive drawings and models (Emerson, 2014: 273). Sketch drawings and models are used to record the concept, analysis and observation. Once the concept is developed, scaled orthographic projections, three-dimensional images and modelling can be used for further illustration. A research sketchbook is used to collect, develop, investigate and shape into form a variety of design references and ideas that can be applied to the design concept.

Urban spaces are constituted of geometries and forms which define spaces of different qualities. Hand drawings will be used to represent and generate these qualities for the sake of suggesting visual thoughts about what spaces in informal settlements should become; therefore, the sketching technique applied in this research combines both definitive spatial proposals and inquisitive spatial representation. Researching with visual tools goes beyond producing new knowledge. It produces and suggests more clues into a design problem, design method and design solutions.

Drawing by hand increases the visual perception of a visual researcher and leads to greater awareness of the spatial and non-spatial contexts (Ganzoni, 2014: 264–265). The skill to observe and visually record spatial elements plays a significant role during site analysis. Hand drawing begins with observing, then visualising and lastly expression. By visually absorbing a spatial setting, a visual researcher feeds and stimulates visual perception and ultimately the generation of ideas.

Visual research is composed of analytical and propositional methods – the deconstruction of existing visual work and the development of new design strategies and methods (Noble & Bestley, 2005: 92). Meanings may be decoded from the existing spatial character of informal settlements and compared to a range of related examples. A visual analysis will be engaged in order to study … *the three-dimensional open public spaces*, the *two dimensional surfaces which enclose public space, and the architectural details which giv*e the study area its special character (Moughtin, Cuesta, Sarris & Signoretta, 1999: 50). The background and level of experience of the designer as predetermined by an African informal settlement upbringing will make the research tasks more achievable.

As the goal of the designer is to produce a piece of work, a series of visual tests or design experiments will be used to gather feedback on new architectural ideas and forms of creating places for relationship-building activities in Khutsong Section. An experiment refers to a test or investigation, planned to provide evidence for or against a hypothesis. *The design process is … a series of conceptual shifts or creative leaps* (Zeisel, 2006: 22). Variations of form and space will be created so that feedback can be gathered from targeted audiences and experts within the design field. Imaging, presenting and testing will be repeated and iteratively explored through the visual research process, allowing the relative success or failure of the architectural work to be measured. Trial runs showing alternative design strategies in response to the defined problem will be used. Peer review, thick description, and a … *persuasive account based on a clear step-by-step*

analysis … (Kenney, 2009: 7) will be used to ensure credibility, transferability and dependability for the visual research method.

Successful visual communication is accompanied by writing that describes and interprets diagrams (Rohrer & Pashler, 2012: 635). Spatial and form investigations will be carried out using visual, verbal, graphic and textual methods within the architectural arena. Annotated diagrams, drawings, paintings, videos, animations, virtual reality, photographs, counting and models are tools used for imaging, presenting and testing (Kenney, 2009: 1).

The process will involve the testing of appropriate spaces and forms relative to a consistently applied set of criteria, and will be tested as a process in itself in the exploration of new and innovative architectural solutions appropriate for Khutsong Section informal settlement. Notation, pre-coded checklists, maps, plans and photographs are methods for collecting information that will be employed during the observation and reflection process of the design research.

ETHICAL CONSIDERATIONS IN VISUAL RESEARCH

There are a number of ethical issues to be addressed when collecting visual data. Obtaining informed consent from the people who appear in photographs is one way of addressing ethical challenges (Mitchell, 2011: 56). In addition to getting informed consent, the researcher should ensure that the photo's are not displayed in places and ways that harm the subjects of the photos. The researcher should cautiously create a feeling of trust with the photo subjects and put in place rules of confidentiality for the photo's used in the research (Kenney, 2009: 113).

The following questions should be ethically addressed when conducting visual research (Jones & Watt 2010; Silverman, 2001): Informed consent (Do participants have full knowledge of what is involved?); Harm and risk (Can the study hurt participants?); Honesty and trust (Is the researcher being truthful in presenting data?); Privacy, confidentiality and anonymity (Will the study intrude too much on group behaviours?); Intervention and advocacy (What should researchers do if participants display harmful or illegal behaviour?).

The issue of unplanned-for ethical queries may arise due to unexpected new interests and themes that emerge during the research (Jones *et al.*, 2010). Those affected by the research should be identified according to their wishes, for the topic and questions to be framed in an ethical manner.

In this study the following procedures were followed to address ethical concerns: no direct engagement with community members through specific questionnaires and interviews took place – the study rather focused directly on the built environment in Khutsong Section informal settlement; where photography was used, careful measures were taken not to identify individuals, and children were not included; all pictures where individuals are identifiable were either edited to conceal their identity or deleted; all visual materials produced from observations of spaces and activities are presented in such a way that they do not become intrusive.

MEASURING VISUAL SOLUTIONS

It is not easy to measure the quality of a design, as it contains both objective and subjective components. Although some design indicators may be measured objectively, others lead to intangible assets, reliant in part on the subjective views, experiences and preferences of the individuals interviewed about them. In the study the general agreement concerning the quality of design indicators is that … *good design often resulted from complex and uncertain starting points …; that the process was often evolutionary and non-linear, involving interdisciplinary approaches …; and that it resulted from iterative cycles of cumulative development, where 'satisficing' decisions are acceptable, rather than optimal results* (Gann, Salter & Whyte, 2003: 320). Outcomes of visual research in this thesis will be measured using developed spatial patterns as identified in precedent and context studies. Visual spatial explorations will integrate the technicalities of spatial urban analysis, the complexities of urban simulation, and the specificities of urban design.

Visual research is idiosyncratic and qualitative, and is therefore not easy to measure and evaluate using quantitative approaches. By using spatial thinking and composition fundamentals taught in architecture and art schools, visual researchers can formulate visual assessment criteria. Personalised visual communication techniques developed over time through constant practice in sketching, drawing and model making equips a visual researcher with intuition regarding visual evaluation (Czech, 2014: 267–268).

Allowing other visual experts and even the general public into the mind and ideas of a visual researcher through sketching and drawing is a way to address subjectivity in the visual research process. Imaging occurring in the mind of the researcher can be transmitted to others through image making and development. Visual thinking and communication stimulate a dialogue between a researcher and other visual experts, helping to control subjectivity in a visual study.

Visual learning and research holds credibility com-

CONCLUSION

APPLYING VISUAL ASSESSMENT IN SOLVING SPATIAL PROBLEMS IN KHUTSONG SECTION INFORMAL SETTLEMENT

parable to that of linguistic approaches. A visual cognitive system involves creating images in the mind, manipulating and evaluating ideas before, during and after externalising them (Archer: 1965). In Bloom's *Taxonomy of Educational Objectives,* six cognitive levels of behavioural complexity in visual learning and visual content production (Wagan, 2009: 32) are interpreted as follows:

1. Visual knowledge: collection and recall of spatial information.
2. Visual comprehension: visual translation, interpretation or extrapolation of spatial knowledge.
3. Visual application: the application of spatial knowledge to a new situation.
4. Visual analysis: the graphical dissembling of spatial knowledge into parts and the identification of relationships between these parts.
5. Visual synthesis: bringing together pieces of spatial knowledge to form a whole and build relationships for new situations.
6. Visual evaluation: judgements about the value of spatial inputs, outputs and methods for a given purpose/spatial problem.

Diagrams and presentation drawings are graphical tools that will be used to visually communicate urban spatial ideas. Spatial ideas that are still floating in the mind of a visual researcher become accessible to people other than the researcher when condensed and crystallised into diagrams and drawings. Formal and functional precedents that are relevant to the design problem will be used to justify, validate and measure the resulting spatial solutions for Khutsong Section. These precedents will provide references and inspire spatial ideas in the visual research process (Righini, 2000: 85). The ultimate presence and meaning of these condensed and crystallised spatial ideas are accessible when they are made into a physical model. If the scale of the model approaches 1:1, these ideas are even more accessible.

In this thesis the term "visual research" is used to denote the following set of research activities: precedent studies – whereby socio-spatial aspects of settlements in Africa and other third world countries are documented and analysed using photographs, diagrams and drawings; site analysis – involving a visual representation and analysis of existing spatial arrangements in the selected study area and entailing site visits, site photographs and notes, site analysis sketches, maps, and analytical sketches; visual-spatial exploration – towards idea generation through exploratory, interactive design sketches and models; a design product represented visually (with drawings and model) as an outcome of the synthesis of the precedent studies, site analysis and design exploration process.

Great architects get their inspiration from other fields, architectural precedents, and all forms of visual culture (Kiroff, 2002: 259). Visual expression is a central advantage when conducting visual assessments of precedent studies, spatial context and spatial solutions. A visual researcher's background, expertise, skills and spatial frame of reference drive the visual research process. These factors ensure the availability of a visual language to communicate spatial ideas – the graphical representation of existing and imagined space. When analysing precedents and context, sketches and drawings are used to extract spatial elements and establish relations between these elements.

Interpreting and translating the structure and meaning of spatial precedents, and ultimately deducing spatial arrangements that effect positive and negative visual and spatial impact, visual researchers sketch and draw to understand, be aware of and learn about spatial content. When generating ideas, visual communication techniques facilitate the testing and synthesis of ideas by exploring, integrating, relating, editing and changing graphic representations of a range of spatial solutions.

In this study precedent studies are defined as the investigation of historical and current spatial interventions and arrangements in the cultural, social, economic and political contexts of African and other third world country settlements. These include formal and functional spatial solutions in countries, cities, suburbs, villages, neighbourhoods and houses that have come before (Righini, 2000: 178). For the visual researcher they help to connect the contextual framework, intent and working process of the visual enquiry and its outcome.

Drawings and photographs will be used to represent spatial elements by studying their interrelationships in accordance with to evident spatial experiences and uses.

Thereafter, translation and interpretation of these spatial elements will be done through image-making techniques, with the aim to record observable African threshold spatial patterns that can be applied further on in the site analysis and design exploration process. The visual study will investigate how vernacular and contemporary building forms are related to context and culture through the ordering, organisation and massing of spatial elements. Both formal and functional precedents will be used to justify and

guide specific architectural interventions in Khutsong Section informal settlement.

Site analysis involves the identification of spatial and non-spatial problems, potentials and components on a specific physical site. The site analysis is completed by establishing relationships between these problems, potentials and components in a study area, culminating in developing a site-specific design problem. The use of observational and life drawing to document current spatial arrangements becomes important in this research activity.

Drawings will be produced to represent identified spatial elements and their relationships to each other, explaining existing spatial arrangements and experiences. A visual researcher requires drawing skills as well as skills in photography to record site-specific spatial conditions observed on site. The aim of this exercise is to grow the researcher's awareness of fundamental systems in the study area, preparing the ground for a design exploratory drawing process.

An expected outcome of the site analysis is a clear and comprehensive representation of existing spatial profiling and structure using drawings and models (Zimmerman, 2000). Site analysis entails the taking of inventory and evaluation of the spatial, formal, functional, cultural, contextual and historical aspects of a selected site so as to formulate a design problem and identify the potentials of the site. In site analysis, visual illustrations will be used to map the spatial structure and profile which have a bearing on the social and cultural value of the study area. Through this process the visual researcher will come to understand the underlying causes of the atmosphere of a place and therefore respond appropriately to context and possible pressing issues. The existing spatial ele-

ments will be integrated within a proposed redevelopment plan to continue the site's sense of place and enhance its intrinsic value.

Photographs extended into drawings of maps, sections, three-dimensional sketches and models will be used to represent and interpret the socio-spatial qualities of the site.

The term "design process" refers to the association, synthesis, introduction, evaluation and reassembly of spatial elements through image making and model making towards creating a systematic spatial solution to solve an established design problem. Idea-led forms of visual communication entailing the generation, analysis and development of ideas are dominant in this research activity. Therefore, conceptual problem solving and interrelation of spatial elements in an iterative visual research process will be attained through exploratory drawings from memory and imagination. This iterative design process leads to a richer design product (Unger & Eppinger, 2011: 698). Rather than forcing linear thinking, a visual researcher benefits from lateral thinking, used to conceptualise and develop spatial solutions.

In this study visual communication techniques will be used to effectively produce spatial solutions through idea generation and experimentation in the design process. Spatial profiles and patterns deduced from precedents and site analysis will be applied to ensure an integrative site-specific spatial response. Image-making techniques and other means of spatial exploration promote an iterative visual dialogue to ensure a multi-faceted investigation of the design solution (Mehalik & Schunn, 2006: 528–529). This exploratory and investigative mode allows the re-

searcher to reflect, be self-critical, learn and improve while unveiling personal values and design problem-solving skills. The outcome of this activity is a visually represented spatial design solution possessing the strengths of a range of spatial design solutions produced in the process.

The term "design product" denotes a narrative visual representation of a spatial and systematic design solution. The product consists of interrelated spatial elements forming a whole which is visually represented as new work accompanied by new conclusions. Integrative, site-specific designed spatial solutions will be visually represented using drawings and models. Design solutions are usually not flawless, but present consolidated solutions which, while having restricted possibilities, also have the potential for further improvements in order to concretise a particular spatial scenario. They allow the visual researcher the opportunity to reflect on the value of visually represented materials and visual methods for a given design purpose or problem.

The concluding stages of the research will involve the convergence of the most successful and effective results of the investigations already undertaken, along with the initial problem or idea; therefore *one ... acceptable response within a range of possible solutions ...* will be achieved (Zeisel, 2006: 22). A complex series of factors will be synthesised, ranging from technical production processes to understanding the meanings of space and form and addressing socio-spatial issues. The process of design is intertwined with the process of making the designed form or space; therefore the design process will be documented as evidence that will be used to measure the success or failure of the resulting spatial solution, by referring to design constraints and requirements that will be established in the research process.

PART 2
Research

2.1   AN AUTOBIOGRAPHY OF THE VISUAL RESEARCHER

I was born in 1983 and brought up in Mabeleni, a rural informal settlement located 50 kilometres east of Mbabane the capital city of Swaziland. Mabeleni is a siSwati word that may be interpreted as food or sorghum. People gave it this name because the land boasts numerous water springs, high rainfall, streams, green mountains, arable land and very diverse flora and fauna. Although most of the land in Mabeleni is owned by Caucasian farmers, the remaining portions are classified as Swazi National Land occupied by indigenous Swazis and overseen by a chief on behalf of King Mswati III. This sparsely populated rural settlement was headed by the late chief Mdweza assisted by his *tindvuna* [tribal councillor or headman], *umgijimi* [messenger], *mabhalane* [secretary], and *emancusa* [land agents] when I was just a young boy.

While attending primary school at a Dutch mission school and later at the African Evangelical Church mission school, I spent most of my years in my uncle's homestead. This was a cluster of nine detached buildings interconnected with a series of open spaces. He walked with friends and my cousins for about two-and-a-half hours in each direction to school and back. I have more than twenty cousins with whom I shared space to sleep, eat, play and do daily household chores. During the day, as young boys, if we were not at school we would play at open spaces around houses of the homestead or walk to the nearest rivers to swim and gather wild fruits.

We had no toys, so we made our own toys using stripped car parts from scrap cars to make toy guns and wire to make toy cars. Sometimes we would walk into the forests and sculpt wooden spoons from pine trees or dig clay near river streams and mould bulls to play with. In the evening as boys we were responsible for gathering and driving our uncle's cattle, goats, sheep and horses into their kraals. Girls spent most of their time with the mothers helping with domestic work. After all the gates and kraals were properly locked, everyone gathered around the kitchen wood fire cooking stove patiently waiting for supper. Sometimes boys were given food in one big kitchen bowl and so we would gather around and eat together. Our family had no television then, so we would listen to the radio to know what was happening in the rest of the country and in the world. I used to imagine the audio short stories which aired on our local radio station. This was a time to bond and talk about what happened during the day followed by instructions from uncle about what of needs had to be done the next day.

Boys worked together while talking and sometimes singing to lighten the burden of the work under a scorching sun. Boys were given the responsibility to repair boundary fences, plough the fields, erect the structure of stick and mud [wattle and daub] houses, fetch water from the river, attend to all domestic animals, slaughter animals and assist with building activities. My uncle owned a truck which he used for the supply of river sand, plaster sand and rocks to construction sites. Therefore, sometimes during weekends, I assisted him to service and repair the truck.

> What I defined as a home was mostly the vast open space around and within our fence where we spent most of our time and the small houses that provided shelter from the rain and darkness.

Growing up surrounded by a large family, a vast open space and neighbours, school teachers and traditional community of leaders framed the way I perceive space and the way space can be used.

I learnt *Ubuntu* [the spirit of humanity] from the practical examples, instructions and rebukes from my elders. I was taught to show respect to all people, young or old, to care and respect nature, to be the first person to greet any one I met on the way, to kneel and look down when communicating with an elder, to share the little I have and to support our neighbours when celebrating and when mourning. I observed different kinds of people practising *Ubuntu* all around my community at school and even in urban areas. For example, every child knew that when an elder enters a room or a bus the child should give up a seat for that elder.

I watched how our neighbours approached our homestead. They would, while still at a distance from the houses, announce themselves, chanting the surname and praise name of the head of the family. This meant that trees were important in the open spaces because that is where the visitor could kneel or be seated under the shade, while waiting for the adults to attend to them.

We planted avocado trees, peach trees, banana trees and guava trees along the edge that separates the crop fields from the open spaces of the homestead. This is where adults would spend their time under the shade on a hot day and usually used the same space to entertain visitors. Seating in this location provided a good view to the surroundings, especially the crop fields so as to be able to watch against straying cattle and goats.

Although the wire fences allowed people to enter from any direction, it was designed to guard against intruding herds of cattle and flocks of goats and sheep. The second boundary within the fence of the homestead was either a screen wall, covered and sometimes uncovered a low seating wall or raised platform in front of the main entrance into each dwelling. This is another space where I would spend time, having social conversations with friends or seated while waiting for someone to come out of the house. This gesture respect for the privacy of the individual inside the house.

Although most of the cooking and other domestic activities were carried out inside buildings, our family viewed the completely enclosed space as a space made specifically for private activities, mostly for sleeping. Therefore the greater part of our daily activities occurred in outdoor spaces, we played outside, we worked in the fields and open spaces, our pit latrine was outside, we sometimes cooked outside, we ate under the shade of houses and trees and I used also to bath outside. Within the boundary fence of the homestead I felt safe.

Fridays were very exciting to me because most of my cousins would come back home from boarding schools and from the city. When as boys, there was a full moon, we visited friends and walked to the fields to play games. Sometimes Saturday mornings after milking the cows and releasing all the animals into grazing fields we invited our friends and ventured into the mountains to gather honey, wild fruits, hunt rabbits and birds, play soccer and do many other things boys and my community did. My uncle had a scrap Audi car which had a sound body, so sometimes on Fridays my two cousins and I would sleep in the car just to have a different experience.

In 1995 my uncle passed away while I was writing final exams in the final year class when in primary school. The space my uncle created for us was no longer the same. Before he left us, I knew that as long as I was within the boundaries, I was protected and I had a father figure to take care of me. Therefore, after this sad event in 1996 I left Mabeleni behind with her many hills, valleys, gorges, friendly neighbours and family members. Whenever I visited the rural settlement, childhood memories of the activities that took place in the different spaces would return as I watched the houses my uncle built fall apart.

I migrated to an urban informal settlement called Mahwalala in Mbabane, Swaziland and moved in with a family relative to obtain high school education.

We shared a room in a mud compound of six rental rooms. This was a place with many mud houses, rammed earth houses and very few concrete blocks houses. The settlement was without clean water, tarred roads, electricity and sewerage services. After school I would walk about 30 minutes to reach a stream where I would fetch water and carry a 20 litre container back home.

The open spaces around the rental mud houses did not feel safe. Therefore, I spent most of my time after school inside the house. A network of pedestrian pathways meandered around houses without boundary fences, as we had had in the rural settlement. I learnt to cook for myself and do all the household chores because the relative I lived with worked night shifts.

Since there were no cattle to be gathered from the fields any longer, I had a lot of time after school to visit friends and hang out with them in the nearest grocery store. I also enjoyed quiet time, drawing houses as far as the capabilities of my architectural exposure allowed. Most boys would be either spending their time socialising at shop frontages or playing soccer at a make-shift soccer field near a commercial node in Mahwalala.

Space felt small and so limiting in the urban informal settlement, located illegally on privately owned land. On a day in 1996 I was standing at the door of our room watching pedestrians walking in front of our room when I made a decision that I would study architecture so that I might one day improve the lives of people living in informal settlements. I imagined different house forms that may make my settlement look better and safer for all people. I believed that, through spatial interventions informed by existing systems in the informal settlement, urban living conditions for the poor can be better than what they were then.

In the late 1990s, through the effort of community leaders and initiatives of the state, the private land was bought from the owner and its residents were allocated plots. Road infrastructure and services were provided. What used to be a high-density informal settlement is now transforming to be a suburb with property values growing annually. When I left Mahwalala in 2003, it was evident that the community-driven and state-funded informal settlement upgrading project resulted in spatial interventions that were in synergy with existing systems, thus yielding positive outcomes of upgrading of the informal settlement. In the following visual essay, I make a reconnaissance of my socio-spatial experiences as a means to tap into African indigenous and tacit understanding so as to inform visual-spatial research or design processes (*see Addendum 2*).

A VISUAL ESSAY
OF SCENES FROM CHILDHOOD

1.001

1.002

1.003

1.001 I was born in car on the way to the hospital – 1983.
1.002 My uncles sitting in the shade of a tree and me kneeling as a gesture of respect when talking to them – late 1980s to 1995.
1.003 A family meeting in a beehive-shaped house – 1983–1995.
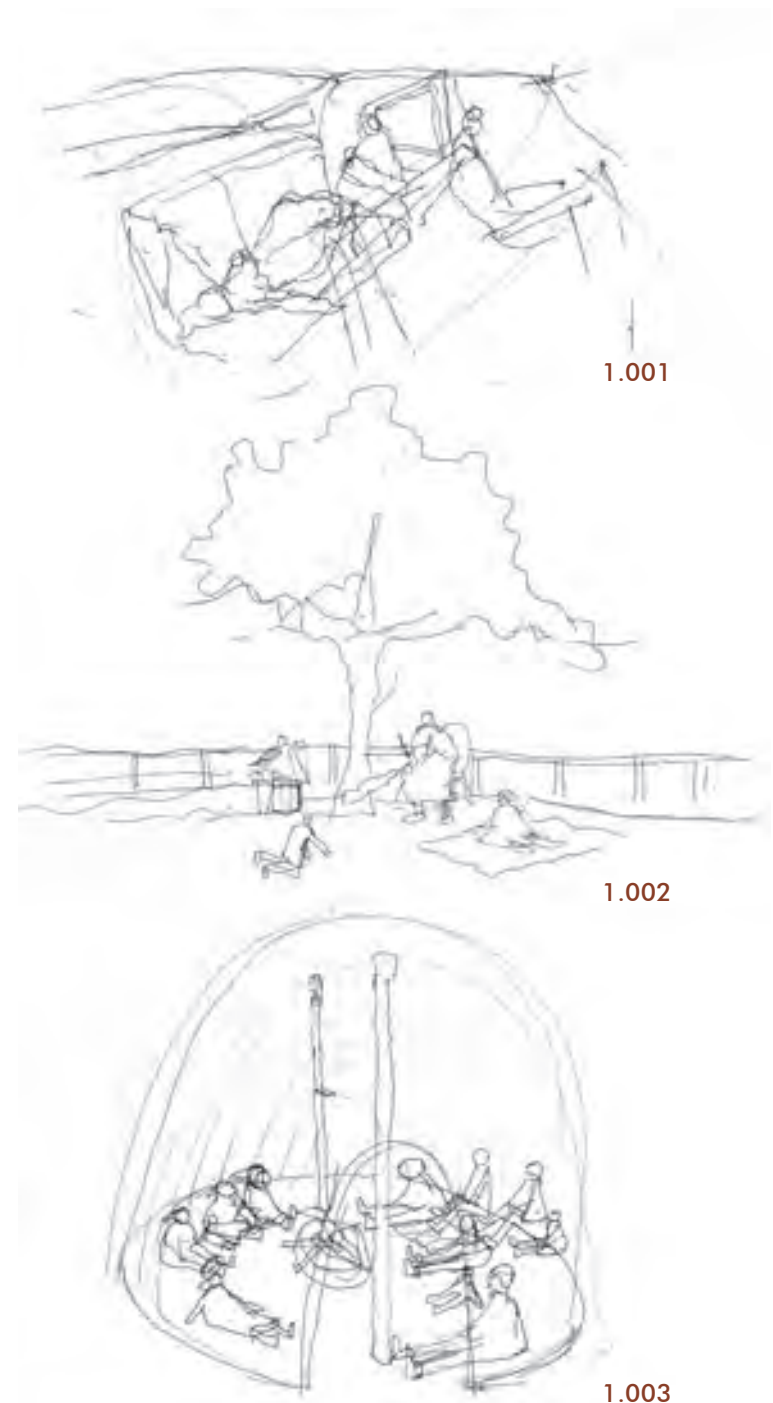
1.004 My uncles, cousins and me around a fire-wood stove in a kitchen – late 1980s to 1995.

1.005 My uncle's wife doing laundry at a river while my cousins and me playing 'grass sliding', late 1980s to 1995.

1.006 My cousins and me as boys socialising, sitting on rocks under a tree – late 1980s to 1995.

1.007 My cousins, friends and me playing football – late 1980s to 1995.

1.010

1.008

1.009

1.011

1.008 My cousins, friends and me swimming on a very hot day – late 1980s to 1995.

1.009 My cousins, friends and me sliding down slippery river bedrock, where I almost lost my life –1995.

1.010 My uncles, cousins and me planting maize – late 1980s to 1995.

1.011 My cousins and me slaughtering a sheep for a family ancestral ritual – late 1980s to 1995.
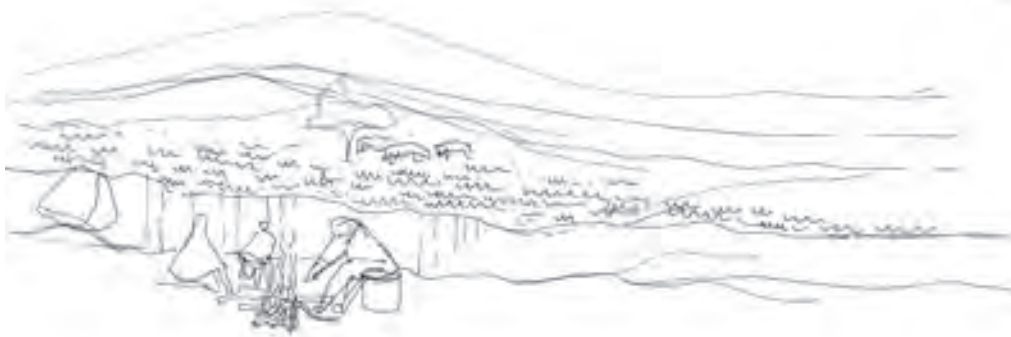
1.012

1.014

1.013

1.015

1.012 My cousins and me sitting around a fire in a cold day, and siyting under a tree in hot day, watching a flock of sheep nearby – late 1980s to 1995.

1.013 The urban settlement in Mbabane, where I stayed between 1996 and 2003.

1.014 My cousin getting married in the kraal – late 1980s to 1995.

1.015 My uncle's funeral – 1995.

1.016
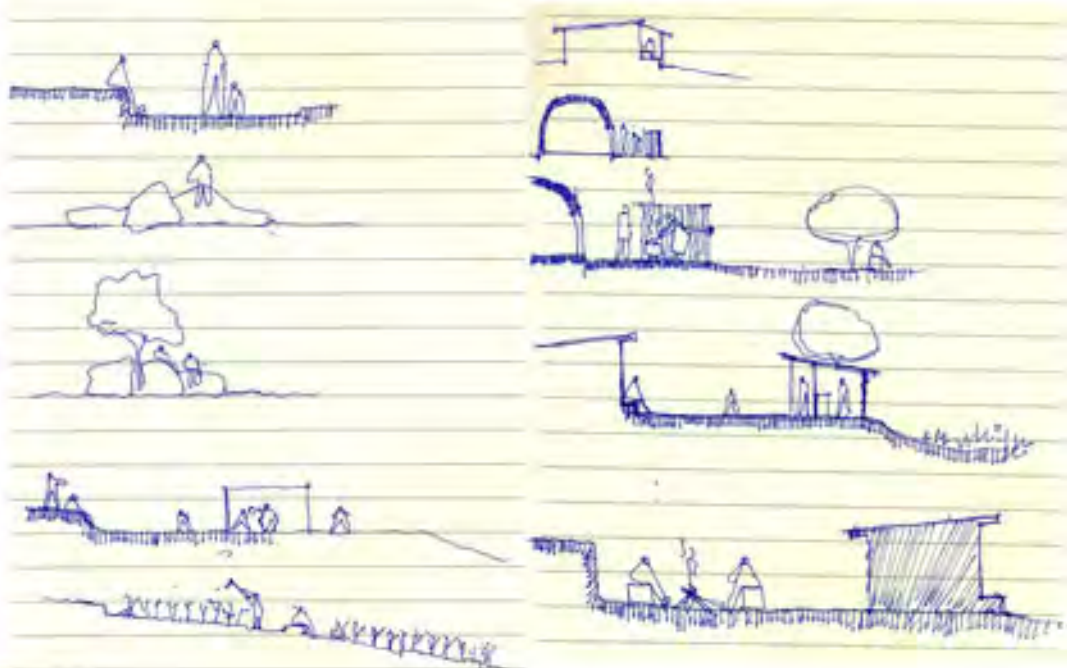
1.019

1.020
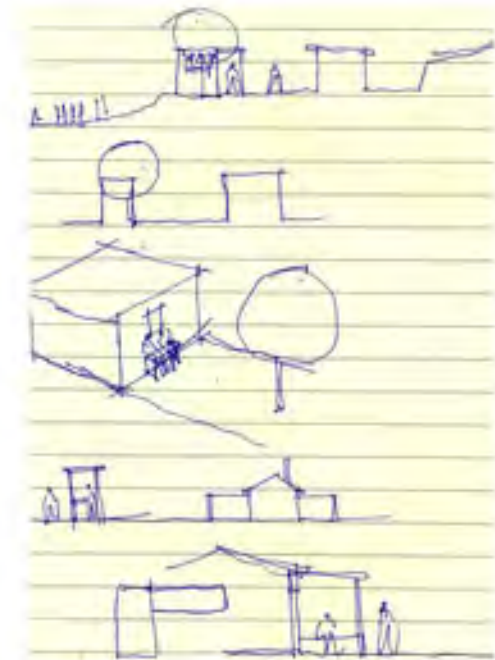
1.021
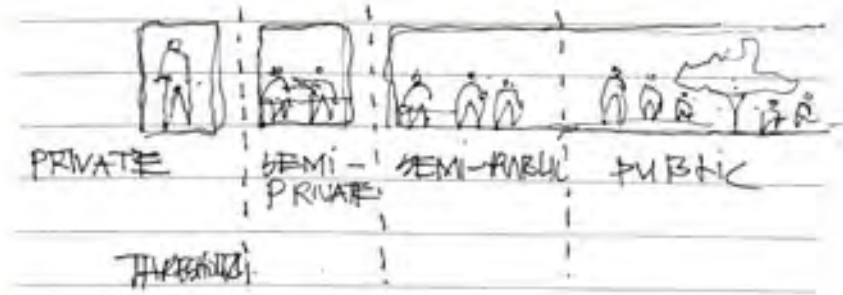
1.017

1.018

1.016 The use of semi-public spaces in the rural informal settlement.

1.017 People seated in front of a local grocery store in rural and urban informal settlements.

1.018 My uncle's homestead where I was born and brought up – 1983–1995.

1.019 The use of public spaces in the rural informal settlement – late 1980s to 1995.

1.020 The use of semi-private spaces in the rural informal settlement – late 1980s to 1995.

1.021 Spatial layers in my uncle's homestead: public, semi-public, semi-private and private – late 1980s to 1995.

PHOTOGRAPHS OF RURAL AND URBAN INFORMAL SETTLEMENT WHERE I GREW UP

1.022 A winding road through wattle forests planted by local residents of Mabeleni, opens up to this memorable view – late 1980s to 1995.

1.023 This area is called Mabeleni to mean that there is plenty of food because the soil is good for agriculture and the area boasts many rivers, streams and springs – late 1980s to 1995.

1.025 A view to the Dutch mission school where the author attended primary school in 1991, near the school is a cattle deep-tank where the author used to dip his uncle's herd of cattle once a week.

1.024 This is the dusty road the author walked as a child to school and back. It meanders around hills, climbs over mountains and crosses many rivers – late 1980s to 1995.

1.026 A sunset of this quality brings comfort to the residents of Mabeleni, a land of many wattle forests, hills, rivers and rocks – 2014.

1.028 Electric power lines funded by the Chinese government span the landscape of Mabeleni. This sparsely populated rural informal settlement is developing into an urban area – 2014.

1.027 Constellations of rocks dresses this hill near the author's bus station with, texture, shadows and geometry, a memorable scenery – 2014.
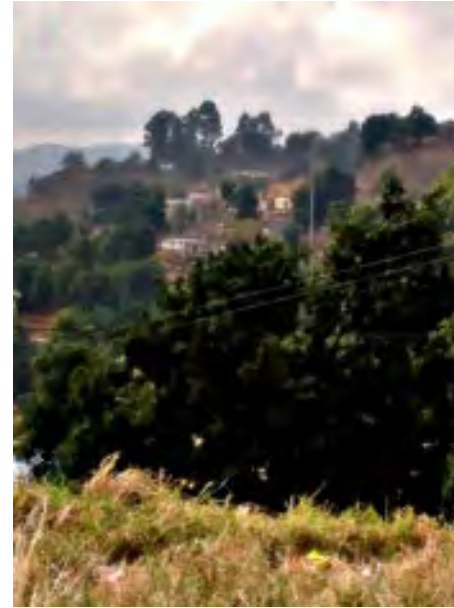
1.030 This place is called Mahwalala, an urban informal settlement in Mbabane, upgraded from 1996 to 1999. I lived here while attending high school – 2014.

1.032 This old wattle and daub house engulfed by gigantic trees that provide shade for outdoor seating will soon be demolished, to be replaced by a new concrete block house – 2014.

1.029 This is African Evengelical Church (AEC) Mbuluzi Mission where I attended primary school from 1992 to 1995. I used to walk an hour and half from home to this school – 2014.

1.031 Old wattle-and-daub houses co-exist with new modern concrete block houses in Mahwalala, where self-help housing is a process enabled by provision of services and infrastructure – 2014.

1.033 Here is another up-graded urban informal settlement in Mbabane called Makholokholo, depicting neglected urban spaces and a mixture of houses, churches and schools – 2009.

1.034 A tree-lined street in a suburb known as Saint Marks because it was formed as a result of the Aglican mission station and school 1 kilometre away from Mbabane CBD – 2006.

1.035 This is the only well-used park in Mbabane, called Coronation Park, and populated with pine and gum trees in a network of wetlands – 2006.

My wish to pursue architectural studies was realised in 2003 after enrolling at the University of Pretoria, Department of Architecture. I had no academic background in art or technical drawing. With a fresh mind and a determined spirit I developed my visual vocabulary from the design principles we were taught at that time, used when constructing illustrated images to represent spatial ideas. These principles are: perceptual skills, perspective and foreground, middle ground and background, space and depth, relative dimensions, scale, positive and negative, texture, direction, line, shape, form, volume, composition, colour and value. I practised my sketching skills through the coaching of my classmates, imitating drawing techniques in published sketch books, drawing trees and other objects until I developed my personal visual vocabulary.

I understood that the success of a visual research depended on my passion, originality, creativity, distinctiveness, flexibility and constant effort. The more I perused design literature and the more design projects I did, the more my ability to combine my unique personal visual language, image-making and visual storytelling skills with generic skills and multidisciplinary methods improved. I brought my childhood and personal spatial experiences and background to the design drawing-board in search for a visual storytelling skill and developing my drawing skills to record and develop spatial ideas. I have also developed reflective and independent visual learning by leaning on my strengths and understanding my weakness.

As a visual researcher I have developed a personal visual language and the ability to generate, manipulate and articulate spatial ideas in response to place-making trends and the physical, social, economic and political context. I draw from memory and observation combined with analytical and exploratory drawing with the aim of creating a narrative and for sequential visual representation or abstraction of spatial solutions. In the process of my visual research, visual communication entails conceptual illustration, symbolism, visual metaphors, representational and abstract imagery as well as the representation of objects. I use drawings for proposing spatial ideas, setting constraints, researching, conceptual thinking and the application of visual metaphors, similes, analogies, comment, humour and graphic narratives. In the following architectural visual portfolio, I exhibit visual-spatial problem-solving techniques and communication skills that I have acquired during academic tutelage, internships and practice.

A VISUAL-SPATIAL PORTFOLIO
DESIGN INCEPTION DRAWINGS

1.036 Student project, mixed-use development, Des Baker Competition 2005.
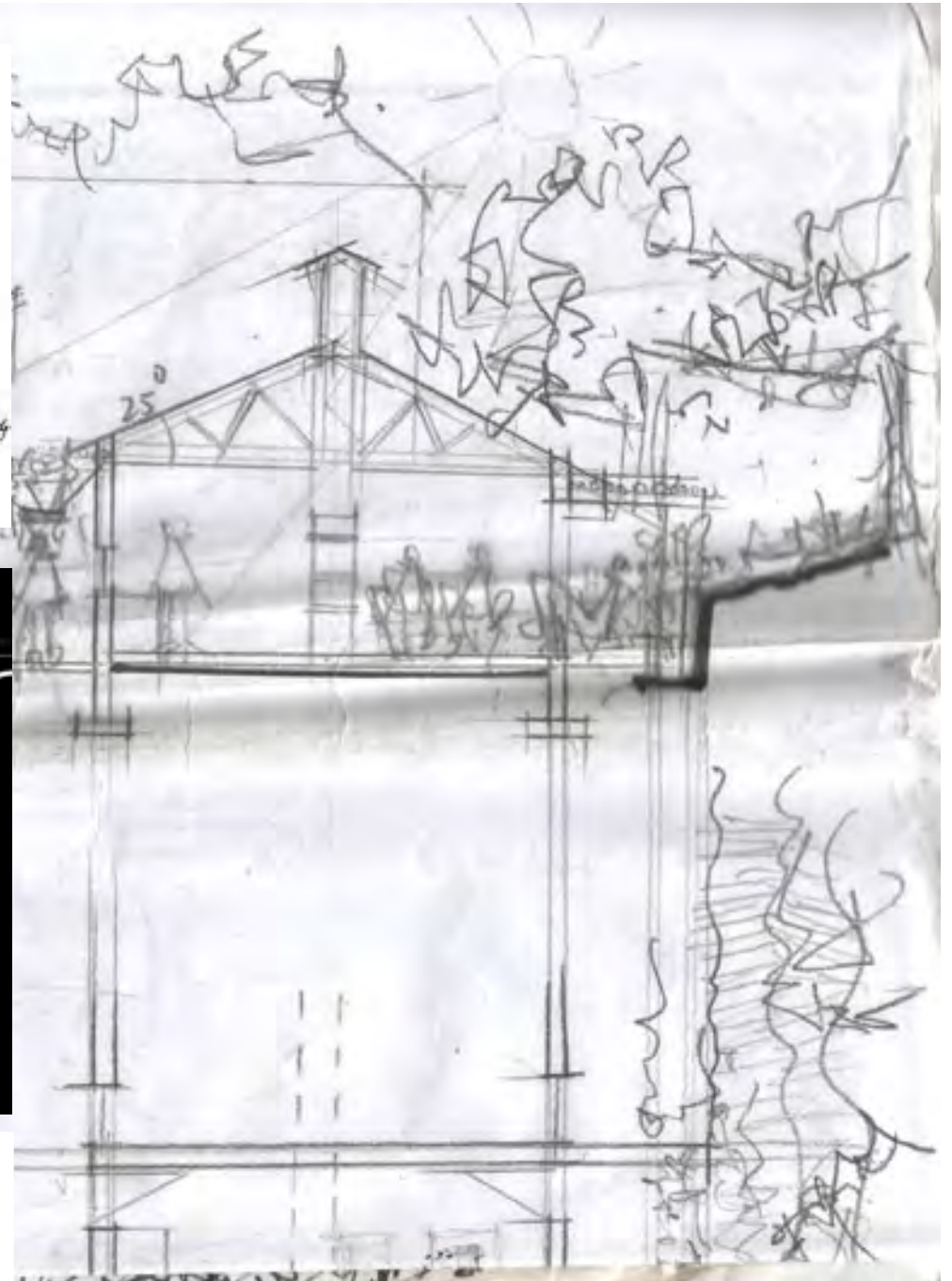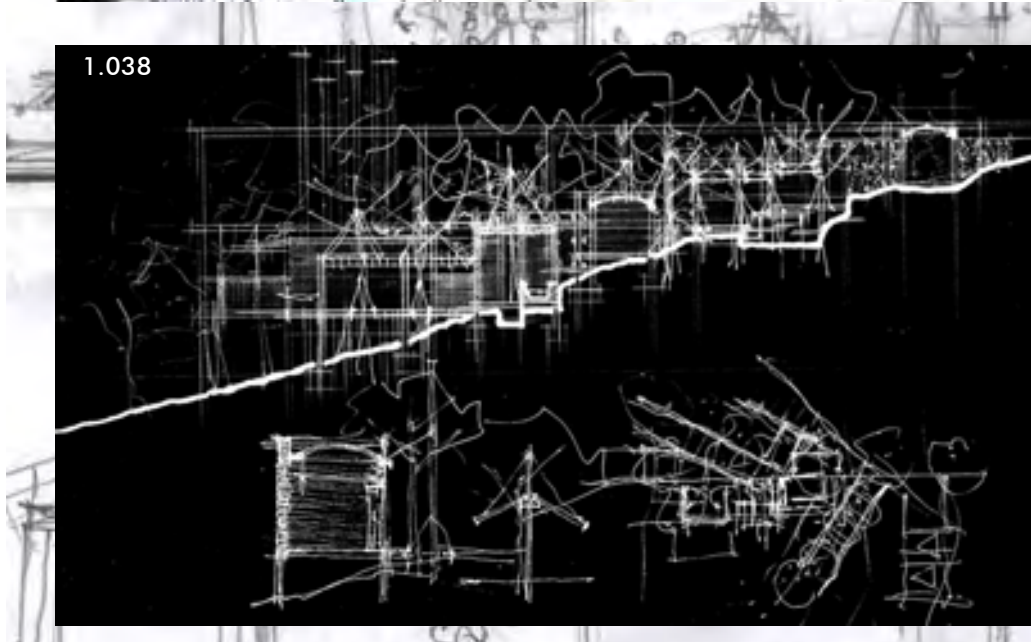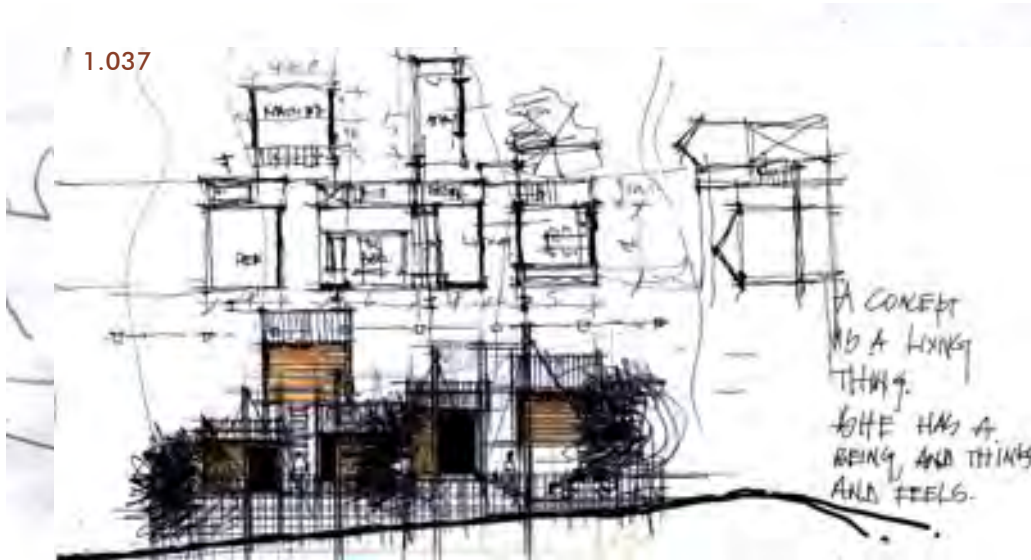
1.037

1.038

Concept drawings for idea generation.

1.037 Student project, Steel House Competition, Pretoria, South Africa.

1.038 Student project, Steel House Competition, Pretoria, South Africa.

1.039 Proposed flats, Mbabane, Swaziland.

Conceptual drawings to generate spatial ideas.

1.040 Proposed Swazi Auto Spares building, Manzini, Swaziland.

1.041 Proposed Swazi Auto Spares building, Manzini, Swaziland.
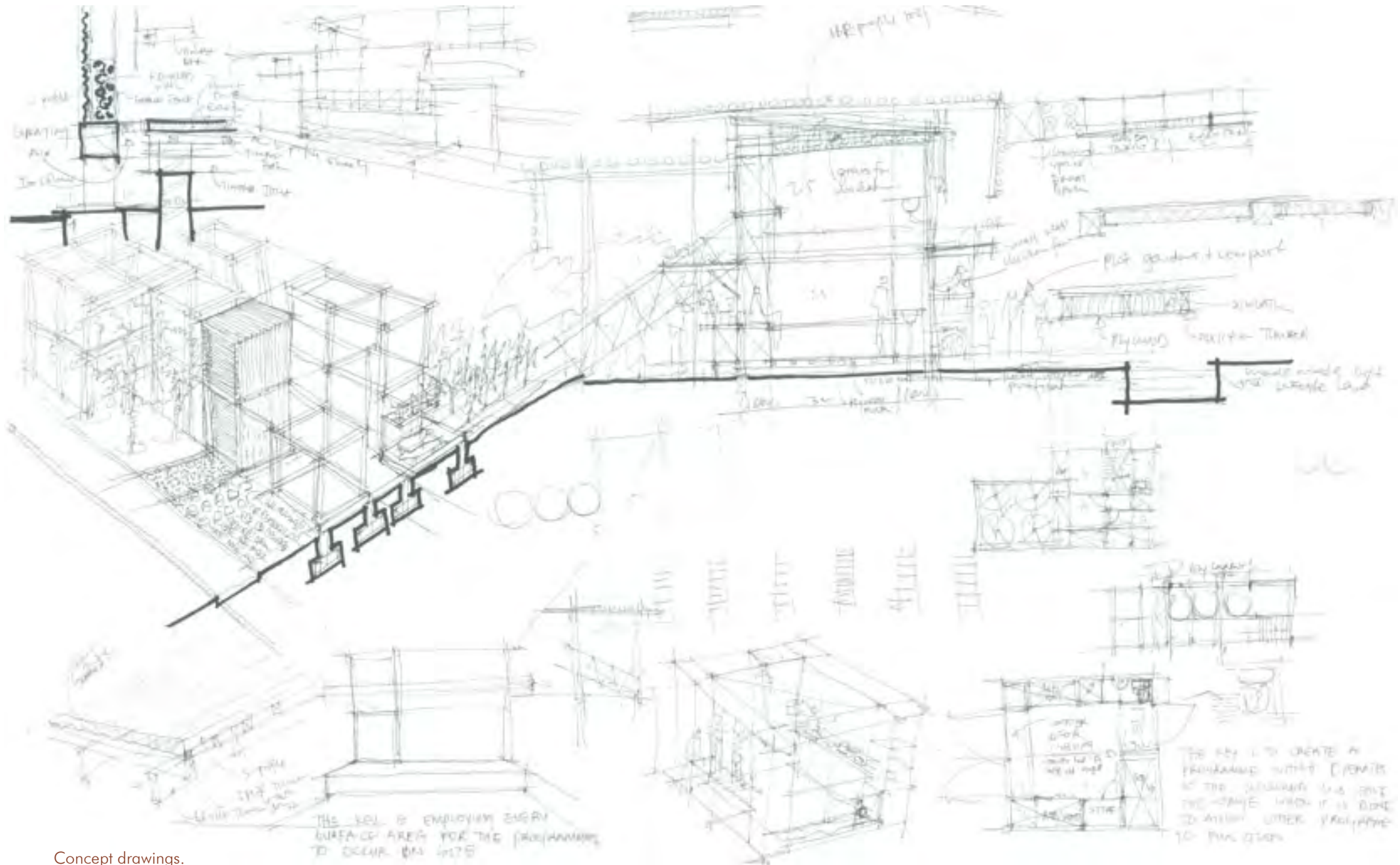
Concept drawings.
1.042 Student project, Refilwe adaptable housing, Cullinan, South Africa
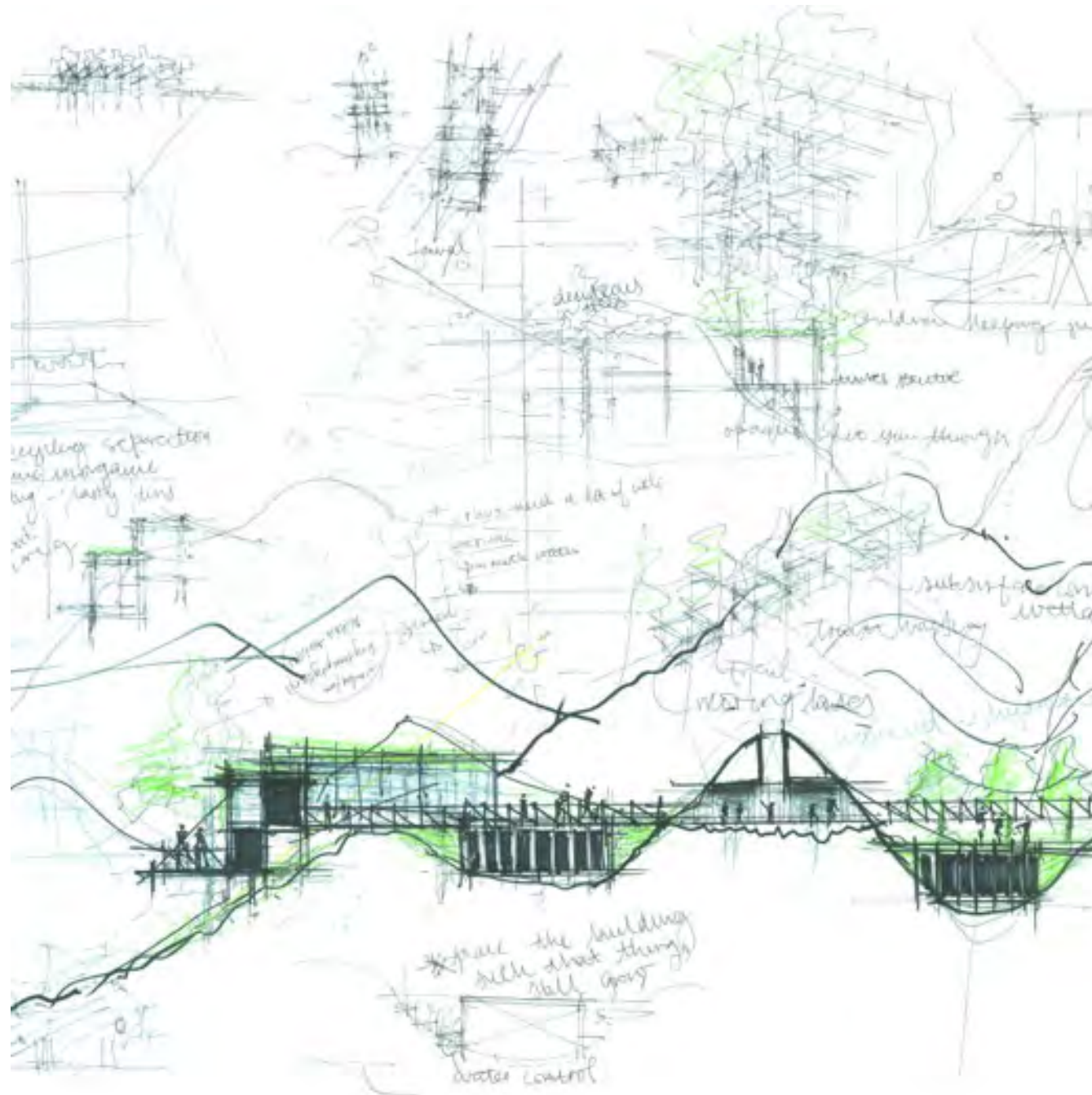
Concept drawings.
1.043 and 1.044 Student project, Crater Museum, Vredefort, South Africa.

1.045
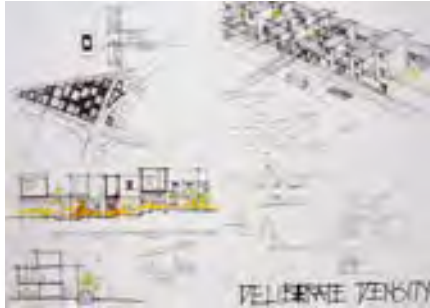
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1.047
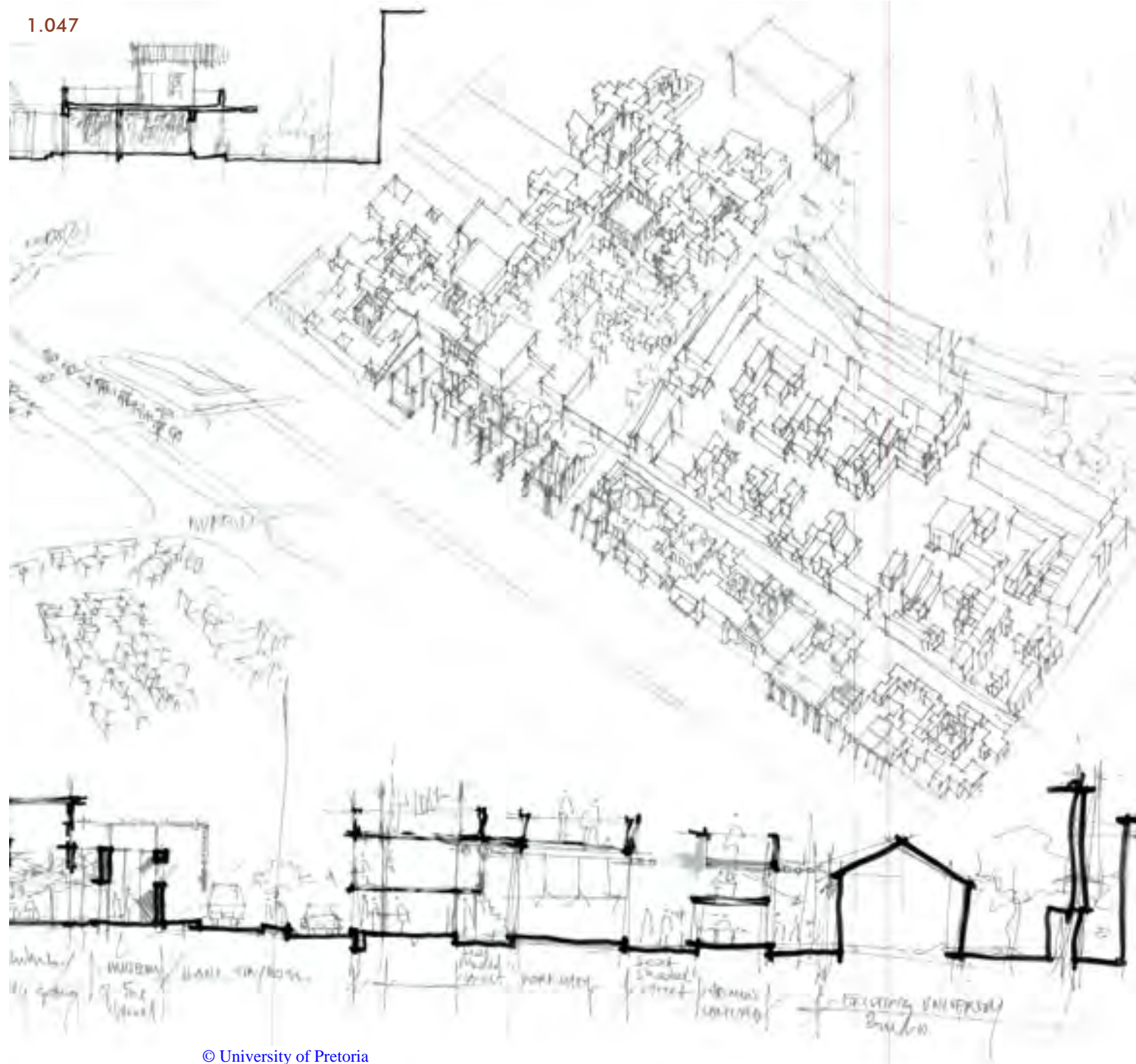
Concept drawings, section and isometric.

1.045 Student project, Social Housing, Mamelodi, South Africa.

1.046 and 1.047 Student project, Mixed-use development, Mamelodi, South Africa.
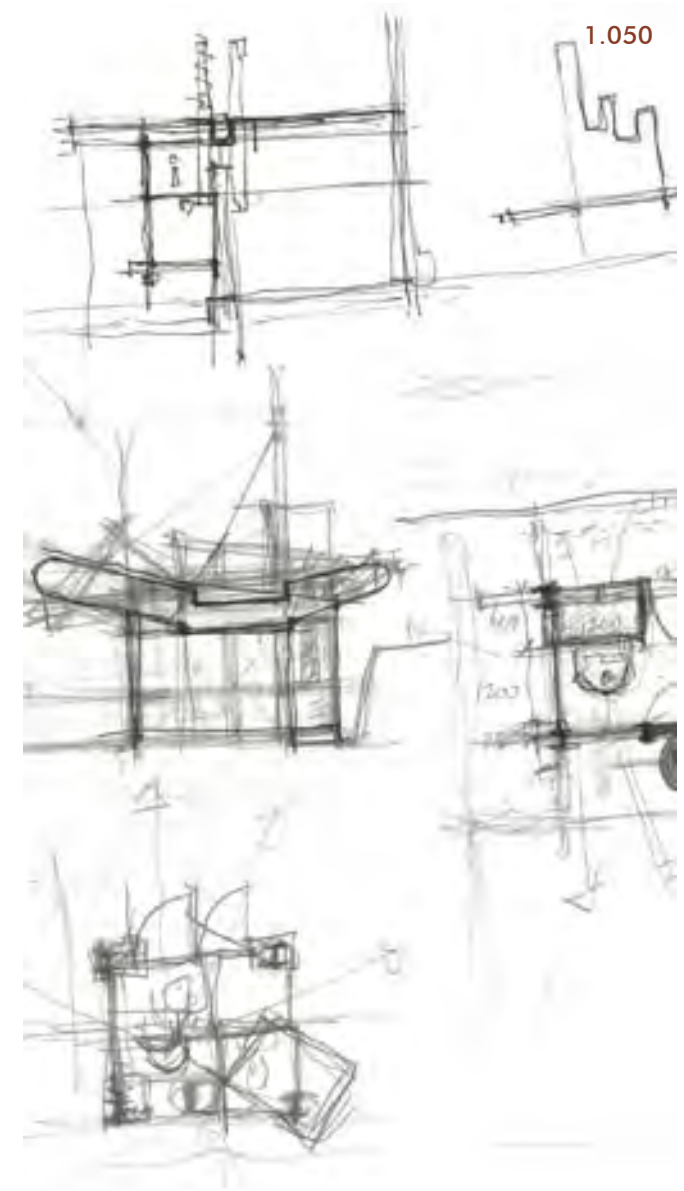
1.048

1.049

1.050

Conceptual drawings, section and isometric.
1.048 Courtyard design, SIBS Building, Mbabane, Swaziland.
1.049 Gate house design, SIBS Building, Mbabane, Swaziland.
1.050 Gate house design, SIBS Building, Mbabane, Swaziland.
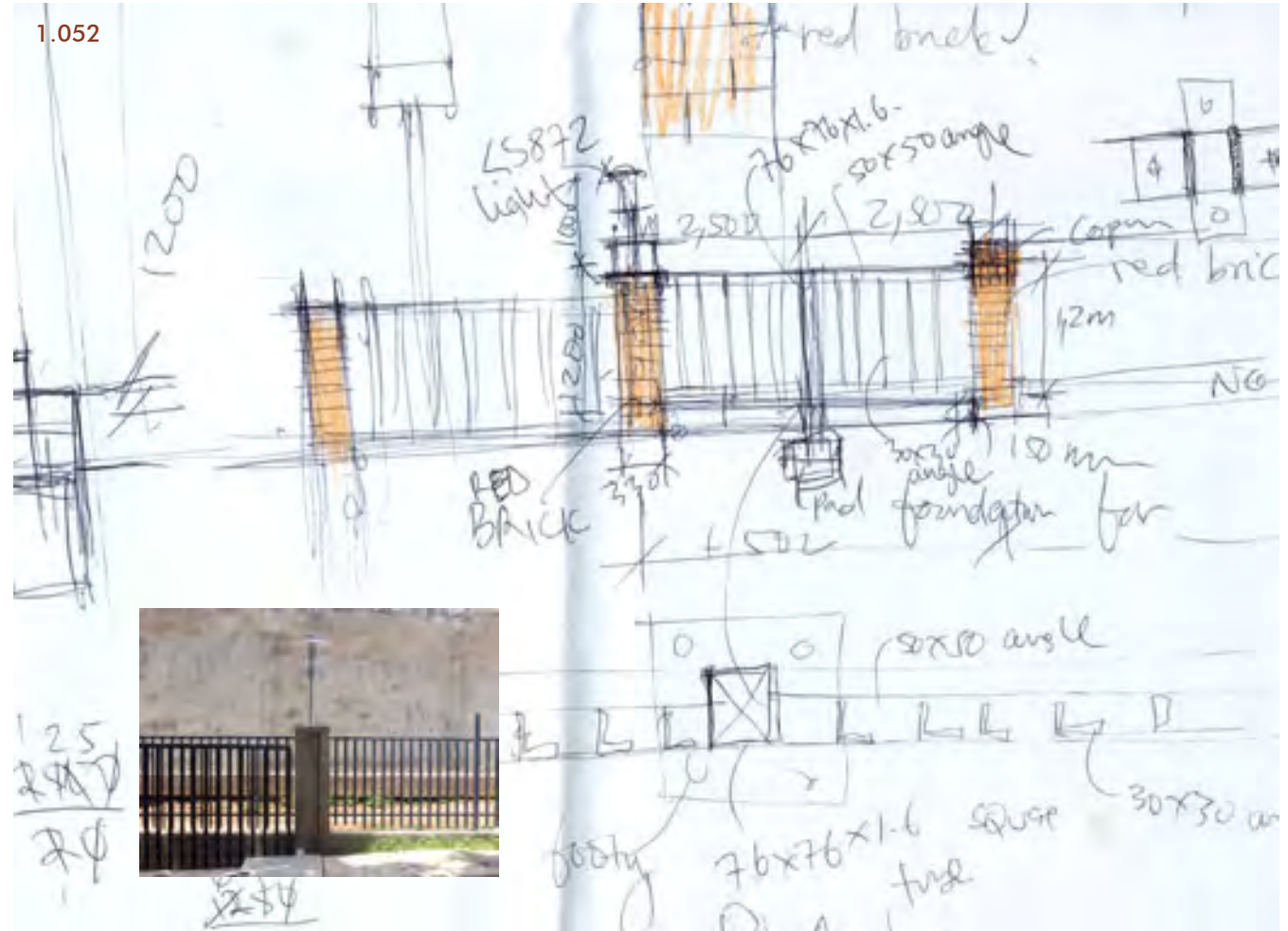
1.051

1.052

Conceptual drawings to generate spatial ideas.

1.051 New entrance designs for Simunye Clinic, Simunye, Swaziland.

1.052 Fence design, SIBS Building, Mbabane, Swaziland.

1.053

1.054

Concept sketches and elevation.

1.053 and 1.054 Nurse's station counter and furniture, Siyanaka Hospital, Manzini, Swaziland.

1.055 Siyanaka Hospital building, Manzini, Swaziland.
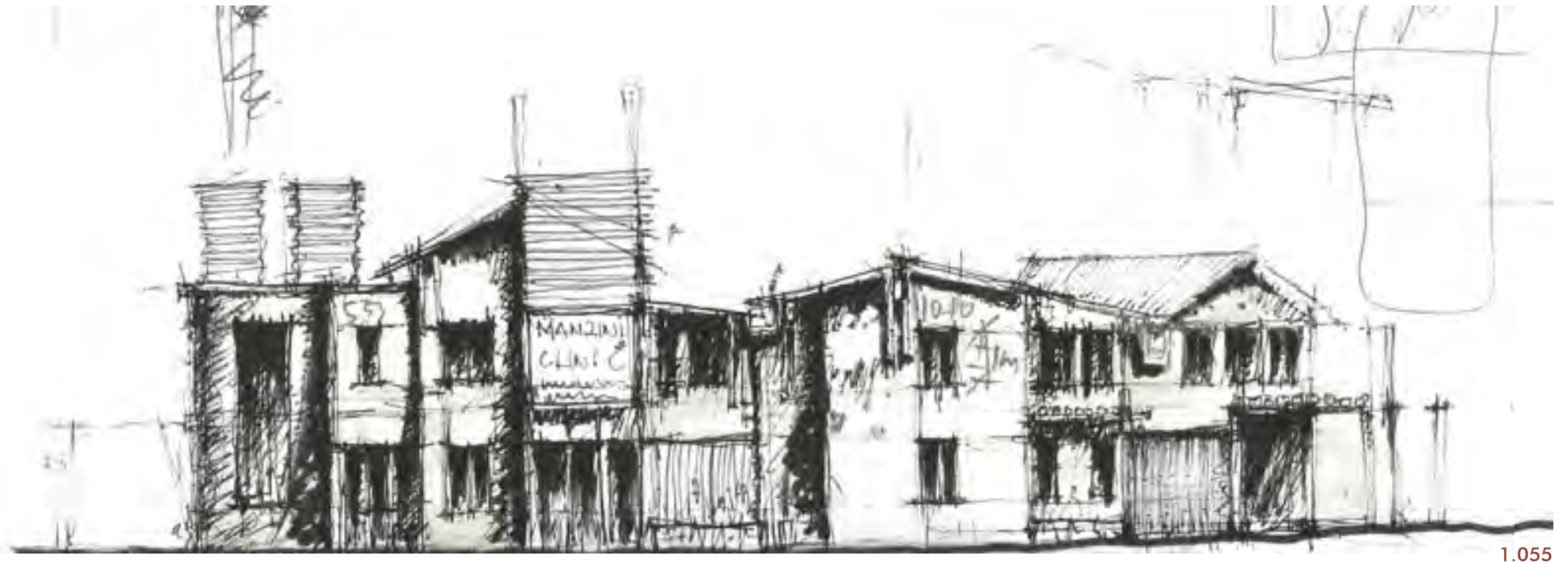
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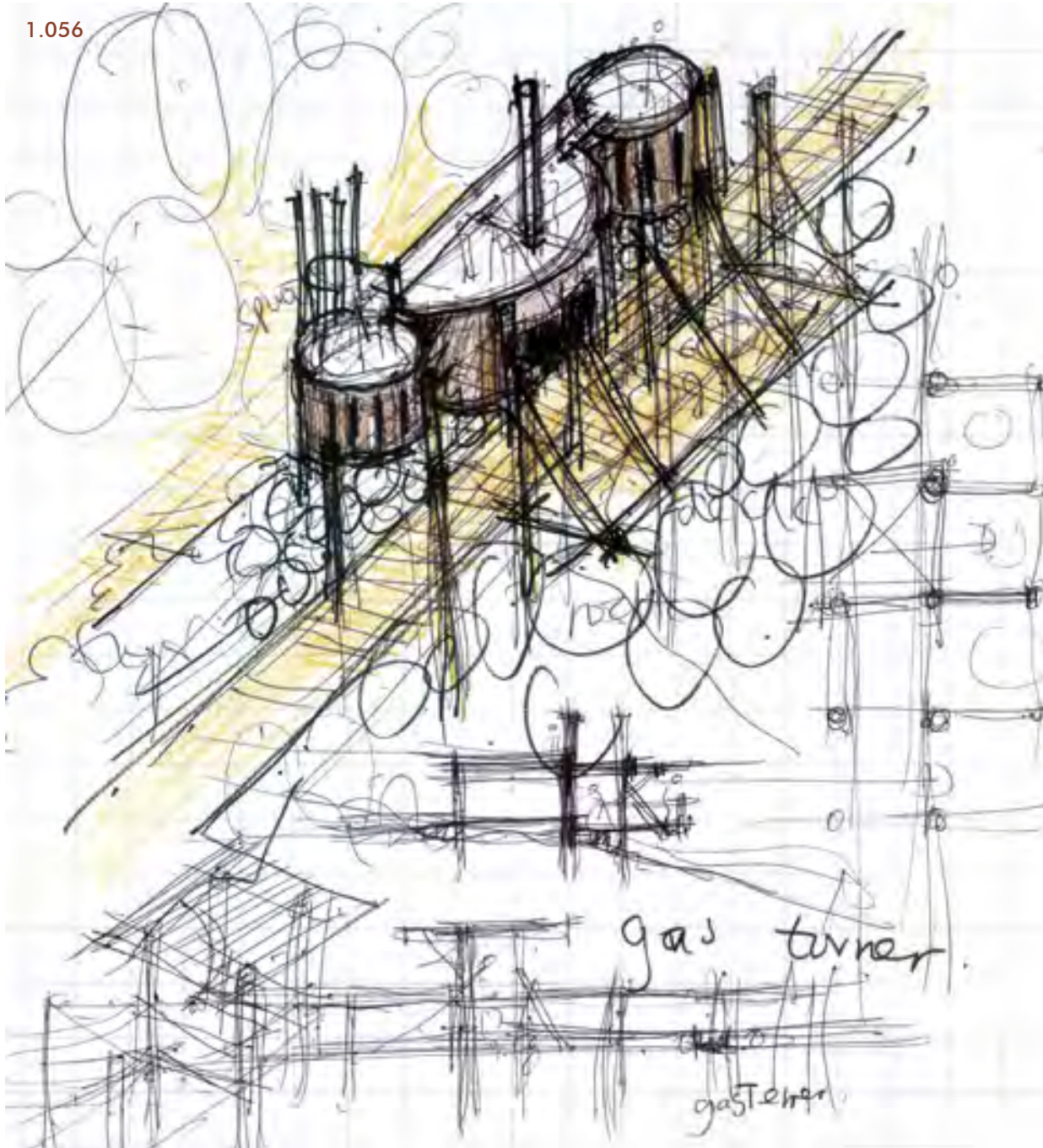
1.056

1.057

1.058

Concept drawings.

1.056 Proposed restuarant, Maguga, Swaziland.

1.057 Proposed Church Building, Luyengo, Swaziland.

1.058 Park design for a rural area.
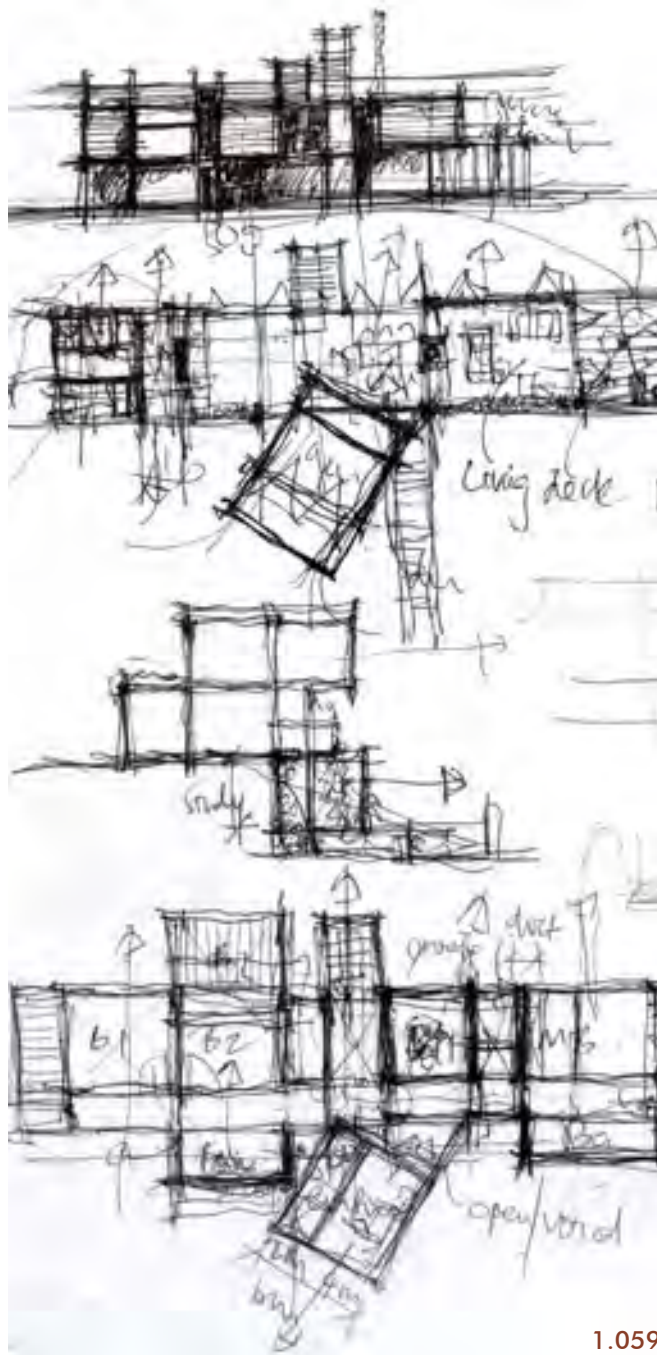
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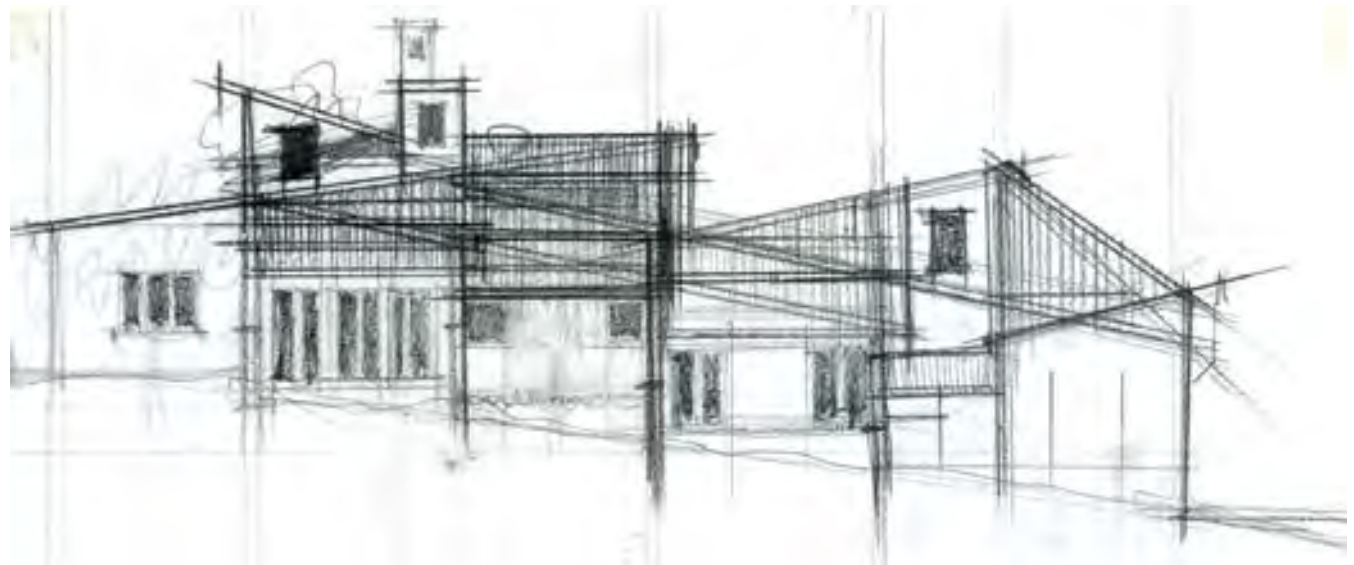
1.061

1.059

Concept drawings.
1.059 Proposed residential building, Mbabane, Swaziland.
1.060 Proposed additions to a lodge, Vryheid, South Africa.
1.061 Residential building additions, Mbabane, Swaziland.
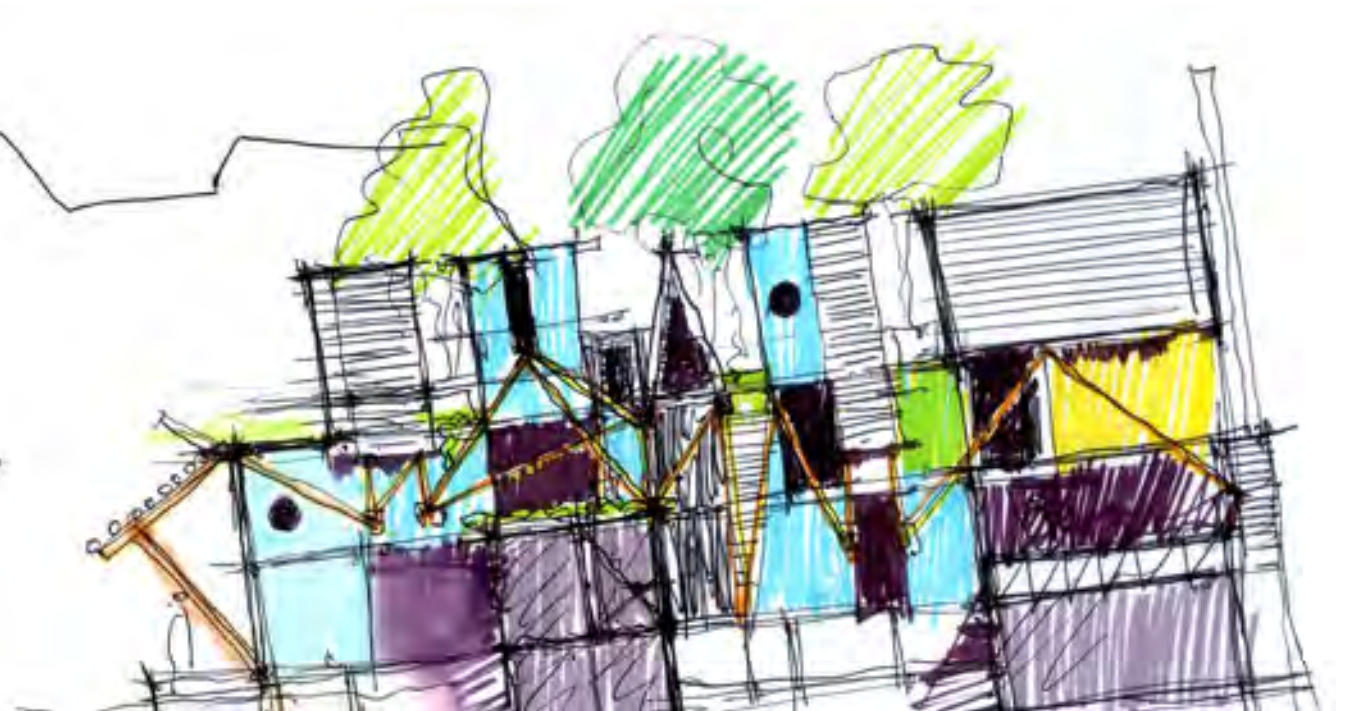
1.063

Concept drawings.

1.062 Proposed residential house, Mbabane, Swaziland.

1.063 Proposed wedding event space.
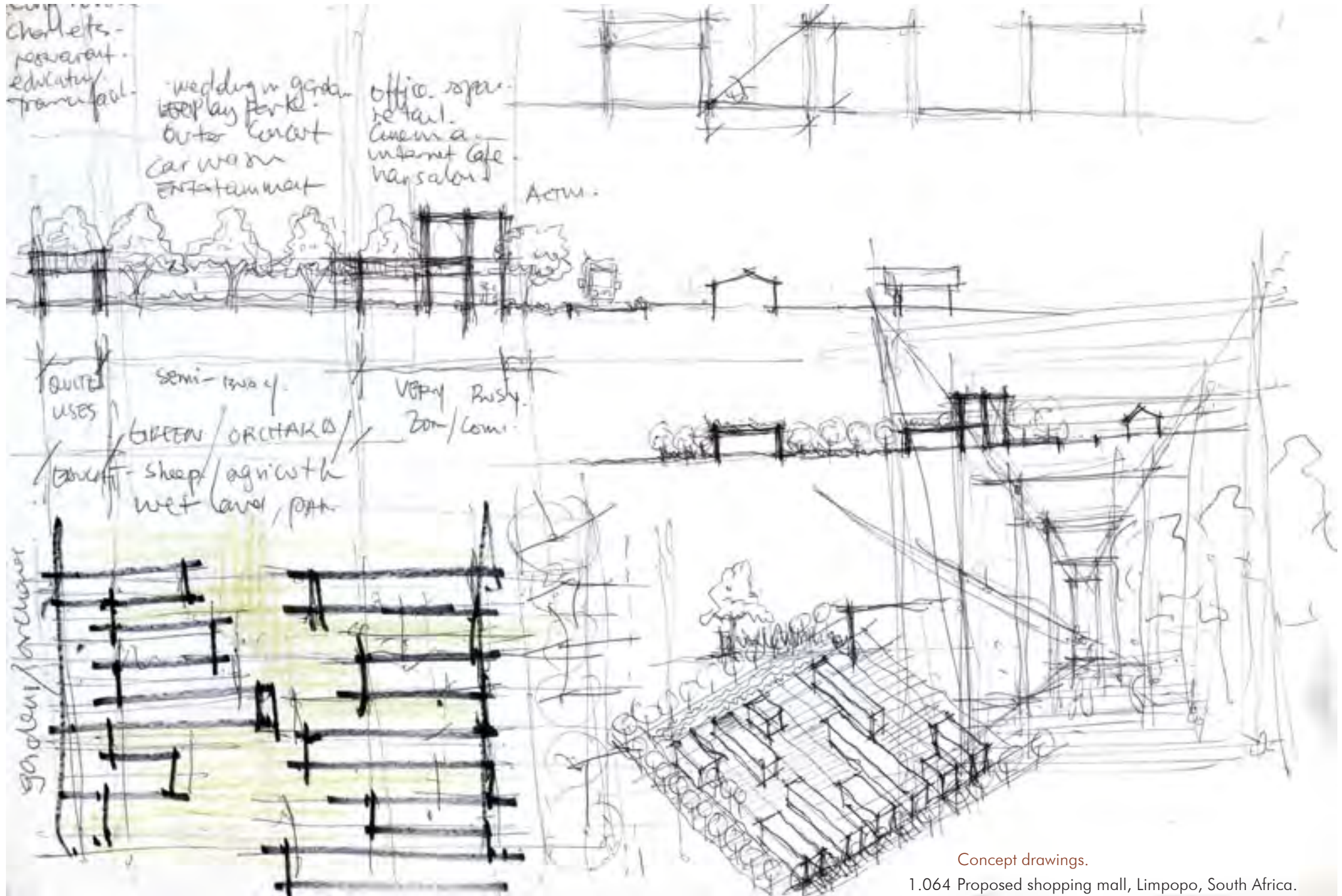
Concept drawings.
1.064 Proposed shopping mall, Limpopo, South Africa.

1.065 Residential building additions, Pretoria, South Africa.
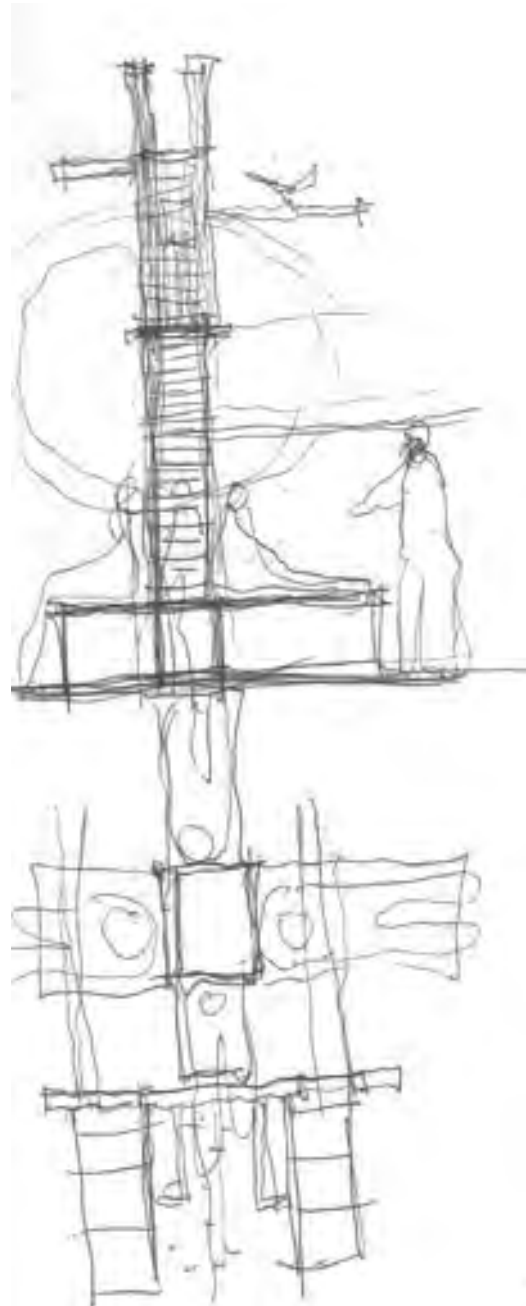
1.066 Proposed street furniture, Pretoria, South Africa.
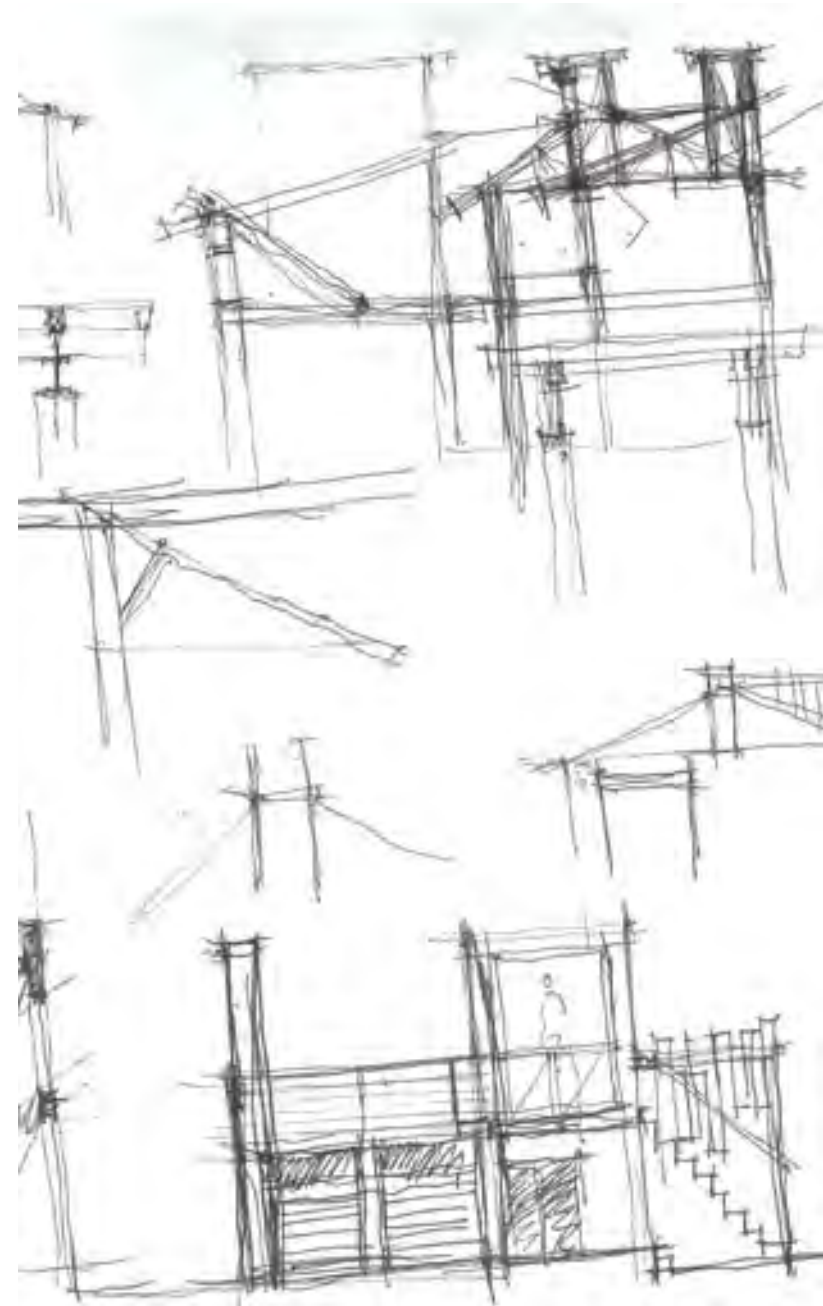
1.067 Residential building additions, Centurion, South Africa.

1.068 Residential building additions, Centurion, South Africa.
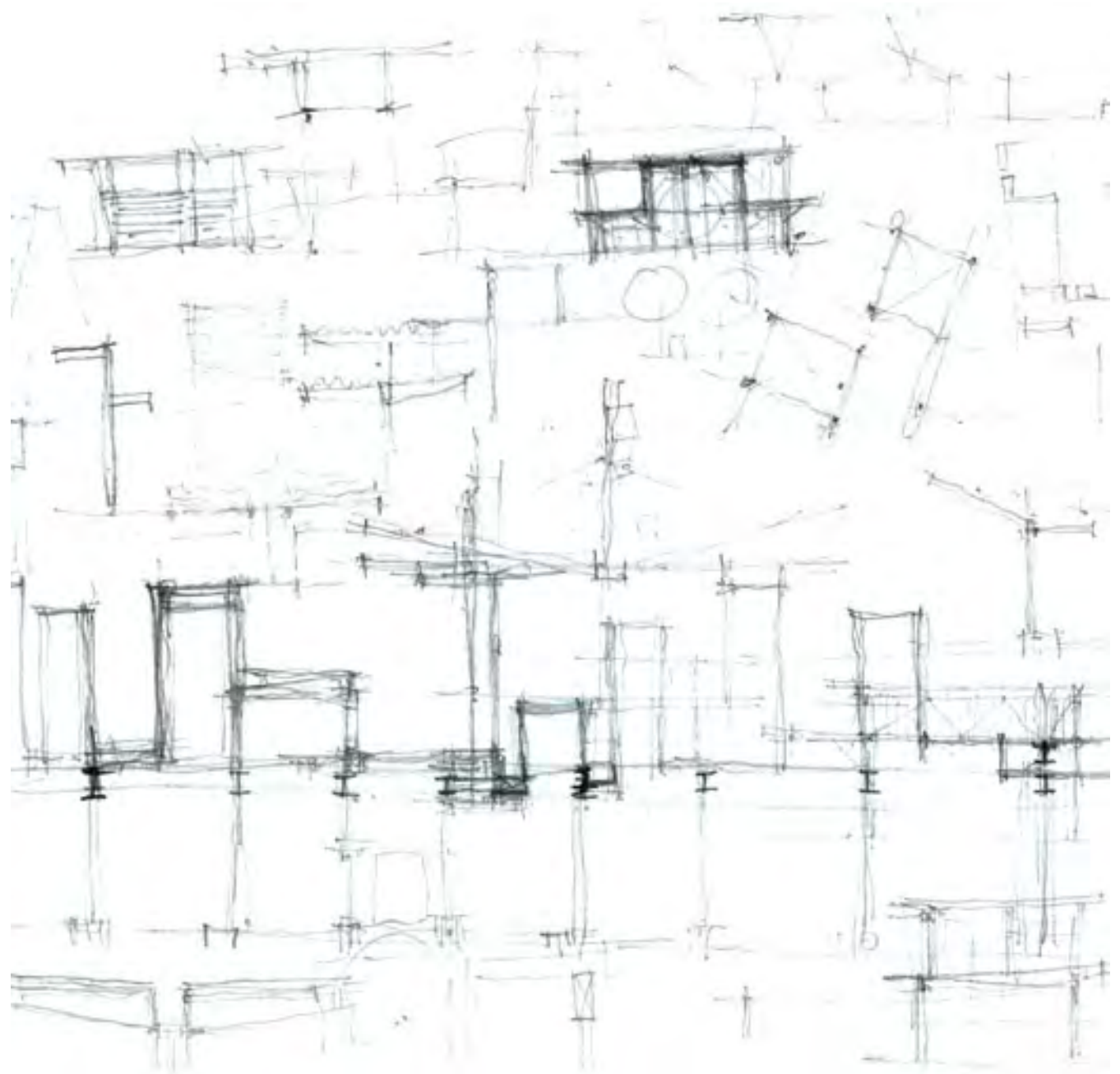
1.069 Proposed taxi rank structure, Pretoria, South Africa.

CONCEPT DEVELOPMENT DRAWINGS
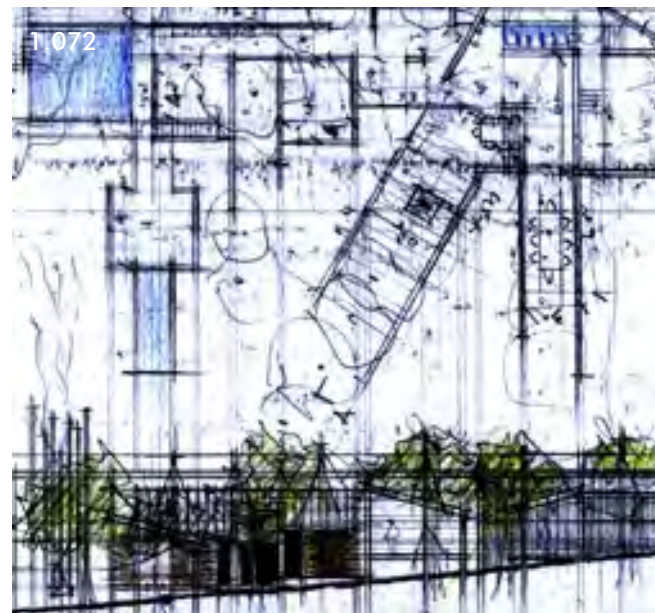
Conceptual drawings for presentation.

1.070 Proposed lodge, Mpumalanga, South Africa.

1.071 Proposed residential building, Pretoria, South Africa.

1.072 Student project, Steel House Competition, Pretoria, South Africa.

1.073 to 1.074 Student project, Housing, Mamelodi, Pretoria, South Africa.

1.077

1.076
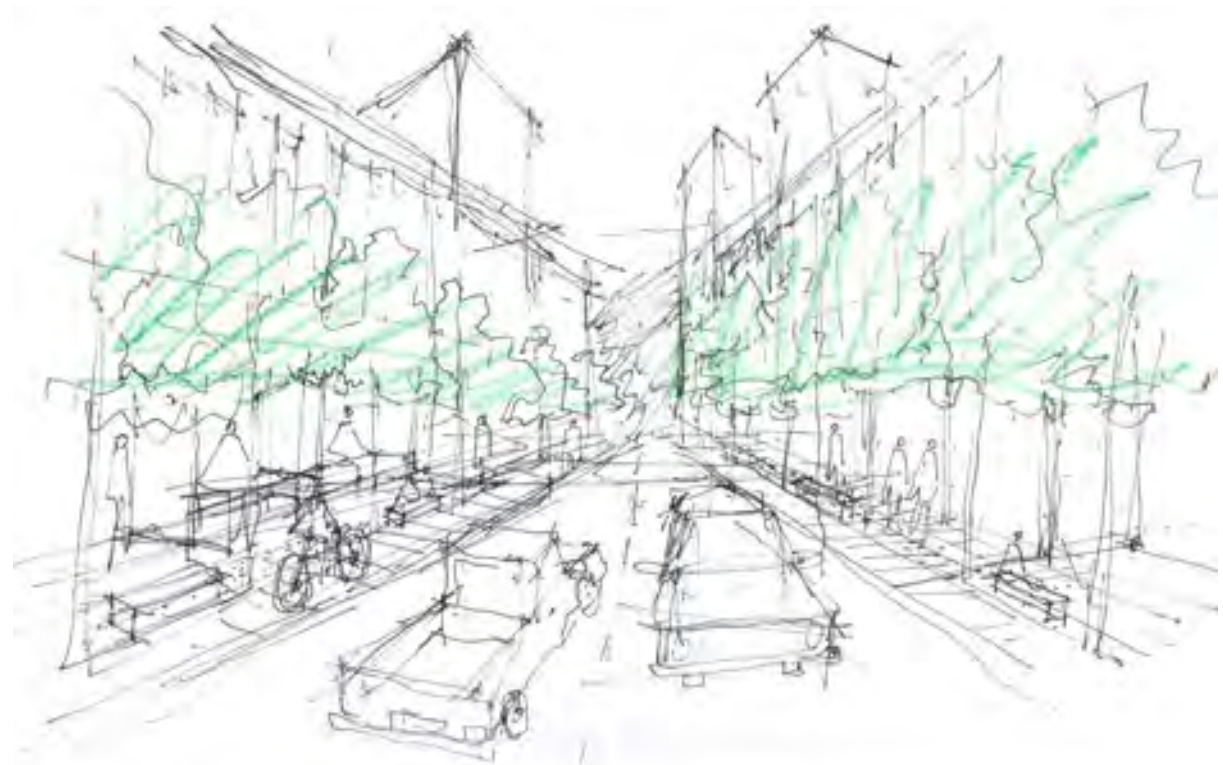
streets

STREET FOR PEDESTRIANS: SEATS, SHADE & TREES, URBAN SCALE.

1.075

AREAS OF REPOSE with SURVEILLANCE
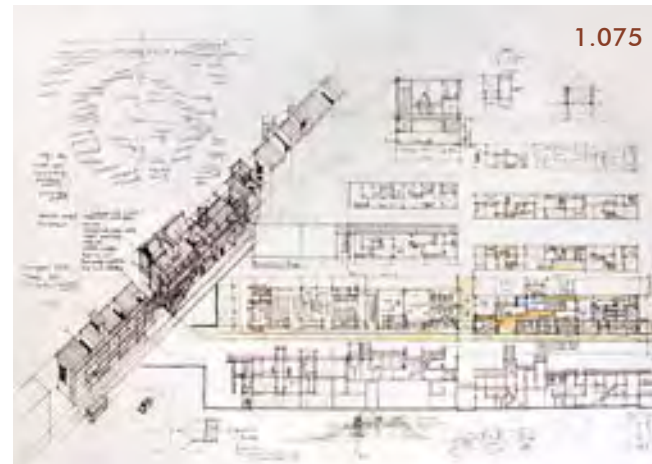
Conceptual drawings for presentation of urban framework.
1.075 to 1.077 Student project, Housing, Mamelodi, Pretoria, South Africa.

1.078
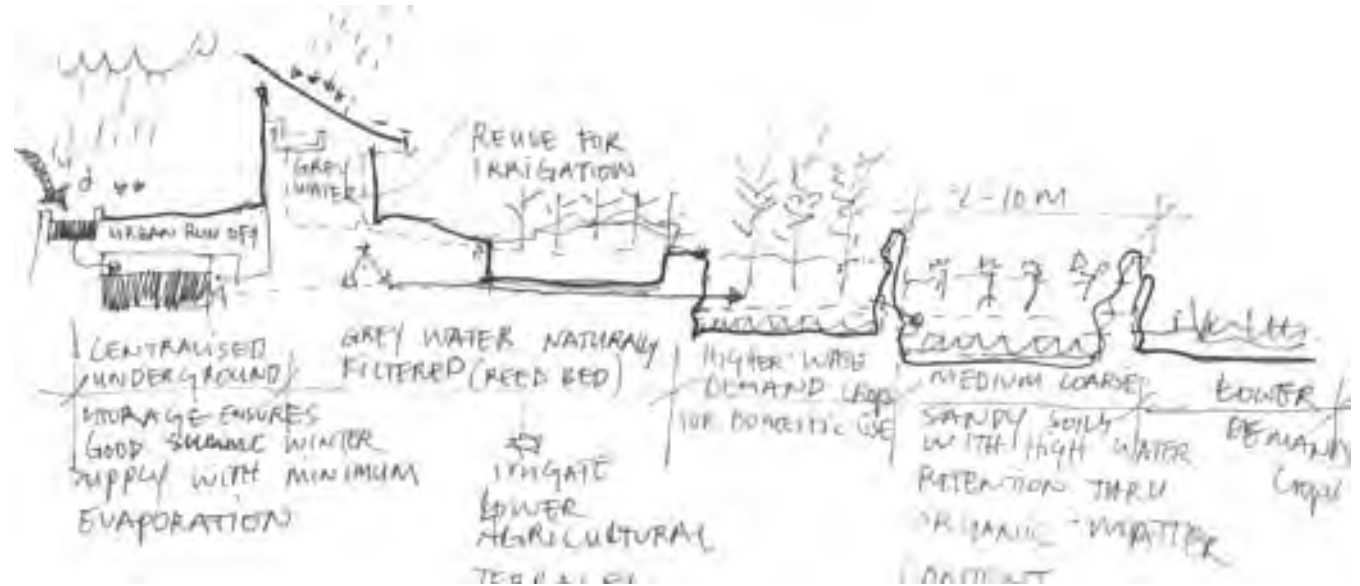
1.079
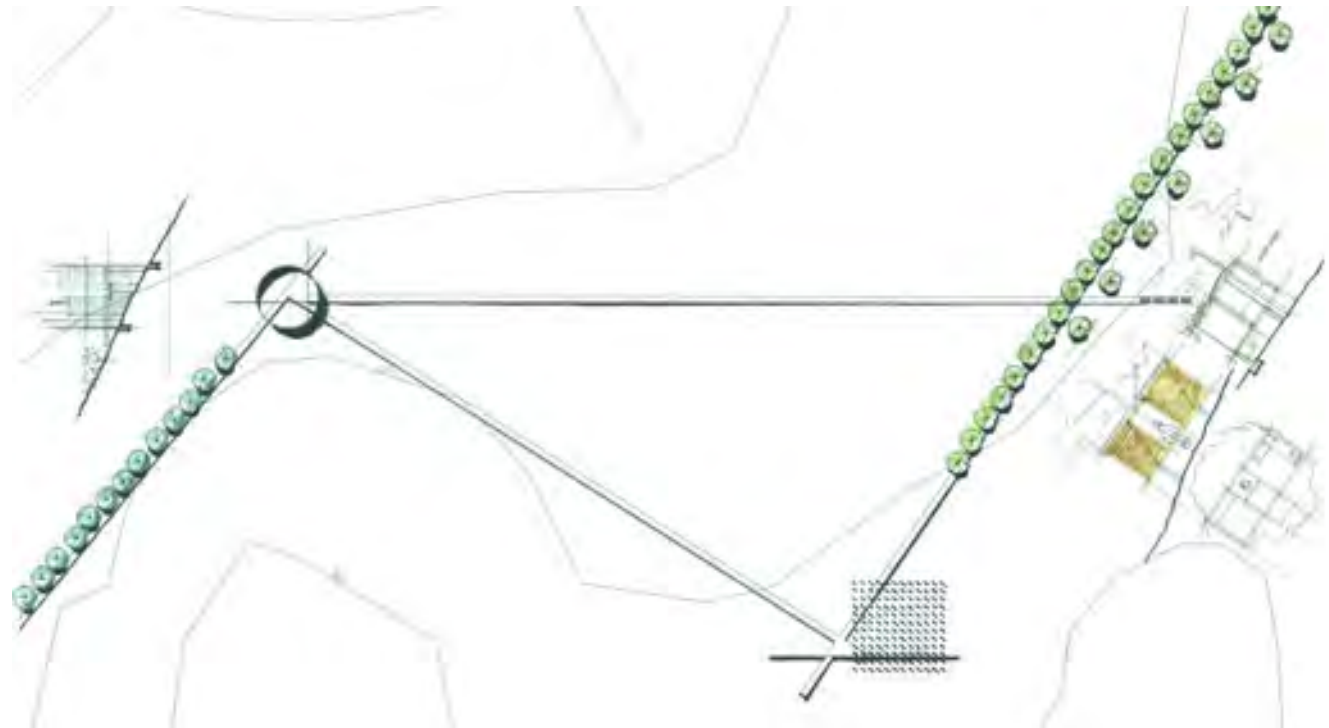
Drawings for conceptual presentation.

1.078 Student project, Housing, Mamelodi, Pretoria, South Africa.

1.079 Student project, Crater Museum, Vredefort, South Africa.

1.081
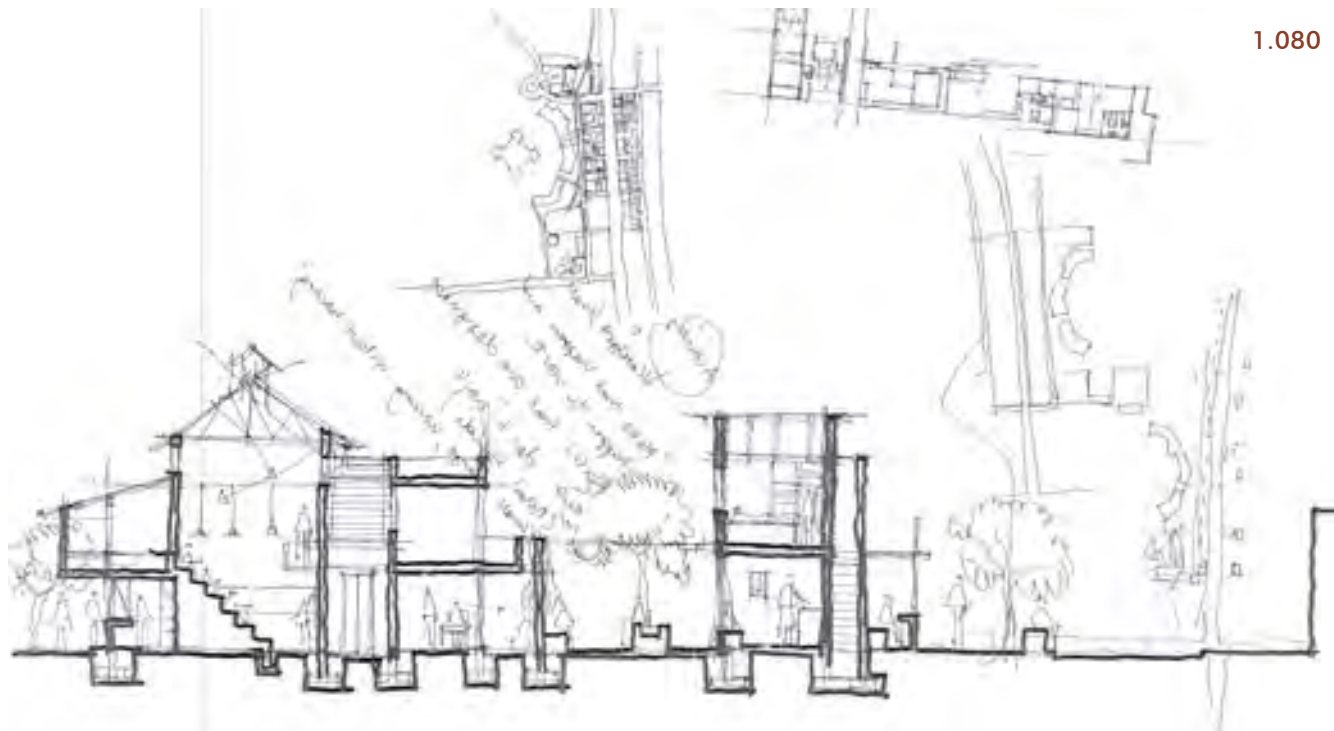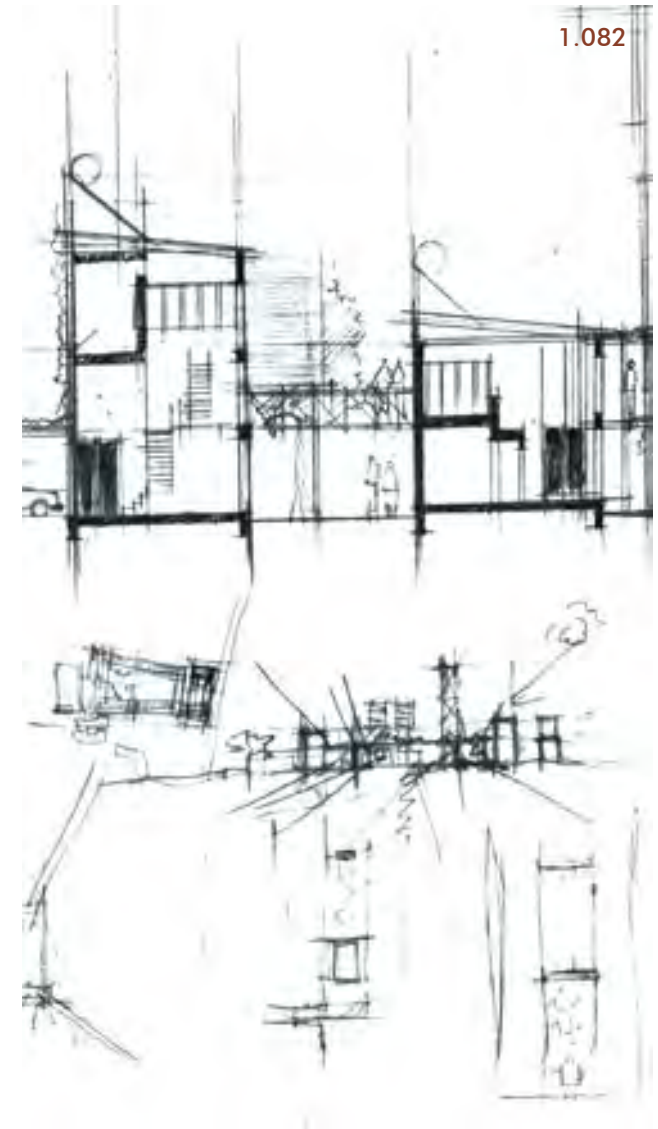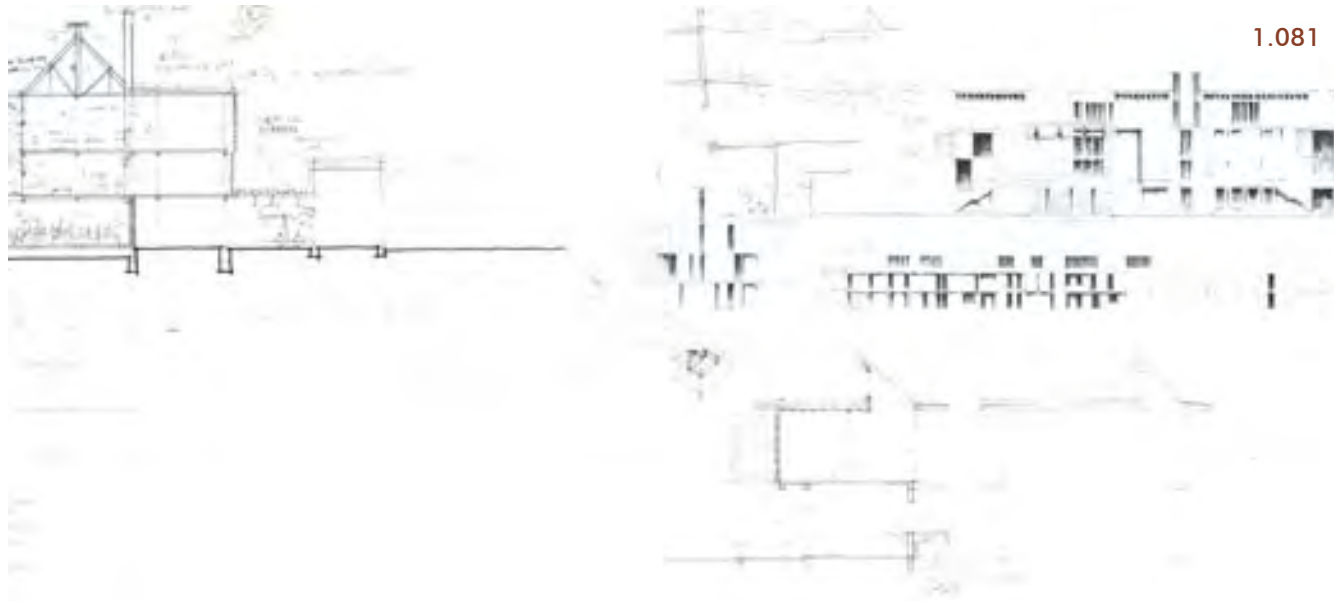
1.082

1.080

Conceptual drawings.
1.080 to 1.082 Student project, Mixed-use development, Mamelodi, South Africa.

1.083

1.084

1.083 and 1.084 Student project, Mixed-use development, Mamelodi, South Africa.
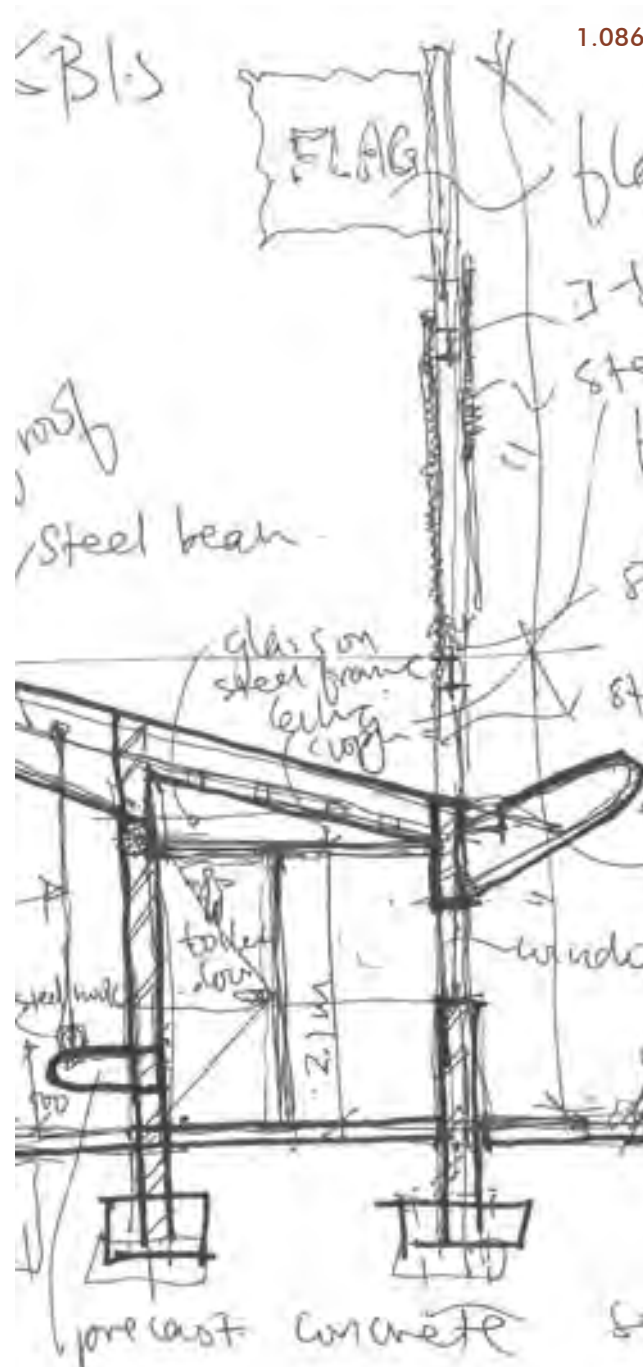
1.085

1.086

1.087

Conceptual drawings for development of construction drawings.

1.085 Proposed Church Building, Luyengo, Swaziland.

1.086 Gatehouse design, SIBS Building, Mbabane, Swaziland.

1.087 Gatehouse design, SIBS Building, Mbabane, Swaziland.
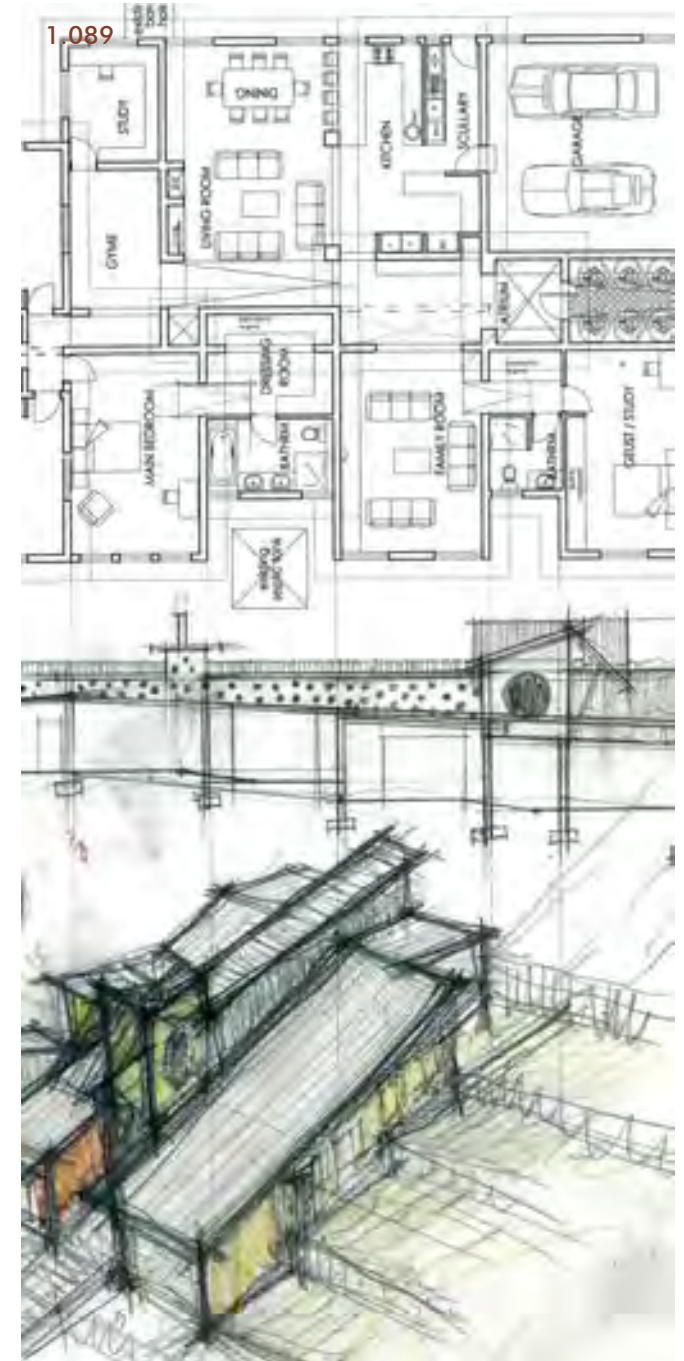
1.090

1.089

1.088

Conceptual drawings.
1.088 Hospital building, Siyanaka Hospital, Manzini, Swaziland.
1.089 Additions to residential building, Mbabane, Swaziland.
1.090 Proposed chalets, Vryheid, South Africa.
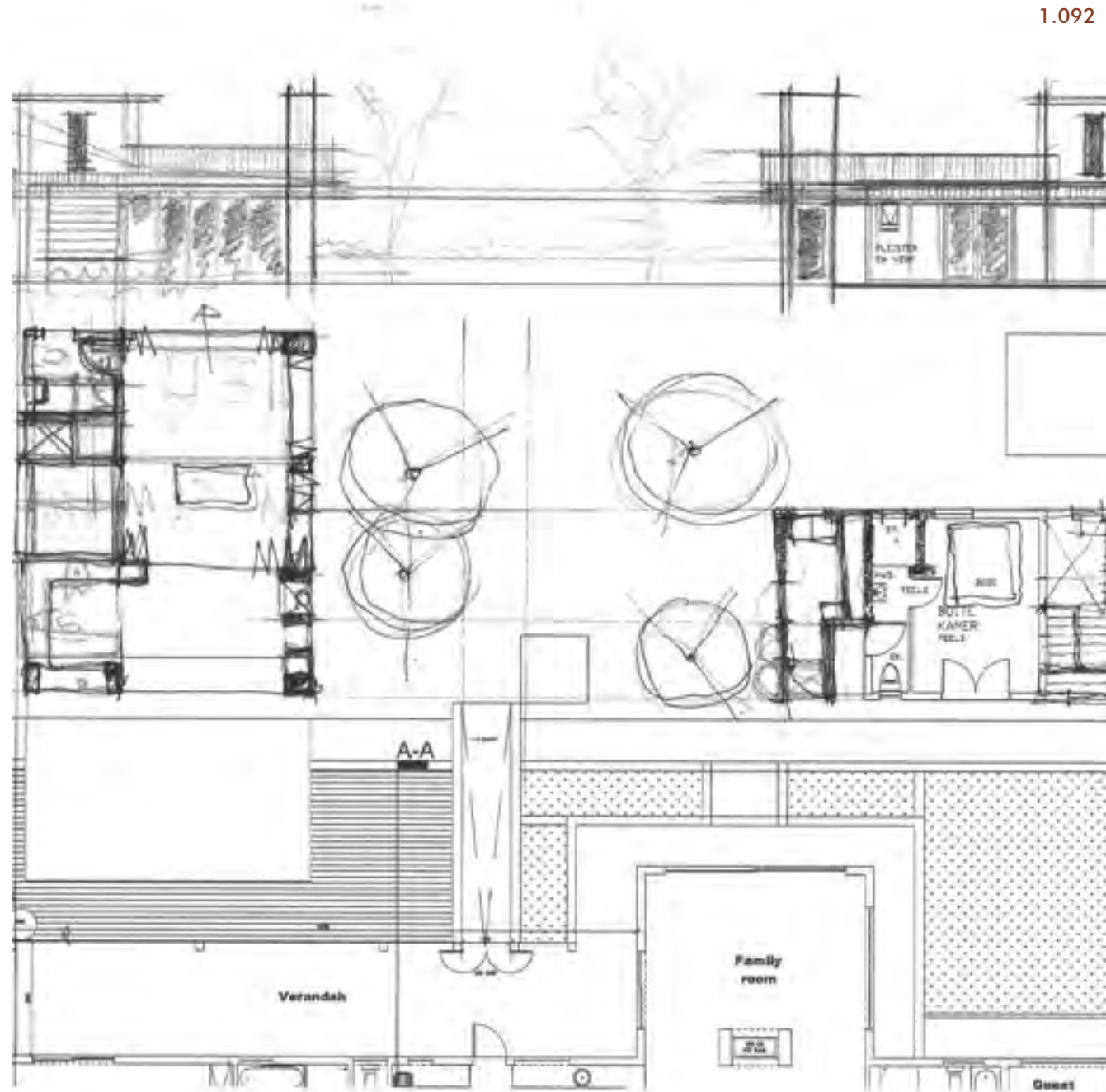
1.091 Proposed additions to conference building, Vryheid, South Africa.

1.092 Proposed additions to a residential building, Pretoria, South Africa.

CONCEPT PRESENTATION DRAWINGS

1.093

1.093 Proposed new residential building, Piggs Peak, Swaziland.
1.094 Student project, Crater Museum, Vredefort, South Africa.

1.096

1.095 Student project, Crater Museum, Vredefort, South Africa.
1.096 Student project, Mixed-use development, Mamelodi, South Africa.
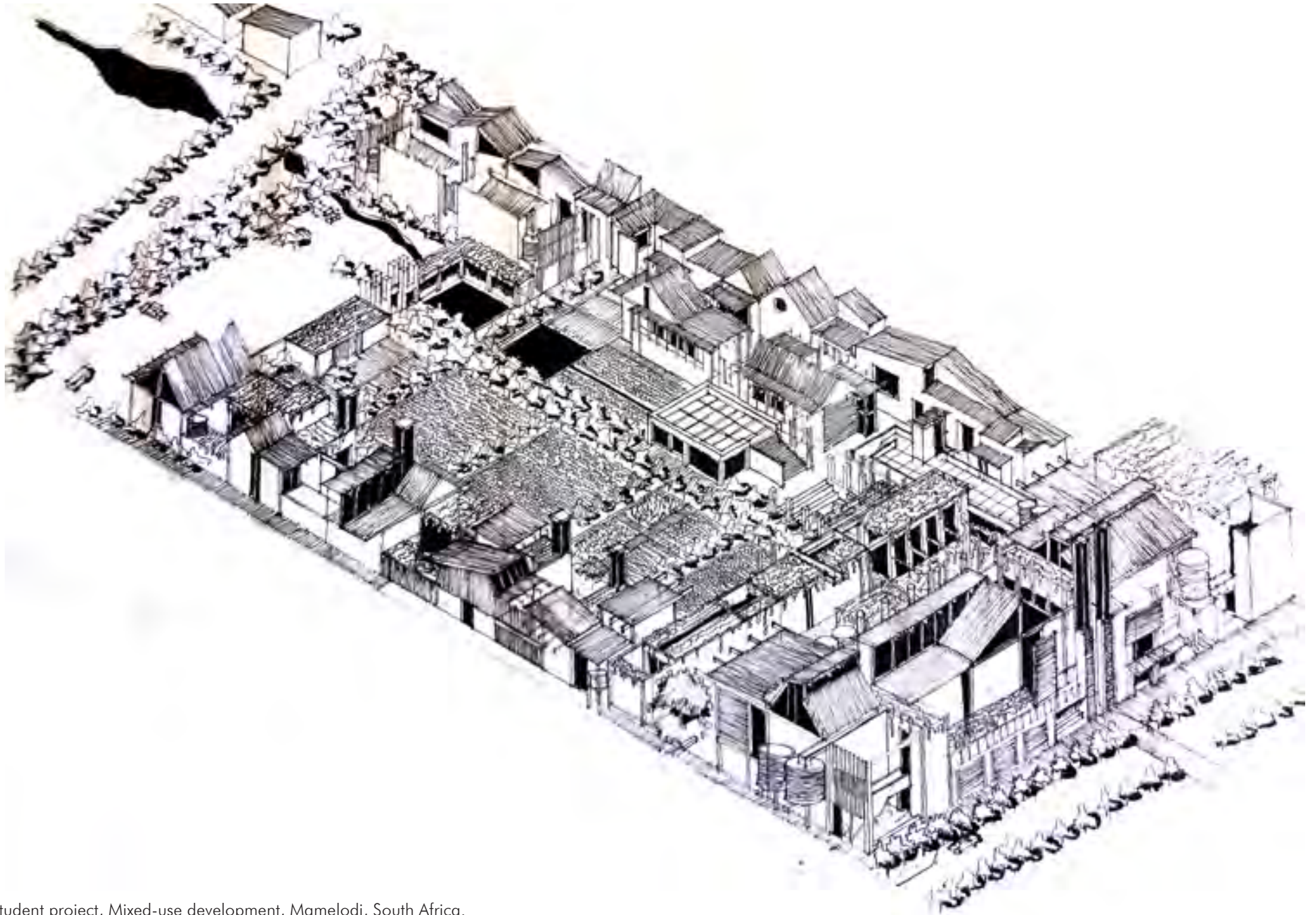
1.097 Student project, Mixed-use development, Mamelodi, South Africa.
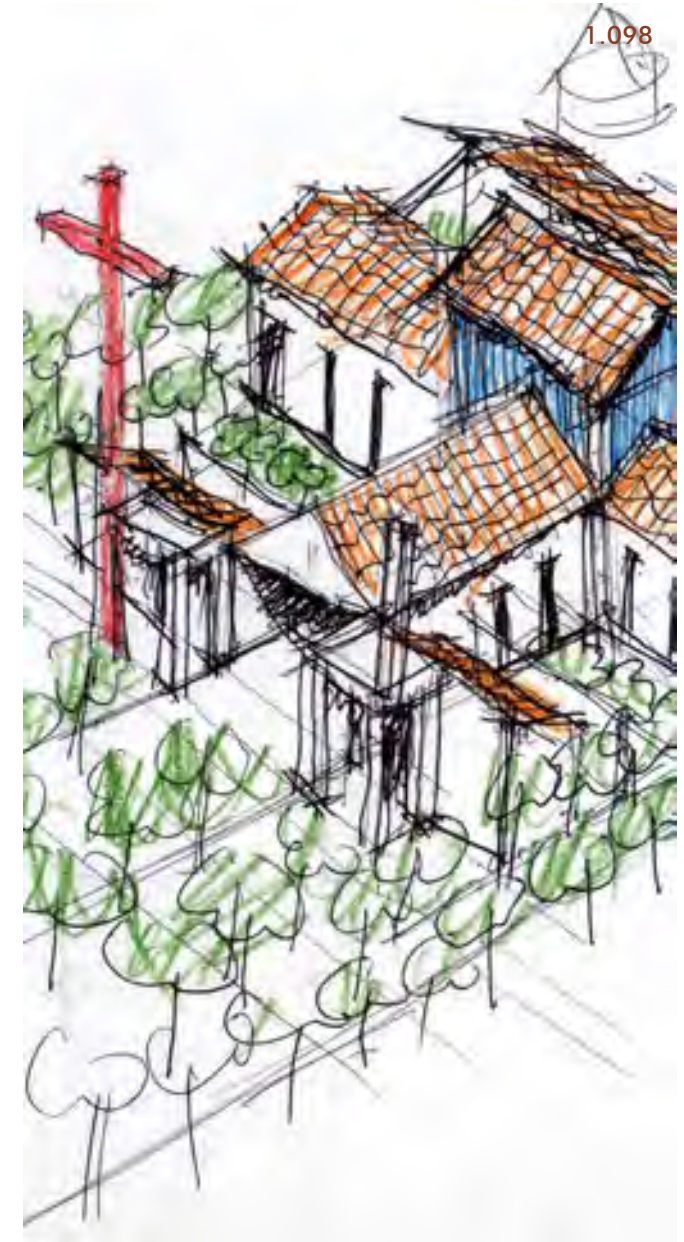
1.099

1.098

1.098 Proposed church building, Luyengo, Swaziland.
1.099 Proposed additions to conference building, Vryheid, South Africa.

1.100

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1.100 Lodge, Vryheid, South Africa.
1.101 Lodge, Vryheid, South Africa.
1.102 Proposed residential building, Centurion, South Africa.

1.103

1.104

1.103 Proposed mixed-use development, Limpompo, South Africa.

1.104 Proposed flats, Mbabane, South Africa.

1.105
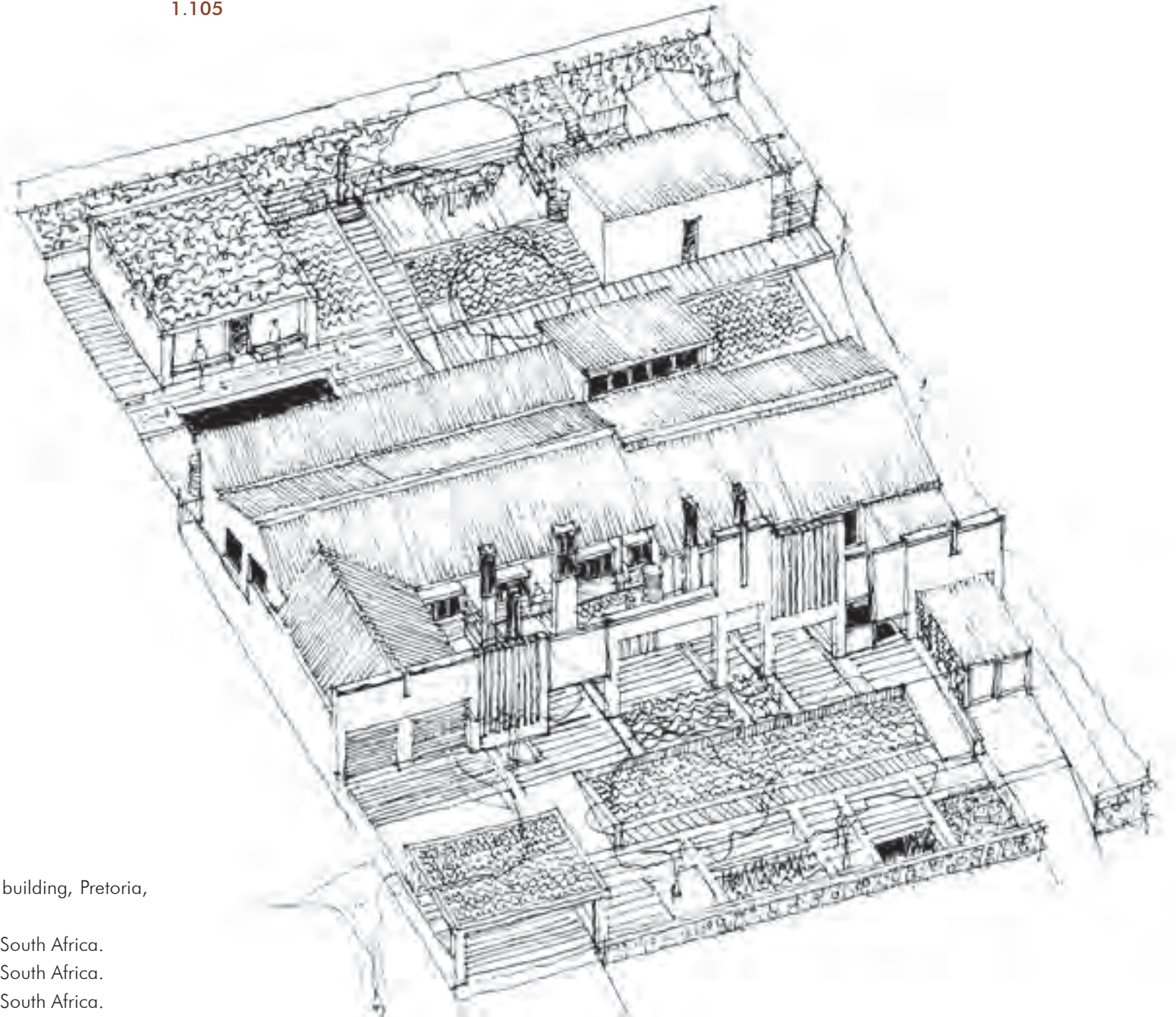
1.105 Proposed additions to a residential building, Pretoria,
       South Africa.
1.106 Proposed shopping mall, Nelspruit, South Africa.
1.107 Proposed shopping mall, Nelspruit, South Africa.
1.108 Proposed shopping mall, Nelspruit, South Africa.
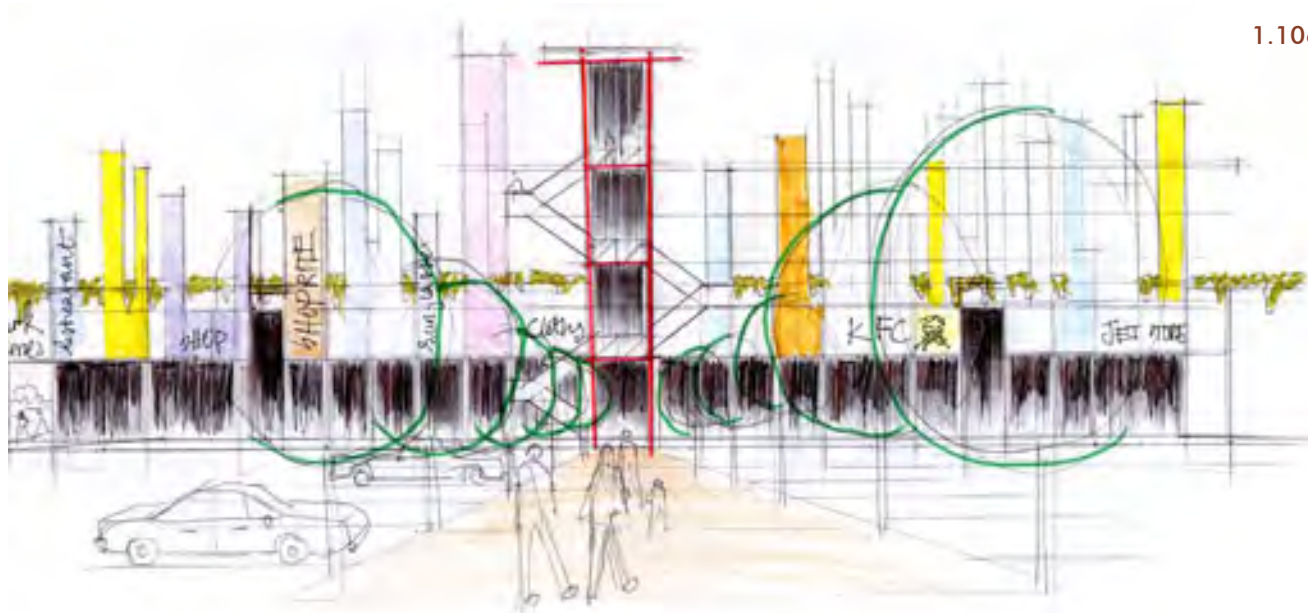
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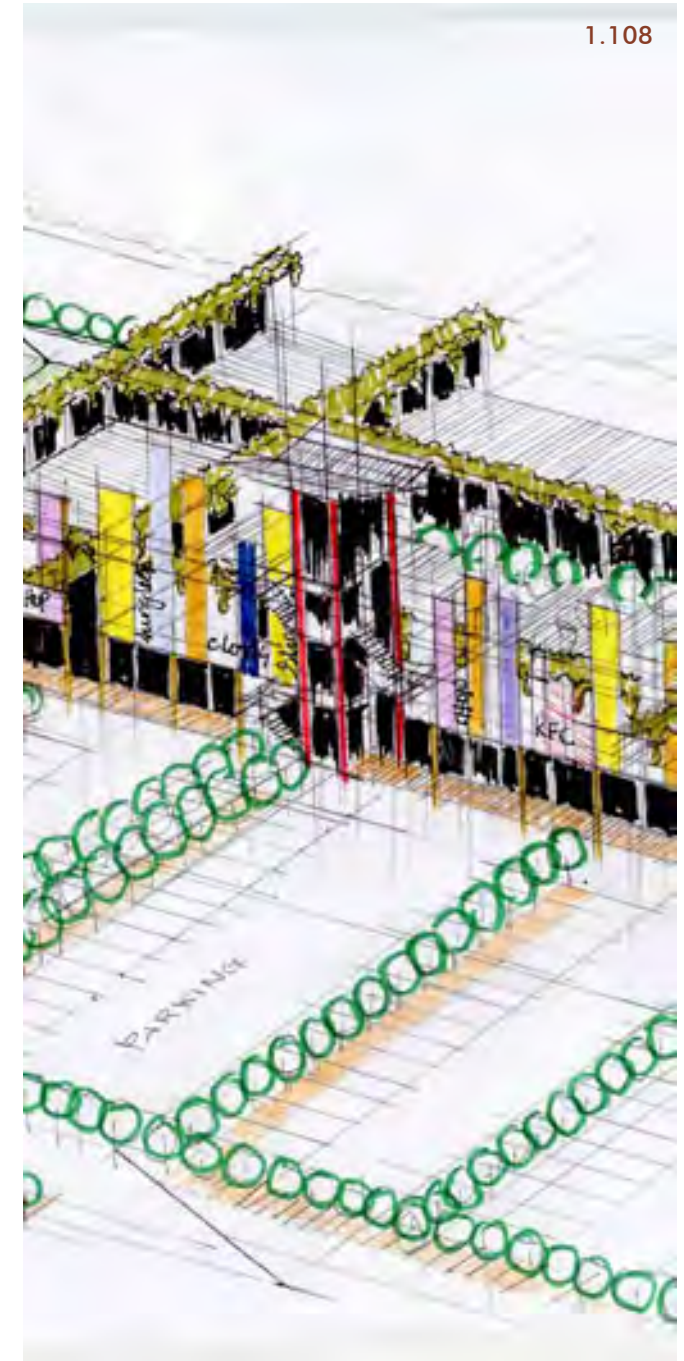
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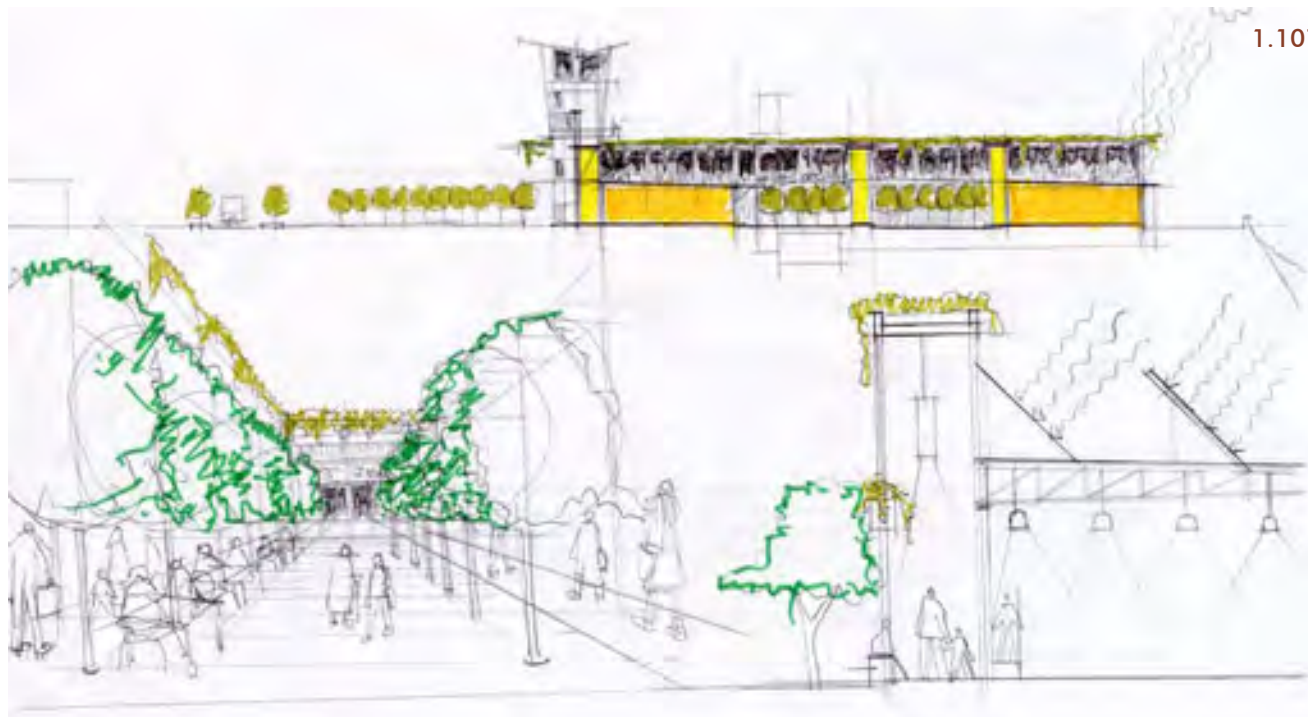
1.107

DESIGN PRESENTATION DRAWINGS
AND MODELS

1.112

1.109

1.111
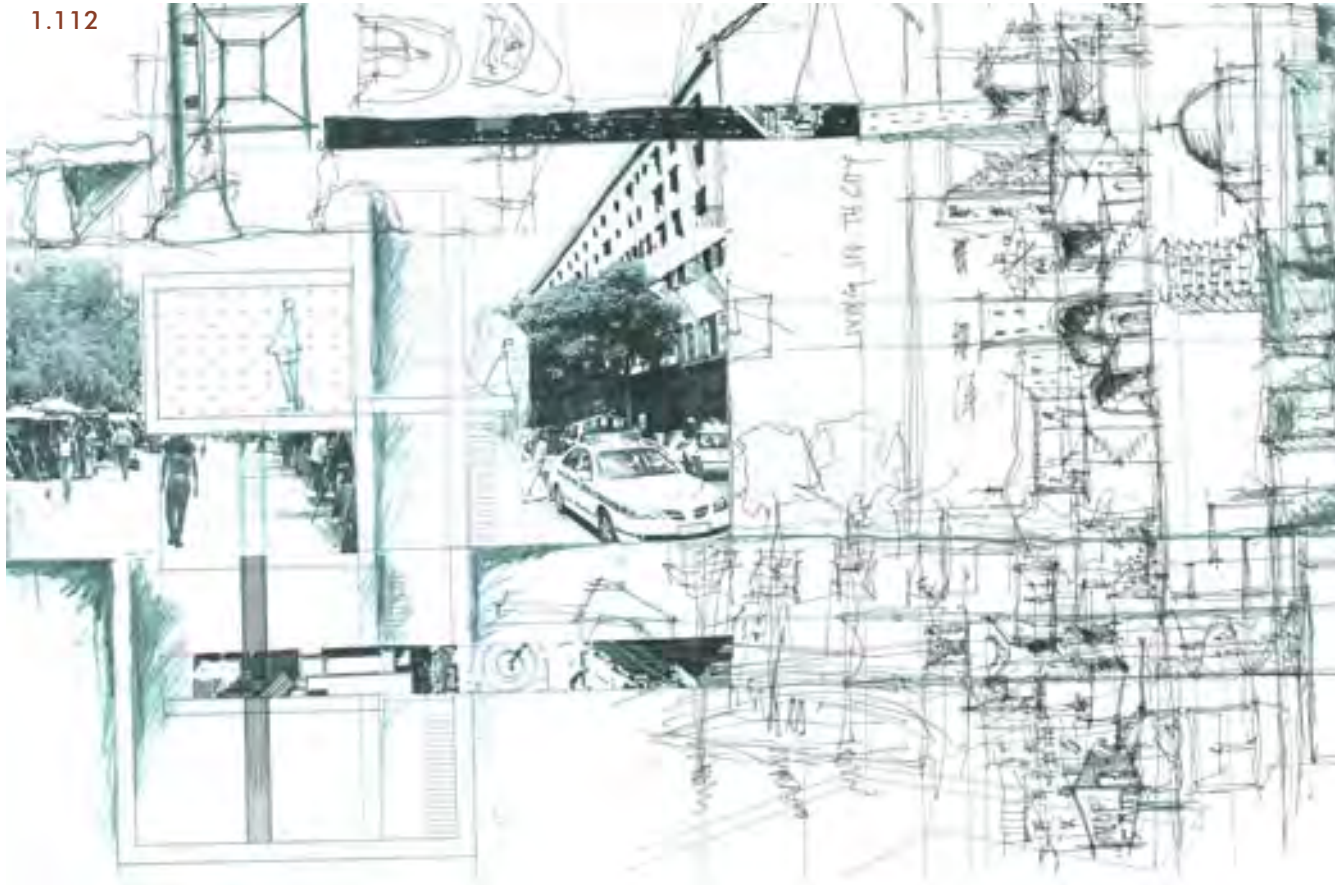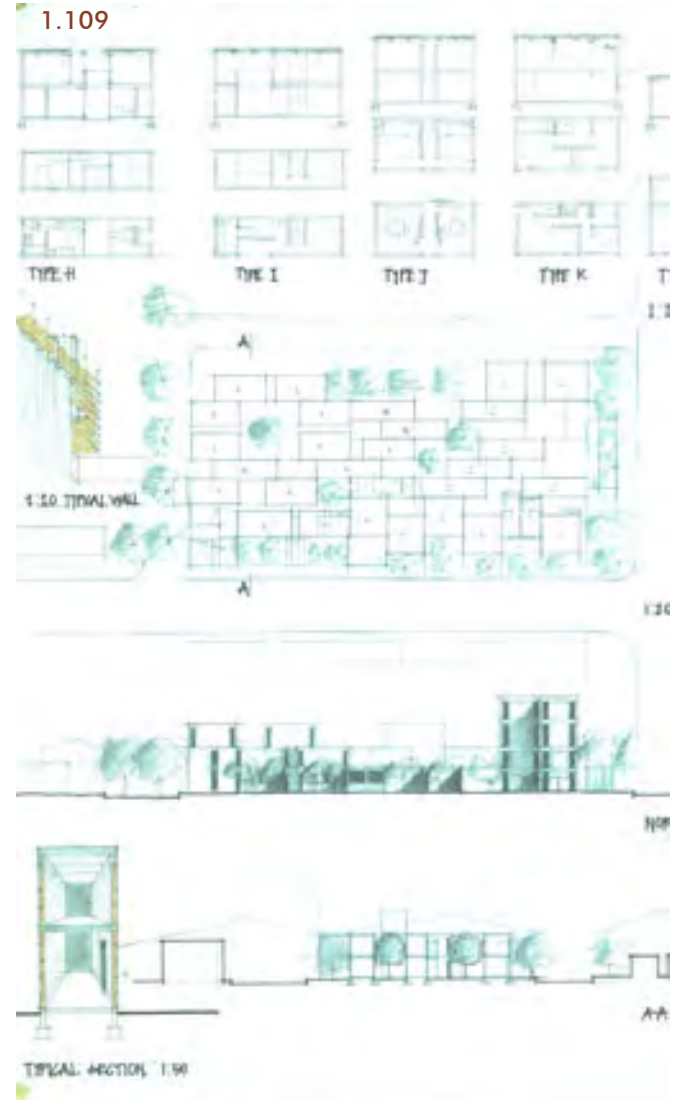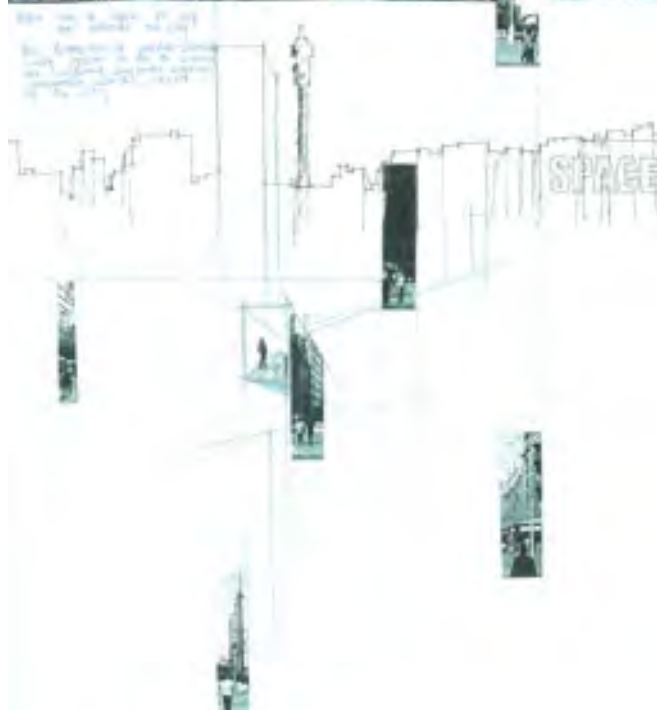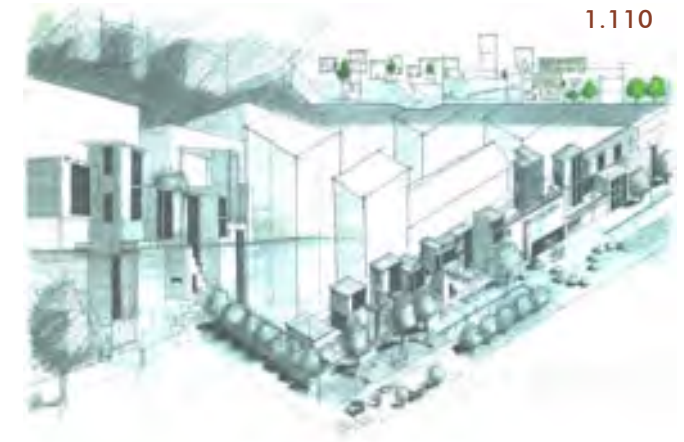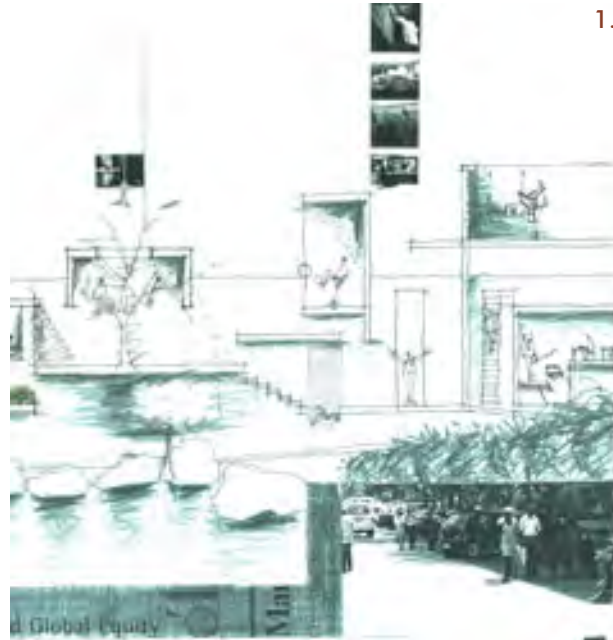
1.113

1.110

1.109 Student project, Social Housing, Attridgeville, South Africa.

1.110 to 1.113 Student project, Mixed-use development, Des Baker Competition 2005.

1.114

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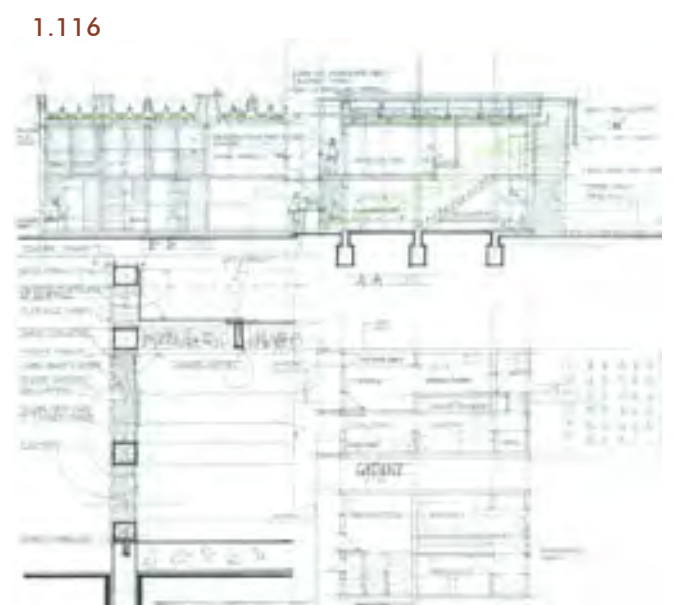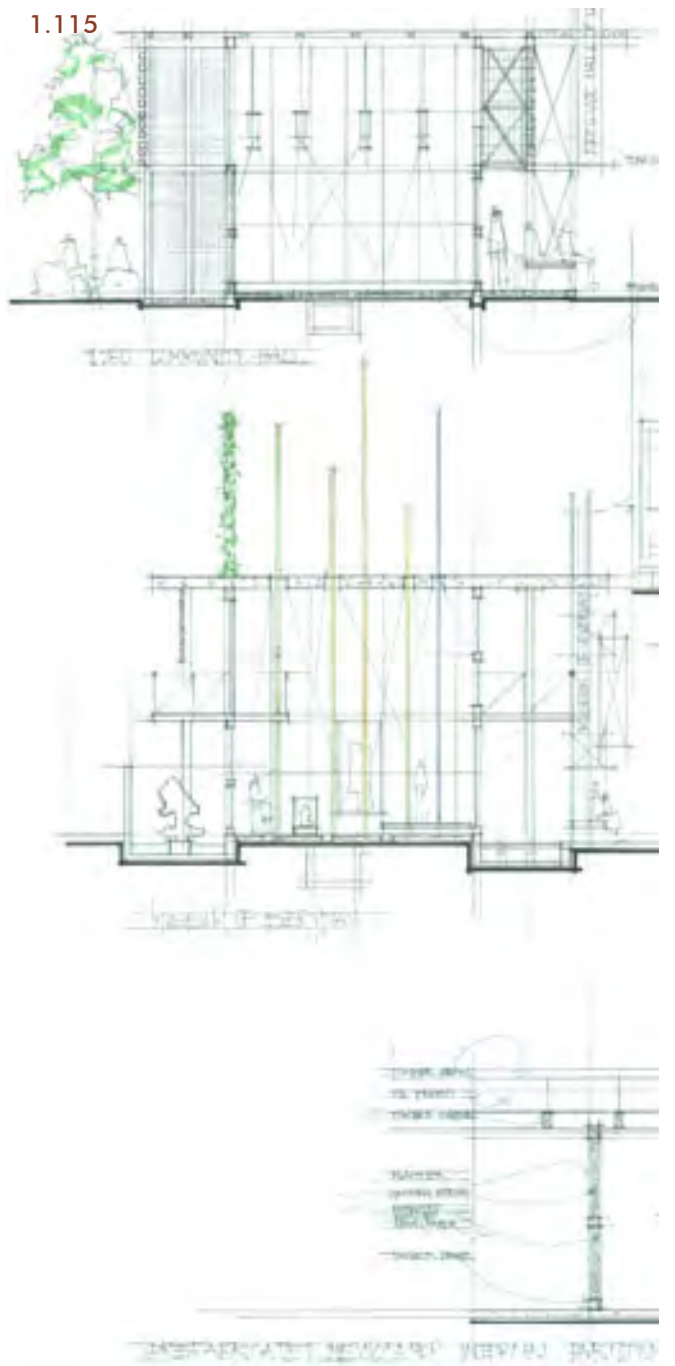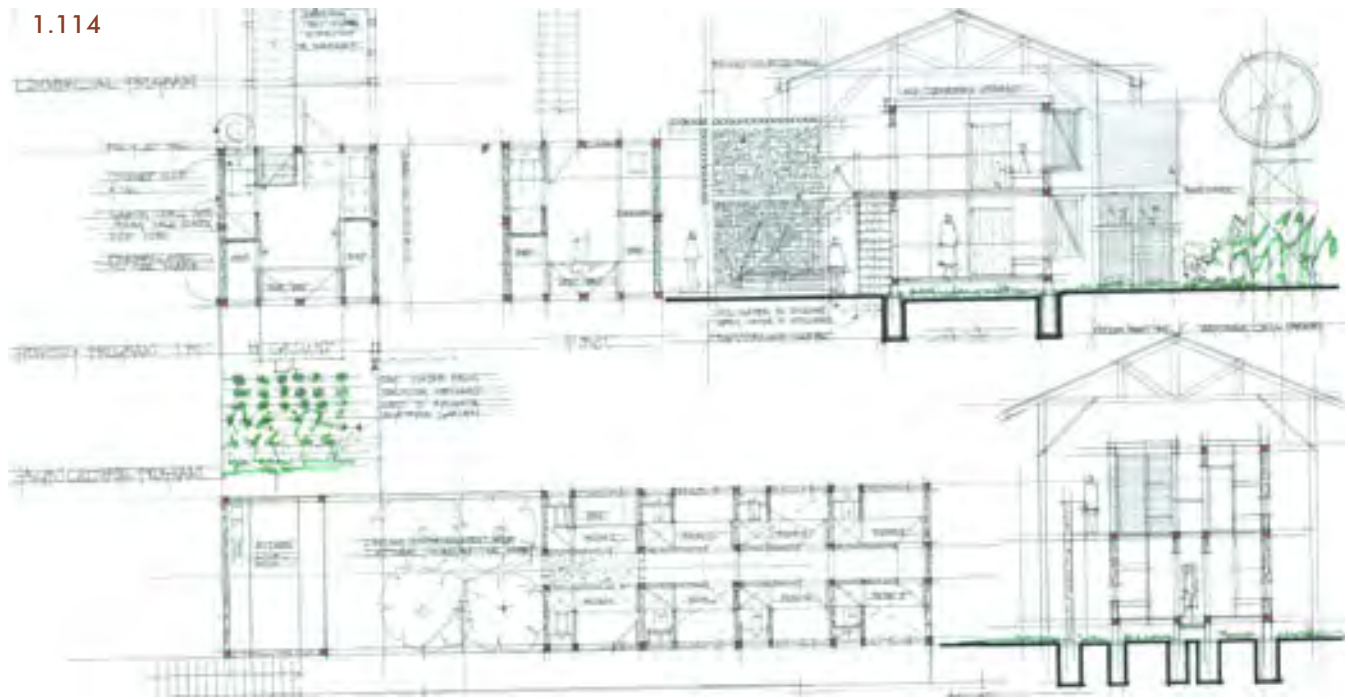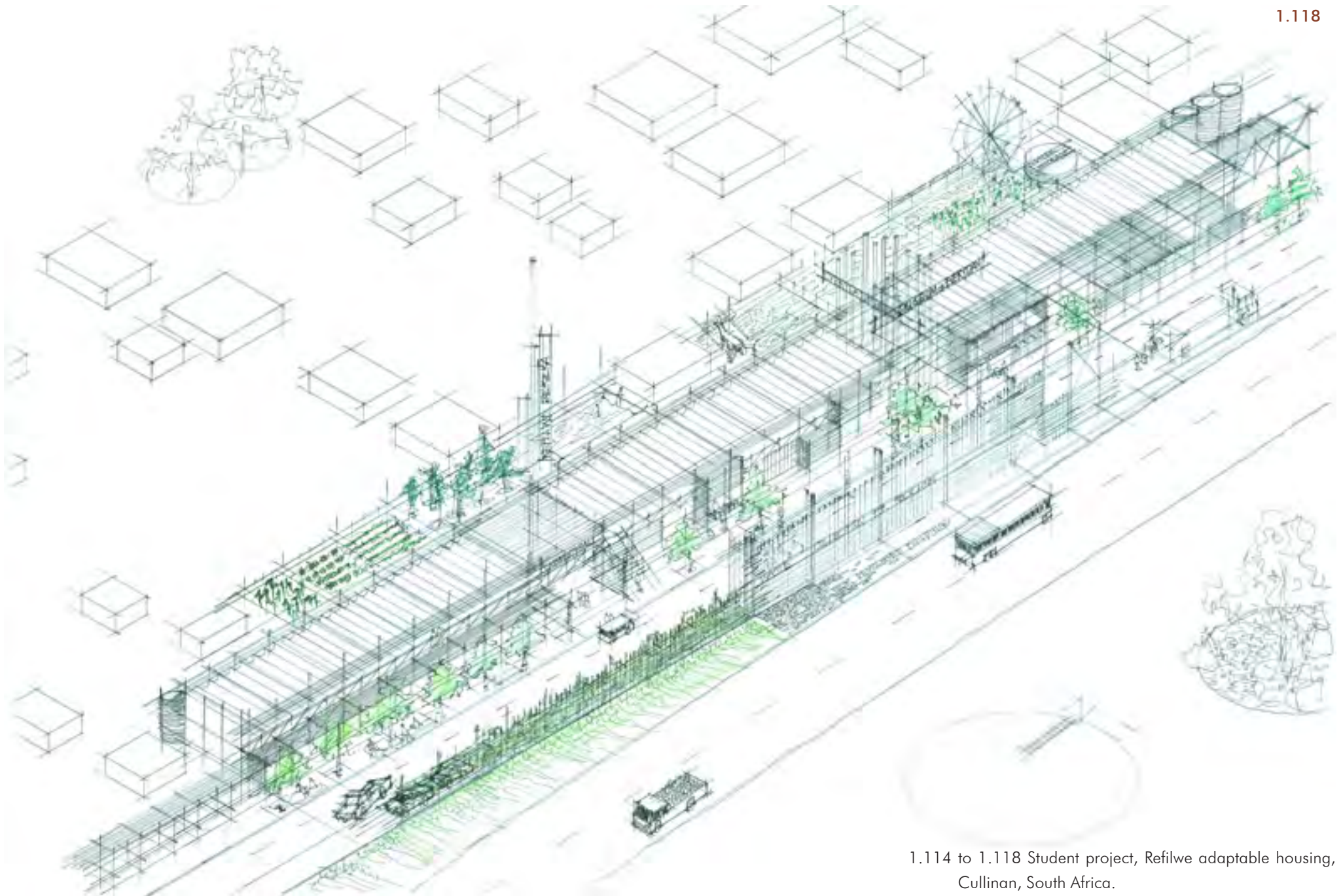
1.118

1.114 to 1.118 Student project, Refilwe adaptable housing, Cullinan, South Africa.

1.119

1.120

1.121

1.122

1.123

1.124

1.125

ATOP-DETAIL OF STREET RENT-OUT ROOMS 1:10

ABOVE-DETAIL OF TIMBER AND STEEL SCREEN WALL 1:10
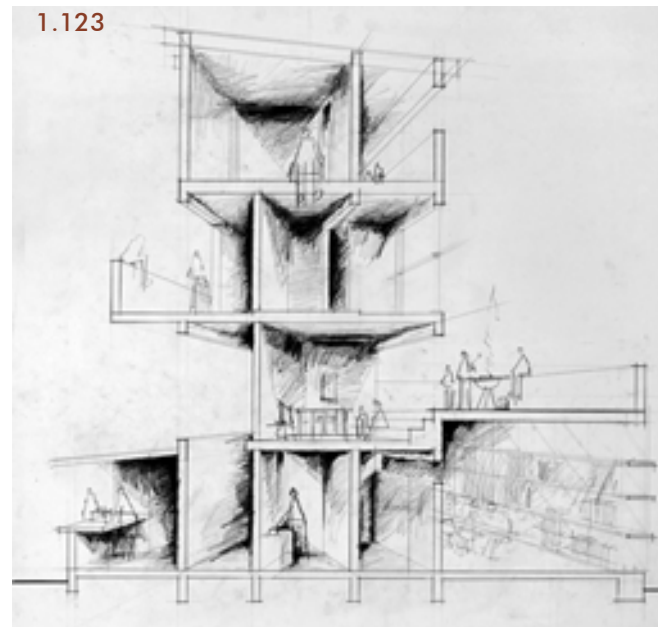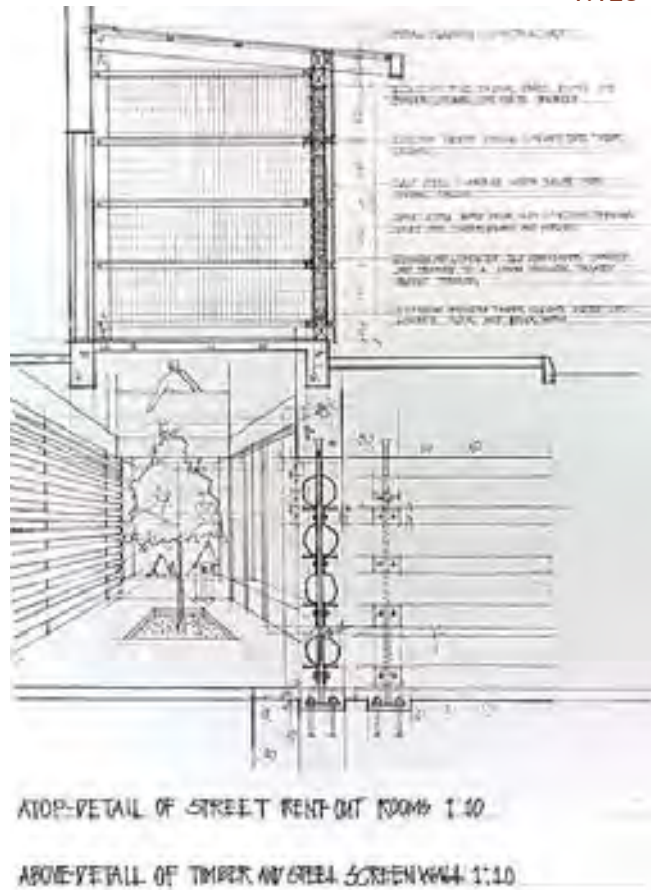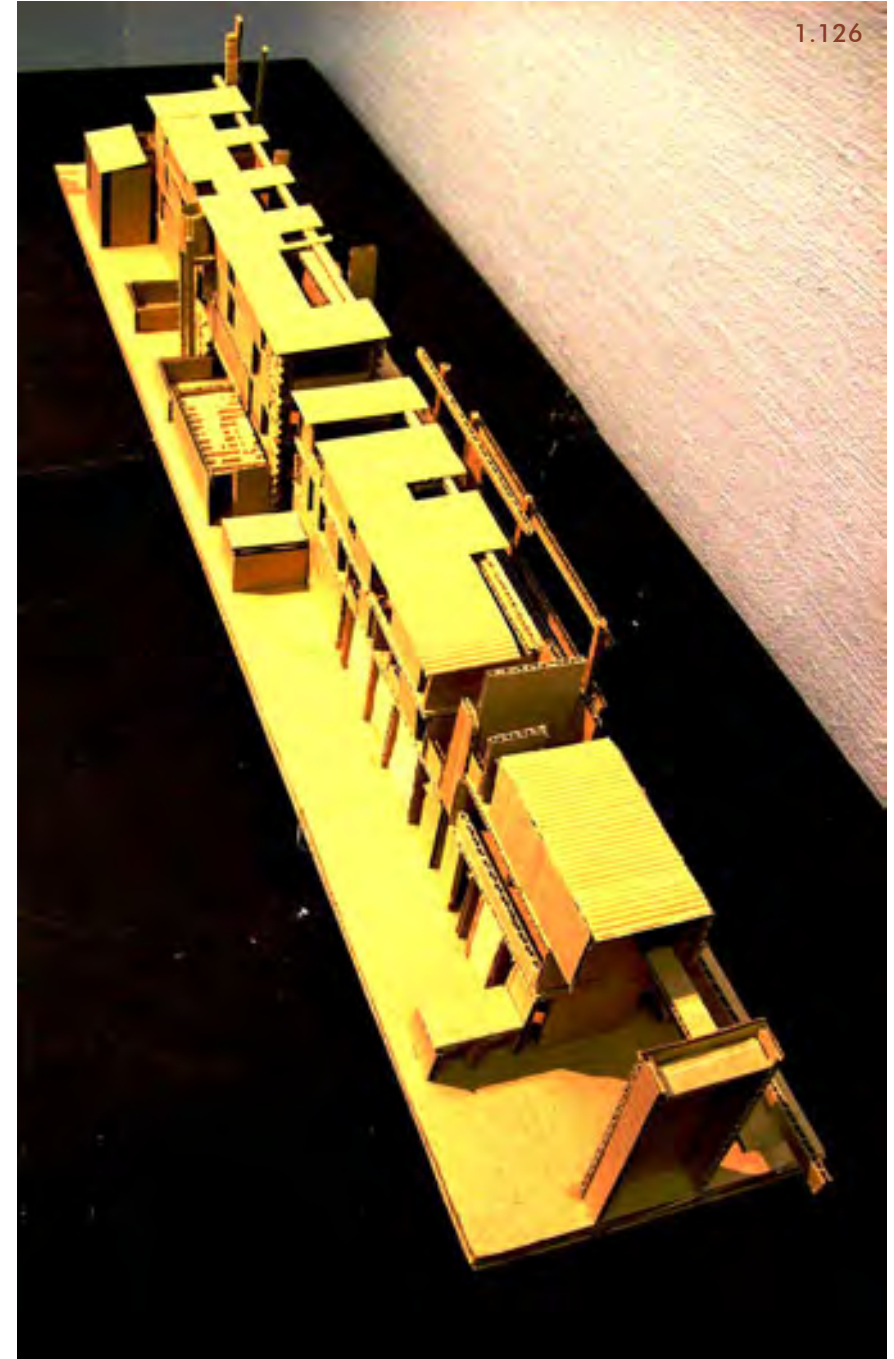
1.126

1.119 to 1.126 Student project, Social Housing, Mamelodi, South Africa.

1.127

1.129
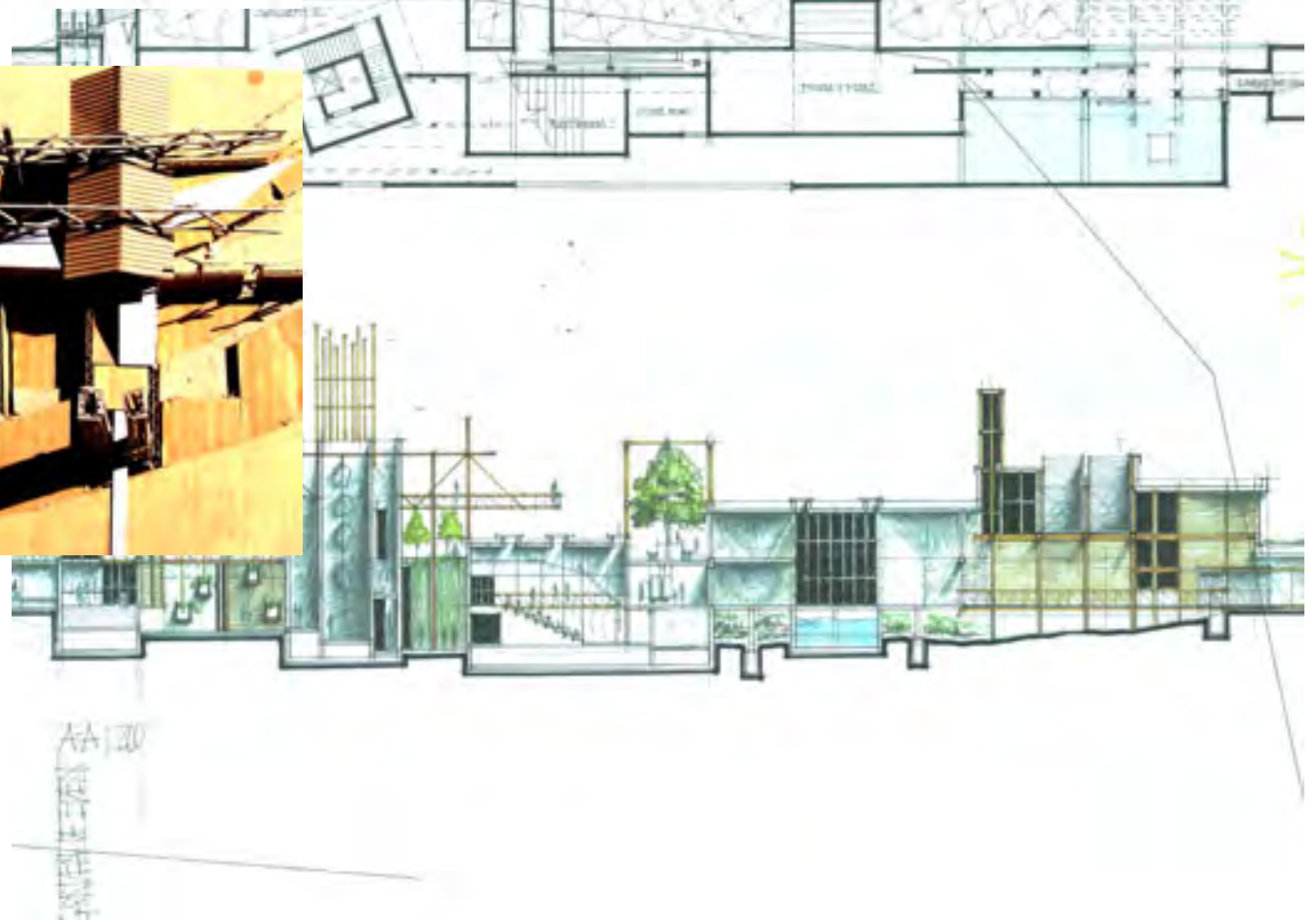
1.127 tp 1.129 Student project, Crater Museum, Vredefort,
      South Africa.

1.130

1.131

HINGED STEEL GATE WELDED TO STEEL MAIN FRAME

A

1:10   SIMPLIFIED FLEXIBILITY   A-A   A
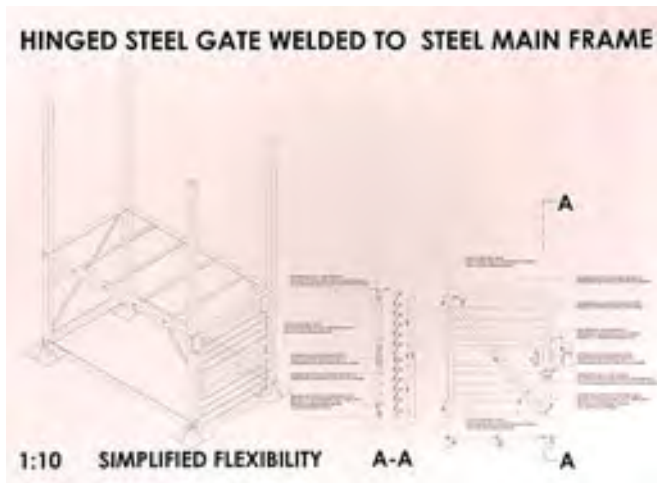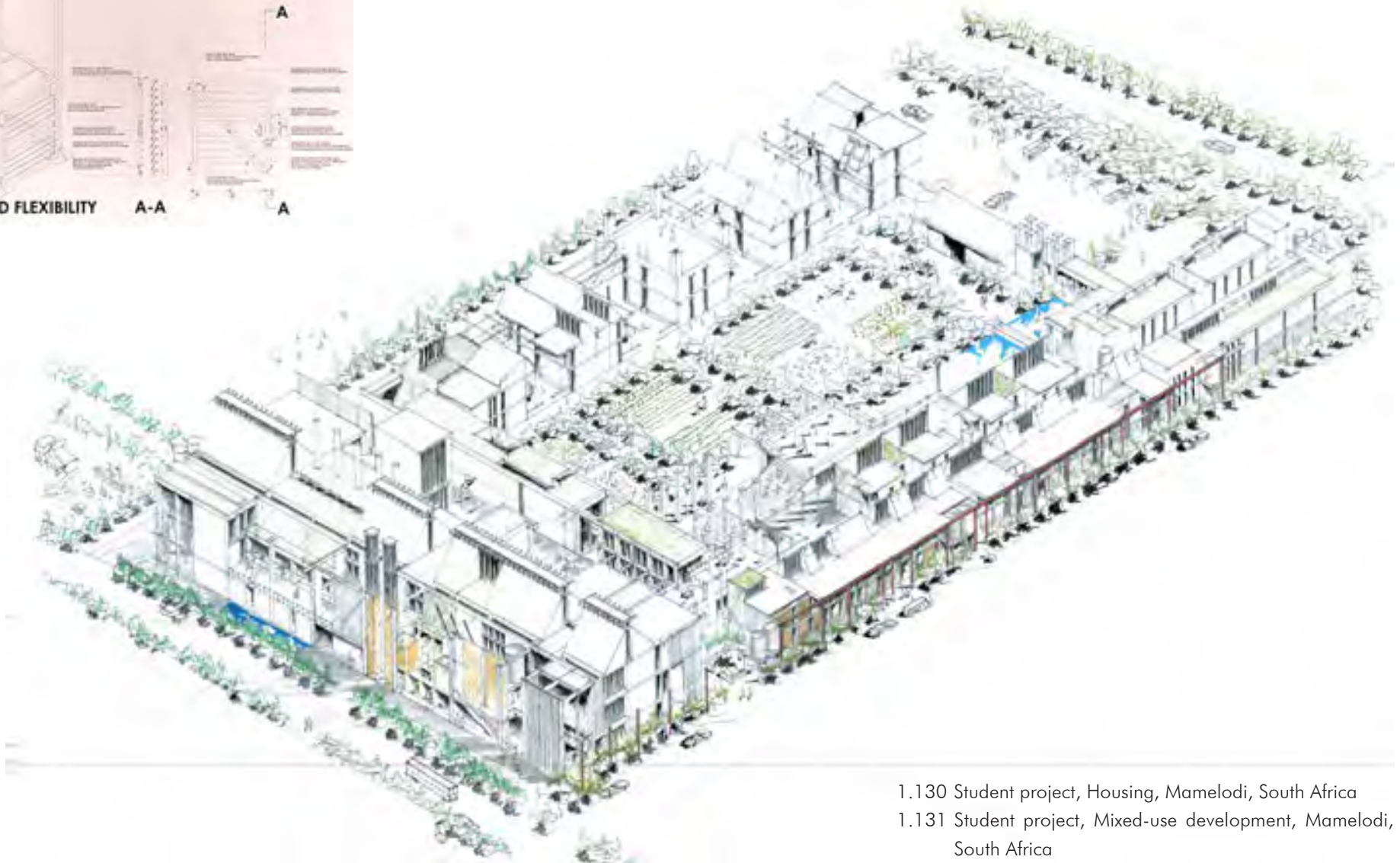
1.130 Student project, Housing, Mamelodi, South Africa

1.131 Student project, Mixed-use development, Mamelodi, South Africa

1.132

1.133

ACTIVITIES...FORSTERING **FRIENDSHIP** AND **UNITY** BY PLACE-MAKING

1.134

1.135

1.136

1.132 to 134 Student project, Mixed-use development, Mamelodi, South Africa.

1.135 Proposed additions to a residential building, Pretoria, South Africa.

1.136 Proposed new residential building, Limpompo, South Africa.

A VISUAL-SPATIAL ANALYSIS OF PRECEDENTS
PHOTOGRAPHS: SPATIAL DOCUMENTATION

2.2 VISUAL-SPATIAL PRECEDENT STUDIES
INTRODUCTION

Historic African huts had few small-sized and sometimes no windows and thus interior spaces were mainly connected by one door. Intimate relationship-building activities occurring in these enclosed private spatial domains were almost completely disconnected from semi-private, semi-public and public activities. These spatial articulations show that there are varying levels of enclosure for relationship-building activities in private spaces (personal space), semi-private and semi-public spaces (family space) and public spaces (community space). Intimate relationship-building activities are completely disconnecting (by total enclosure) from other activities. A high degree of less intimate social connectivity can occur in semi-public and public spaces.

In the following visual-spatial precedent analysis and extrapolation will include non-Bantu sub-Saharan African settlements and other third-world informal settlements, to check if there are socio-spatial similarities with Bantu settlements so as to establish socio-spatial patterns (*see Addendums 1 to 2*).

2.001 Division of functions: a) the independent supporting framework, and b) an apartment.

2.002 A kitchen entrance with seating, Ghana.

2.003 A bedroom entrance with seating, Ghana.

2.004 Entrance to compound with seating, Zaire.

2.001

2.002

2.003

2.004
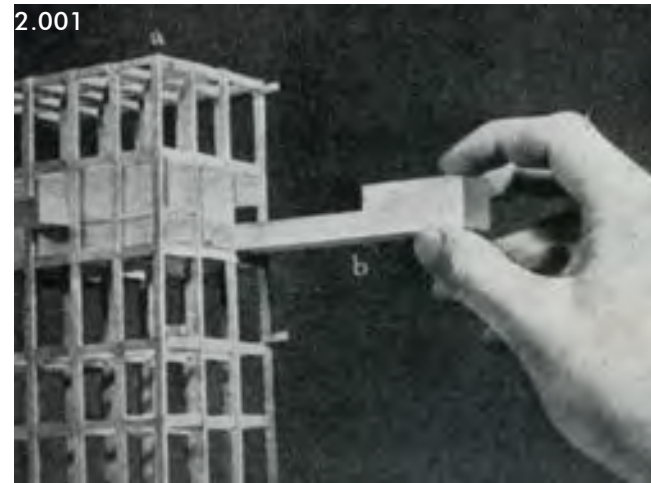
African visual-spatial precedents.

2.005 A decorative compound wall with seating, Zaire.

2.006 A dwelling with low walls, steps and seating, Vhufuli, Venda.

2.007 A dwelling with low walls, steps and seating around the entrance, Mavambe, Gazankulu.

2.008 A covered entrance gate to a compound with seating, Nigeria.

2.009 An aerial view of an African settlement in the city of Logone-Birni in Cameroon.

2.010 An aerial view of Labbezanga village in Mali, showing a fractal spatial arrangement.

2.011 A fenced informal home with poorly defined spatial thresholds, Mamelodi, South Africa.

2.012 A fenced informal home with a covered entrance, Mamelodi, South Africa.

2.013 A grocery store entrance with a bench and a shaded informal trader's spot, Mamelodi, South Africa.

2.014 Market spaces in African informal settlements.

Precedents in Surabaya, Indonesia.

2.015 A covered tuck shop entrance with movable seating in a *kampung*.

2.016 A house entrance with movable seating in a *kampung*.

2.017 A house entrance with trees and seating in a *kampung*.

2.018 A street view showing a line of trees, flowers, boundary walls and covered entrances in a *kampung*.

2.019 A street view showing a row of covered and uncovered house entrances with seating in a *kampung*.

2.020

2.022

2.025

2.021

2.023

2.024

2.026

2.027

2.028

2.029

2.030

South African spatial documentation.

2.020 A street view showing boundary fences, pedestrian walkway, gardens and covered house entrance, Maritang informal settlement, South Africa.

2.021 A colourful fenced dwelling with a semi-enclosed private open space, Maritang informal settlement, South Africa.

2.022 A fenced dwelling with a covered entrance and a semi-enclosed private open space used for domestic and social activities, Maritang informal settlement, South Africa.

2.023 An unfenced dwelling with an uncovered entrance with a combined step and seating, Mhagandaganda informal settlement, South Africa.

2.024 A pedestrian street view lined with dwellings with covered and uncovered entrances and fenced and unfenced private spaces, Mhagandaganda informal settlement, South Africa.

2.025 A open public space with a community water collection point which is also used as a laundry space, Mhagandaganda informal settlement, South Africa.

2.026 A group of men surrounding and holding down a bull in preparation for slaughtering it, Durban, South Africa.

2.027 A group of men slaughtering a bull for a family event, Durban, South Africa.

2.028 A Swazi traditional homestead, Lobamba, Swaziland.

2.029 A street lined with shops is closed so as to be used for a soccer game, Thembisa, South Africa.

2.030 Spectators sit under a shading structure to watch a soccer game in the street, Thembisa, South Africa.

DRAWINGS: SPATIAL DOCUMENTATION

2.033

Ron Herron, Free Time Node – Trailer Cage, montage 1967. It shows a support structure to provide plug-in points for mobile or temporary spaces.

2.031

2.032

2.034

2.031 High walls were used to screen open public spaces from private open spaces in the ancient Great Zimbabwe (11th–15th Century), Zimbabwe.

2.032 High walls are used to define private open spaces and semi-public open spaces in Luo Compounds, Kenya.

2.034 High walls with seating are used to contain a semi-enclosed semi-private open space which is used for domestic activities (1976), Lesotho.
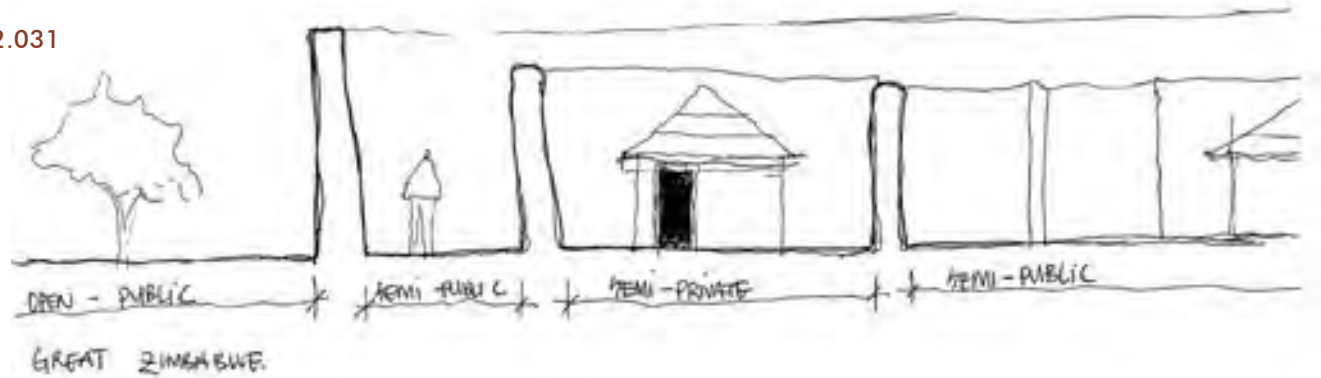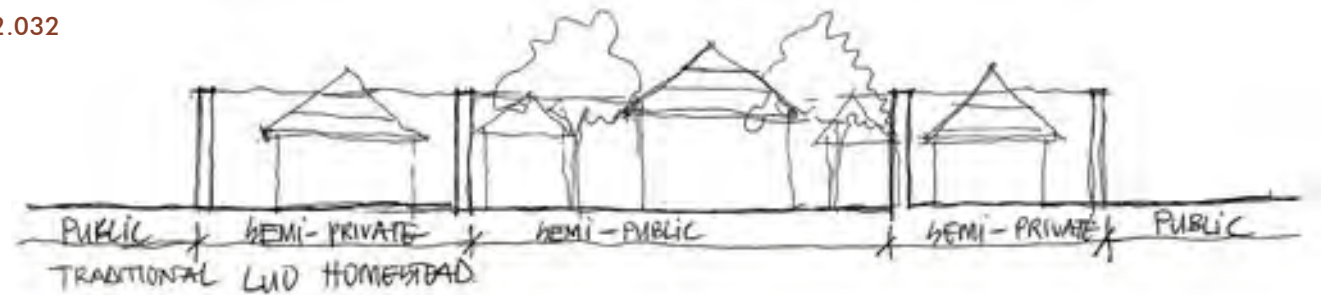
2.035

2.037

Low walls with seating and steps are used to demarcate transitional space.

2.036

2.038

2.035 Low walls with seating are used to screen an open private space in front of stand-alone dwellings from a public open space in a Pedi compound, South Africa.

2.036 Low walls with seating are used to define open semi-private spaces adjacent to open semi-public spaces in a Ndebele compound. Walls with seating are used at the entrance to the compound, South Africa.

2.037 A community meeting is held under a tree, a practice well-known as the *lekgotla*, South Africa.

2.038 Low walls with seating and steps are used to demarcate a transitional space between open spaces around stand-alone dwellings and crop fields, South Africa.

2.039

2.041

2.042a
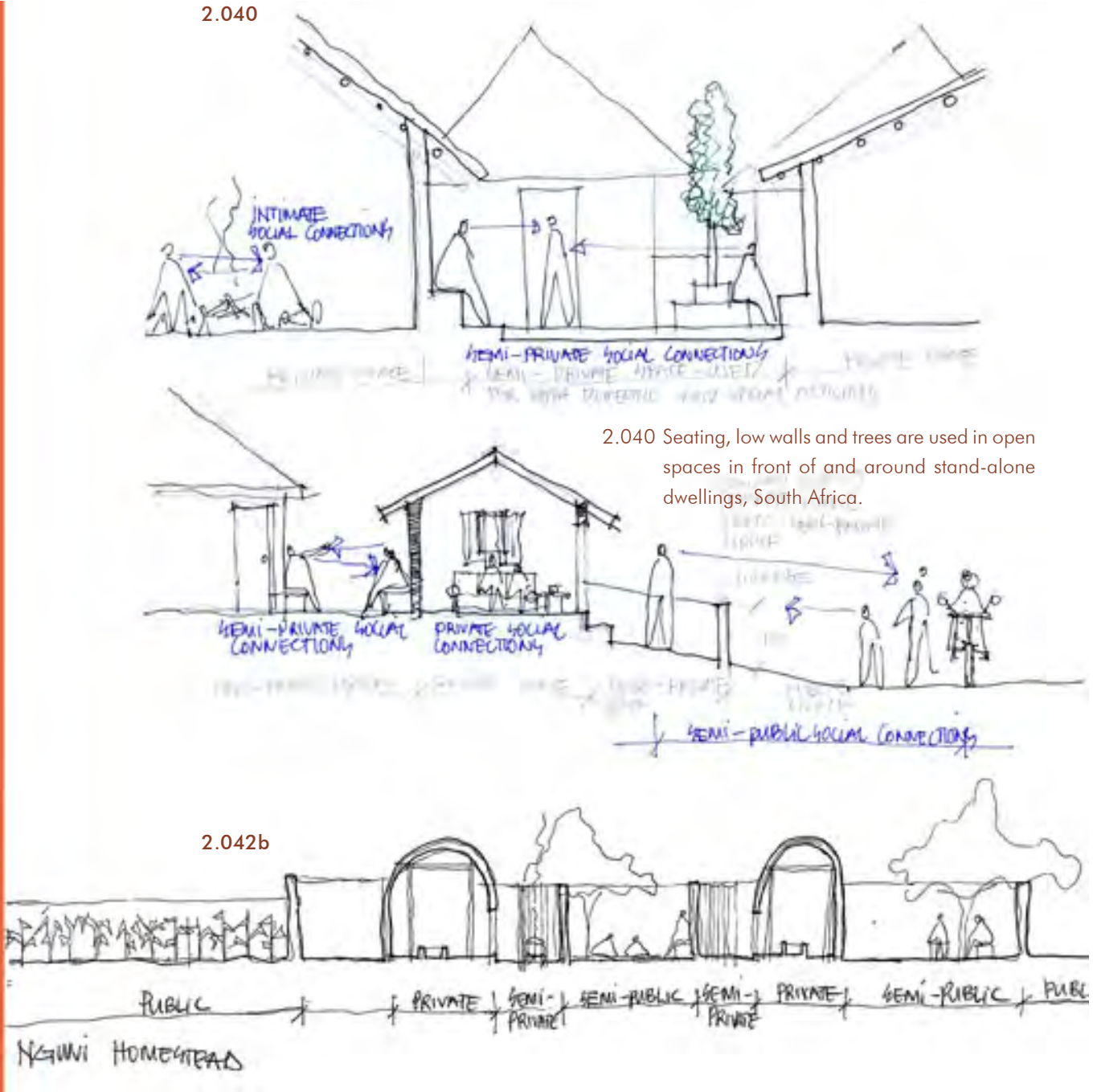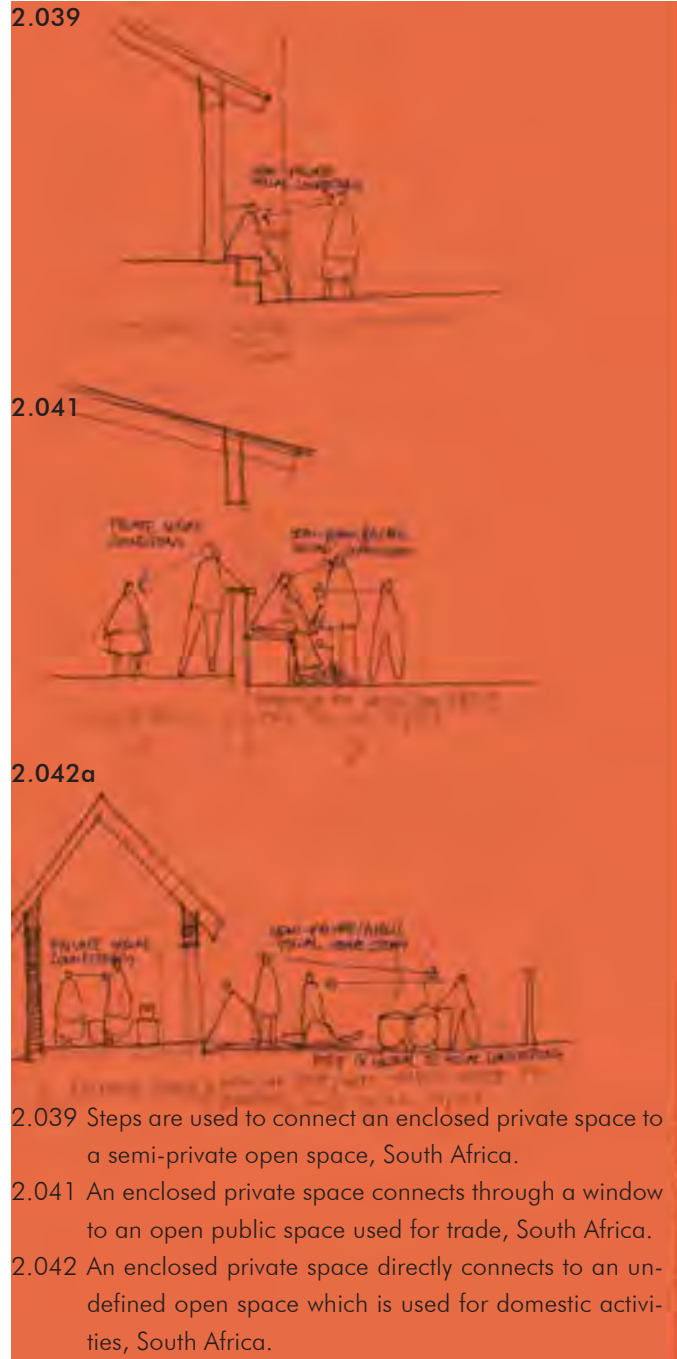
2.040

2.040 Seating, low walls and trees are used in open spaces in front of and around stand-alone dwellings, South Africa.

2.042b

NGUNI HOMESTEAD

2.039 Steps are used to connect an enclosed private space to a semi-private open space, South Africa.

2.041 An enclosed private space connects through a window to an open public space used for trade, South Africa.

2.042 An enclosed private space directly connects to an undefined open space which is used for domestic activities, South Africa.

2.045
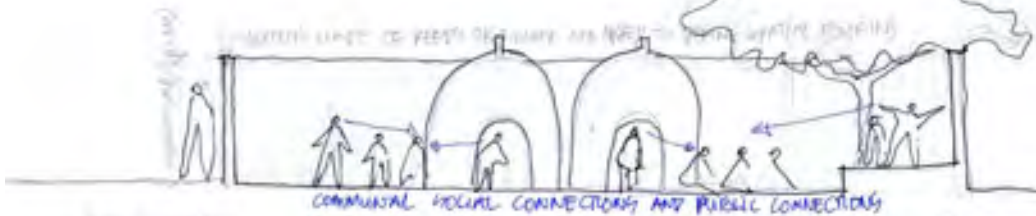
2.044

2.043

2.046

2.043 High walls, a raised platform and trees are used to define an open space around meeting pavilions at a *penhundla* (a community gathering space at or near a chief's home), South Africa.

2.044 Stand-alone dwellings are arranged to open towards a central open space which is further defined by low walls with seating and trees, South Africa.

2.045 A dwelling opens onto an open space defined with low walls and surrounded by trees. This open space accommodates domestic and social activities, South Africa.

2.046 Screen walls are used to define semi-private open space in front of stand-alone dwellings, leaving semi-public open spaces that interconnect the compound, South Africa.

2.048

2.047

2.047 An entrance area defined by low walls, seating and a tree, and an entrance defined by a wide step which is also used as seating, South Africa.

2.048 A variety of transitional spaces result from different articulation of roof overhangs, seating, steps and low walls, South Africa.

2.049 Composition of forms was achieved by applying a human scale, creating variety of form and indoor-outdoor spatial organisation in this Gurunsi compound (1985), Burkina Faso.

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2.050 Stand-alone dwellings are organised around an open space which connects to a public pedestrian pathway in a Gurunsi compound(1985), Burkina Faso.

2.051 High and low boundary walls were used to separate open private spaces around dwellings and trees from public open spaces, Ethiopia.

2.052 High screen walls are used to define semi-private open spaces in front of entrances to stand-alone dwellings. A low timber fence known as *lihange* is used to separate crop fields from opensemi – public spaces around the dwellings (1990s), Swaziland.

2.053 The space in front of a dwelling is defined with screen walls, low walls, seating and trees, while the spaces at the back of dwellings are usually left unarticulated (1990s), Swaziland.

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2.054 The front elevation of a stand-alone dwellings is facing towards the crop fields, trees, gardens and kraal (1990s), Swaziland.

2.055

2.055 A low wall was used to enclose the open space between two circular dwellings, and a kraal was aligned to the square dwelling so as to create an L-shaped layout at the front (1990s), Swaziland.

2.056 Intimate social interaction and domestic activities occur indoors; semi-private social and domestic activities occur in screened open spaces; semi-public social activities occur in open spaces defined by trees and low walls; and public social activities occur under trees and in left-over open spaces around dwellings and screened open spaces (1990s), Swaziland.

2.057 A covered entrance with seating was used as a threshold space to separate indoor space from outdoor space, and also for social activities (1990s), Swaziland.

2.058–2.059 The covered entrance with seating and steps is used to connect the interior of the grocery store to the surrounding open public space (1990s), Swaziland.
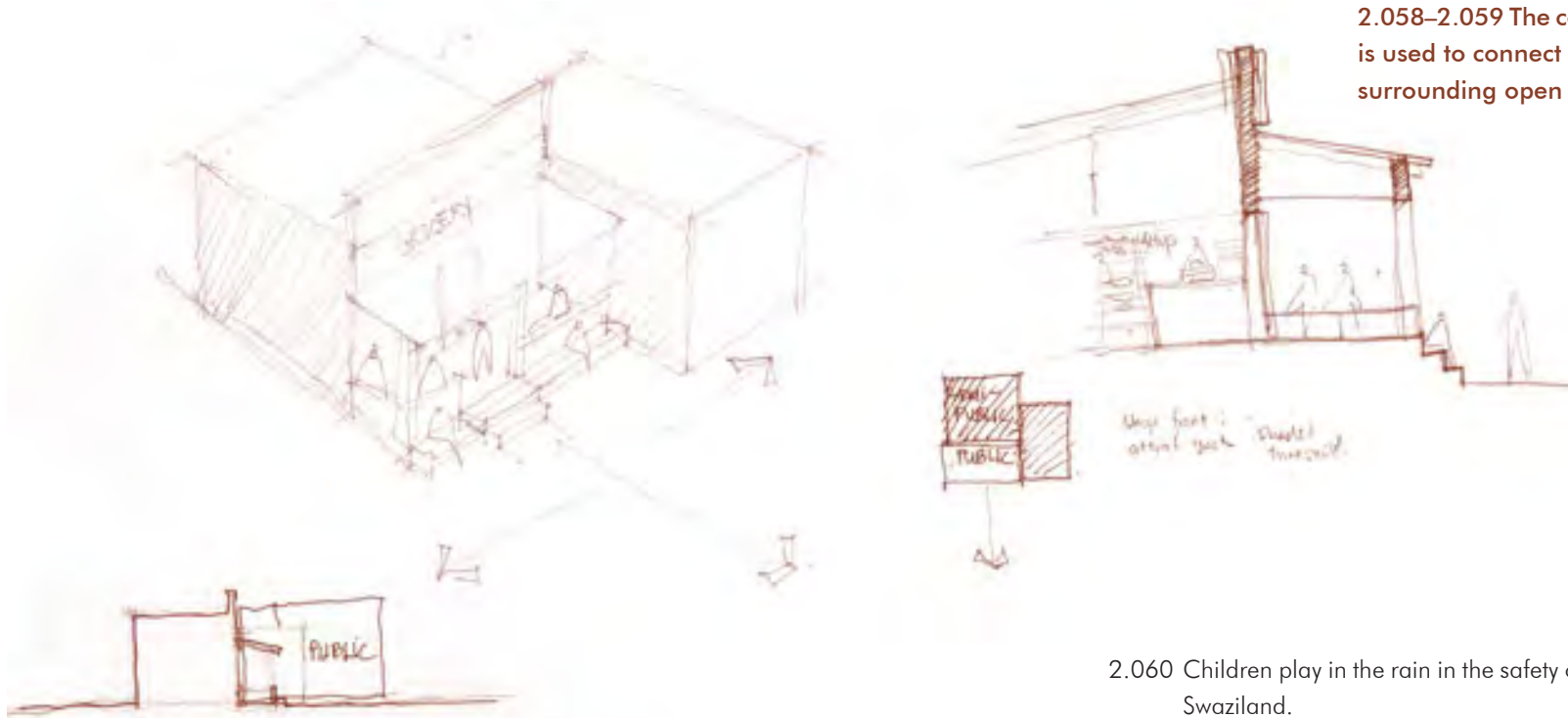
2.060 Children play in the rain in the safety of open spaces around buildings (1990s), Swaziland.

2.061 Children take baths in the open spaces around dwellings (1990s), Swaziland.

2.062 Community members attend, support and help out during burial processions, an event that is usually accompanied by lots of singing (1990s), Swaziland.

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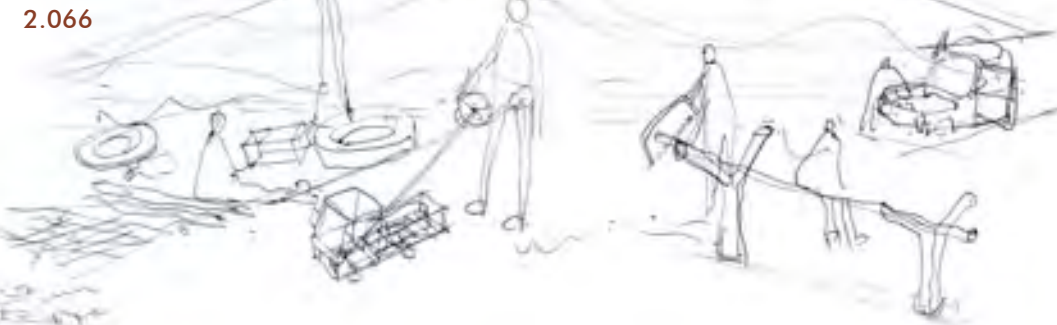
2.063 Community meetings are held under trees in open spaces, a practice also known as *lekgotla* in the seTswana language (1990s), Swaziland.

2.064 Boys usually make a fire, roast corn and play a game, known as *mla-balaba,* under a tree while herding cattle (1990s), Swaziland.

2.065 Boys perform a Swazi traditional dance while girls sing and clap hands for them in open spaces around dwellings (1990s), Swaziland.

2.066 Boys use wood and recycle wire fences, car tyres and parts available in open spaces in homesteads to create toy wire cars (1990s), Swaziland.

2.069 A street view shows shaded entrances, seating, trees and children playing (1999), Maputo, Mozambique.

2.070 A transitional space is defined by a covered entrance and trees used for social activities (1999), Maputo, Mozambique.
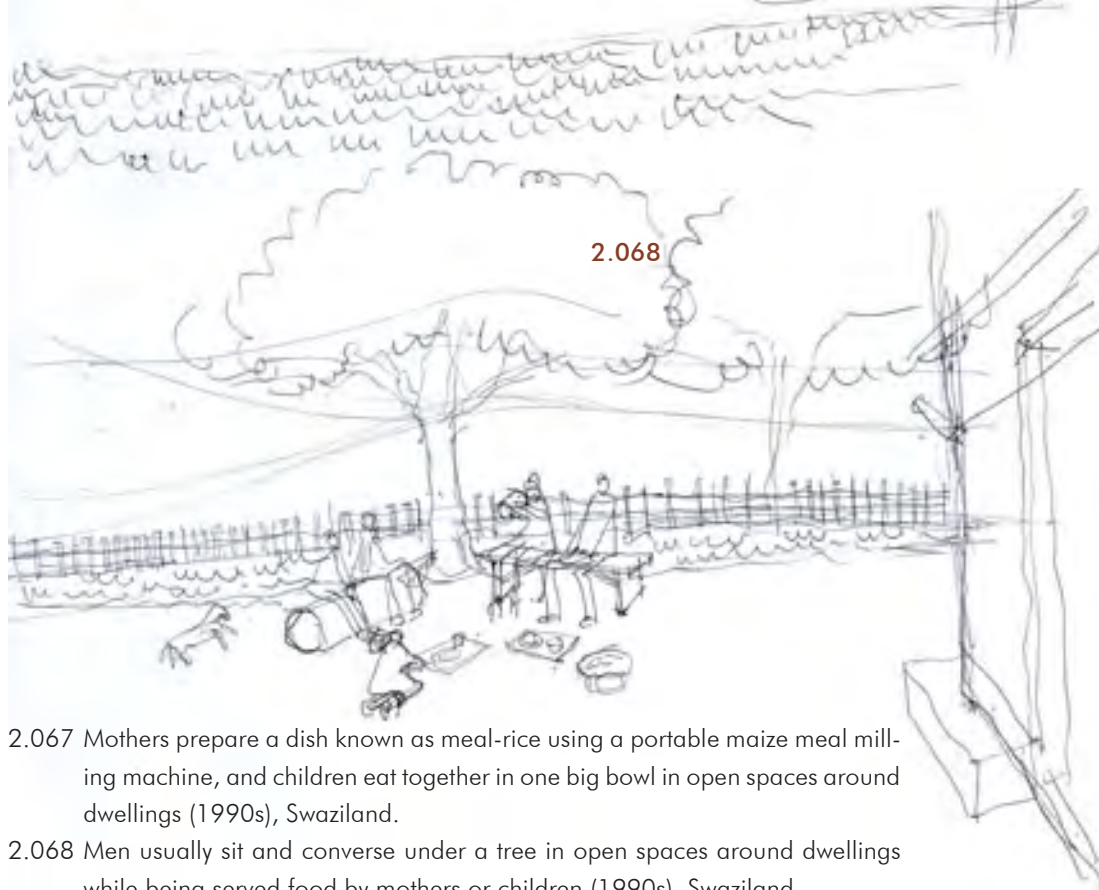
2.067 Mothers prepare a dish known as meal-rice using a portable maize meal milling machine, and children eat together in one big bowl in open spaces around dwellings (1990s), Swaziland.

2.068 Men usually sit and converse under a tree in open spaces around dwellings while being served food by mothers or children (1990s), Swaziland.

2.071 A road island in this highway is used by carpenters for making and selling furniture (2000), Lagos, Nigeria.

2.072 Loosely defined thresholds between semi-private and public spaces can disturb semi-private social interactions (2007), Khayelitsha, Cape Town.

2.073 Open spaces in front of dwellings is used for seating and economic and social activities (2007), Khayelitsha, Cape Town.

2.071
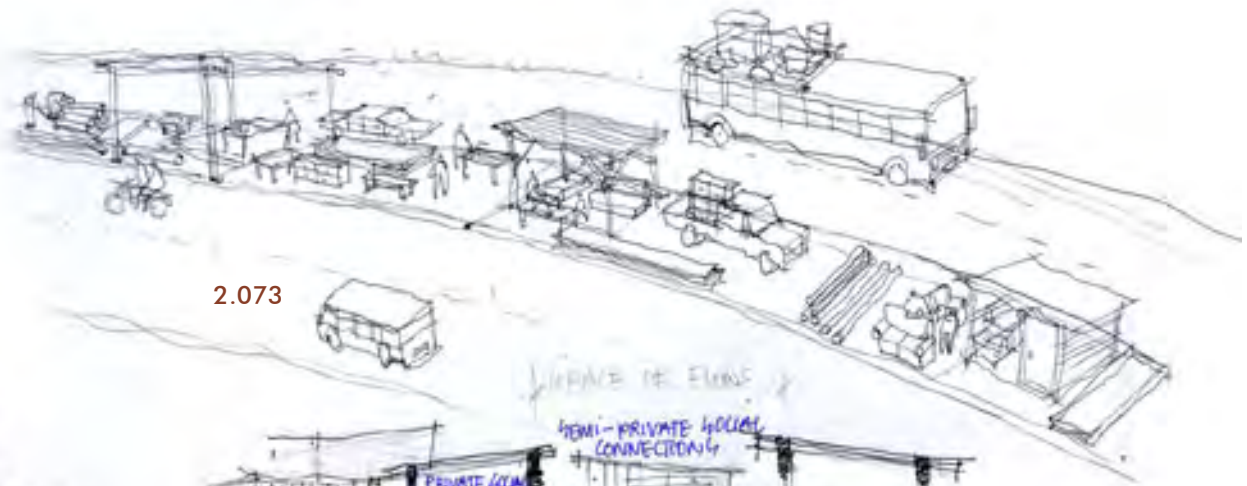
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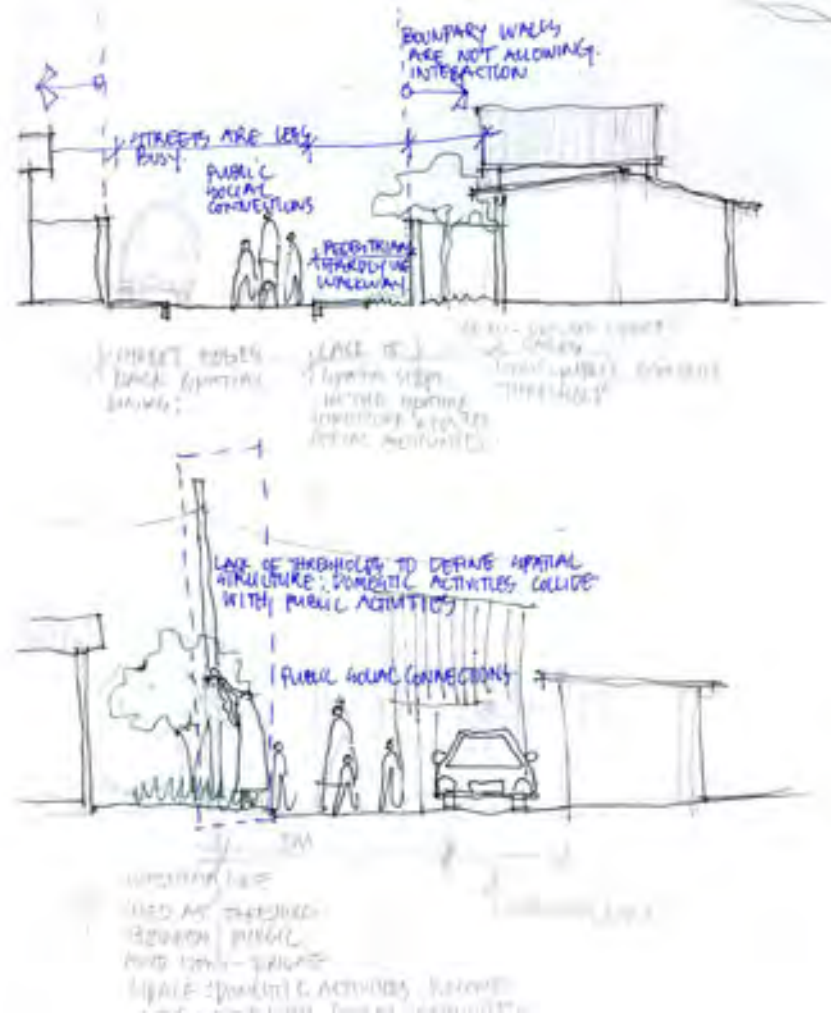
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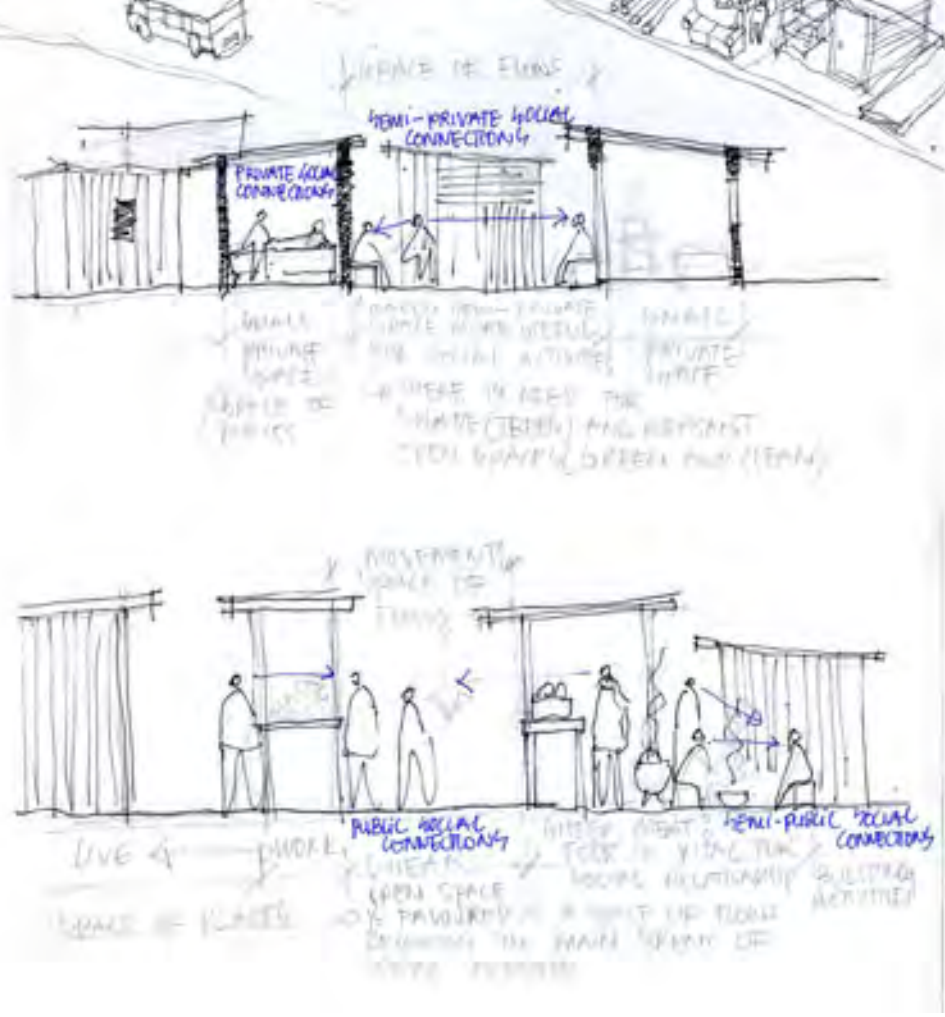
2.075

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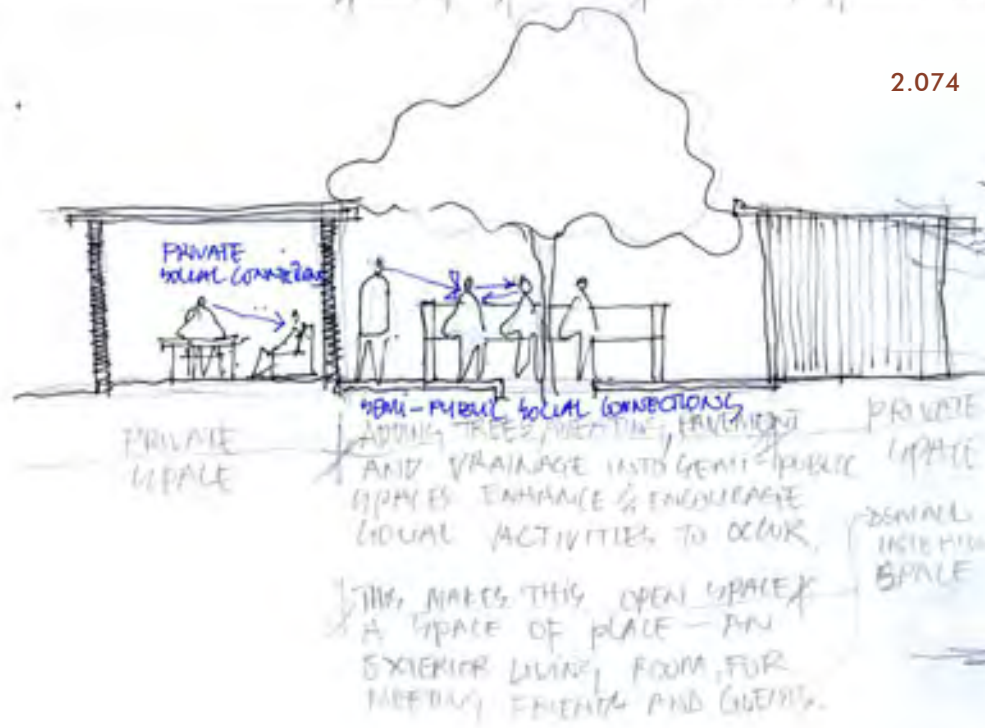
2.076

2.074 Trees in open spaces around dwellings provide shade, thus attracting social activities (2007), Khayelitsha, Cape Town.

2.075 This urban spatial structure indicates a progression from open private spaces, to semi-public open spaces and circulation spaces, and finally public spaces (2007), Mamelodi, South Africa.

2.076 Poorly defined threshold spaces between interiors of dwellings, private open spaces, and public open spaces or streets contain fewer social activities (2007), Mamelodi, South Africa.

2.077 Dwellings that are situated further away from the street boundary may have a weaker connection to the street, whereas dwellings located closer connect strongly, sometimes even giving rise to economic activities (2007), Mamelodi, South Africa.
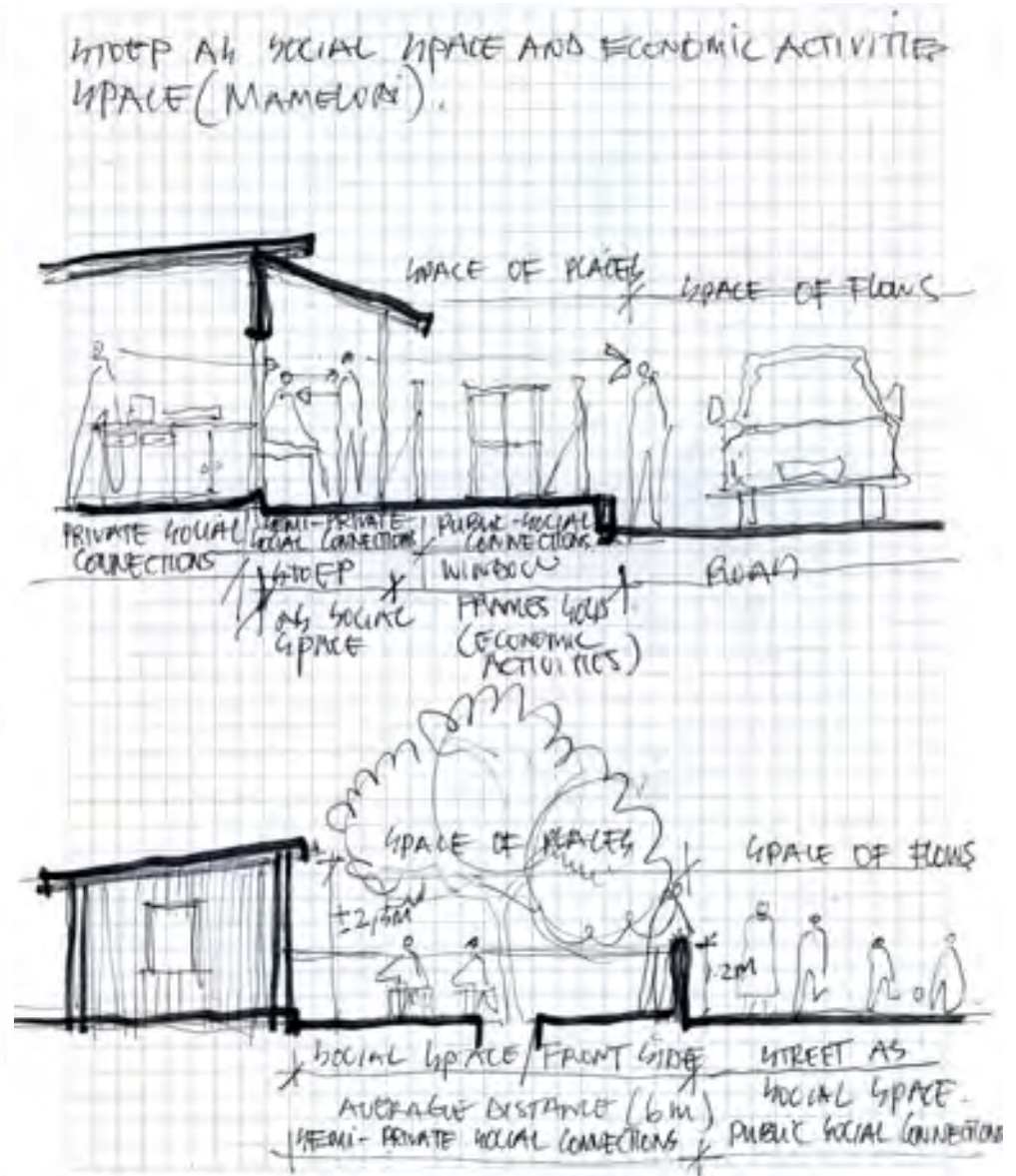
2.078 Covered entrances are sometimes used as *spaza* (tuck) shops, and sometimes private open spaces are fenced off from busy streets to be used for social and domestic activities (2007), Mamelodi, South Africa.
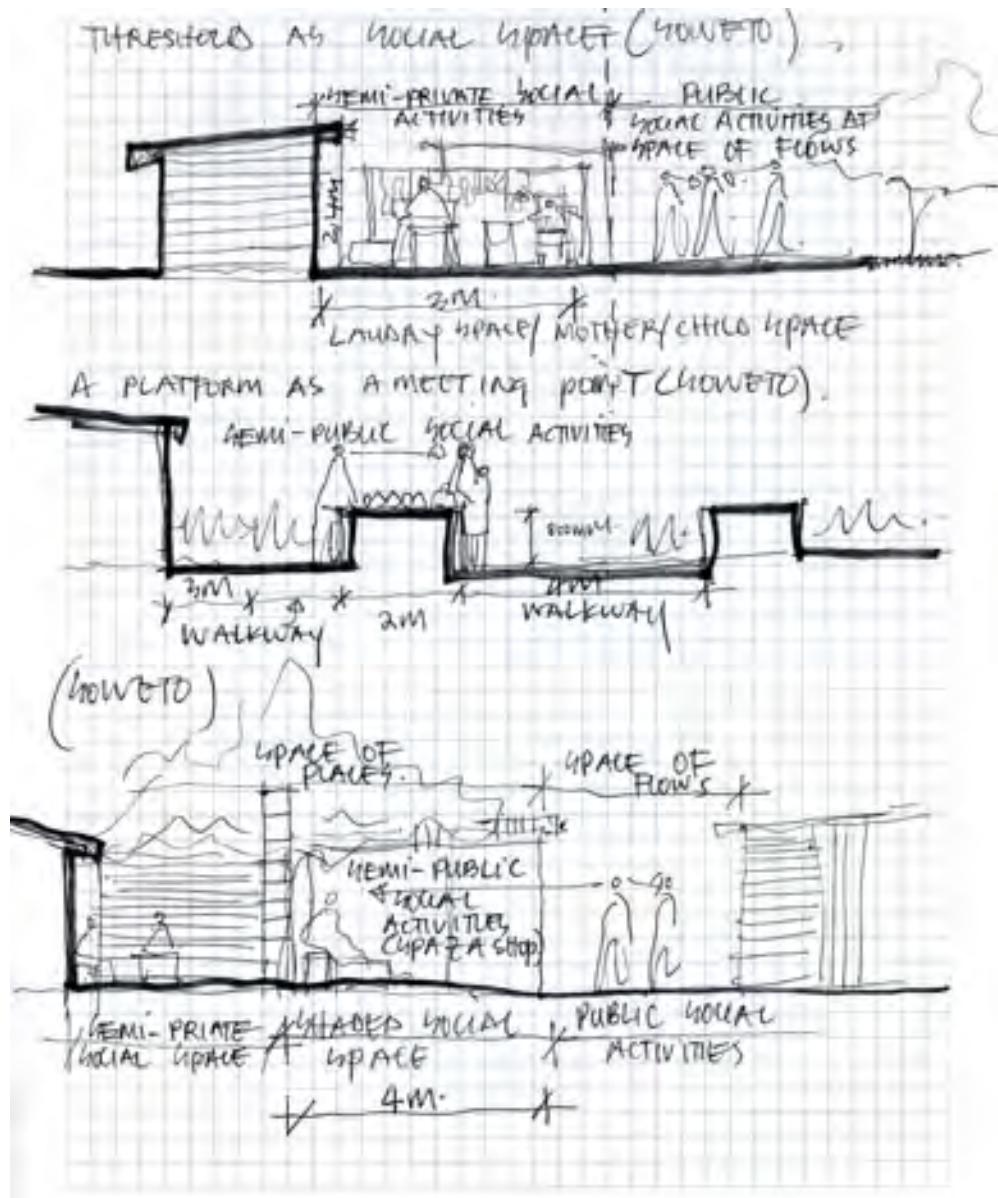
2.079 *Spaza* (tuck) shops, fences and raised platforms are spatial elements used to separate private open spaces from public open spaces (2007), Soweto, South Africa.
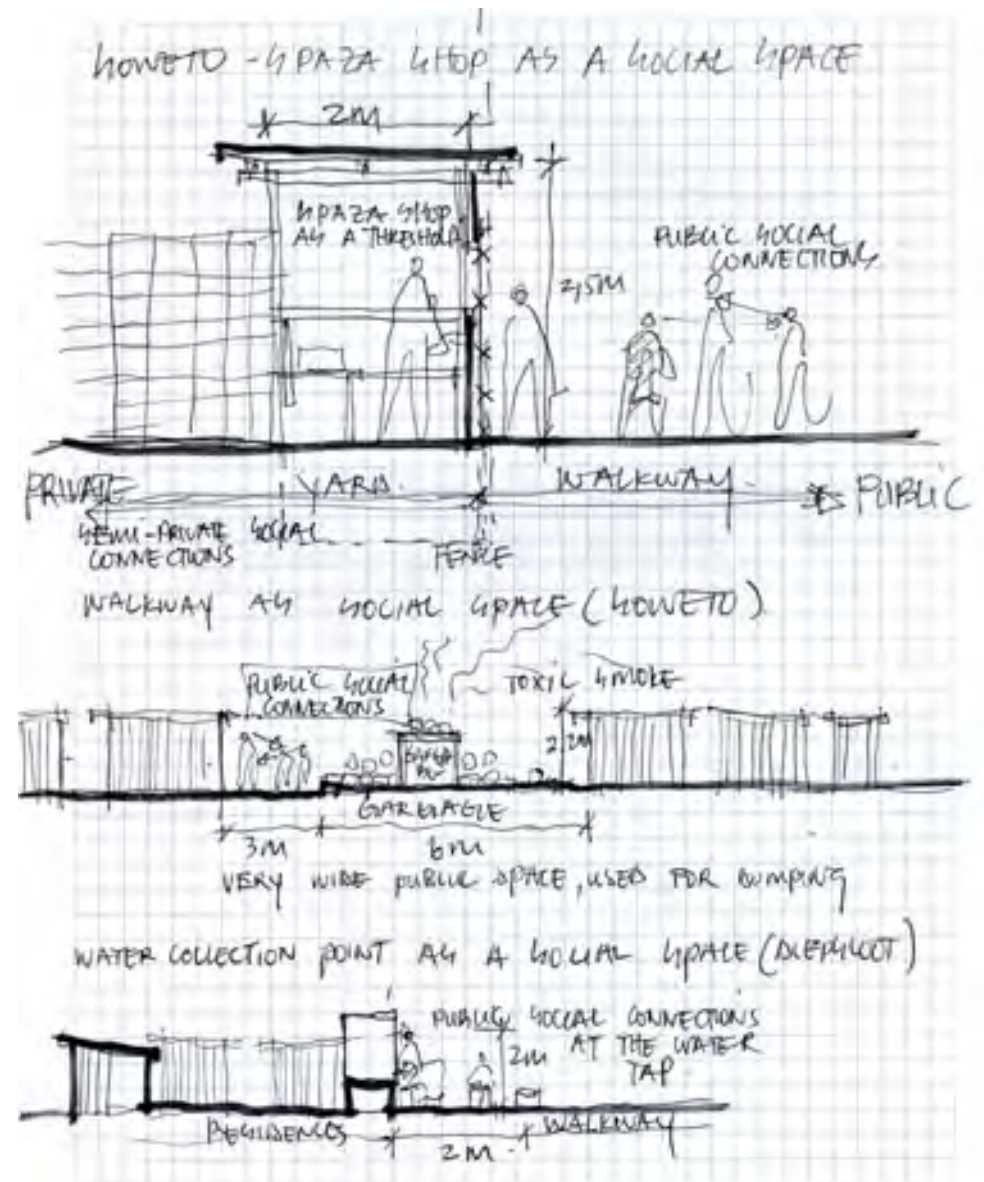
2.080 Spaces used for specific activities like *spaza* shops and water collection points are kept cleaner compared to open public spaces with no assigned activity (2007), Soweto, South Africa.
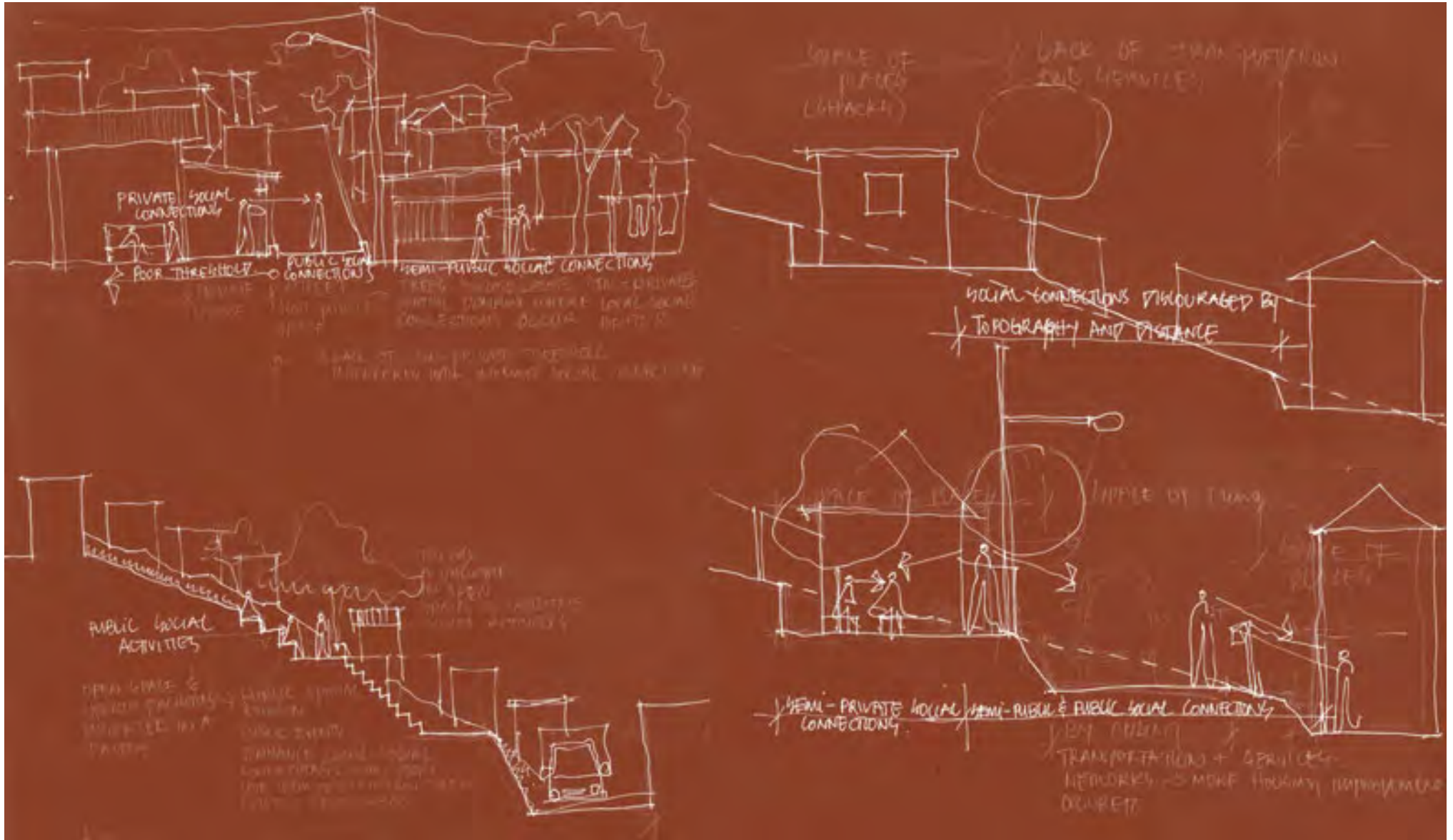
2.081 Improving open public spaces, pedestrian walkways, roads and sports facilities in favelas is a step towards dignifying human living conditions in poverty-stricken communities (2009), São Paulo, Brazil.

2.082 In Mahwalala informal settlement, roads and services were inserted between dwelling units, after which many residents improved their houses. This is an example of how a simple upgrade of the space of flows in informal settlements can encourage and inspire residents to improve their dwellings (2009), Mbabane, Swaziland.
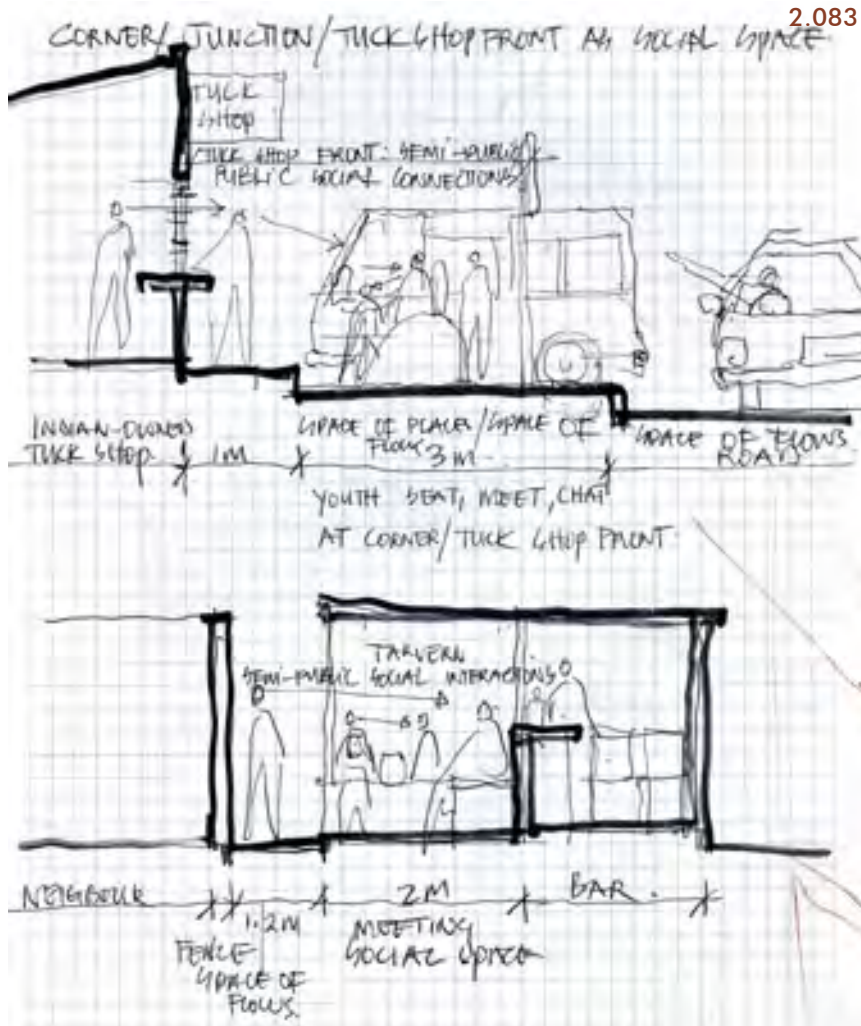
2.083 Social interactions occurring in front of a tuck shop, taxi stop and a bottle store are examples of how economic activities can attract social activities in public spaces (2011), Soshanguve, South Africa.

2.084 In this *kampung* a street profile with a mixed-use street edge indicates that the space of places of economic activities serves well as a threshold separating the public spatial domain from the semi-private spatial domain. A grey-water recycling facility was also installed in the street, allowing ease of maintenance (2011), Surabaya, Indonesia.
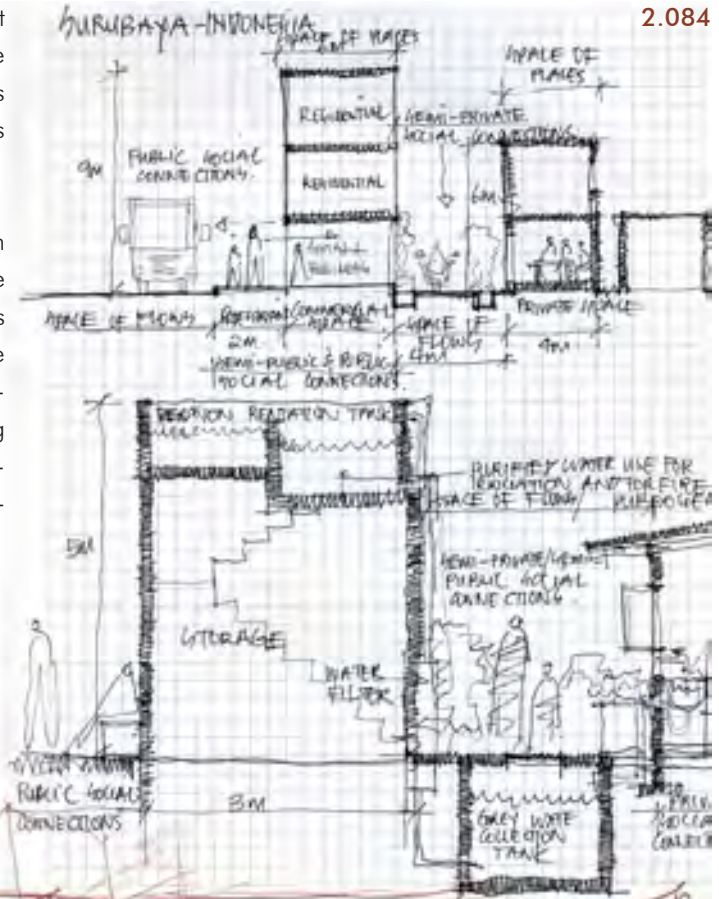
2.085 Streets in *kampungs* are sometimes used for wedding events by installing a tent and placing chairs in front of houses, implying that open public spaces and streets can have multiple uses in informal settlements (2011), Surabaya, Indonesia.

2.086

2.087 The front elevation of dwellings often face towards a fenced or unfenced open private space, with trees, seating and sometimes a *spaza* (tuck) shop (2012), Alaska informal settlement, South Africa.

2.088
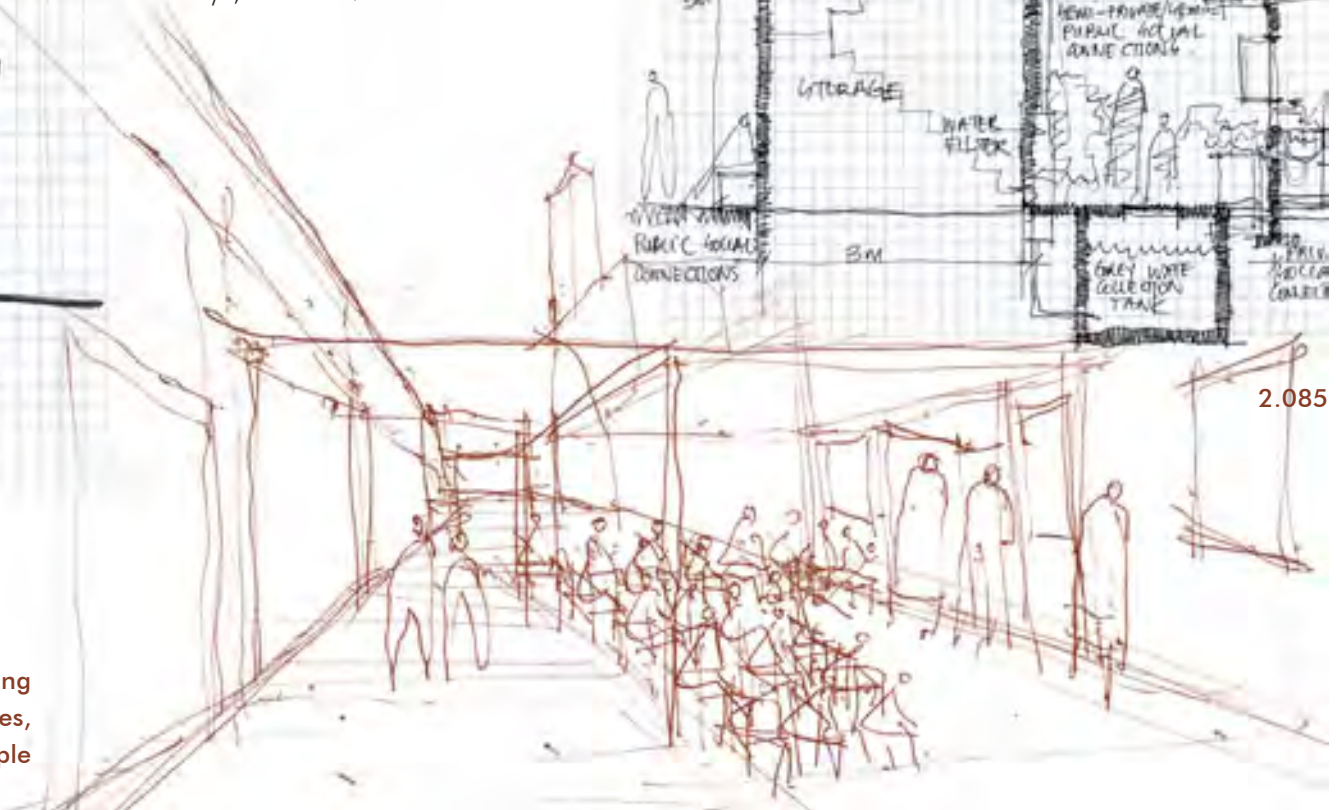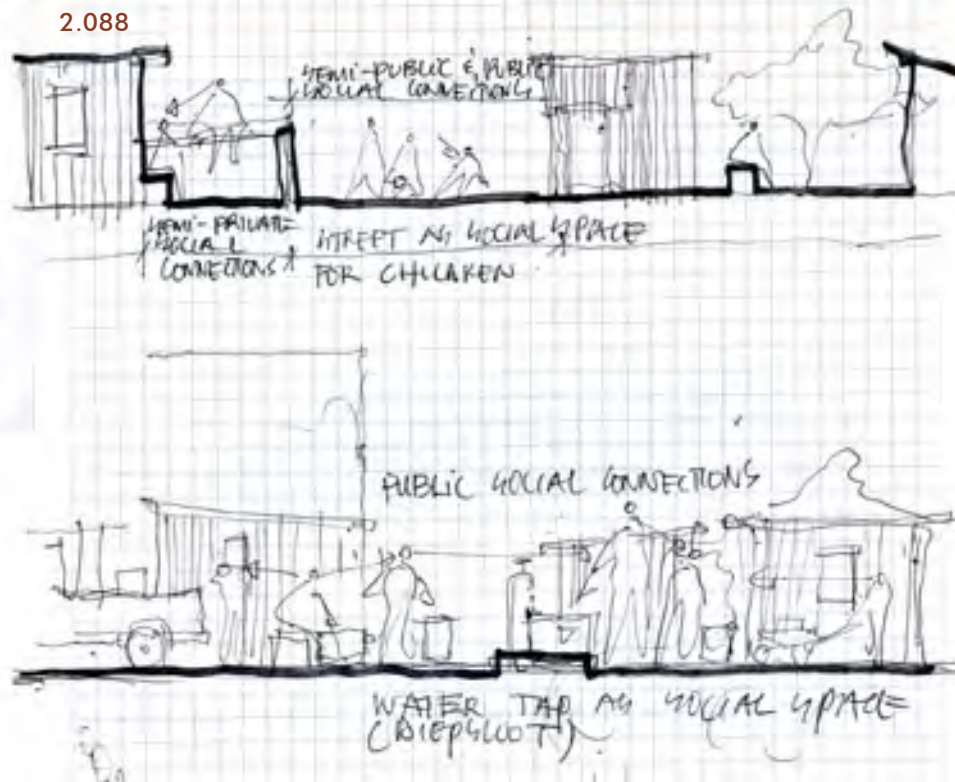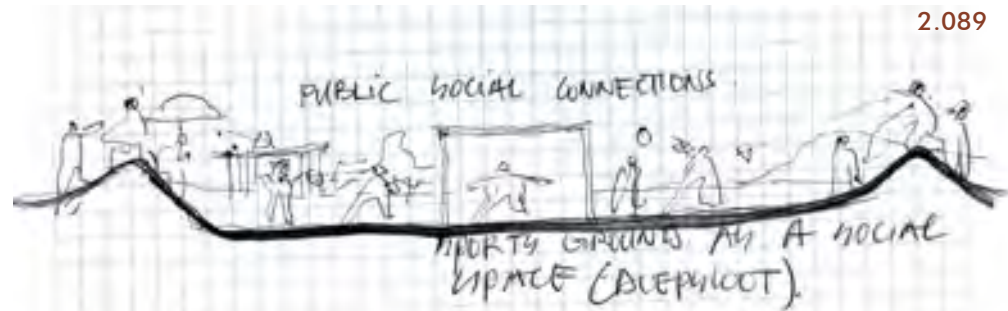
2.086 The spatial structure of *kampung* streets indicates how closely related private, semi-private and semi-public spatial domains increase social interaction and encourage micro-scale economic activities (2011), Surabaya, Indonesia.
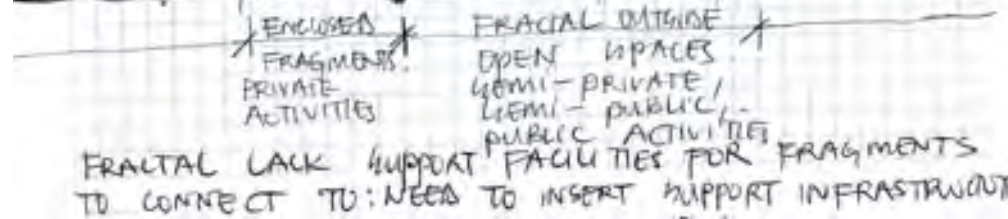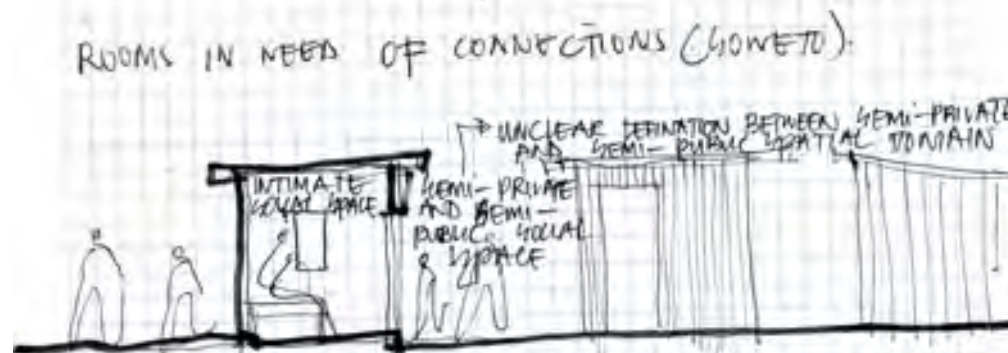
2.088 Open spaces around dwellings and streets have multi-functional uses because they are not restricted and controlled. Social and economic activities mix together in these places (2011), Diepsloot, South Africa.
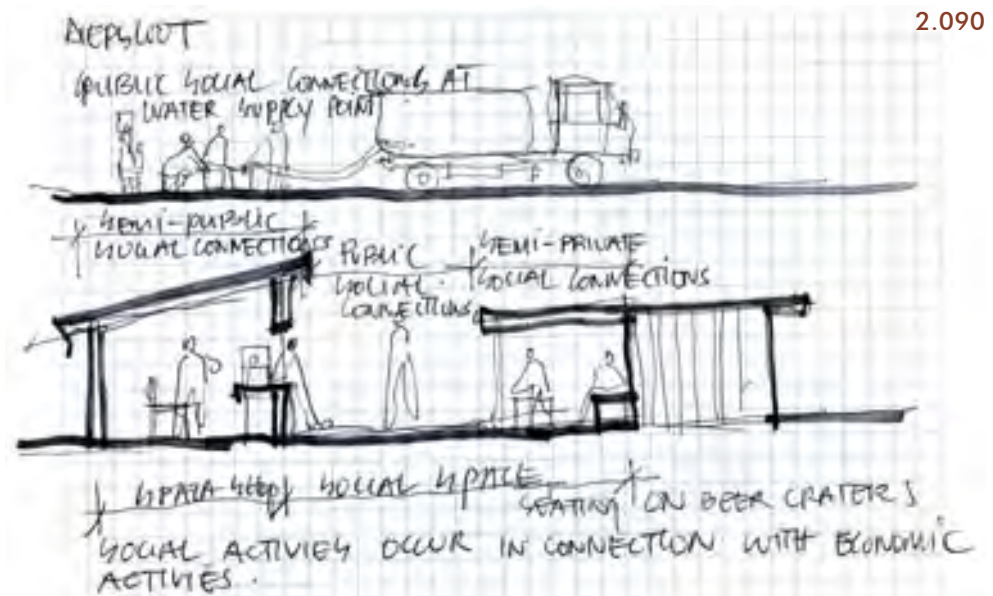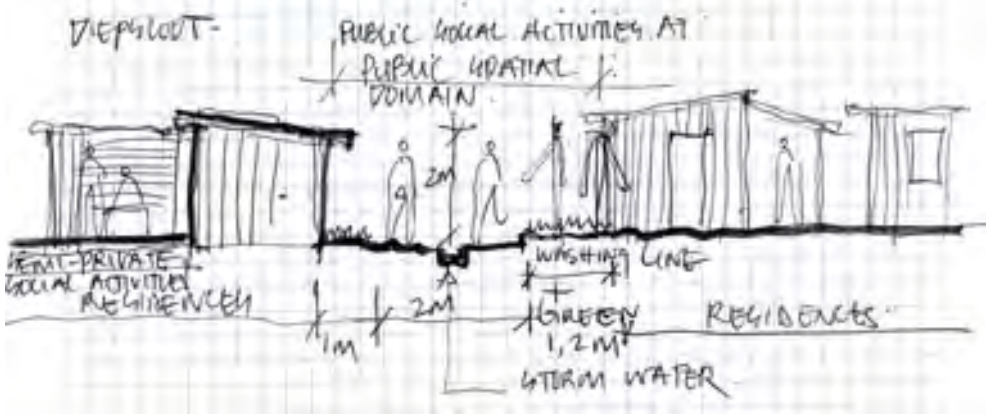
2.089 Local residents initiate activities like sports, markets and domestic activities in the available open spaces, and the infrastructure to enable these activities is then added later by local municipalities (2011), Diepsloot, South Africa.

2.090 Pedestrians passing in front of covered and uncovered entrances to dwellings usually exchange greetings with those who are sitting and standing by, as a sign of respect and a gesture of hospitality (2011), Diepsloot, South Africa.

2.093
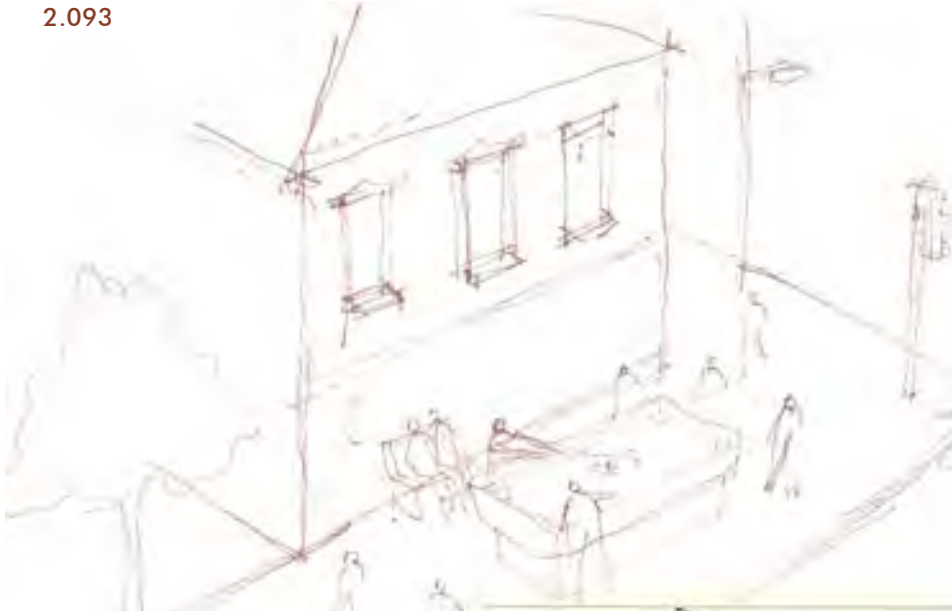
2.093 Taxi (mini-bus) drivers pass the time by playing snooker while waiting for passengers (2014), Durban, South Africa.

2.092
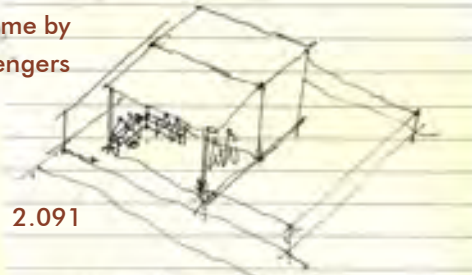
2.091

2.091 Commercial spaces like grocery and bottle stores usually have covered entrances and seating, which allows people to stay longer and attract more customers to the store (2012), Slovo Park informal settlement, South Africa.

2.092 Taxi (mini-bus) stops and stations usually attract micro-scale economic activities, because they are characterised by high volumes of pedestrian movement (2012), South Africa.

2.094 When performing certain ancestral rituals or in preparation for wedding ceremonies, funerals and family gatherings, men are usually responsible for slaughtering animals in open spaces in townships (2014),Durban, South Africa.

2.095 Main public transport stations are a haven for micro-scale economic activities to thrive (2014), Durban, South Africa.

DRAWINGS: SPATIAL ANALYSIS

2.096
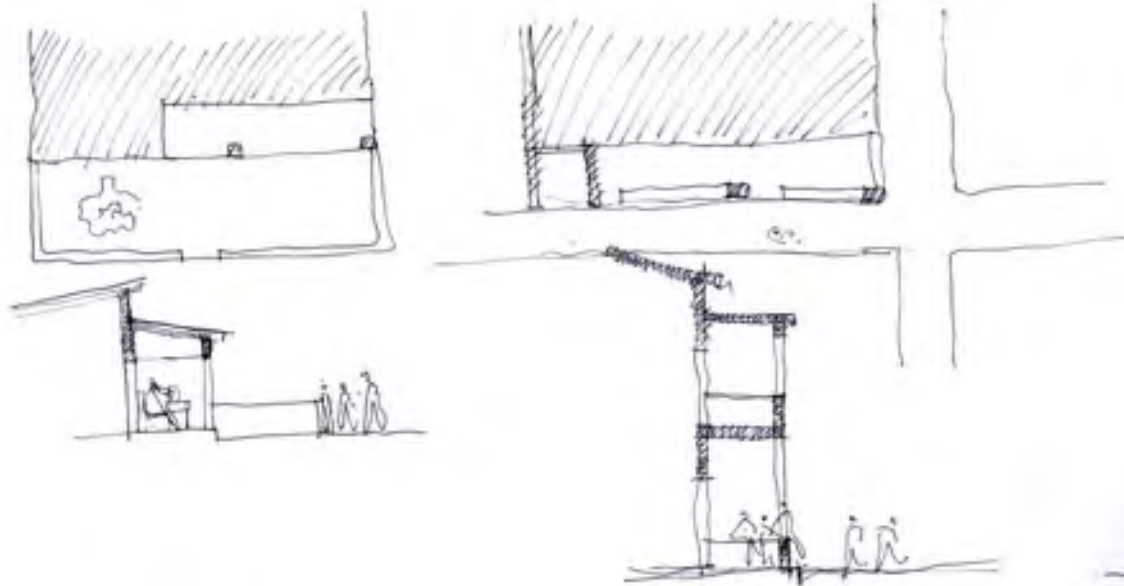
2.097
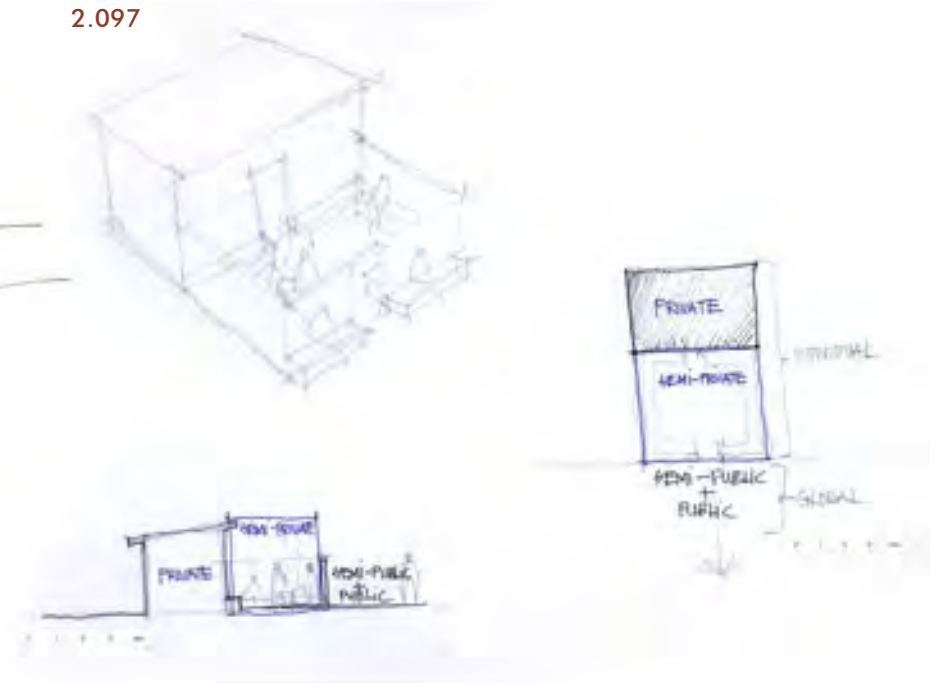
2.096 Dwellings with a front yard have a weak connection to the street (street—open private space—threshold space—dwelling interior space) whereas a dwelling located on a street boundary is strongly connected to the street (street—threshold space—dwelling interior space).

2.097 A 1.8 metre high wall helps to screen domestic and other private and semi-private activities from very busy adjacent semi-public and public open spaces.

2.099

2.098
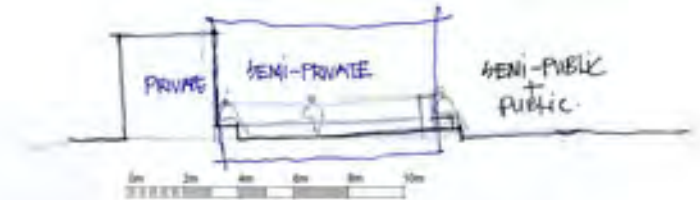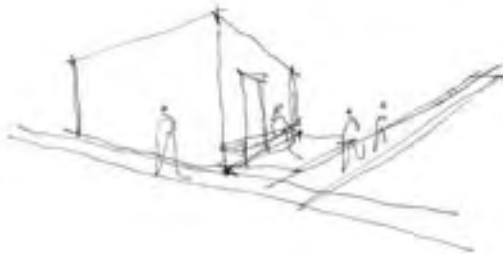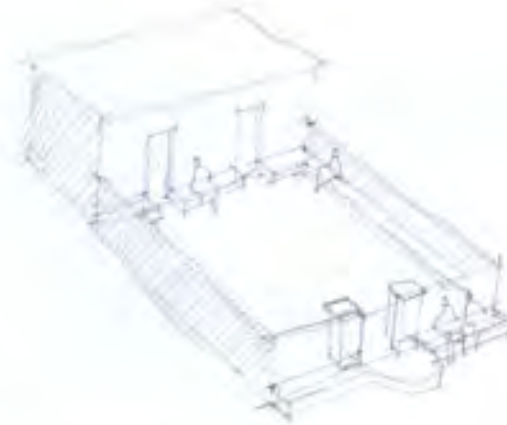
2.100
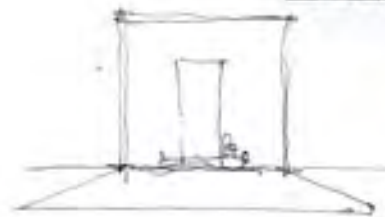
2.101

2.098 A 1.2 metre high wall helps to separate domestic and other private and semi-private activities from less busy adjacent semi-public and public open spaces.

2.099 A longer transitional space between the street and a dwelling is desirable than a shorter one when aiming for outdoor private and semi-private activities.

2.100 A shaded transitional space is more desirable than one without shade when aiming to encourage sitting in front of a dwelling.

2.101 Adding low walls in the open private space between the front of a dwelling and the street can promote sitting and social activities.

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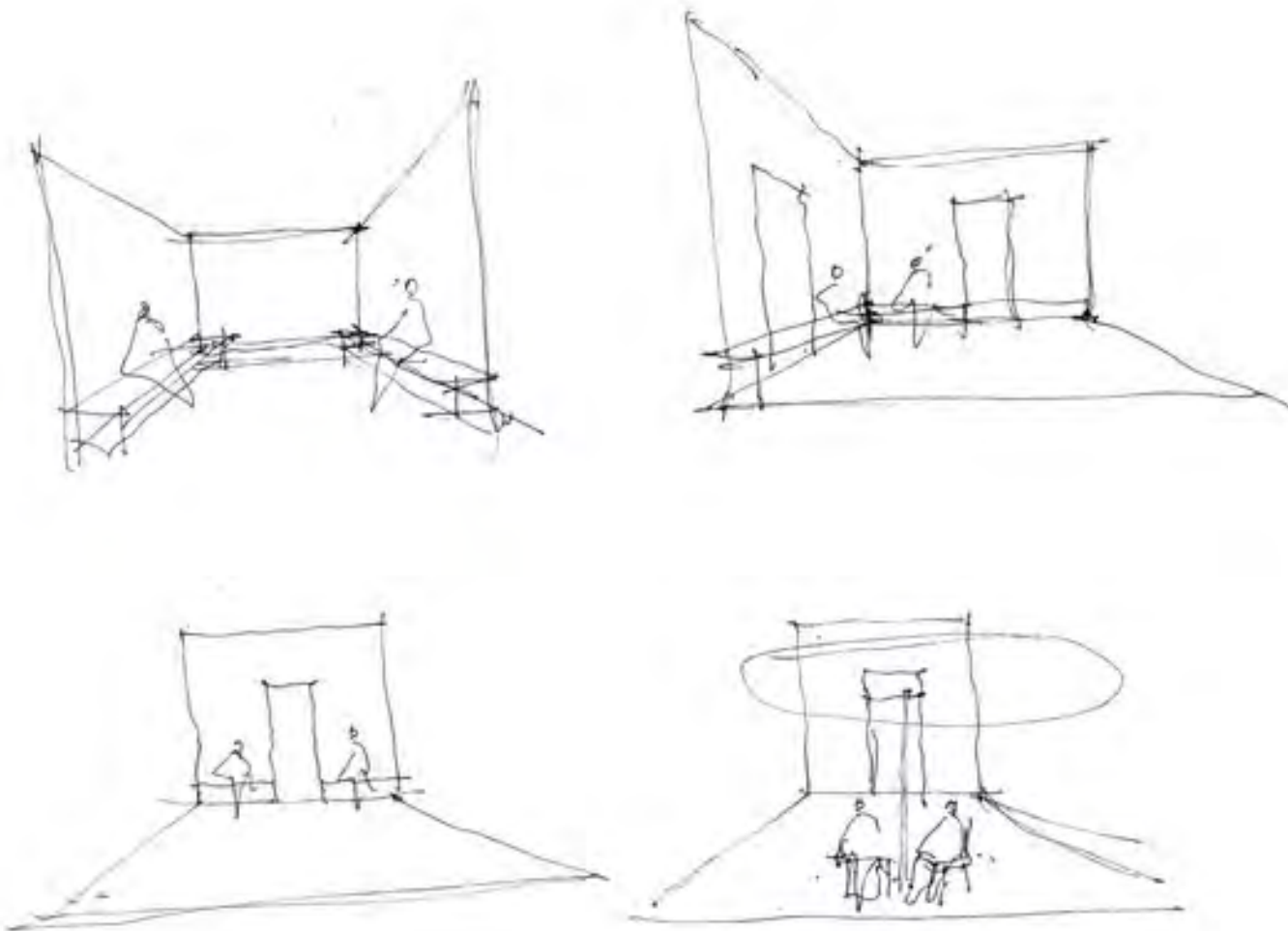
2.102 Articulating the front yard of a dwelling by adding verti-
cal spatial elements, seating and trees may encourage
people to sit and socialise in front of a dwelling.

2.103 Adding low walls with an opening and a covered en-
trance accentuate the transitional space between the
street or public open space and the dwelling.

2.104 Adding a tree, low walls and seating in front of a dwell-
ing with a longer front yard can be perceived as a ges-
ture of hospitality by guests and visitors, an appeal to
sit down and enjoy the shade on a hot day, converse
and let a passer-by see into the front yard.
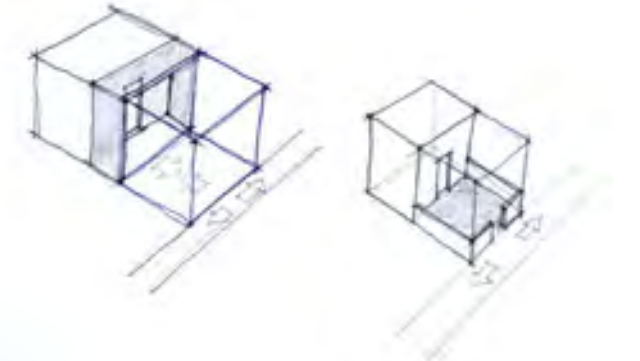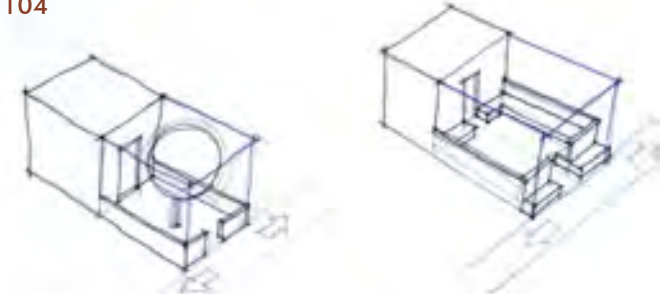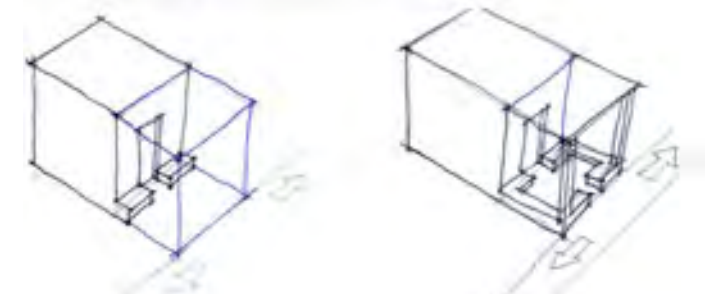
2.105 A transitional space with shading and more seats is more
desirable than one withoutshading and fewer seating
spaces.

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2.110
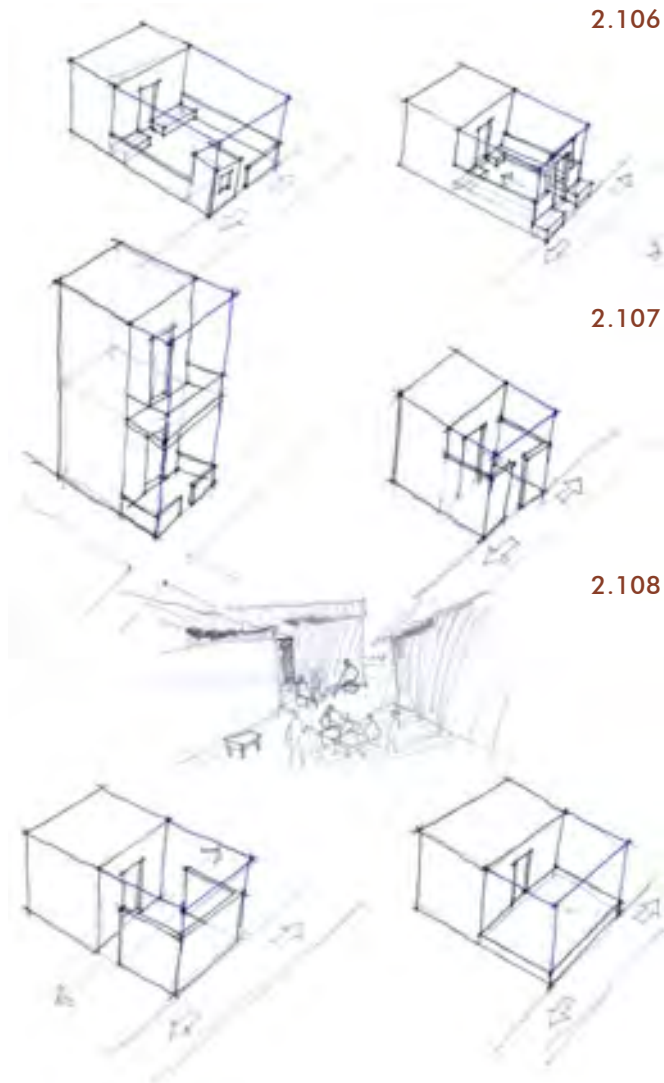
2.106 In addition to providing low walls and seating, the street boundary can be further articulated by adding a *spaza* shop or by providing an entrance opening with seating.

2.107 Dwellings located closer to a high-traffic street or pedestrian pathway can have a balcony on the first floor if it is a multi-story building, or high screen walls can be used for a single storey to create open buffer spaces for private and semi-private activities.
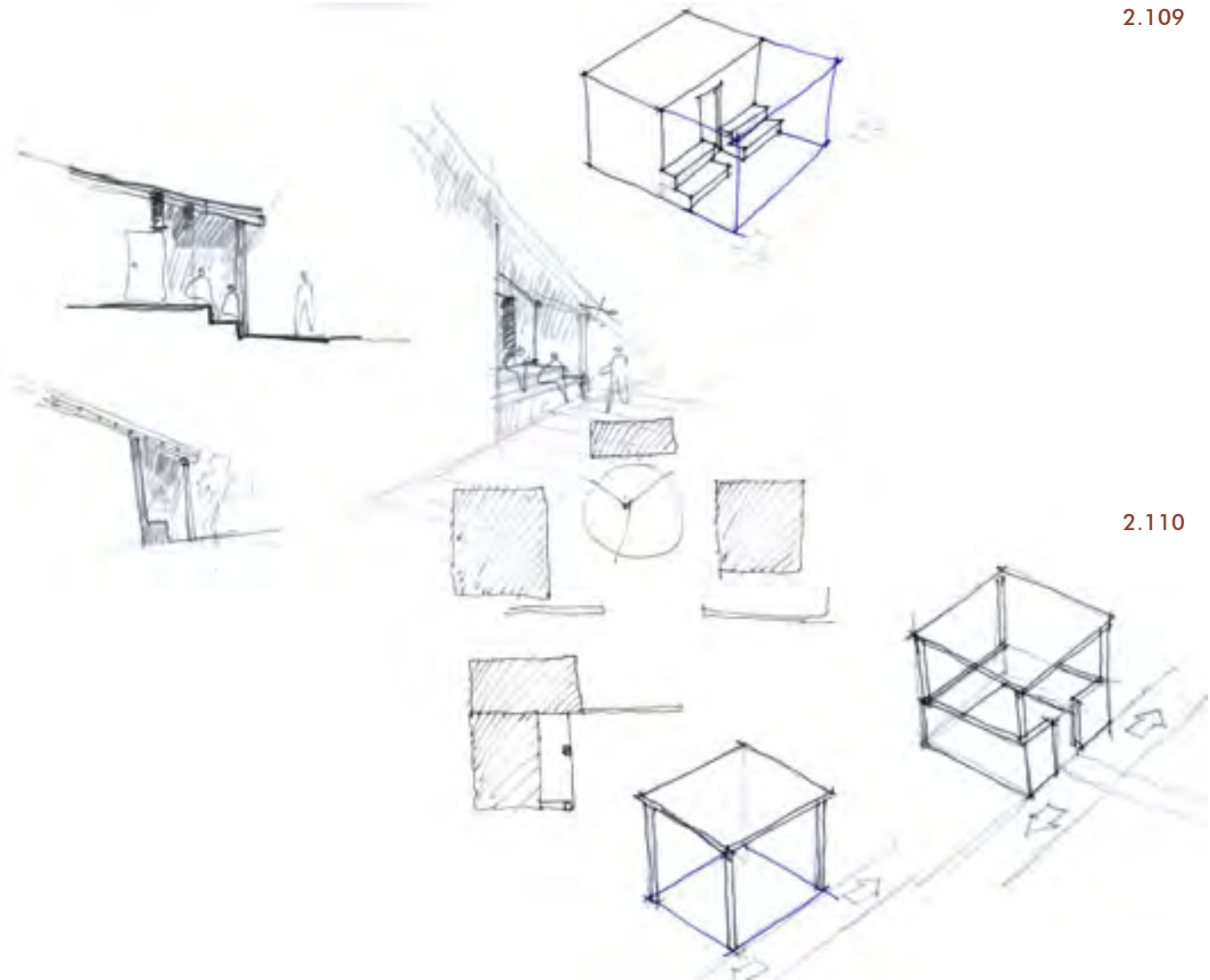
2.108 If a dwelling needs to connect to adjacent dwellings by means of circulation spaces, high walls can have two openings on both sides so as to screen semi-private activities. A raised platform can be used to articulate the transitional space in front of a dwelling that directly connects to adjacent dwellings.

2.109 A covered entrance that directly connects to a busy street can be articulated by having a raised floor level (of about 0.8m) with steps so as to reduce the degree of connection between the dwelling and the street.

2.110 Shed structures are sometimes used in private open spaces to accommodate domestic, economic and social activities.
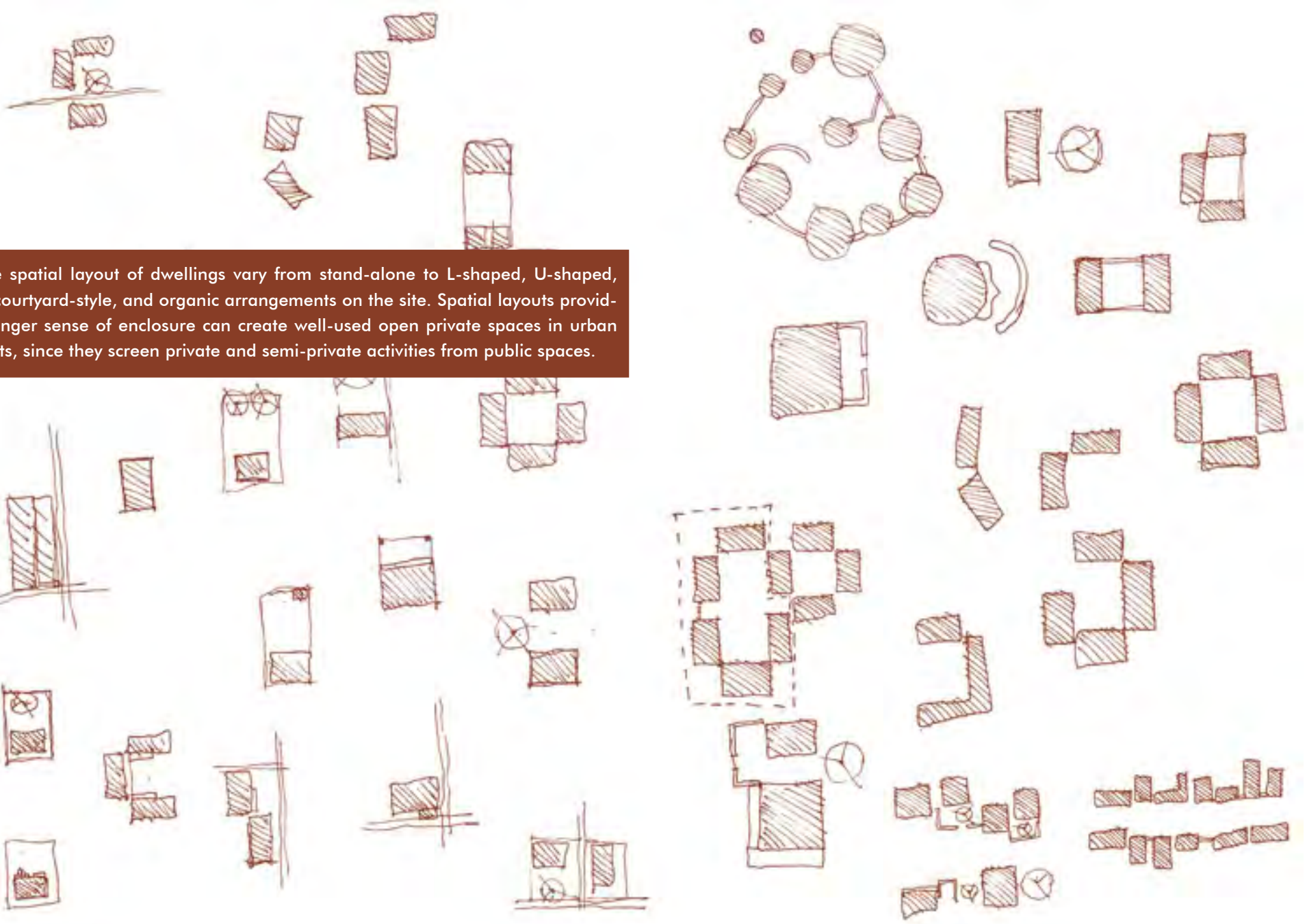
2.111 The spatial layout of dwellings vary from stand-alone to L-shaped, U-shaped, parallel, courtyard-style, and organic arrangements on the site. Spatial layouts providing a stronger sense of enclosure can create well-used open private spaces in urban settlements, since they screen private and semi-private activities from public spaces.
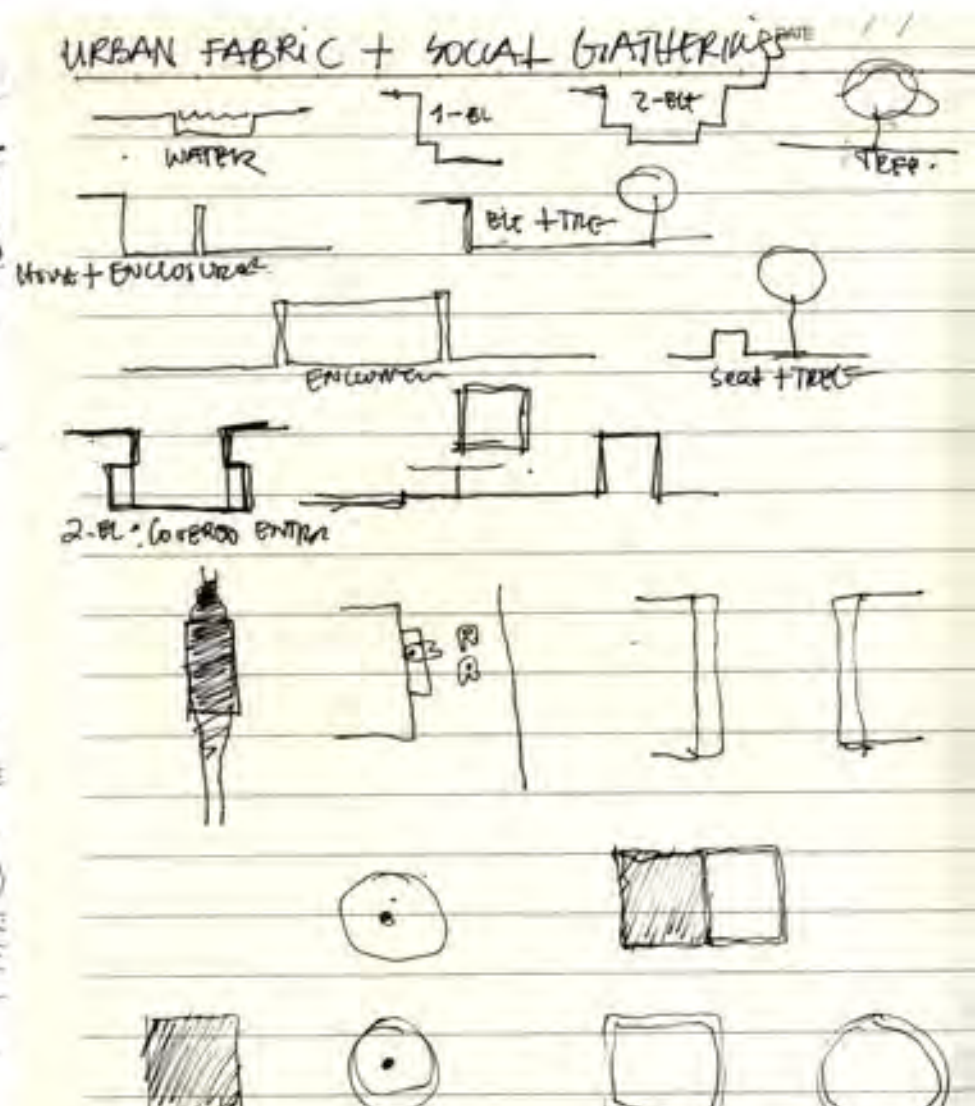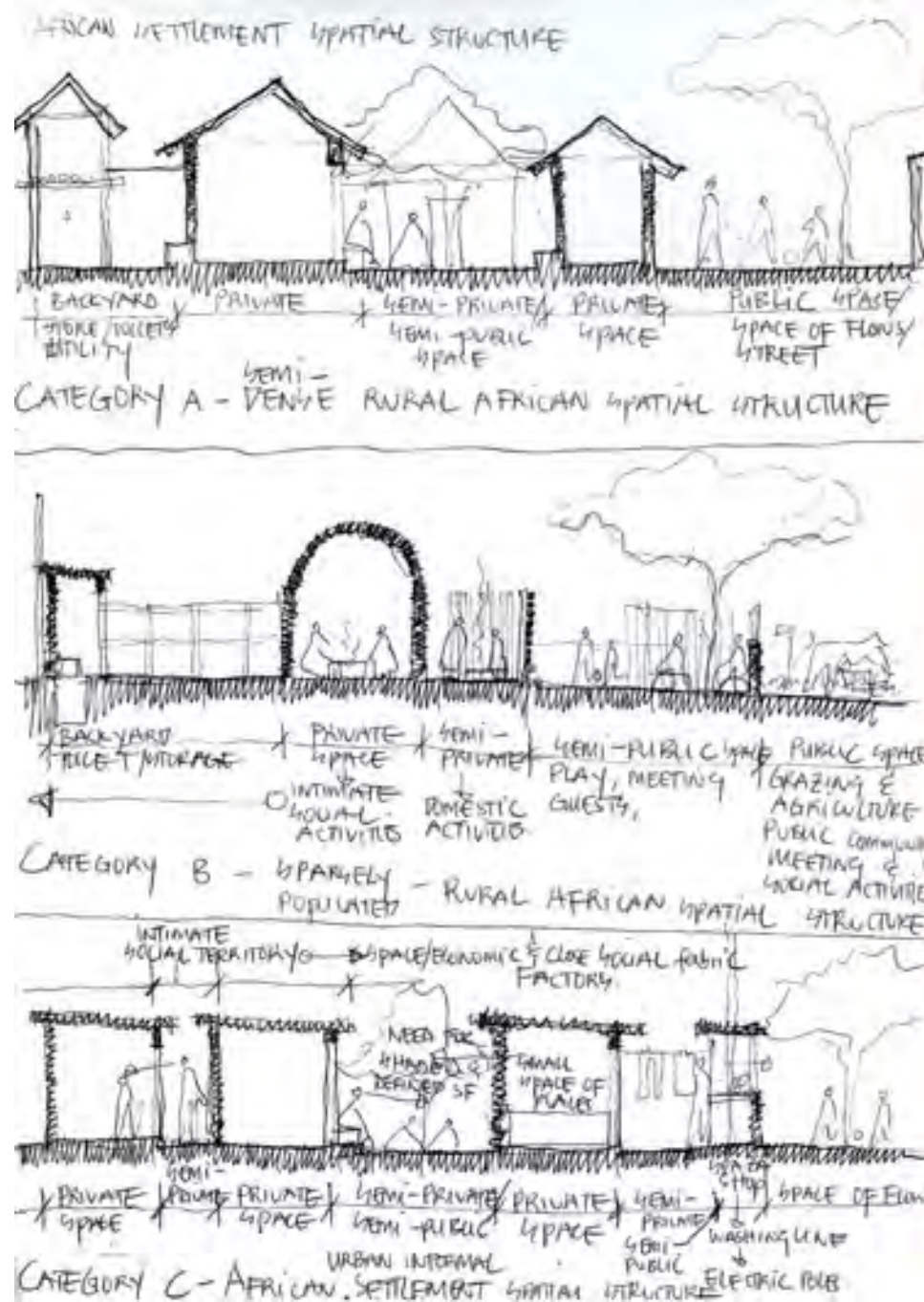
2.112 Typical cross-sections of an African compound, a homestead, and an urban informal settlement. The sections show the use of spatial thresholds to separate different spatial domains, meaning that the degree of intimacy for each social interaction determines the space used for that activity. The profiles of transitional spaces between dwellings and streets or open public spaces consist of boundary walls, seating, trees, covered entrances and articulated horizontal platforms.

2.113
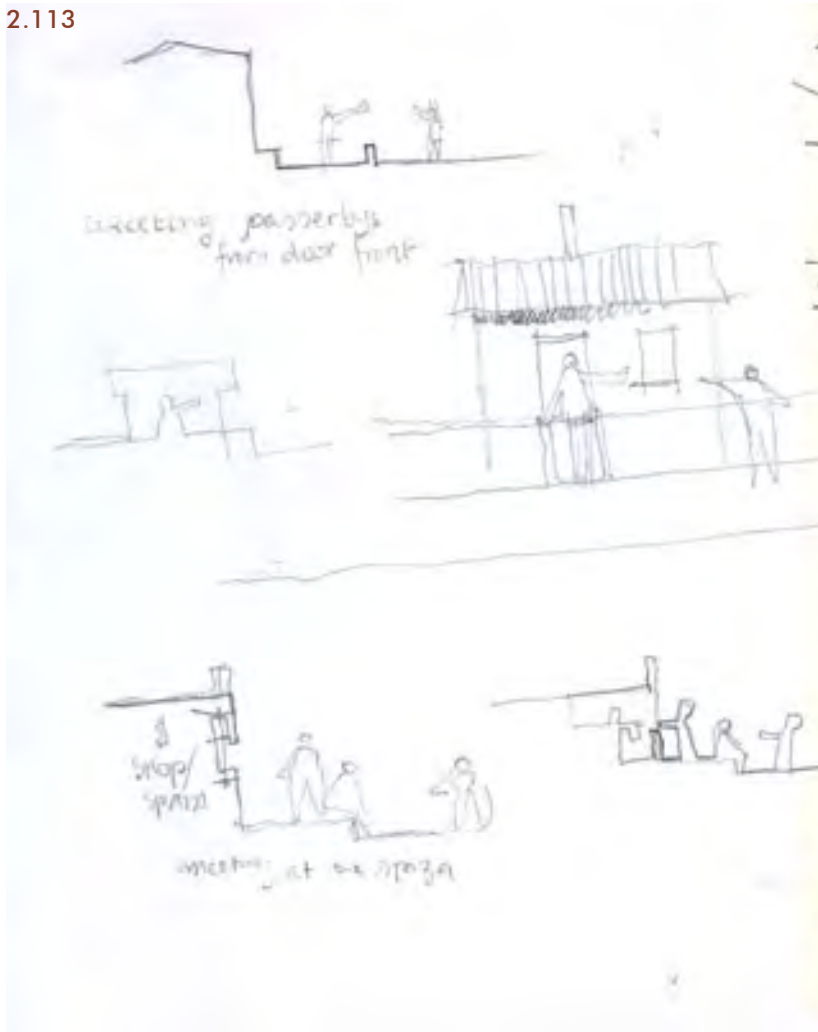
2.114
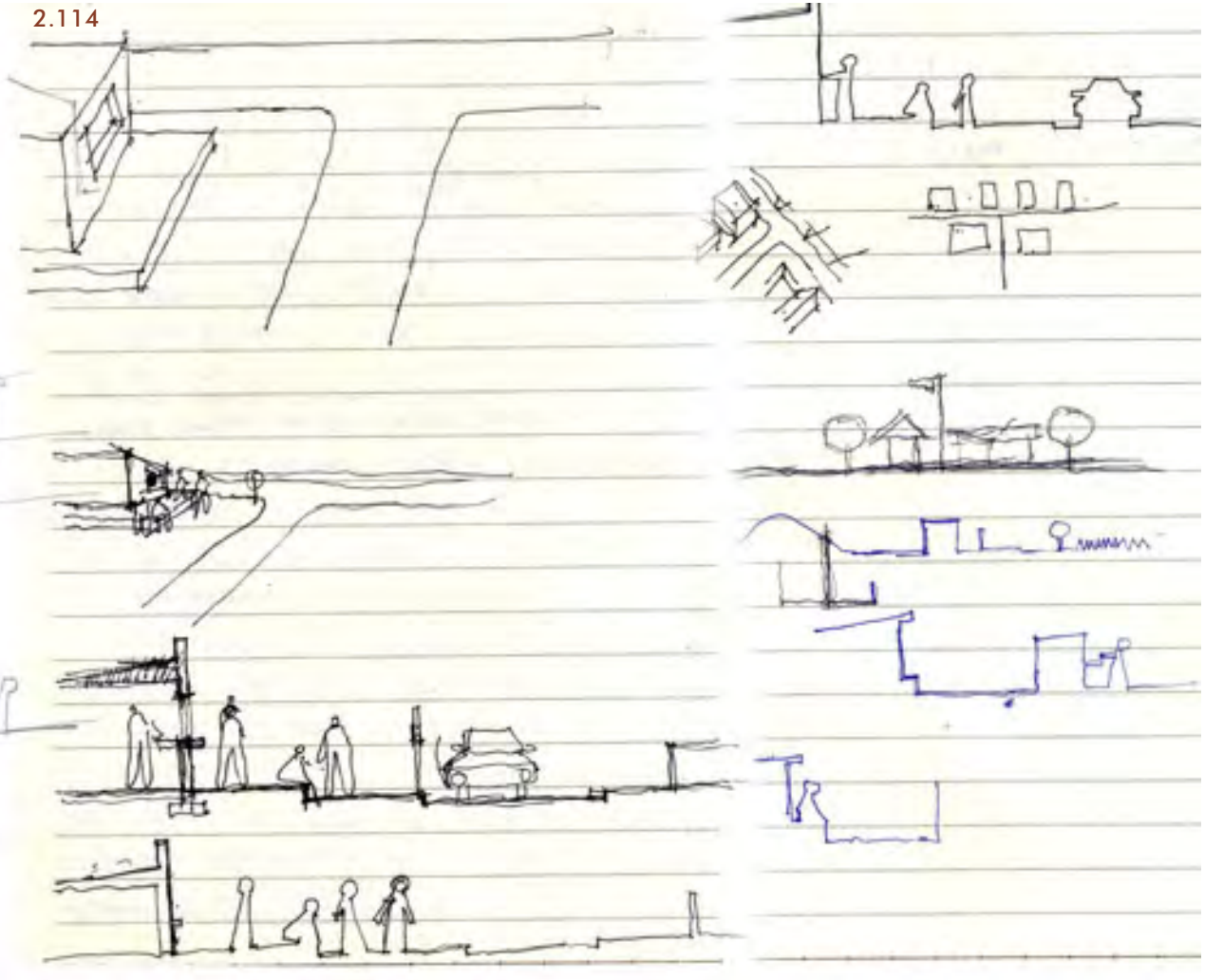
2.113 The open private space in front of a dwelling that connects to the street is a transitional space that allows a person to linger between private and public life, greeting a passer-by, and receiving and entertaining visitors. There should be a seating place from which to watch what is happening in the streets and neighbouring dwellings.

2.114 Spaces between buildings and the street should attract social activities which will in turn support economic activities and lead to good neighbourhoods.

2.115

2.116
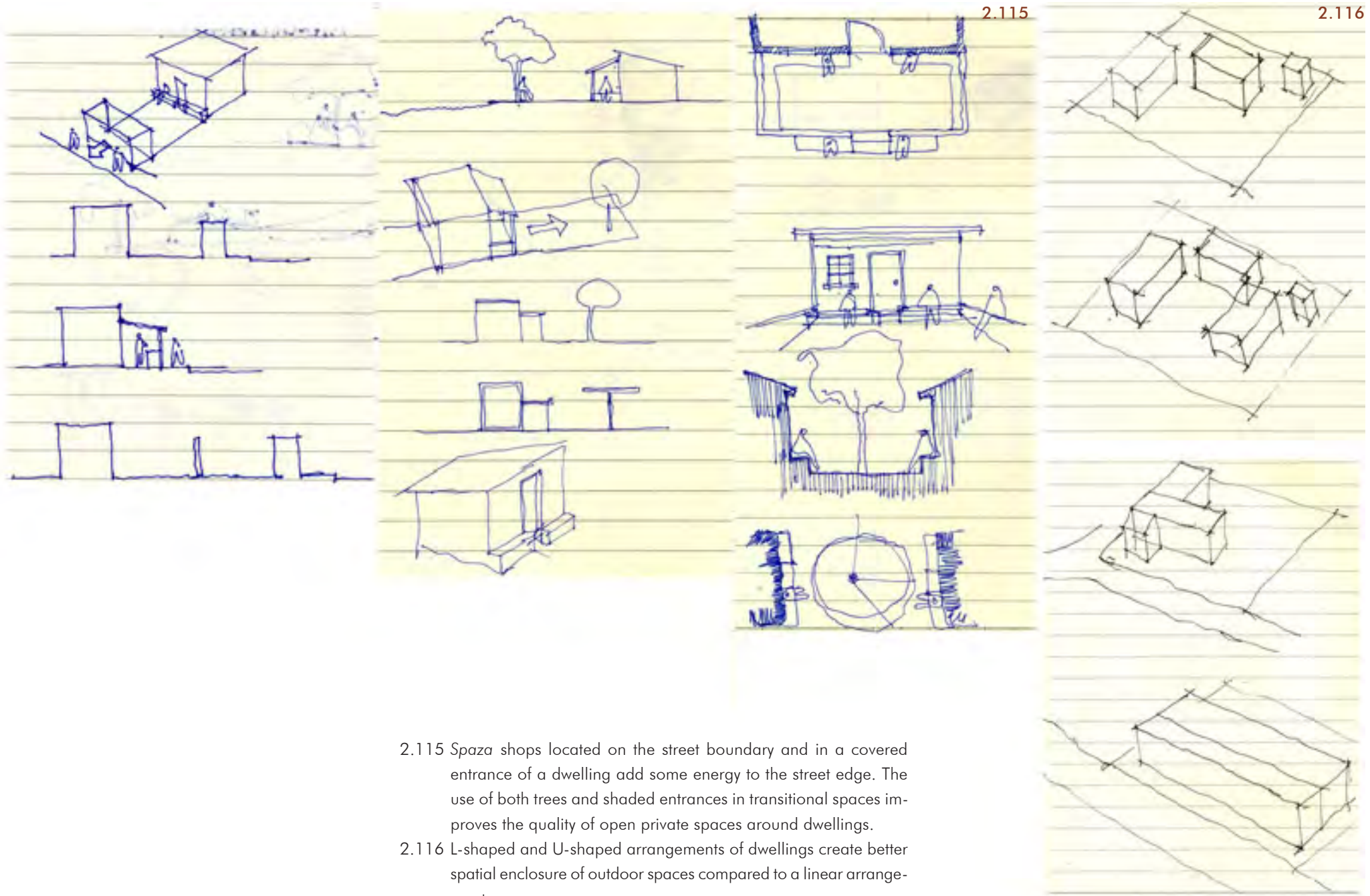
2.115 *Spaza* shops located on the street boundary and in a covered entrance of a dwelling add some energy to the street edge. The use of both trees and shaded entrances in transitional spaces improves the quality of open private spaces around dwellings.

2.116 L-shaped and U-shaped arrangements of dwellings create better spatial enclosure of outdoor spaces compared to a linear arrangement.

DRAWINGS: SPATIAL INTERPRETATION AND EXTRAPOLATION

The variety in the building profiles on the street is an outcome of the uniqueness of each person or family.
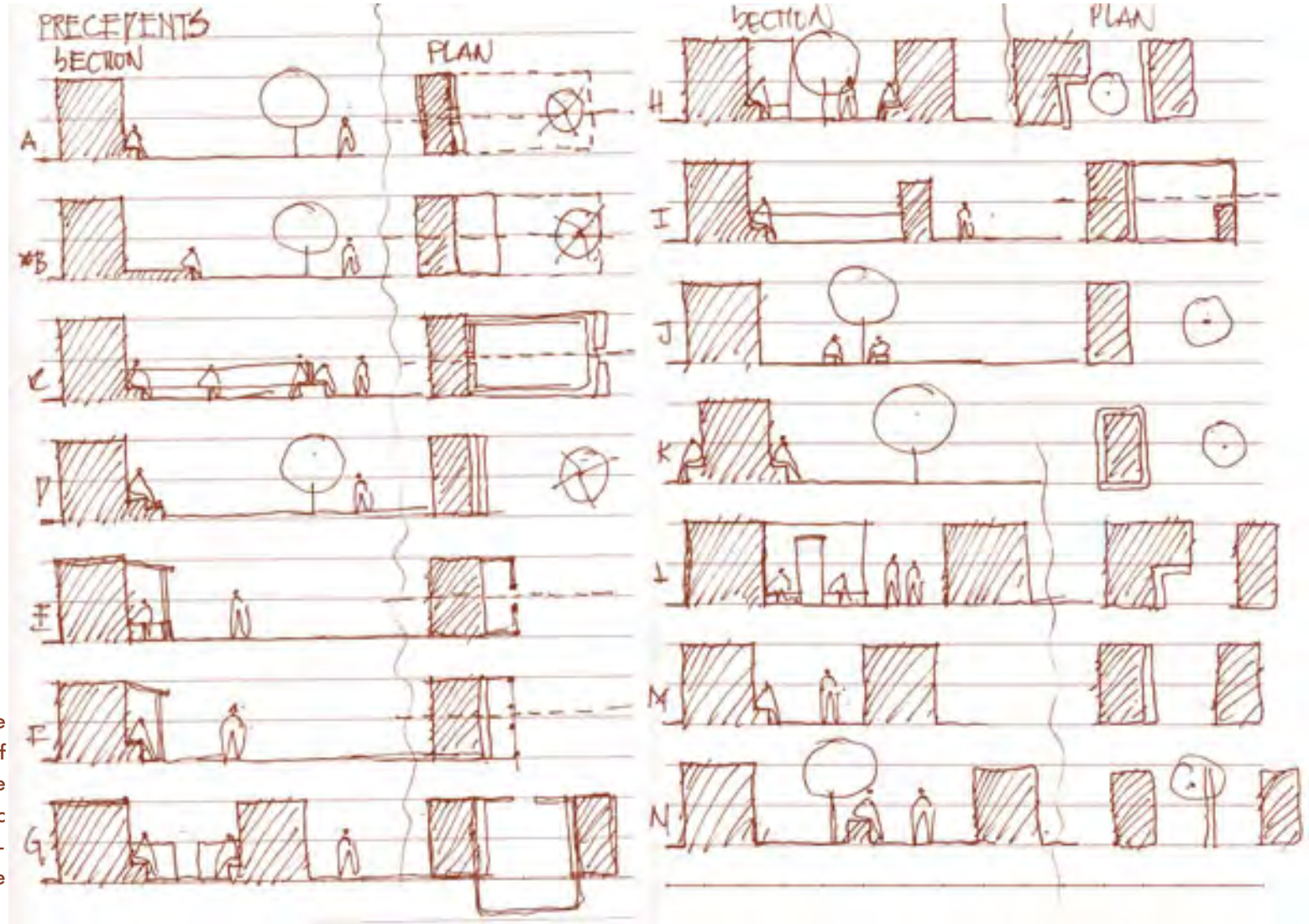
2.117 The articulation and appearance of the front elevation and front yard of each dwelling is a reflection of the home owner's social orientation and economic standing. The variety in the building profiles on the street is an outcome of the uniqueness of each person or family.
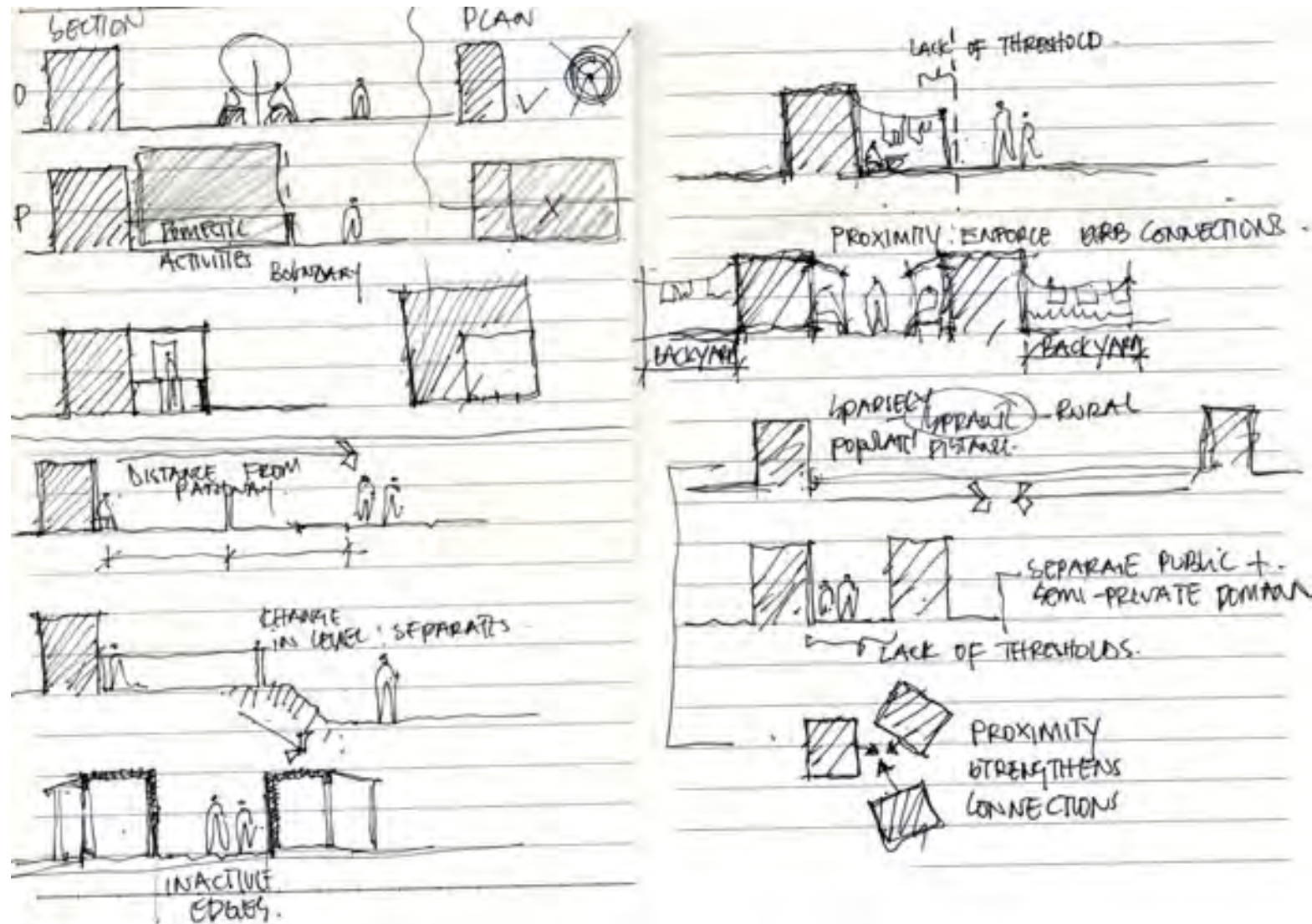
2.118a The arrangement of form and articulation of spatial thresholds to screen domestic activities from public open spaces is a depiction of the human desire for dignity. The way in which spatial territories are defined is an indication of how the resident wishes to relate with the community and the world at large.

2.118b Transitional spaces are defined and transformed by articulating both horizontal and vertical spatial edges.

2.119 Adding seating to the front of a dwelling implies that the threshold space is meant for seating and conversation. Adding a tree in front of the dwelling implies that the transitional space is meant for seating and entertaining guests and visitors.

2.120 Stepped seating and low walls in front of a dwelling imply that the space is arranged to contain a small group of people for semi-private and semi-public activities.

2.121 Low walls, seating and a tree in the front yard of a dwelling implies that the space is arranged to allow a group of people to fill up the space and spill over beyond the defined private open space.

2.119   **2.120**   **2.121**

2.122   2.123   2.124

2.125   2.126   2.127

2.122 Uncovered entrances may have been left open due to lack of financial means or with the intention to extend the dwelling in the near future. Uncovered entrances are also common in situations where the resident does not spend a lot of time at home or in that particular building (like a stand-alone bedroom in a homestead).

2.123 Open spaces defined by L-shaped building forms with a low wall or tree imply a high degree of spatial enclosure and privacy for social and domestic activities.

2.124 Open spaces defined by parallel front views of dwellings imply a degree of privacy and spatial enclosure. A stranger walking through these types of spaces may feel like an intruder.

2.125 Adding a tree in an open space defined by parallel dwellings increases the degree of privacy and can slow down the pedestrian traffic.

2.126 A U-shaped building arrangement provides a high degree of enclosure and privacy compared to an L-shaped arrangement.

2.127 A covered entrance with or without low walls implies that the threshold space is intended for sitting and other private or semi-private activities.

2.128
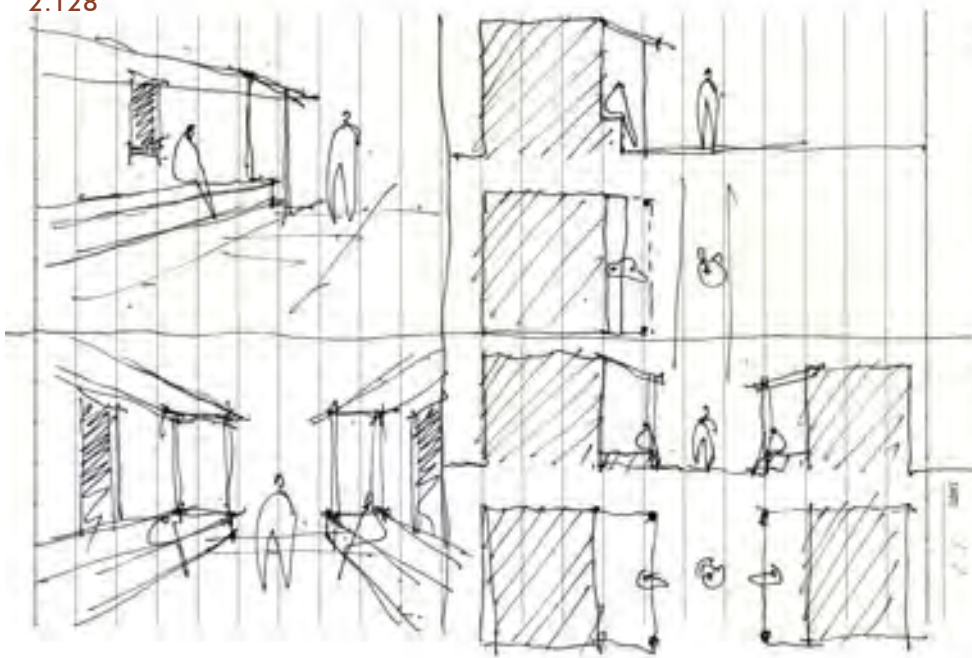
2.129
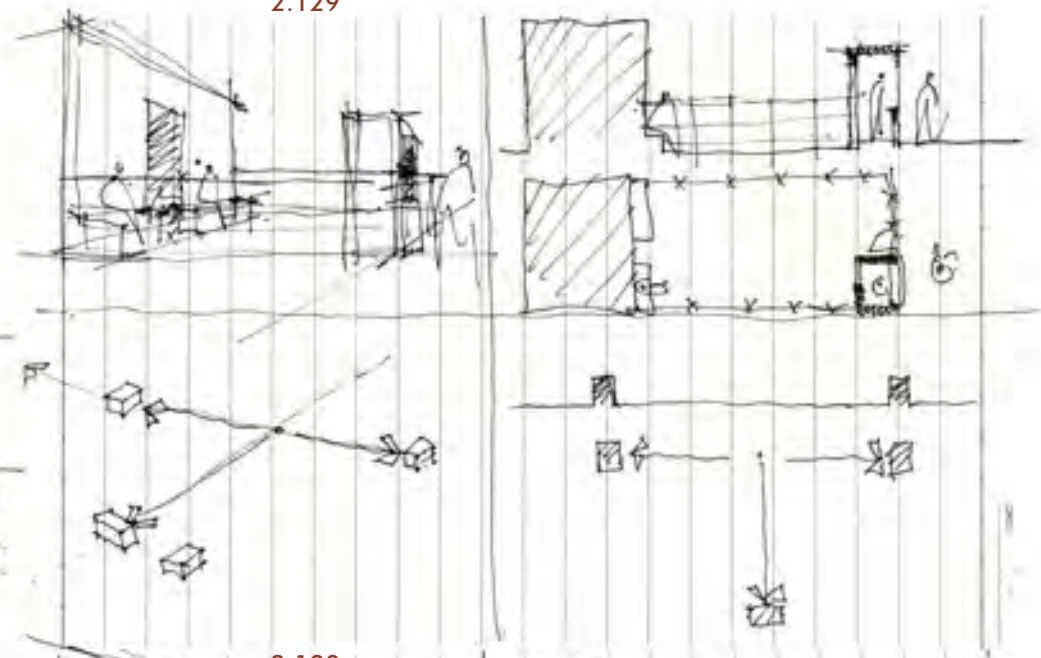
2.130
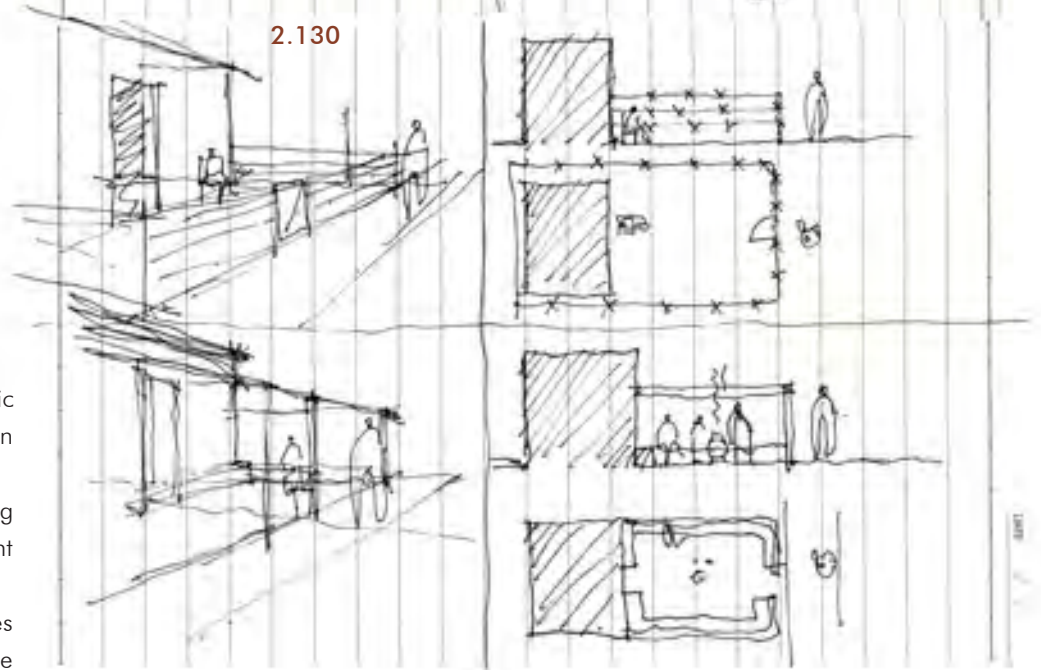
2.128 Covered entrances facing towards a pedestrian walkway or semi-public and public open spaces are meant to bridge and dignify the transition from the private domain to these spaces.

2.129 Placing a *spaza* shop along the street boundary implies that the residents are willing to be interrupted by the public while engaged in semi-private activities in the front yard of the dwelling.

2.130 A boundary fence implies an allocated territorial space where the dweller exercises the authority to practise his or her unique way of being an individual, while at the same time being a participating community member.

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2.133
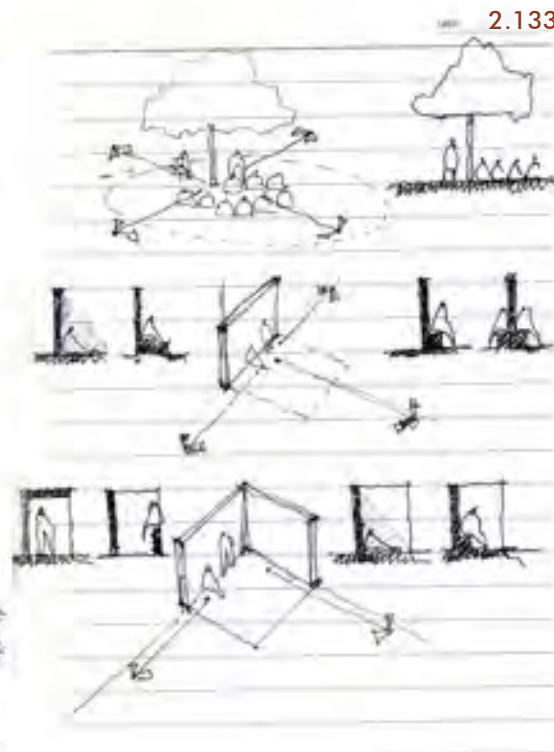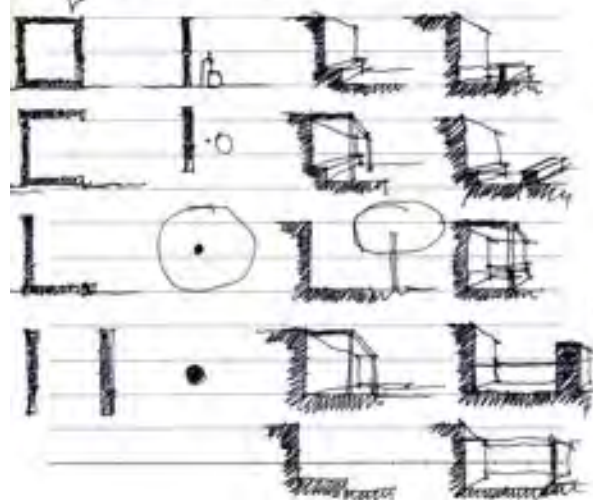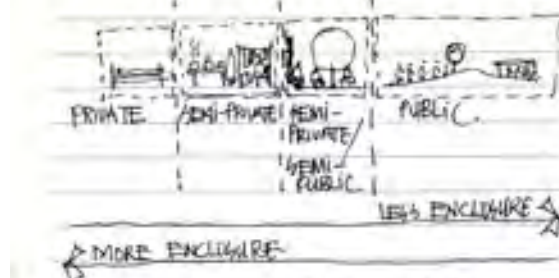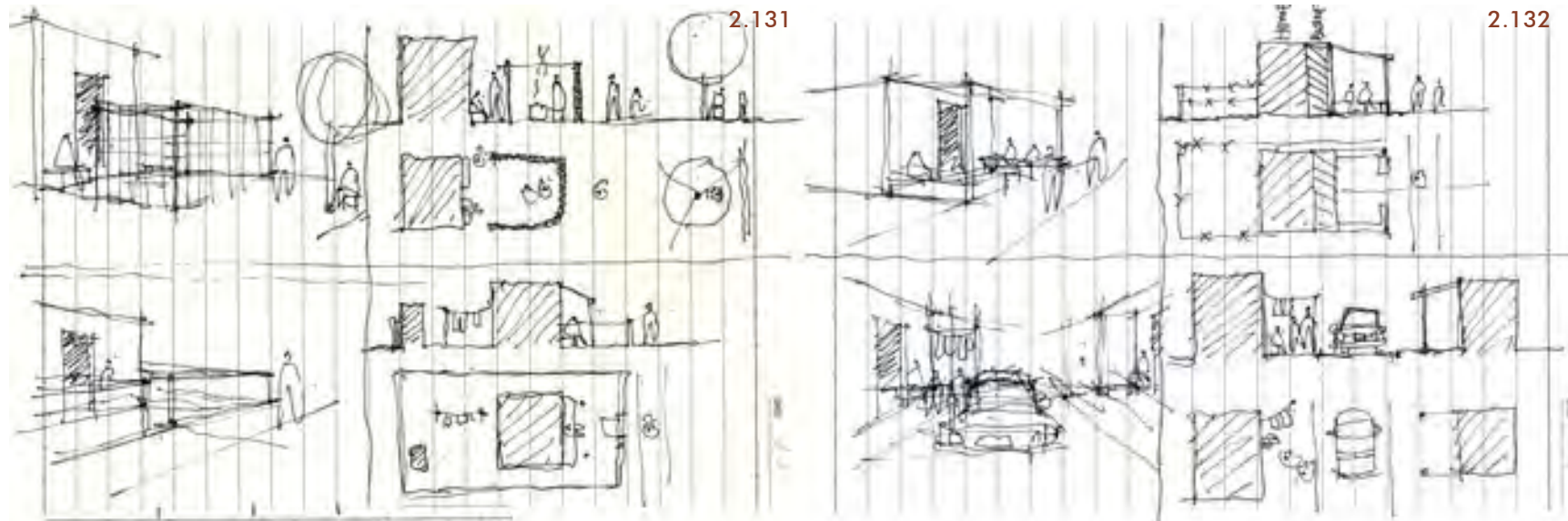
2.131 Screening of domestic and other private activities using walls and spatial arrangements to block views from public spaces implies that the dwellers desire to have a sense of dignity. Sometimes, as a result of a lack of economic means, the ability to protect one's dignity is lacking.

2.132 Due to the lack of space in densely populated informal settlements, *spaza* shops are attached to dwellings and domestic activities are exposed to public spaces.

2.133 The common spatial elements used to define spatial thresholds of dwellings are walls, steps, seats, trees and roof overhangs.

2.134
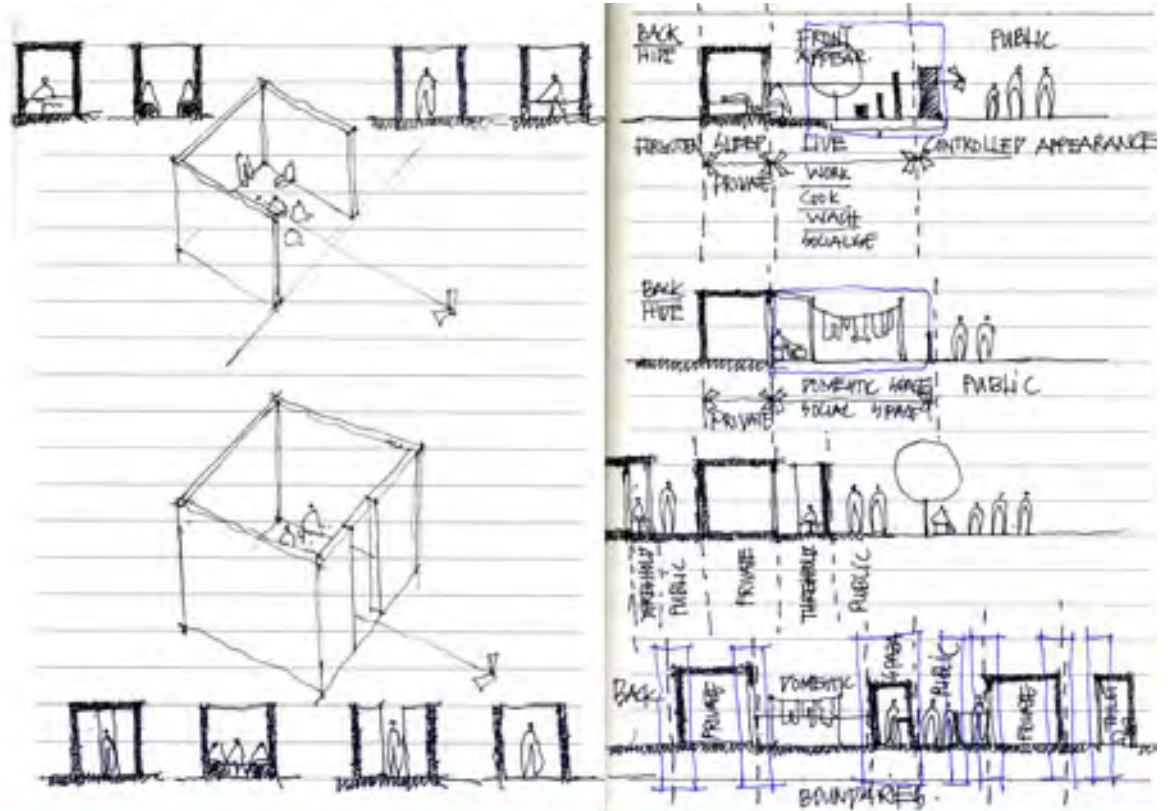
2.134 Private spaces have the highest degree of enclosure, for example the *Nguni* beehive-shaped dwelling has one small door and no windows, followed by semi-private spaces or open private spaces, then semi-public spaces, and lastly public spaces.

2.135 The spatial arrangement of dwellings and the articulation of building shape on plan can contribute positively or negatively to the outdoor space around and adjacent to it.

2.136 The spatial arrangement of dwellings and the articulation of the building shape on section can contribute positively or negatively to the outdoor space around and adjacent to it.

2.135   2.136

DEFINED OPEN PUBLIC SPACE

LOW WALLS AND HIGH WALLS IMPLY SPACE TO DEFINE OPEN PUBLIC SPACES. HIGH WALLS PROVIDES PRIVACY IN LIMITED SPACES.

HIGH WALL

LOW WALL

VISUAL INTEREST CAN BE CREATED BY SEMITRANSPARENT WALL/FENCE WHICH ALLOWS VIEW OF ELEMENTS BEHIND; LOW WALLS CAN PROVIDE PRIVACY WHILE SITTING BUT PERMIT VIEWS WHEN STANDING.

THREE BUILDINGS ARE ARRANGED TO DEFINED AN OUTDOOR SPACE

UPPER SPACE / LOW SPACE / TRANSITION

STEPS SEPARATE OUTDOOR SPACES AND CREATE TRANSITION SPACE.

TRANSITION 2 / SEMI-PRIVATE SPATIAL DOMAIN / TRANSITION 1 / PUBLIC SPATIAL DOMAIN

STEPS ARE LOCATED AT THE EDGE OF THE BUILDING AND AWAY FROM BUILDING EDGE, THEREBY CREATING TWO TRANSITION SPACES.

TRANSITION / DOMESTIC ACTIVITIES / SPAZA SHOP / PUBLIC SPATIAL DOMAIN

SPAZA SHOP LOCATED AT STREET BOUNDARY SCREENS DOMESTIC ACTIVITIES FROM THE STREET.

2.137 Transitional space articulation for a better quality of open private spaces using walls, steps, roofs, trees and *spaza* shops can promote better social and economic conditions in urban informal settlements.
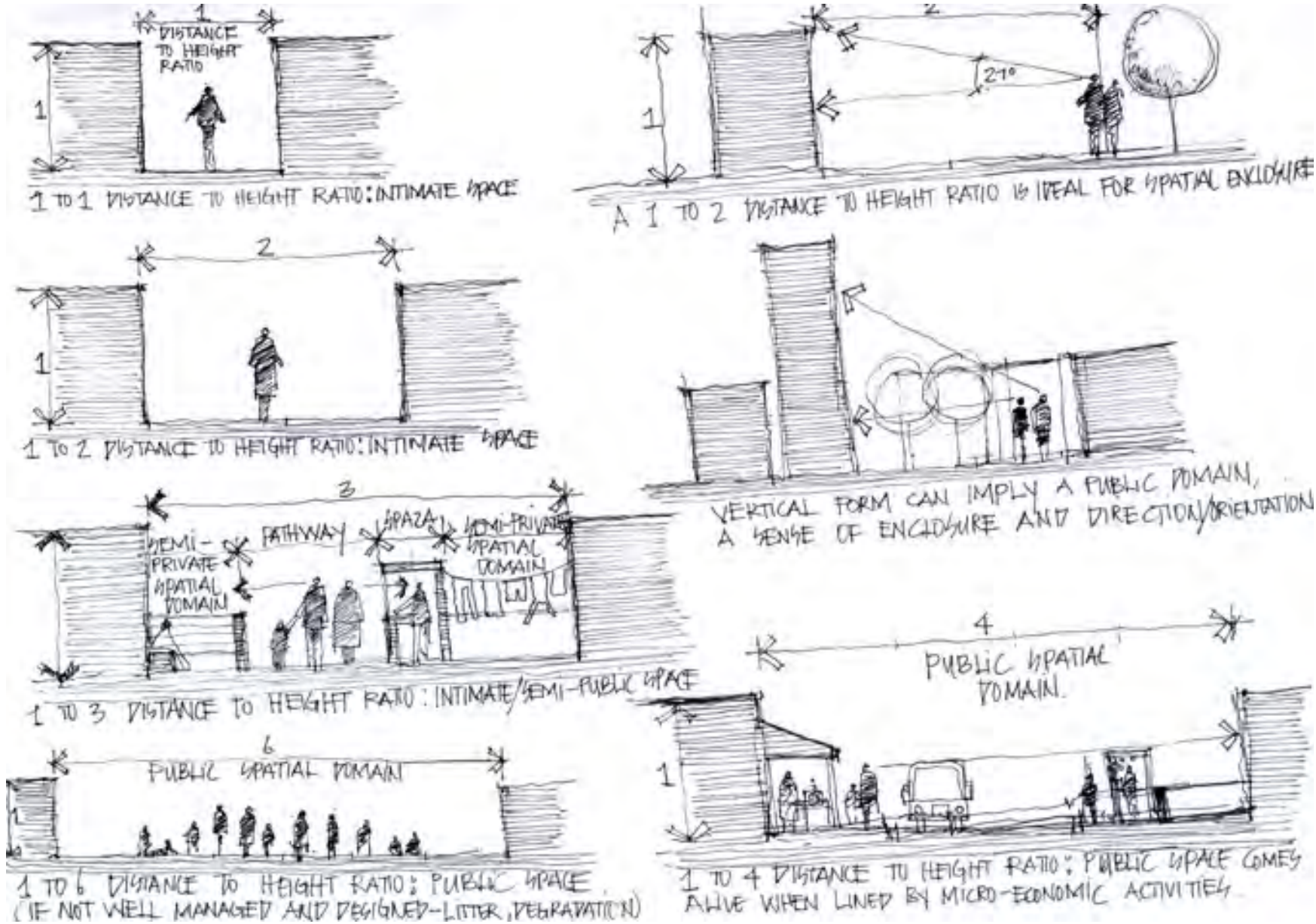
2.138 The distance to height ratio of buildings and the spaces between them can be manipulated to achieve a higher or lower degree of privacy.

1 TO 1 DISTANCE TO HEIGHT

1 TO 4/4 TO 1 DISTANCE TO HEIGHT

A 1 TO 1 DISTANCE TO HEIGHT RATIO CREATES A FULL SPATIAL ENCLOSURE

A 1 TO 1 SPATIAL ENCLOSURE DISTANCE TO 1 LOST HEIGHT RATIO

SPACE STOPS ABRUPTLY: INSERT TRANSITION SPACE

FLAT WALL CREATES A DEFINITE SPATIAL EDGE; NO INTERPENETRATION OF SPACE

TRANSITION SPACE   PUBLIC SPACE

TREES FRAME VIEWS INTO THE STREET AND SHADE IN SEMI-PRIVATE SPACE.

TRANSITION SPACE   PUBLIC SPACE   TRANSITION SPACE

TREES PROVIDES SHADE AND SPATIAL ENCLOSURE IN THE STREET.

2.139 The size of trees in relation to the horizontal and vertical dimension of an open space has an impact on the way open spaces are perceived and experienced.
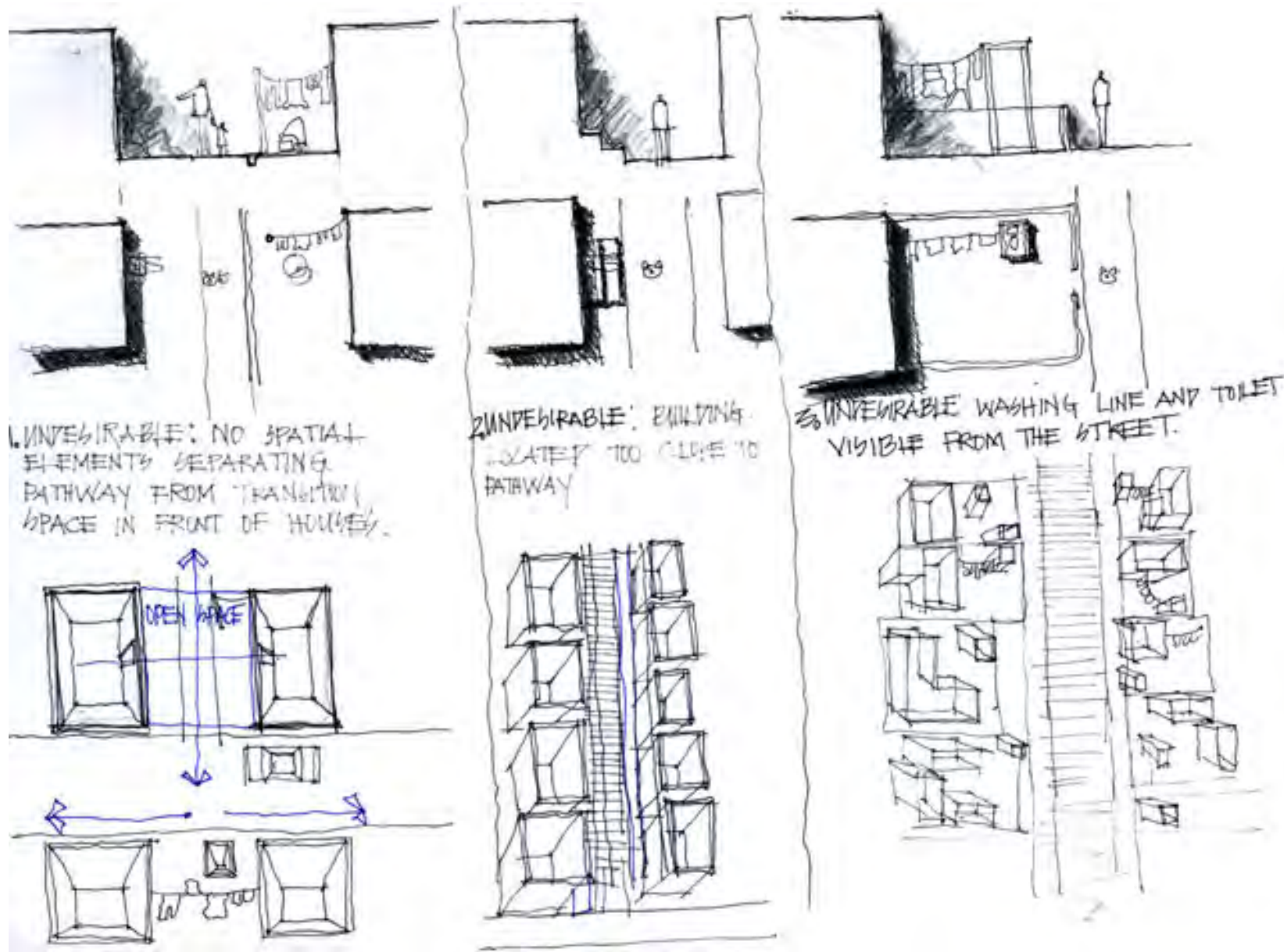
2.140 Undesirable spatial conditions of open spaces used for domestic activities between and in front of dwellings.

TOO FAR FROM STREET

4. UNDESIRABLE: BUILDING TOO FAR FROM STREET THUS WEAK CONNECTION OF SPACE

5. UNDESIRABLE: POOR PEDESTRIAN AND VEHICULAR ACCESS, POOR AIR CIRCULATION AND DAYLIGHT, AND POOR TRANSITION SPACE (FIRE HAZARD TOO)

LACK MICRO-SCALE ECONOMIC ACTIVITIES

6. UNDESIRABLE: LACK OF MICRO-SCALE ECONOMIC ACTIVIES RESULT TO AN INACTIVE STREET EDGE BOUNDARY — STREET LACKS DIVERSITY AND IMAGEABILITY

2.141 Undesirable spatial arrangements of front yard spaces of dwellings.
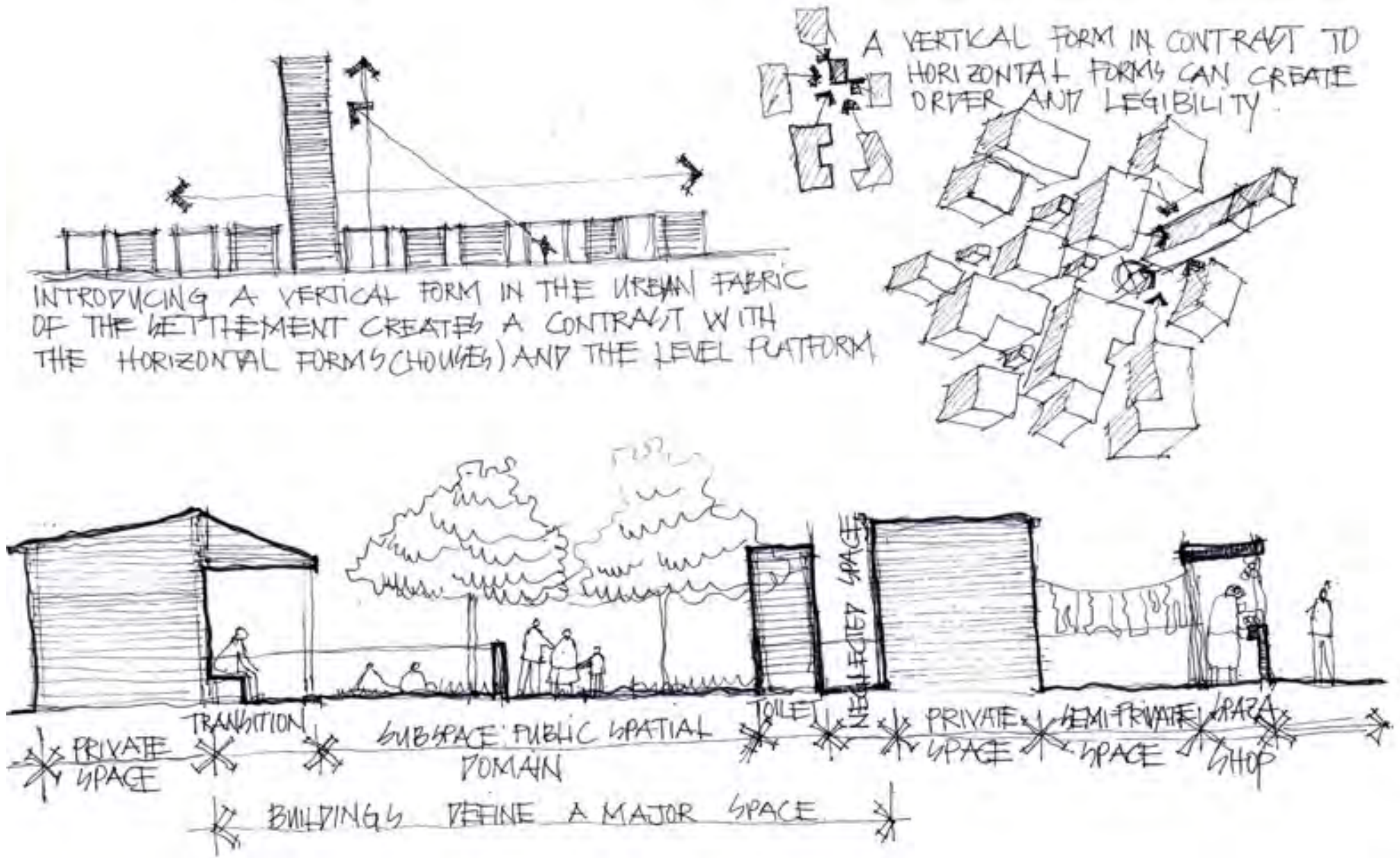
2.142 Desirable spatial forms and open space arrangements for a higher quality of urban living.

2.143

2.144 African space is a system of interconnected spaces whereby there is harmony and balance between individual privacy and communal space:

1. A high degree of enclosure in private spaces – rooms, kitchen, storage, usually one door and relatively few and small windows limiting a visual connection between the interior and exterior | 2. Seating at the front of buildings and at entrances to private homes | 3. Fruit Trees are common in front of dwellings | 4. Low walls are used to define private open spaces used for domestic and social activities around buildings | 5. Agriculture is mostly subsistence – gardens, crop fields and farm animals (chickens, cattle etc) along with fruit trees are common in private open spaces | 6. High walls are used to screen outdoor cooking spaces | 7. Private open spaces around buildings have a visual connection to streets or pedestrian pathways.

2.145 African spaces are usually characterised by stand-alone dwellings connected by open spaces which are defined by walls, seating and trees.

2.144

2.145

2.143 Different kinds of spatial threshold boundary elements that can be used to define a transitional space.
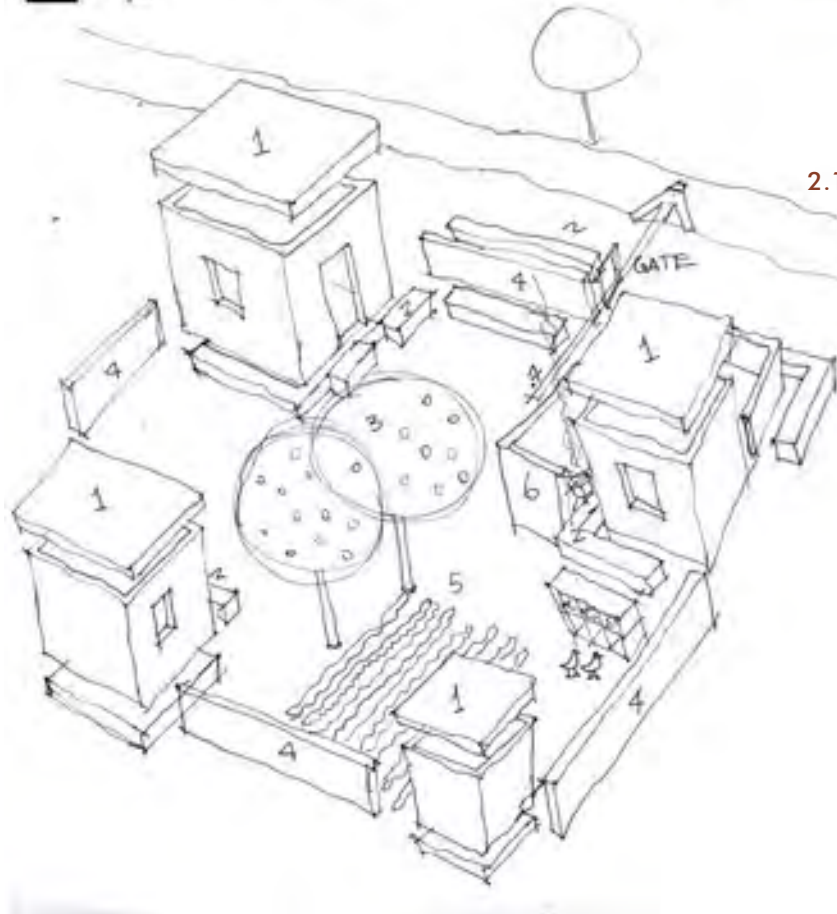
DRAWINGS: SPATIAL FINDINGS

2.146 Threshold 1: Dwelling—seat—tree—seat—low wall—seat—street.

2.147 Threshold 2: Dwelling—seat—seat—low wall—seat—street.

2.148 Threshold 3: Dwelling—seat—street.

2.149 Threshold 4: Dwelling—seat—tree—street.

2.150 Threshold 5: Dwelling—covered entrance—seat—street.

2.151 Threshold 6: Dwelling—seat—*spaza* shop—street.

2.152 Threshold 7: Dwelling—extended seat/step—street.

2.153 Threshold 8: Dwelling—seat—low wall—street.

2.154 Threshold 9: Dwelling—seat—high screen wall—street.

2.155 Threshold 10: Dwelling—steps—street.

2.156 Threshold 11: Dwelling—*spaza* shop—covered seating area—street.

2.157 Threshold 12: Dwelling—seat—low wall—articulated gate—seat—street.

2.158 Threshold 13: Dwelling—seat—transparent fence—street.

2.159 Threshold 14: Dwelling—seat—tree—low wall—street.

2.160 Threshold 15: Dwelling—covered entrance—seat—transparent fence—street.

2.161 Threshold 16: Dwelling—*spaza* shop—street.

2.162 Threshold 17: Dwelling—extended step/seat—low wall—step—street.

2.163 Threshold 18: Dwelling—seat—low wall—tree—street.

2.164 Threshold 19: Dwelling—seat—detached screen wall—street.

2.165 Threshold 20: Dwelling—seat—detached screen wall—street—tree—seat.

2.166 Threshold 21: Dwelling—seat—street—*spaza* shop—dwelling.

2.167 Threshold 22: Seat—dwelling—seat—tree—low wall—step-street.

2.168 Threshold 23: L-shaped dwelling—seat—low wall—street—street.

2.169 Threshold 24: Dwelling—seat—street—dwelling—covered entrance—seat.

2.170 Threshold 25: Dwelling—seat—street—seat—dwelling.

2.171 Threshold 26: Dwelling—covered entrance—seat—street—seat—covered entrance—dwelling.

2.172 Threshold 27: Dwelling—covered entrance—seat—street—seat—dwelling.

2.173 Threshold 28: U-shaped dwellings—seat—street—seat—dwelling.

CONCLUSION:
Design Motif

2.174 Threshold 29: Dwelling—seat—tree/street—seat—dwelling.

Although the different African houses in relation to the open spaces around them, show different degrees of privacy and various articulations of spatial thresholds, there are similarities in the way spatial domains are demarcated for various relationship-building activities. All of them use walls, roofs, and sometimes minimum or no window openings with only one door leading to private spaces (bedrooms) and they all have semi-public spaces connect directly to public spaces.

The prevalent semi-public spaces may reflect the fact that family relationships are expected to be stronger than relationships with outsiders in the community and the private spaces could depict the fact that completely enclosed spaces are dedicated to intimate relationships.

Sub-Saharan African settlements depict a spatial structure similar to that of Bantu settlements. An interconnecting spatial structure is prevalent and seems to be an extension of the strong *Ubuntu* communal spirit of sub-Saharan African communities. Relationship-building activities seem to thrive in this kind of spatial arrangements, thus, fostering strong neighbourliness and community ties. Multiple spatial connections for relationship-building activities are achieved through series of spatial thresholds that interconnect separated spaces.

The articulations of spatial thresholds in African settlements represent the way people wish to relate their personal space to that of other people. Thresh-

olds can be used as means through which private, semi-private, semi-public, and public spatial realms are connected. It is apparent from the spatial analysis that connections between these spatial domains are given varying articulation in African settlements, except for connections between semi-pubic (semi-enclosed) and private (enclosed) spaces which. These spatial threshold patterns will be applied when analysing and designing spaces that promote social connections in Khutsong Section.

Sub-Saharan African communities are characterised by thriving social and communal ties because the spatial structure of their settlements encourages social interactions. It is important to ensure a porous spatial structure which consists of permeable spatial thresholds between semi-private, semi-public, and public spatial domains. One main lesson that can be drawn from African settlements socio-spatial patterns is that different spatial zones are demarcated for relationship-building activities according to the degrees of intimacy.

The upgrading of African settlements should enable different kinds of relationship-building activities to occur in order to grow and maintain strong communal ties. Relationship-building activities can either be promoted or discouraged by the way spaces and forms are articulated. Therefore spaces can be articulated as a response to community values and cultural practices which emanate from *Ubuntu*. These invisible cultural rules are played out in *everyday* activities occurring in forms and spaces articulated for them.

This can be applied to the in situ upgrading proposal for the study area by designing for spatial porosity and interconnectivity so that more social interactions can occur in the settlement.

2.3 A VISUAL-SPATIAL SITE ANALYSIS
INTRODUCTION

Khutsong Section is an urban informal settlement characterised by high densities with very strong social bonds between residents. The settlement is diverse in its built forms, materiality, sub cultures and people, with poor infrastructure and services, and has a reputation for being intricate, organic, participatory, innovative and progressive in its approach to challenges. There appears to be tremendous scope for upgrading in Khutsong Section to reflect this diversity, connectedness and innovation.

The informal settlement is surrounded by social housing clusters in distinct neighbourhoods, each with its own particular environmental setting, social history, cultural identity, civic pride and community image. Within the informal settlement there are also identifiable sub-clusters. Consideration of the nature, character and culture of each of these sub cultures provides the context and platform for incremental informal settlement upgrading.

The shared commitment and sense of belonging of the local people towards these sub-cluster neighbourhoods can inspire and generate the concepts for an informal settlement in situ upgrading project. The designer's role as visionary, facilitator and interpreter has the capacity to express both the metaphysical and mythical experience of 'place'. Through design, designers can link people to 'place' and facilitate relationship-building activities, connections, engagement and cultural belonging as an integral part of function and performance. Designers have the opportunity to challenge and capture the 'everyday', where form and space as creative intervention or inspiration can be purposeful.

It is worth mentioning that some of the children that were born and raised in informal settlements end up feeling at home where they live. Wiping away an entire informal settlement socio-spatial setting is being insensitive to their history and their community. Using the findings from the spatial analysis of precedents, the following visual-spatial site analysis will be focused on understanding the existing urban fabric and open spaces of Khutsong Section. The presence or absence of the fractal and pedestrian-oriented spatial urban nature of the informal settlement discussed in Part 1 of this study will be investigated through photography, hand-drawings and computer-generated drawings and spatial modelling.

The aim of this analysis is to establish a design problem by understanding existing socio-spatial conditions of Khutsong Section informal settlement which will inform the design investigation.

A VISUAL-SPATIAL ANALYSIS OF KHUTSONG SECTION
URBAN BLOCK SCALE ANALYSIS

3.001 Khutsong Section is located in South Africa within the municipal border of the City of Johannesburg.

3.002 Khutsong Section is located in Midrand, in Ivory Park township in the northern part of Gauteng. The indicated informal settlements mushroom close to resources and job opportunities. Most of them are located near mobility spines, railway lines and economic nodes. Khutsong Section is close to the Midrand economic node.

3.003 Khutsong Section is located close to two main roads, a school, and a shopping centre further south along Freedom Drive. It is also surrounded by formalised residential areas. This means that the existing infrastructure and amenities can support the in situ upgrading of the settlement.

3.001

3.002

3.003

Location of Khutsong

▲ Informal Settlement
— Motorway
— Mobility spines
— Rail
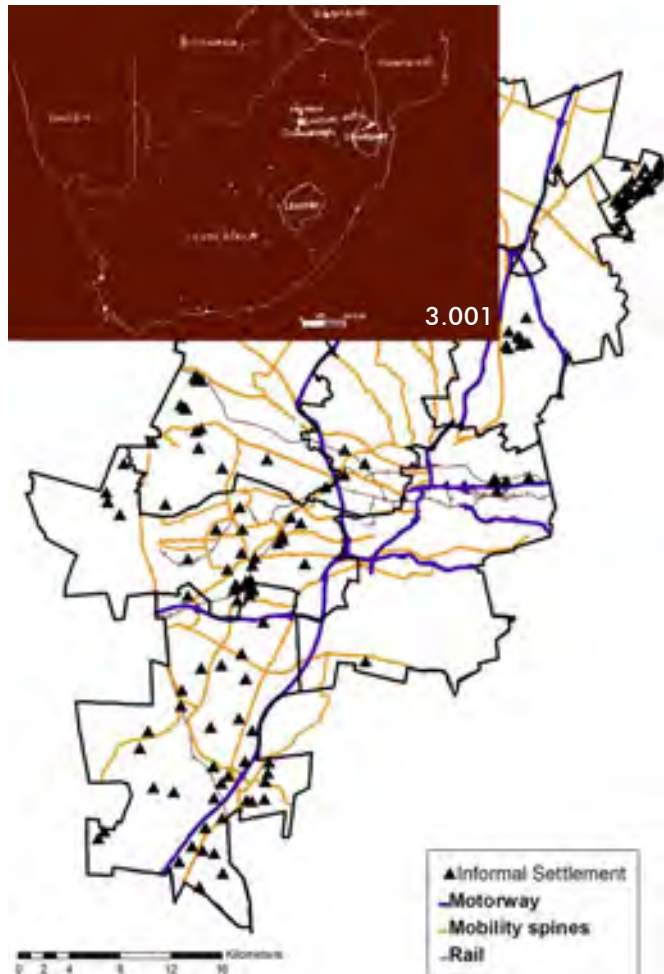
Aerial represenation of Khutsong
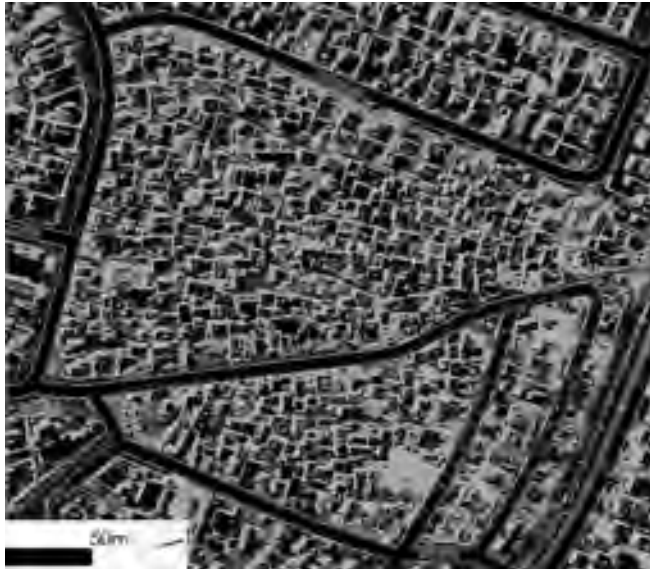
3.004 Positive spaces (buildings) are indicated in black and negative spaces (open spaces) are indicated in grey. Khutsong Section's urban layout is more organic, whereas the formal residential blocks around it are rectilinear, aligning to the layout of roads.

3.005 The variety in sizing and orientation of dwellings in Khutsong Section presents richness and complexity in the urban morphology which is lacking in the formal houses around the settlement.

3.006 Khutsong Section is a triangular urban block bordered by two streets and a water channel which is also used as a pedestrian and vehicular route.

Representation of urban spatial fabric

3.007 This map indicates the formal residences in contrast to the informal arrangement of the dwelling units in the informal settlement. The fine urban fabric of the settlement promotes pedestrian access and a variety of open public spaces which the formal layout lacks.

3.008 Khutsong Section was formed 19 years ago by people who migrated from rural areas, Thembisa township and foreign countries to be near economic opportunities. The informal settlement consists of a finer urban grain compared to the formal residential settlements around it.

3.012 Existing fractal space of flows, cluster of settlement blocks, shops, water collection points, and the primary route going through Hlanganani Street and Moagi Street. Shops are located along busy pedestrian routes and roadways. The fractal pathway network supports micro-economic activities by increasing access for the flow of people, goods and services. Most of the water collection points are also located along pathways to increase access for residents.
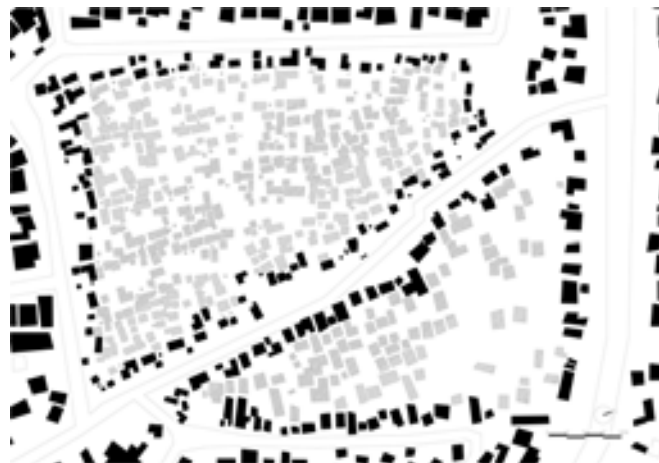
3.009 The urban form density of Khutsong Section informal settlement in **2004**.

3.010 The urban form density of Khutsong Section informal settlement in **2009**.

3.011 The urban form density in Khutsong Section informal settlement in **2015**.

Represenation of existing buildings

3.013 The articulation of urban forms and open spaces is proportioned according to the human scale, creating a spatial complexity which is desirable in urban spaces. However, there is too much complexity and as a result the continuity of the open spaces and pathways of the settlement is affected. Complexity denotes the spatial and visual richness of urban places, and continuity is about the level of ease of navigating and understanding an urban space. Human scale denotes the articulation, size and texture of physical urban elements that tie to the proportions, size and ergonomics of humans.

3.014

3.015

3.016

3.014 A view from Moagi Street shows that the edges of the informal settlement block lack continuity. Continuity refers to the degree to which streets and urban spatial edges are visually demarcated by the arrangement of buildings, trees, walls and other elements.

3.015 A view from a water channel shows that the edges of the informal settlement block have a very high number of spatial linkages. Linkages denote visual and physical connections from open spaces and streets to buildings, open space to open space, and the network of streets, established with the intention to unify urban elements.

3.016 A view from 22nd October Drive shows that the urban spatial fabric of the informal settlement has a good degree of spatial transparency. Transparency denotes the level of visual and physical connection beyond street edges and open urban spaces which allows people to survey and perceive human activity.

3.017

3.018

3.019

3.017 A view from the corner of 22nd October Drive and Hlanganani Street shows how the variety of form and space created by the informal layout and shack typologies provides a rich spatial experience in the settlement. This urban fabric supports various social and micro-economic activities in the open spaces.

3.018 A view from Hlanganani Street shows a haphazard arrangement of building forms and a fractal system of open spaces around buildings. The urban structure of the settlement lacks coherence, which is an urban spatial attribute that denotes a perception of visual order.

3.019 A view from the corner of Hlanganani Street and Moagi Street shows a poor level of spatial enclosure of the open spaces around buildings. Enclosure denotes the degree to which streets and open private and public spaces in front of buildings are spatially bounded and contained by walls, trees, other building forms and urban spatial elements. The arrangement of buildings, trees and boundary lines forms a fractal transportation network that interconnects different spaces.

3.020

3.021

This bird's eye view over Khutsong Section shows the relation of existing building forms and the series of open spaces and pathways that make up the urban fabric of the settlement. The settlement has since densified significantly as shown on page 173. There are no double storey buildings in the settlement yet, which implies that the potential to accommodate a higher population density is not fully utilised.
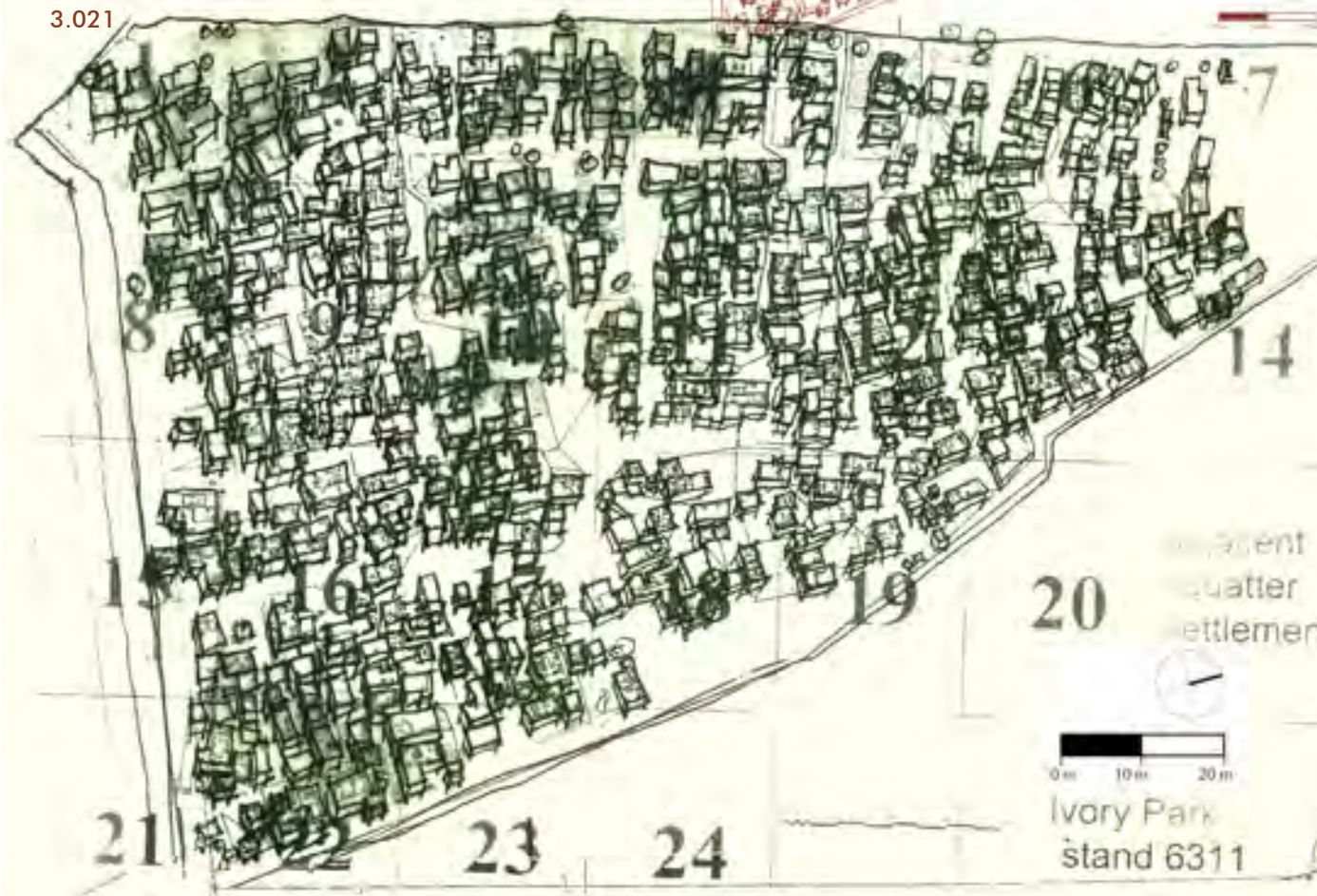
This bird's eye view over Khutsong Section shows an urban spatial structure with a memorable visual character. Memorable places are those with the quality of being recognisable and distinct, which is the result of attributes and the arrangement of certain physical urban elements which evoke emotions, create lasting impressions, and capture attention.

3.022 The edges of internal streets of Khutsong Section show the poor levels of continuity and coherence.

3.023

3.024

Analysis of existing spatial arrangement

3.025

3.023 The main fractal network of internal streets in Khutsong Section connect to Hlanganani Street, Moagi Street, and the water channel.

3.024 A variety in building form, orientation and sizing produces a complex system of open spaces and streets in the urban spatial structure of Khutsong Section.

3.025 The irregular network of open spaces around buildings in Khutsong Section reduces the level of transparency of the urban fabric.

3.026 Superimposing the 2004, 2009 and 2015 building footprints of Khutsong Section onto each other highlights internal streets that have not changed over the years that the settlement has expanded. This ad hoc demarcation of access routes in the process of place-making produces memorable urban spaces.

20m

3.027

3.028

OPEN CORNERS CREATE A WEAK PERCEPTION OF SPATIAL ENCLOSURE.
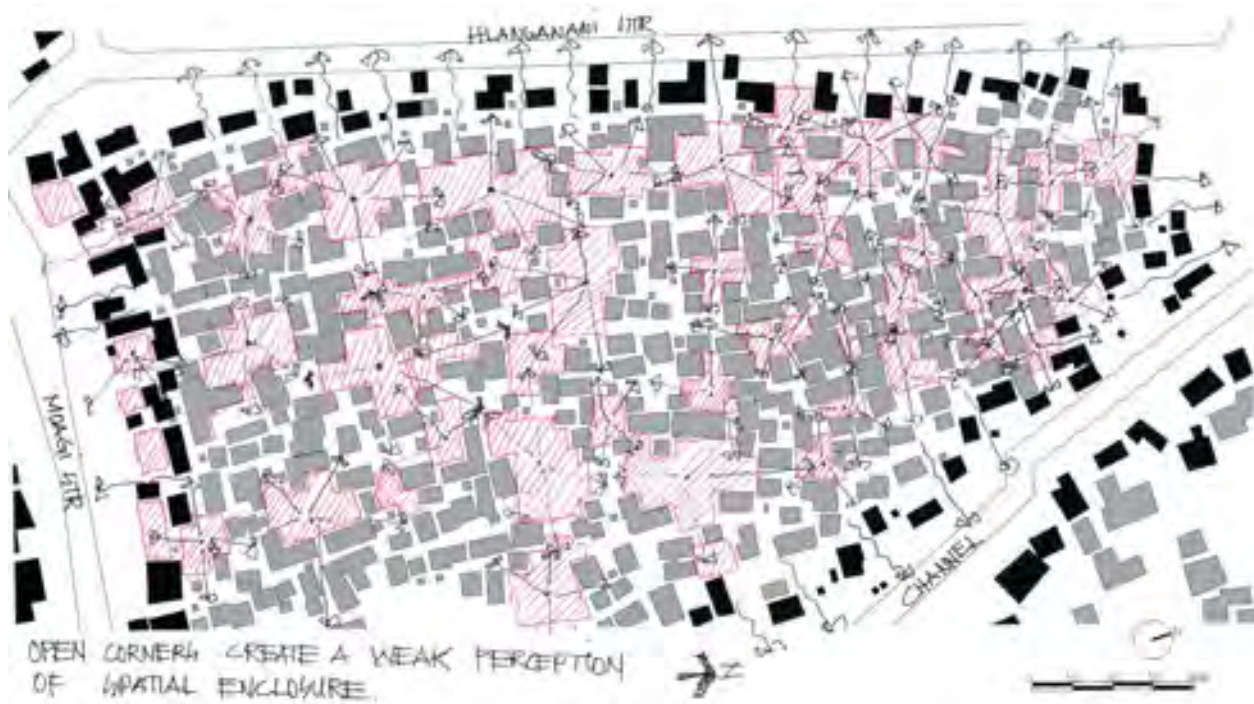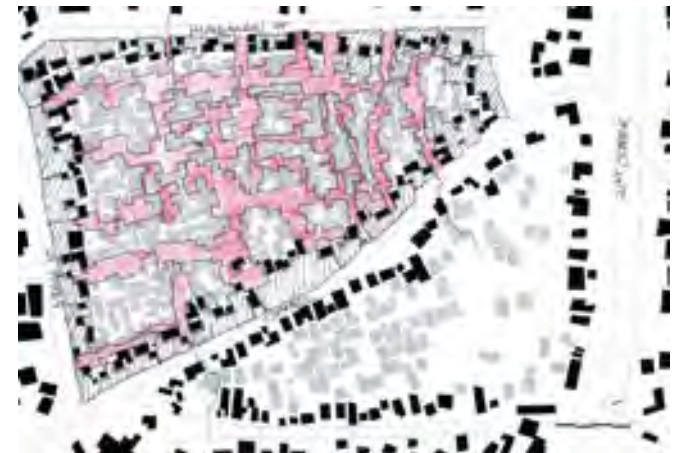
3.030 Too many visual connections (spatial leaks) beyond streets and open spaces in Khutsong Section compromise desirable levels of spatial enclosure.

3.029

3.027 Depiction of Khutsong Section's pedestrian-oriented spatial structure which differs from the rectilinear car-oriented structure of many cities. Some of these routes are wide enough to allow vehicles to drive through at very low speed. The advantage of this site is that paved roadways are available within walking distance from any part of the informal settlement. Small pedestrian routes feed into medium-sized routes, which in turn connect to wider roads.

3.028 Existing internal streets and urban blocks in Khutsong Section. The red lines highlight the fractal transportation network which is connected to surrounding roadways and the existing concrete channel. The groups of fragments of shacks form clusters that are serviced by this organic pathway system, similar to the way blood veins supply blood to different organs of the human body.

3.029 Some of the open spaces in front of dwellings have a high level of enclosure (L-shaped, U-shaped and completely contained) and some are loosely contained.

3.031

3.032

3.031 Mini-bus taxis run along Freedom Drive which connects to 22nd October Drive. The edges of the settlement are very porous, allowing good pedestrian access in and out of Khutsong Section.

The settlement is trapped among the formal residential developments all around, which limits its horizontal growth. The promotion of high-rise buildings in the settlement may create enough capacity to accommodate a growing population. Adequate access to 22nd October Drive exists where taxis and buses are available.
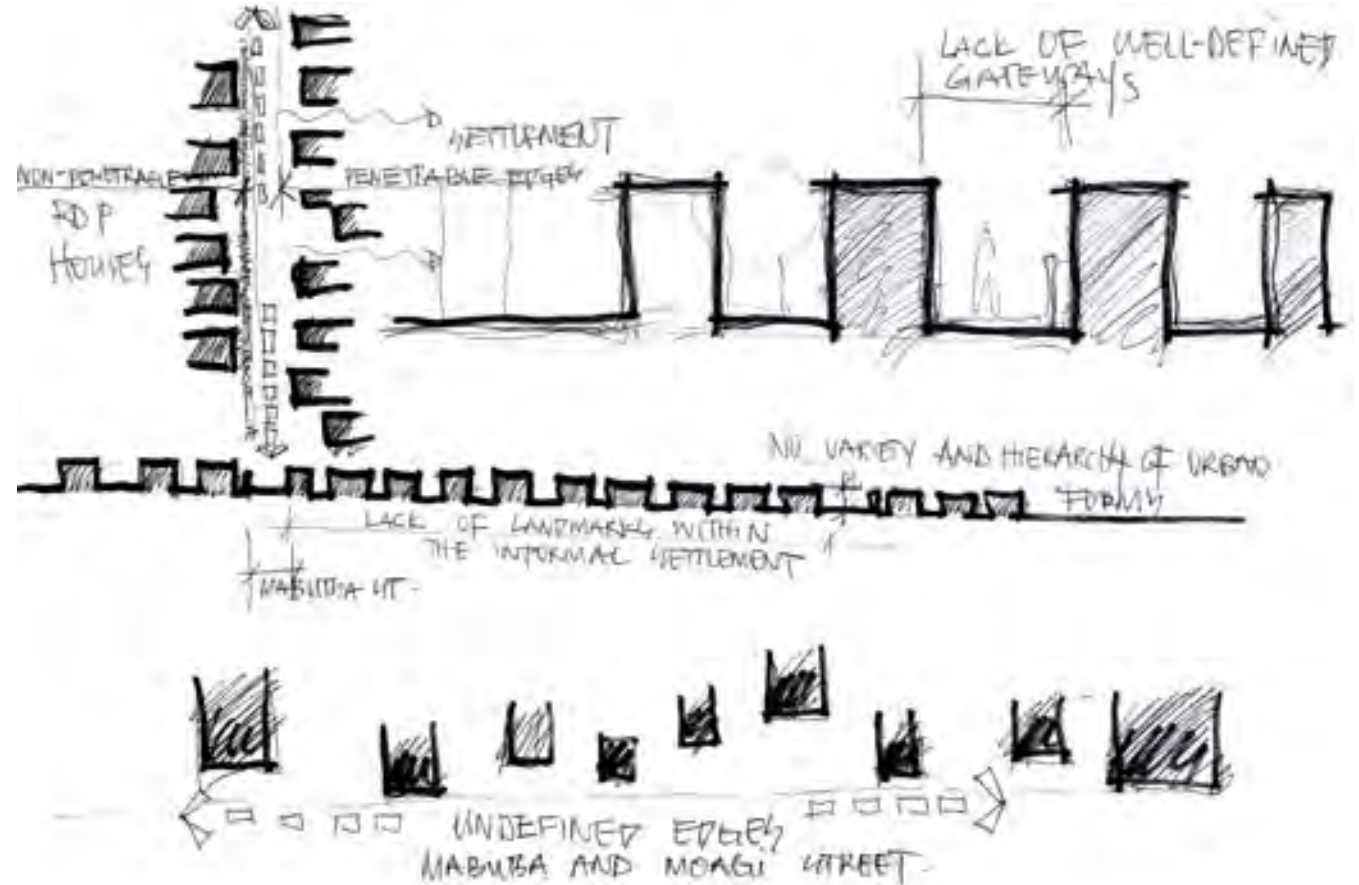
3.032 The edges of Khutsong Section informal settlement are very porous, allowing easy pedestrian movement throughout Khutsong. These diagrams are based on observations of the settlement's street edges. They show that there is good pedestrian access into the settlement, but a lack of continuous building façades along the street affects the quality of open spaces.

3.033 The organic linear open spaces around buildings in Khutsong Section provide opportunities for surprises when private open spaces hidden around corners are suddenly discovered.
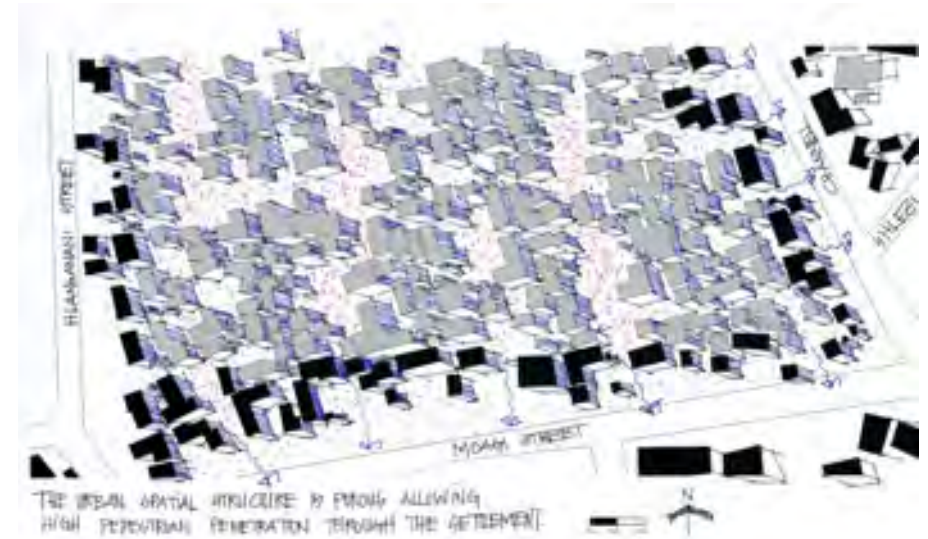
3.034 The organic linear open spaces in Khutsong Section create a spatial setting whereby views and foci constantly change as one moves through the space.

3.035 The clusters of buildings in Khutsong Section are engulfed by organic linear streets and open Spaces, connecting irregular and open spaces within each cluster.
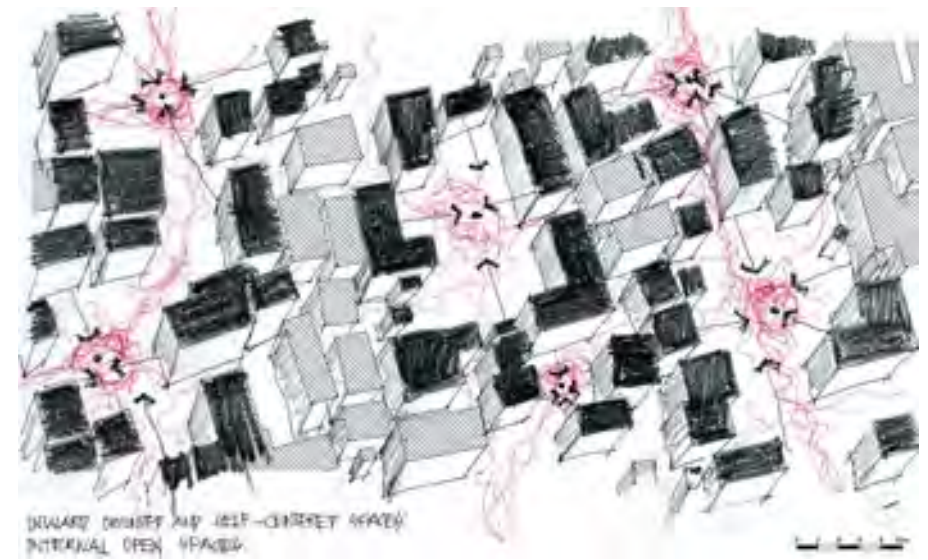
3.036 A cluster of buildings arranged around a central open space creates a good degree of enclosure and promotes semi-private activities in front of dwellings by screening public pathways and open spaces.
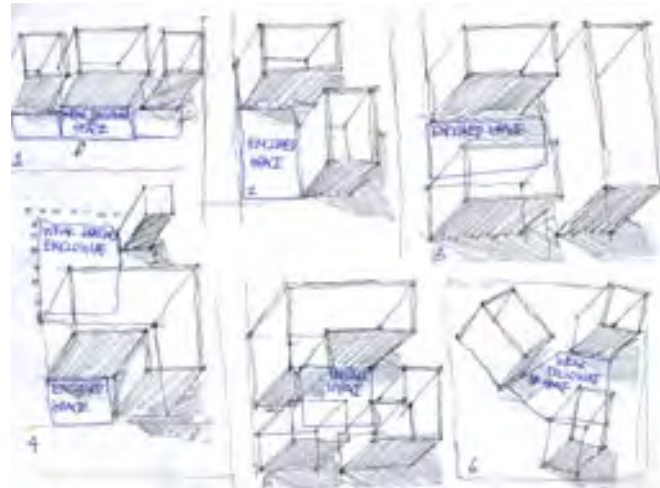
3.038 Different types of building clusters and the way they enclose private open spaces in relation to the street.

3.039 The fractal or organic linear pathway system is a result of the arrangement of buildings, and is negotiated by moving pedestrians in order to access other places. These pathways create a high degree of linkages and transparency in Khutsong Section, because they physically and visually connect to all dwelling units within the informal settlement and the surrounding roadways.
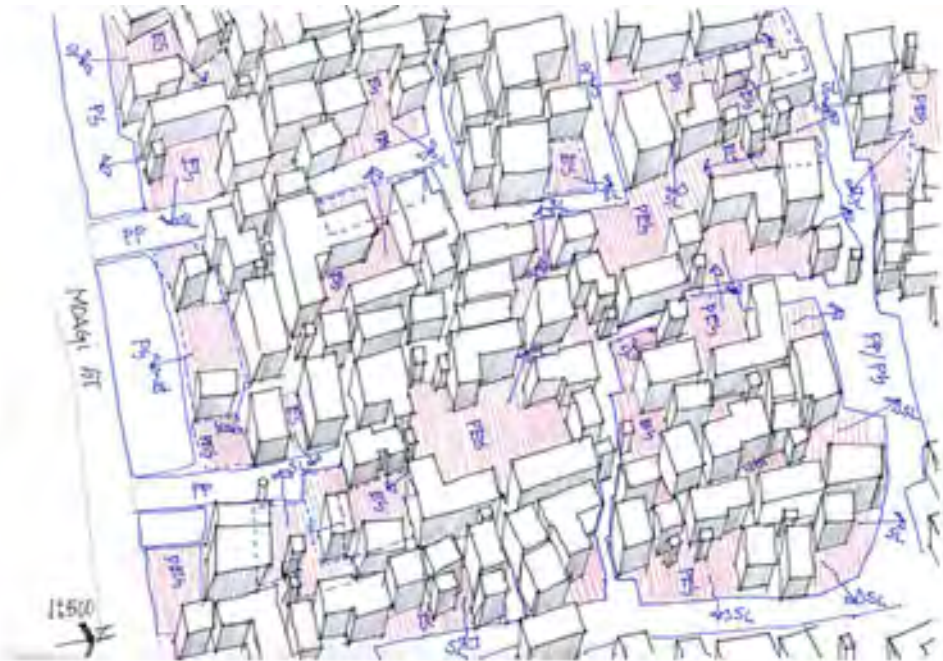
3.037a–3.037g The non-90° relationships in some compositions of buildings and clusters in Khutsong Section create spatial variations, complexity and elements of surprise. Individual buildings in a cluster which are arranged to have a 90° relationship are visually related through aligned edges. Overlapping building facades in a cluster with 90° relationships tend to create a stronger sense of spatial enclosure. At the block edges of the informal settlement (along Moagi Street, Hlanganani Street and the water channel) the composition is chaotic, the result of uncontrolled orientation which creates weak relations among buildings.

Private front yards become focused open spaces in L-shaped and U-shaped building clusters which have strong orientation and direction to the open side. Building edges on streets and pathways (PP – public pathways) form a channelled linear space where the attention is drawn towards the ends of the street, if buildings are linearly arranged and their façades are aligned. Open corners in a cluster of buildings enclosing a central open space create a sense of weak spatial enclosure (SP – spatial leaks and PES – poorly enclosed spaces), whereas closed corners create a strong feeling of spatial enclosure (ES – enclosed space). An inward-oriented and self-centred arrangement of buildings in a cluster creates a central common semi-private open space whereby the buildings screen semi-public and public spaces.

STREET-SCALE ANALYSIS

Moagi Street

3.040 The edge of Khutsong Section on the right-hand side displays a lack of tidiness, continuity and legibility. Tidiness denotes the cleanliness and physical condition of an open urban space.

3.041 A *spaza* shop is located along the boundary fence and washing lines, domestic activities and toilets are visually exposed to open public spaces and the street because of the see-through street boundary fences.

3.042 Poorly managed run-off water from dwellings and water collection points contributes towards the untidiness of the street.

3.043 This water collection point is located very close to the fenced dwelling in the background, which implies that when the people fetch water or do their laundry they may intrude on the privacy of the residents.

3.044 This L-shaped dwelling and the waterless toilet provide a strong enclosure for the front elevation open space which is used for washing lines and domestic and social activities.

3.045 An example of a *spaza* shop attached to the dwelling of the *spaza* owner and unfenced dwellings, whereby private and semi-private open spaces spill onto public spaces. The resulting spatial conditions carry the memory of the effects of poverty and how it strips human dignity.

3.046

3.046 Poor definition of threshold space causes untidy and poorly enclosed open private spaces.

3.047 L-shaped and U-shaped building arrangements help define the boundaries of private open spaces. *Spaza* shops attached to dwellings work as transitional spaces that connect interior spaces to public outdoor spaces.

3.048 The *spaza* shop owner sits at the vehicle and pedestrian gate, away from the shop but close enough to see incoming customers. Locating *spaza* shops on the street boundary helps to partially screen private activities in front of dwellings from the street and open public spaces.

3.047

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3.052

3.050 A great need exists to define public spaces and integrate services and transportation networks in a manner that will produce good urban spaces. One way to achieve this would be by using *spaza* shops as filter layers (thresholds) between private and public domains to increase urban spatial legibility.

3.051 Due to the poor insulation of roofs and walls, residents usually sit under trees and in shaded areas during the day. A need exists for open green spaces, good drainage of run-off water and storm water, and shaded spaces along streets and open public spaces so that more relationship-building activities could occur.

3.052

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3.057

Hlanganani Street

3.052 Residents use the private open spaces along front of dwellings for socialising and domestic activities. Water-less toilets and water taps were provided by Govern-ment for residents. This street is characterised by very green lawns because it receives high levels of water run-off due to the fact that the site slopes down from 22nd October Drive towards Hlanganani Street.

3.053 This view from Hlanganani Street shows buildings in the background which become a visual focus point because of their linear arrangement along this pathway.

3.054 An unpaved road and poorly managed run-off water and waste affect the tidiness of this street and adjacent open spaces.

3.055 Dwellings are usually built with a timber frame and a collage of steel roof sheeting and other materials, with textures, sizes and articulation of physical elements that match human proportions and size. The building forms also give the street a distinct, memorable and recog-nisable spatial quality.

3.056 On the opposite side of Khutsong Section there are formal houses which have decorative boundary walls and gates leading to a high degree of memorability, legibility, complexity, continuity, coherence, enclosure and tidiness. However, the levels of linkages and trans-parency are low along this street edge.

3.057 Street vendors take advantage of high levels of pedes-trian traffic by displaying food, vegetables and other products along the street.

3.058
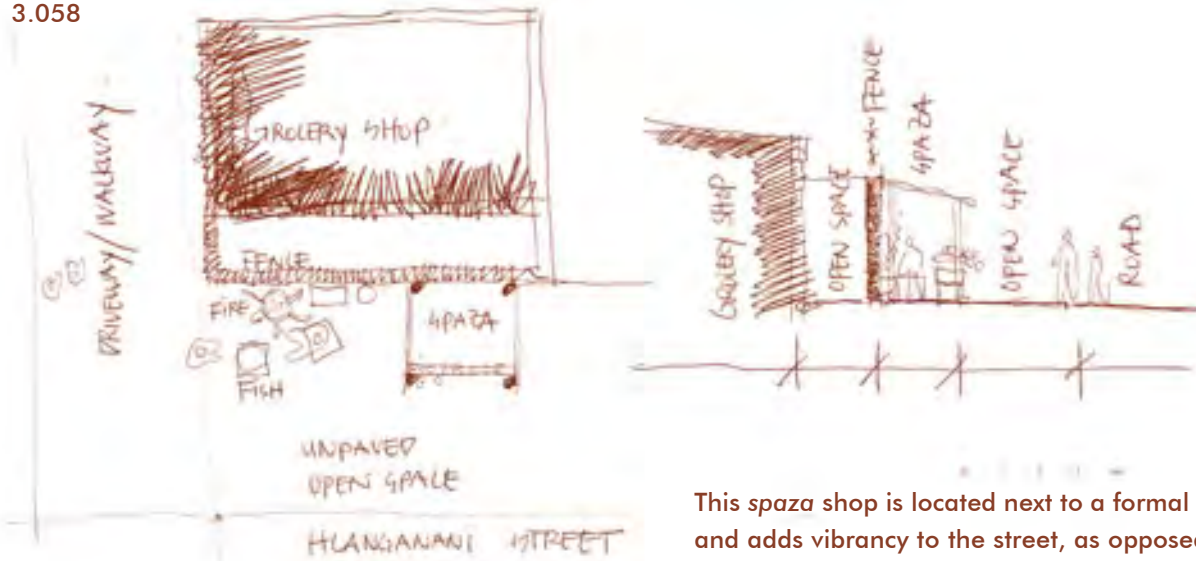
This *spaza* shop is located next to a formal grocery shop and adds vibrancy to the street, as opposed to the solid fence of the grocery shop.

3.059 These two L-shaped dwellings and toilet partly enclose a private open space that directly connects to the street. This open space can be improved by articulating the street boundary.

3.060 Here more fences are used to demarcate the semi-private open spaces in front of houses along this street, compared with houses deeper into the settlement.

3.061 The thresholds of some of the houses are articulated by using covered entrances, seating and paved frontages.

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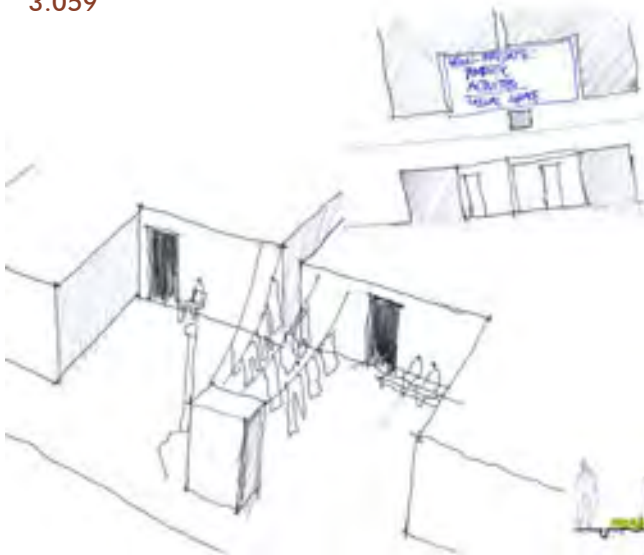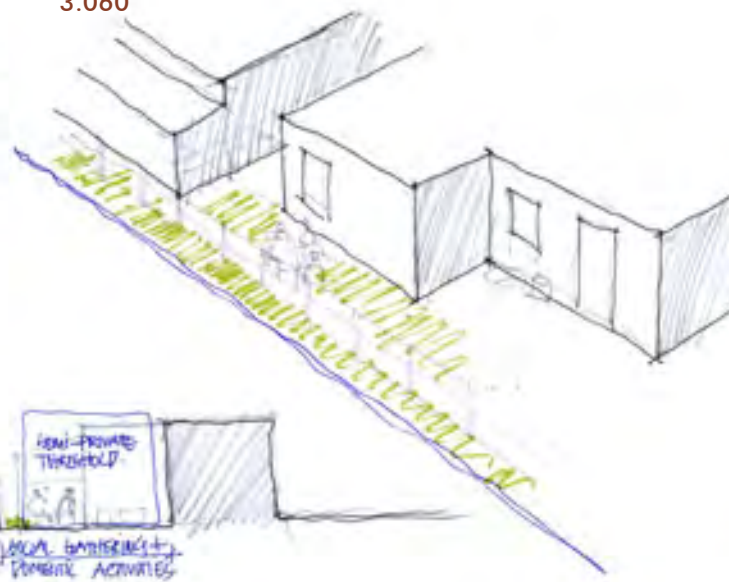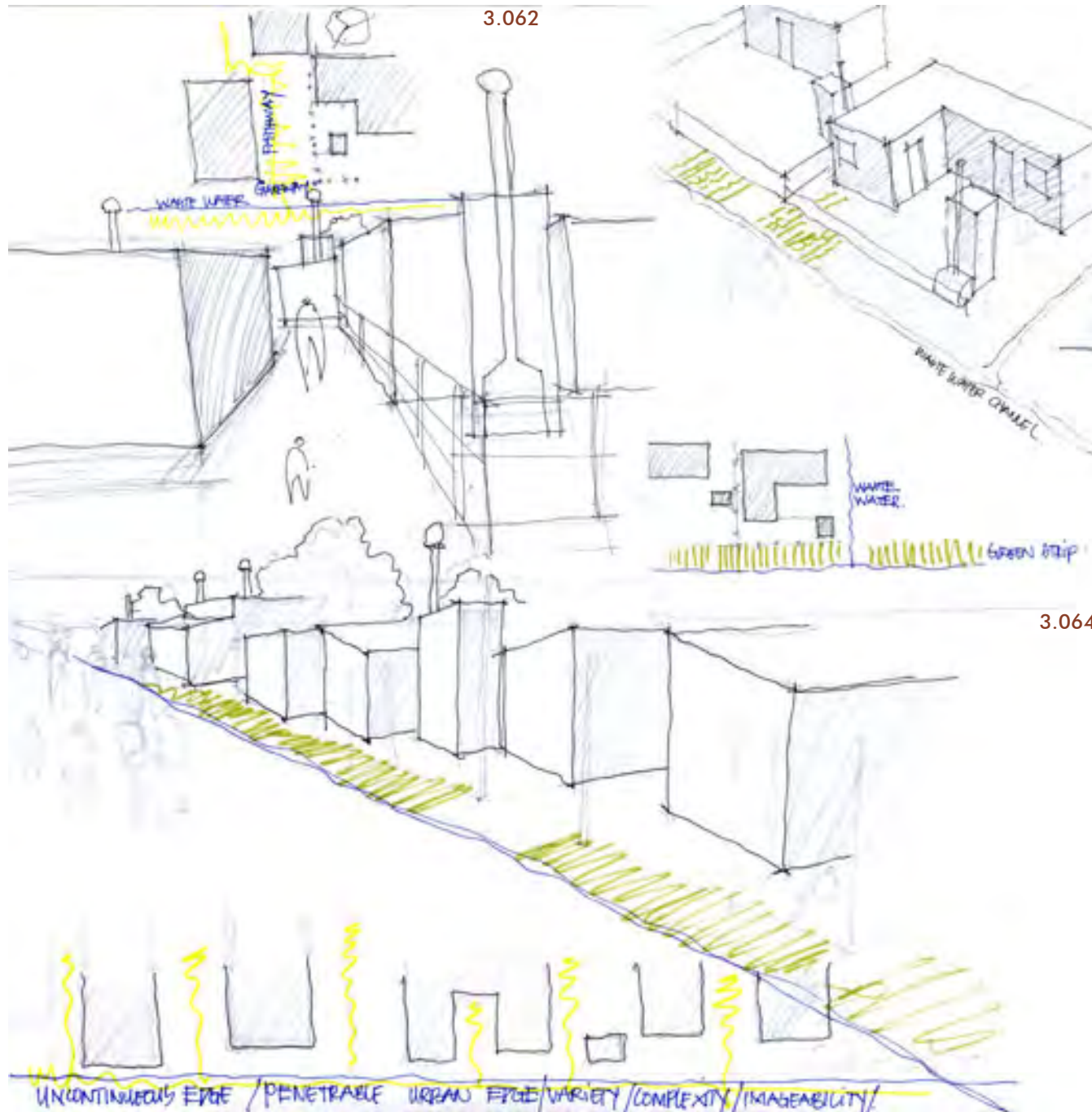
3.062 This organic linear pathway wraps around clusters of dwellings and connects to the main street. The walls of the buildings, toilets and solid and see-through fences define the edges of the pathway.

3.063 The spatial arrangement and sizing of the building forms are related to pedestrian movement and human proportions. High levels of spatial transparency compromise the sense of spatial enclosure of private open spaces and affects spatial continuity and coherence.

3.064 Although there is high degree of transparency and spatial linkages, this street edge has poor continuity because building edges were not aligned.

The Channel

3.065 Some of the houses are built with bricks, indicating a sense of permanence compared with the make-shift houses of timber and steel sheeting.

3.066 A poorly defined public spatial domain lacks the necessary architectural elements that support social activities.

3.067 The owner of this *spaza* shop lives in the L-shaped dwelling behind and keeps the open spaces clean and tidy. Usually open spaces that are not closely related to dwellings are littered and untidy.

3.068 The concrete channel directs run-off and storm water that flows through underground pipes penetrating into the informal settlement.

3.069 Due to the lack of a backyard space, the front yard is used for domestic and social activities while functioning as a pathway that connects to adjacent dwellings and open spaces.

3.070 The existing deep channel running through the settlement transports grey water from kitchen and laundry activities towards a larger channel in 22nd October Drive. To prevent diseases, a submerged channel should be provided to convey this water to storage tanks, after which it can be pumped through a water purification system. This would ensure clean public spaces to encourage social activities.

3.065

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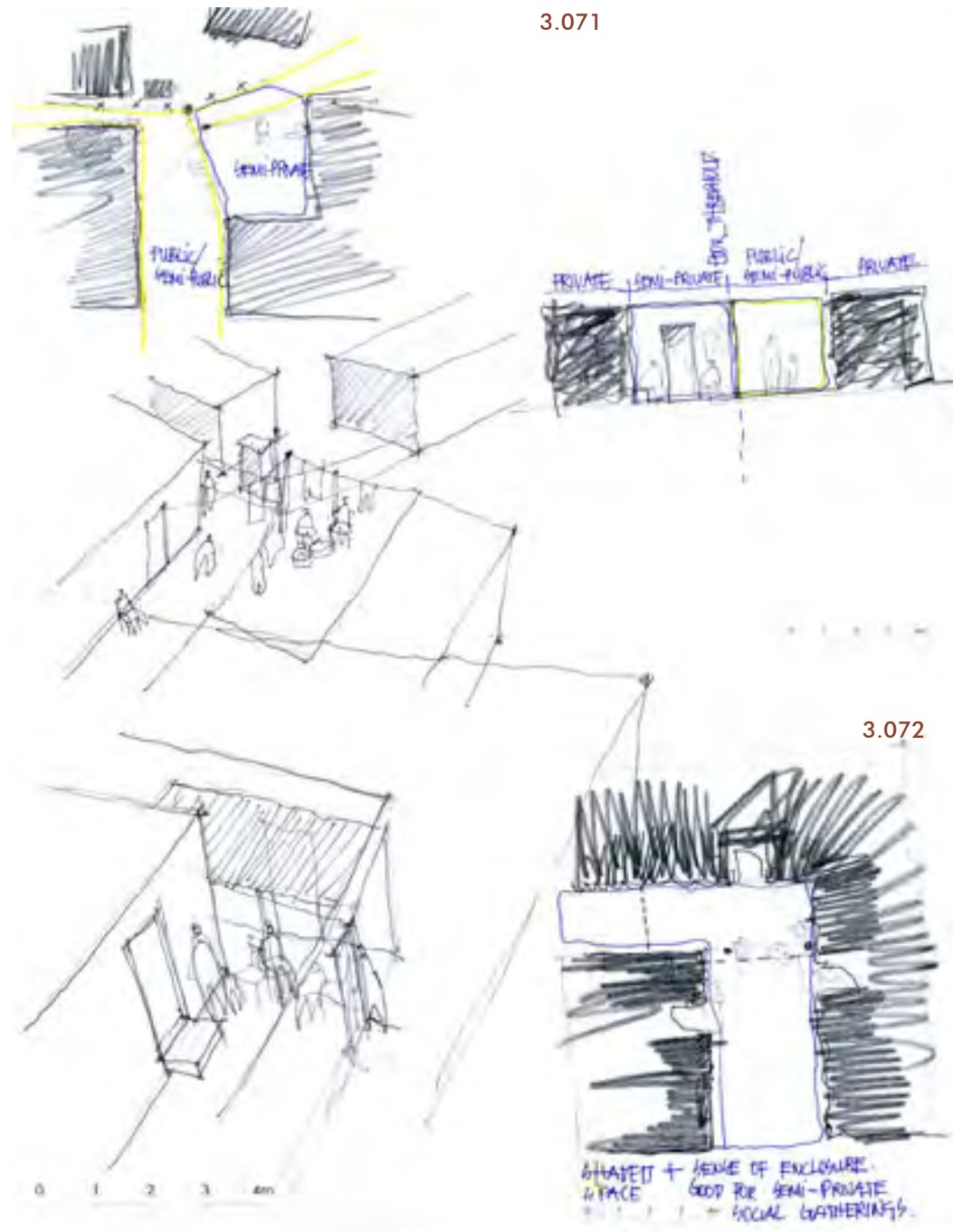
3.071

3.073

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3.071 Washing lines in front yards clutter the open space and disrupt pedestrian movement.

3.072 These buildings are arranged to have their front doors opening towards a linear private open space which is used for sitting and social activities.

3.073 Residents along existing deep channels running through the settlement use fences to define and demarcate their semi-private spatial domains. Adding a boundary fence and a *spaza* shop draws a clear line between the private open spaces and the street. A 90° relationship between the dwellings, *spaza* shop, boundary fence and street creates good visual order and a stronger sense of spatial enclosure.

3.074

3.074 This dwelling has a private open space that is at a higher level than the street and a solid boundary fence, allowing residents to passively survey the streets, while making it difficult for pedestrians to see into the dwelling.
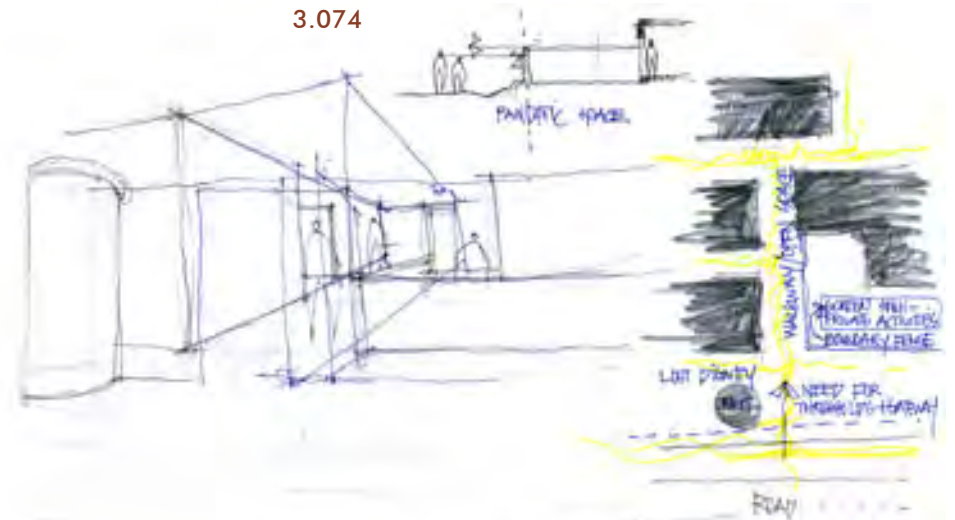
3.075
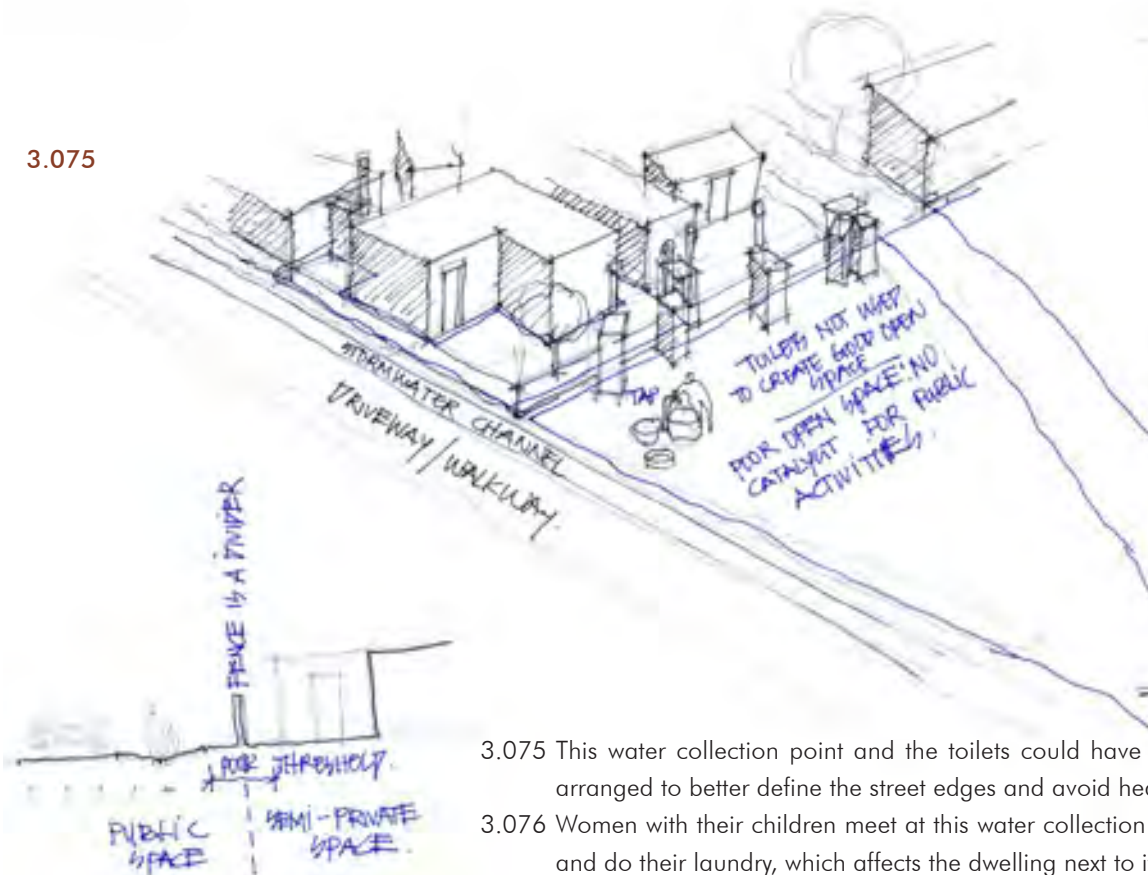
3.076

3.075 This water collection point and the toilets could have been designed and arranged to better define the street edges and avoid health hazards.

3.076 Women with their children meet at this water collection point to fetch water and do their laundry, which affects the dwelling next to it.
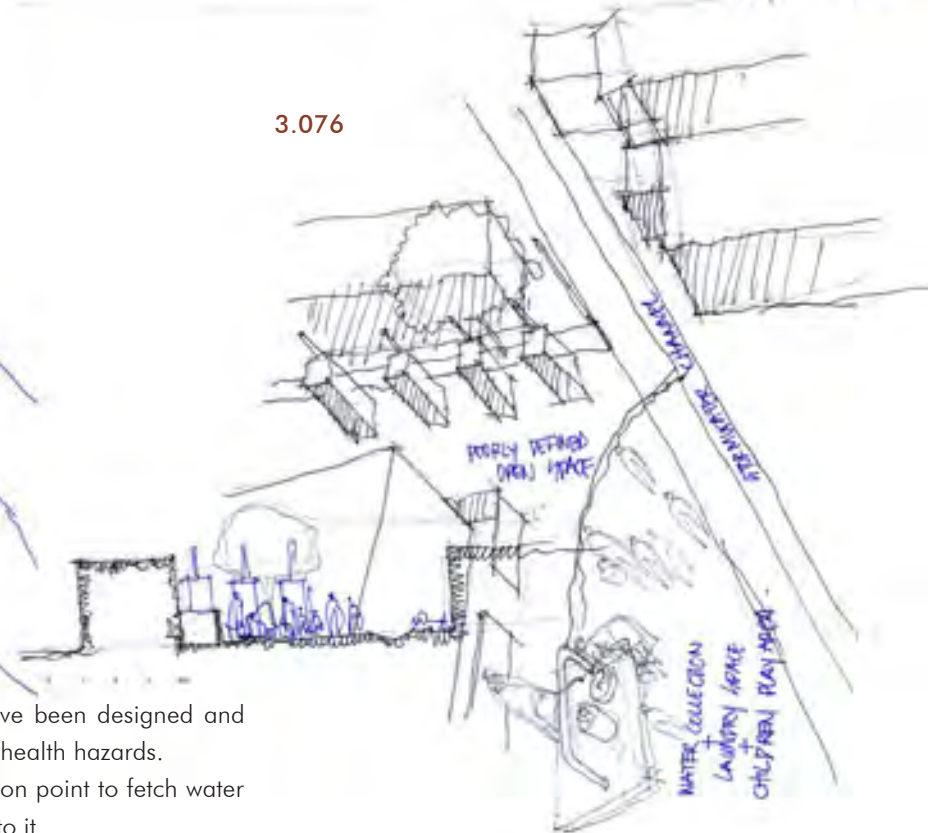
3.077 Residents along the existing deep channels running through the settlement use the spaces in front of their houses for domestic activities which are intertwined with social activities. The lack of a semi-public spatial domain between the semi-private and the public (the pathway along the channel) interrupts semi-private social activities.

3.079 The arrangement of the L-shaped dwelling, *spaza* shop and toilet in relationship to the street defines transitional space that integrates social activities with micro-scale economic activities.

3.080 These clusters of buildings have rear and side elevations facing towards the street, with front façades facing a central courtyard space with covered entrances, seating and trees.
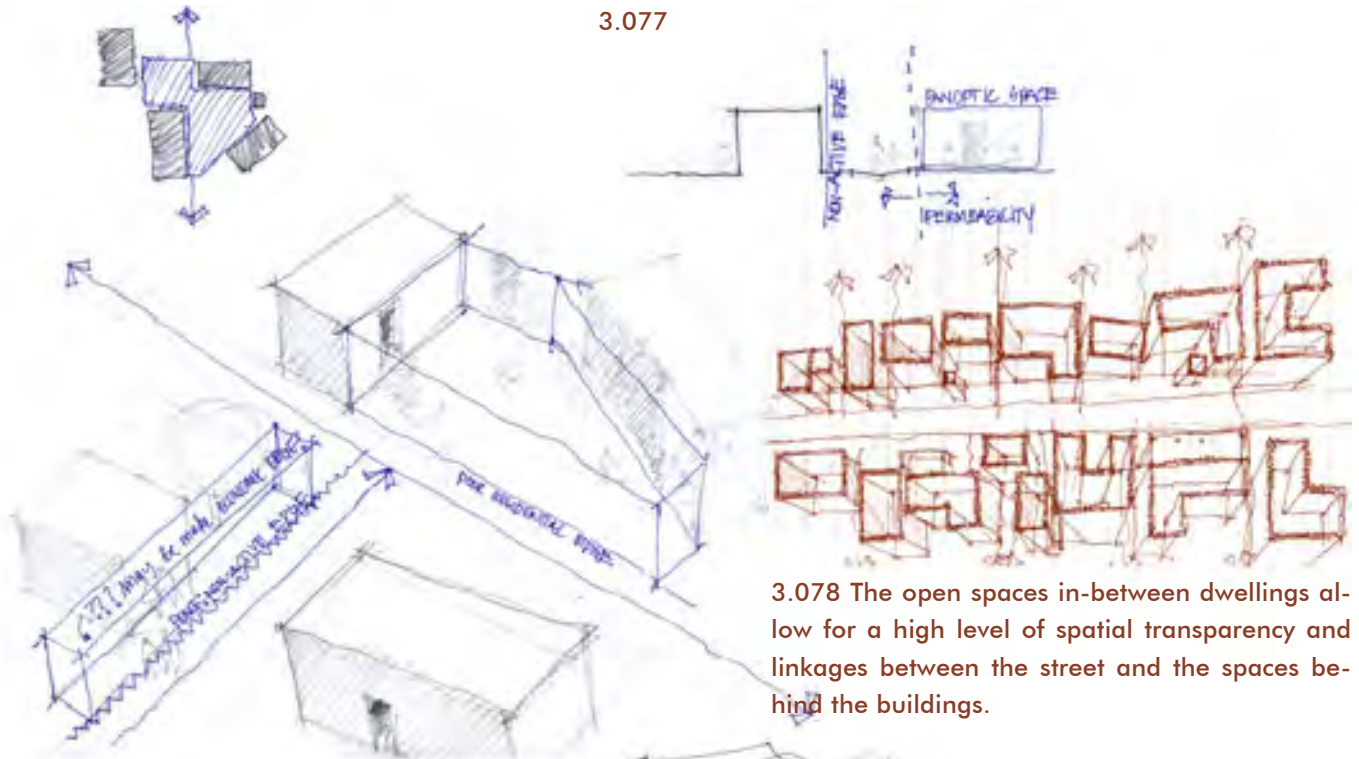
3.077

3.078 The open spaces in-between dwellings allow for a high level of spatial transparency and linkages between the street and the spaces behind the buildings.

3.079

3.080

3.082 The spatial profiles indicate different uses and articulation of front yards, street boundary edges and back yards of a cluster of buildings.
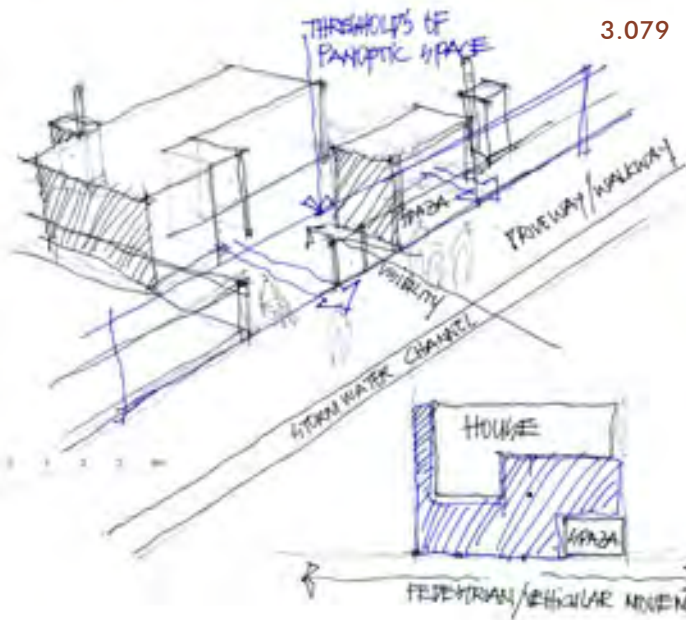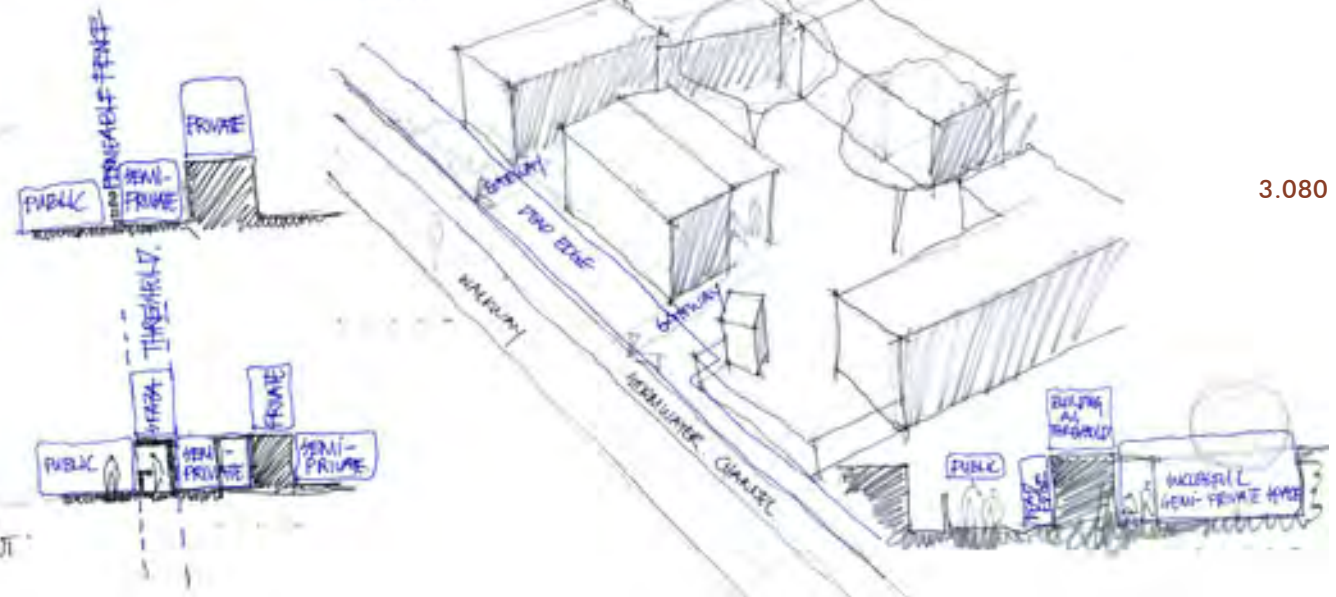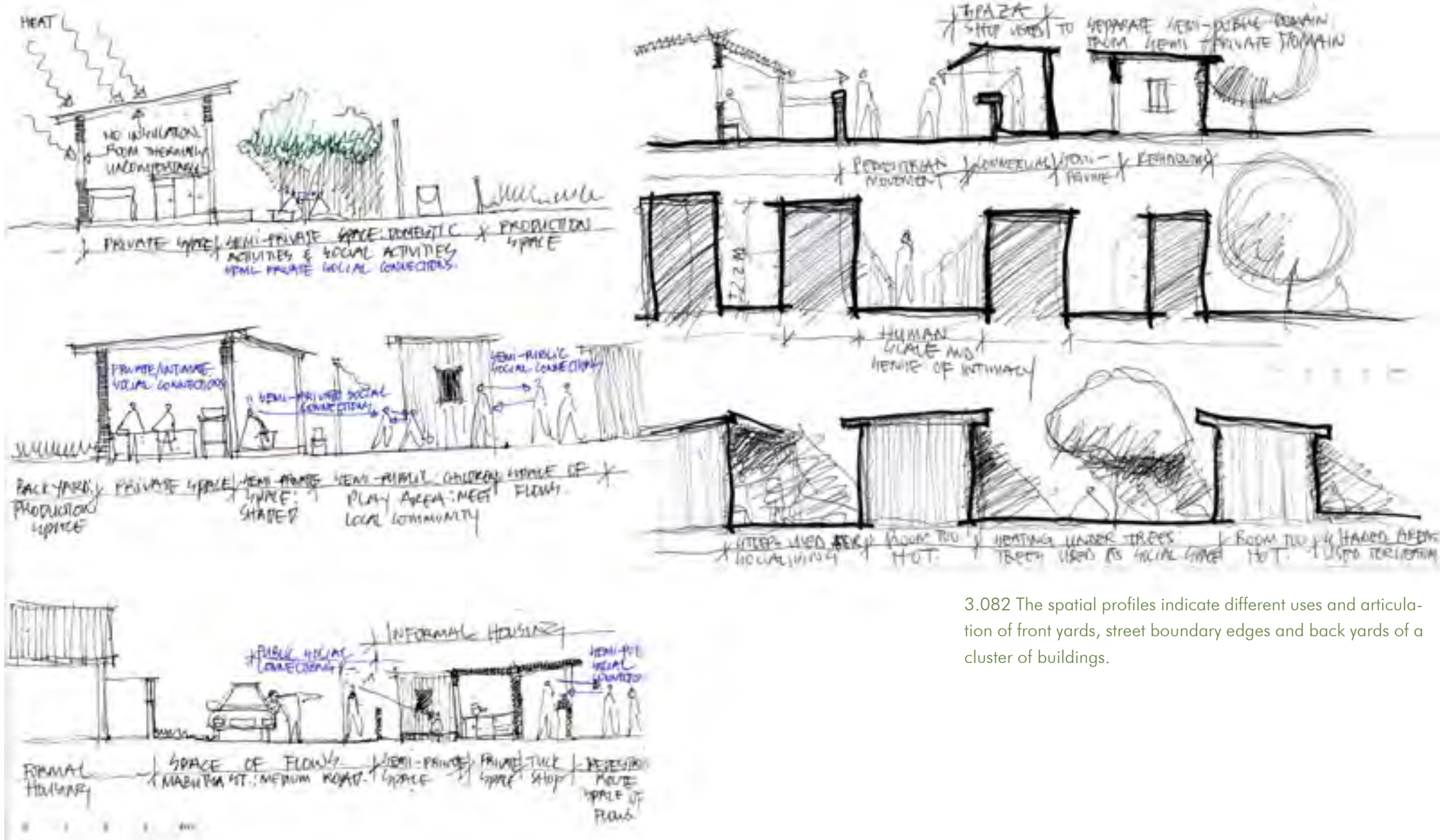
3.081 An analysis of the spatial structure of Khutsong Section, showing social interactions in spaces of places and spaces of flows (Author, 2013). These drawings were based on the understanding of African settlements and the observation of socio-spatial aspects of Khutsong Section. Spatial thresholds play an important role to demarcate private, semi-private, semi-public, and public spatial zones.

3.083 Residents close to existing deep channels running through the settlement enjoy the sunlight while watching people walk in front of their houses and greeting and chatting with friends.

3.084 Residents sit in private open spaces shaded by trees and surrounding houses.

3.085 The lack of a semi-public spatial domain between the semi-private and the public (the pathway along the channel) interrupts semi-private social activities.

3.086 Open private spaces with a strong sense of enclosure. Seating and covered entrances attract social activities.
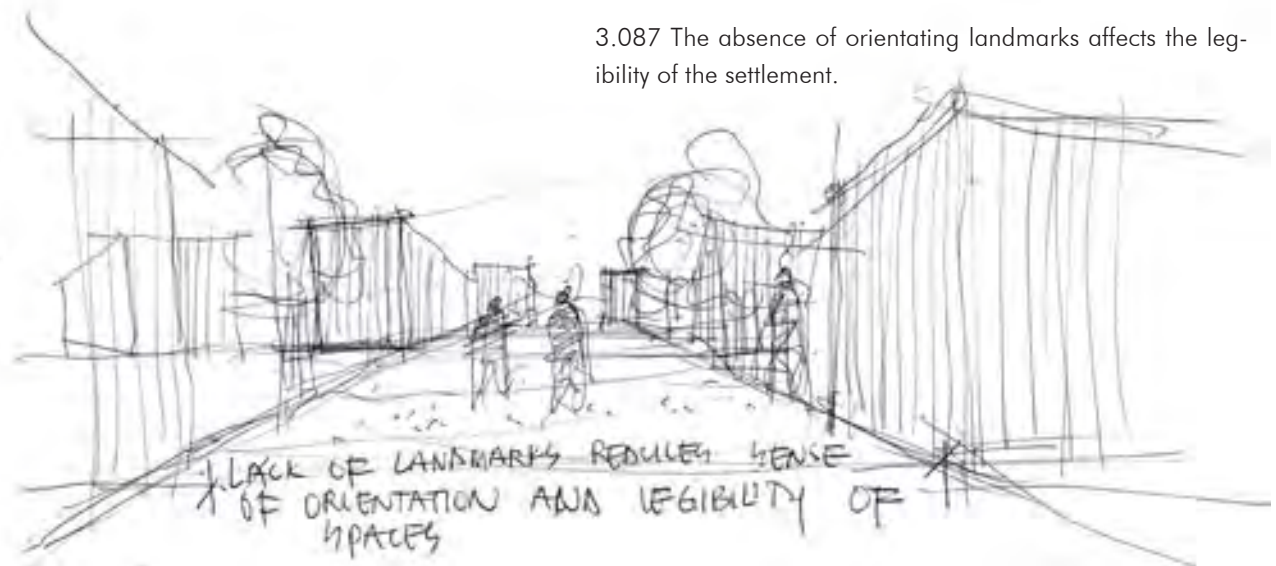
3.087 The absence of orientating landmarks affects the legibility of the settlement.

3.088 Salvaged mattress steel frames, timber, sails and scrap metals were used to create this high street boundary wall.
3.089 This framed opening and triangulated timber gate directly connects the street to the front yard of the dwelling covered with a plastic fabric.

Shlezi Street

3.088

3.089
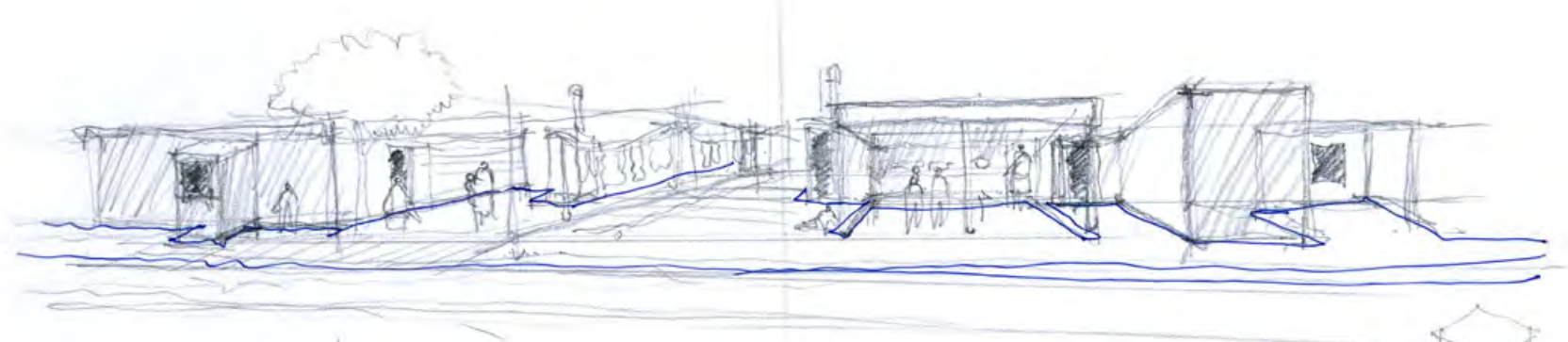
3.091 Social activities and micro-economic activities are intertwined along this street where the market spaces act as thresholds between the public and semi-private spatial domains.
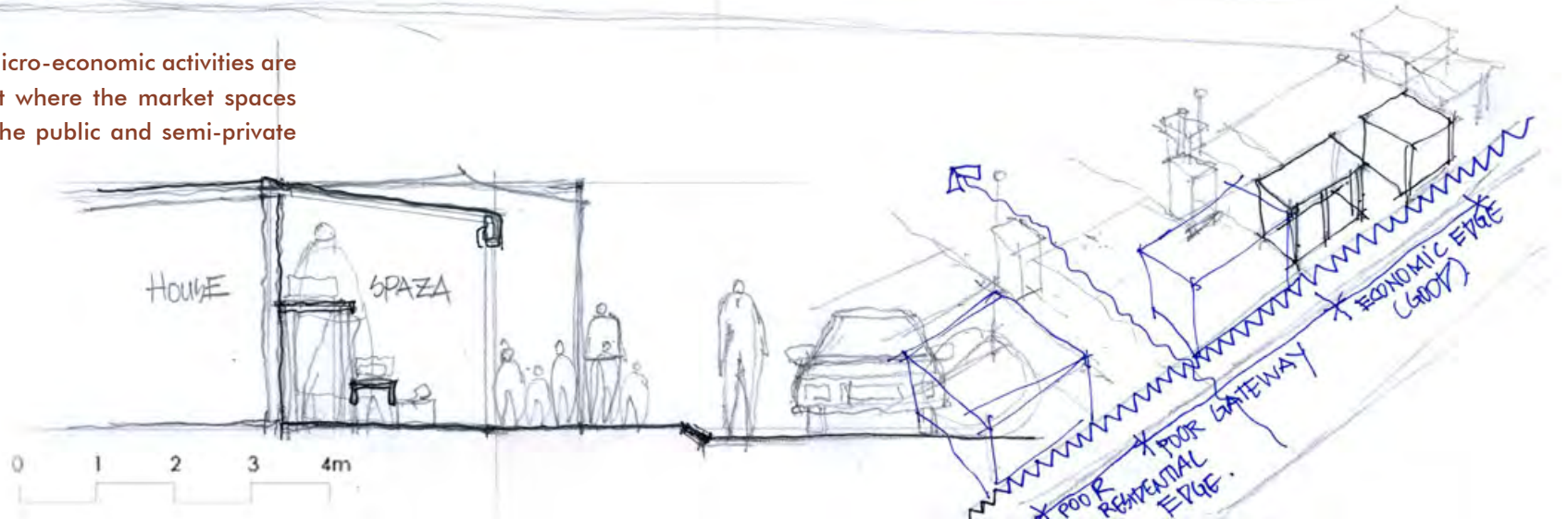
3.090 Pedestrians walk in the road because fences and build-ings encroach onto the unpaved sidewalk. Spaces in front of permanent houses on the left of the road are also used for economic activities usually accompanied by social interactions.

3.092 This *spaza* shop forms part of the boundary fence open-ing towards the street while encroaching onto the open space in front of the owner's house, which is shared by the toilet. Some *spaza* shops are positioned in front of dwellings and accessed through a pedestrian gate from the street.

3.093 Where there is no street boundary fence, the dwellings and *spaza* shops function as thresholds between the street and open spaces behind the dwellings. Toilets and the *spaza* shops become part of the streetscape. *Spaza* shops are sometimes attached to a house and connect-ing open spaces in front of the dwellings for residents to sit, do their laundry and socialise while watching for customers.

3.094 Adding more trees along streets could help support some of the social activities. Paving and storm water drain-age are also needed on the pavement to encourage more activities. If more spatial thresholds were inserted between semi-private and public spaces it could help to dignify domestic activities like laundry, cooking and semi-private social interactions.
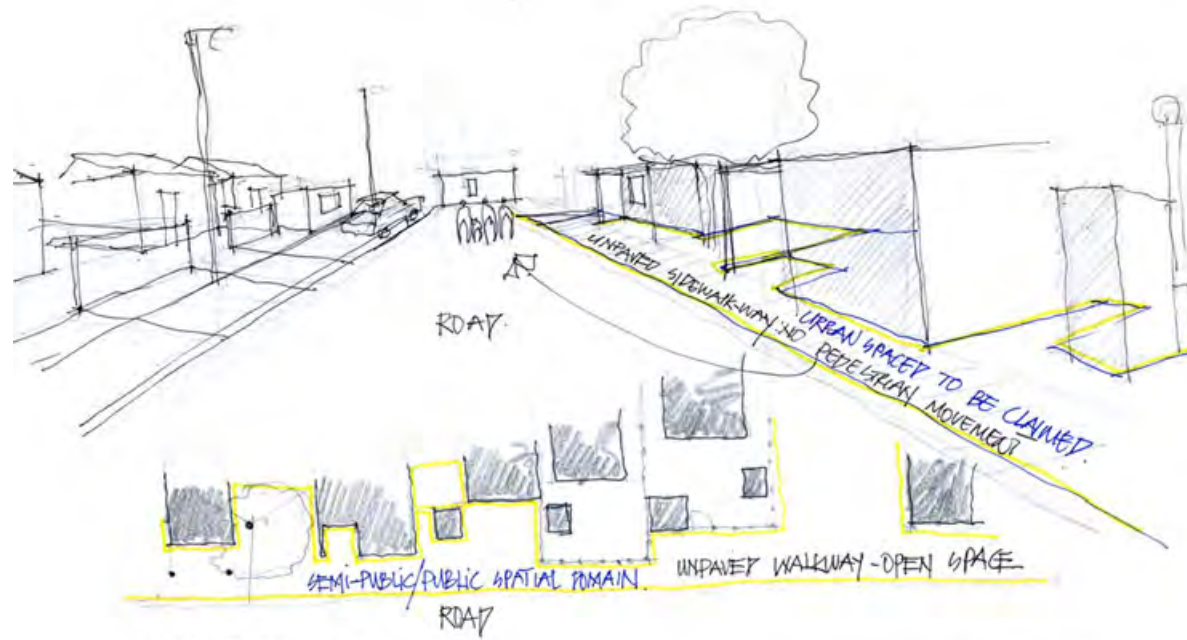
3.090
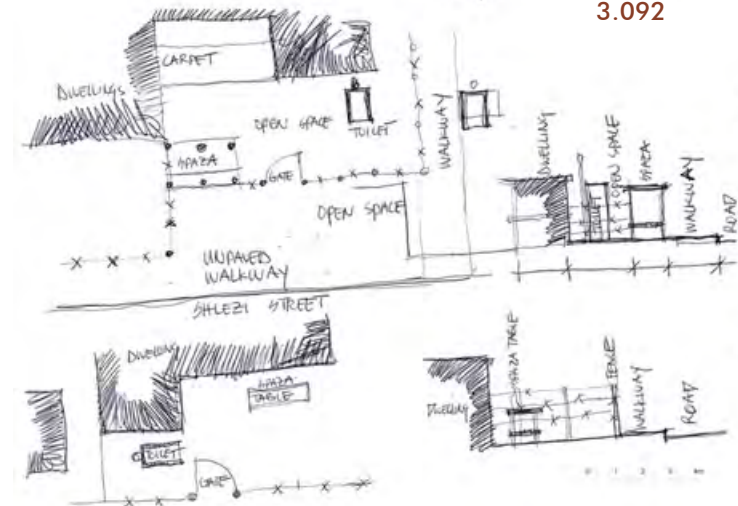
3.092
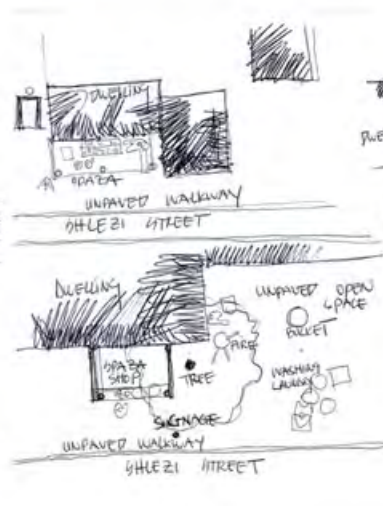
3.093
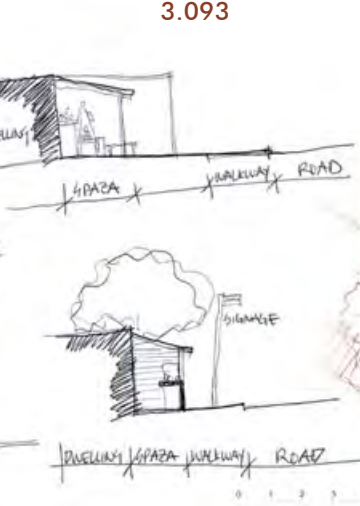
3.094

22nd October Drive

3.095 An example of how a social activity (playing cards) is integrated with a micro-economic activity (commercial sewing) where the channel joins the main storm water channel along 22nd October Drive.

3.096 This front yard contains fruit trees which provide shaded seating spaces and is separated by a see-through fence.

3.097 This is a tidy open space which invites people to sit. It contributes positively to the street.

3.098 Micro-scale economic activities are used to separate
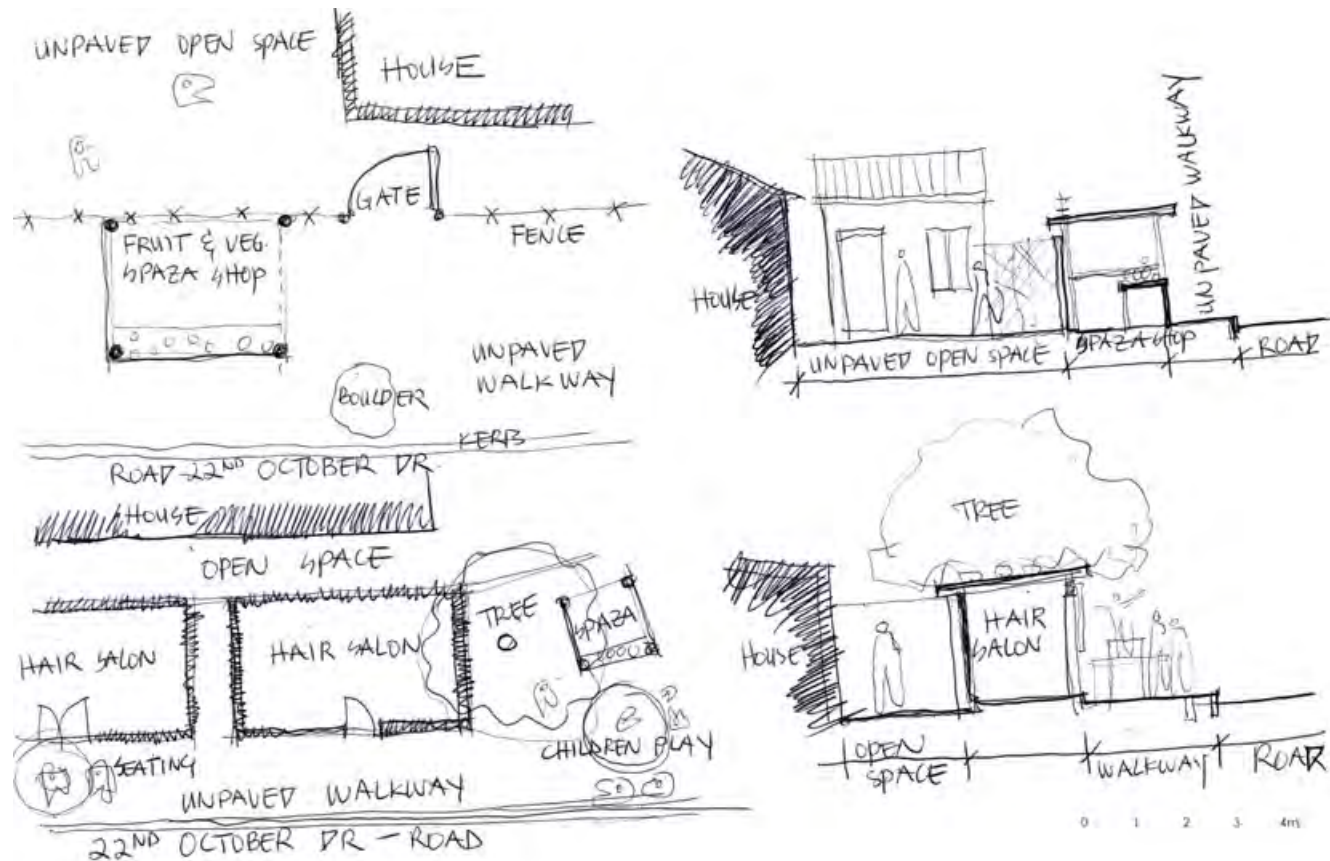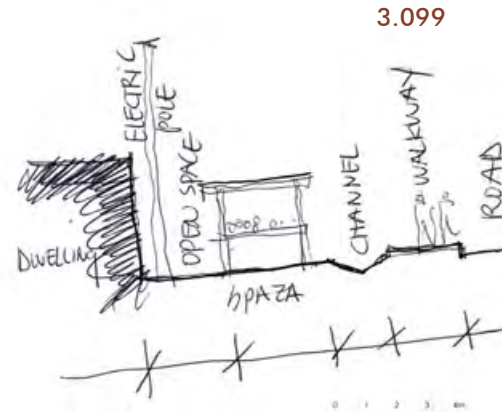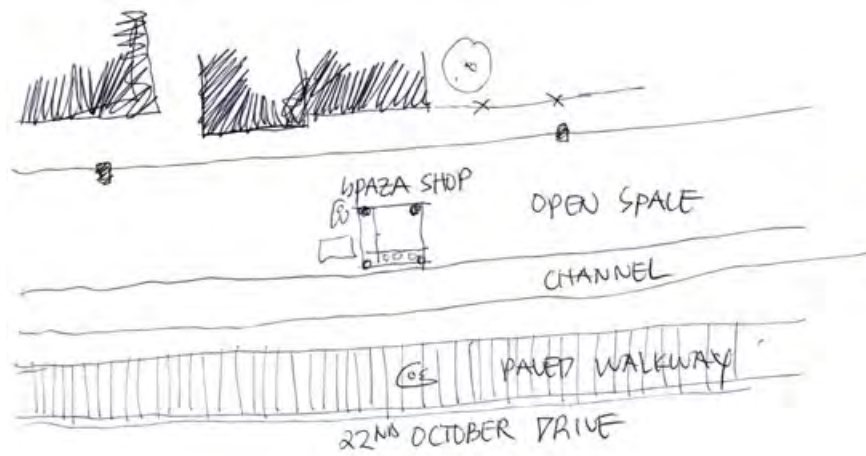
3.099

3.099 The location of this *spaza* shop indicates the need for proximity and connection to pedestrians and cars passing by. It is not attached to any house or boundary fence but is located near selling opportunities.
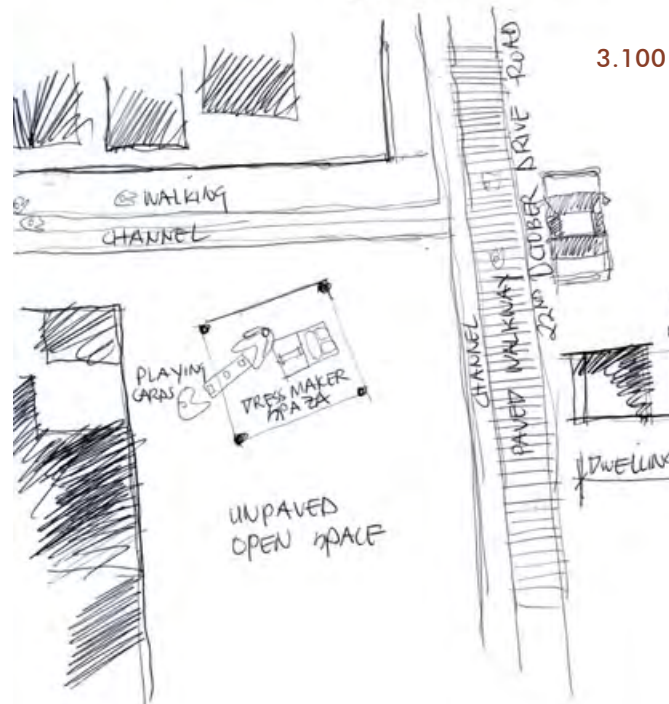
3.100
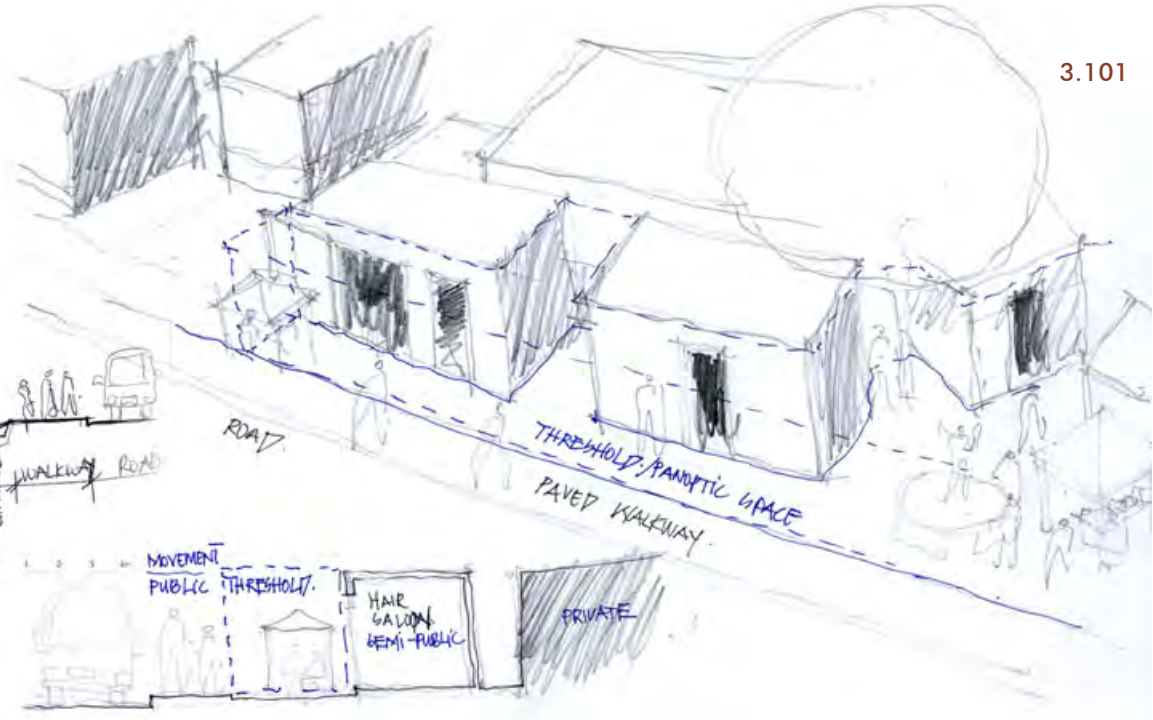
3.101

3.100 This *spaza* shop is located in an open space at the intersection of a busy pedestrian route and a high-traffic road bordering Khutsong Section informal settlement and other formal residential areas.

3.101 This agglomeration of hair salons and fruit and vegetable *spaza* shops attracts social activities and adds vibrancy to the street while screening semi-private activities in front of the houses behind the shops.

INTERNAL STREETS IN KHUTSONG SECTION

3.102 Laundry activities in front of a T-shaped dwelling with a covered entrance.

3.103 Laundry and social activities in front of a fenced T-shaped dwelling with a covered Entrance, located on a busy pedestrian and vehicular route.

3.104 Laundry and cooking activities in front of a L-shaped dwelling with a covered entrance along a busy pedestrian pathway.

3.105 Laundry activities in open private spaces with trees in front of a cluster of L-shaped and rectangular buildings.
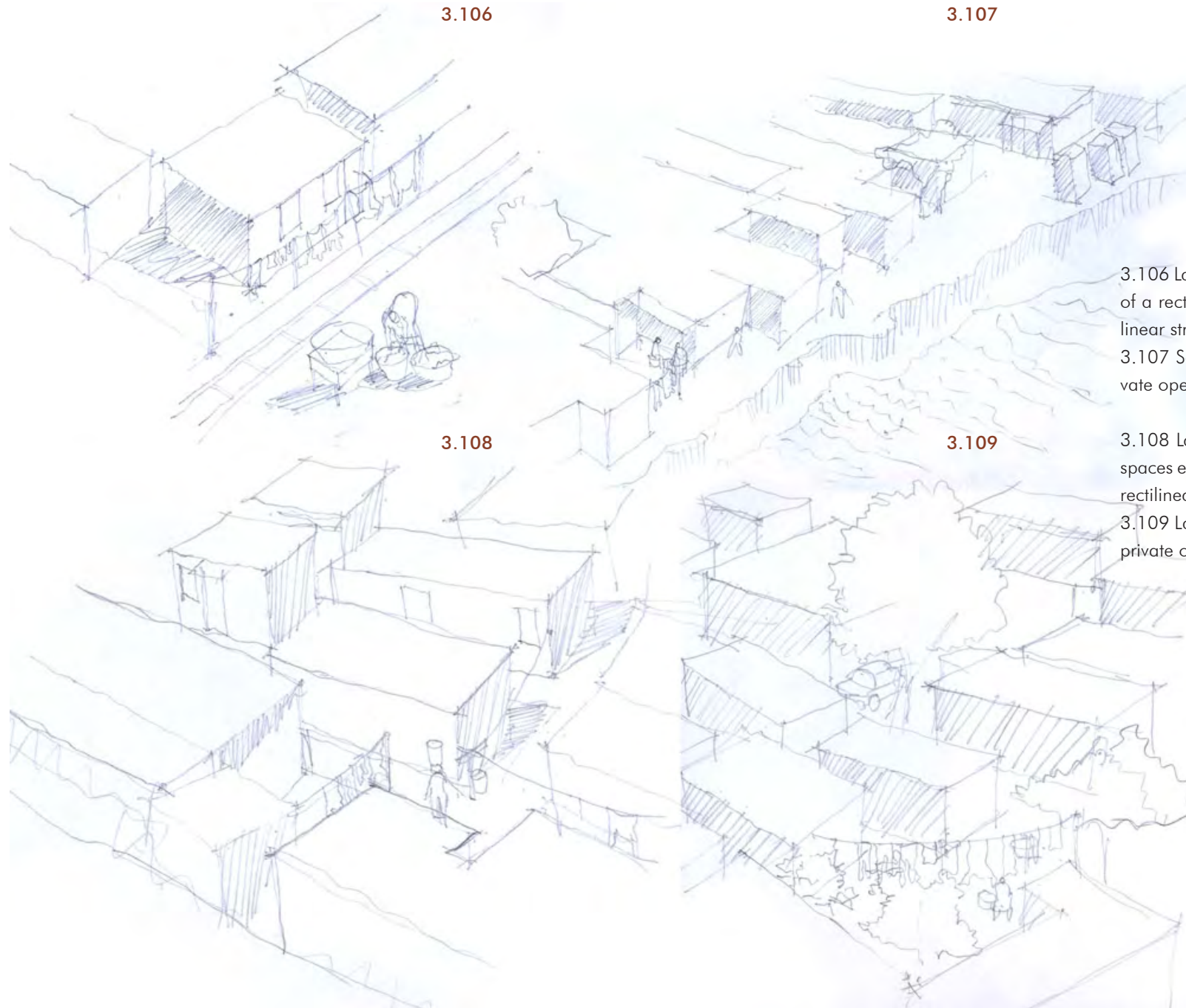
3.106

3.107

3.106 Laundry activities in an open space in front of a rectangular corner building which is part of linear street edge.

3.107 Social activities in shaded pockets of private open spaces along a pedestrian pathway.

3.108

3.109

3.108 Laundry activities in front of central open spaces enclosed by buildings of different sizes and rectilinear shapes.

3.109 Laundry activities in front of a tree-shaded private open space linking to other open spaces.

CONCLUSION:
Design problem

The analysis reveals that over-development without planning has caused overcrowding, inadequate social and economic infrastructure and services and consequently poor living conditions in informal settlements. The spatial analysis also shows that in some instances there is insufficient spatial threshold to separate one spatial domain from the other.

It is also clear that the lack of clean and quality urban open spaces in Khutsong Section limits the potential for more relationship-building activities to occur. Strategic addition of urban, landscape, and architectural elements and systems can strengthen the spatial structure of Khutsong Section to ensure an urban fabric that encourages and supports more relationship-building activities.

The following section will delve into proposed systems, spatial elements, and activities that may place Khutsong Section in a strategic position to be a settlement that has growing relationship-building activities which are integrated into economically and environmentally sustainable development.

2.4 A VISUAL-SPATIAL DESIGN INVESTIGATION
INTRODUCTION

Previous components of this research aimed to provide appropriate understanding, required to enable the design and formation of spatial structures that enhance social relationship-building activities in African informal settlements. This understanding that leads to a design proposal has its focus on the connection of enclosed spaces and open spaces around buildings, of the chosen study area of Khutsong Section Informal Settlement located in Ivory Park, Midrand, Johannesburg, Republic of South Africa (*see Addendum 3*).

The research method employed to address the design problem discussed in Chapter 3 is predominately reliant on visual analytic activities, using sketches to explore different spatial arrangements that foster spatial connectivity and encourage social activities. The research will utilise narrative diagrams, drawings, photographs and models as tools for imaging, presenting and testing the research. This will involve the testing of appropriate space. Cross-section drawings shall be used to investigate different spatial structures, because they can effectively illustrate how social connections are interconnected with the space of places and space of flows. **The visually-based investigation will be informed by the theoretical context in Part 1, the precedent studies in and the site analysis of the study area in the previous sections of Part 2.**

4.001 Khutsong Section is strategically located in an area with good vehicular access and transportation networks.
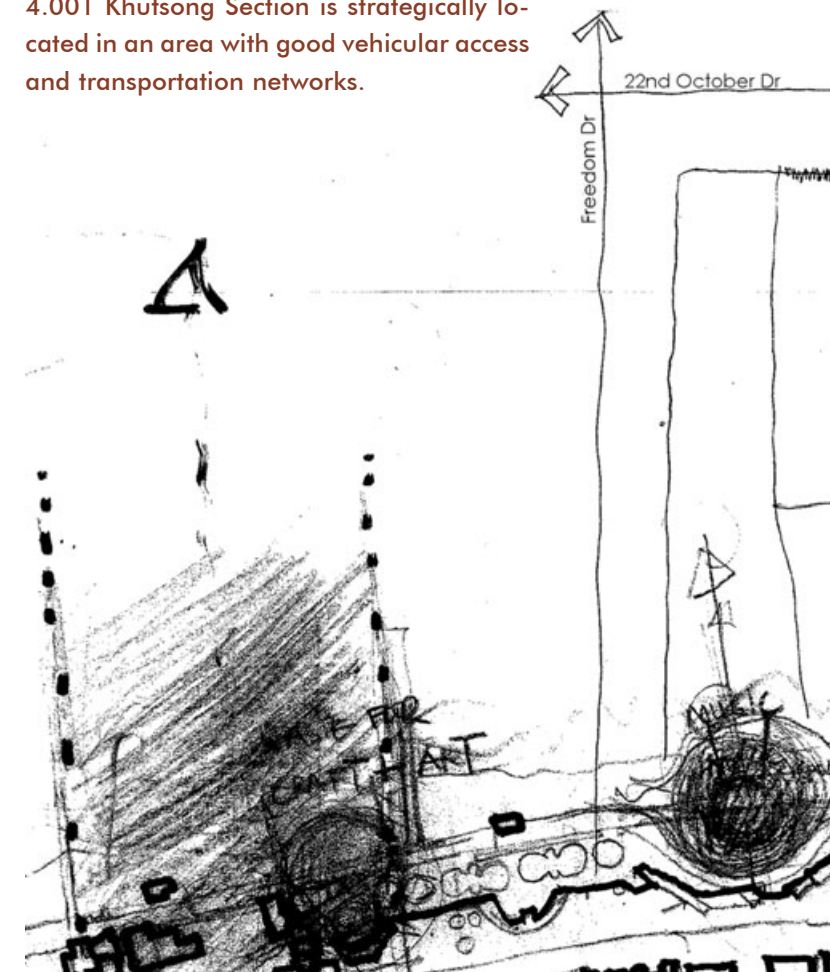
A VISUAL-SPATIAL INVESTIGATION THROUGH DRAWINGS AND COMPUTER-GENERATED MODELS
URBAN SCALE EXPLORATION
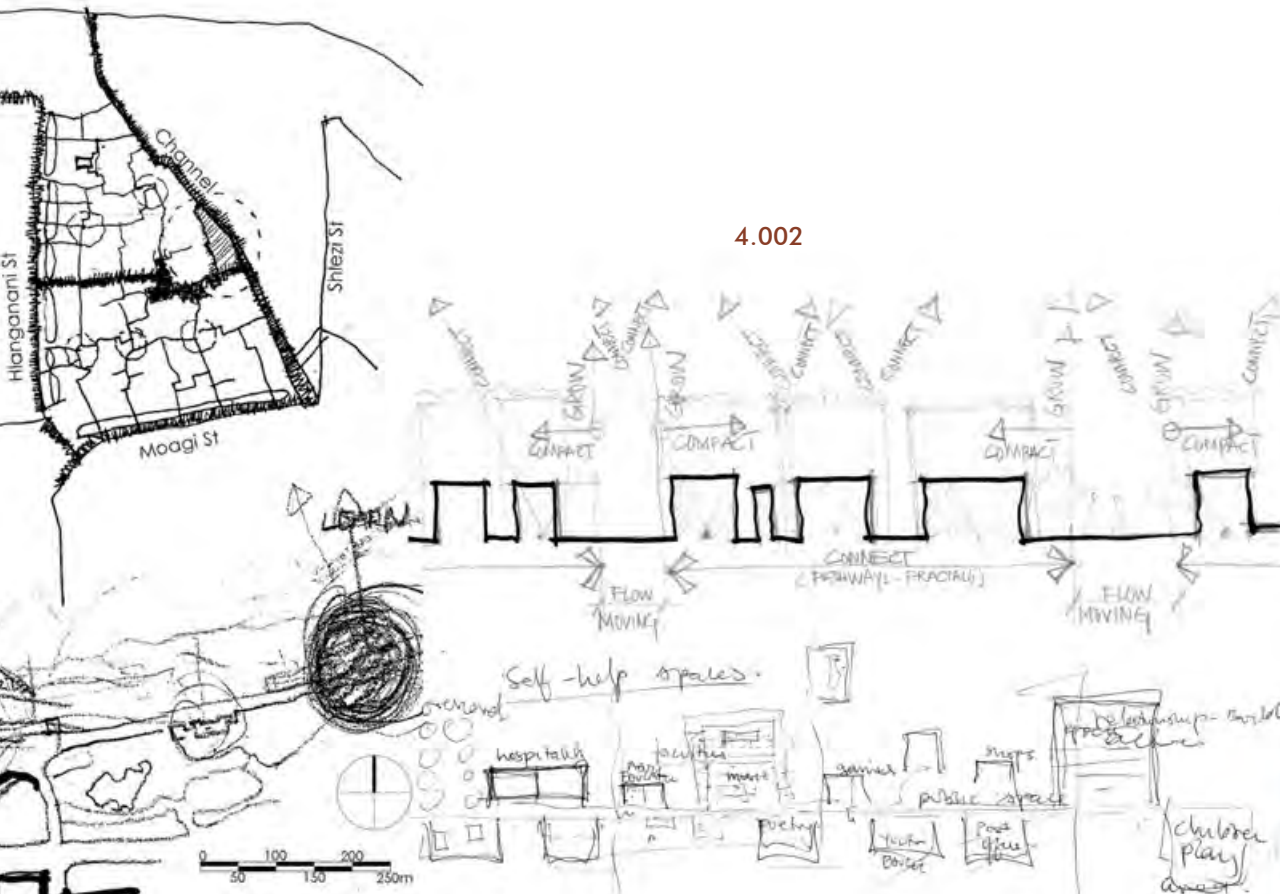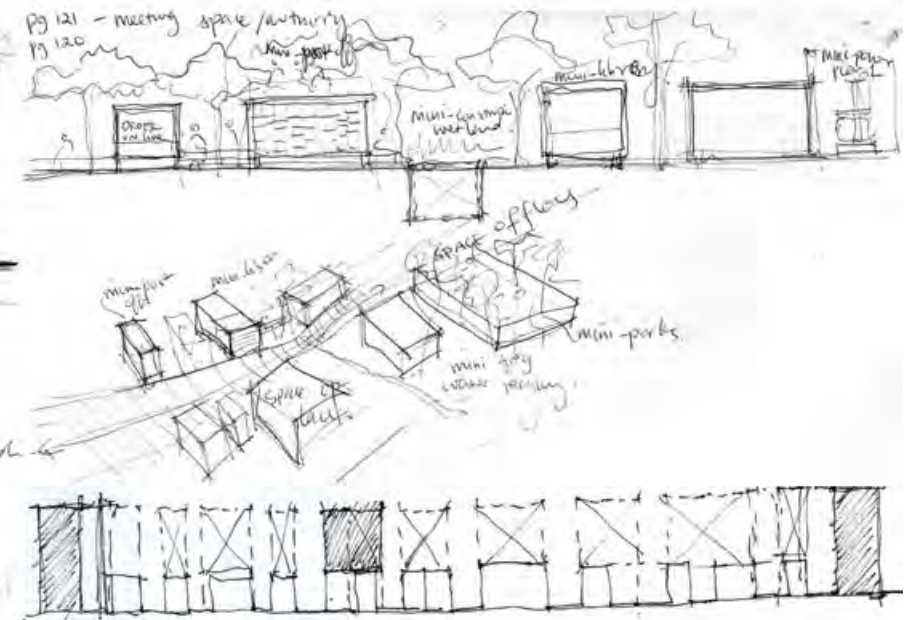
4.002 The main design strategy is to create transitional spaces that will limit the horizontal growth of Khutsong Section in order to encourage vertical growth to achieve high densities and a more liveable settlement.

4.003 Once vertical growth occurs, open pockets of spaces around buildings can be used for pocket parks, recycling stations, and economic and social activities.

4.002

4.003

4.004 Once vertical growth occurs, open pockets of spaces around buildings can be used for pocket parks, recycling stations, and economic and social activities.

4.005 The need exists to limit horizontal growth in order to preserve open public spaces. Hence, vertical growth may be encouraged to help achieve high residential densities while ensuring that there are sufficient amenities, services, and infrastructure for all households.

4.006 Inserting a two-storey linear urban spatial spinal cord through the informal settlement as enabling infrastructure could allow the easy flow of pedestrians, goods and services while strengthening the spatial structure and legibility of the urban fabric.

4.004
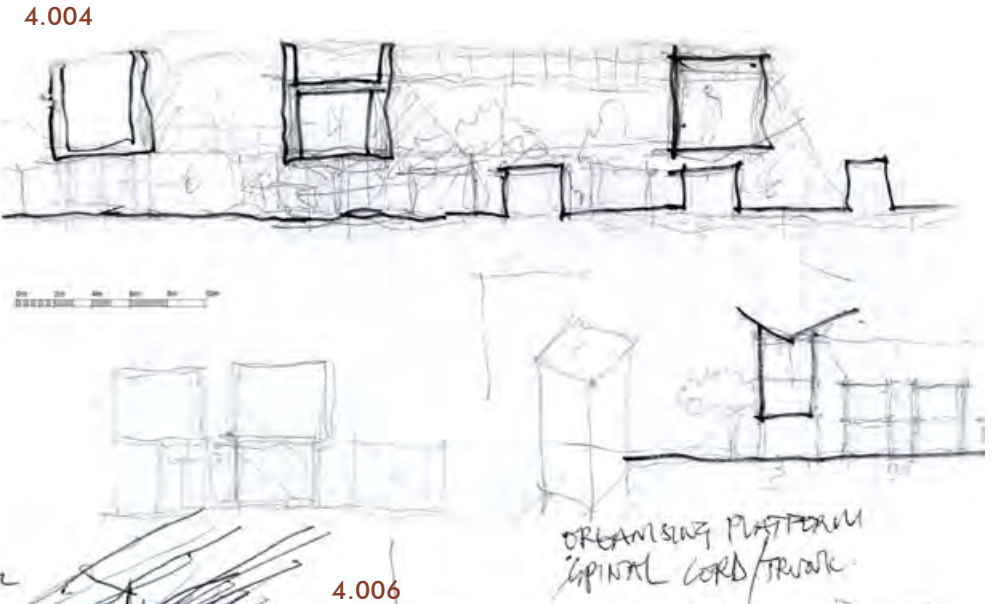
4.005
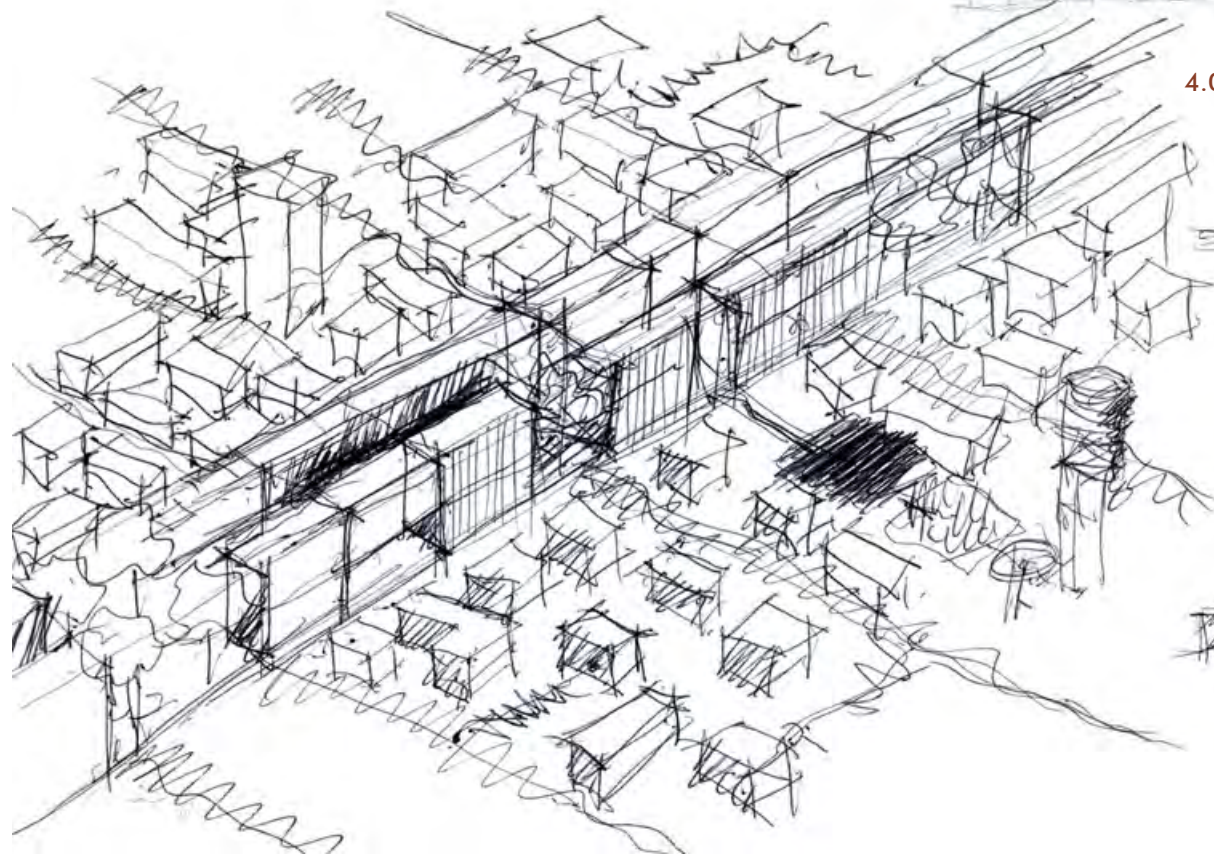
4.006

4.007 Vertical spatial growth could also allow more landscaping to be inserted into the open public spaces around existing houses. By adding trees, retention ponds, constructed wetlands and paving, open spaces may improve the quality of the urban space in general.

4.008 High-density housing may be achieved along with high-quality urban spaces by articulating open spaces around buildings.

4.009 This design intervention aims to create a fine-grained fabric for the informal settlement, while introducing spatial thresholds that define the change from public spatial domain in open public spaces and streets, to semi-public and semi-private spaces that lead to individual houses.
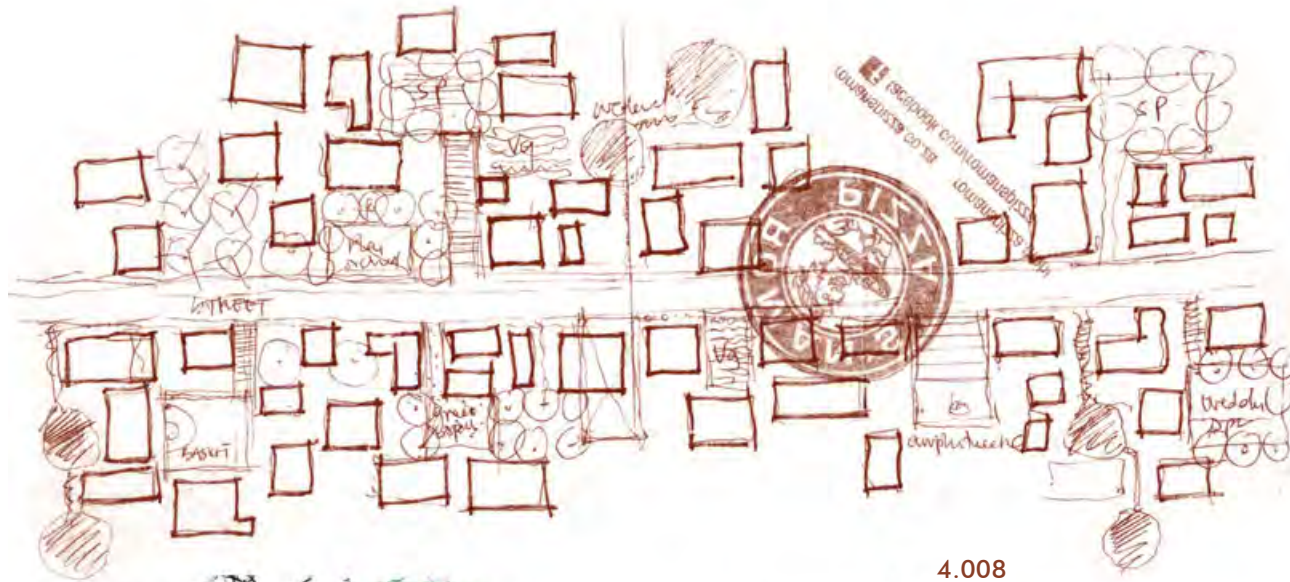
4.008
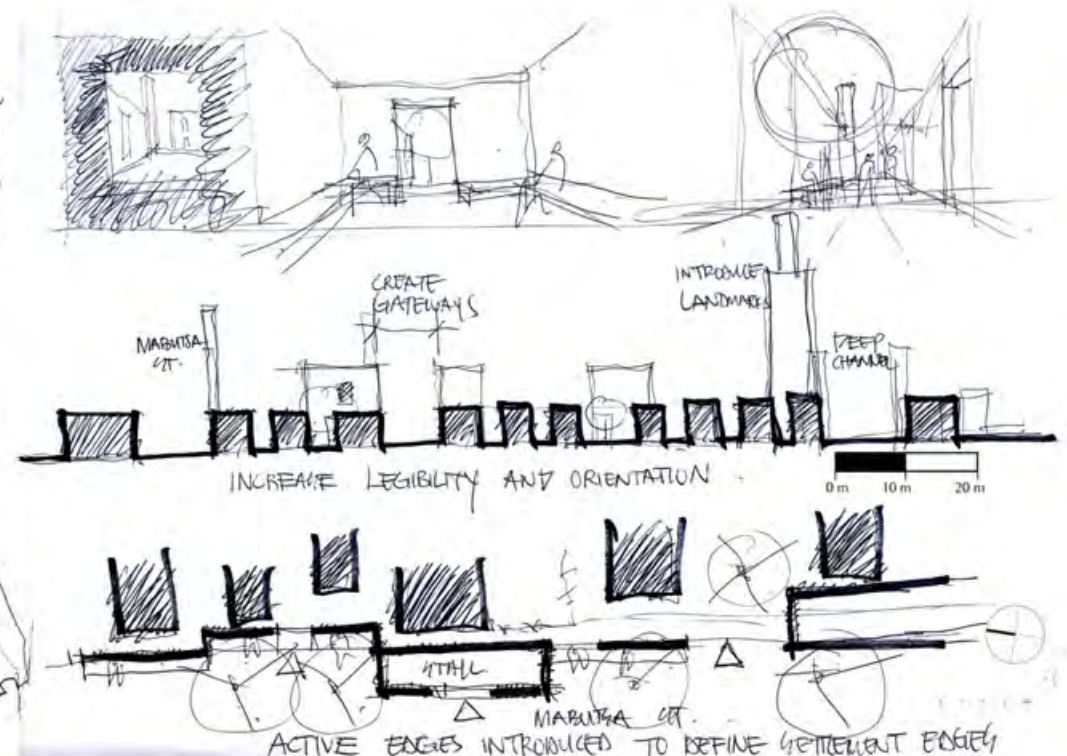
4.009

4.010
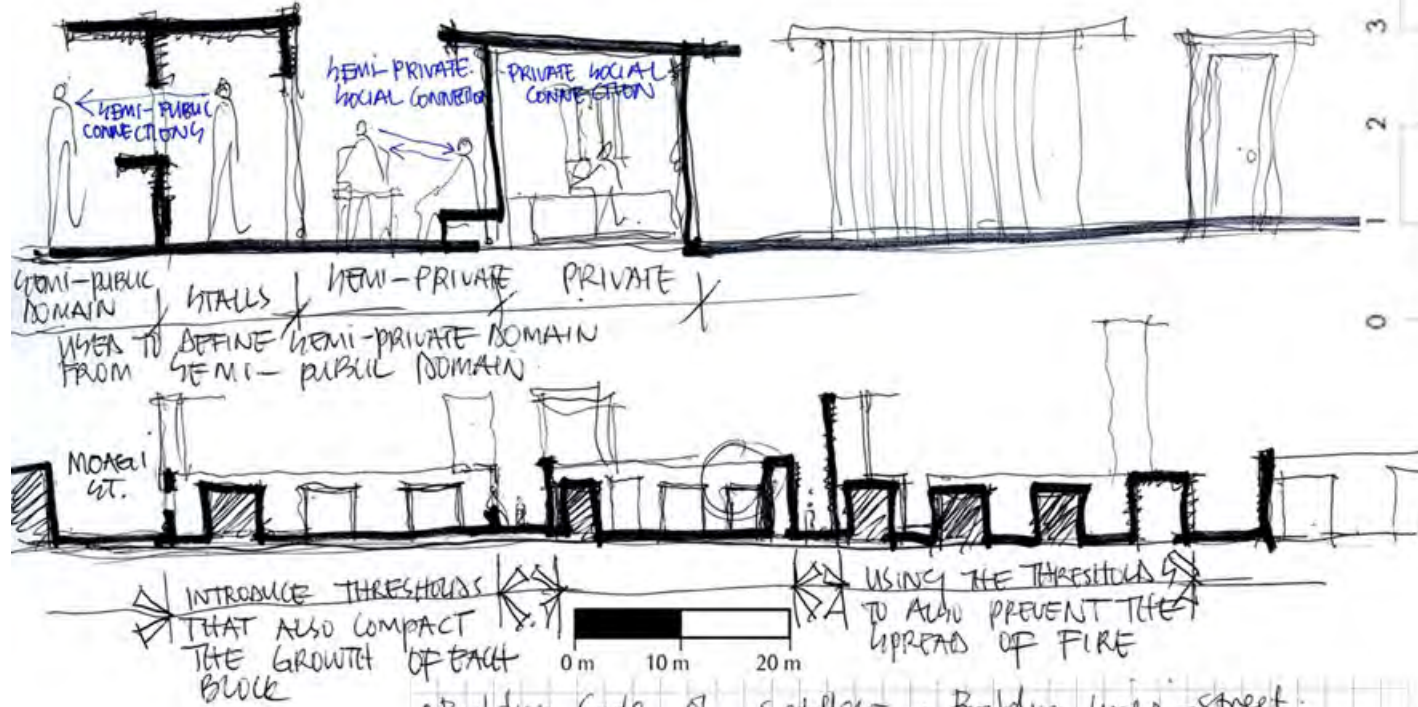
4.011a
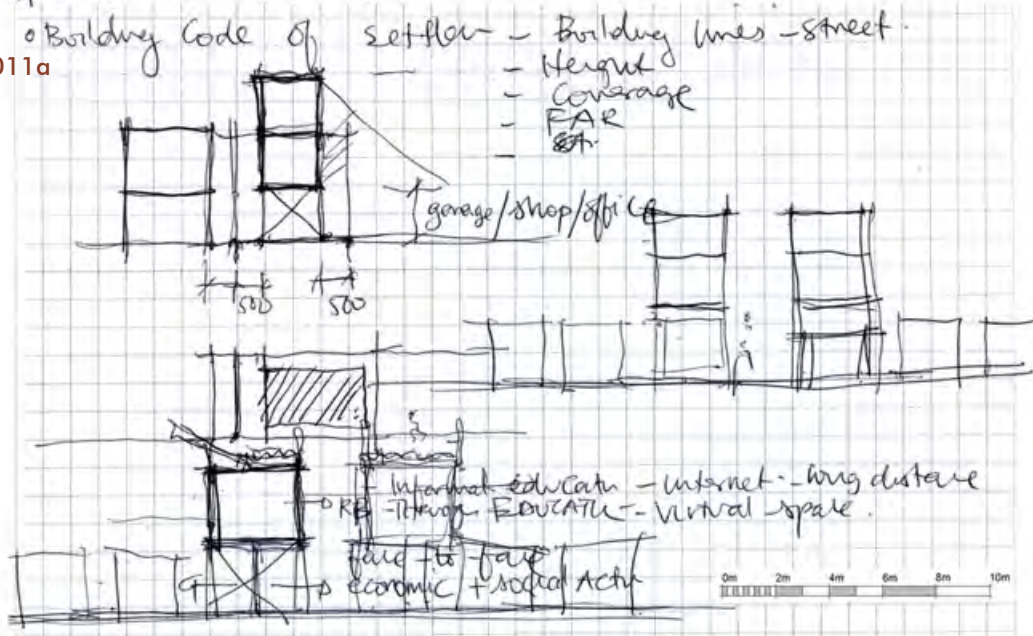
4.010 The analysis of the spatial structure of Khutsong Section shows that there is a need to insert spatial thresholds in some areas to dignify the transition from one spatial domain to the next.

4.011a–4.011b Developing densification and upgrading scheme for informal settlements with a site-specific building code for Khutsong Section could ensure sustainable urban regeneration.

Developing densification and upgrading scheme for informal settlements with a site-specific building code for Khutsong Section could ensure sustainable urban regeneration.

4.011b

4.012 This layout highlights existing pathways, with inserted rectangular forms imitating the existing urban fabric of Khutsong Section informal settlement. The aim of this approach is to achieve a subtle urban spatial quality using the existing spatial structure.

4.013 This layout shows the strong visual impact of inserting new buildings (coloured in red and orange) along the street edges of clusters. This solution is intrusive because the size of proposed buildings dominates the existing spatial structure and will require that some of the existing houses be demolished to make enough space for the intervention; therefore further design explorations will aim for more subtle design interventions.

4.014

4.015
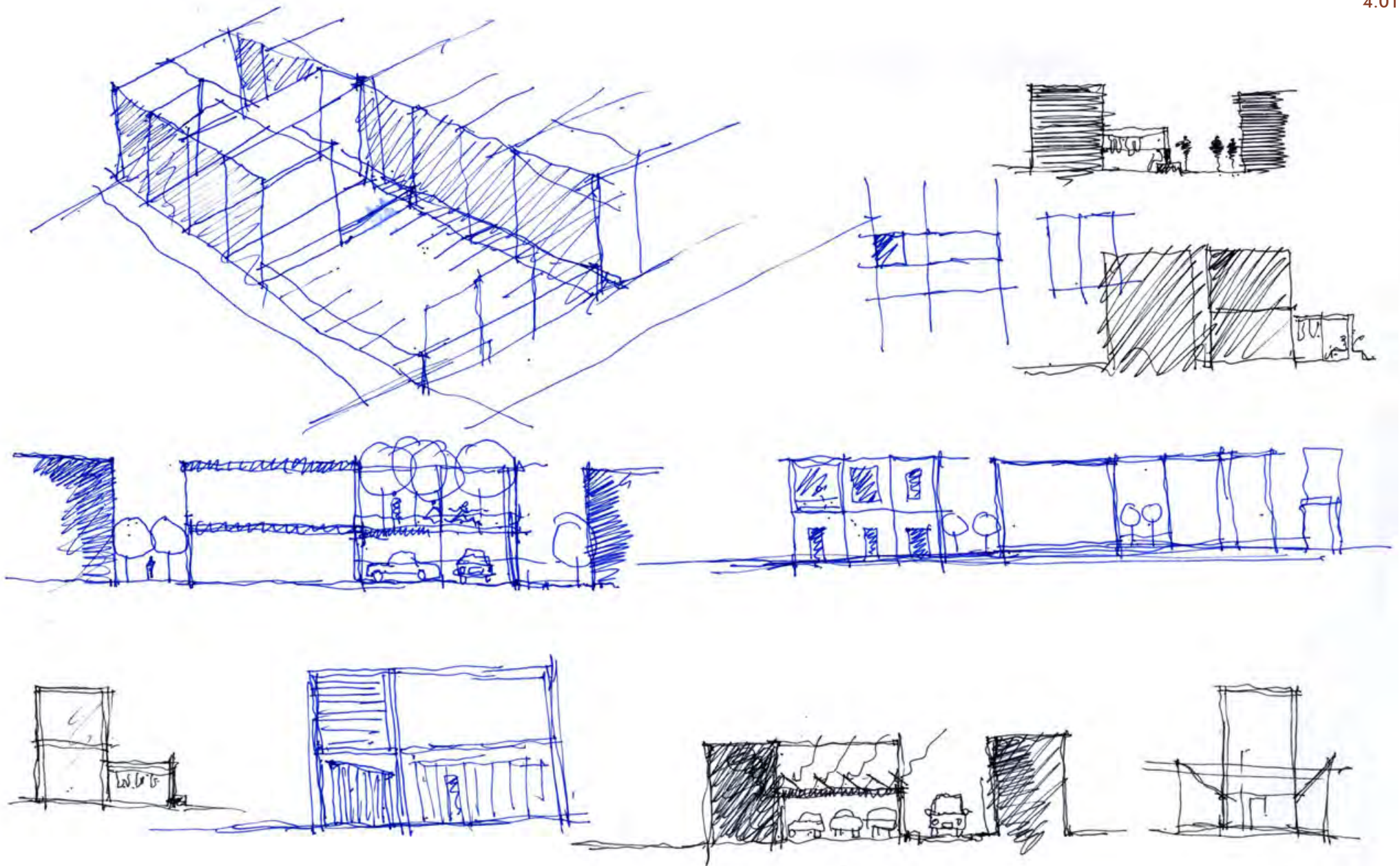
4.014 In this solution, double-storey buildings that accommodate educational and economic activities are inserted along the street at the centre of the settlement, after which small buildings are inserted at existing dumping sites. Trees are also inserted along existing streets to improve the quality of public spaces.

4.015 This design option shows the spatial effect of adding a second fractal pathway above the existing urban fabric. This pathway is used for urban agriculture and the harvesting of solar power and rainwater, a solution which is also visually invasive in the existing urban fabric.

4.016 In order to avoid invasive forms that visually dominate the existing urban form, a fragmental approach is used in this design option. Pockets of open spaces and new building forms proportional to the existing ones are inserted in a manner similar to the existing urban layout to achieve a subtle new development. Forms are juxtaposed by imitating the way residents add new houses within the informal settlement. The design focuses on improving mainly the open urban spaces.

4.017

4.018

LARGE SHADE TREES ARE LOCATED ON SW, W & NW SIDES OF BUILDINGS. AND OUTDOOR SPACES TO SCREEN HOT AFTERNOON SUN.

PLANT MATERIAL USED FOR FIELDWARE

CENTRAL SPACE

PLANT MATERIAL USED FOR LINKAGE.

4.017–4.018 These drawings illustrate the visual and spatial impact of proposed forms and elements (rendered in grey) in relation to the existing building footprints (rendered in black).
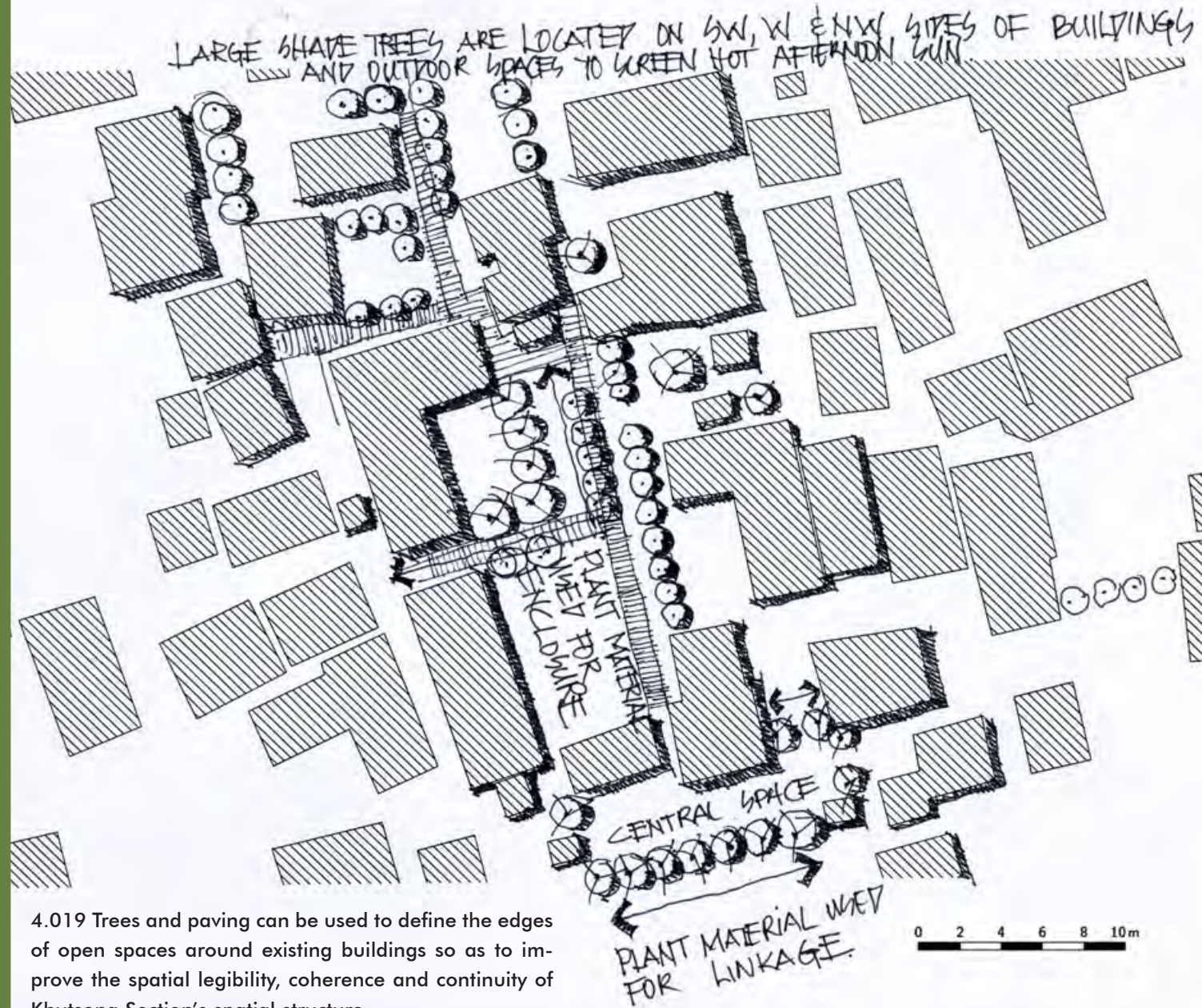
4.019 Trees and paving can be used to define the edges of open spaces around existing buildings so as to improve the spatial legibility, coherence and continuity of Khutsong Section's spatial structure.

4.020 Allocating individual plots (coloured in yellow, blue and green) based on the existing public open spaces, pedestrian and vehicular routes (coloured in black), and open semi-private spaces (coloured in red) can help release the potential for self-improvement of houses and open spaces.

0 m   10 m   20 m
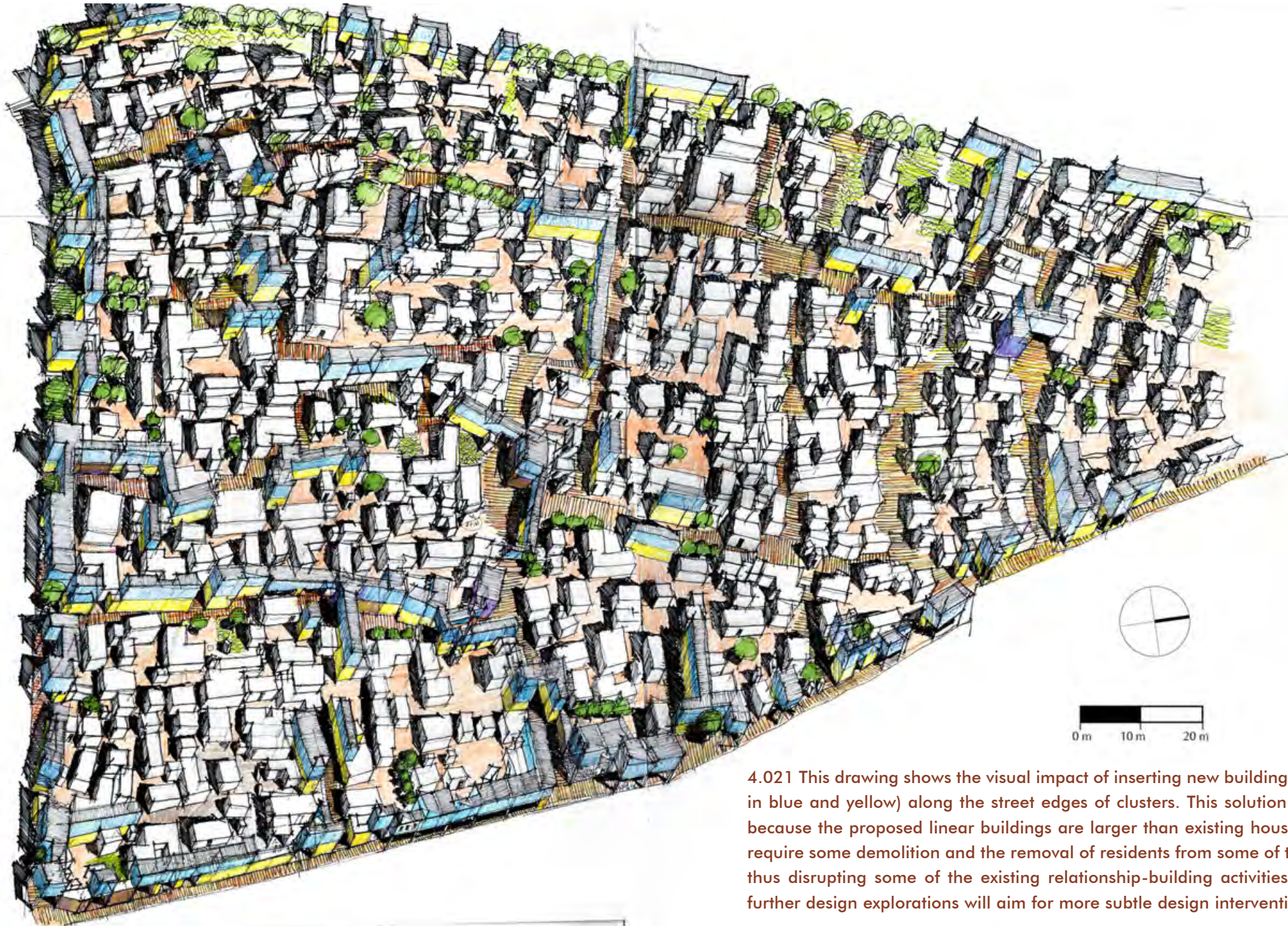
4.021 This drawing shows the visual impact of inserting new buildings (coloured in blue and yellow) along the street edges of clusters. This solution is invasive because the proposed linear buildings are larger than existing houses and will require some demolition and the removal of residents from some of the houses, thus disrupting some of the existing relationship-building activities; therefore further design explorations will aim for more subtle design interventions.

add public facilities, improve the quality of outdoor spaces, and define the edges of streets

4.022 Intervening only in existing open spaces so as to add public facilities, improve the quality of outdoor spaces, and define the edges of streets and public spaces can be achieved using and articulating minimally invasive urban forms and elements.

4.023 This option aims to insert two-storey buildings as fragments in different open spaces and along busy streets, while also inserting gathering spaces and service systems in between existing structures in a more context specific manner.
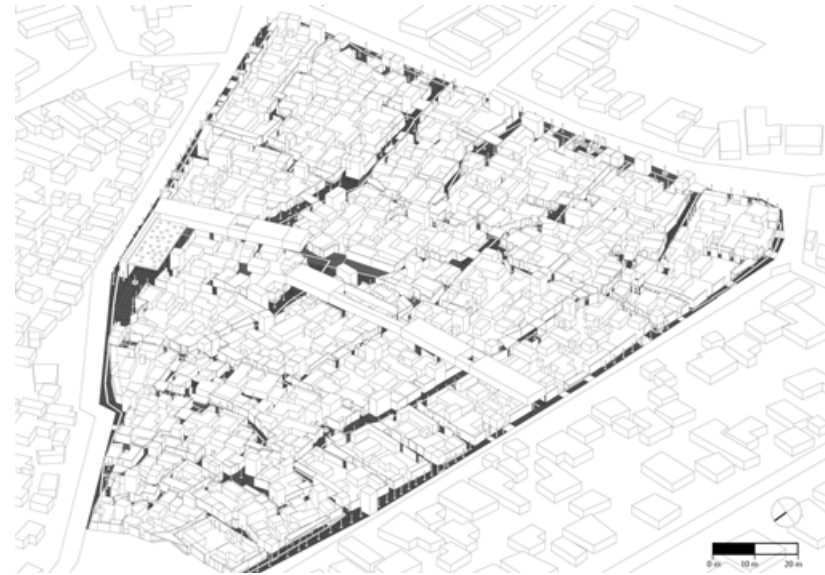
4.024–4.027 The added buildings and urban elements are responsive to site-specific conditions of the streets, open spaces and buildings of Khutsong Section. Further articulation of the proportions and sizing of the proposed forms can improve the legibility and coherence of the settlement.
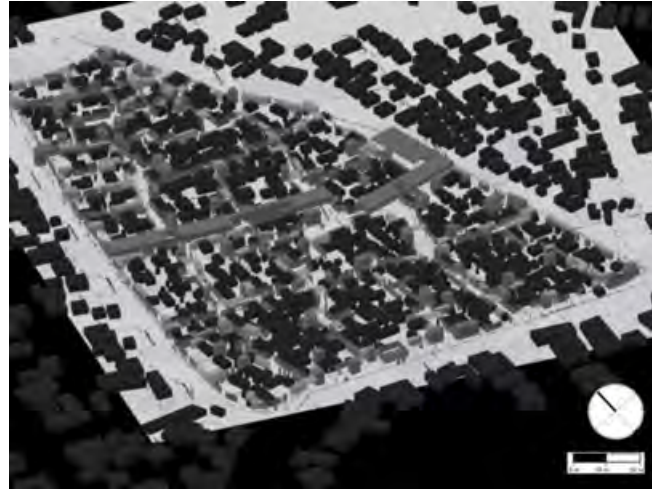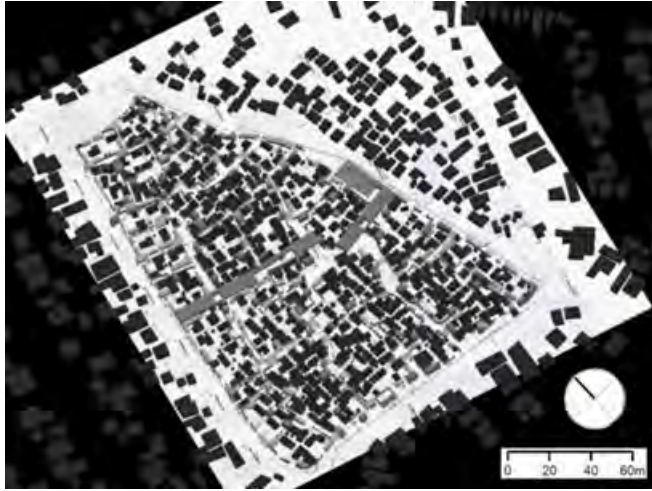
4.028–4.031
Proposed urban elements and forms (rendered in grey) are related to existing buildings to strengthen the enclosure of open spaces, legibility, coherence, continuity, complexity, memorability, tidiness, linkages and transparency between buildings, open spaces and streets.

4.032–4.033
This design option shows the effect of adding a second fractal pathway above the existing urban fabric. This pathway can be used for urban agriculture and the harvesting of solar power and rainwater. This solution is also visually invasive but creates spatial linkages, coherence and continuity in the existing urban fabric.

4.034
In this solution the double-storey buildings are inserted along the street located at the centre of the settlement and accommodate educational and economic activities. Small buildings are inserted on existing dumping sites. Trees are also inserted along existing streets to improve the quality of public spaces.

4.035 This design option shows the visual impact of the second storeys inserted over existing buildings.

STREET-SCALE SPATIAL EXPLORATION

Activities in space

4.036

4.037

4.038
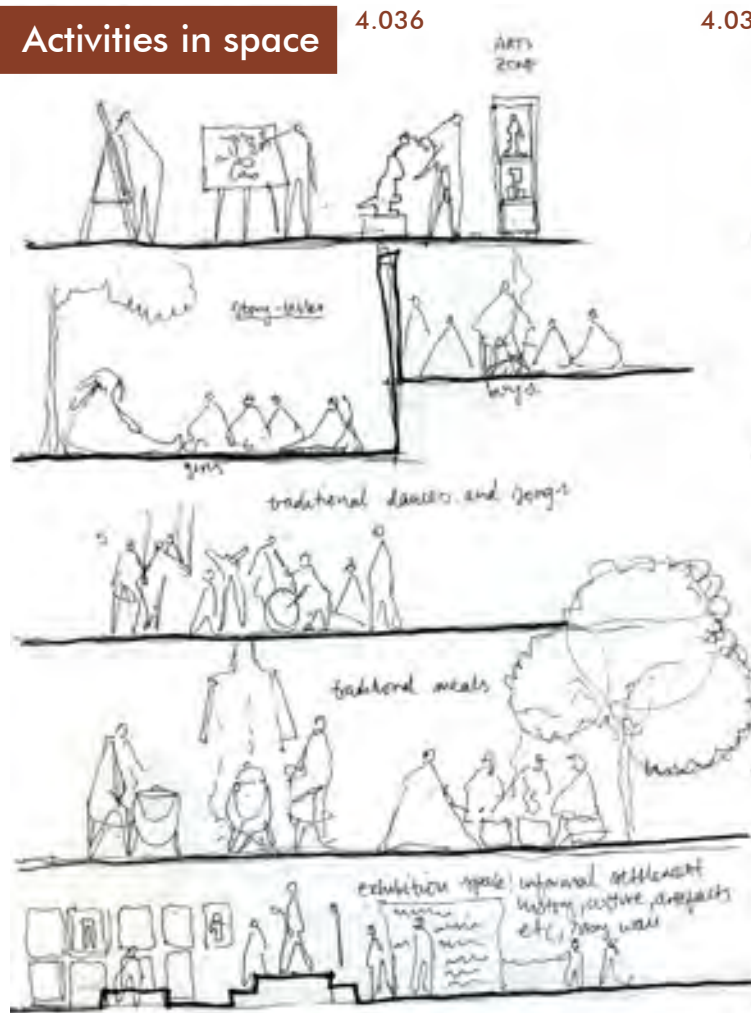
4.036 Activities like arts and crafts, storytelling, music, cooking, eco-learning, eco-entertainment and other cultural activities could be arranged in interconnecting spaces within the settlement.
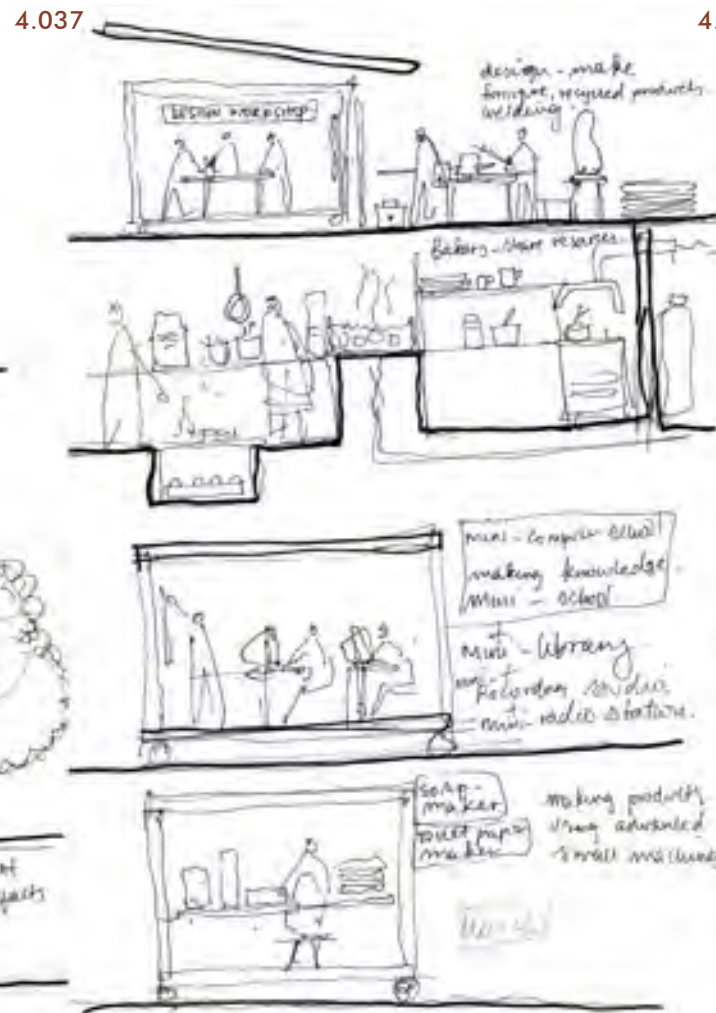
4.037 Retail activities could also be arranged in interconnecting spaces within the settlement.
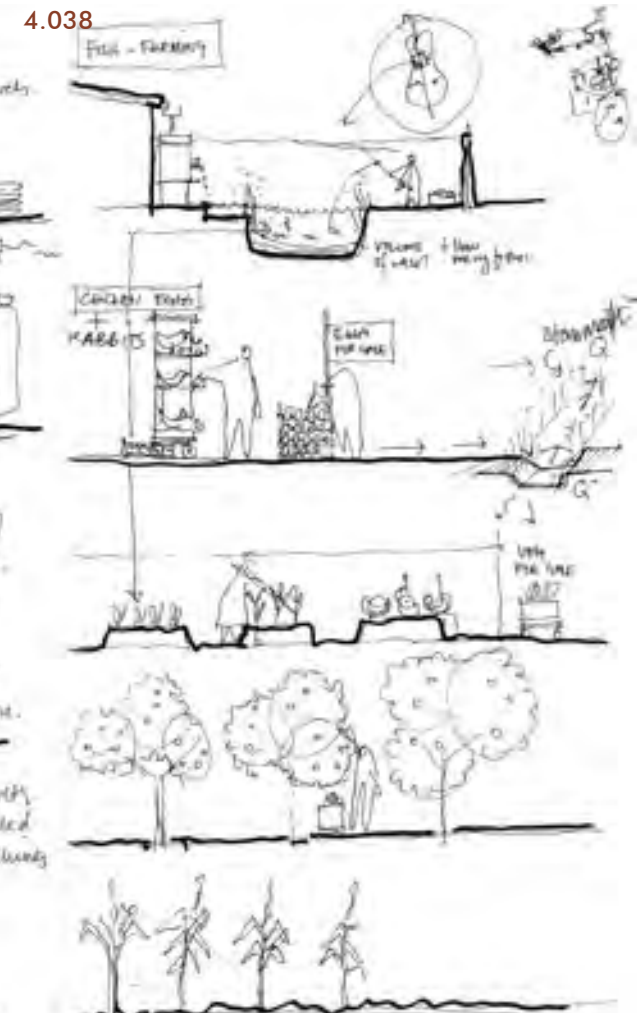
4.038 Urban agricultural activities could be arranged in interconnecting spaces within the settlement in a manner that improves urban spatial quality.
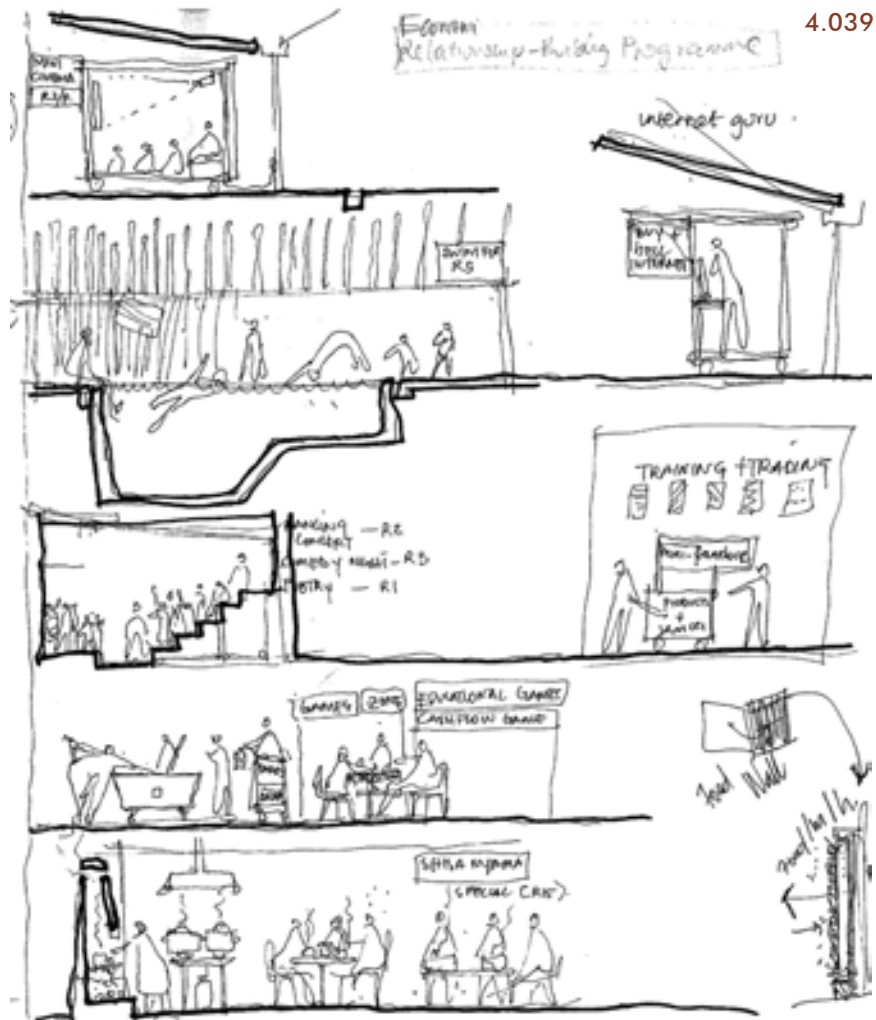
4.039 Sports and leisure activities could be arranged in interconnecting spaces within the settlement in a manner that improves the urban spatial quality of the settlement.
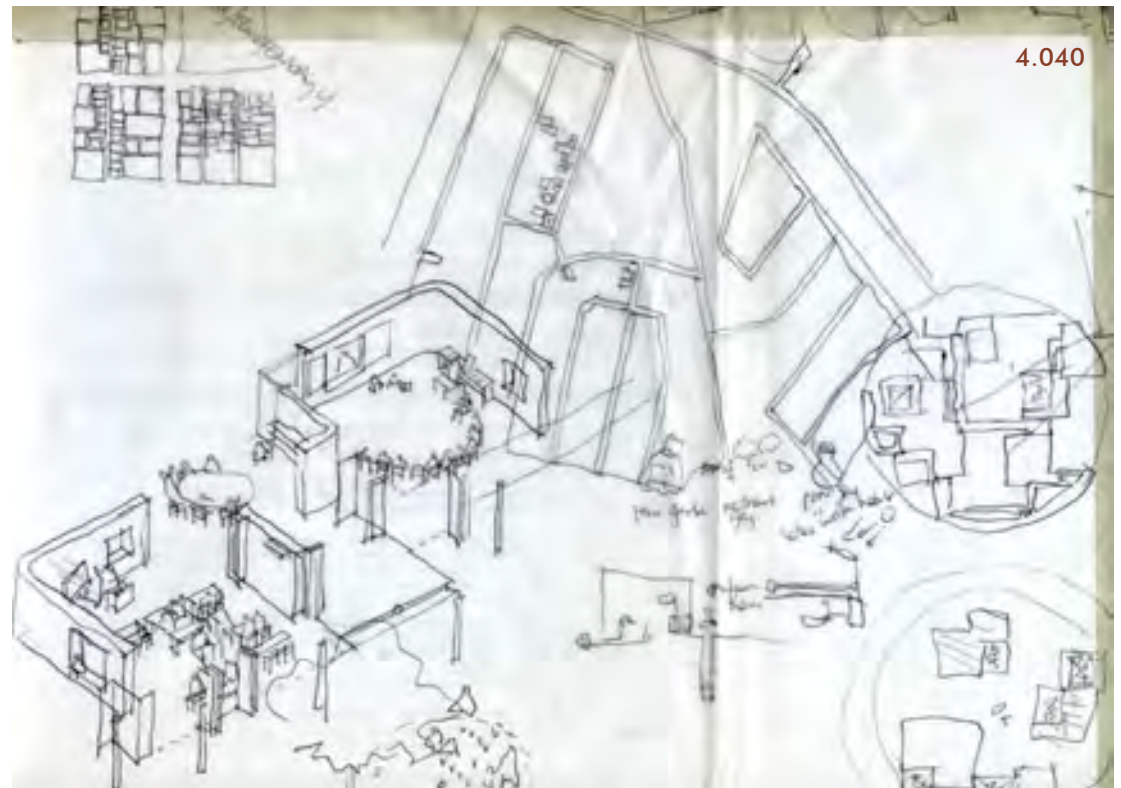
4.040 Vertical spatial planes, columns and trees could be used to create spaces where people can gather. Semi-enclosed spaces support semi-private and semi-public activities. Vertical spatial planes, columns and trees should be articulated by inserting openings, seating and finishes that serve as means to filter private and semi-private activities from public activities.

4.041
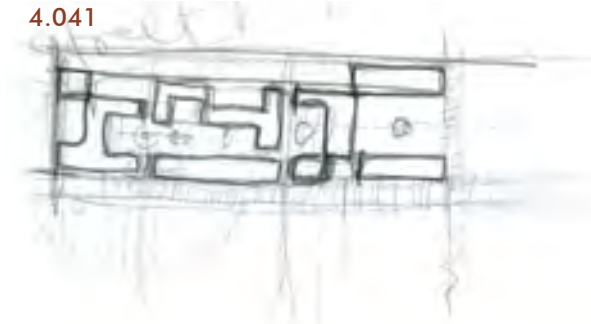
4.041 Open spaces in the settlement can be designed to integrate social activities with micro-scale economic activities.

4.042 Community gathering spaces can be created by manipulating vertical spatial elements and trees to provide enclosure. The horizontal spatial plane can be articulated with seating, steps and platforms.

4.042

SNOOKER   MLABALABA BOARD   TV SCREEN
GAMES, CARDS, DICES.

Open spaces in the settlement can be designed to integrate social activities with micro-scale economic activities.
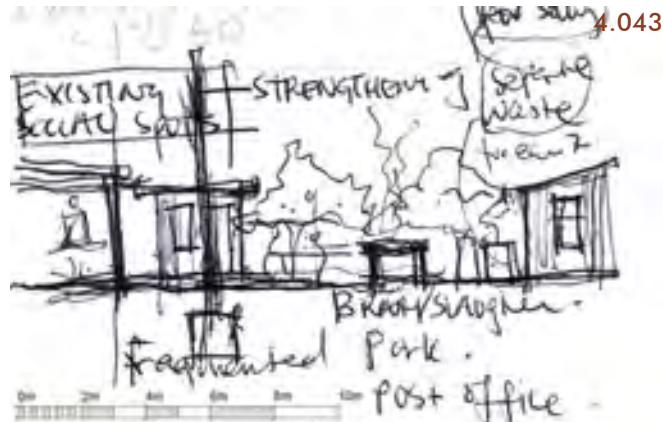
4.043

4.044

4.045
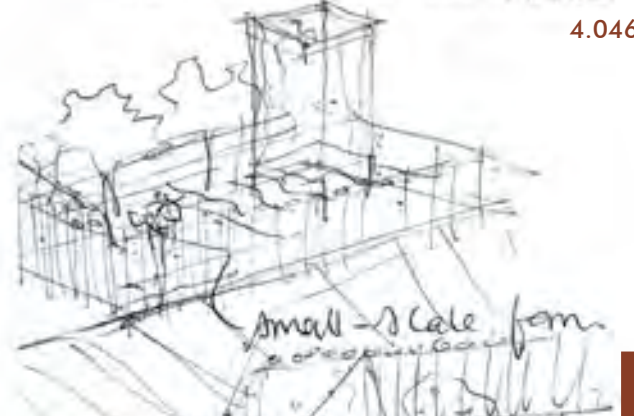
4.046

4.047

Spatial structure & theshold articulations

4.043–4.044

Vertical spatial planes could be inserted between existing semi-private social gathering places in order to screen noise and provide a degree of privacy from adjacent busy streets and open public spaces.

4.045–4.046

Linearly arranged trees, walls and other vertical physical elements can be used to enclose pockets of green and agricultural open spaces.

4.047

Adding first floor levels with balconies above existing dwellings in Khutsong Section can provide shaded spaces that can be used for social and micro-scale economic activities.

4.048

4.049

LIGHT

4.050

4.051

4.052

WALKWAY

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4.048–4.052
Tidiness and memorability can be achieved by paving and adding seating, street furniture, vertical space-defining elements and trees in open spaces and streets of Khutsong Section informal settlement.

paving and adding seating, street furniture, vertical space-defining elements and trees
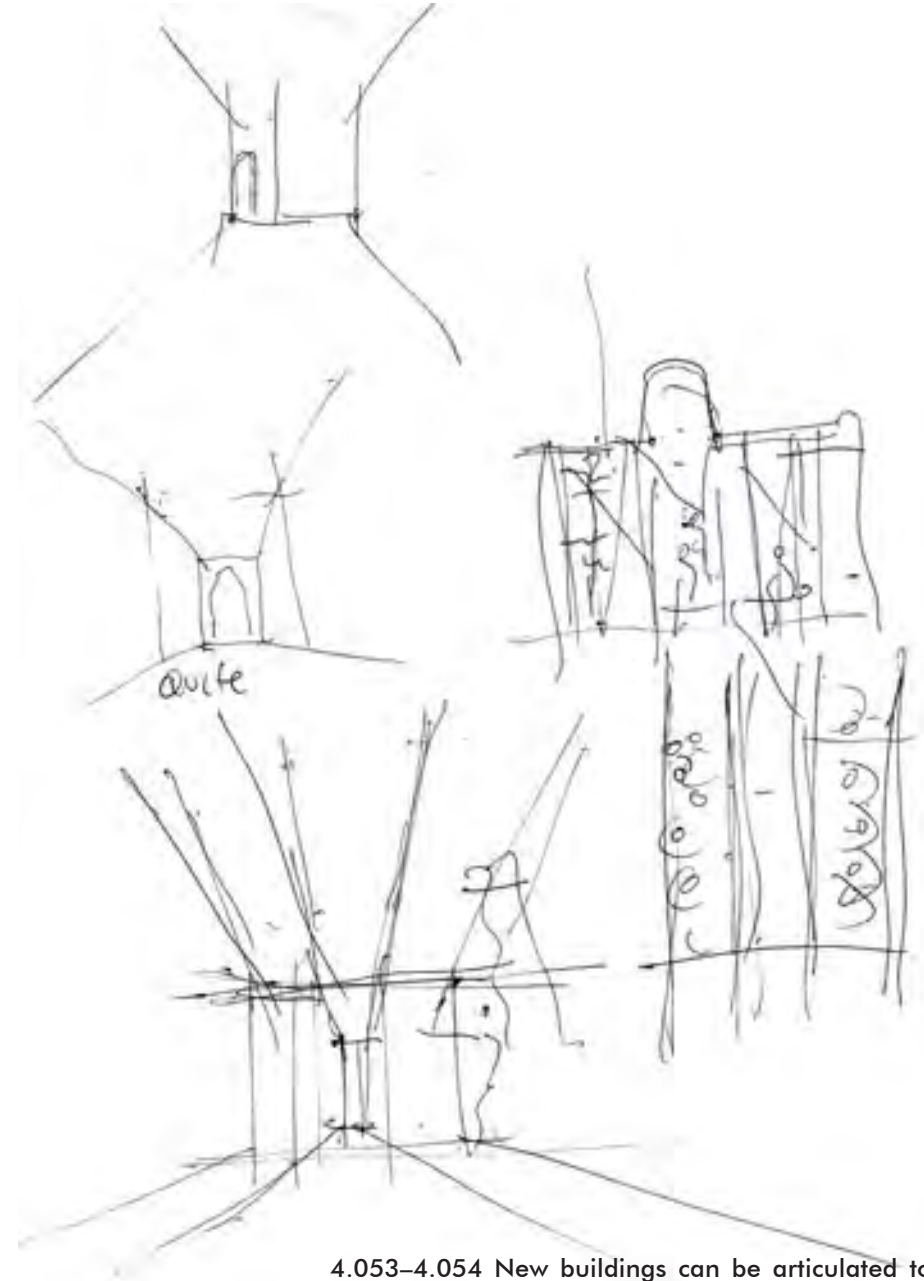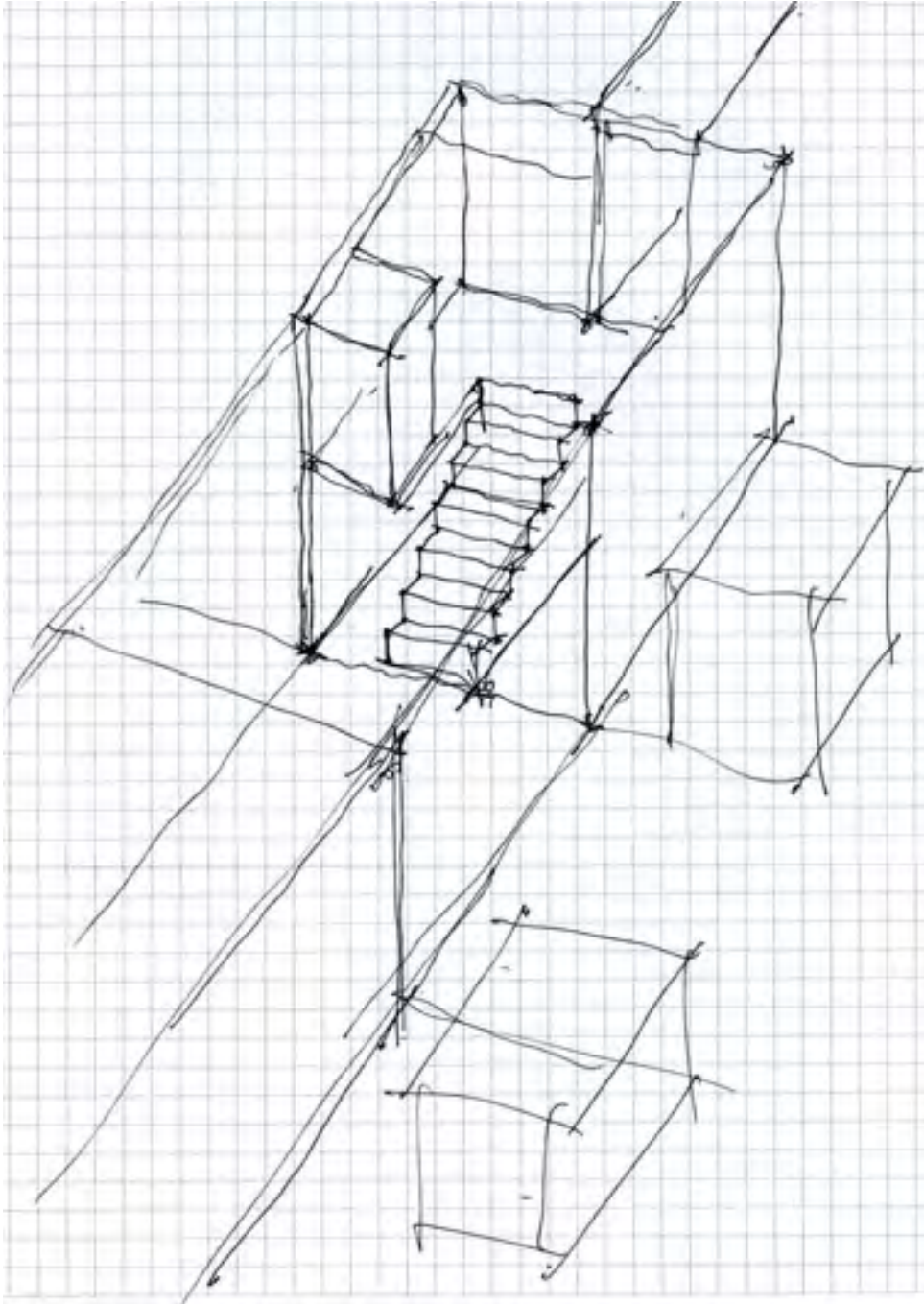
4.053–4.054 New buildings can be articulated to enclose urban spaces and frame openings to act as gateways that connect open spaces.

A variety of thresholds are inserted to separate semi-private activities from public activities.

4.055
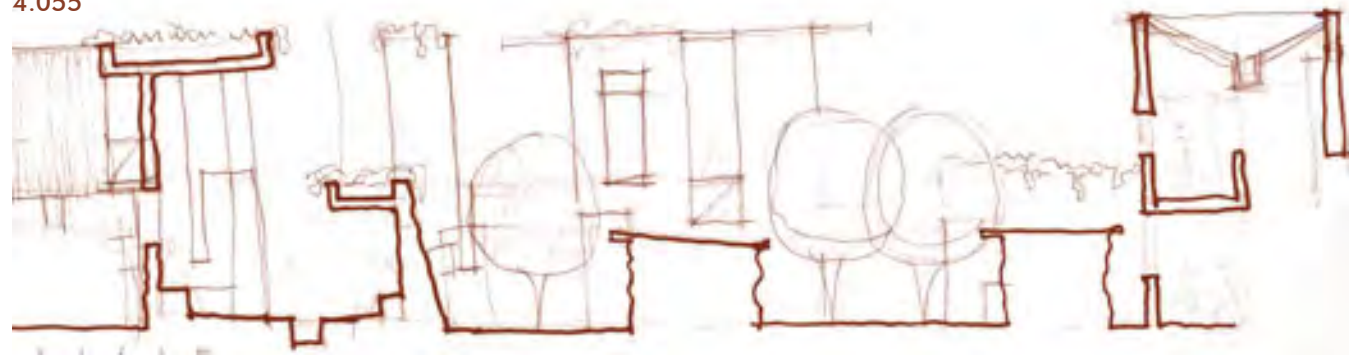
4.056
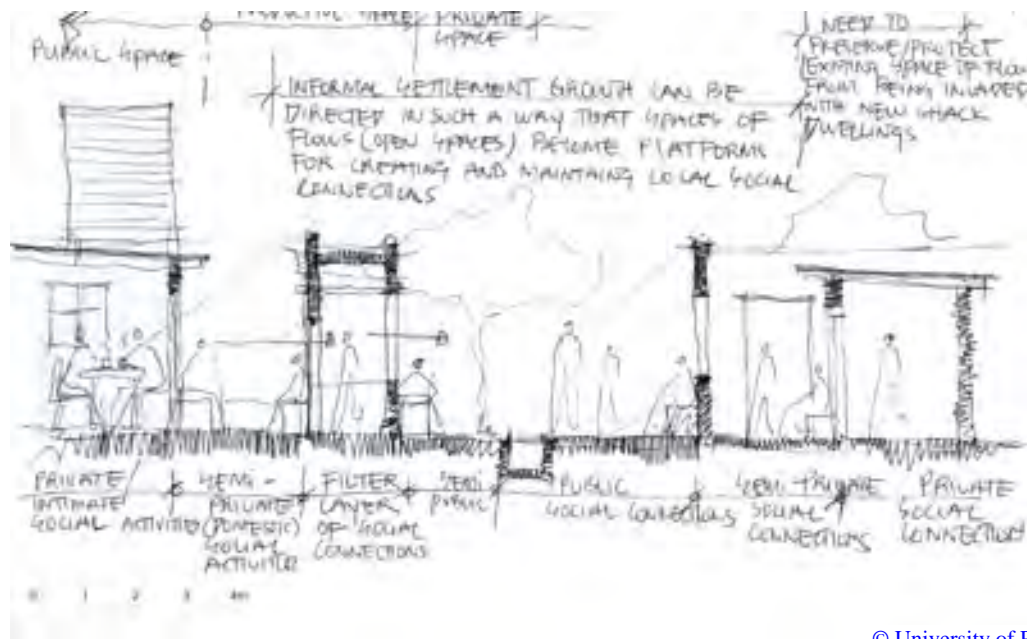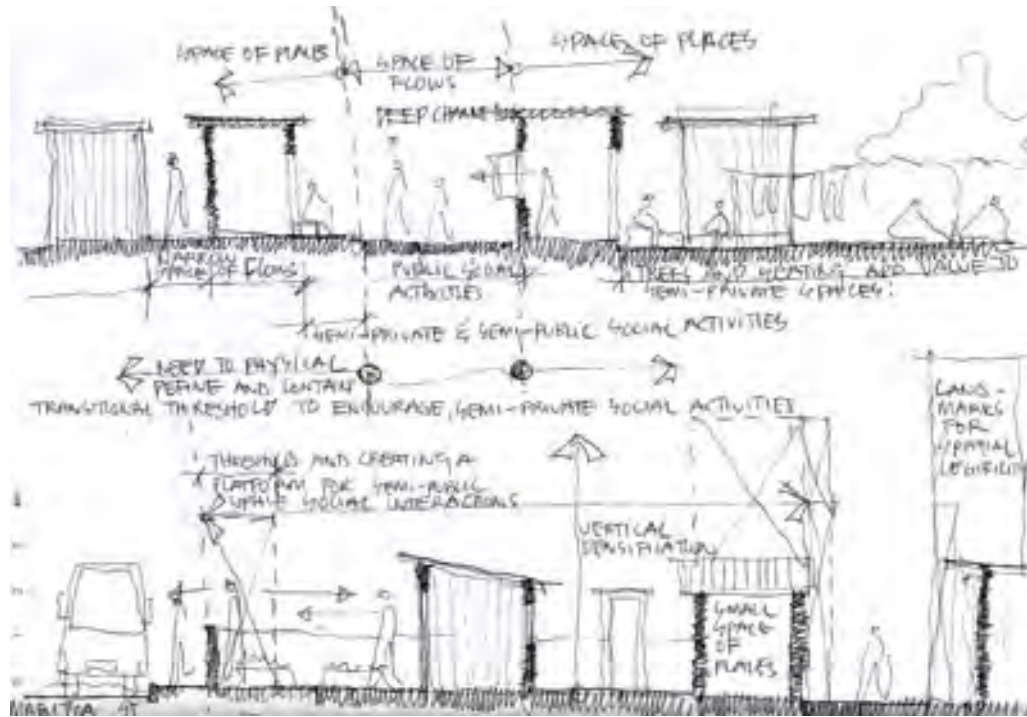
Small buildings and partially enclosed open spaces that are proportional to existing building forms are inserted in a manner similar to the existing urban layout to achieve a subtle new development.

4.055–4.058

In order to avoid invasive forms that visually dominate the existing urban form, a fragmental approach is used in this design option. Small buildings and partially enclosed open spaces that are proportional to existing building forms are inserted in a manner similar to the existing urban layout to achieve a subtle new development. Forms are juxtaposed by imitating the way residents add new houses within the informal settlement. A variety of thresholds are inserted to separate semi-private activities from public activities.

4.059
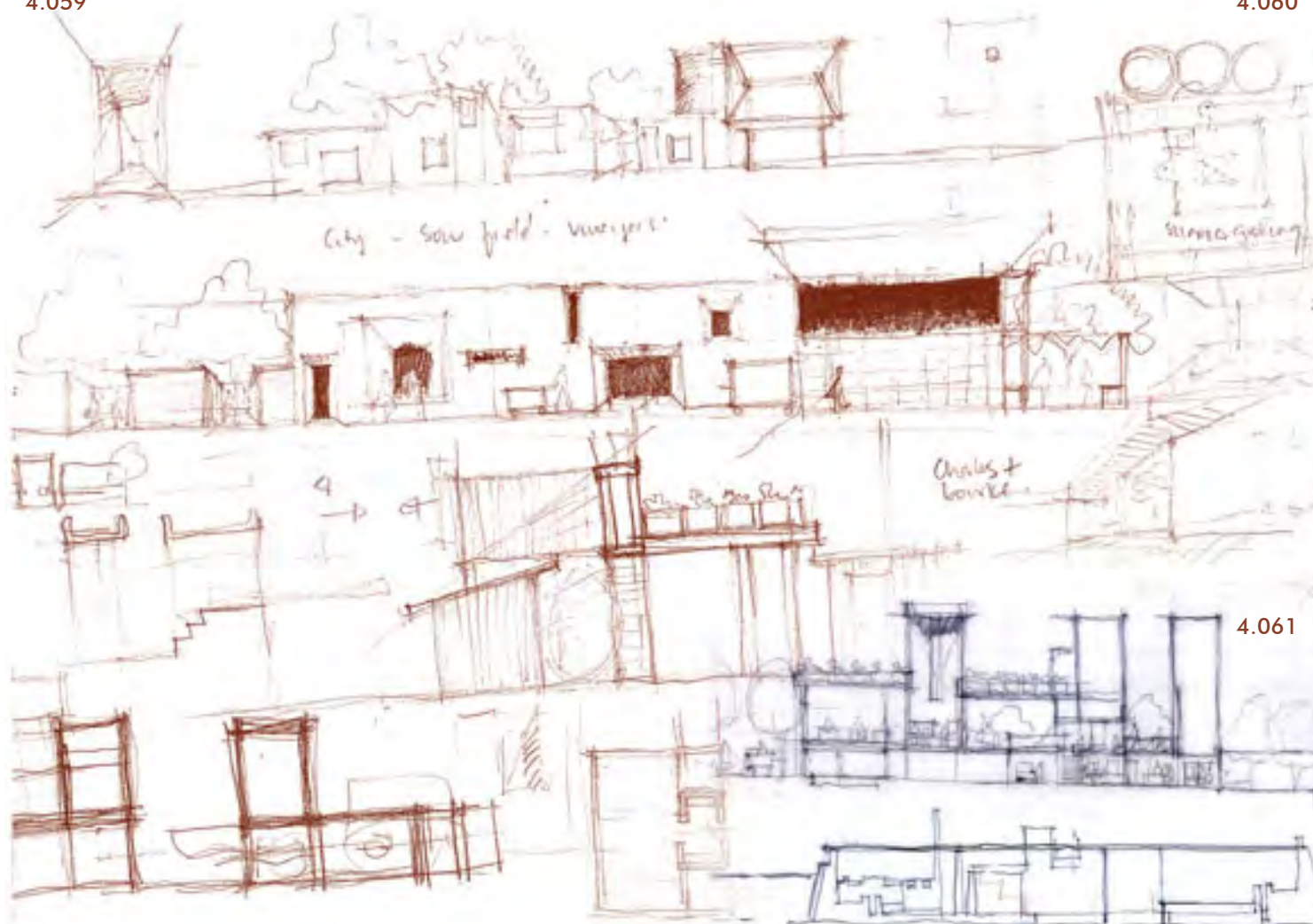
4.060
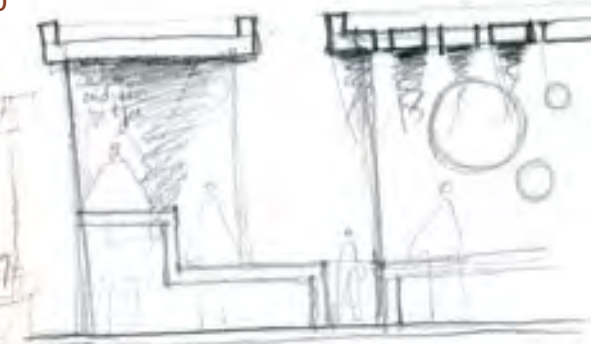
4.061
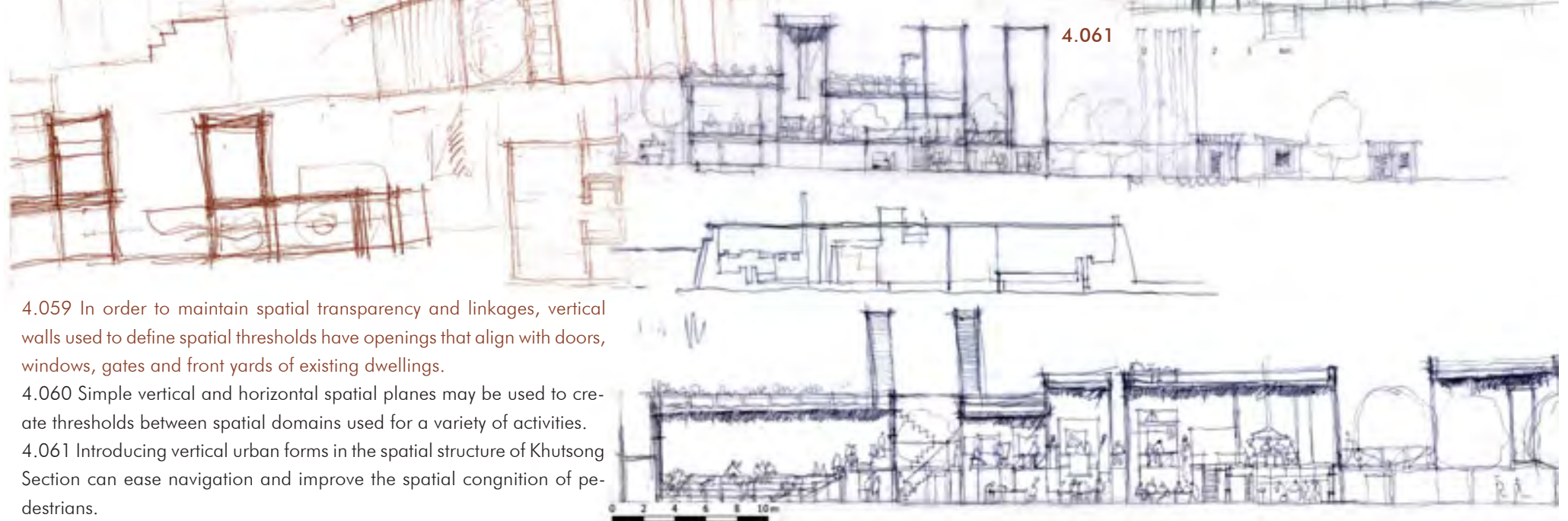
4.059 In order to maintain spatial transparency and linkages, vertical walls used to define spatial thresholds have openings that align with doors, windows, gates and front yards of existing dwellings.

4.060 Simple vertical and horizontal spatial planes may be used to create thresholds between spatial domains used for a variety of activities.

4.061 Introducing vertical urban forms in the spatial structure of Khutsong Section can ease navigation and improve the spatial congnition of pedestrians.

4.062

4.063

4.065

4.062–4.066
Screen walls with seating and trees can be used to partially enclose pockets of spaces to attract social and micro-scale economic activities along streets, while screening semi-private activities in the front yards of dwellings and acting as firewalls to guard against the spread of fire.
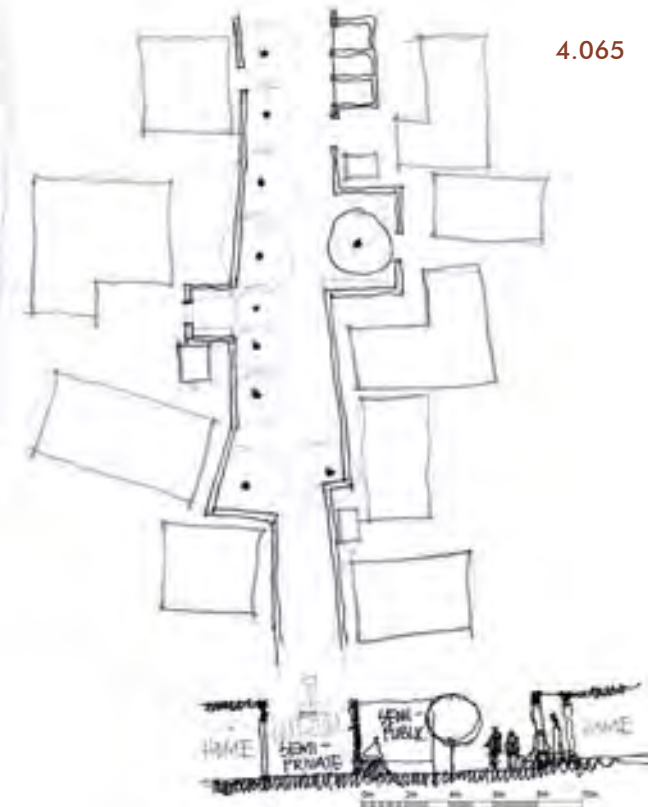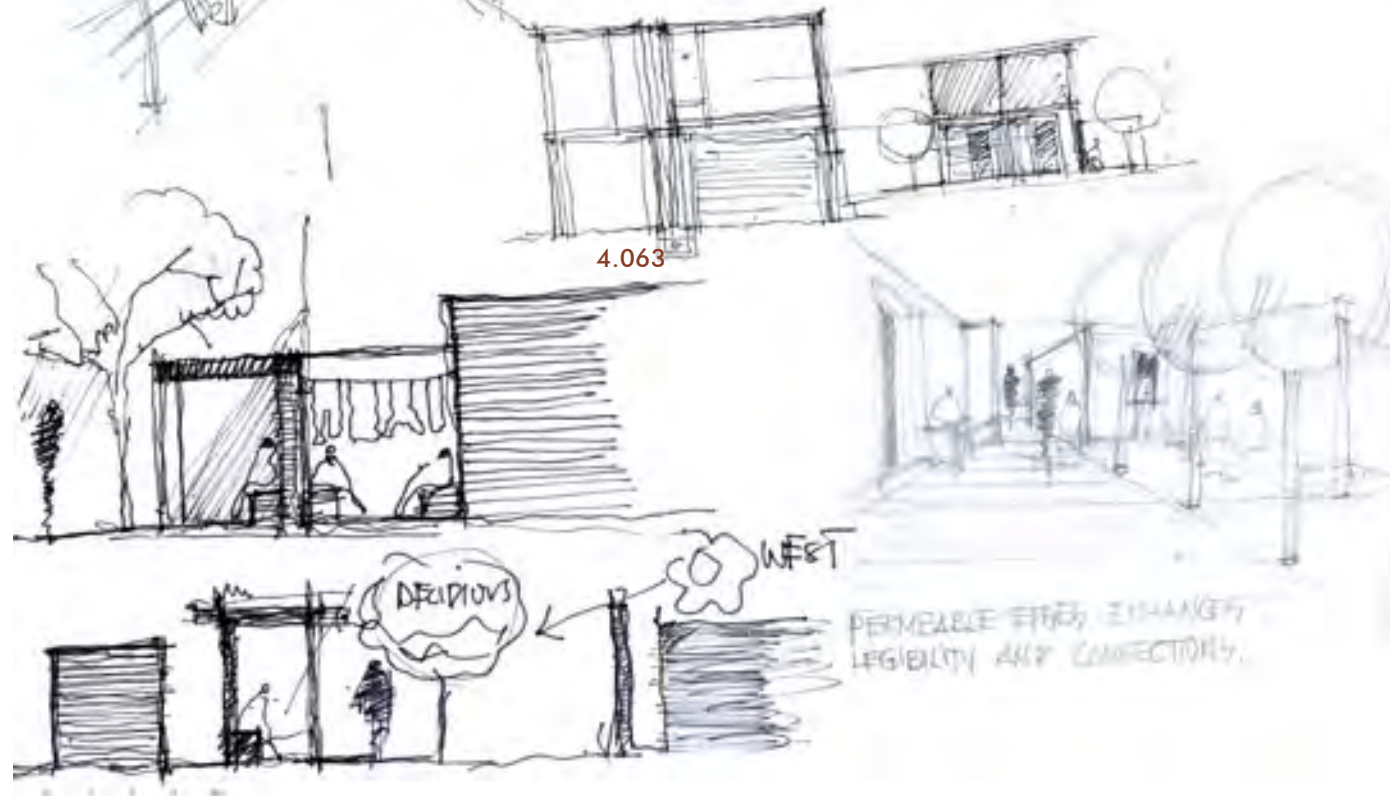
4.064
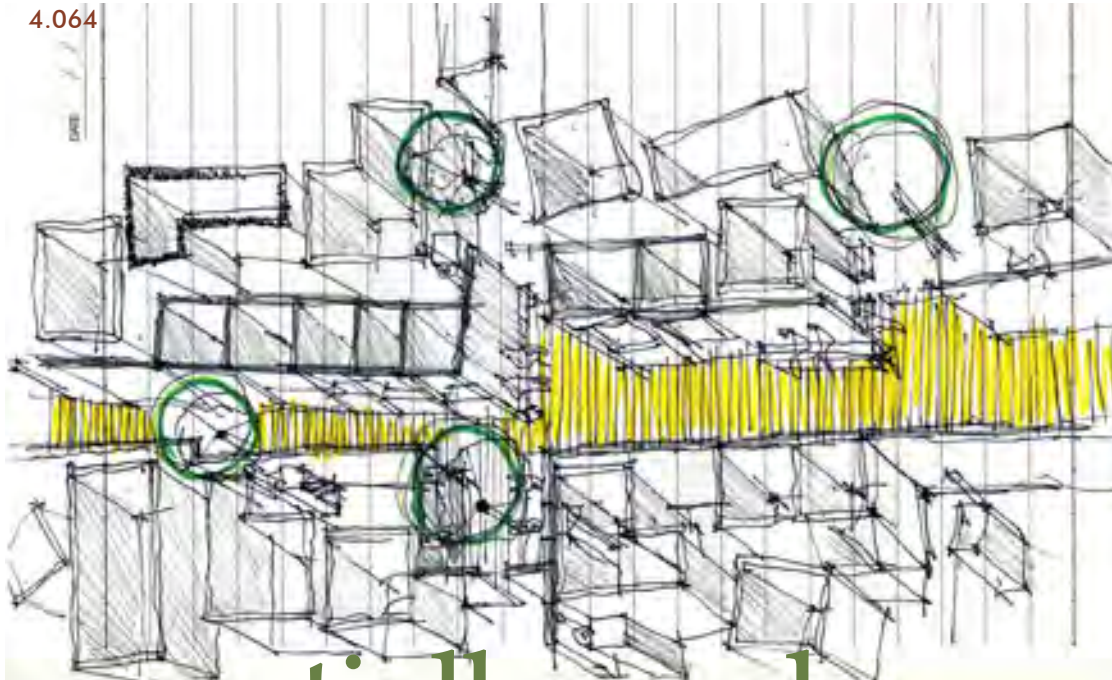
4.066
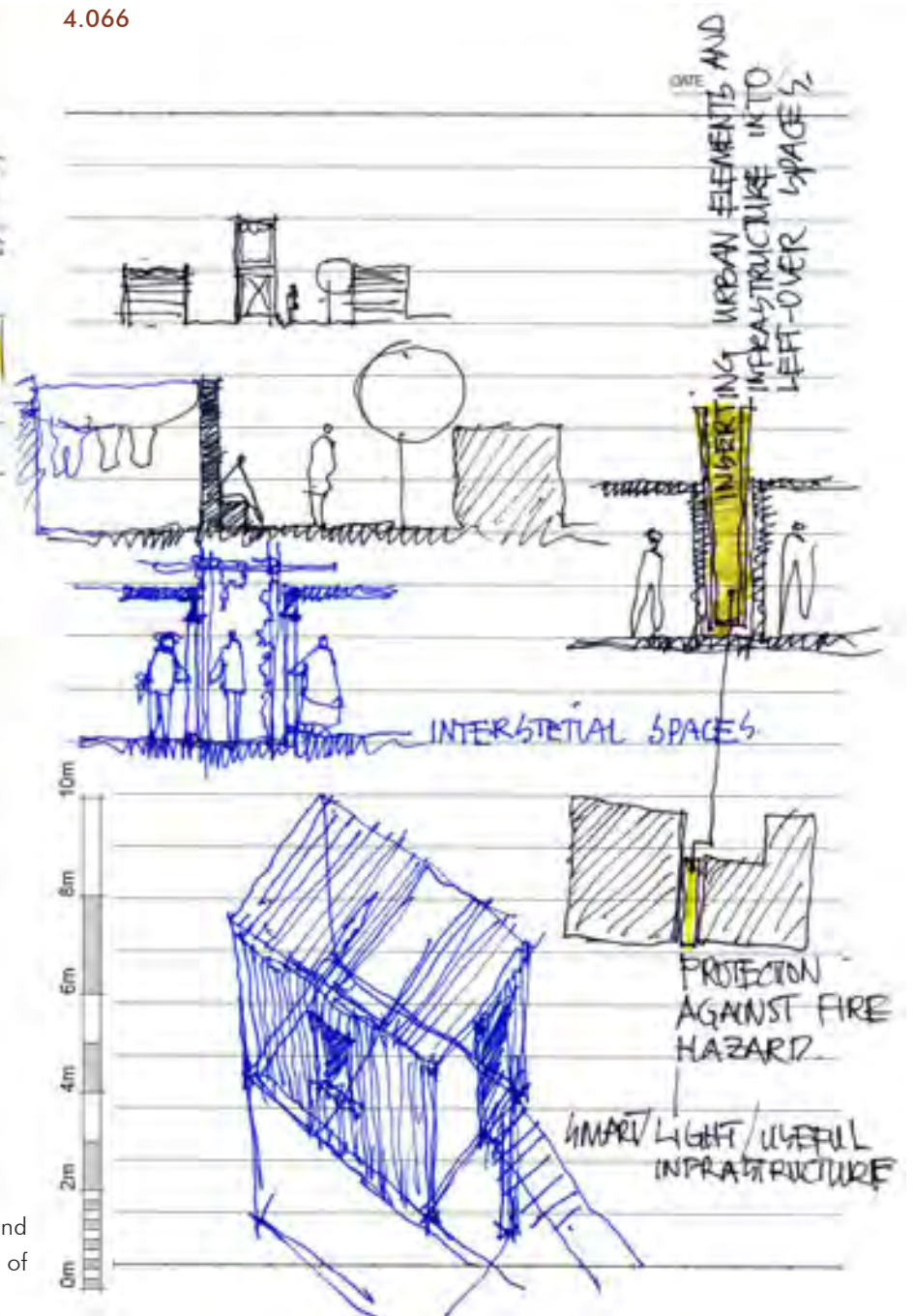
partially enclose pockets of spaces

4.062–4.066

Screen walls with seating and trees can be used to partially enclose pockets of spaces to attract social and micro-scale economic activities along streets, while screening semi-private activities in the front yards of dwellings and acting as firewalls to guard against the spread of fire.

4.067

4.06

GATEWAY AS THRESHOLD/TRANSITION SPACE: OUTDOOR ENTRY SPACE.

BUILT ELEMENTS, FORM AND SCREEN/TREE DEFINES THRESHOLD EDGE

RECYCLING TOWERS/TREES + TREE CANOPY/SCREEN WALLS AND LOW WALLS ARE USED TO CREATE LEGIBILITY, COMPLEXITY AND COHERENCE IN OPEN PUBLIC SPACE

RECYCLING TOWER FUNCTION AS FOCI (FOCAL POINT/SURFACES IN THE URBAN SPACE).

OPENINGS IN A SCREEN WALL CONNECT SEMI-PRIVATE SPACE TO PUBLIC SPACE

MICRO-ECONOMIC ACTIVITIES, EDGE DEFINES THRESHOLD BETWEEN PUBLIC AND SEMI-PRIVATE SPACE

TOO MUCH ENCLOSURE, ENCLOSURE ON FOUR SIDES IS NOT DESIRABLE BECAUSE IT CAN BE THREATENING IN PUBLIC CONTEXT, ALTHOUGH ATTRACTIVE IN PRIVATE SPATIAL REALM.

FOCI: A SINGLE FOCAL TREE AT THE CENTRE OF A SPACE

FOCI-DEFINING FOCUS SPACE

SPATIAL ENCLOSURE WITH A LOW WALL AND PERMEABLE LINE OF TREES ALLOWS VIEWS TO WALKWAY

4.068

4.067–4.071

LOW WALL, SEATING AND TREES CAN BE USED TO CREATE TRANSITION SPACE FROM PUBLIC SPACES AND WALKWAY (OR STREET) INTO SEMI-PRIVATE SPACES.

A TREE IS POSITIONED AT THE CENTRAL POSITION

A TREE IS POSITIONED AT A CORNER TO PROVIDE SHADE TO SEAT, WHILE SPACE AT THE CENTRE IS LEFT FOR PUBLIC ACTIVITIES

Threshold and open space design principles to be applied in further spatial explorations.

4.070

4.071

4.067–4.071
Threshold and open space design principles to be applied in
further spatial explorations.

4.072
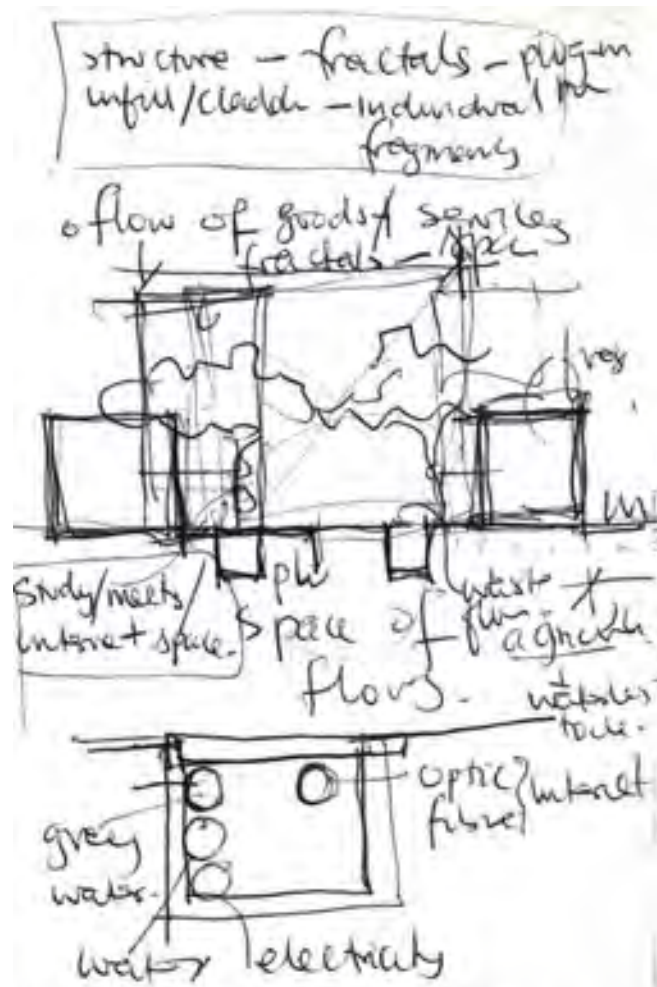
4.072–4.074
Existing pedestrian and vehicular routes can be used for circulating services and providing minimally invasive amenities so as to enable self- improvement of houses and the growth of micro-scale economic activities.

Minimally invasive spatial interventions

4.073

4.074
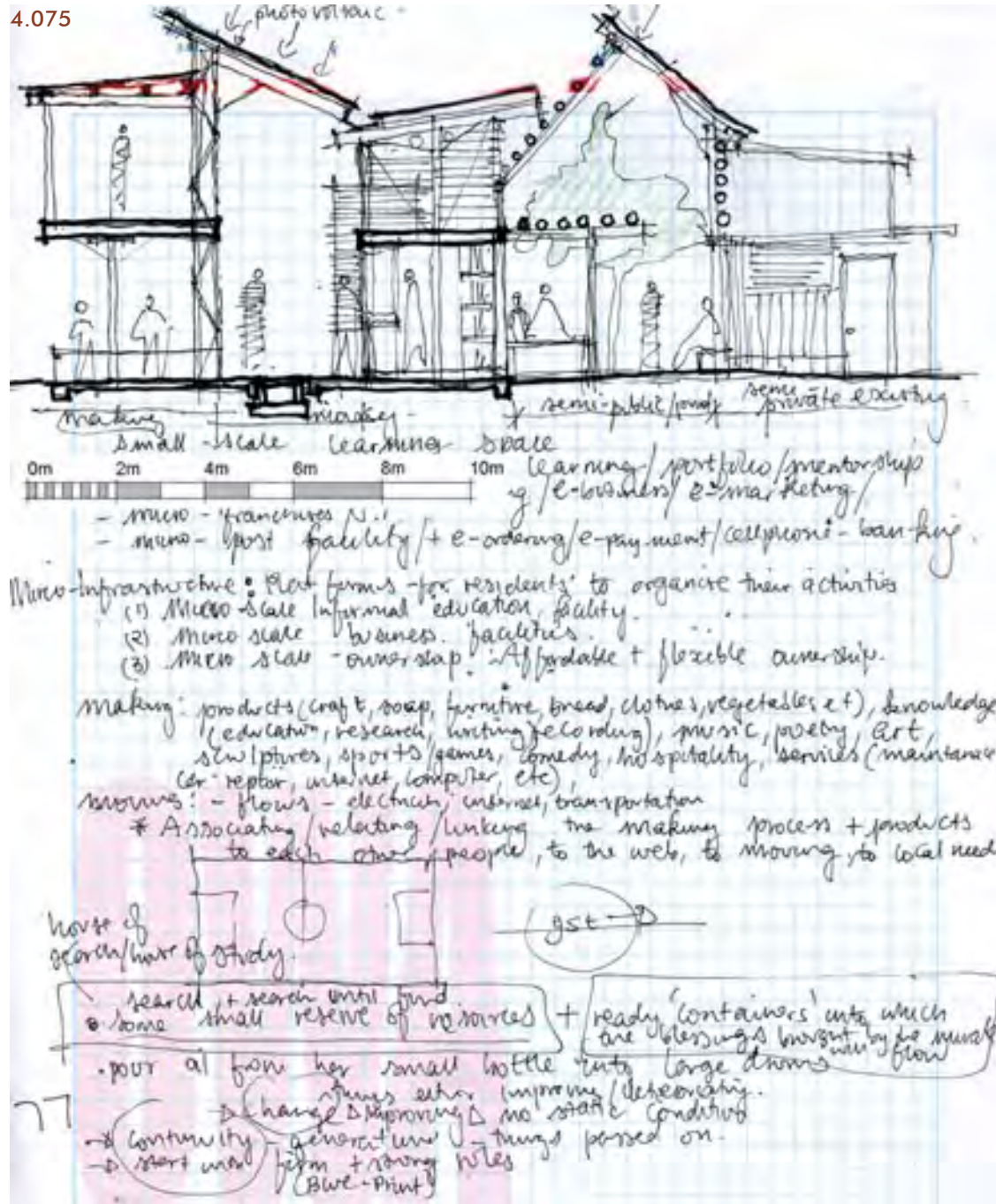
4.075

4.076
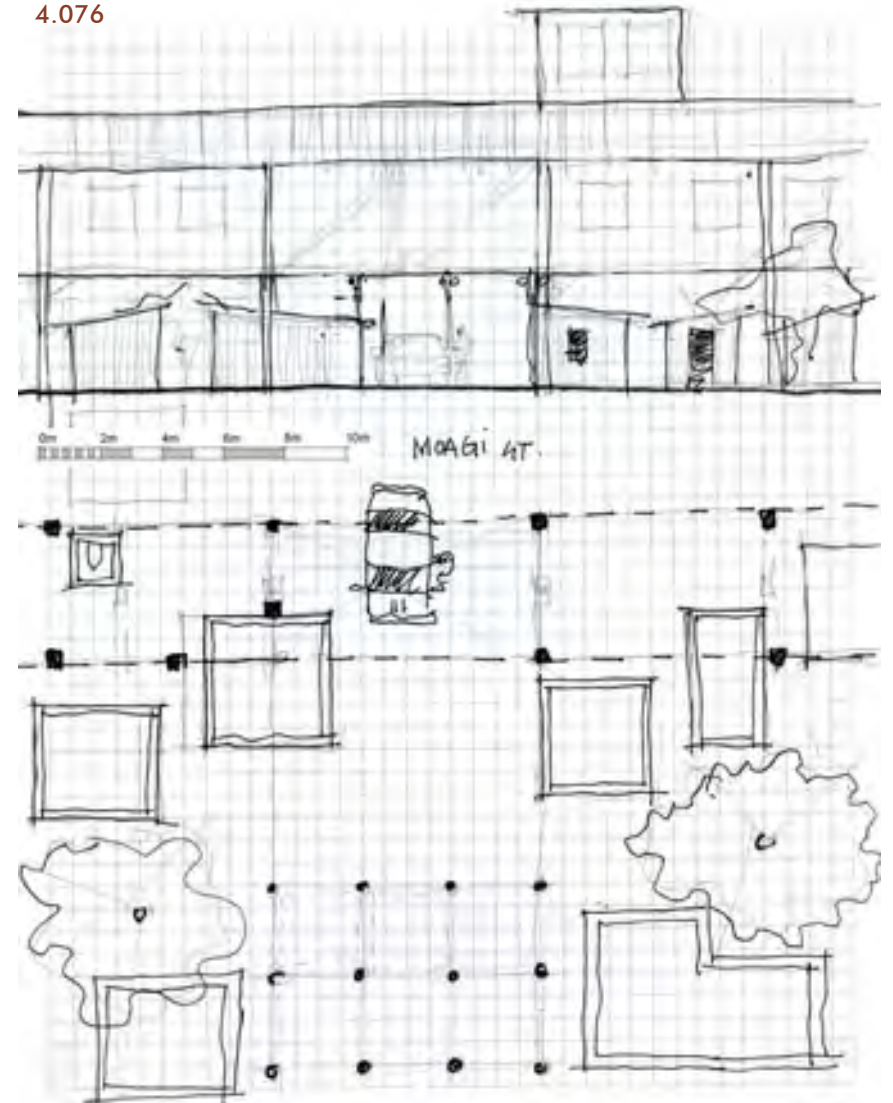
4.075 Inserting pre-fabricated structural components to upgrade the existing fractal pathways within Khutsong Section may help to simplify the construction process, because there are few roads wide enough to give access to construction vehicles. 4.076 Minimally invasive spatial interventions could be achieved by elevating proposed structures by using columns so as to add new spatial layers without demolishing existing dwellings.

4.077 Minimally invasive spatial interventions could be achieved by proposing movable and light-weight space-defining elements that can be relocated and re-used as the informal settlement transforms and develops.
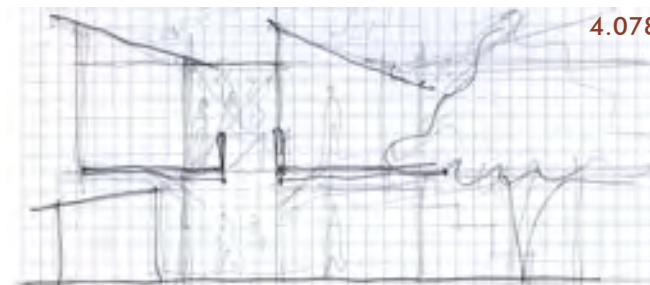
4.078
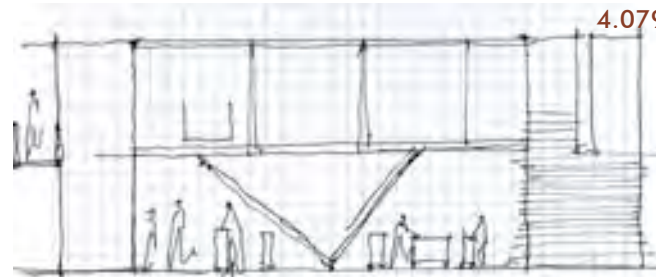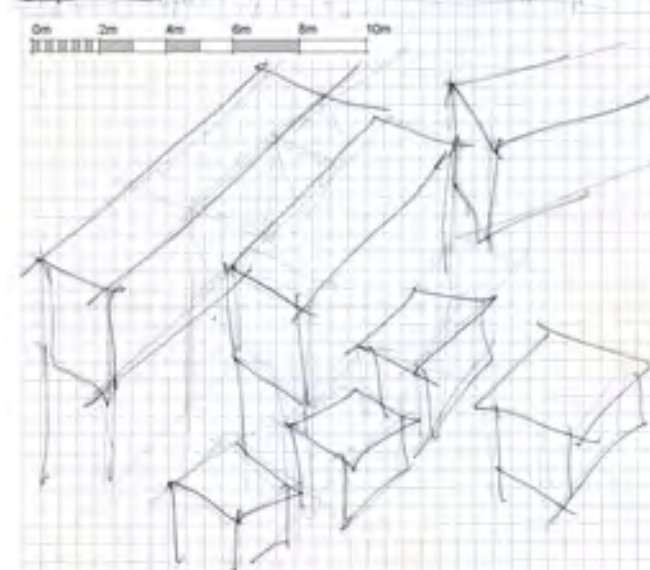
4.079
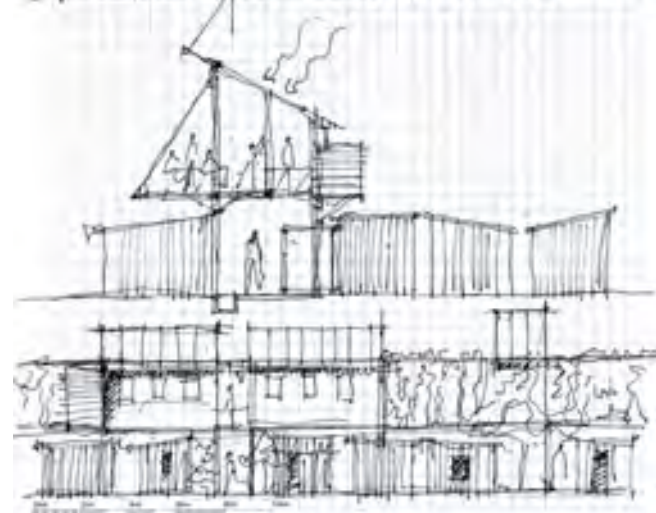
4.080

Vertical green walls, raised walkways and roofs can be used to make streets more attractive.

4.078–4.080

Lightweight structures can be used to create spaces, support solar panels for energy production, carry planters for food production, and to harvest rain water. Adding green roofs, seating, paved pathways, drainage and service channels, and creating a continuous block edge (indicated by red lines) along streets may help to beautify the public spaces of the informal settlement. Layers of vertical and horizontal spatial thresholds can be used to densify and diversify activities occurring in the open spaces of Khutsong Section. Vertical green walls, raised walkways and roofs can be used to make streets more attractive and usable by accommodating social activities.

4.081
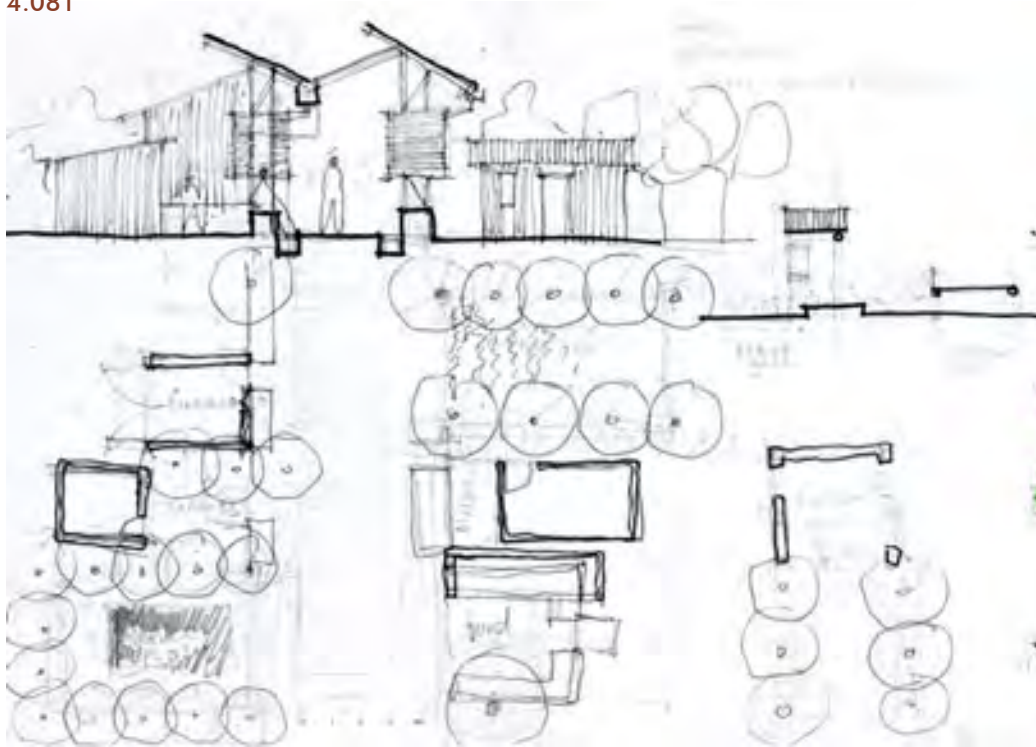
4.082

4.081 Inserting trees and rainwater-harvesting systems around existing houses could result in a green and sustainable open urban space that helps to blend new buildings and urban elements with existing shacks.
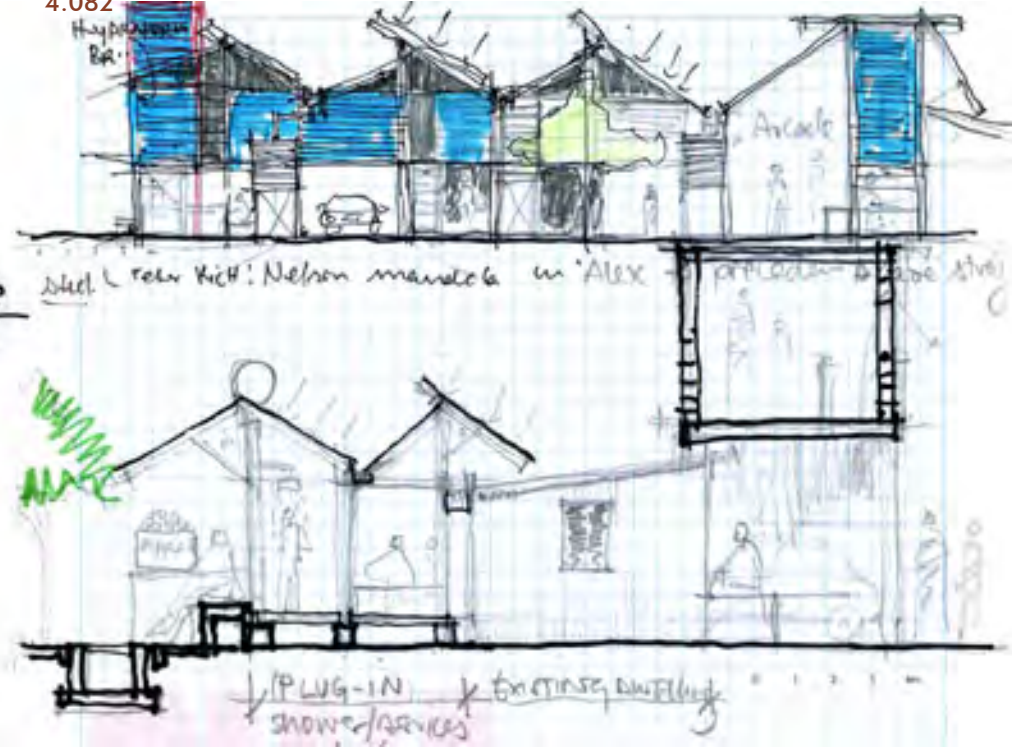
4.082 The use of a structure and infill system could help to simplify the construction process during the upgrade of the informal settlement. Lightweight structures equipped with solar panels and rainwater collection tanks could be prefabricated and then transported to Khutsong where they can be connected to existing houses.

4.083 A lightweight steel structural system with pre-cast concrete components may ease the construction process. Steel components of the system may be transported and erected more easily and quickly than masonry construction.

4.084 The insertion of a double-storey building and lightweight structures for micro-scale economic activities provides shaded spaces. Seating can be inserted to support social activities at ground level.

4.083

4.084
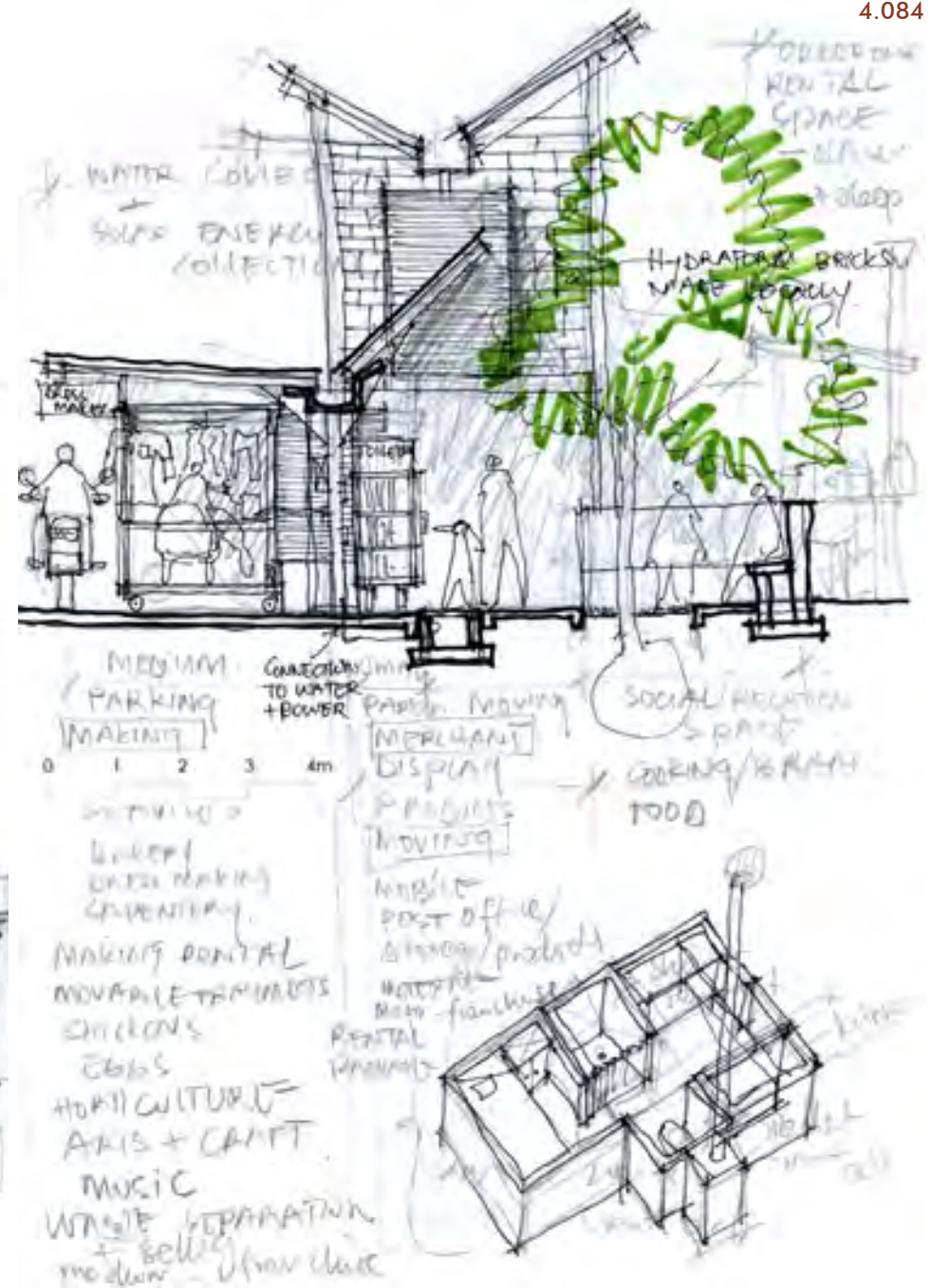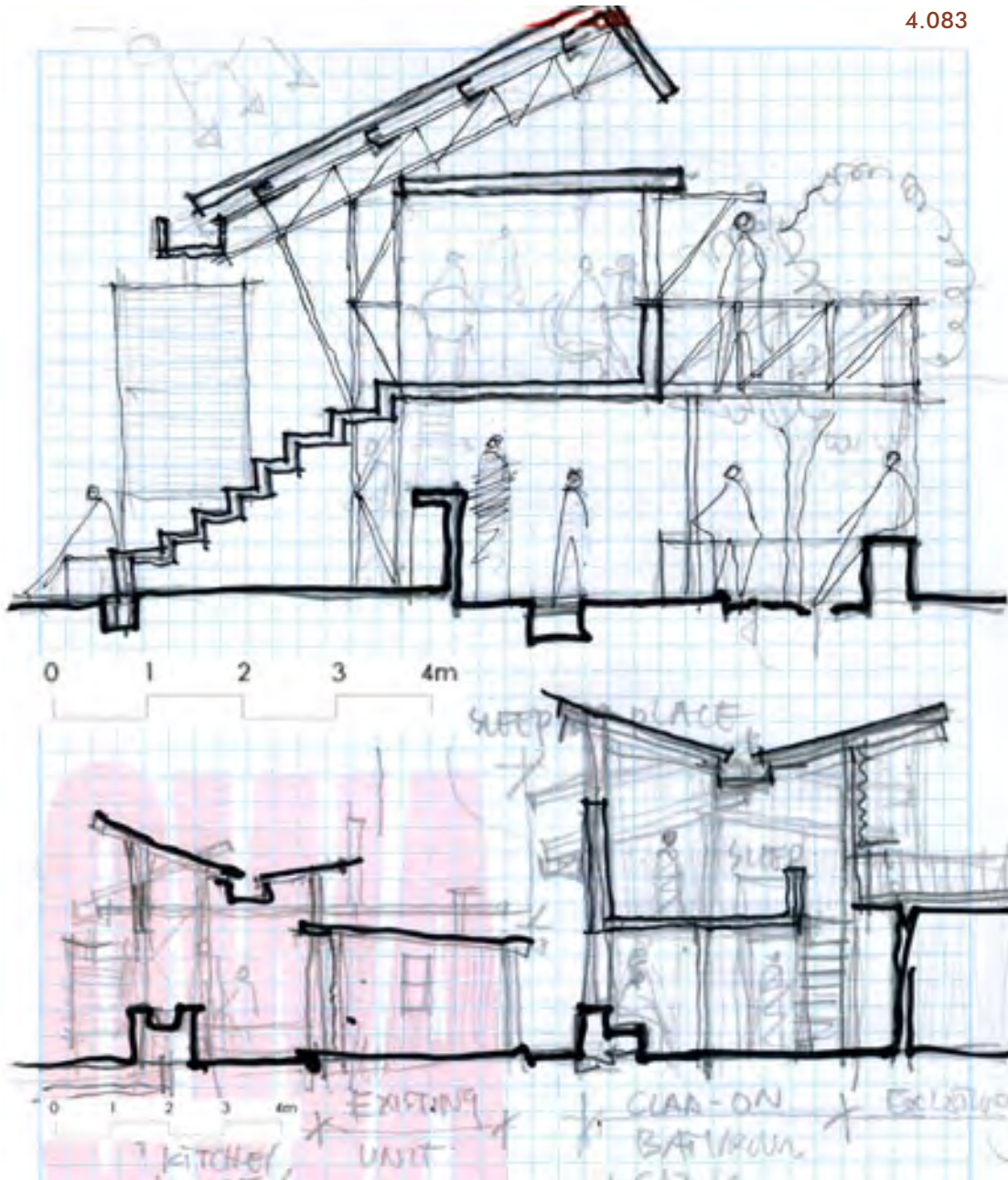
A simple steel butterfly shed can be used for the parking of movable double-storey rooms.

4.085

4.086
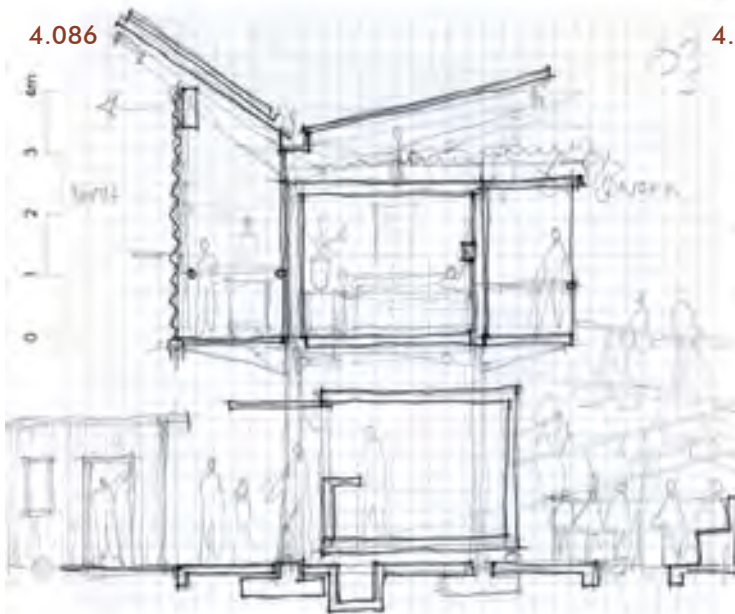
4.087
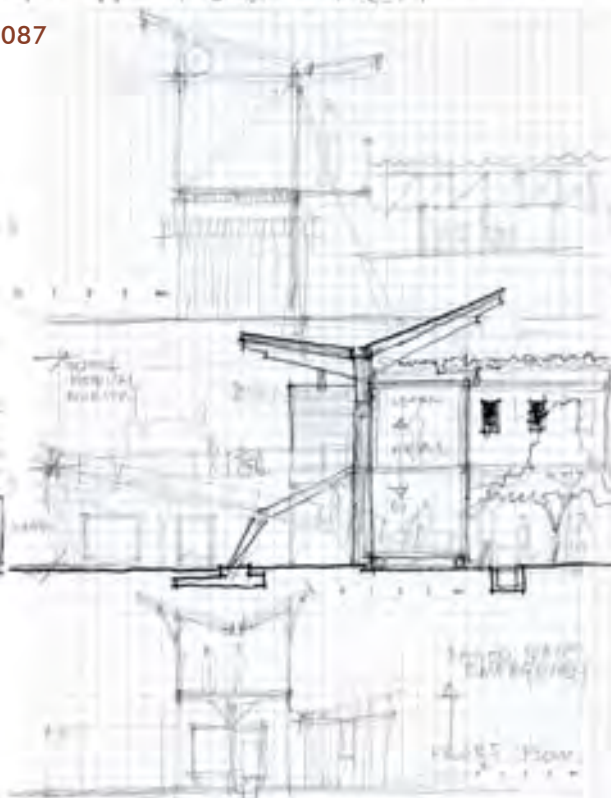
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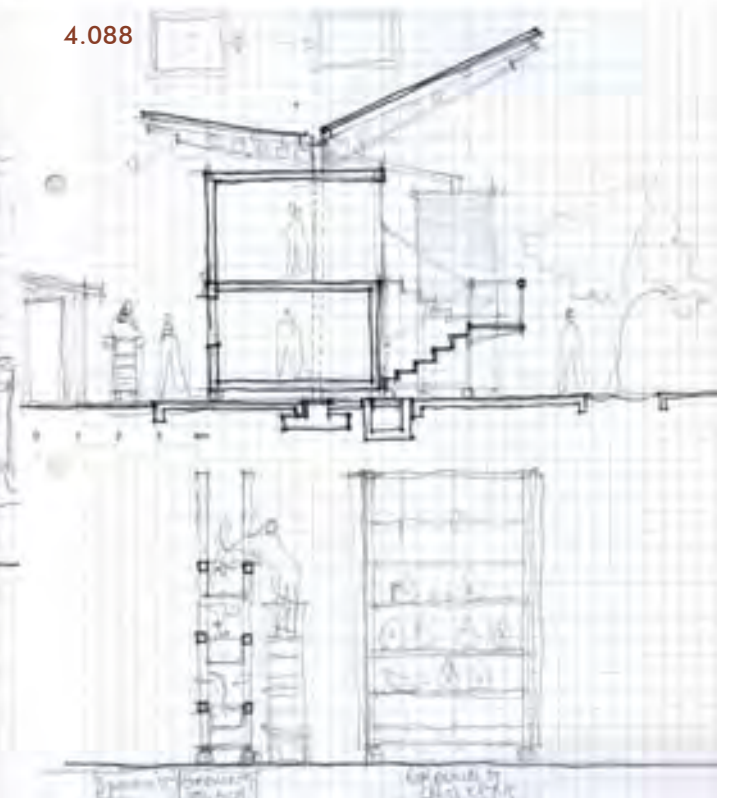
4.085–4.088

A simple steel butterfly shed can be used for the parking of movable double-storey rooms while allowing a variety of activities when the containers have been removed. Lightweight steel stair systems could be connected and disconnected as required.
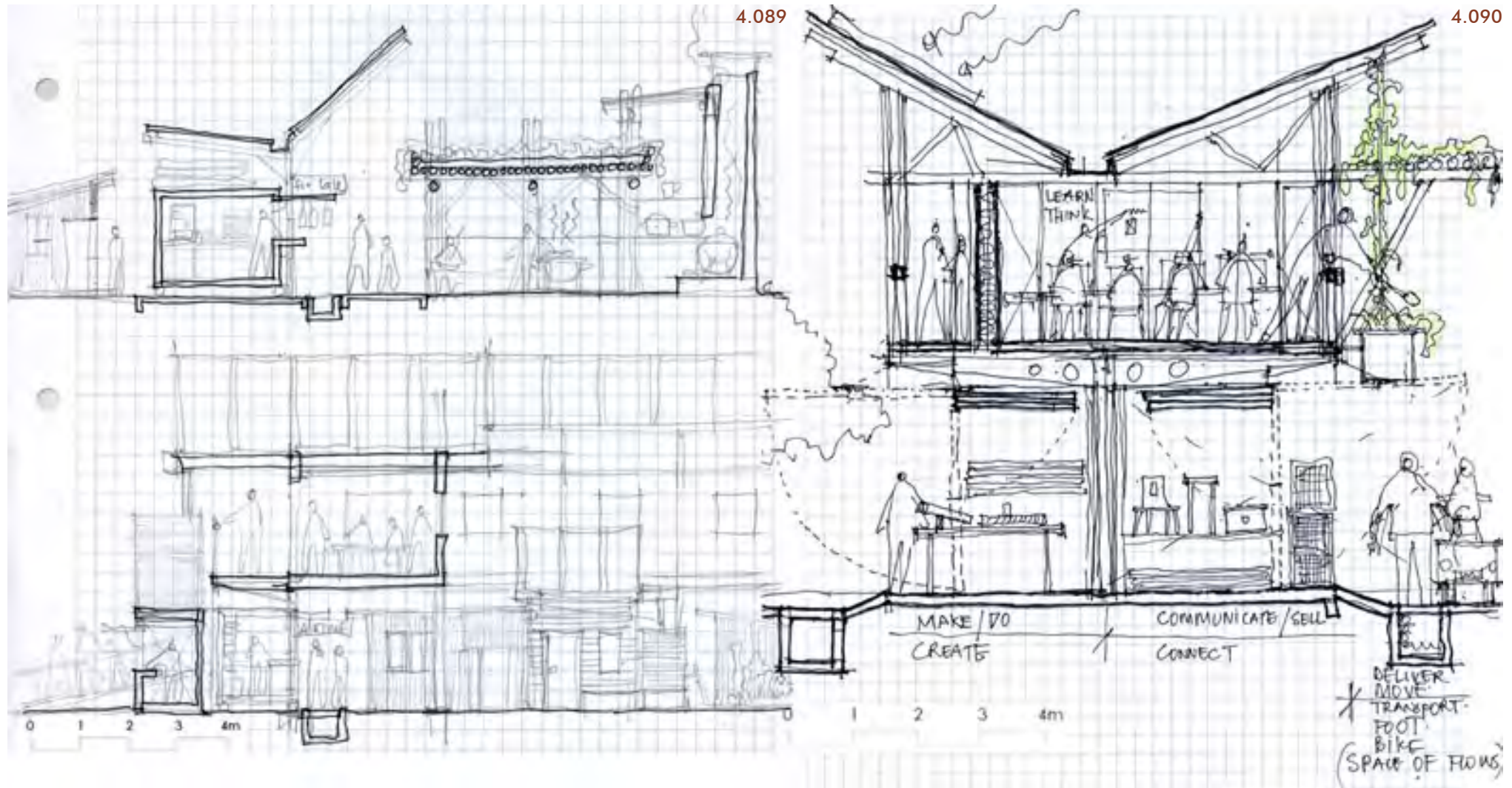
4.089 By improving the edges of open spaces and streets using lightweight and demountable structures, the urban fabric and network of open urban spaces in Khutsong Section can enable social and economic activities.

4.090 This structural system reduces the footprint of the new building while providing shaded space below which could be used for economic activities. Vegetation could be used to reduce the visual impact of the structural steel forms.

4.091–4.093 Steel elevated walkway structures could be used for urban agriculture and the harvesting of solar power and rainwater, while providing walking and seating space above the existing houses in the informal settlement.

4.094

4.095
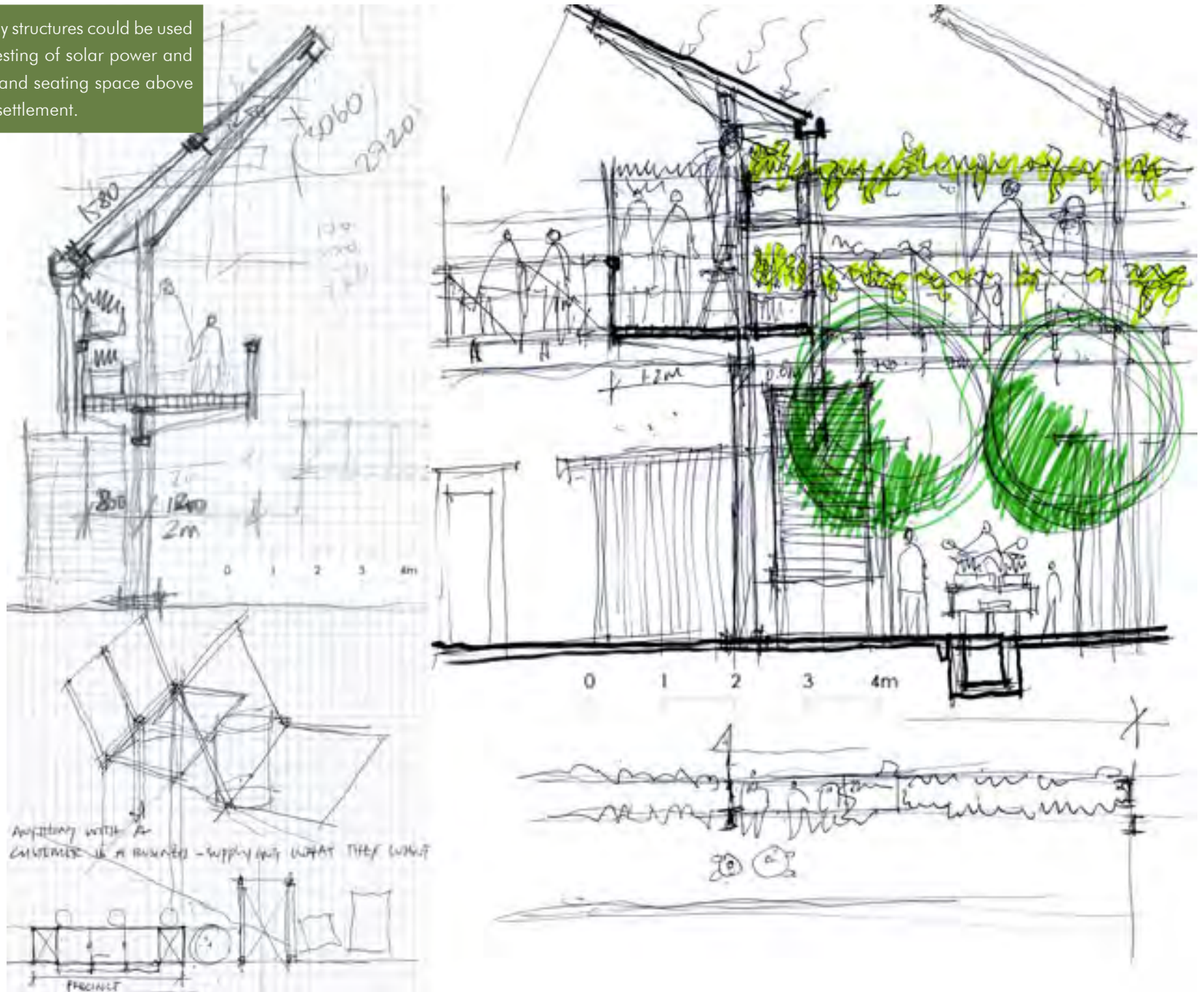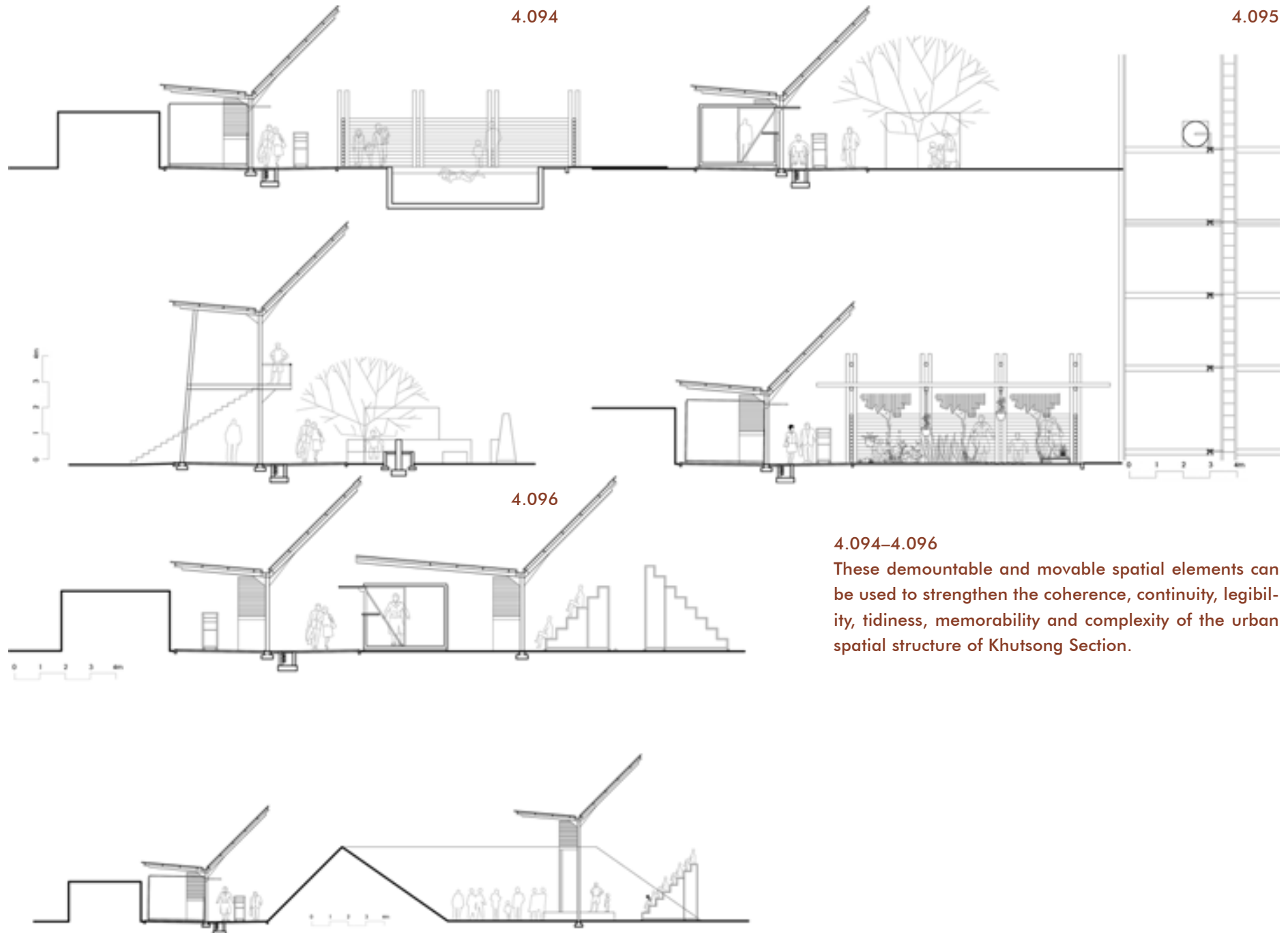
4.096

4.094–4.096

These demountable and movable spatial elements can be used to strengthen the coherence, continuity, legibility, tidiness, memorability and complexity of the urban spatial structure of Khutsong Section.

Integrative spatial interventions

4.097

4.098

4.099 4.097–4.099
Improved central spaces enclosed by clusters of buildings can be interconnected by paved pathways or roads and plantings, and though information and telecommunication network infrastructures.

4.100
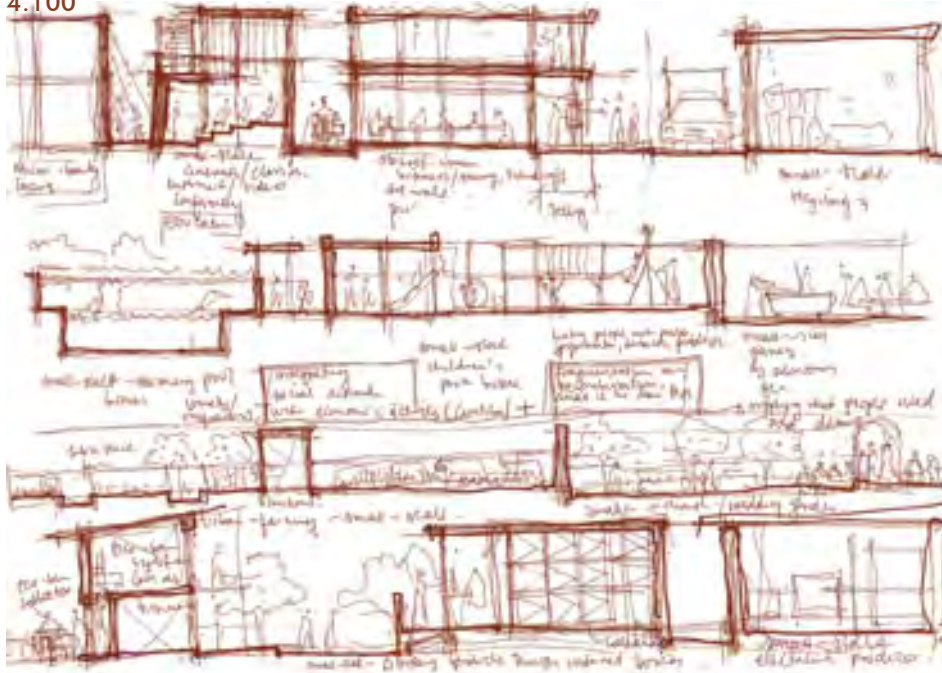
4.100 Vertical spatial growth could help achieve high densities (top image) (Author, 2013). Open urban spaces could be used for swimming pools, games areas and play areas for children (second from top). Urban agricultural activities may play a vital role in achieving a sustainable informal settlement (second from bottom). Amenities like small post offices and satellite government services could also be inserted into some of the open urban spaces within the settlement (bottom). These spaces that support a variety of activities should be well connected through a series of thresholds (indicated with red arrows) that signify and demarcate private, semi-private and public activities.

4.102
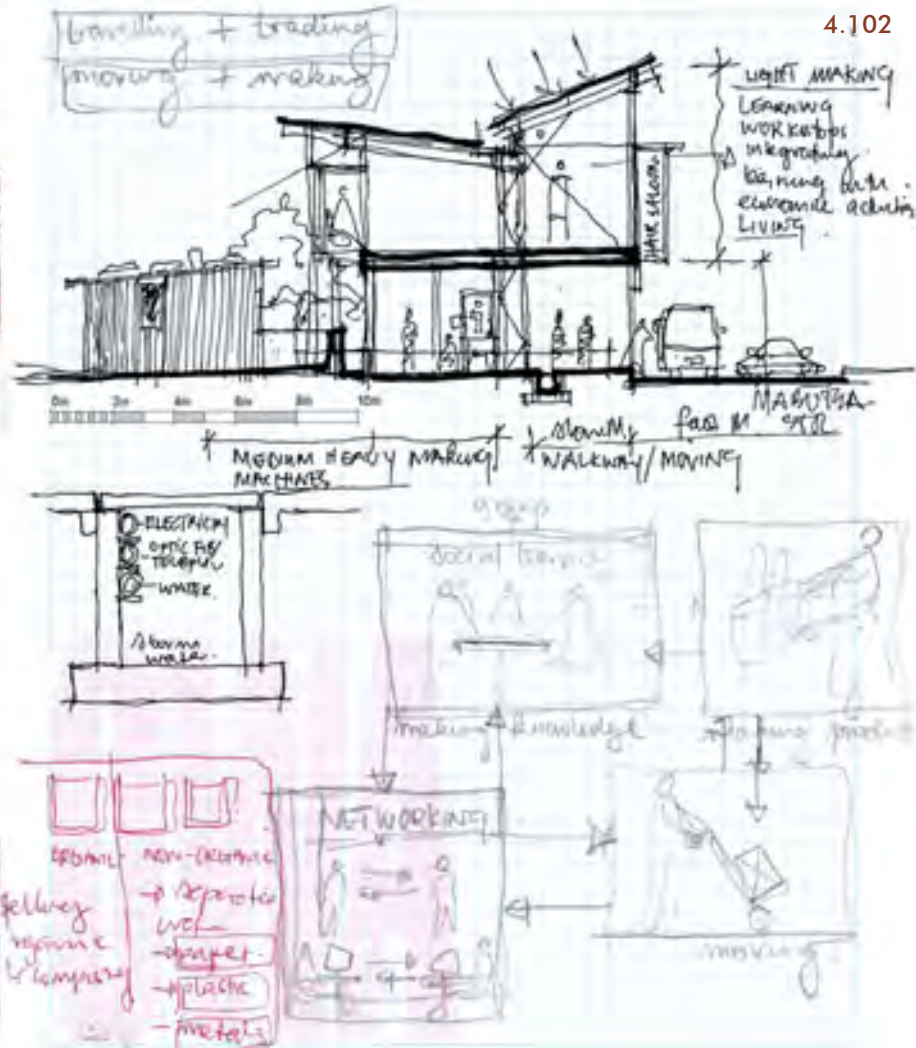
4.101

4.101–4.104
Inserting two-storey buildings at the edges of the settlement could help to attract business and integrate Khutsong Section with the surrounding formal housing in Ivory Park. Local learning and production activities require a good flow of services, goods, people and knowledge to and from different parts of the settlement.
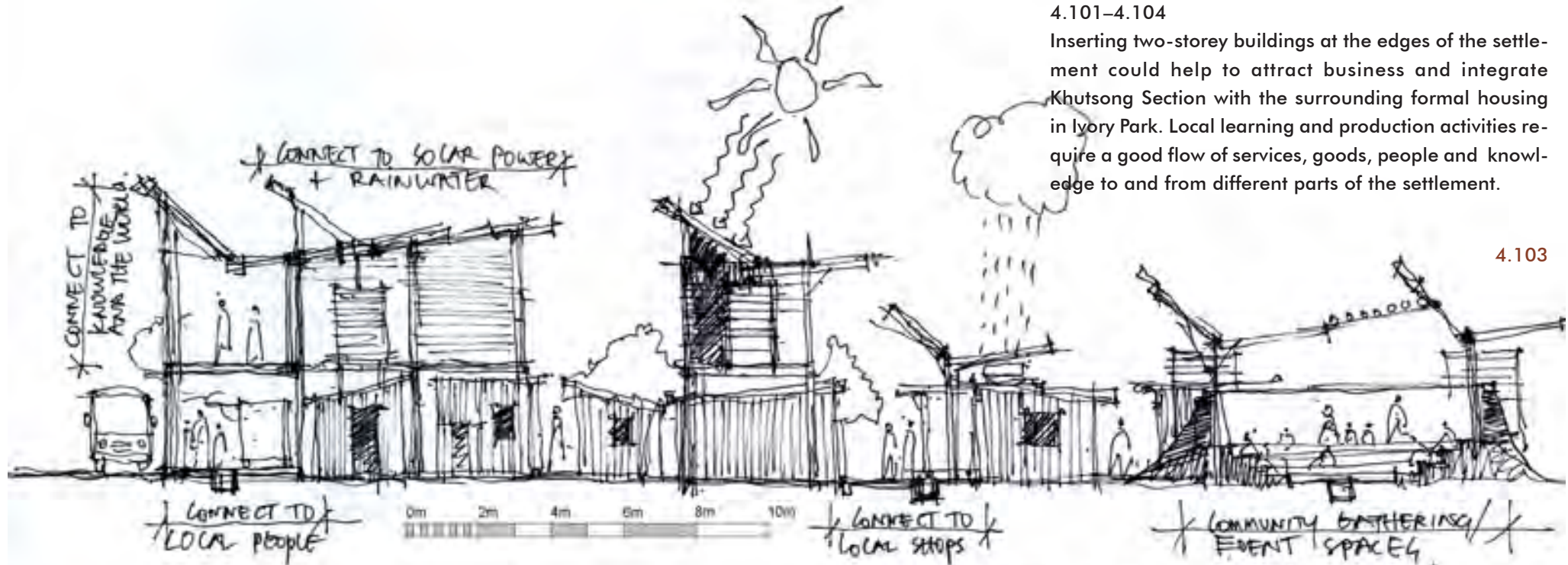
4.103

4.104

4.105–4.106 Spatial and infrastructural interventions can serve the purpose of creating an integrative urban spatial structure. Inserting spatial thresholds by using low walls, seating, level changes and trees may help to create a spatial structure that supports and integrates social and economic activities in urban spaces of the settlement.

spatial thresholds by using low walls, seating, level changes and trees

4.105

4.106

4.107

URBAN KIT: SEATS, TREES, MOVING SHOPS, LEARNING SPACES, water tanks.
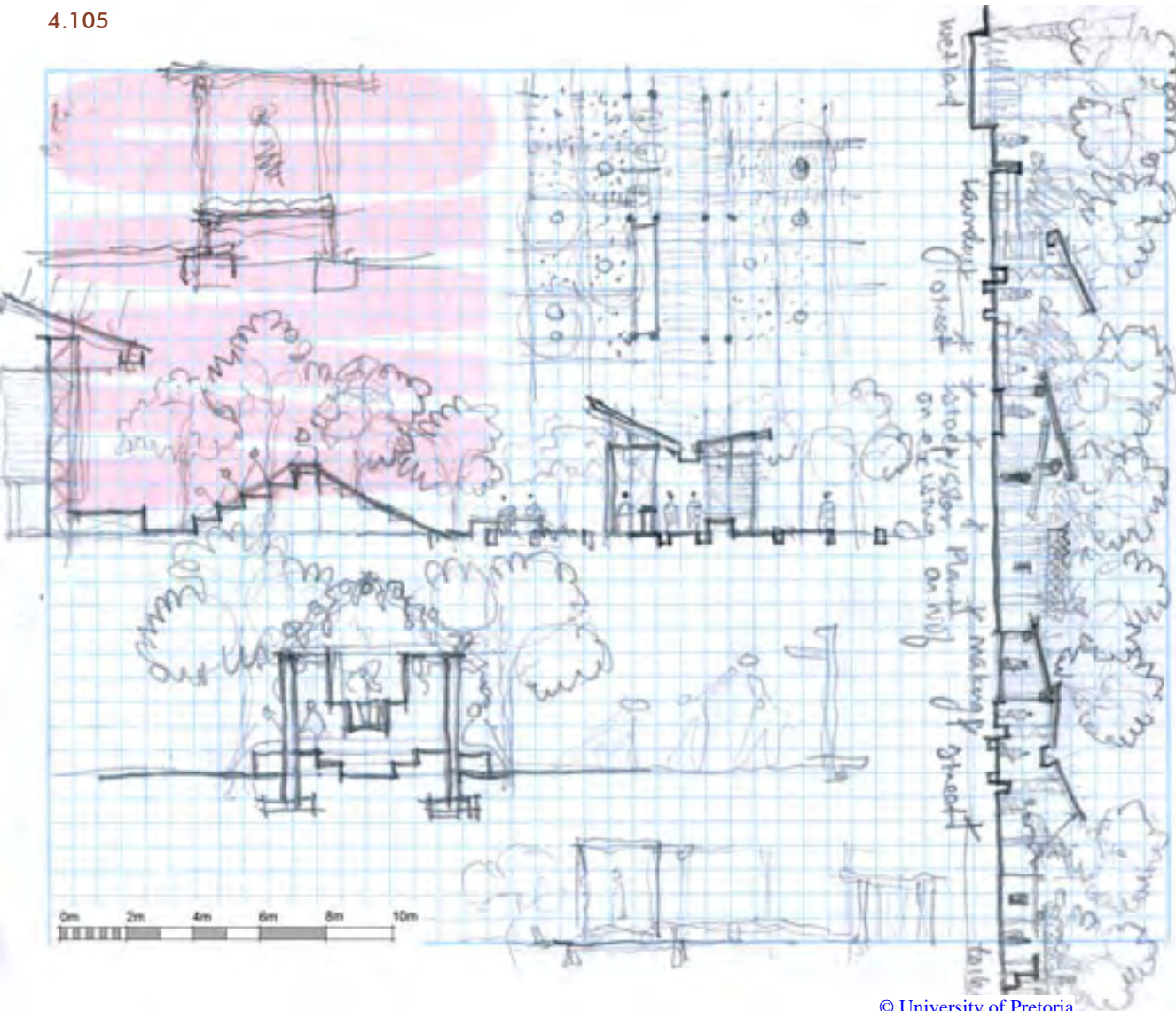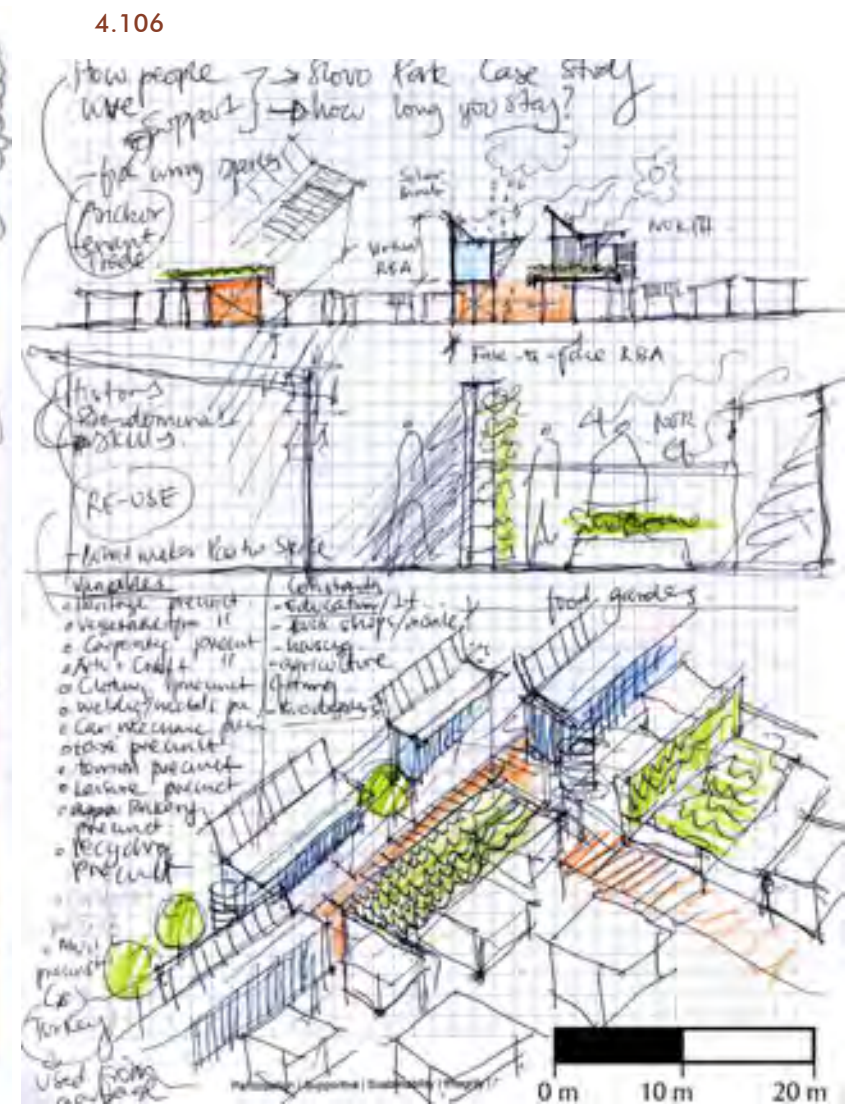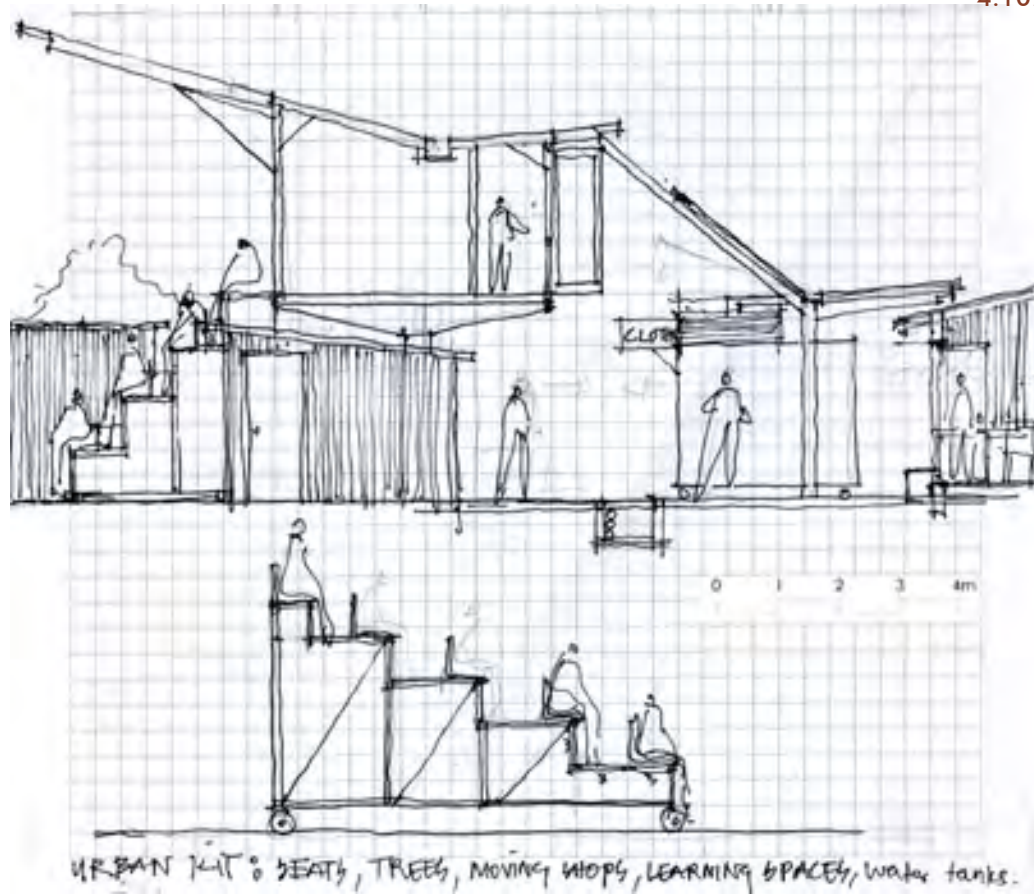
4.107 Mobile steel seating structures could be used in integrated open public spaces for community and other social gatherings. This mobile structure can be easily integrated with urban open spaces.

4.108

EVENTS VENUE
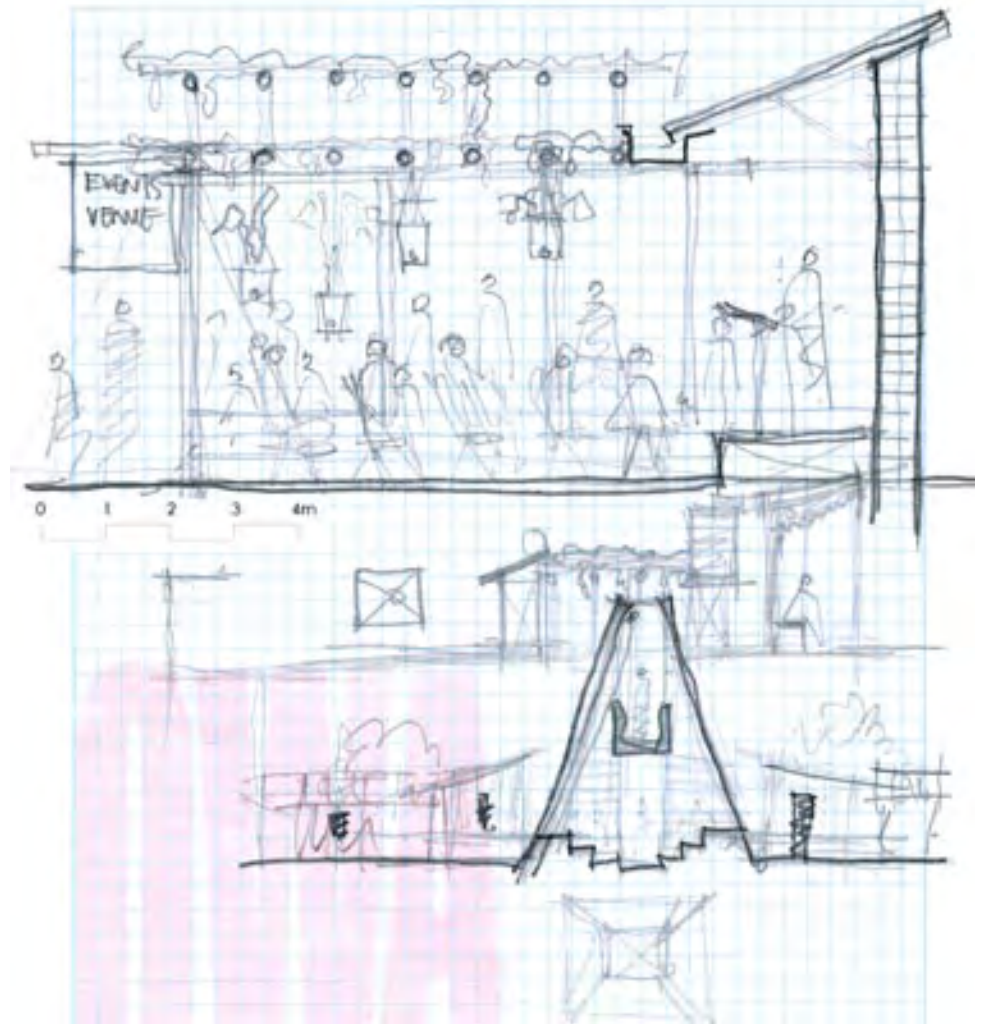
4.108 Open spaces can be improved for social gatherings, defined by using vertical spatial planes and vegetation to attract people to them. Semi-public communal space may need thresholds that separate it from public spaces in order to encourage semi-public relationship-building activities.

mobile steel seating structures

4.109
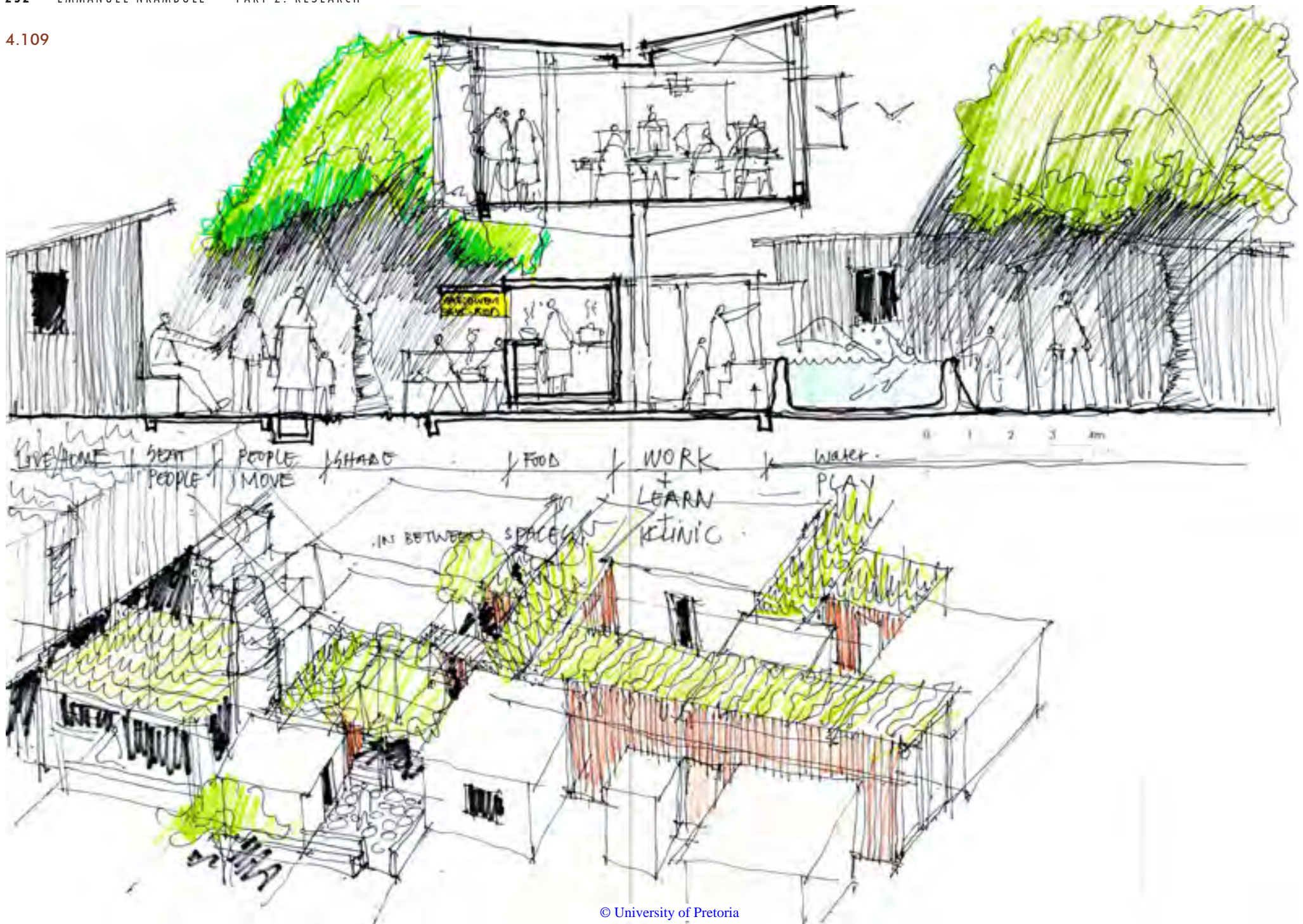
Prefabricated and demountable kitchen and bathroom units can be added to existing shacks.

4.110

4.111
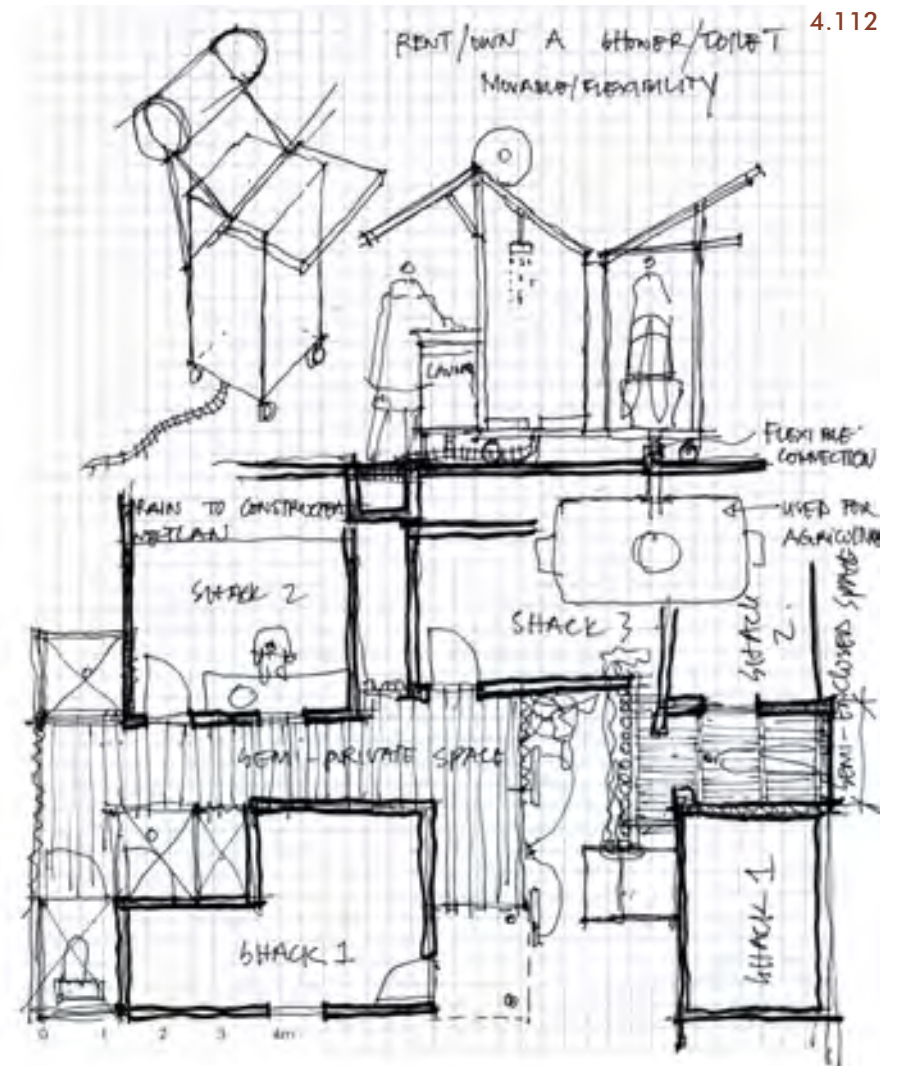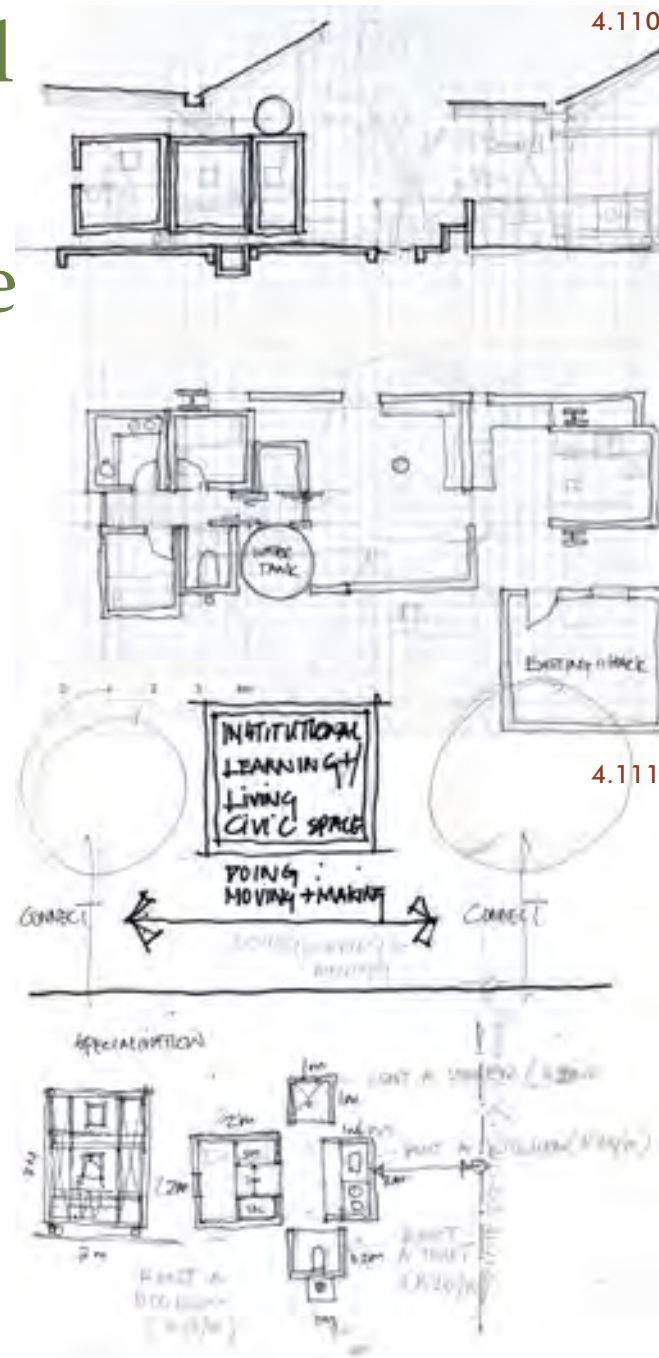
4.112

4.109–4.112 Prefabricated and demountable kitchen and bathroom units can be added to existing shacks so as to provide services and better define open spaces. Green infrastructure can be added to the existing streets and open spaces around existing dwellings. Vertical spatial growth would allow enough space at ground level for micro-scale economic activities which would promote social connections. Facilities for an education program can be located on the first floor, while economic activities can take place on the ground floor, where sellers can have a direct connection with buyers.

4.113–4.114 Elevating proposed buildings for residential and public use above existing dwellings can make it easier to regenerate the informal settlement at ground level without relocating residents. Integrating grey-water recycling, greenery, and rainwater and solar harvesting systems within the form can produce an enriching urban environment.

4.115

4.116

Integrative systems interventions
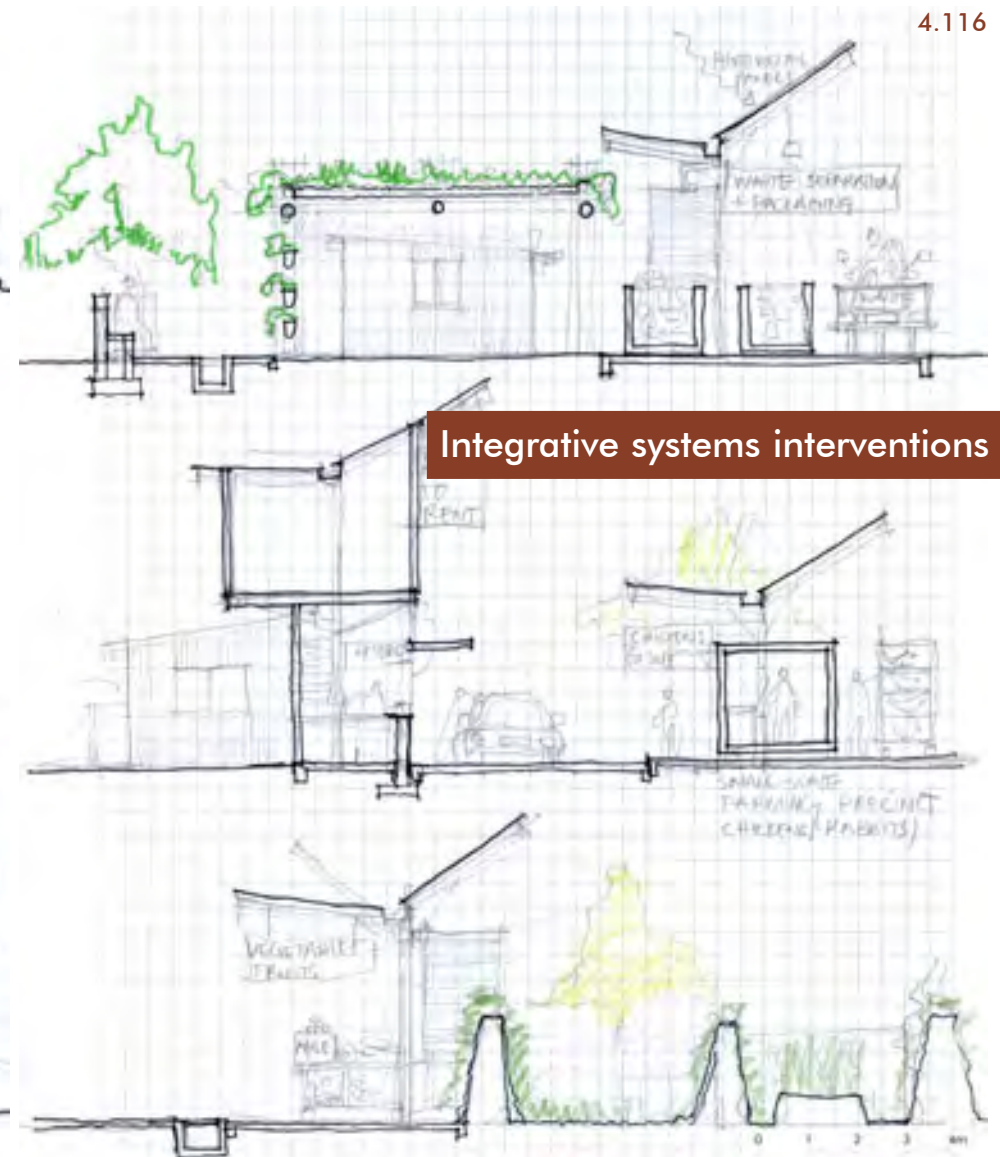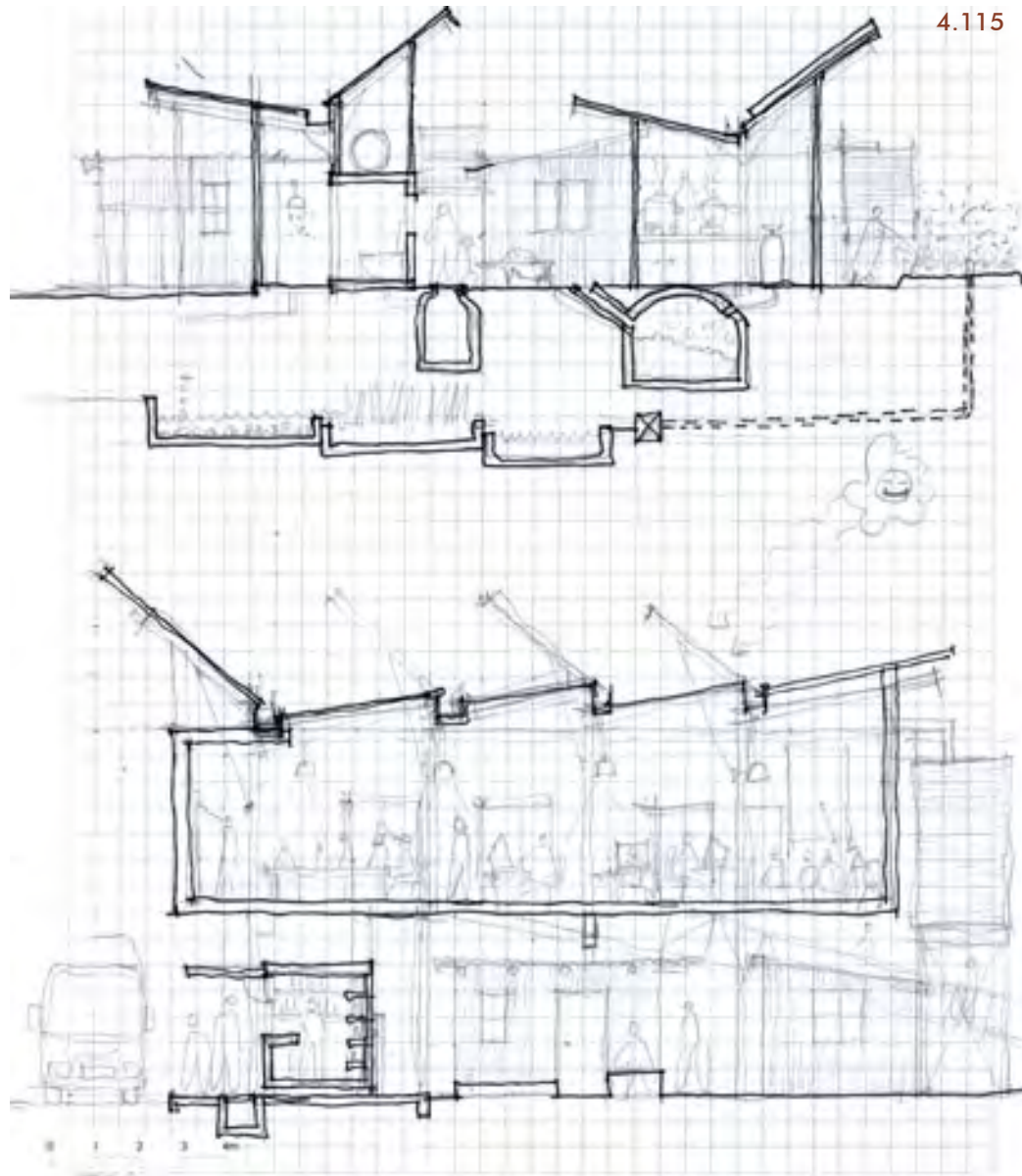
4.115–4.117 The spatial structure of Khutsong Section can be improved by providing light-weight and responsive site-specific infrastructure in open spaces and streets. The collection, sorting and packaging of solid waste can be done at recycling stations linked to paved pathways within the settlement. Rainwater can be harvested and used in urban agriculture to irrigate vegetable gardens.

The spatial structure of Khutsong Section can be improved by providing lightweight and responsive site-specific infrastructure in open spaces and streets.
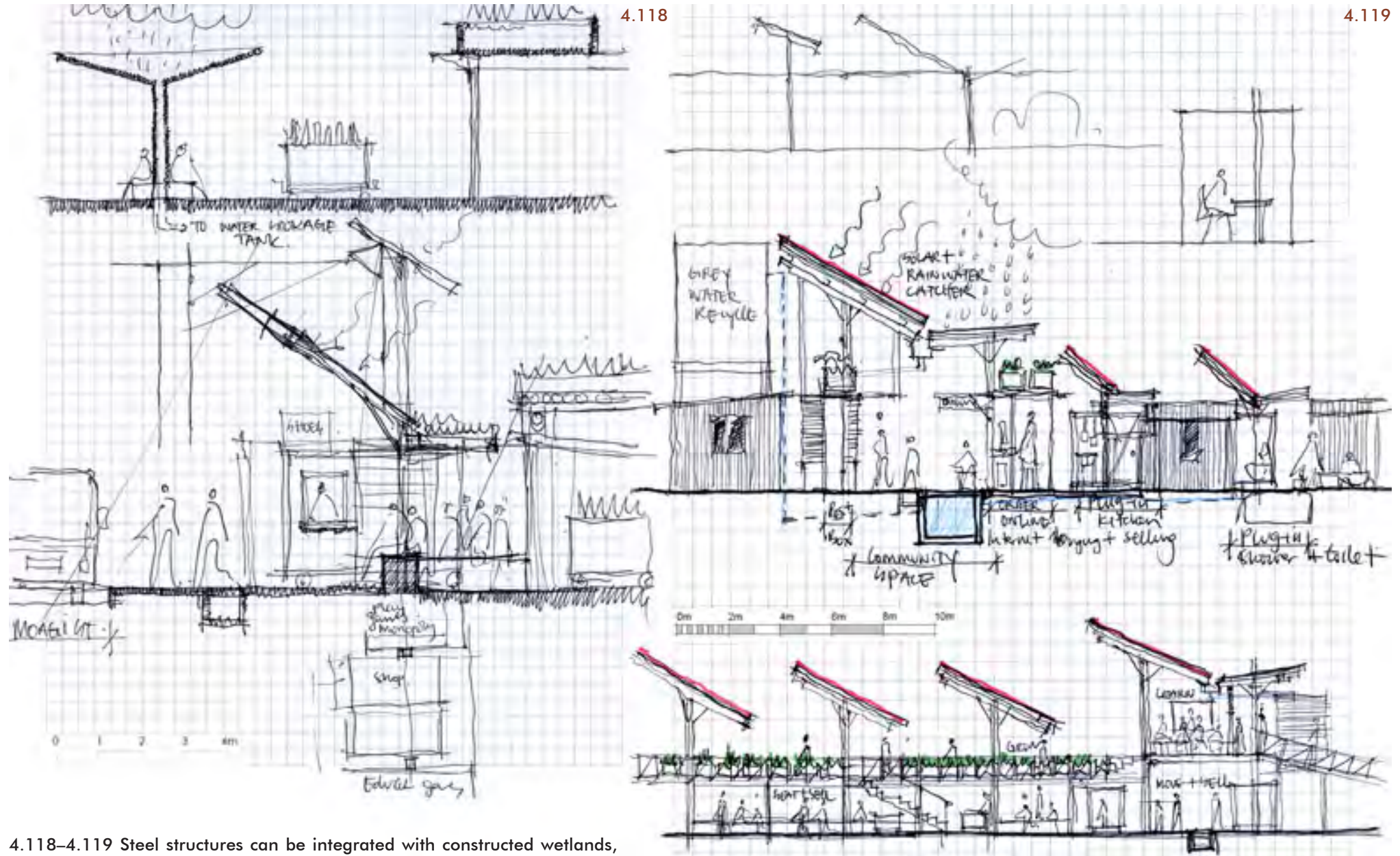
4.118

4.119

4.118–4.119 Steel structures can be integrated with constructed wetlands, water recycling facilities, and urban agriculture. Water recycling systems, rainwater harvesting, urban agriculture, and mobile tuck shops can be integrated to create a thriving and resilient informal settlement.

4.120
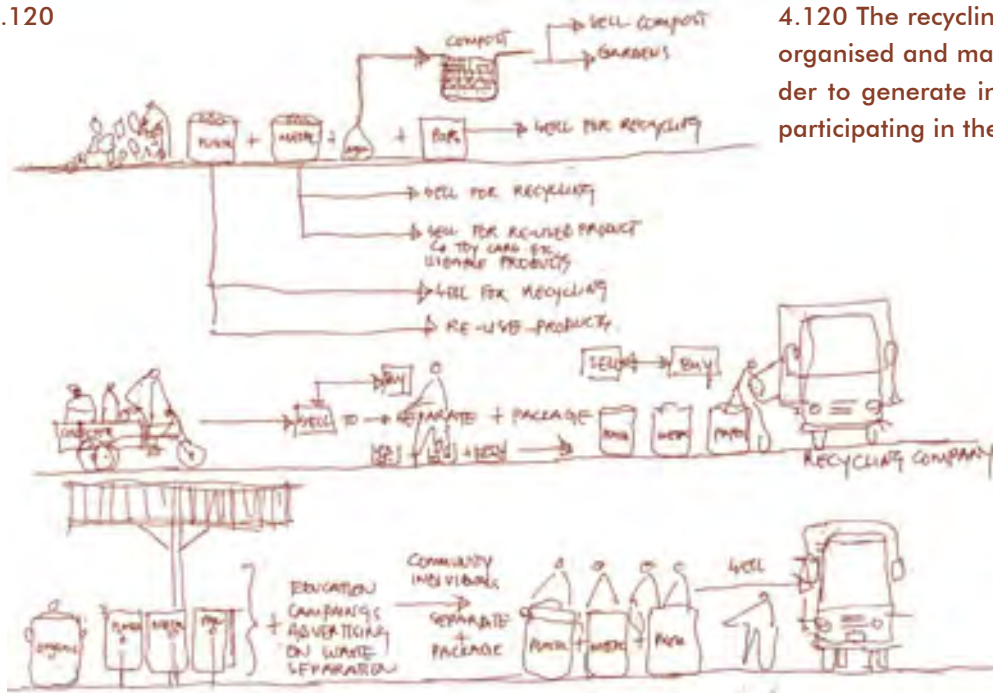
4.120 The recycling of solid waste could be organised and managed by residents in order to generate income for the individuals participating in the recycling programme.

4.122
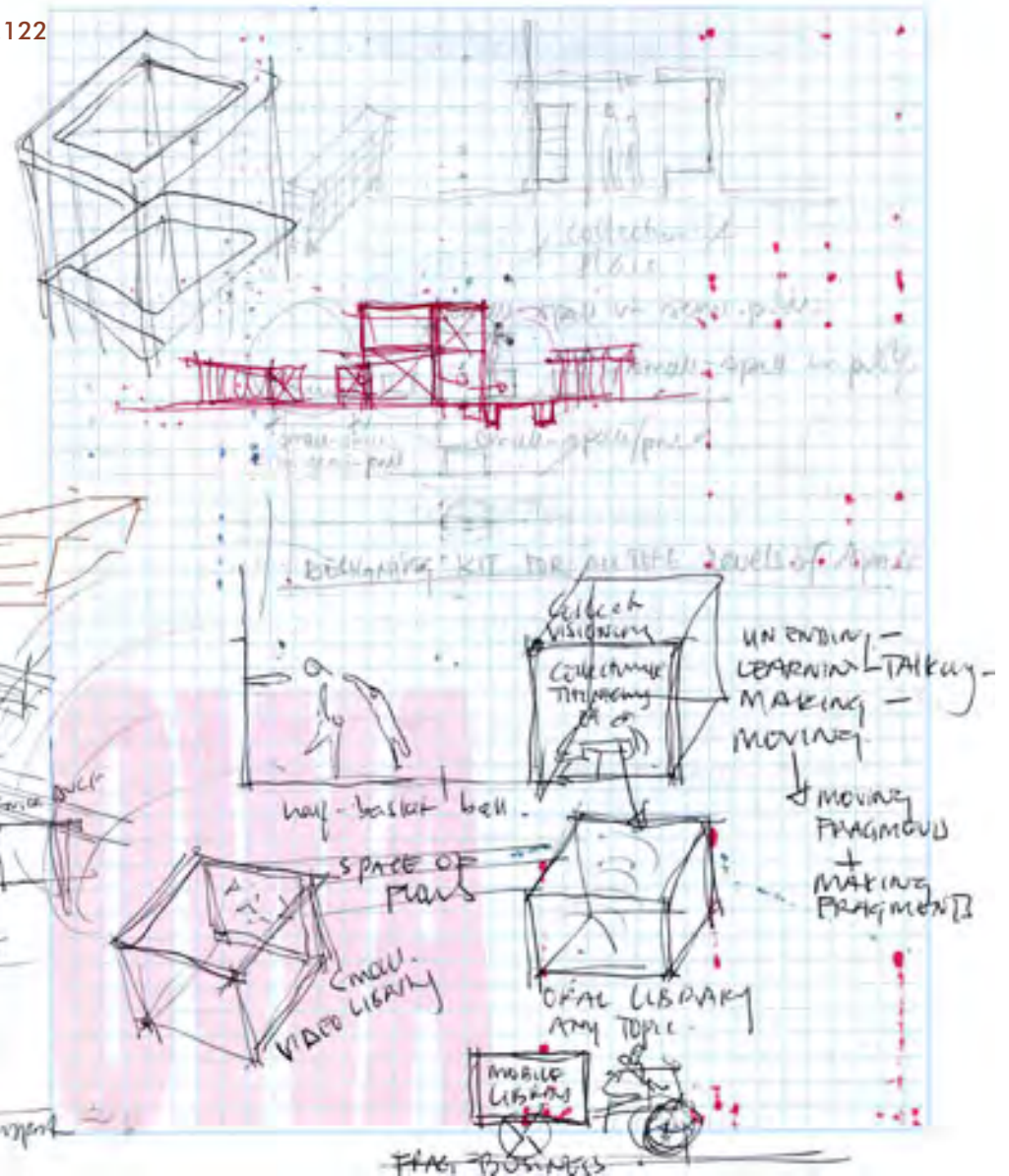
4.121
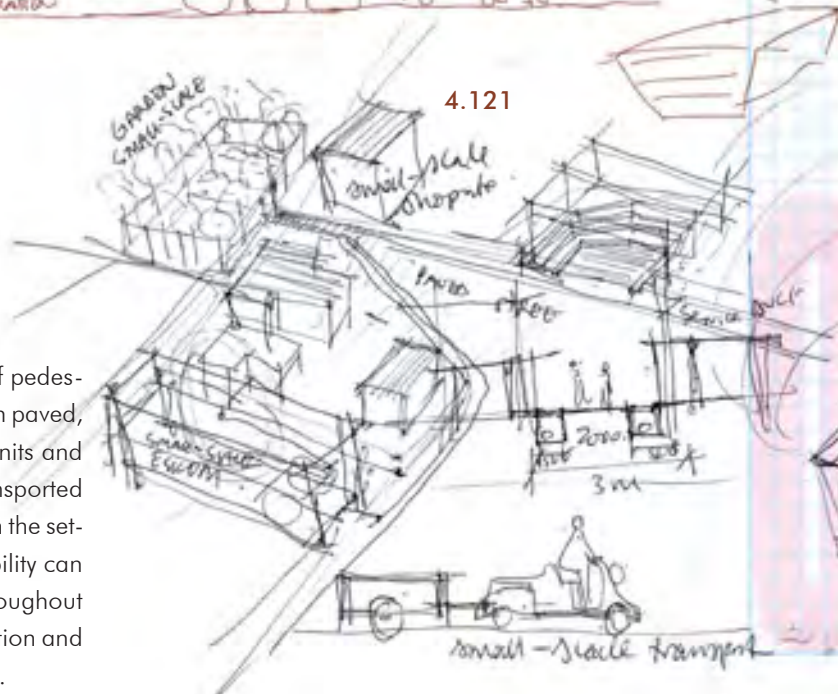
4.121–4.128 After the network of pedestrian and vehicular routes has been paved, mobile street furniture, housing units and other elements can easily be transported to wherever they are needed within the settlement. Designing for better mobility can ensure better living conditions throughout the different phases of transformation and development in Khutsong Section.

4.123
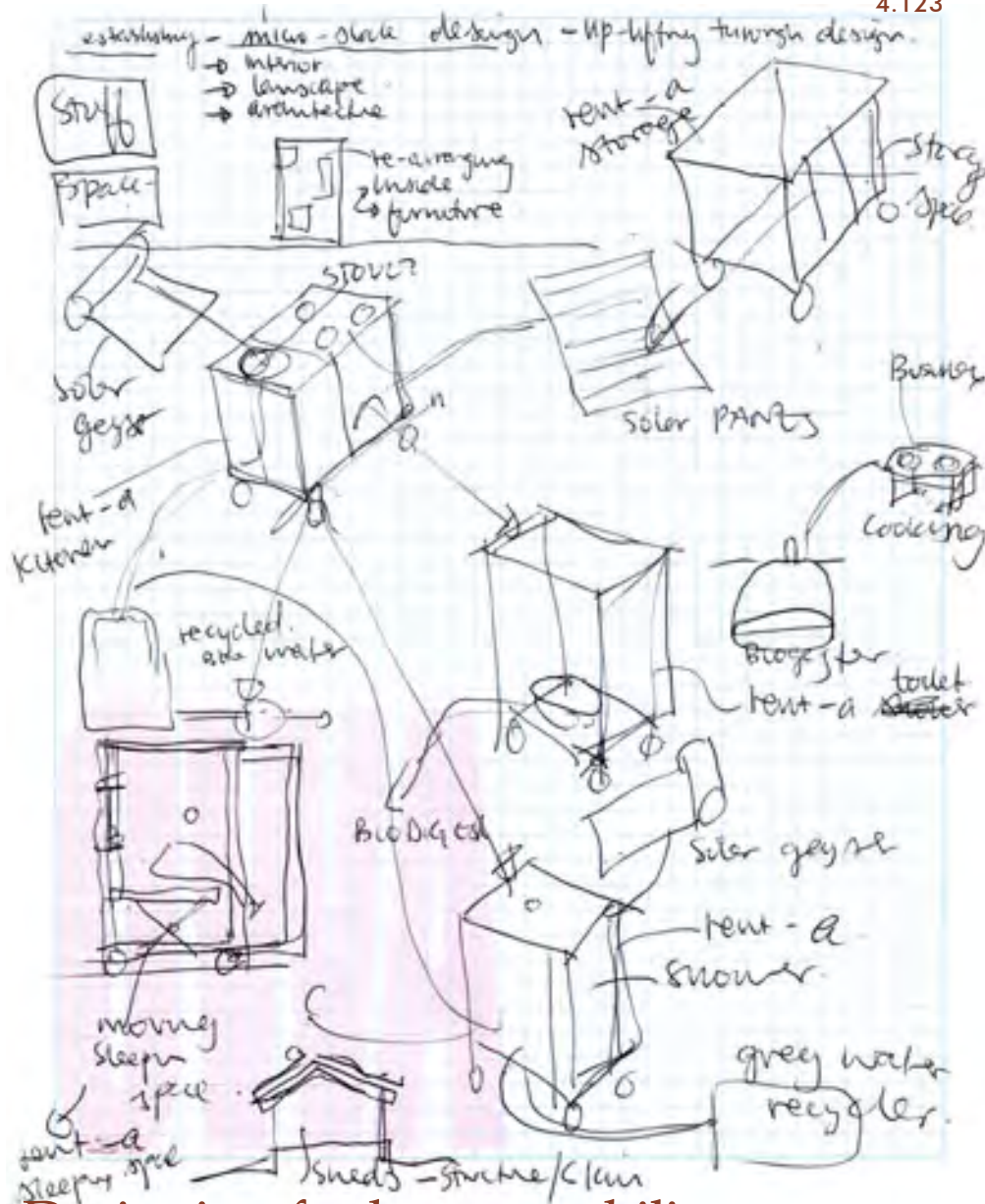
4.124
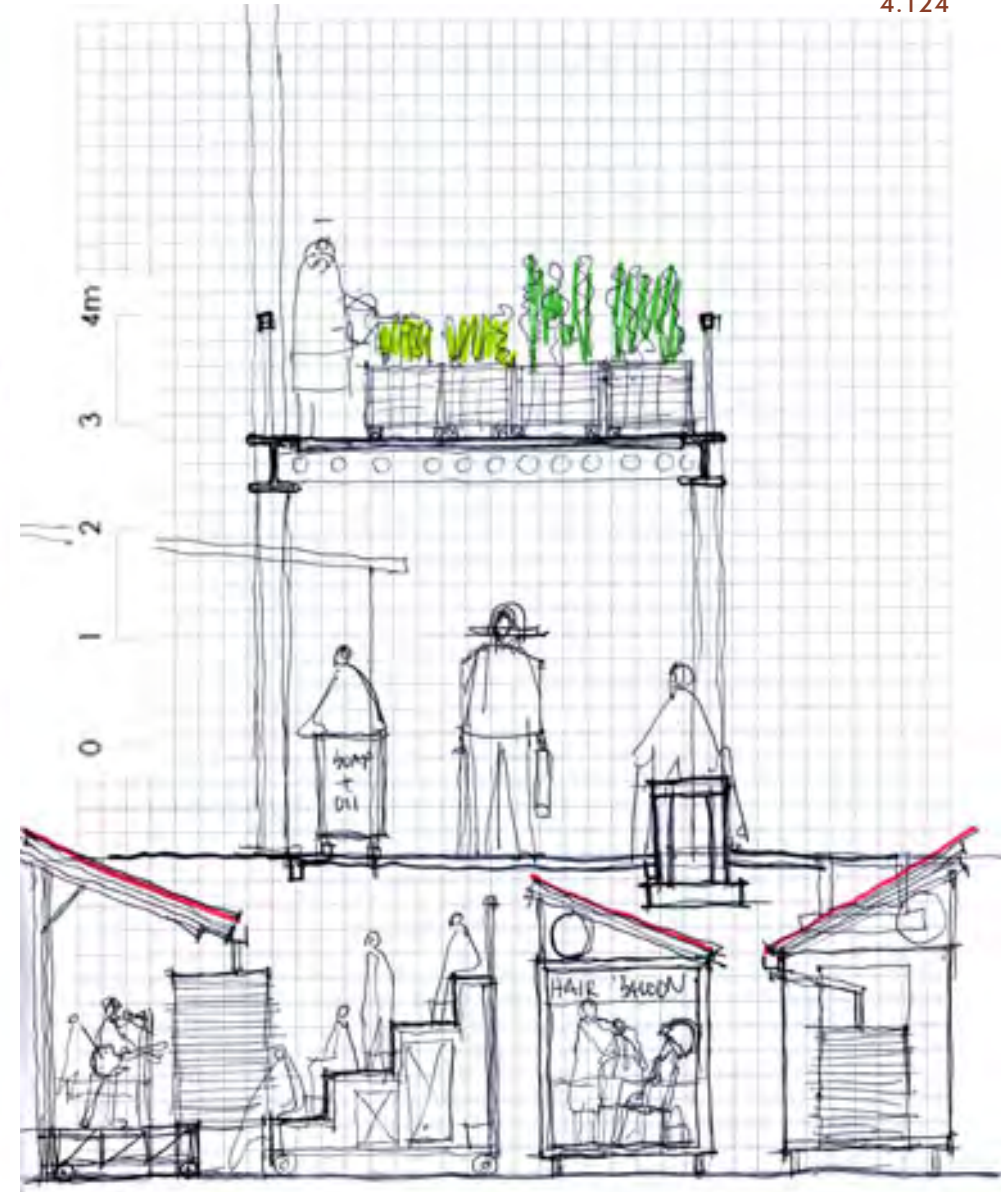
Designing for better mobility can ensure better living conditions throughout the different phases of transformation and development in Khutsong Section.

4.121–4.128 After the network of pedestrian and vehicular routes has been paved, mobile street furniture, housing units and other elements can easily be transported to wherever they are needed within the settlement. Designing for better mobility can ensure better living conditions throughout the different phases of transformation and development in Khutsong Section.

4.125

4.126

4.127

4.128

CONCLUSION:
Design invesitgation outcomes

The visual research began by responding to existing fractal pathways, spatial zones (houses and *spaza* shops), food gardens, water collection points, trees, community gathering space, toilets, waste collection points, poor economic conditions, low levels of education and relationship-building activities.

The design response for each of these aspects resulted to a range of socio-spatial solutions which will be integrated to form a holistic and consolidated design solution. Through this design investigation, vertical spatial planes are used to provide transitions from semi-private to public spatial domains. These transitions provide seating, trees, shops, gates, shaded spaces and limited visual connections between semi-private and public spatial domains.

The design solutions will be refined to be an integrated and consolidated design proposal for Khutsong Section.

PART 3
Research outcomes

3.1   A SPECIFIC SOLUTION CONSOLIDATED BY VISUAL-SPATIAL DESIGN

The main aim of this research was to explore visually-based research techniques to solve urban socio-spatial problems in informal settlements, using Khutsong Section informal settlement as a vehicle. This process began by establishing a theoretical, physical and methodological context for the study. Creating a context helped to establish design motifs, constraints and procedural means for achieving the main aim of the study. Thereafter, a visual narrative of the visual researcher's childhood socio-spatial memories in African settlements and his developed architectural visual research capabilities were used to establish a background and direction for the visual research process. A visual analysis of precedents and the study area was then conducted to formulate a design problem and design parameters so as to justify and inform the spatial design process that was to follow. The visual research and spatial design processes were focused on creating enabling urban environments by transforming and connecting existing private residences, private open spaces, and urban open spaces in Khutsong Section.

The architectural visual research was applied using Khutsong Section as a means to understand specific existing spatial and non-spatial attributes of streets and spatial arrangements in informal settle-

ments. Each street and open space in an informal settlement is unique and possesses specific characteristics. The existing layers of pedestrian and vehicular movement routes, the water supply system, shops, dumping spots, open spaces, food gardens, trees, fences, and footprints of houses were taken apart so that each design investigation could address them. Through the visual-spatial design investigation, the visual researcher addressed the disadvantages and explored the advantages of these layers. Thereafter, the layers and the associated range of design solutions were re-assembled and integrated to create a consolidated system of spaces. The consolidated de-

sign solution and further modifications to the urban layout are shown in the following graphical representation.

5.001   Paved fractal pedestrian and vehicular routes within Khutsong Section connect to the main roads: 22nd October Drive and Freedom Drive.

5.002   Individual plots are allocated and new buildings and trees are proposed based on existing spatial arrangements so as to increase spatial legibility, continuity, coherence, memorability, linkages, transparency, tidiness and integrated social and economic activities and enabling urban environments.

A VISUAL-SPATIAL REPRESENTATION OF THE DESIGN SOLUTION

5.002

Final responsive open space design solution for Khutsong Section

new buildings and trees are proposed based on existing spatial arrangements

Hlanganani St

Moagi St

Channel

Food gardens

Community swimming pool

**Community gathering /
Education/Recycling space**

Micro businesses space

0   10   20   30m

5.003 Khutsong Section integrated and consolidated upgrading proposal: Layout drawings. Shops are coloured yellow and the spaces used for recycling and community gatherings are coloured red. These lines of shops serve as semi-public spatial domains separating semi-private spaces from public spaces. This responsive design approach strengthens the existing fractal pathway structure by integrating trees, seating, paved areas, water collection systems, food gardens, existing houses and shops, waste collection points, urban elements, and community and educational facilities into a holistic design intervention. The aim is to express the identity of place and community values of Khutsong Section by creating aesthetic appeal, utility and functionality, while increasing opportunities for relationship-building activities which are integrated with educational and economic activities.

5.004 Added buildings along the edges of streets help strengthen the legibility and coherence of the urban spatial structure of Khutsong Section. The section drawings show the use of small shops, vertical spatial planes, recycling stations, seating, trees and low walls to create a connection between semi-private spatial domains and public spatial domains.

5.005
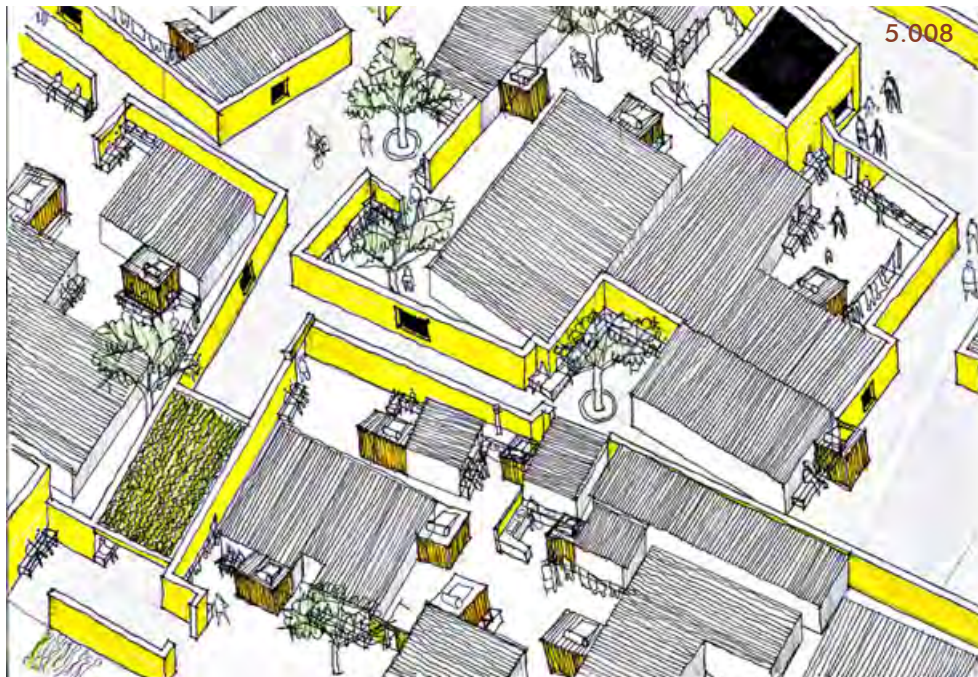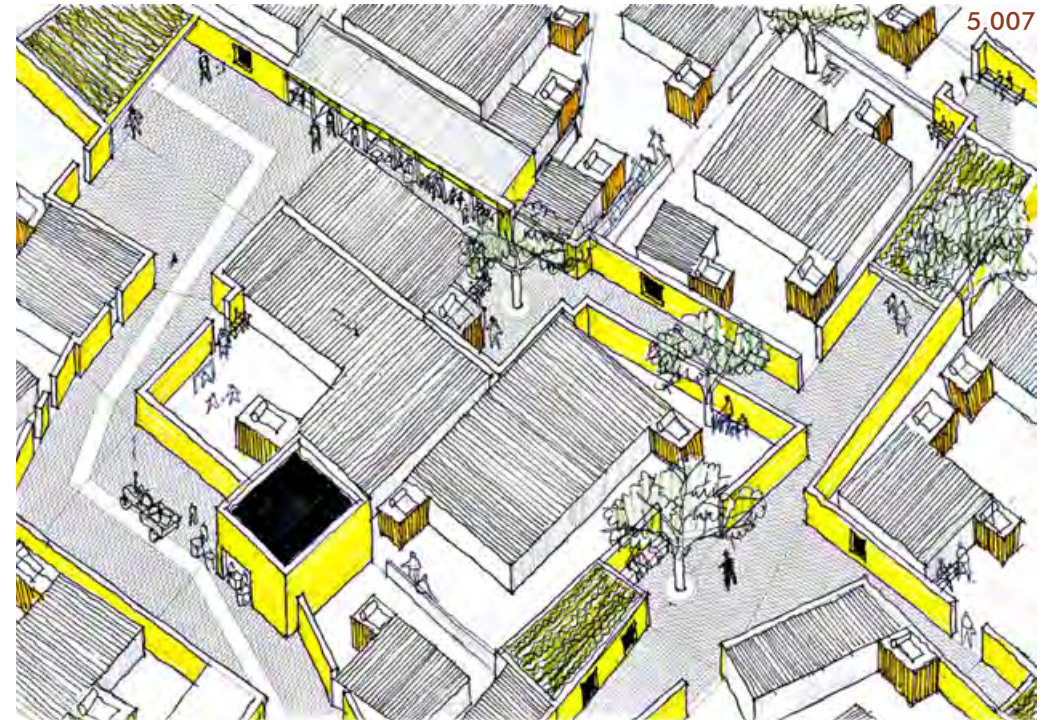
5.005–5.010
Recycling stations for water and solid waste are articulated to function as landmarks and gateways in order to provide legibility within the settlement. Linear thresholds, lines of small shops, trees, seating and low walls are used to connect semi-private spatial domains to public spatial domains.

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5.009

5.010

5.005–5.010
Recycling stations for water and solid waste are articulated to function as landmarks and gateways in order to provide legibility within the settlement. Linear thresholds, lines of small shops, trees, seating and low walls are used to connect semi-private spatial domains to public spatial domains.

Recycling stations for water and solid waste are articulated to function as landmarks and gateways.
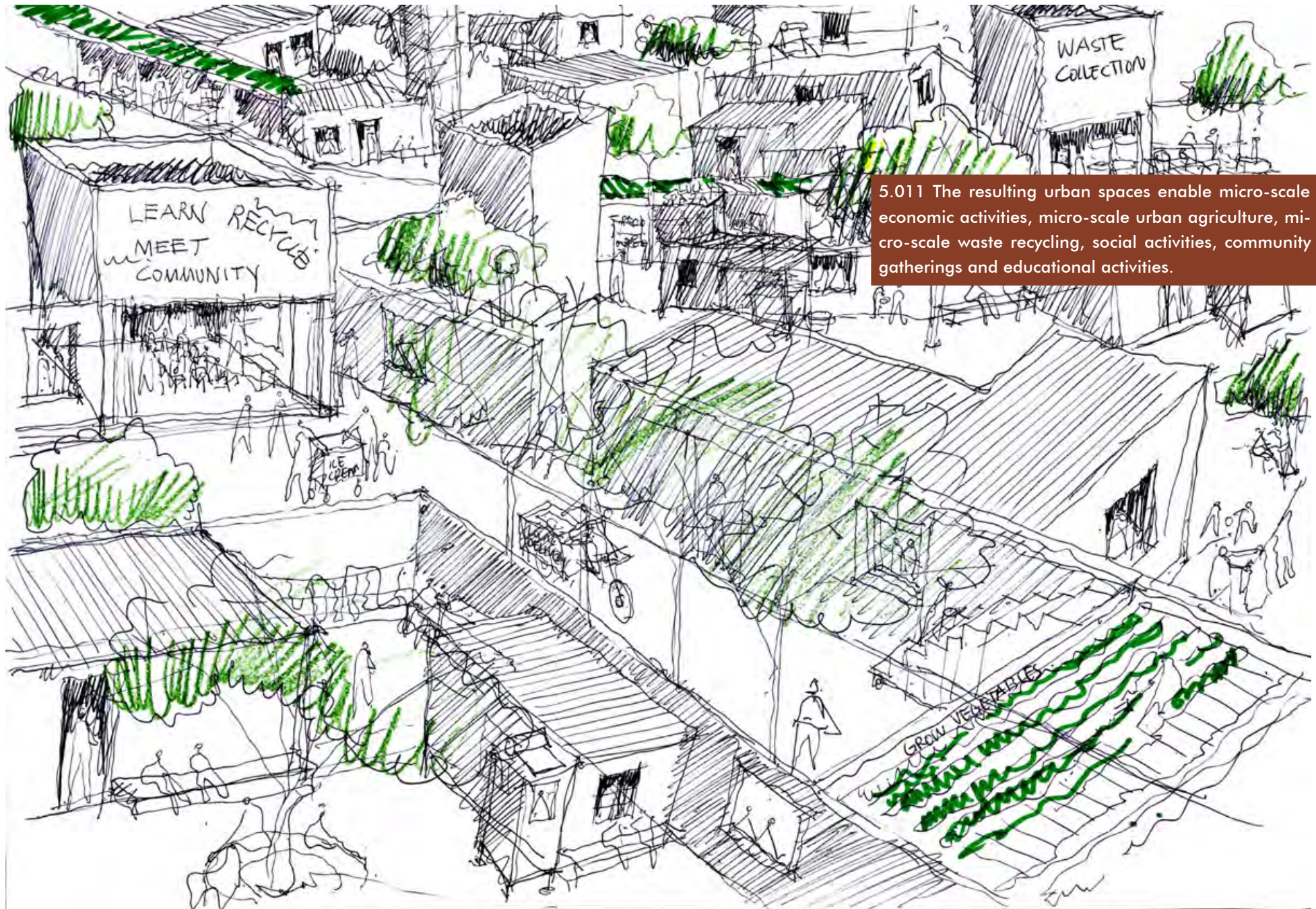
5.011 The resulting urban spaces enable micro-scale economic activities, micro-scale urban agriculture, micro-scale waste recycling, social activities, community gatherings and educational activities.

5.012
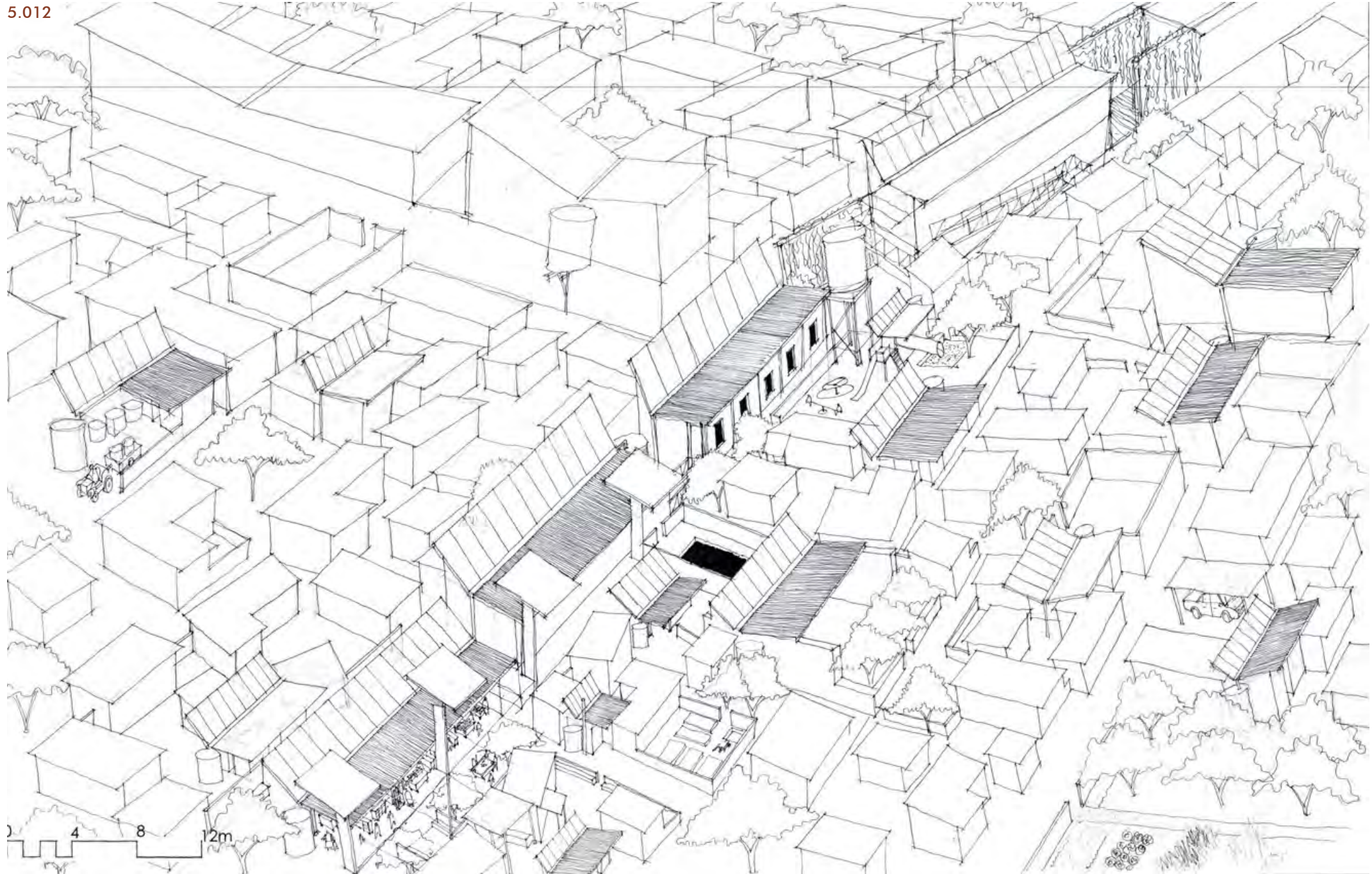
5.013

5.012–5.013
Educational, economic and social activities can be integrated along the busiest streets, which can also be used for the circulation of services and to connect to recycling stations proposed at existing dumping sites.
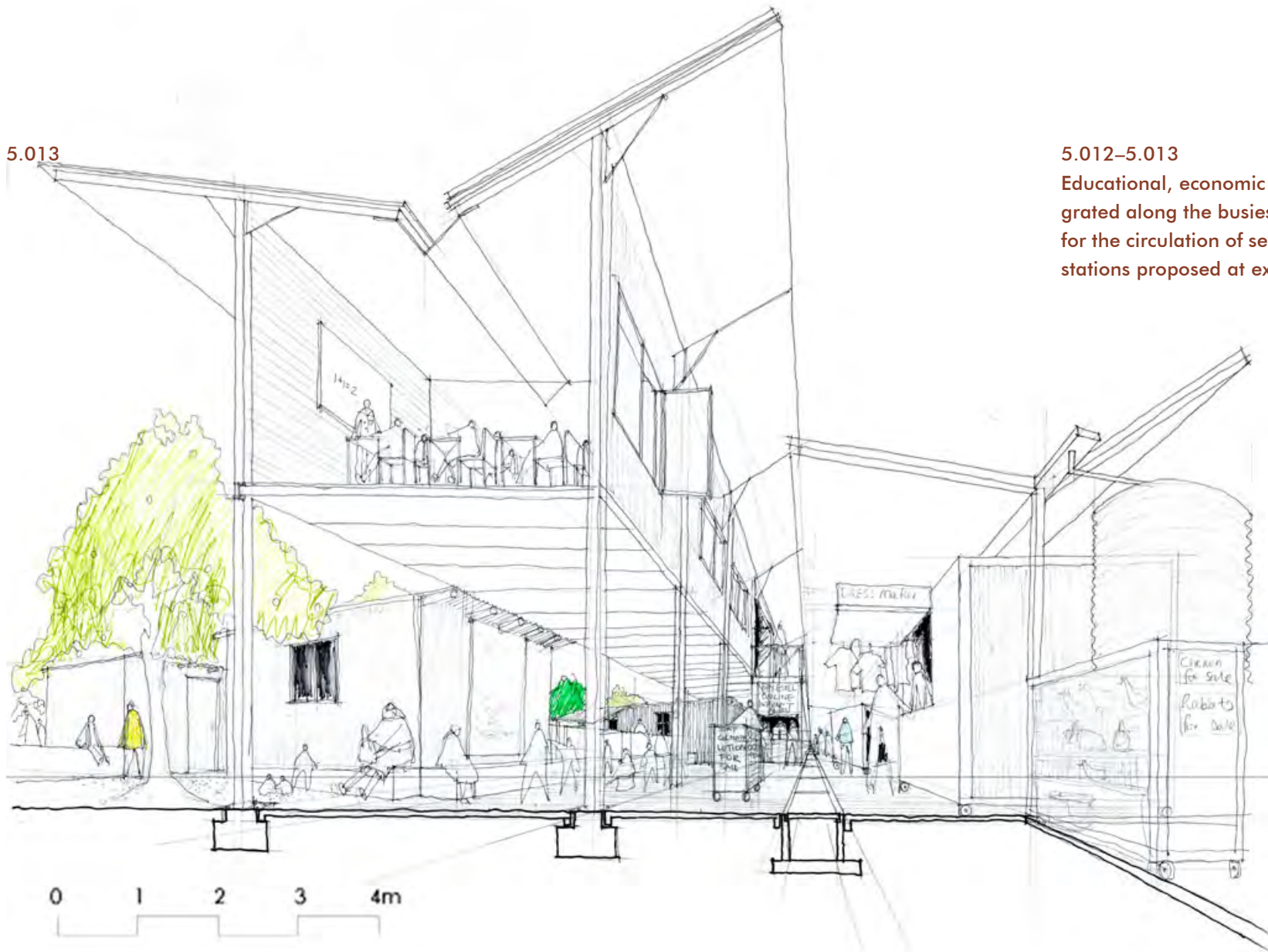
5.014–5.015

Mobile waterless toilets, stairs and planters can be used to promote the quality of life in the settlement, closing the gap in service delivery. Mobile structures for different uses can be used on paved transportation networks with good access and service connection points into which they can be plugged to support social and economic activities.

5.014
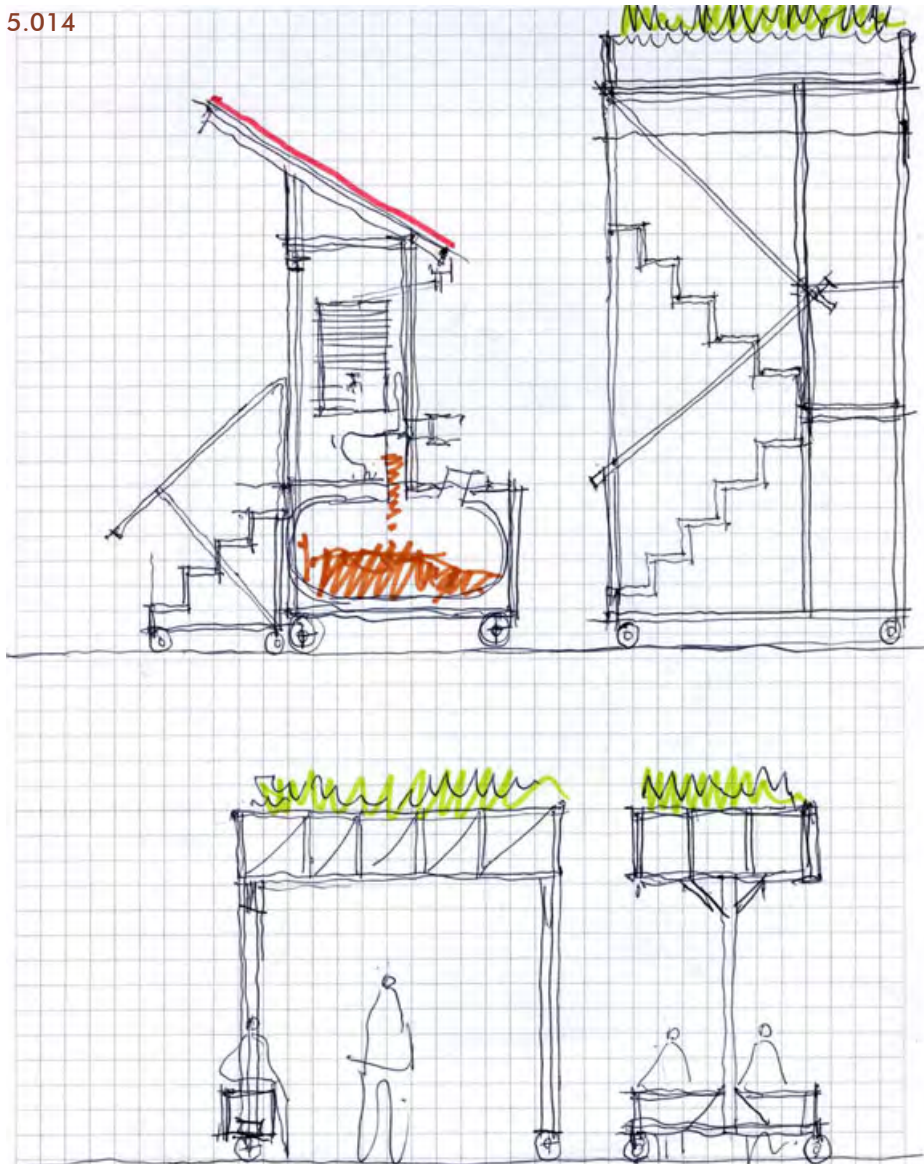
5.015
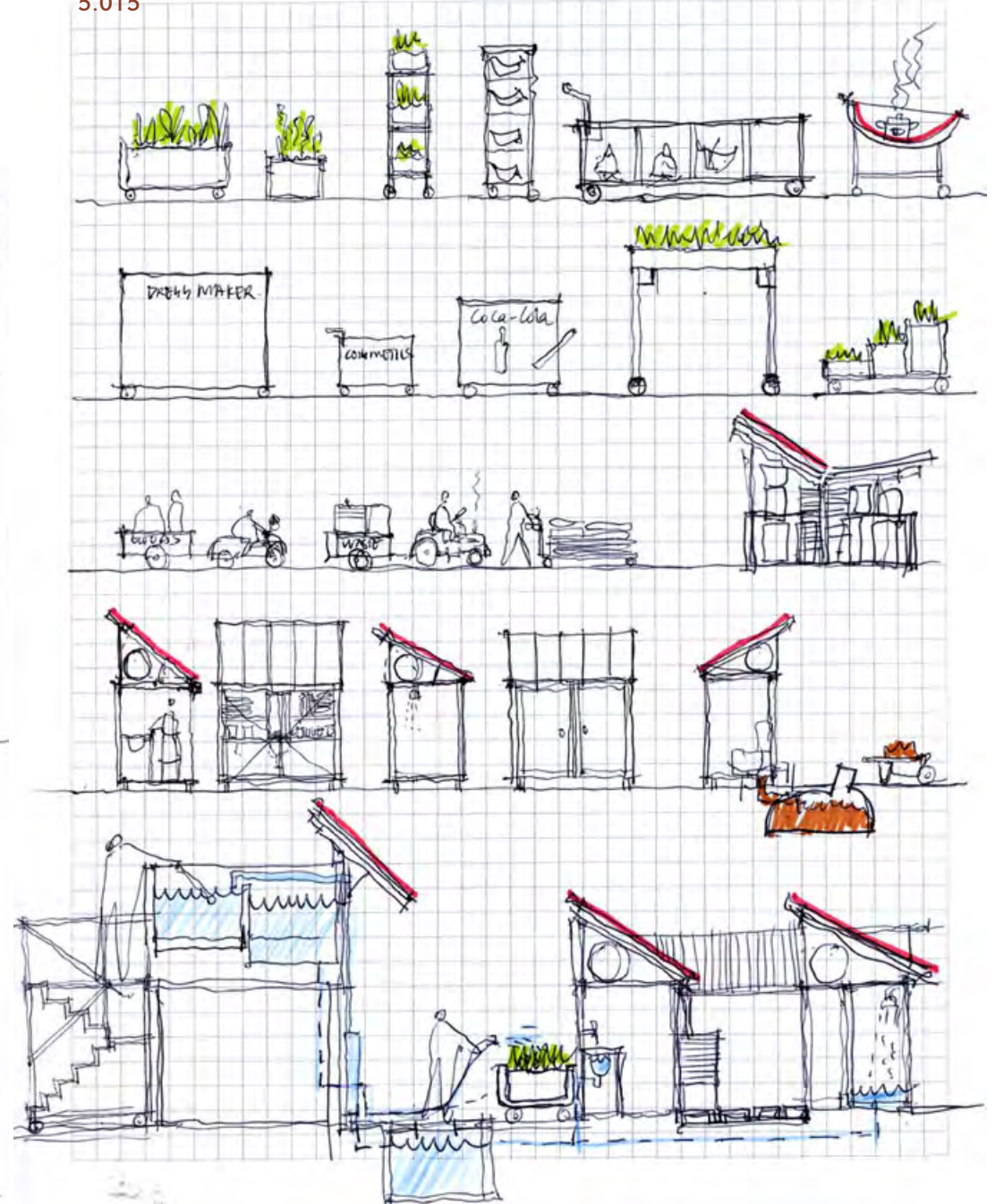
5.016

5.018

5.016–5.020
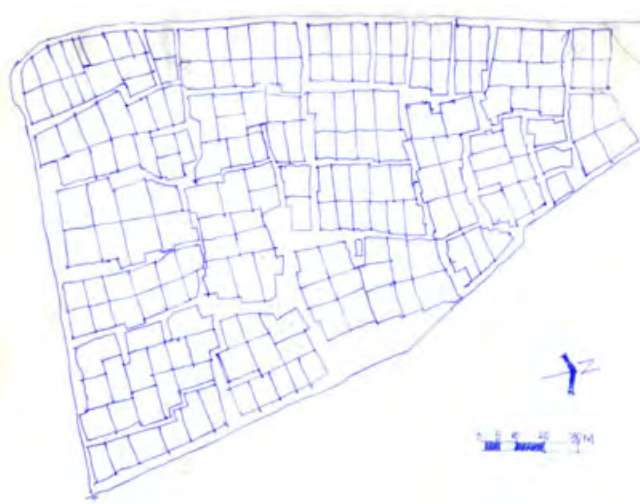
Allocation of title-deed private plots to residents can stimulate the local economy within Khutsong Section because of market-driven property values and sales. These drawings show different options for plot allocation layouts.

The existing informal boundary lines demarcating spaces claimed by owners of existing dwellings shown in images 5.016 to 5.017 are contrasted with images 5.018 to 5.020 which depict rigid layouts of plots. The latter lacks the complexity and variety present in the former.

Further urban layout proposals for Khutsong Section

5.017
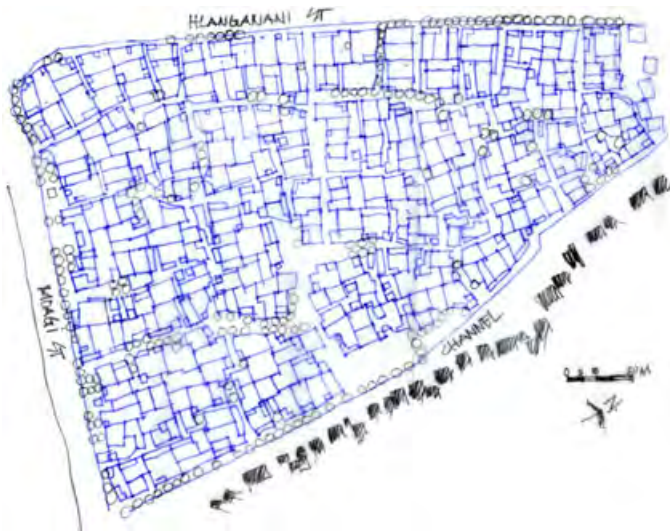
5.019
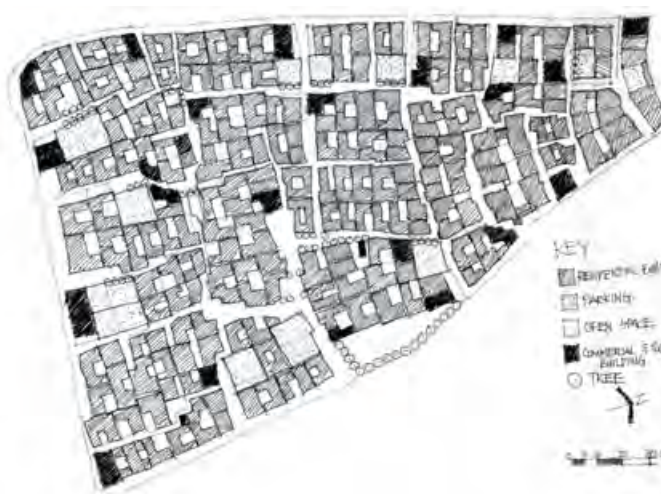
5.020
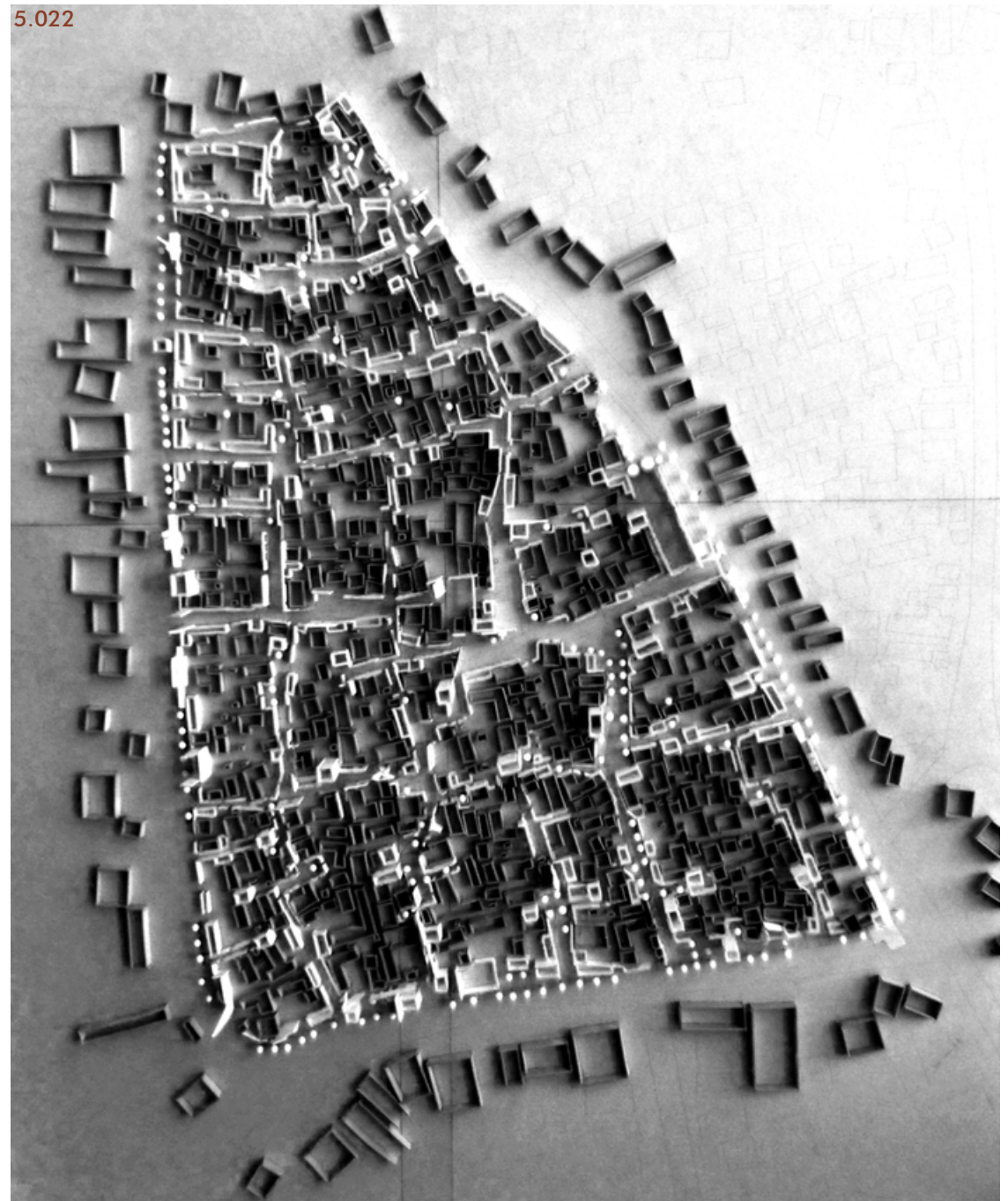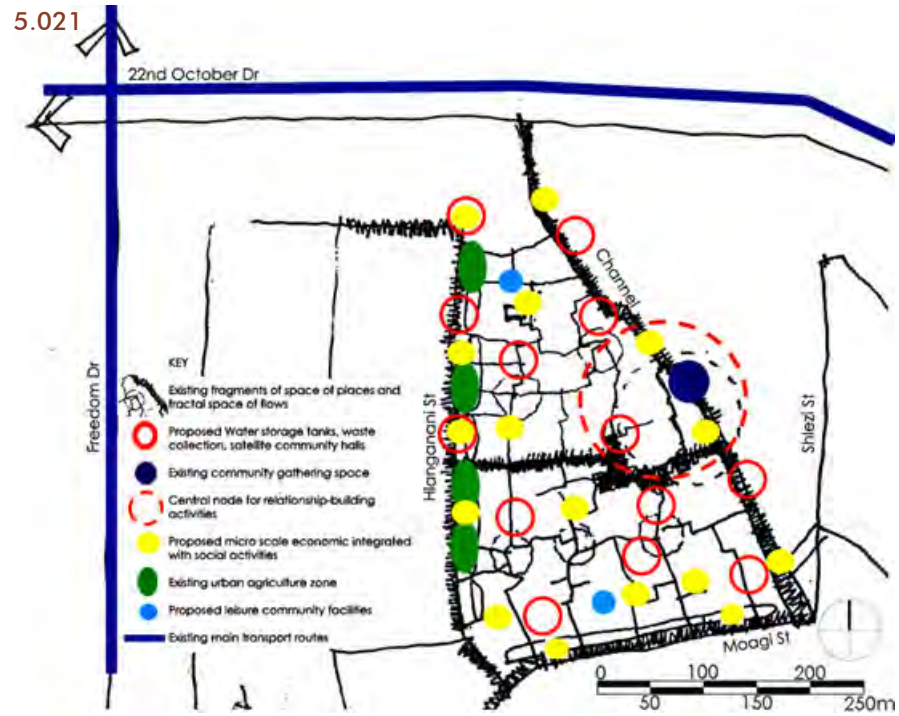
5.021 Strategic spatial positions and interventions for the Khutsong Section up-
     grading proposal.
5.022 A picture of a model for the Khutsong Section upgrading proposal.

5.023–5.027 Pictures of the model for the representation of the final spatial design solution for the Khutsong Section upgrading proposal.
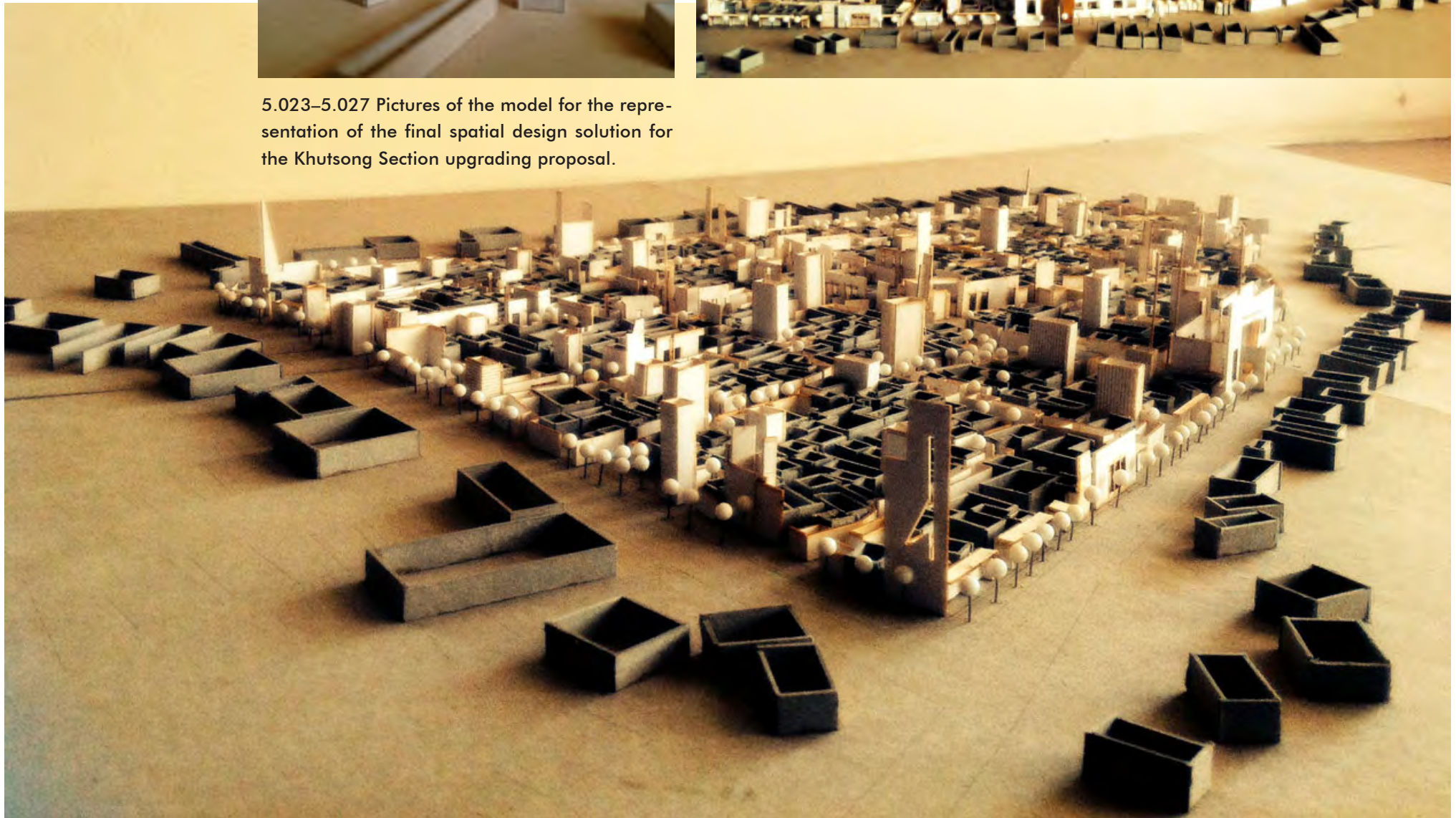
5.023–5.027 Pictures of the model for the representation of the final spatial design solution for the Khutsong Section upgrading proposal.
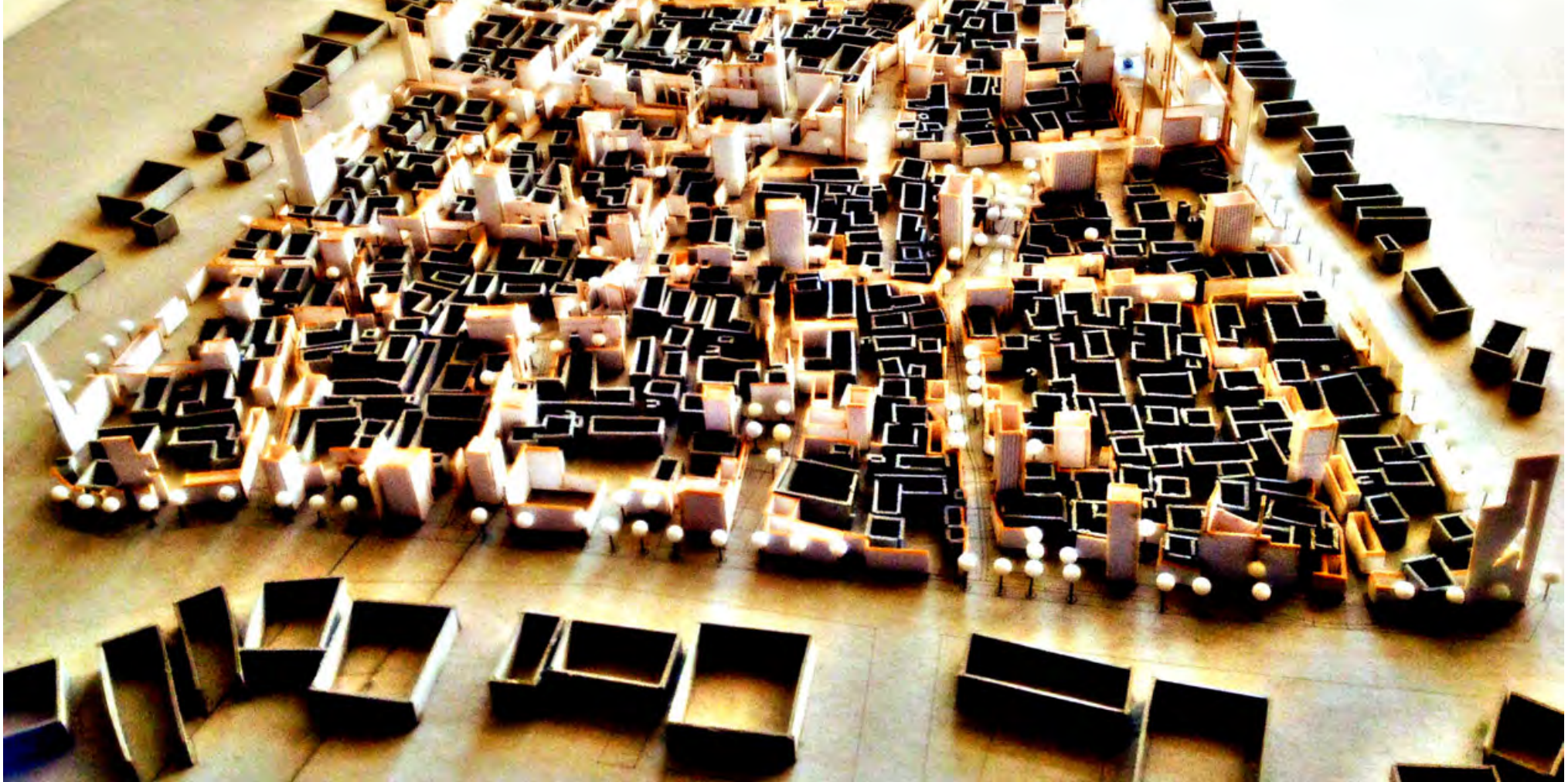
5.028 A graphical illustration of the final spatial design solution for the Khutsong Section upgrading proposal.

DESIGN IMPLEMENTATION PHASES

Implementing this proposal would result in new and improved technical skills and knowledge, increased income-generating capacities, and greater public awareness at community and national levels. The proposal addresses the triple-bottom-line leading to social, economic and environmental development and returns by: improving open spaces which can be used for relationship-building activities in order to strengthen social ties within the community; providing spaces for community gatherings, ICTs services and educational activities; providing more spaces for micro scale economic activities; and providing water management systems, waste management systems, energy systems, and green infrastructure.

The following proposed design phases are aimed at enabling more social relationships, micro-economic activities, and a variety of mixed-use activities (*see Addendum 6 for more details*).

Phase 1 – Green infrastructure: Street paving, drainage, trees, energy needs, urban agriculture, and water and waste recycling facilities.

Phase 2 – Place-making infrastructure: Threshold boundaries, gateways, landmarks, seating, more trees, civic space, small shops and fragments of communal facilities.

Phase 3 – Social infrastructure: Education centres, information centres, ICT centres, and infrastructure identified over time.

PHASES 1 & 2 OF THE CONSOLIDATED DESIGN SOLUTION FOR KHUTSONG SECTION

The aim of these phases is to offer numerous micro-scale integrated and diverse opportunities and interest areas for locals within each neighbourhood. Public spaces represent the space of flows that facilitates and connects these opportunities with the occupants in their vicinity. This is done in accordance with the following aspects:

1. Connections: Small pathways connect to medium pathways which connect to the main roads that feed into the settlement. Movement of people, goods and services flows through the hierarchical transportation network. Spaces between individual dwelling units and the streets serve as thresholds to connect semi-private activities to semi-public activities. The fine-grained urban morphology of informal settlements increases the permeability of street edges in each urban block. The progression from public domain, to semi-public domain, to semi-private domain and to the private domain could be enabled by inserting thresholds between spatial domains.

2. Nodes: These are different concentrated zones characterised by unique public activities like micro businesses, social spots, community gathering spaces, taxi stops and so on.

3. Landmarks and gateways: Introducing landmarks and gateways to public spaces would enhance legibility within an urban morphology. Gateways could be considered as thresholds between public domains along the busy main roads and semi-public domains on medium roads inside a settlement.

4. Energy: Individuals can own small solar panels to power some of their domestic appliances, like a solar cooker, a radio, a television etc., and to charge their cell phones (Jones, 2010: 98). Locals, especially young people, could produce pedal power for physical exercise while simultaneously powering, for example, stages for local events, cinemas and mobile phone chargers.

In this case, health activities can be integrated with social activities using ecological means. Hydrogen-fuelled cell power and biogas may be located at energy parks to supply each block of six dwelling units. Biogas units may also be used to produce gas for cooking and for heating water. Spiral Sun Solar Showers that use coiled pipes to heat water may also be used.

The key is to integrate these sustainable energy options with a variety of small economic and social activities. These options, instead of a big energy plant that is owned and operated by an outside company or the state, separated from the daily activities of the informal settlement, may ensure a sense of owner-

ship and may make these intermediate technologies valuable to the locals.

5. Water: Water may be categorised into four types (Jones, 2010: 181–182): (i) Clear water is potable water used for drinking only, which is supplied from stand-pipes or from bulk dispensing tanks. (ii) Blue water can be used for showering, washing and other contact human activities. A dam, river, tank etc. are the usual sources of this type. (iii) Grey water is used water from baths, hand washing basins, showers and any other washing operations. This type of water contains no organic contamination. If it is filtered it may be re-used for non-contact uses, like flushing toilets, irrigation, to extinguish fires, and any other non-contact activities. (iv) Brown/black water contains silage from food and effluent from toilets and is directed straight into sewer drains and septic tanks. Waste water may be managed by capturing and treating grey water, using soak ways or a reed bed, and by mechanical filtering. Rainwater may also be captured and stored in rainwater tanks. Waterless urinals and toilets may be used to avoid contamination of clear water.

6. Solid waste: Some of the residents in informal settlements are collecting and separating waste as a means of creating a living for themselves. The support infrastructure in the settlement should enable such individuals and even increase ways of rewarding those who participate in such activities (Jones, 2010: 301). Integrating waste collection, separation, salvage, re-uses, and repurposing with economic and social activities may ensure sustainability. Organic waste may be composted and then sold to people who need compost for their gardens. Alternatively, organic waste may be used to produce biogas. Educational campaigns should be part of the initiative to privatise and commercialise waste management in the informal settlement.

7. Re-use: Re-use of recycled materials for building purposes and for domestic products like sofas, tables, chairs and so on is common practise in informal settlements. Many dwellings are a collage of different materials salvaged from construction sites and other places. Public spaces have a different and unique sense of place due to the way these materials are put together in each dwelling unit. This culture of recycling materials is very strong in informal settlements and could be celebrated in public spaces.

The following systems, spatial elements, and activities are proposed for Khutsong Section:

1. Planting and trees: An entire orchard of fruit trees to be planted in each public space and along transportation networks throughout the settlement. Residents have already planted different fruit trees at their homes, which makes the settlement more hospitable.

2. Small-scale agriculture: Spaces for small-scale agriculture and farming to be provided. A variety of vegetables and crops to be encouraged, and local small-scale farmers to be provided with continuous training sessions on improving their harvests.

3. Seating: Seating to be provided under planted trees, along streets, at water collection points and at other existing social spaces. These social spaces to be equipped with braai and food-preparation facilities. Solar-powered street lights to be provided in existing social spaces.

4. Fractal pathways: The existing multi-directional, multiple and organic pathways to be paved. At least one 500 mm wide and 500 mm deep storm water channel to be provided that can also accommodate service pipes and cables along the pathways. Entrances to main pathways to be given a unique identity to enable users to orientate themselves.

5. Small-scale commercial and educational activities: The upgrade to allow for a variety of home-based small-scale tuck shops, internet cafes and other small businesses along pathways. They are to be integrated and related to public social spaces so that continual educational programs and mentorships could be organised and facilitated by settlement and street committee leaders to empower small-scale businesses. Local small-scale (for each street) education committees could also be created. Large and well-established educational institutions may provide support as the need arises, and collaborate with the community in training and implementation programs.

6. Small satellite community halls: Each street to have small gathering halls with a capacity of about twenty people. These satellite halls to be positioned at the entrances of streets and equipped with toilet and cooking facilities. They will facilitate community meetings, youth activities, church gatherings, educational programs, mobile libraries, clinics, etc.

7. Water collection spaces: Trees to be planted at communal water taps, providing facilities for seating and hand-washing of laundry. The water to be channelled to water recycling systems which will be maintained by locals in collaboration with the local authority.

8. Waste water systems: Waste water to flow through proposed channels along the pathways, be collected in retention ponds, and then be channelled into constructed wetlands and other water-purifying systems. The purified water to be used to water gardens, plants and trees. In each street, households can appoint a person to take responsibility for maintaining the channels and sort out blockages at an agreed fee.

9. Waste collection: In each street, households could agree to separate their waste into organics, plastics, metal and paper, in collaboration with the people who are already collecting and selling waste to recycling companies.

Hamdi (2004) suggests that fragments of street-level enterprises and small organisations in informal settlements can become smart by connecting to city-level, national-level, and even international-level organisations. These connections may become more affordable and possible through ICTs.

PHASE 3 OF THE CONSOLIDATED DESIGN SOLUTION FOR KHUTSONG SECTION

After fragmental use zones and spaces have been created, fractal transportation networks at different scales to connect the fragments could be established. The following network and digital communication infrastructure can help to increase interaction and support relationship-building activities (Mitchell, 2003: 95–118; Dijk, 2006: 130):

1. Telecommunication networks: Activities that cannot be linked by face to face interaction to be linked or connected through telecommunication (Mitchell,

2003: 69). Video conferencing, email, internet, cell phone messages, social networks (WhatsApp, Mxit, Facebook etc.) could be used to link individuals, businesses, organisations and communities. These networks interconnect rooms and buildings within the settlement and also link them to the entire World Wide Web. Locals to access resources that are at the other end of the world without leaving their neighbourhood.

2. Wireless capability: Support for the small-scale economy within the settlement to help locals to gain access to wireless networks provided by existing mobile network service providers. Smart mobile phones have the potential to connect locals at a more affordable and efficient speed. Portable wireless devices to be used for economic, educational, social and other purposes.

3. Local support stations: Providing small-scale internet service stations throughout the settlement is necessary for the success of network connectivity. These stations should preferably be owned by locals who would assist through the provision of computer and telecommunication hardware, software, access to subscription services, maintenance, upgrading and repair services as well as technical consulting (Mitchell, 2003: 74). Locals to be given opportunities to be trained in small community halls to become tutors and give training as a business opportunity.

The South African Presidential National Commission on Information Society and Development (PNC on ISAD) has revealed its aim to develop e-cooperatives ... *to become enterprises in Internet cafés and other ICT-related activities in their area* (South Africa Yearbook 2010/2011, 2010: 102). The PNC on ISAD intends to

provide socially excluded citizens with access to ICT facilities.

4. Delivery services: Local small-scale order-online service stations to be located all over the settlement. These stations could also function as collection points after an order has arrived, similar to the way a post office functions. They should be owned by locals to facilitate the flow of goods into the settlement.

5. Strengthened existing social spaces: Khutsong Section settlement's existing social gathering places are located along transportation networks. These social spaces could be used for these internet support and delivery stations. Considering the value of the oral tradition of notation in African culture, these social spaces could be rearranged to allow video conferencing for educational activities, national government meetings, and other social gathering events.

6. Products, information and services could be brought to these already existing social spaces. Local small businesses could be traced and empowered via these stations (nodes). These infrastructures may enable micro-scale businesses or organisations to have better opportunities so as to become global entities by linking to the rest of the global flow of social networks and economic opportunities. The facilities provided are aimed at increasing opportunities for people to connect to other people, so that they can expand their opportunities to find ways of earning more money by supplying some of the things that the rest of the community needs or wants.

FINDINGS

New layers were introduced to the existing layers in order to enrich the identity of place by bringing out the positive attributes of the open spaces of the settlement. These new layers include paving of existing routes, strategic positioning of trees, seats, drainage systems, waste collection systems, spaces for micro economic activities, shading devices, and walls. The purpose of these layers is to provide immediate solutions to the needs of the community of Khutsong while setting up a foundation for future developments. They are intended to be a light infrastructure that has minimum disruption in the existing spatial fabric.

> **A systems design approach was used to develop a responsive, integrative, and relevant design solution.**

The solution attempts to reflect the culture of place and community values by providing site-specific solutions. The resulting aesthetic appeal, utility and functionality of the design response proposal can help uplift the civic image of the settlement and cultivate its cultural identity and social networks. The design also integrates relationship-building activities with economic and environmental to ensure sustainability through innovative design resolutions. These issues were used in the spatial strategy to form part of the policy framework for the upgrading of Khutsong Section (*see addendum 5*).

The final integrated and consolidated design solution proves that a fragmental and fractal urban spatial intervention can improve the urban spatial quality by using simple forms and components. This design solution helps to cultivate Khutsong Section socio-spa-

tial potential, support sustainable local economic development, and create context-specific sustainable urban spatial environment. The following findings were drawn from the research process:

1. The mixed-use, very fine-grained, pedestrian-orientated, fractal and fragmental nature of the urban fabric of an African informal settlement tends to increase opportunities for social relationship-building activities. The analysed African rural settlements depicted a fractal and fragmental spatial structure consisting of spatial thresholds interconnecting public, semi-public, semi-private and private spatial domains. This spatial arrangement promotes different levels of relationship-building activities in African communities.

2. These social activities are integrated with economic, cultural, domestic, political and educational activities.

3. This interconnected nature of the urban fabric of African informal settlements is ideal for enhancing social connections.

4. A significant visual and spatial impact can be achieved by subtly introducing edge and threshold defining forms in Khutsong Section.

These forms can:
- (i) **Strengthen hierarchy in the spatial structure of the settlement to encourage relationship-building activities to occur in private, semi-private, semi-public, and public spatial domains.**
- (ii) **Enhance legibility within the urban fabric of the settlement.**
- (iii) **Accommodate integrated solid waste collection**

stations which are located along with storm and waste water recycling, which are also near ICTs infrastructure and energy systems which will support for the development of the settlement.
- (iv) **Serve as an enabling infrastructure for in situ upgrading of the informal settlement.**

SUSTAINABILITY

1. Social sustainability will be achieved through the improvement of open spaces that can support the creation and maintenance of relationship-building activities in Khutsong Section. ICTs centres, continuous community participation, education and training programmes shall help sustain relationship-building activities in the settlement. The upgrading proposal shall also contribute towards creating a good civic image and a cultural identity in Khutsong Section through the site specific, integrated and consolidated design solution.

2. Economic sustainability will be achieved through the provision of enabling infrastructure, services, continuous training, transportation systems and mobile components that can support the formation and expansion of micro scale economic activities in Khutsong Section. Economic growth and sustainability shall also result from strong social ties created by vibrant relationship-building activities. Local residents can also get an income by collecting and selling solid waste while helping to keep the settlement clean and function.

3. Environmental sustainability will be achieved by the protection and improvement of open spaces through the insertion of trees, storm water retention and waste water recycling systems, solid waste col-

lection, urban agriculture and solar energy harvesting systems. The improvement of the environment and systems of Khutsong Section shall be integrated with social and economic activities. The provision of trees, storm and waste water recycling systems and the well-organised open spaces can also attract relationship-building activities. The environment shall also be equipped with services and enabling infrastructure which shall sustain economic activities.

3.2   WIDENING THE APPLICABILITY
THEORETICAL APPLICABILITY

This study is useful in furthering an understanding of social and economic activities and the way they take place in the spatial construct of informal settlements. The theoretical context used for contextualising visual research in this study can be applied in the town planning, urban design and architecture disciplines so as to generate spatial composition motifs which can inspire and drive problem-solving processes in spatial design. Consequently, this understanding can be of value to those designing urban spaces with better human living conditions for the following reasons:

1. The study has applicability in that it encourages and stimulates discussions about African space, and about *ubuntu* as a design motif. It demonstrates how an African perspective can be of value in the urban design and architecture disciplines, as an attempt to highlight the need for native African spatial design philosophies to be better documented in order to contribute towards the design of improved built environments.

2. The study is also useful in that it promotes an interdisciplinary approach for solving urban open space problems. The sources used in the context of the literature are taken from a variety of disciplines such as the social sciences, town planning, urban design, architecture and the physical sciences. This is a relevant approach, since urban design and architectural problems are complex, multi-layered and multidisciplinary because they must relate to the way society functions in the physical environment.

THE SPECIFICS OF VISUAL RESEARCH

In this study it is shown that visual research as a method has demonstrated potential to be successfully used as a tool for solving spatial design problems in the urban design and architecture disciplines. Urban designers and architects are visual communicators by the nature of their profession, meaning that they must have developed discipline-specific skills – a consistent, personal and creative visual language to address spatial problems. Through drawing from memory, the researcher was able to explore some African tacit and indigenous socio-spatial knowledge systems. These knowledge systems served as design informers and played an important role in interpreting the selected precedents and extrapolating design motifs from them. The researcher also reviewed his architectural portfolio so as to identify and describe his visual-spatial problem-solving methodology.

Spatial problems in informal settlements and urban areas have different layers which involve human activities which occur in specific settings. The application of visual illustration was done in a broad spectrum of media and communication techniques that were used to survey and document existing spatial conditions and multi-layers in urban environments. The process of surveying and documenting urban spaces employed the researcher's skills in observa-tional drawings, drawings from memory, location and off-site drawings, and analytical drawings. Consequently, the same visual communication methods can be used to visually define and analyse urban spatial problems, a visual understanding of which is fundamental if the visual researcher intends to generate spatial ideas and solutions. Also, a visual and spatial understanding of the disciplinary and physical contexts promotes an appropriate spatial design response and becomes an informed stimulus for imagination in the visual researcher's mind.

Therefore, the visual research method is an effective way of thinking about, addressing, and solving spatial problems, compared to using only literature-based research methods. Visual communication makes it easier for the researcher to engage with tacit knowledge systems, formulate spatial design problems, iteratively solve spatial problems, and communicate the resulting spatial solutions.

By using visually-based research methods, it is suggested in this study that urban designers and architects can easily communicate their vision of sustainable upgrading to the involved community and other stakeholders. Visually illustrated urban spatial design solutions can be used to facilitate community engagement. Through a visually-based engagement with the process of upgrading, residents of informal settlements may have an opportunity to share experiences, cement their social relationships, instil environmental awareness, cultivate micro-economic activities, re-envision the future, and strengthen their sense of belonging. In the process of upgrading informal settlements, visual illustrations can be used by urban designers and architects to communicate:

- the cultural identity of an informal settlement;
- the development of streetscapes, precincts, parks, gardens and other open spaces;
- the participatory and celebratory experiences of festivals, gatherings and special events;
- the recognition by the public and private sector of a urban designer's and architect's role in society to inspire and challenge a community towards a positive future.

Visual illustration can be used by these design professionals to persuade, inform, generate ideas and communicate sustainable upgrading proposals. This study values visual assessments by these professions as socially, economically, culturally, ecologically and spatially significant research forms. Communities and the state need us, as urban design and architecture professionals, to help them make sense of socio-spatial interdependencies and to interpret spatial visions pictorially.

BROADENING THE UNDERSTANDING
OF A SPECIFIC CONTEXT:
DESIGN GUIDELINES FOR THE UPGRADING
OF INFORMAL SETTLEMENTS
The contexts of the literature, visual-spatial precedent studies, site analysis and iterative visual-spatial design process were used to establish a generalised approach to the context-specific conditions which exist in informal settlements. Using the visual research method, the researcher was able to contextualise, research and reflect on current and historical conditions of liveability in these settlements, and the social, cultural, economic and spatial contexts. Therefore, when upgrading informal settlements, visual research methods can be used in specific contexts to:

- provide an essential reference point to the positioning of the public image and 'branding' of an informal settlement;
- reinforce and highlight the residents' historical roots, cultural heritage and traditions as manifested in space and time;
- enable a spiritual connection between past cultural heritage and present living culture;
- create landmarks, i.e. symbols of recognition and orientation to help people navigate and encourage an experiential journey of informal settlements;
- improve the spatial legibility, coherence, continuity, tidiness, memorability, complexity, enclosure and transparency of informal settlements;
- unearth and evoke sensorial experiences within the symbolic realm inherent in people's cognitive 'mental maps';
- promote relationship-building activities by connecting space of places to space of flows;
- empower the expression of collective memory by shaping and manipulating spaces to become 'places' of collective significance and ownership in order to promote a sense of well-being;
- promote reflection, inspiration and celebration;
- challenge perceptions and prejudices; and
- propose better urban open spaces, cultural facilities, community centres, infrastructure, educational facilities, communal spaces and meeting places.

The visual-spatial precedent study and site analysis together broaden understanding of common spatial features observable in informal settlements; these were documented through drawings and photographs to illustrate a pattern of spatial arrangements and how these relate to socio-economic activities. The graphical representation, documentation, analysis and interpretation of specific spatial contexts in informal settlements promote better socio-spatial understanding for urban designers and architects, enabling these design professionals to easily use this study to assist them to better 'read' and understand informal settlements so as to be able to produce appropriate design responses in these contexts.

The resulting site-specific solution for Khutsong Section can have broader applications and be used as a generic approach in the design disciplines. This is made possible through the formulation of spatial design guidelines which can play an important role in streamlining sound design practices that can be used by communities, municipalities, town planners, urban designers and architects. The following guidelines outline procedures which can be followed to determine a course of action for sustainable upgrading projects. These procedures can be related to an upgrading spatial strategy (*see Addenda 4 and 5*) so as to position informal settlements as examples of sustainable upgrading.

FRACTAL SPACE OF FLOWS
The urban spatial structure of informal settlements consists of two main elements: space of flows (waste dumping spots, water collection points, pedestrian and vehicular movement routes) and fragments of space of places (dwellings, shops, semi-private, semi-public, and public open spaces, and toilets). Then enabling infrastructure is the third element which can be introduced in settlements.

The space of flows is like blood arteries and veins of a human body because they are the conduits through which the people, goods, services, and in-

formation are circulated throughout the settlement. Therefore, the first part of the guidelines will address the improvement of existing pathways, water, energy and solid waste dumping spots.

Existing pathways

All existing pathways shall be mapped to record the traffic flow of pedestrians and vehicles at different times within the informal settlement. Pathways of a minimum width of 1 metre on busy routes shall be identified for paving. In these paved pathways a drainage channel shall be installed, flowing towards the lowest point of a junction between zoned clusters of dwellings. The size of these drainage channels shall be determined by calculating the storm water flow per zoned cluster of dwellings.

A recycling station and community hall to serve each cluster

At least one water recycling station shall be provided for every two clusters at street junctions where storm water and grey water storage tanks are positioned. All dumping sites shall be identified and allocated for solid waste recycling stations, except if such a dumping site is not accessible from a paved pathway. Each solid waste station shall be equipped with solar panels and a rainwater collection tank, and may be used by local residents to store, sort, package and sell such waste as a means of income generation.

A building footprint of a maximum of 18 square metres shall be permitted for each station. Each station shall be equipped with solar panels, play pumps and rainwater collection tanks with a minimum storage capacity of 5 000 litres, unless rainwater and storm water calculations require otherwise. There should be a minimum of 1 000 litres available in storage tanks

(installed with pressure pumps) at any time of the day for fire-fighting purposes. The solid waste and water recycling stations shall be used as landmarks by articulating their height, form and finishes to help pedestrians orientate themselves within the settlement. These recycling stations shall also be used for committee and other community meetings to drive development projects and to run training programmes for each zoned cluster within the informal settlement.

FRAGMENTS OF SPACE OF PLACES

The second part of the guidelines deals with all the enclosed and open spaces that are connected or adjacent to the space of flows. The interventions will exclude the improvement of individual dwelling houses but include the introduction of thresholds between open spaces around dwellings and pedestrian and vehicular movement space, provision of seating, stalls for micro scale enterprises, trees, and food gardens.

Existing houses

Clusters of a minimum of 5 houses and a maximum of 70 houses shall be identified and zoned following the existing fractal pathway structure around them. Paved pathways shall be used as a means of supplying services and to access each zoned cluster.

Spatial thresholds and domains

Existing fences and invisible boundaries separating activities at each dwelling shall be identified. Spaces where domestic activities like laundry, cooking and other semi-private social activities take place shall be zoned as semi-private spatial domains. Spaces used for micro-scale economic activities like tuck shops shall be zoned as semi-public spatial domains. Linear spaces used by pedestrians, playing children, vehi-

cles and for community gatherings shall be zoned as public spatial domains. Existing fences and dwelling activity thresholds between semi-private spatial domains and public spatial domains shall be identified and marked for installation of the spatial threshold techniques discussed below.

Seating

Seating and low walls of a minimum height of 300 mm and maximum height of 900 mm shall be installed as thresholds between any semi-private spatial domain and any relatively less busy pedestrian pathway. All such seating and low walls shall have a minimum depth of 400 mm. A minimum of 0.3 linear metres of seating shall be provided for each 3 square metres of urban plaza areas like community gathering spaces, in front of shops, and on pathways. Seating with a minimum width of 760 mm shall be accessible from both sides. In order to make provision for handicapped persons, a minimum of 5 per cent of the required seating shall have backs at least 300 mm high and a minimum seating depth of 355 mm.

Linear spatial thresholds

Where existing pathways of a maximum width of 3 m separate two existing block edges of a zoned cluster, a wall with a minimum height of 3 m shall be installed with openings aligning with the sizes of doors, windows and gates of the nearest houses, shops and block edges. To indicate gateways and thresholds between one zoned cluster block and the next, such walls shall be articulated by using height, decorations, openings and finishes reflecting social motifs of the relevant cluster blocks. Such walls may be used for signage and graffiti only for the purpose of promoting legal products and services offered within the set-

tlement. Such walls shall be arranged in such a way that they prevent the spread of fire and limit existing zoned cluster blocks from encroaching onto paved pathways.

Shop frontages

Where existing shops face an existing pathway adjacent to an existing fence or invisible activity boundary located a minimum of 2 m away from a house located in a zoned cluster, a strip of shops a minimum of 2 m wide shall be installed on both sides. These shops shall be installed in such a manner that a continuous block edge of a zoned cluster is achieved. All such uses shall be directly accessible from the adjacent public space or adjoining arcade. The arrangement of such shops should maximise northern exposure wherever possible.

Except for that portion of a pathway that widens along a narrow street, a minimum of 50 per cent of the total frontage of new building walls fronting onto an open public space, exclusive of such frontage occupied by existing houses and recycling stations, shall be allocated for occupancy by retail, service establishments, libraries, museums and art galleries.

Trees

A minimum of one tree of 100mm diameter or more shall be planted for each 6m of the entire street frontage bordering two cluster blocks. Such trees shall be positioned in such a way that a continuous block edge is formed while shade is provided to seating located in public open spaces. These trees shall be planted in at least 5 cubic metres of soil per tree. Existing trees should be preserved wherever possible unless they are invasive species or obstructing the quality of open urban space.

Existing urban agriculture

Existing urban agriculture and farming activities shall be preserved and conserved. Such activities shall be supported by continuous training programmes in order to ensure their continuity and sustainability.

Existing water collection points

All existing water collection points shall be paved and equipped with seating and trees complying with the requirements mentioned above. Drainage channels from taps shall be linked to channels leading water to water recycling stations.

ENABLING INFRASTRUCTURE AND SUPPORT

The last component in the guidelines addresses the need for technology, skilled labour and leadership to ensure a continued and growing development in informal settlements. This will be done through the provision of ICT infrastructure, mobile systems that can be used by micro scale enterprises, and on-going training and skills-transfer programs.

ICT infrastructure and education

Channels provided in the paved pathways shall be used for running ICT cables and community halls shall be equipped with Wi-Fi hot spots. Each community hall shall have a technical room to be used by an information technology technician who will be responsible for providing on-going training, assistance, and management of e-learning, e-trading, and e-governance for local residents with the support of the Department of Communication and the Department of Education.

Components

A variety of mobile components shall be custom-designed and manufactured for the purpose of street vendor activities within the informal settlement. Solar powered cart cars shall be used to transport goods, waste, and people where roads are too narrow for vehicles within informal settlements.

Maintenance

Building owners in each zoned cluster shall be responsible for the maintenance of the urban open space, including, but not limited to, the confinement of permitted obstructions and litter, and the control, care and replacement of vegetation within the zoning lot and in the street nearest to their cluster block.

Management

A management committee consisting of local residents and officials from the local municipality shall be formed. The responsibility of the committee shall be to manage services and resources with the help of block committees, ward committee and the local residents of informal settlements.

CONCLUSION

A responsive and integrative design approach can be achieved by using the guidelines outlined above. The guidelines respond to existing space of places and space of flows in informal settlements by pointing out specific actions that can promote sustainable neighbourhoods.

3.3 FURTHER RESEARCH

The achievements of this study point to the need for further research on sustainable and affordable ways of improving informal settlement upgrading, the concurrent and aligned improvement of existing housing stock and the achievement of efficient tools for promoting community participation in informal settlements. The following are deemed to be important to advance knowledge in the field of research:

- Continued collaboration and communication between the Department of Human Settlements, Department of Public Works, local municipalities, South African Bureau of Standards (SABS), architectural and planning schools in tertiary institutions and the environmental design professionals, in order to define the role of planners, urban designers, architects, and landscape architects in UISP projects.

- Developing spatial strategies and town planning schemes that are responsive to and suitable for informal settlements.

- Finding more visual research approaches to structure community participation as a tool to share knowledge, transfer skills, and create an on-going dialogue between the community, relevant government departments, and the built-environment professionals.

The need also exists for further research on the South African National Standard (SANS 10400-A (2010)) National Building Regulations (NBR) to achieve energy-efficient buildings, fire protection, structural safety, and sustainable service systems for informal settlements. Informal settlements present numerous challenges that can be viewed as possibilities and opportunities for urban designers and architects to explore and tap into to create sustainable human settlements.

The research for this study only dealt with interventions that can be made in public and semi-public spaces in informal settlements; therefore a need exists to employ visual assessment as a research tool to investigate sustainable solutions for the improvement of semi-private open spaces and individual dwelling units in each cluster in the settlement. The results should lead to context-specific socio-spatial solutions that integrate the relationship-building qualities achieved through this research, with other quantitative and qualitative norms of achieving an appropriate quality of housing with urban density, form and space ratios, and adequate services and infrastructure.

The development of visually illustrated guidelines to be used for the improvement of self-help housing in informal settlements could prove useful when upgrading these settlements. Further research is necessary for addressing the challenge of land ownership and how the architectural profession can be structured to provide its services to community members in informal settlements. Perhaps the direction of the research will need to redefine formality and informality in informal settlements, and help establish policies that can promote infrastructure provision, housing and private land ownership through the involvement of the urban design and architectural professions.

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ADDENDA
1: Research approach

Knowing that causes are connected to effects helps one make wise decisions and helps one to respond prudently to life's circumstances. Reading about political and labour problems in southern Africa reveals that the price of chromium will rise by implication, resulting in higher prices for stainless steel and everything made of it. Recognizing that how a child is treated will affect what type of adult he or she becomes encourages one to take care of his or her marriage and family.

Everything that people do has consequences, as does anything that they neglect. People do best by becoming adept at seeking out context and connection for almost everything. Visual-spatial precedent studies, site analysis and design explorations methods will be employed in this research to search for hooks, fasteners or connectors in the form of relationship-building activities and spaces in informal settlements. Sets of boundaries within which to be engaged in a visual investigation can help a designer to direct a project and precisely identify the problem or series of problems that need to be addressed (Noble & Bestley, 2005: 46).

The research methodology selected for this study must be suitable for creating an informal settlement upgrading design proposal that is justifiable in terms of the processes used, can address the research problem and achieve the research objectives (Noble & Bestley, 2005: 59). A qualitative methodological approach will be used in this study whereby contextualisation and the creation of urban form and space will be explored. The researcher, as viewer of the design product, may also subjectively respond to the visual forms and the reading of the graphically represented spaces. Conclusions will be drawn from predominantly qualitative data to uncover the causality of relationship-building activities occurring in informal settlements (Babbie, 2005). The

collected data will be employed to inquire into and investigate social networks and their spatial implications in African settlements.

According to Mouton (2003: 161) ... *qualitative (or naturalistic) evaluation approaches involve the use of predominantly qualitative research methods to describe and evaluate the performance of programmes in natural settings, focusing on the process of implementation rather than on (quantifiable) outcomes.* The qualitative approach helps to uncover the *Being* as it manifests as a *being*. The motives or essence of an informal settlement is presented through the unfolding or prevalence facilitated by technology.

The selected research method will be used as a tool to understand and learn from the socio-spatial interdependencies in informal settlements. According to Payne ... *The real challenge for developing countries is to focus on the social and economic practices that work for the poor on the social problems and modify official systems of regulations, standards and procedures to incorporate these, rather than expecting the poor to adapt to the middle class perspectives of bureaucrats and professionals. This involves ... examining, and building on, systems of local finance and livelihood strategies the poor themselves have developed out of the necessity to improve their lives* (2009: 17).

As far as the empirical realm is concerned, validity refers to the extent to which a specific measurement provides data that relate to commonly accepted meanings of particular concepts (Babbie, 1995: 123–130). In this study, this will be achieved by using content validity. Content validity deals with the degree to which a measure covers the range of meanings included in the concept.

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ADDENDA
2: Historical approach

In order to learn about and understand the background and growth of African settlement patterns, a historical research approach will be employed (Silverman, 2001: 16). This contextual research will inform the designer, focus the design project, and lay down a strong case upon which appropriate and useful solutions may be constructed (Noble & Bestley, 2005: 125). The author was born and brought up in informal African settlements. The historical account will be informed by childhood experiences, education, and narratives of events gathered from an African community (Neuman, 2006: 420).

This study is searching for social determinants in the use of space, and it is difficult to identify and measure social values. The very attempt of identifying may even alter the measured values; therefore, since the author grew in up in an African settlement, the participant-observation experience will help to moderate the findings. The research argument will utilise an African relational ontology termed *Ubuntu* (*I am we; I am because we are; we are because I am; I am in you; you are in me*) (Chilisa, 2012: 108–109). The *Ubuntu* concept was not taught to the author as a course would be taught in a modern school or college. The word *Ubuntu* was rarely mentioned, yet it radiated from many fragmented daily teachings, examples, corrections and reproofs on how to forge and maintain relationships with other human beings, both the living and the non-living. There was an emphasis on spirituality that is expressed in covenants, love, and harmony among peoples and communities.

What is seen and what is experienced in our everyday lives is as likely to be as significant in our understanding and creation of history as the reading of books or archives (Ashton & Kean, 2009: 7). The use of diverse sources in the writing of history plays an important role. In this study, local and personal experiences will be connected to material (books or archives) and experiences to broaden the author's understanding of the past, while challenging and changing the way it is perceived (Ashton & Kean, 2009: 7).

Following this, references to other authors who have observed and documented history of Bantu-speaking societies will balance the biases of the author (Tunstall, 2006). The visual-spatial background of Bantu-speaking societies will outline the influence of their social activities and values in the settlement pattern and spatial use being observed. Perhaps, in this context, causal relationships could be established as far as spatial construct and social structure are concerned (O'Leary, 2009). Bantu-speaking communities share similar traits with other sub-Saharan African communities. Therefore, the social-spatial analysis will include examples from some sub-Saharan countries because informal settlements in South Africa are composed of many African nationalities.

A historical approach will help to connect the physical and intangible historical layers that have created the *genius loci* of informal settlements (Moughtin, Cuesta, Sarris, & Signoretta, 1999: 27). The sustainable upgrading spatial strategy will build on these layers, both visible and invisible, in the spatial construct of settlements. Layers of history of Khutsong Section informal settlement will be peeled back in order to uncover hooks and connectors that link relationship-building activities with spaces in the settlement.

This research method involves studying different types of content, including text, images, maps, drawings, and so on, from the past to the present. The disadvantage may be that frequency of content may be wrongly associated with significance of content (Kenney, 2009: 8). The ethical issues to be addressed are the biases of the investigator (Kenney, 2009: 8). These issues will be dealt with by using multiple coders who have expertise and who will regularly view the content of the research (Kenney, 2009: 8).

Moreover, indigenous research methods (Chilisa, 2012) will also be used to validate the childhood experiences of the author in African informal settlements. Post-colonial African indigenous knowledge of relationship-building activities and spaces could enable designers to bridge the gap created by colonisation, imperialism and the subjugation of indigenous knowledge. In African and other communities the following are the characteristics of indigenous knowledge:

1. Indigenous knowledge is accumulative and represents generations of experiences, careful observations, and trial and error experiments;
2. It is dynamic, with new knowledge continuously being added and external knowledge adapted to suit local situations;
3. All members of the community, that is, elders, women, men and children, have indigenous knowledge;
4. The quantity and quality of indigenous knowledge that an individual possesses will vary according to age, gender, socio-economic status, daily experiences, roles and responsibilities in the home and the community, and so on;
5. Indigenous knowledge is stored in people's memories and activities and is expressed in stories, songs, folklore, proverbs, dances, myths, cultural values and community, beliefs, rituals, laws, local language, artefacts, forms of communication, and organization.
6. Indigenous knowledge is shared and communicated orally, by specific example, and through cultural practices such as dances and rituals (Grenier, 1998; Chilisa, 2012: 99).

ADDENDA
3: Geographic and demographic description of the study area

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The Khutsong Section site is registered as a community facility stand which may be used for a school or clinic purpose (*see Table 3.5*). However, this site has been occupied informally for residential purposes. Midrand grows annually at a rate of 15 per cent. As more people migrate to the area, social housing developments cannot contain the growing population. The largest income component for the GDP of the larger Gauteng province comes from the knowledge economy, like financial and information institutions (Gauteng Department of Finance, 2012).

More than 80% of the Midrand population is located in Ebony Park (Kaalfontein), Rabie Ridge and Ivory Park at an average population density of 8 261 people per km², meaning that 93% of the Midrand population occupies 7% of the land (an area of approximately 20 km²) (*see Table 3.1*). More than a quarter of the population in Ivory Park, Ebony Park and Rabie Ridge are children below the age of 15 years, and more than 40% of the population is below the age of 25 years (Aurecon South Africa, 2011: 7–10).

Compared to Ebony Park and Rabie Ridge, Ivory Park is the largest area and has the biggest population (*see Table 3.1*). The advantages of a densely populated area are increased economic opportunities and more possibilities of being socially connected. The population in Ivory Park is estimated to be 182 613, covering Ivory Park, Ebony Park and Rabie Ridge . This number is projected to grow by 3.2% a year, inferring that the necessary infrastructure that shall accommodate the growing population needs to be put in place. Those who are excluded from benefiting from government social housing projects resort to informal settlements to be closer to economic opportunities. The average age for Gauteng and the Johannesburg area is 29 years, and this indicates the inclination of future growth in the study area as a result of the proportionally younger population (Statistics South Africa, 2011).

Due to its high unemployment rate and township location, the education profile for Ebony Park and Ivory Park is lower than that of the Johannesburg Metro area as a whole.

Table 3.1 Ivory Park Population (Aurecon South Africa, 2011: 9).

Table 3.2 Population projections for Ebony Park and Ivory Park (Aurecon South Africa, 2011: 9).
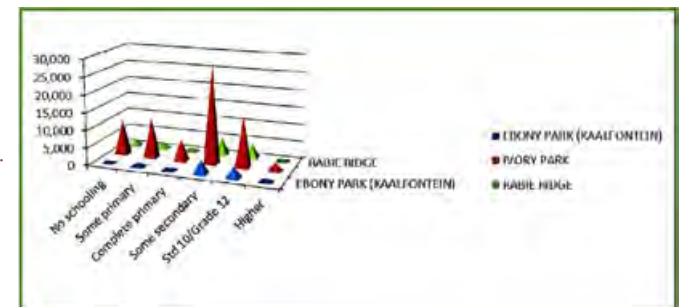
Figure 3.1 Education levels (Aurecon South Africa, 2011: 13).

Nearly 80% of the adult population over 20 years of age residing in Ivory Park have not completed their secondary education (*see Figure 3.1*). The average population in the area is young, impoverished and unskilled. A study done in Ivory Park shows most residents are using rental accommodation to provide income (Aurecon South Africa, 2011: 11). The area is characterised by mainly informal small-scale business activities and is experiencing development in the light industrial manufacturing sector.

Ivory Park's projected population for 2015 is 159 370, which may put more pressure on natural resources and existing infrastructure (*see Table 3*). However, a growing population should not be perceived as a negative element if proper planning and preparation has been put in place by the State. A growing population is a resource if each individual gets equal opportunities to empower him or herself as to actively participate in the growth of the economy. With a projected population increase of 213 762, some 31 149 people (approximately 9 326 dwelling units) shall be occupying Ivory Park, Ebony Park and Rabie Ridge by 2015 (*see Table 3.2*).

About 53% of the population of Ebony Park and Ivory Park is employed and over 65 % of the population earn less than R850 per month (Community Survey (CS), 2007). Between 43% and 50% of the population between the ages of 15 and 65 years has no income, and approximately 15% of the same population sector have a monthly income of between R 1 and R 1 600 (CS, 2007).

In Ivory Park, the wholesale and retail trades dominate the local economy by 18.9%, followed by manufacturing at 16%, social and personal services at 12.4%, construction at 11.2%, and financial, insurance, real estate and business services at 10.4% (*see Tables 3.3 and 3.4*). This implies that increasing education opportunities and facilities in Ivory Park may boost the financial, real estate and business services. In Ivory Park, Ebony Park and Rabie Ridge about 33.5% of the employed population are in elementary (lower paid) occupations, ranging from 16 to 17% are in craft and market related occupations, followed by approximately 13% in the service sector and retail and sales positions, 10 to 12% in professional positions, and lastly 10 to 13% in legal, senior official and managerial positions (Aurecon South Africa, 2011: 11).

	Ebony and Ivory Park (%)
Manufacturing	16,5
Construction	11,2
Wholesale and Retail Trade	18,9
Financial Insurance Real Estate and Business services	10,4
Community Social and Personal Services	12,4
Private households	
Undetermined	30.6

Table 3.3 Industry sector distribution of the employed population of Ebony Park and Ivory Park (Aurecon South Africa, 2011: 11).

	Ebony and Ivory Park (%)
Service workers, shop and Market sales workers	13.0
Craft and Machine operators and assemblers	16.7
Plant and Machine Operators and Assemblers	16.5
Elementary occupations	33.5
Undetermined	20.3

Table 3.4 Industry sector distribution of the employed population of Ebony Park and Ivory Park (Aurecon South Africa, 2011: 11).

Basic information on the settlement		
	Number	Source of data
Estimated population of the settlement	3015	Leadership
Households	700	Leadership
Shacks in the settlement (habitable and non-habitable)	700	Leadership
Settlement age	19 years	Leadership
Owner of the land on which the informal settlement is established: Municipality		

	Description
Toilets	Self-made
Water	Communal taps
Area lighting	No lighting

Constraints to development that the settlement is facing: Access to educational, recreational and social facilities	
	Yes/No
Recreational facility	No
Primary school	Yes
Secondary school	Yes
Community funded crèches	Yes
Community centre	No
NGO/CBO	No
Church	No

Health Facilities		
	Type of clinic or hospital	Distance from the settlement to the clinic/hospital
Clinic	Fixed	
Nearest hospital		9 km

Access to transport facilities and other public services		
	Fare to town (one way)	Distance from the settlement to the facility
Bus and taxi service	R9	
Nearest rail station		6 km
Nearest fire station		2 km
Nearest post office		5 km
Nearest police station		2 km

Table 3.5 The profile of Khutsong Section informal settlement by Community Organisation Resource centre (CORC) (2012).

A high unemployment rate, low education standards, insufficient infrastructure and services, poor housing conditions and a growing population in Ivory Park indicates that socio-economic conditions may worsen in the future if the necessary measures are not taken (*see Table 3.6*). Existing natural systems like rivers, wetlands, and vegetation are in danger of degradation because of population growth and lack of enviro-friendly land development practices. The

visual research and spatial strategy shall be used to explore the potential of urban social capital by integrating relationship-building activities with education, micro scale economic activities, and enviro-friendly design. The growing population and existing natural systems and infrastructure will be used as a support system for proposed spatial and systems interventions (*see Figures 3.2 to 3.5*).

FACILITIES / AMENITIES CALCULATOR

CURRENT POPULATION

CLASS	CATEGORY	TYPE	DU/FAC	POP/FAC	ha/FAC	NO OF FAC	TOTAL (ha)	DISTANCE (m)	WALKING / TRAVELING TIME (min)
FACILITIES	Educational	Créche / Pre-primary / Nursary School	938	7,500	0.1000	29	2.85	1,000	20
		Primary School	938	7,500	2.4000	29	68.40	1,500	30
		Secondary School	1,250	10,000	4.6000	21	98.33	2,250	30
		Tertiary Education	5,625	45,000	1.5000	5	7.13		
	Health	Clinic	625	5,000	0.1000	43	4.28	1,000	20
		Day-Hospital	1,250	10,000	0.5000	21	10.69	2,000	40
		Community Health Centre	7,500	60,000	2.0000	4	7.13		
		Community Hospital	10,000	80,000	1.5000	3	4.01	5,000	
		Regional Hospital	40,000	320,000	4.0000	1	2.67		
		Old Age Homes	5,000	40,000	1.0000	5	5.34		
	Social	Community Centre / Social Hall	2,750	22,000	0.5000	10	4.86	1,500	30
	Cultural	Place of Worship	250	2,000	0.1500	107	16.03	1,500	20
		Library / Museums	2,500	20,000	0.2500	11	2.67	1,500	30
	Public Service	Post office	1,375	11,000	0.0500	19	0.97	2,000	40
		Police Station / Courts / Correctional Facilities	3,125	25,000	0.7500	9	6.41	1,500	20
		Fire Station	7,500	60,000	1.2000	4	4.28		
		Municipal Service Centre	6,250	50,000	0.3000	4	1.28		30
		Market	6,250	50,000	0.5000	4	2.14		
	Transport	Filling Station / Service Centre	2,500	20,000	0.7500	11	8.02		
		Parking Garages	2,500	20,000	0.2000	11	2.14		
		Taxi Ranks / Bus Stations / Depots	2,875	23,000	0.3000	9	2.79		
AMENITIES	Sport	Sportsfields	963	7,700	0.6000	28	16.66		
		Mini-soccer	1,563	12,500	0.5000	17	8.55		
		Basketball	1,563	12,500	0.0420	17	0.72		
		Sports Stadium	6,250	50,000	3.0000	4	12.83		
		Public open space	125	1,000	0.5800	214	123.98		
	Recreation	Recreation Centres	2,500	20,000	0.5000	11	5.34		

Table 3.6 Facilities Calculator – current population of Ivory Park (Aurecon South Africa, 2011: 28). With an estimated population of 182 613 one can expect to find the above breakdown of social and civic infrastructure within the study area.
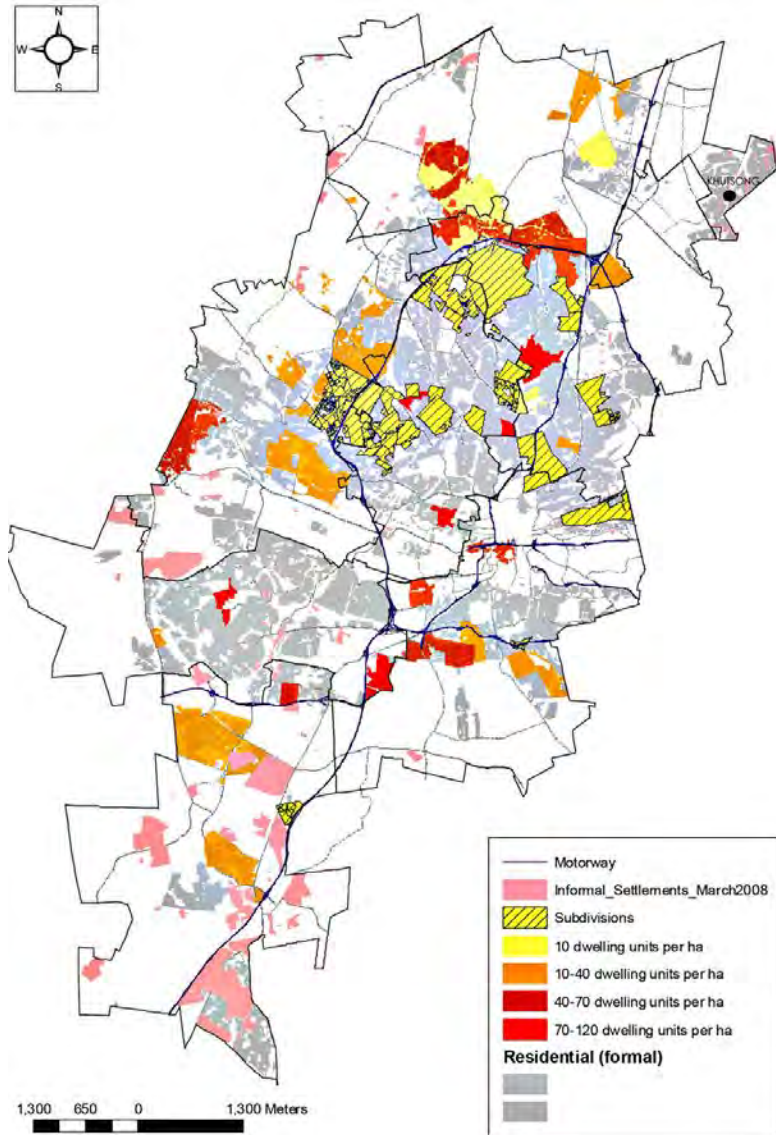
Figure 3.2 Residential patterns in Gauteng (City of Johannesburg, 2012). Similar to informal settlements, formal housing grows along mobility spines. Transportation networks and infrastructure form a good foundation for city growth. This principle will be applied at a neighbourhood scale when developing the Khutsong Section SUSS. The existing routes will be used as a development skeleton onto which the space of spaces may connect.
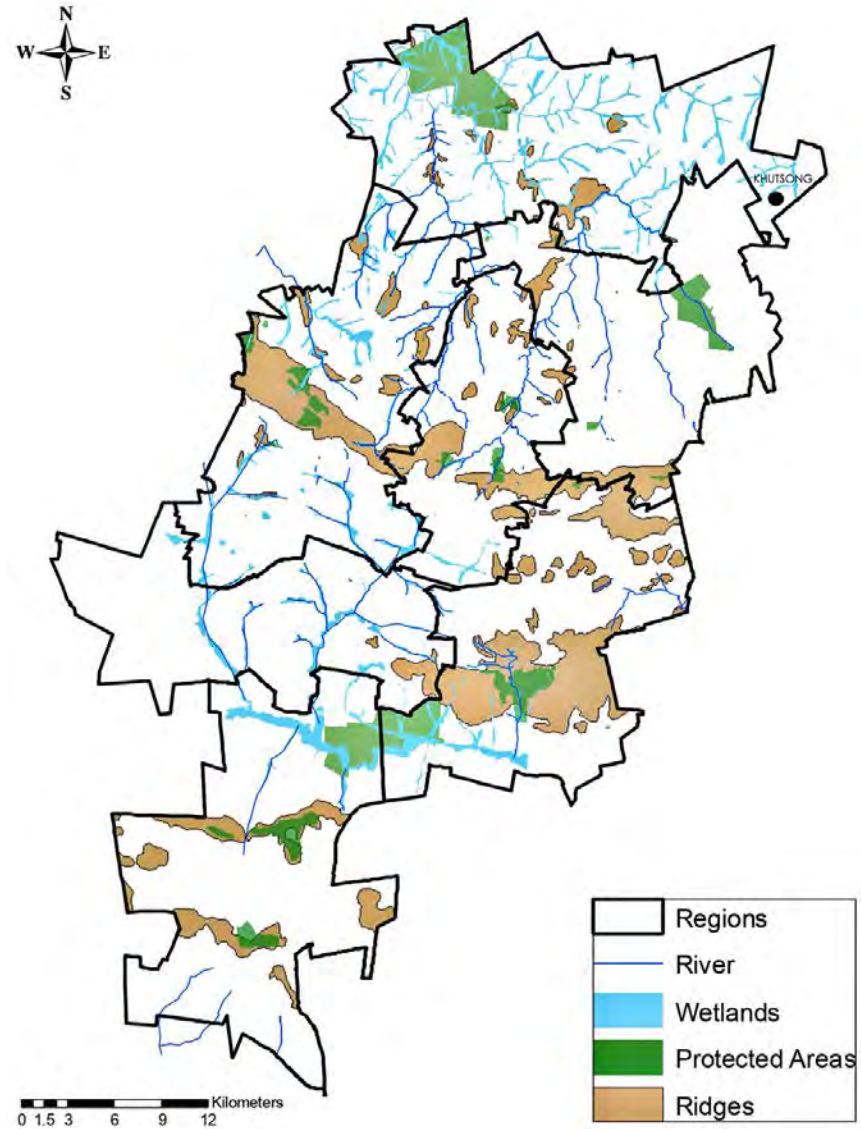
Figure 3.3 Open spaces in Gauteng (City of Johannesburg, 2012). Khutsong Section is located neither on a ridge, nor on a wetland, and thus may be developed without posing an environmental threat. It is also not located on a protected green belt. This criterion is important for a sustainable upgrading for Khutsong Section.
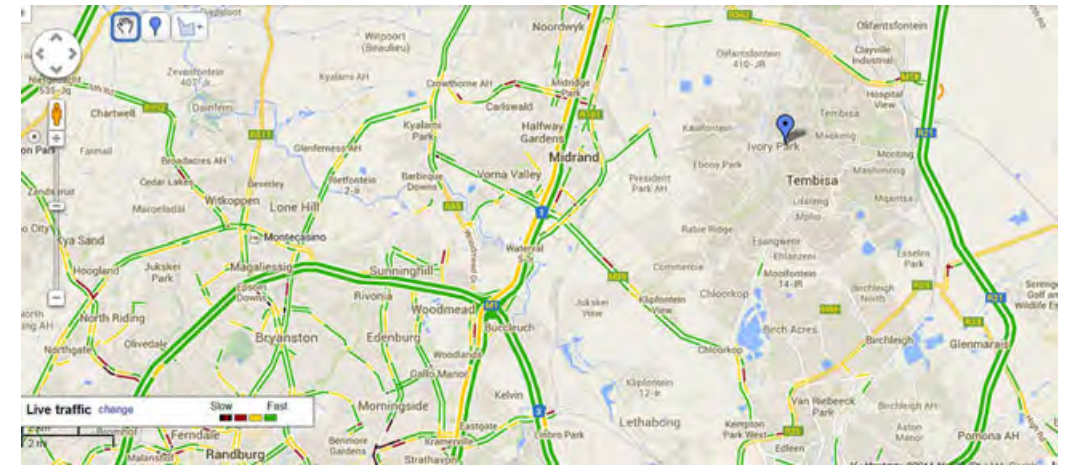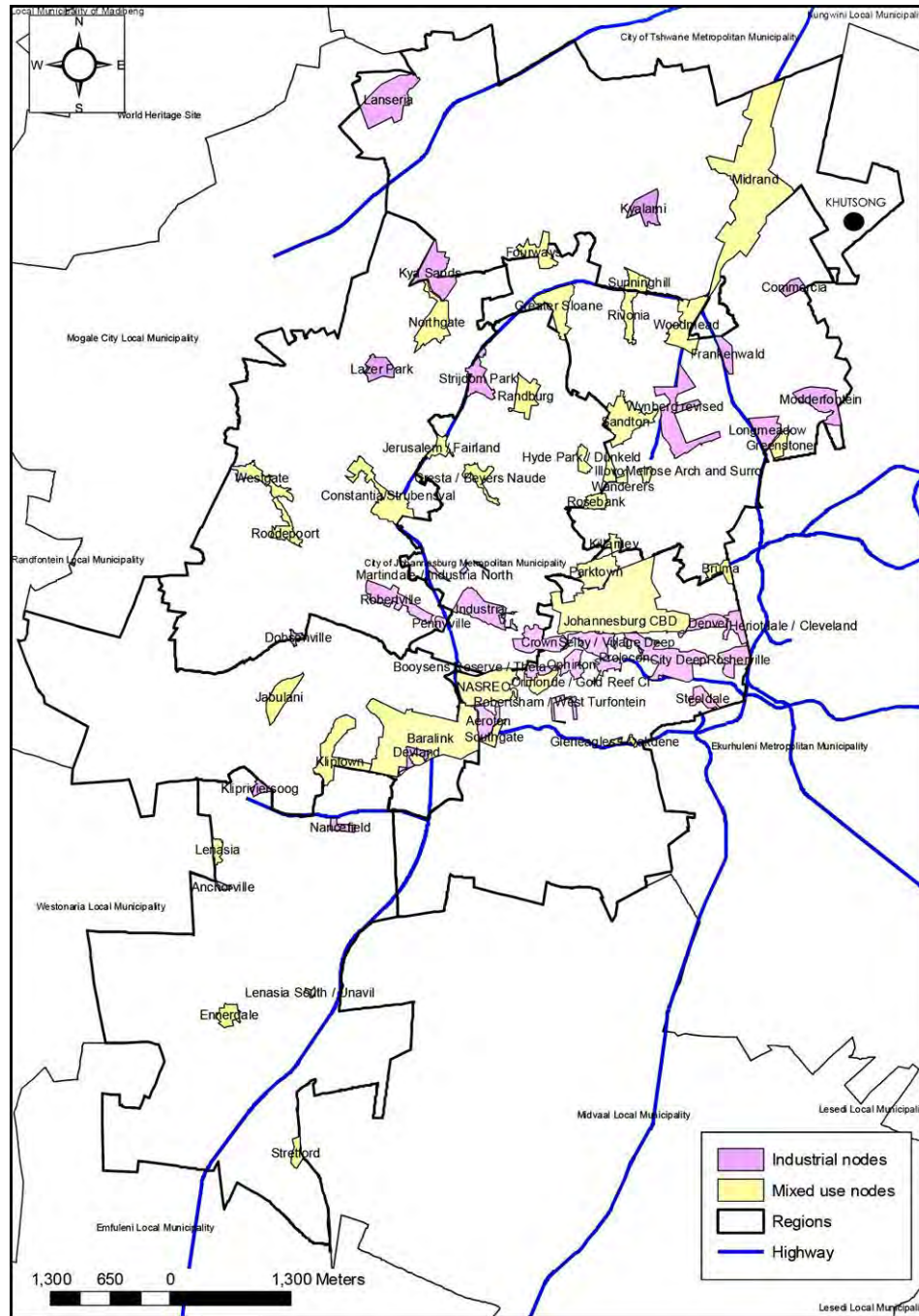
Figure 3.5 The position of Ivory Park in Johannesburg (shown with a starburst). Khutsong Section is located near Halfway House, which is an important economic node in Midrand (Google Maps, 2014).

Figure 3.4 Nodes in Gauteng (City of Johannesburg, 2012). Midrand is classified as a mixed-use node, which has attracted rural-to-urban immigrants and foreigners.

SPACE OF FLOWS ANALYSIS: FRACTALS

Figure 3.6 indicates how Khutsong Section relates to regional connections to national and provincial arterial roads. The average distance between Ivory Park, where Khutsong is located, and the nearest national or regional road varies from 5 to 10 km. *Figure 3.7* shows main external and internal vehicular movement patterns within Ivory Park. The bulk of external movement routes flowing into Ivory Park are from Modderfontein Road (west), Olifantsfontein Road (north) and Andrew Mapheto Drive (south). Internal vehicular movement flows through local streets into the main collector roads like Archerfisher Drive and 29th September Drive. In turn, these roads connect to 21st August Drive and Republic Road, enabling the different areas in Ivory Park to link with mobility roads that connect to surrounding areas. *Figure 3.8* indicates movement patterns of non-motorised transport (NMT) in Ivory Park that mainly occur along main roads like Archerfisher Drive, 29th September Drive, 21st August Drive and Republic Road. The analysis shows movement between the main non-motorised generators and attractors. Existing transportation networks are car-oriented with insignificant consideration for pedestrian movement. Available public transport types are taxis and buses and train stations are located away from Khutsong Section. The visual research shall be used to analyse the existing transportation networks of the study area to propose pedestrian-oriented and cyclists pathways that are well-connected to surrounding roadways and fragments of development nodes to form an informal settlement polycentric urban spatial structure.
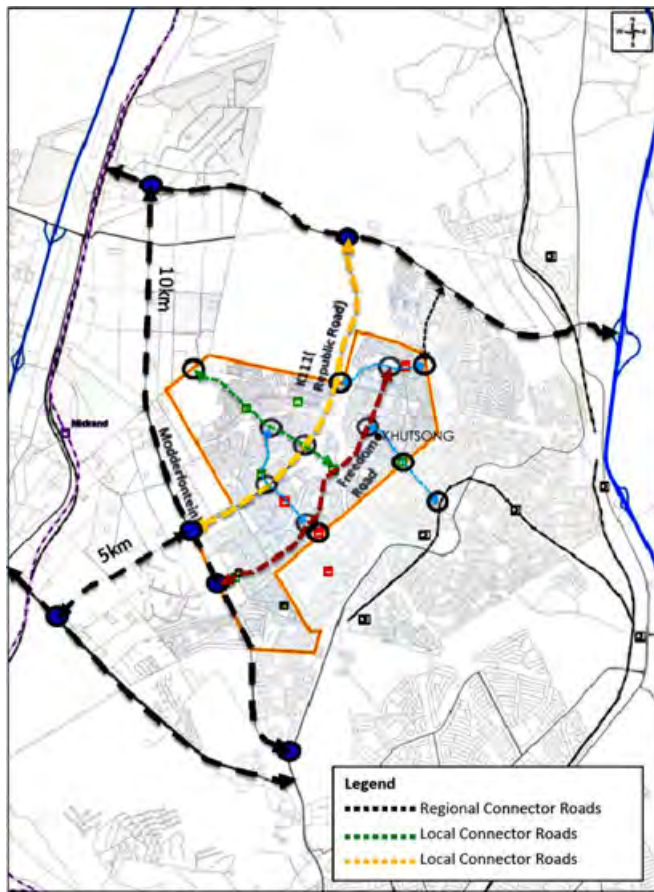
Figure 46: Ivory Park Regional Connectivity

Figure 3.6 The regional connectivity of Ivory Park (Aurecon South Africa, 2011: 49).

Figure 42: External and Internal Vehicular Movement in Ivory Park

Figure 3.7 External and internal vehicular movement in Ivory Park (Aurecon South Africa, 2011: 47).

Figure 3.8 Internal NMT movement patterns in Ivory Park (Aurecon South Africa, 2011: 47).

SPACE OF PLACES ANALYSIS: FRAGMENTS

The properties within Ivory Park are either zoned in alignment with Annexure F of the Less Formal Townships Establishment Act, 1991 (Act No. 13 of 1991), or the Black Communities Development Act, 1984 (Act No. 4 of 1984) (BCDA). *Figure 3.9* indicates that the main zoning in the area is for Residential use, and a major portion of Ivory Park is zoned for Public Open Space so as to address all the flood areas and streams flowing through the area. The central area is zoned for Business and many other smaller Business zones are distributed all over the area. The middle and southern parts of the area are zoned mainly for Educational uses. Sites that are situated around the existing stream areas are zoned for Public Open Space, along with a few fragments of smaller sites reserved as small park areas for children to play in. The current open space system within Ivory Park is approximately 260ha of the total 1 920ha area, meaning that 13.5% of the total area is zoned for this land use besides the various smaller sized stands (*see Figures 3.9–3.11*).

Generous reservations have been made for Community Facilities in various portions of Ivory Park; Land zoned for Agriculture was provided for on the eastern, northern, north-western and southern parts within the area. The south-western and central part of Ivory Park has large areas zoned for Special purposes. On the southern and western sides of the area provision has been made for plots with a Reservation of Land zoning. *Figures 3.7 and 3.8* shows land-use trip generators between fragments of space of places. These fragments (land uses) tend to stimulate trips from neighbouring areas towards Ivory Park. In the morning, peak-period trips from most of the residential areas of Ivory Park are generated towards external zones. During the af-
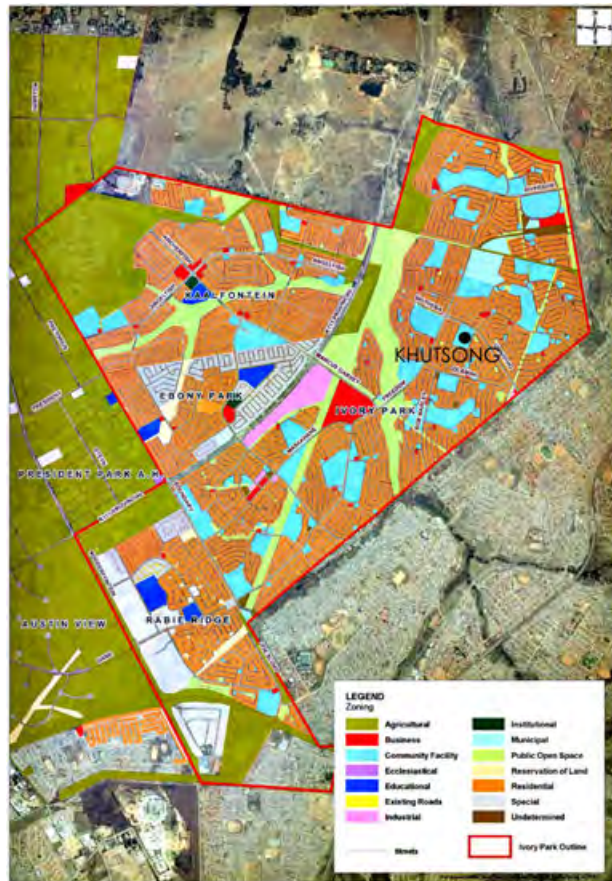
Figure 18: Existing Zoning

Figure 3.9 Existing zoning in Ivory Park (Aurecon South Africa, 2011: 24).
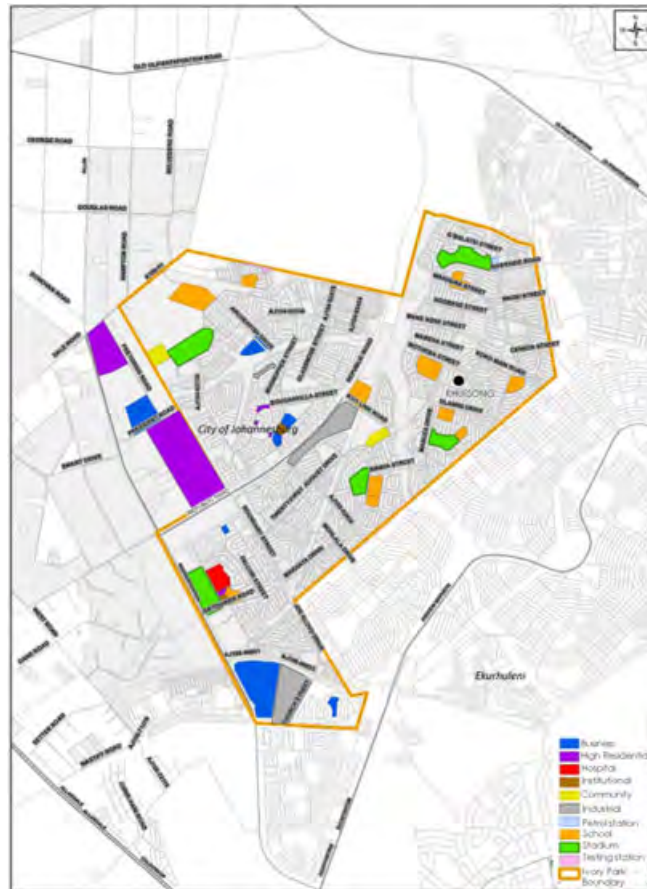
Figure 3.10 Land use trip generators in Ivory Park (Aurecon South Africa, 2011: 46).

Figure 3.11 Open space areas in Ivory Park shown in green and white colour (Aurecon South Africa, 2011: 34).

ternoon peak-period trips are attracted towards residential areas. The Savemore shop in Rabie Ridge and the Shoprite in Ivory Park serve as regional attractors that draw vehicular trips from outside the area.

According to the City of Johannesburg (2012), Midrand has unique urban characteristics, available amenities and infrastructure. Khutsong Section is located close to a high-tech and light-industrial node, with good access to public transport, shopping malls, and sufficient water supply and sewer systems. This informal settlement is well located for an upgrade since it offers access to economic, educational and job opportunities. These fractals (service infrastructure) and fragments play a crucial role in supporting a variety of social relationship-building activities in the area.

CONCLUSION

The existing urban fabric of Ivory Park lacks the qualities of a compact city because amenities and shopping malls are difficult to access from Khutsong Section owing to long distance and lack of sufficient interconnecting pedestrian routes. The visual research and spatial strategy shall address the need of an integrated mix-use development and a finer urban fabric to increase connectivity and relationship-building activities.

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ADDENDA
4: Urban spatial strategy

An urban spatial strategy entails shaping material resources and regulatory powers in urban development processes by means of connecting urban dynamics and various stakeholders (Eucher & McGovern, 2003: 20). Creativity lies at the core of strategic planning, which encompasses processes of interactions and consequential effects between different innovative processes (Baycan, 2011: 19; Forte, 2011: 296–99). It is strategy-making focused on urban areas, involving the creation of a conceptual vision of an urban region and then forming institutional vehicles through which to develop and maintain the strategic focus. Strategy implies that the calibre of certain decisions and the resultant actions are considered more important than others for the purpose of producing structural responses to problems, challenges, aspirations and diversity.

A new vision for the identified urban region should be clarified and should indicate key aspects like: identification of the scale and distribution of new housing provision; priorities for the environment; transport; infrastructure; economic development; agriculture; and waste treatment and disposal (Anas et al., 1997: 8). An urban spatial strategy encapsulates technological creativity, which consists of artistic creativity, scientific creativity, and economic creativity (Baycan, 2011: 18). A spatial strategy should create places made for people, well-connected and permeable places, places of mixed and varied densities, distinctive places, and sustainable, resilient and robust places (Adams & Tiesdell, 2013: 11).

A strategy ensures that these aspects are integrated into any new planning framework by local, regional and national government bodies. The strategy challenges and confronts deeply-held values about places and environments, affecting property rights, business interests, and movement patterns of daily life (Eucher & McGovern, 2003: 20). It deals with people's habits with regards to a sustainable lifestyle, such as waste disposal, energy and water usage, environmental protection, achieving a small urban footprint, and sacrificing resources for future generations. A strategy has to do this because it must effect positive change and development, and change usually demands that people should forfeit their comfort zones. *Table 4.1* indicates four meanings for strategy, which all emphasise the notion of changing the status quo by altering the physical structure, creating new goals, establishing new policies, and presenting a strong, positive vision for developing urban areas (Healey, 2007: 180).

Strategy as ...	Underpinned by...	Expressed through ...	Illustrated by ...
Physical structure	Morphological analysis	Plans as maps and designs	1953 Milan PRG 1935 Amsterdam GE Plan 1985 Amsterdam *structuurplan* (in part)
Orienting goals	Socio-spatial analysis to identify threats to goals	Policy statements about programmes of action to achieve goals	1970s facet plans in Amsterdam 1980 Cambridgeshire structure plan 1980 Milan PRG
A framework of principles	Systematic technical and interactive search procedures to reduce uncertainty	Framing concepts, projects and programmes; policy criteria	Cambridgeshire structure plans 1985 Amsterdam *structuurplan* (in part)
An inspirational vision	Interactive processes to imagine futures and mobilise attention	Metaphors, storylines and manifestos	Futures exercises in Cambridge and Amsterdam in the 1990s

Table 4.1 The meanings of a strategy (Healey, 2007: 180).

ADDENDA
5: Proposal for a sustainable upgrading spatial strategy (SUSS) and a policy framework for informal settlements

An urban spatial strategy can be defined as the set-apart, structured and interrelated series of crucial decisions and actions that result in achieving a clearly stated conceptual vision through the means of established policies and tactical choices (Eucher & McGovern, 2003: 19–20).

The institutional work of forming new policy perspectives and ideas helps to ensure that the key aspects of the urban regional development will be implemented. The main determinants of urban and regional form are: economy, culture, environment and politics (Fainstein & Campbell, 1996: 4); therefore, the urban spatial strategy can be awarded statutory power and can become a legal document. Through urban policy-making, spatial strategies serve to identify priorities, cultural and ideological currents, and the restructuring of economic and social systems (Fainstein & Campbell, 1996: 2–3).

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SUSTAINABLE UPGRADING OF AN INFORMAL SETTLEMENT
For the SUSS , the concept of upgrading of informal settlements is defined as site-related and place-responsive spatial, service and system manipulations in the public and private domains of the informal settlement urban fabric, which would enhance the built and natural environments and add value to the urban character as well as elevate the cultural identity of a city through the use of a diverse range of urban, architectural and landscape forms, services, systems and design applications (Hamdi, 2010: 5–6).

The upgrading in informal settlements will encompass private and public spatial domains which will inject vitality into public open spaces. Each aspect of the upgrade will reflect and/or challenge a relationship with the urban fabric through site-specific interpretation. The upgrade will extend the capacity of people to engage with a site by adding value through an aesthetic, functional and spatial narrative (Petrescu, 2007: 237–46). The intent and content of each upgrade phase may consider 'meaning' in its entire social, economic, cultural and environmental context, and therefore acknowledge the city's urban fabric and community culture. This may take account of people's habits, beliefs, traditions, trading practices and aspirations, and all that governs their lifestyle and quality of life.

THE VALUE OF UPGRADING INFORMAL SETTLEMENTS
Different practises of upgrading of informal settlements can be used for achieving the different aspects of the issues outlined above. The following section will define the different practises in order to select the ones that can be used for the SUSS for informal settlements.

THE PRACTICE OF INFORMAL SETTLEMENT UPGRADING
There are different approaches in terms of origin, influence and urban and/or architectural forms that provide a range of opportunities for creativity and for innovative informal settlement upgrading works (Awan, Schneider & Till, 2011: 538–9; Salomon, 2013: 435). As practical guidelines, these concepts and approaches become valuable tools with the potential to inspire and to better guide the upgrading decision-making and implementation process.

Slums are considered incubators of the future prospects of the global city (Rao, 2013: 675). Each upgrading project presents distinct qualities and features that are best served by a custom-made approach to design, to project management support systems, and to the allocation of resources (Rao, 2013: 684). The gathering of relevant information to inform the design brief, the initial planning process, and the establishment stages are also vital in the appointment of the right consultants and appropriate construction techniques and products (Kaji-O'Grady, 2012: 152–64). Informal settlement upgrading projects can be classified under five interrelated practices (*see Table 5.1*). Each practice is dependent upon the circumstances of the relevant/specific upgrading project. These practices provide a guide to assist with identifying the best approach to the procurement and commission process for the upgrade.

Table 5.1 Design practices that can be used for the upgrading of informal settlements:

DESIGN PRACTICE and DESCRIPTION
Urban Design
This involves upgrading by strategic positioning and articulation of urban form and space within the site in order to achieve spaces that have cultural relevance, sustainability and design resonance. This upgrading approach is informed by, and integrated with, urban design elements to enhance the informal settlement's urban char-

acter through site analysis and interpretive research (Adams & Tiesdell, 2013: 11–15). The upgrading works evolve from a contextual design response to the site's particular characteristics, spatial qualities and culture.

Collaborative Design

This refers to the upgrading of an informal settlement by the strategic application of skills and site integration/intervention. It is created through collaborative design processes to reflect cross-disciplinary design interpretations (Hamdi, 2010: 85). Collaboratively planned and designed informal settlement upgrading projects combine the expertise of any of the following professionals: architects, urban designers, town planners, environmentalists, landscape architects, engineers, artists, graphic designers, and/or other relevant professionals, to enhance the quality, sustainability and functionality of private, semi-private, semi-public, and public spatial domains. Design and systems inter-relationships strengthen the outcomes.

Architectural Design

This refers to the upgrading of informal settlements that gains by the spatial and structural design presence of the architecture and by the formalised design alignments of the built form (Scruton, 2013: 146). The upgrading projects integrate architecture with the immediate urban context, as part of the built environment, through the manipulation of form, functional planning, space use, materials, textures, colours and scales (Hamdi, 2010: 69–76). The functional planning and applied design of open urban space features enhance the architectural structural forms of the built fabric of an informal settlement, both as interior and exterior design solutions.

Socially Responsive Design

This refers to the integration of social relationships, historical and local neighbourhood identity references. The upgrading evolves as a response to, and a reflection or interpretation of, community culture, and includes responses to specific social, environmental and cultural issues (Awan et al., 2011: 41–57). As socially responsive design the upgrading project acknowledges community,

the distinctive culture of 'place' and the diversity of the social, political and environmental contexts. It involves a strategic process of community consultation and analysis combined with interpretative research, and is a means to facilitate creative relationships between community and designer. Existing social structures in informal settlements can initiate and drive projects that benefit the community, focusing on tenure acquisition and economic growth.

Acupuncture Design

This approach to upgrading gains by a more considered deliberation of how it is integrated in and responds to the site, becoming a catalyst for future upgrading projects. The upgrade is presented as an individual statement, an isolated object, or an installation on site. Incremental design interventions are usually done at micro-scale, in alignment with a grand master plan that ensures interconnection between each intervention (Rao, 2013: 682). It may not necessarily be integrated, but can physically or conceptually emphasise intervention on the site. As an intervention it may address and influence the site and/or manifest purely aesthetic modes and be positioned on the site as a facilitator for incremental future interventions. This approach responds to the scale and economic constraints of informal settlements (Hamdi, 2010: 201). Micro-urbanism sites operate within infrastructural networks which enable them to be flexible in nature (Duong Ba Wendel, 2013: 544).

Systems Design

This approach to upgrading gains by interrelating and interconnecting urban form elements, architectural and landscape elements, services, transportation networks, and land parcels of different uses, in order to form an interdependent and holistic built environment. The upgrade emerges from existing land uses, and urban, architectural and landscape elements are layered with new networks of services and information and telecommunication technology infrastructure in a systematic manner. Each component of the system is sustained by the other components that are directly or indirectly linked to it. The process involves coordination and integration of site, services

and structural elements in the conception, design, design development and procurement processes. Infrastructure networks respond to micro-urbanism that rejects large-scale approaches to urban renewal (Duong Ba Wendel, 2013: 544). These networks are vested in ecological design as their foundational principle, entailing rainwater collection, systems for the biological treatment of waste, *brise soleils*, weather seals, permeability treatment of the ground for increased water drainage, and solar panels for energy collection (Duong Ba Wendel, 2013: 545).

CONCLUSION

A systems design method will be adopted as the overall design approach that will be used to develop the guidelines for the upgrading of informal settlements. This method will play a central role in interconnecting the social, cultural, spatial, functional, technological, infrastructural, environmental and economic aspects of the development. Systems design can play a central role in achieving a sustainable vision for informal settlements by integrating social, cultural and economic activities with the built environment. The existing and emerging social networks, social spaces, water networks, services, architectural forms, public open spaces, urban elements and landscape can be interconnected to form a sustainable and incremental spatial system.

The advantage of this design approach is its ability to interrelate service networks, activities, and spaces in a manner that facilitates sustainable livelihoods. Although these connections can sometimes be chaotic and confusing, identifying and categorising each part can ensure a sense of order in the interconnected components. The design process will begin with a historical and a context study in order to respond to specific social, environmental and cultural issues that are related to the people living in the study area. This will include drawing from an existing spatial development framework for the region where Informal settlements is located, so as to incorporate the inputs of urban designers, town planners, environmentalists, economists and engineers. Small-scale design interventions will then be interconnected to form a sustainable system of spaces, activities and services.

DESIGN-RELATED FACTORS THAT INFLUENCE THE SUSTAINABLE UPGRADING SPATIAL STRATEGY OF INFORMAL SETTLEMENTS

Upgrading projects can contain a variety of stimuli. Such projects can be inspired by, and give creative design expression to, concepts that evolve from the following design-related factors:

FACTOR and DESCRIPTION

The culture of place

The relationships between people and places and their resonance and associations with, and memories of, specific locations can evoke distinctive aspects of local cultural and social identity, characteristics, features, values and community attachments (Brown & Maudin, 2013: 349–53). A place may be defined as the fabric of the character of the site, the daily activities of people, and the spatial arrangements that achieve a sense of orientation and belonging (Susser, 2002: 315). People-responsive upgrading projects integrate aspects of the culture of habitation into the design intent and content for Informal Settlement Upgrading briefs (Petrescu, 2007: 226–34).

Site specificity

Conceptual relationships, physical alignments and people/place considerations of a specific location can inspire art that responds to the physical dimensions of that location, and which interacts with the historical, environmental and built forms (Forte, 2011: 296–99). The site is influenced by cultural and social relationships and political activities (Hamdi, 2010: 160–64). Site responsive design processes avoid generic design solutions, i.e. designs that are often directly copied from other contexts and placed on a site without knitting it with the context.

Informal settlement as Platform /
Informal settlement as City

The commemoration of special times (whims, seasons, intangible elements that create 'sets' and 'players'), and celebration of spatial qualities provide the context for temporary site animations and/or permanent site-specific design interventions and installations that contribute to the character of the streets and open public spaces. This leans on the concept of urban informality that views an informal settlement as a city system (Rao, 2013: 677).

Cultural Identity

The process of interpreting the culture of daily living and exploring the social, cultural and aesthetic context of places can evoke social, historical, political and cultural themes (Brown & Maudin, 2013: 343). Defining the 'local common ground' to incorporate the unique cultural elements of the site can present the authentic social and cultural character of an informal settlement and its neighbourhood to facilitate relationship-building activities and a sense of cultural belonging.

Civic Image

Remembering significant social and/or community events, celebrating people and places and reflecting on history can often lead to contemporary insights and expressions of the civic identity of an informal settlement (Heynen & Wright, 2013: 41).

Cultural Heritage

Embracing the informal settlement's cultural heritage and history through the telling of personal stories using spatial representations can integrate an informal settlement's built and natural landscapes with cultural traditions, experiences and collective memory (Diez, 2013: 275).

CONCLUSION

The design-related factors described above will be used to help focus the spatial strategy to context specific interventions. They will be used to transform spaces in the settlement into places that the residents can relate to and that enables them to achieve better living standards. The establishment of the culture of place of informal settlements will entail identifying cultural practices and spatial arrangements of buildings, materials used to construct structures, urban elements, and the characteristics of open spaces. These are akin to cultural identity because the culture of daily living occurs in a space, which in turn transforms the space into a place by imparting cultural meaning to it. The mapping of social activities within informal settlements will help to highlight both the culture of place of the settlement and the cultural identity of the residents. Through this process matters related to the civic identity and cultural heritage of informal settlements may emerge. Then site specificity will involve the mapping of existing physical aspects of informal settlements, including existing building footprints, vegetation, sun movement, services, pathways, and other spatial features. This process will help to link the physical context of informal settlements with its metaphysical context by employing the design forms and interpretations discussed below.

DIVERSITY OF EXPRESSION OF DESIGN FORMS AND INTERPRETATIONS

The SUSS will engage with a variety of individual design forms and a multiplicity of cross-disciplinary interpretations. These include the design forms shown below:

DESIGN FORM and DESCRIPTION

Landscape Design

Green infrastructure, landmark statements and interpretations such as land art, landscape as earth works, and landscape design elements like trees and vegetation to enhance the quality of the urban open space (Reid, 2007: 1–5).

Functional Design

Waste water recycling systems, solid waste recycling systems, water taps, telecommunication systems, street furniture, lighting, solar and other energy harvesting systems, and traders' mobile stalls (Scruton, 2013: 34–5).

Applied Design

Paving, pathways, floors, walls, windows, doors, stairways, seating, shading structures, fencing and garden features.

Signage as a 'place-making' tool

Graphic text, lighting design, industrial artefacts re-interpreted as art, and industrial design.

Animation
Site responsive, spatial and interactive movement patterns, performance, music, dance, theatre, sound, light and art projections (Awan et al., 2011: 100).

Visual art
Sculpture, painting, billboards, screens, photography, digital prints, industrial design installations, and writing/ text work (Awan et al., 2011: 100).

Multimedia
Reflections and responses as actual or virtual reality, using digital imagery, film, video, photography and cybernetics (Awan et al., 2011: 100).

CONCLUSION

Once the contextual and cultural aspects of informal settlements have been identified, they will be interpreted and expressed through design. Existing pathways, services, landscapes, social and economic activity nodes and building footprints will form the base from which the urban and landscape design can emerge and evolve. The primary design forms and expressions will be applied design, functional design and landscape design. These elements can play a vital role in revealing and expressing the culture of place in the settlement. Places can then be created by altering, re-ordering, and re-arranging the features of the spaces of Informal settlements. These elements will form the backdrop on which visual art, animation, multimedia and graphic design can be displayed to express the cultural identity, cultural heritage and civic image of Informal settlements. Forms, volumes, materials, tectonics, textures, lighting, and other forms of visual and spatial expression can be interrelated to create a place with meaning and belonging.

DELIVERY AVENUES

The Public Sector refers to the upgrading of informal settlements generated from the budgets of the Department of Human Settlements to drive the informal settlement upgrading instrument. The Department of Human Settlements budget allocation for 2013/14 is R28.1 billion, which

is 97% of the total budget for the Housing Development Finance Programme (HDFP) which includes the upgrading of informal settlements (Department of Human Settlements, 2013: 3). The Breaking New Ground policy is the vehicle currently used by the state to achieve this goal.

The budget allows for consultants like urban designers, architects, landscape architects, surveyors, engineers and artists to contribute to the overall conceptual design of a building or space, and for designers to work directly on specific commissions as part of the development.

The Department of Human Settlements' funding instrument seeks to support the upgrading of informal settlements through a phased process under the Upgrading of Informal Settlements Programme (NDoH, 2004: 2).

Phase 1 – The first phase is characterised by the recording, during the project initiation stages, of the specific needs of individuals in informal settlements. This phase entails surveying the community within the informal settlement to identify the housing and infrastructural needs of the community. This is achieved through a process of consultation and involves determining the geo-technical situation and physical suitability of the land for upgrading. This happens through a municipality grant provided by the province for survey, registration, participation, facilitation, dispute resolution, geotechnical investigation, land acquisition, pre-planning, and engineering services.

Phase 2 – The second phase consists of basic services provision, social amenities and tenure security for the entire community. This is done through funding provided by the Social and Economic Amenities Programme for sports fields, community centres and municipalities.

Phase 3 – This phase entails the development of housing based on the needs of the community. The housing options are medium-density housing and free-standing houses created through mutual aid and community self-help or local contractors. Phases 2 & 3 include: a detailed town plan, land surveying and pegging, a contour survey, the land survey examination fee, civil engineering fees, site supervision fees, permanent engineering services provision, project manage-

ment, relocation grants, social service support and relocation food support to households.

Phase 4 – This is the phase of implementation through partnerships involving national and provincial governments and municipalities. Each municipality is required to make a capital contribution of 10% towards upgrading projects and the Municipal Infrastructure Grant Programme funding for UISP. The idea was that nine pilot projects were to be launched in each province, working towards a complete programme implementation status by 2007/8. Funding was also made available in order to outsource projects to the private sector at the initiation, project planning and management stages. The Departments of Home Affairs, Education, Public Works, Provincial and Local Government, Health, and Environmental Affairs were called in for support. These plans did not go as expected, as can be seen at the N2 highway informal settlement upgrade project in Cape Town.

The Private sector refers to the contributions made by developers or private patrons towards enhancing the public domain in and around their developments, especially in South African townships. These contributions can be voluntarily originated by the developer, or they can be a mandatory or negotiated outcome of a local municipality's development approval process. In South Africa, private developers who contribute towards the socio-economic improvement of African settlements are usually awarded Broad-Based Black Economic Empowerment (BBBEE) points (5%). Contributions may also include gifts or donations, and grants from various federal and state government and/or private philanthropic trusts.

The Community refers to community-driven projects that originate from local people identifying a site, an idea or an opportunity (Hamdi, 2010: 18–20). The governing system for local communities in South Africa uses ward councillors and ward committees. Informal settlements are usually governed by section leaders who can sometimes motivate local residents to make contributions toward improving aspects of their neighbourhoods.

Funding from any of these sources can be used for up-grading of informal settlements projects in many different ways. These can, for example, include:

- creating site specific permanent or temporary spatial systems and service interventions in informal settlement improvements;
- creating distinctive products, services and functional items for use within interior and exterior settings, such as streetscapes, infrastructure projects, publicly accessible areas in public or private developments, parks and other open spaces; and
- purchasing/ leasing of existing products or services to be permanently/ temporarily sited in the private, semi-private, semi-public and public domains towards creating a better life for residents.

The spatial strategy for informal settlements is developed and put forward as a suitable guide for future upgrading projects within informal settlements, in keeping with, and adding to, the intentions articulated in the Breaking New Ground (BNG) 2004 policy and the Upgrading of Informal Settlements Programme (UISP). The UISP is targeting the provision of basic infrastructure, services and land tenure for 400 000 informal settlement households by 2014 (NDHS, 2013: 1). The proposed upgrading strategy addresses the dilemma of providing basic infrastructure, services and quality urban open spaces in a systematic manner that would result in social, economic, and environmental sustainability. The main challenge of the UISP is the difficulty of upgrading of dense urban informal settlements. The proposed strategy goes further than just improving basic infrastructure and services to address the socio-economic conditions in the informal settlement. The thinking regarding the upgrading of informal settlements is approached in a responsive style to accommodate local conditions. The Department of Human Settlements has learned in theory to be sensitive in its attitude towards the upgrading of such settlements. The BNG policy (NDoH, 2004: 1–2) allows for a new informal settlement upgrading mechanism to:

- support upgrading on an area-wide basis;
- maintain delicate community networks;
- minimise disruption of existing social networks; and
- enhance community participation through a phased process.

The South African government supports Public Private Participation (PPP) in developing areas that have poor economic and social conditions – one example is the Township Renewal Programme (TRP). Through the SUSS, developers can support and participate in creating sustainable informal settlement upgrading for informal settlements, extending its reputation as an example of a sustainable, innovative, creative and design-oriented human settlement. The Department of Provincial and Local Government has furthermore prepared the Draft National Urban Strategy (DNUS) (2004), which proposes a vision for South African towns and cities to be spatially and socially inclusive, well-designed, and developed in an environmentally efficient manner (NDoH, 2004: 5–6). The following discussion will deal with policy issues that can be used as vehicles to achieve the vision of the informal settlements spatial strategy.

POLICY CONTEXT

The policy for upgrading of the informal settlement can be classified as urban rehabilitation policy. Urban rehabilitation policies tend to target spatially deteriorated urban neighbourhoods that consist of socially excluded communities and can be categorised into three models: an expert model; a partnership model; and a community planning model. The expert model excludes the community relying on municipal experts and consultants, concentrating primarily on the provision of physical infrastructure and improving local trade in informal settlements. Partnership model on the other hand, includes physical infrastructure provision, supporting the local economy, community development, training programs, and multi-professional management agency. In contrast to these models, the community planning model involves the local community to address physical infrastructure, self-sufficient economy, community infrastructure, neighbourhood programs, training

programs, multi-professional district management agency, and research on indicators of social exclusion and social capital. A community planning model will be used to develop a policy framework for the informal settlements spatial strategy because it supports the existing social capital, which the Breaking New Ground policy attempts to do.

Breaking New Ground – the SUSS identifies and supports the Breaking New Ground's concepts of place making, management and sustainability, and aligns with the following objectives as articulated in the Breaking New Ground (NDoH, 2004: 1–11) comprehensive plan:

- promoting densification and integration;
- enhancing the role of the private sector;
- shifting from product uniformity to demand responsiveness;
- supporting urban renewal and inner city regeneration;
- developing social and economic infrastructure;
- facilitating community engagement and empowerment; and
- job creation.

The proposed spatial strategy relates to the BNG objective of ensuring densification by providing quality urban open spaces that are well connected to courtyards around residential units. The strategy also aims to encourage waste management programmes that involve local residents, private recycling companies, and the local municipality of Ivory Park. The strategy aims to provide the necessary social, educational and economic infrastructure to empower and enable local residents to build their own houses by responding to their specific needs. It also aims to achieve ongoing community engagement and empowerment through continued training programmes that help strengthen micro-scale economic activities.

Heritage Recognition Strategy – the Department of Human Settlements recognises that informal settlements have existing social networks through which residents have established a means to survive and that give them a sense of identity and belonging. People living in informal settlements may develop a connection with their landscape and the existing fabric, uses, associations and meanings. Retain-

ing the use of place, meanings and associations in informal settlement upgrading projects can be achieved by ensuring sensitive spatial, structural, systematic, artistic, formalistic and functional interventions. The demographics of most informal settlements in South Africa show that most of the people living in these settlements are foreigners who do not possess South African identity documents and are thus disqualified from receiving social housing benefits. These foreigners can be considered a minority group that is vulnerable to xenophobic attacks and socio-economic discrimination (Harber, 2009: 170–89). New upgrading policies should address the social value of these minority groups who have established rich social networks and connections in the urban landscape.

POLICY DIRECTION

The new thinking in the Department of Human Settlements is to support best practice informal settlement upgrading that generates the potential to creatively link people, places and economic opportunities (NDHS, 2013: 1–6). New innovative upgrading projects which exemplify excellent urban design practice will be a good base for creating national upgrading strategies and policies with economic benefits, through enhancing places, services, and community-building activities.

Mindful of the UISP of the Department of Human Settlements, in the past deemed to have negative effects (Huchzermeyer et al., 2006: 1–15) for informal settlement upgrading practices, the informal settlements strategy proposes a qualitative change in the way upgrading will be perceived, scoped and presented. A key premise of this future direction is that innovative and sustainable upgrading will be the planned outcome of a site-referential and interpretive approach, which addresses the many wide-ranging social, physical, historical, environmental and cultural qualities and dimensions within the culture of place. Upgrading will:

- Result from collaboration between the community of the site (with its idiosyncratic values and beliefs), the private sector and the design community (including cross-disciplinary linkages), as appropriate to each upgrading project.

- Be managed by a process that allows creative ideas to manifest, ranging from purely functional and aesthetic modes to highly innovative forms that challenge notions of urban renewal in the public domain.

CONCLUSION

Policy is the vehicle that can be used to enforce strategic spatial interventions that can result to sustainable upgrading of informal settlements. The following discussion will expand on policy principles that can be used to drive collaborative and innovative upgrading projects.

POLICY PRINCIPLES

Policy is the vehicle through which the vision of a sustainable upgrading can be achieved. It can be used to put in place the necessary legal framework, financial and human resources that can be used to implement the SUSS. This can be implemented by adhering to the following policy principles which come from the visual research process discussed in the previous sections:

Principle 1: Responsive design

The design approach to the development of sustainable upgrading of informal settlements will be responsive, reflecting the identity of place and community values, while facilitating job creation, sustainability, innovation and creativity as described below:

RESPONSIVE DESIGN ELEMENT and DESCRIPTION

Identity of place

Informal settlements upgrading project will reflect, and respond to, the distinctive cultural fabric of each location or site, through the interpretation of urban character, the natural environment and/or the unique visual aesthetic of the chosen site and its surrounds. The upgrading will reference the social, historical, environmental and/or cultural lifestyle expressions of the area, with specific focus on the civic and neighbourhood identity.

Community values

Informal settlements upgrading project will evoke acces-

sible references to the heritage and living culture of daily expression, the specific community values, and the community's cultural expression, meanings and aspirations that inform the distinctive cultural identity of a particular locale. Sometimes upgrading projects may introduce something new of greater cultural value, or that appropriately respects the existing culture by using public participation.

Job creation

Informal settlements upgrading project will always include continued education, training and skills development aspects through the installation of information and telecommunication technology infrastructure, a localised small-scale network of educational facilities, a means of collaborating with the private sector, small-scale on-the-job training facilities, and the management and maintenance of infrastructure. The local municipality in partnership with the private sector can train, appoint and manage individuals from the settlement to operate and maintain waste collection facilities, micro-scale urban agriculture, solar energy systems, waste and storm water facilities, the cleaning of public spaces, and the maintenance of trees.

Existing and new micro-franchises and network marketing systems may be introduced to the settlement by integrating it with a continued education, training and skills development programme. These micro-franchises and network marketing systems can be created and introduced through collaboration between interested local residents and private sector organisations. The micro franchises will build on the existing street and door to door vendors. The marketing network will fit in well with the existing strong social networking culture in informal settlements. This will ensure the sustainability and growth of micro-scale economic activities in informal settlements.

Land parcels and uses

Informal settlements upgrading project will retain existing residential and commercial land parcel uses, and new uses should be strategically allocated for ease of access and convenient proximity to each cluster of the informal settlement. All new land uses and networks should be in

harmonious and synchronous relation with existing ones. To respect existing micro-scale activities and uses in informal settlements, and to ensure high density and a very fine urban grain, the minimum land parcel shall be 9 square metres and multi-storey developments will be promoted. Existing pathways and road networks will be improved and integrated with different service networks to ensure good accessibility and connections.

Sustainability
Informal settlements upgrading project will stimulate sustainable thinking in the use and management of resources, energy and waste. Through a systems design approach, all aspects of the upgrading process will be infused with social, economic and environmental sustainability. Existing and emerging social networks can be cultivated and harnessed to create an environmentally-friendly neighbourhood with a growing economy.

Innovation
For the informal settlements upgrading project every problem will be viewed as a challenge that can be transformed into an asset through innovation and creativity. Although informal settlements are seen as chaotic and confusing, innovation and creativity can be used to transform the chaos into order by spatial, infrastructural and programmatic interventions. Developing informal settlements into sustainable neighbourhoods will require social, economic and environmental creativity and innovation. This can be achieved by the synergy of the inputs of all the various stakeholders involved in the upgrading project.

CONCLUSION

This aspect of the policy touches on site specific design solutions which will require an understanding of the tangible and intangible context of Informal settlements. Mapping techniques can be used to established apparent community values, identity of place, the challenges of tenure, environmental and socio-economic conditions of the informal settlement. A responsive design approach can lead to innovative solutions which address the needs of the community in a sustainable manner. The following policy principle will outline aspects that need attention in order to ensure holistic upgrading design solutions.

Principle 2: Integrated design
The Department of Human Settlements will need to commit to a relational design and consultation approach, which will ensure that the design development of informal settlements upgrading project demonstrates appropriate aesthetic appeal, functionality and utility. According to this approach, upgrading emphasises integration (e.g. response, memory and facilitation for place-making), and/or promotes intervention (e.g. provocation and challenges for agenda-setting). The three integrated design elements are described below:

INTEGRATED DESIGN ELEMENT and DESCRIPTION
Aesthetic appeal
Informal settlements upgrading project will provide new aesthetic elements, features, qualities and design applications, and it will deliver design outcomes which are integrated into existing and future urban design and architectural built forms (both interior and exterior settings) and natural environments.

Functionality
Informal settlements upgrading project will demonstrate functional and design integration that is both relationally appropriate and relevant to each site, form, setting or place of a community; not only as a physical relationship, but also in terms of the social context of people and place.

Utility
Informal settlements upgrading project will respond to the requirements of care and conservation and comply with the South African Building Standards and Codes for Structural Design and with relevant Health and Safety measures. Furthermore, the longevity of the upgrading project, the suitability and durability of systems, services, fixtures, structural elements and materials, and the appropriateness of materials and construction techniques, will be in line with future maintenance requirements. Upgrading projects will respond to the requirements of the new National Building Regulations, Regulation XA SANS 10400 XA – *Energy Usage in Buildings* and SANS 204 – *Energy Efficiency in Buildings*. Systems and services should be friendly to the environment to ensure sustainability.

CONCLUSION

Urban, landscape, and architectural forms and spaces can be interrelated by an integrative design approach which can ensure socio-spatial interdependence. This policy principle can help ensure that holistic upgrading design solutions are achieved by providing infrastructure and built-environments that support relationship-building activities in Informal settlements. Integrated built-environments can strengthen existing social networks, thus, increasing the urban social capital of the settlement.). Urban social capital is the fundamental asset for informal settlements because it can promote social relationship-building and strong community connections. The following principles will touch on the stakeholders who can work with the community to create responsive and integrated informal settlement upgrading design solutions.

Principle 3- Municipal leadership
Informal settlements upgrading project will need to be driven by the commitment of municipalities to strong leadership and the allocation of appropriate intellectual, administrative and financial resources. In particular, the leadership role of municipalities will embrace both systematic control measures and innovative management procedures to uphold the design intentions captured in the principles outlined above.

In support of its leadership role, municipalities will:

- **Expand the range of opportunities for upgrading projects, by ensuring informal settlements are incorporated in all new major civic and private developments and major civic capital works programs located in and close to these informal settlements, through appropriate financial allocations and changes in statutory planning policies.**

- Delegate the development of the upgrading strategy to an independent and representative body within the Upgrading of Informal Settlements Programme section of the Department of Human Settlements, which has representation at municipalities to ensure a diversity of ideas and views.
- Maintain a continuous effort to engage the public through a broad community awareness program and seek the early involvement of the local community and stakeholders in the initial planning stages of upgrading projects.
- Obtain the support and collaboration of relevant municipal departments including engineering, urban design, open space, social and urban planning, finance and corporate affairs.

CONCLUSION

The number of people living in informal settlement is growing in South Africa, as a result of rural-urban migrations and the influx of foreigners to seek for job opportunities. The municipalities will need to dedicated resources and time in order to achieve better results in implementing upgrading projects in informal settlement. A strong partnership with the community in the informal settlement can go as far as sharing responsibilities from the initiation to the maintenance and expansion of upgrading projects. Specific relationships, linkages and responsibilities of upgrading of informal settlements within the organisational structure of the local municipalities will have to be put in place.

Principle 4 – Recognising designers
From the conception stages, upgrading programmes will utilise the creativity of the design professions, i.e. architects, landscape architects and urban designers, to ensure a balance between functionality and the aesthetic qualities of each component of the Informal settlements upgrading project.

Municipalities will need to facilitate opportunities for designers and engineers to work with each other in collaborative design teams and with local communities in the initial planning and/or concept development stages of up-

grading projects, to interpret and integrate the culture of place and facilitate the process of cultural belonging into functionality and sustainability. Also, municipalities will increase public awareness of the role of design professionals in the community.

CONCLUSION

Current Department of Human Settlement's UISP favours social workers and engineers and neglects the role of design professionals in the various stages of upgrading projects. This study has shown that designers can play a central role in this kind of projects because they have the skills and expertise to interpret, formulate, conceptualise, and visualise spatial and non-spatial aspects of upgrading projects. Designers can provide socio-technical skills because they can engage with communities and municipal technocrats.

Informal settlements upgrading project will achieve its full quality and impact when the planning and design processes incorporate strong leadership, a sound financial base, community consultation, responsive design, integrated functional and aesthetic intentions, and the early involvement of designers. Thus, actions that will deliver the SUSS for informal settlements will allow for:

- partnership arrangements and collaboration, including private sector partnerships;
- consultation across the built environment, the community and other stakeholders;
- collaborative design arrangements across disciplines; and
- integrated planning and design across the organisational structure of municipalities.

The resultant commissioning procedures and procurement systems will enable the creation of upgrading projects that would enhance the social, economic, functional, environmental and urban fabric, and empower the ownership and engagement of local people to ensure site specific and responsive designs that are integrated with the informal settlement's natural and built environments. The following

goals and objectives can lead to the realisation of the vision of the spatial strategy:

DESCRIPTION OF GOALS and OBJECTIVES
Goal 1 Realise a sustainable upgrading project for Informal settlements which offers challenging outcomes, ranging from conventional to innovative and interdisciplinary contextualised design solutions.
Objective 1.1 Create structures for a critical discourse of ideas
Objective 1.2 Adopt tools/models of best practice for upgrading
Objective 1.3 Initiate and lead a strategic program of the Informal settlements upgrading project

Goal 2 Attain high quality upgrading project in Informal settlements' urban spaces.
Objective 2.1 Increase the Public Sector budget allocations for Informal settlements upgrading programme
Objective 2.2 Increase the involvement of the Private Sector in Informal settlements upgrading project.
Objective 2.3 Establish new management arrangements for Informal settlements upgrading project

Goal 3 Achieve integration of the different development phases in Informal settlements' upgrading project.
Objective 3.1 Establish an organisational structure for Informal settlements upgrading project

Goal 4 Increase the awareness of Informal settlements' upgrading project as a valuable and significant cultural heritage, economic and sustainable approach.
Objective 4.1 Design a communication strategy to further professional discourse and public understanding of the value of designers in creating sustainable upgrading solutions for informal settlements.

The goals outlined above can be achieved by taking specific and strategic actions. The following is a brief outline of recommended actions for the SUSS for informal settlements as they relate to the above goals and objectives:

STRATEGIC ACTIONS
A series of appointments
1. Upgrading Advisory Committee
2. Ideas Trust
3. Upgrading Officer

A series of procedural actions
1. Procedures for allocating budgets to upgrading projects. These can be derived from relevant national and regional government departments and municipalities – i.e. Capital Works or Operational and Maintenance budgets.
2. Procedures for cross-disciplinary collaboration across local municipal departments.

A series of procedural documents
1. An Upgrading Clause in the Planning Permit process to guide developer and private sector contributions.
2. An Upgrading Clause in the Capital Works Briefing Documentation and Urban Design Development Program.
3. Upgrading Benefit Case Preparation Guidelines.
4. Upgrading Information Kit.
5. A specific program of upgrading works building on the Department of Human Settlements' current Upgrading of Informal Settlements Programme. This will entail identifying and documenting informal settlements that are suitable for upgrading, using the policies and guidelines of the Land and Housing Unit.

A series of promotional activities
1. Upgrading Brochure
2. Upgrading Website
3. Upgrading Forums and Seminars

A placing of an organisational structure
Divisions: Division of Housing and Human Settlements in collaboration with Division of City Planning and Development
Personnel: Sustainable Upgrading of Informal Settlements Officer (part-time)
Management responsibility: Manager: Urban Design & Architecture
Strategic direction: Upgrading Advisory Committee for Creative and Sustainable inputs: Ideas Trust and Feasibility Committee

These strategic actions can be achieved by breaking the spatial strategy into different phases. The following section will discuss these development stages.

THE DEVELOPMENT STAGES OF INFORMAL SETTLEMENTS UPGRADING

The development of sustainable upgrading in informal settlements will involve different stages of project management. These generic procedures can be custom-made for each upgrading project in line with the model SUSS for informal settlements. An accompanying document, the Upgrading Information Kit, details the procedures inherent in the overall project management of an upgrading project that will be facilitated by the Upgrading Officer. The kit incorporates information to guide pre-commission planning, commissioning and contracting processes, as well as relevant legal matters that address property rights, land use and zoning, documentation of town planning guidelines, and maintenance requirements.

CONCLUSION

The municipality will need to play a proactive role in systematically addressing the strategic opportunities that exist within Ivory Park and informal settlements by preparing and implementing a strategic program for upgrading project development. These opportunities will need to be developed further within a master plan or program of works that will detail the scope of these works, indicating budgetary forecasts and management responsibilities. The design evaluation framework discussed below will be used to measure proposed and implemented upgrading projects to ensure that the vision of the strategy is realised.

DESIGN EVALUATION FRAMEWORK FOR THE UPGRADING OF INFORMAL SETTLEMENTS

To ensure quality control and integrated upgrading project outcomes, the evaluation framework presents six stages of evaluation, reflecting the overall design intentions of the principle of responsive design and the principle of integrated upgrading. It is designed to facilitate evaluative processes inherent in the procurement, selection and commissioning of upgrading projects generated by the three streams – public, private and community. The six design intentions are: Identity of place; Job creation; Community values; Innovation and creativity; Aesthetic appeal; Utility; and Functionality.

These design intentions should be used to test the appropriateness of an upgrading idea, design or project opportunity for its compliance with the SUSS's guiding principles. Whilst all design intentions must be met, it is likely that each upgrading idea, design or project opportunity may only scope some of the design values, outlined under each design intention. One role of the Upgrading Officer would be to lead the assessment process and thereby focus and guide the overall evaluation procedures for each proposed upgrading idea, design or project. The following shows the design intentions and the associated design indicators:

DESIGN INTENTIONS and DESIGN INDICATORS
A. IDENTITY OF PLACE
DESIGN INTENT: Informal settlements upgrading designed to reflect place-based cultures, to be distinctive and reflective of the urban fabric, natural environment and the visual cultures of 'place'.
DESIGN VALUES – is the design culturally appropriate in terms of:
1. Communication – expressing and conveying the essence of the culture of place, cultural identity, and civic image of an informal settlement.
2. Representation – using the appropriate motifs, symbols and design language to denote the ethos of place of an informal settlement.
3. Location/Subject – positioning each program in the informal settlement where it can flourish and in a way that effectively allows it to relate positively to other programs in the neighbourhood.
4. Context – the varied site circumstances in the informal settlement in which the landscape and built environment is (or was) produced and/or interpreted.

5. Identity/Object – the use of design forms and expressions to evoke a sense of belonging and association in the people using or experiencing a design in the informal settlement

B. COMMUNITY VALUES

DESIGN INTENT: Informal settlements upgrading designed to be responsive to the community's ethical frameworks and identification with the sense of place.

DESIGN VALUES – Does the design reflect community identification and involvement in addressing:

1. People/ Place – the use of allegories, attributes, traditional signs and symbols, personifications, motifs, form and voids, paintings, and materials that kindle a relation between a particular community and the immediate environment of the informal settlement.

2. Location/Subject – the members of that community and the physical site of the community, including the relationship of private space to public space, should promote strong community ties in the informal settlement.

3. Identity/Object – using various design forms and expressions to articulate a set of unique attributes of a community that create a sense of belonging amongst its members in the informal settlement.

4. Sustainability of materials – identifying the range of materials that can be fabricated and used by the community of the informal settlement. This entails discovering the indigenous material knowledge and the construction skills of community members.

5. Juxtaposition – harmonising and harnessing contrasting and conflicting ideologies and views of a community in the informal settlement, using design forms and expressions.

6. Representation – engaging the community in selecting a range of design forms and expressions, motifs, symbols and traditional signs that can truly reflect the nature of that community in the informal settlement.

7. Social/Environmental/Cultural – individual and communal socio-spatial facets, relating daily living practices to the way spaces are manipulated and transformed in the informal settlement.

8. Micro-scale economic activities – the location, operation and acceptable conduct of existing and emerging micro-scale businesses in the informal settlement.

C. INNOVATION AND CREATIVITY

DESIGN INTENT: Informal settlements upgrading designed to represent the unfolding of new urban relationships and dialogues as innovations in aesthetics, materials, structural potentials and meaning as a form of site-specificity.

DESIGN VALUES – Is the design original and unique and does it thereby create dialogue and engagement with the concepts of:

1. Time/Place/Memory – linking the past events and places of the informal settlement to the present ones, and projecting these events and places to the future in order to connect people to place and landscape.

2. Symbolism/Abstraction – engaging people with a site by using design to reveal and conceal aspects of represented meanings through the articulation and relationships of forms and materials that are relevant to the informal settlement.

3. Expressive/Emotive – arousing experiential delight by using aesthetics, materials, form and meaning in order to connect people to particular site characteristics of the informal settlement.

4. Divergence/Convergence – exploring new ideas and seeking new solutions by using different approaches, and sifting those ideas using a set of constraints to discover the best solution to a defined design problem.

5. Hybridisation/Differentiation – a process-driven design exercise involving combining and connecting various design solutions to obtain one solution, or deriving the best attributes of each of the available solutions and creating one solution.

6. Systems/Functionality – connecting different parts and components of the design to an interrelated and holistic entity, while ensuring that each part of the design functions optimally.

D. AESTHETIC APPEAL

DESIGN INTENT: Informal settlements upgrading is presented as visually attractive and pleasing and in keeping with the site and its surrounds.

DESIGN VALUES – Does the design present as pleasing and attractive in terms of:

1. Shape/Space/Scale – creating harmony, rhythm and balance between old and new shapes, spaces and scales by relating all the design elements to existing site conditions in the informal settlement.

2. Form/Composition/Style – design forms and the way they are related to each other should emerge from the context to ensure continuity and relevance in meaning.

3. Value/Colour/Textures – the understanding of the community's cultural and design values can lead to appropriate design expressions, as in the selection and combination of colours and textures.

4. Naturalism/Realism – ensuring an authentic design language and formal expression that relates to the relevant context and community.

5. Connection/Repose – strategically deciding when to encourage relations and when to let them remain loose so that variety is achieved through the design.

6. Harmony – using a systems design approach to attain synergy and synchronisation in the design.

E. FUNCTIONALITY

DESIGN INTENT: Informal settlements upgrading designed to provide new elements in the built and natural environments, with contextually appropriate and relevant aesthetic elements, features and qualities.

DESIGN VALUES – Does the design have meaning and relevance in terms of:

1. Form – the way objects and spaces are configured. The relationships of their constituent elements should communicate meaning to the people using and experiencing them, while acknowledging the immediate context and era.

2. Composition – the combination and arrangement of forms should relate to site circumstances and be meaningful to the relevant people

3. Materials – the materials and the way they are used in a design should express or challenge the values of the relevant community in the quest for sustainability.

4. Components – each part of the design should be grounded in a particular context, and all the parts should be organised into a whole that people can relate to.

5. Vernacular style – a design should respect and acknowledge established domestic and functional forms and expressions of the relevant community.

6. Indigenous tradition – connecting new design interventions to the cultural practices of the relevant community in a manner that ensures continuity and sustainability.

F. UTILITY

Design intent: Informal settlements upgrading designed to comply with construction, environmental, maintenance and health and safety measures and standards; and with reference to the inherent properties of the materials used and with shapes modelled according to their functions.

Design values – The design should comply with measures and standards regarding:

1. Longevity – design solutions should achieve a long lifespan for the designed and constructed structures, services and components.

2. Durability – the serviceability of structural elements and services over the lifespan of the designed structures should guarantee good performance and the safety of occupants.

3. Maintenance – the repair and operation of designed structures and services should be viable for the local municipality and the informal settlement.

4. Viability – a design solution should be feasible during construction or installation, in its operational phase, and after its lifespan has run its course.

5. Sustainability – design solutions should help to sustain the social, economic and environmental qualities of informal settlements. Design solutions should achieve sound and sensible social, economic and environmental returns on investments.

CONCLUSION

The strategic decisions and the corresponding policy framework will help focus Informal settlements upgrading project to achieve sustainability. The corresponding design evaluation framework can be used by municipalities and design professionals to measure upgrading design proposals and projects. The following discussion will aim at outlining the course of actions and sound practices that can lead to the sustainable upgrading of an informal settlement.

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ADDENDA
6: Action plan for the sustainable upgrading of Khutsong Section Informal Settlement

Khutsong Section leaders will need to be contacted so that they can help organise a community meeting where the upgrading proposal may be discussed. Once the community has accepted the proposal and have grasped and owned the vision of the spatial strategy government officials will be contacted. In order to acquire the necessary resources and support the Khutsong Section upgrading proposal will be presented to the National Upgrading Support Programme (NUSP) relevant officials in the Department of Human Settlements. With the facilitation provided by the NUSP all the other relevant government departments can be contacted so that they can play their part in the project. Then in preparation for the implementation of the upgrading project there will be a series of community participation meetings involving Khutsong Section residents and leaders, relevant government officials, design professionals and other consultants which will lead to the formation of a project committee. The following action plan indicates project components that will be implemented in three phases.

The three phases can be summarised as follows: Phase 1 – Green infrastructure: street paving, drainage, trees, energy needs, urban agriculture, and water and waste recycling facilities; Phase 2 – Place-making infrastructure: threshold boundaries, gateways, landmarks, seating, more trees, civic space, small shops and fragments of communal facilities; Phase 3 – Social infrastructure: for education centres, information centres, design components and ICT centres.

Implementing the first three parts of phase 1 of the action plan is aimed at addressing immediate problems of poor access because of the unpaved pathways, poor drainage, and lack of waste collection services. The urban spatial quality of the settlement can be improved within 18 months while waiting for the implementation of the next phases. The purpose of the proposed infrastructure is to support relationship-building activities that are integral with economic growth and enviro-friendly built-environments. This can be possible if strategic partnerships are forged and concerned stakeholders are playing their role throughout the upgrading project stages.

A Project Steering Committee consisting of Khutsong Section residents, local city council officials and key Provincial Departments could also be formed. This committee would help fast-track the implementation of the project, coordinate and integrate the various parts of the project, and give feedback on its progress. Community members should hold equity rather than be beneficiaries in the implementation of this spatial strategy.

The community members of Khutsong should be involved at all stages of the development to ensure that they are prepared to take a leading position in maintaining and developing the settlement long after implementation is completed. The community should be involved starting from screening the suitable informal settlement land portions that can be upgraded, to analysis of the physical context and community needs, upgrading project formulation, to implementation, operation, and policy adjustments. This can be achieved by putting in a place a steering committee made up of representatives from all the different stakeholders involved in the project. The committee can influence the active policy for Khutsong Section by using the design evaluation framework to measure implemented projects and then give feedback which can be used to improve lacking aspects of the active policy.

PROJECT COMPONENTS	EXPECTED PROCESS	LENGTH OF PROJECT	STAKEHOLDERS
Mapping of informal settlements	Measuring, data collection and analysis	2 months	Surveyors, Ivory Park local municipality, Khutsong residents
Paving of pathways	Community participation, project formulation, design, approvals, implementation, maintenance	6 months	Ivory Park local municipality, City of Johannesburg, Department of Public Works (DPW), and Department of Public Works, Roads and Transportation (DPWRT), Khutsong residents, consultants
Recycling stations	Community participation, project formulation, design, approvals, implementation, maintenance	10 months	Ivory Park local municipality, Department of Water and Environmental Affairs (DWEA), Khutsong residents, consultants
Energy needs	Community participation, project formulation, design, approvals, implementation, maintenance	On-going	Ivory Park local municipality, ESKOM, Khutsong residents, consultants
Seating	Community participation, project formulation, design, approvals, implementation, maintenance	6 months	Ivory Park local municipality, Department of Public Works (DPW), and Department of Public Works, Roads and Transportation (DPWRT), Khutsong residents, consultants
Linear spatial thresholds	Community participation, project formulation, design, approvals, implementation, maintenance	10 months	Ivory Park local municipality, City of Johannesburg, Department of Public Works (DPW), and Department of Public Works, Roads and Transportation (DPWRT), Khutsong residents, consultants
Shops	Community participation, project formulation, design, approvals, implementation, allocation of retail space, management and operation	12 months	Department of Trade and Industry (DTI), Co-operative Incentive Scheme (CIS), Department of Economic Development (DED), Khutsong residents, consultants
Trees	Community participation, project formulation, design, approvals, implementation, maintenance	1 month	Ivory Park local municipality, Department of Public Works (DPW), and Department of Public Works, Roads and Transportation (DPWRT), Khutsong residents, consultants
Urban agriculture	Community participation, training, implementation, maintenance	On-going	Department of Agriculture, Forestry and Fisheries (DAFF)
Upgrade of water collection points	Community participation, design, documentation, implementation, maintenance	6 months	Department of Public Works (DPW), Roads and Transportation (DPWRT), Khutsong residents
ICT Infrastructure	Community participation, project formulation, design, approvals, implementation, maintenance and management	7 months	Department of Communications and Department of Public Works, consultants, Khutsong residents
Components	Community participation, project formulation, design, approvals, implementation, maintenance and management	On-going	Ivory Park local municipality, City of Johannesburg, Department of Public Works (DPW), and Department of Public Works, Khutsong residents, consultants
Continuous Training Programs	Community participation, selection of local residents willing to participate in training, implementation, feedback, improvements	On-going	Department of Education, Department of Trade and Industry (DTI), Co-operative Incentive Scheme (CIS), Department of Economic Development (DED), Khutsong residents
Maintenance and management	Community participation, appointment of local residents as stockholders, implementation	On-going	Ivory Park local municipality, Department of Public Works (DPW), and Department of Public Works, Roads and Transportation (DPWRT), Khutsong residents

Table 6.1 An action plan for upgrading Khutsong Section.

ADDENDA
7: Response to examiners' comments

FIRST RESPONSE

Thank you for the time and effort you have taken to prepare your comments and the thorough report for my first thesis submission. I have taken some time to read through and assimilate all your recommendations, concerns and criticism. In my opinion the significant contribution of my study in the research field lies in exploring the visual research methodology as a tool in addressing socio-spatial interdependencies in informal settlements. As a result I have decided to refocus the study to address the following aspects:

1. Focus the study only on exploring an urban fabric which promotes social gatherings for Khutsong Section using a visual research method.
2. Introduce the study with an autobiography highlighting the researcher's knowledge of socio-spatial interdependencies observed in the rural and urban informal settlements where he was born and brought up.
3. Restructure the socio-spatial theoretical framework and definitions of terms to create a theoretical context for the visual research process.
4. Rework the discussion on the visual research method as a tool to understand socio-spatial interdependencies resulting to developing an urban fabric which promotes social gatherings for the study area.
5. Unpack and repackage all the analysis which did not come through in my first submission. This will help show the depth of the visual research undertaken in the analysis of precedent studies and context study which informed the iterative design process. This will be the most important section of the study thus the quality and narrative of images and drawings will be improved.

Thank you for giving me an opportunity to resubmit and I hope my second attempt will be to your satisfaction.

SECOND RESPONSE

Please note that as a result of an extensive re-work of the document, original concerns may not be apparent in the later submission.

Examiner 1: Huchzermeyer

1) Why is scale handled so liberally or loosely?...in the axonometric sketches on page 267, if humans in the sketch are the defining scale, then some of the shack roofs span 20 or meters.

This was adjusted to depict the correct scale, but also note that some of the people in the drawings are a representation of children.

2) What is the purpose of the alternatives presented on p.273? ... Given the official tendency in South Africa for Departments of Housing to opt for engineering dominated straight-jacketed solutions (that involve destruction of any sign of informality), should this considerations of alternatives not perhaps be removed/avoided?

Noted as point of discussion: These drawings were formulated based on the existing informal plot boundaries and proposes possible future urban fabrics that accommodate formalisation (title-deed plots) by harnessing the existing social networks. This should also factor in tiny plot sizes (for example, 3m x 10 m, in Tokyo Japan) allowing for self-help housing processes.

3) Corrections

Corrections have been made except for the following:

P33: Mid column: Aims of the study

This is noted as a linguistic issue.

P41: 1st column, mid page 'Whether a person lives in a shack or a palace…'

This is noted as an important discussion: The study proposes that Information and Communication Technologies (ICT) infrastructure be provided as part of service-delivery in informal settlement upgrading initiatives.

P53: Second last line of the page and elsewhere in the thesis 'the visual researcher' – this could in my view be changed to 'I', particularly given the extensive reference later in the thesis to the candidates own childhood and use of first language there. The thesis would benefit from consistency of first language throughout.

This is noted as an important comment, especially for an emerging auto-ethnographic study and will be followed up.

P114: Section 2.2 – here in particular it would be useful to have the references for the images appearing in the caption (they only appear in the list of figures at the front of the thesis. I suggest this be discussed with the supervisor).

This is noted for discussion in departmental agendas and to be shared with colleagues and study leaders.

P273 I recommend leaving out these 'further urban layout proposals'

This is noted as a point of discussion: The layouts were formulated based on existing informal boundary lines and assume a future study in achieving formalisation (attainment of tenure) driven by informal self-help housing processes and the involvement of recognised community organisations like CORC (Community Organisation Resource Centre) as the examiner suggested earlier. This could extend into proposing policy and legislation changes that promote smaller title-deed stands than current to increase affordability for low-income groups.

P279 1st column, second para, 7th line from above, 'called bore water' – this seems confused, please discuss with supervisor.

Noted thank you.

Second last para, 4th line from below: 'or a reed bed' – this option seems ignorant of the space needed for this.

This is noted as a point of discussion: The author proposes that these systems may be accommodated in available open spaces not far from Khutsong and can be integrated into existing natural systems shown in page 298.

P307 Please note that this sensitivity is only in policy and has not yet been shown on the ground.

Noted thank you.

P310: … there is no evidence that DoHS's UISP favours social workers.

Noted and will be discussed: The author attended a informal settlement upgrading tender briefing in 2013 at DoHS, presented by the national co-ordinator of the UISP, Steve Topham, who made clear that since socio-techno skills are required, tender submissions that have been successful in the past are those where social workers were involved.

P314: 1st column, first 2 lines, there is a disappointingly limited level of community participation set out here.

This is noted and will be discussed: This study was done in the context/awareness of Dr. Carin Combrinck's doctorate study in Slovo Park informal settlement on community participation. Therefore, the author decided to focus on the aspect of the design process to propose interventions that can strengthen a social economy in an informal settlement. The author also participated in Carin's participatory research in Slovo Park. This involvement extended to assisting in the co-ordination of the Human Settlements and Urbanism (RFP 721) module in the fourth year programme at the University of Pretoria, Department of Architecture (the author worked with students in the mapping of Alaska informal settlement (Mamelodi) and Slovo Park informal settlement (Johannesburg)).

Examiner 2: Marx

1) That there is no evidence of this ("feedback", "peer review" and "trial runs") in the thesis seems to me to undermine the value of demonstrating the proposed methodology and the candidate's original contribution.

The author has submitted two articles for "peer review" and plans to submit more in the future as consequences of the study. This study also benefited from the feedback received from the first examination of this thesis. Also in the development of the study the author consulted with the following individuals and organisations (who may be contacted) to obtain "feedback" and "peer review":

Fritz and Karlien Thomashoff at Thomashoff + partners architects (Email: fritz@thomashoffstudio.co.za). *Dario Schoulund,* urban designer (Email: darioschoulund@gmail.com). *Rudolf van Rensburg,* lecturer at the University of Pretoria, Department of Architecture (Email: rudolf.vanrensburg@up.ac.za). *Dr Carin Combrinck* (Email: carin.combrinck@up.ac.za). *Dr Jean-Pierre de la Porte* (Email: afrenco@yahoo.com). *Community Organisation Resource Centre* (CORC) (Email: Mengi@courc.co.za). *Free Market Foundation* (Email: fmf@mweb.co.za).

There is no evidence that Khutsong Section could be considered a 'space of flows' or its open spaces a 'space of flows', or if it could, that the 'space of flows' is simply everything apart from the private space of the dwellings. It is problematic that this distinction plays a major part of the thesis but "the interventions exclude the improvement of individual dwelling houses" (p284) – that is, what has been equated with the 'space of places'. That said, I am prepared to give the candidate the benefit of the doubt on this claim.

Noted thank you.

2) The second claim that I find problematic is the use of the concept of fractals. The evidence that Khutsong Section is developing along anything resembling a fractal pattern is very underdeveloped. Indeed, the candidate states that the settlement is characterised by "too much com-plexity" (p174), and is "chaotic" and "untidy". 'Fractal' appears to be interchangeable with 'hierarchical' and I would need convincing for it's continued use. Unless a convincing justification can be inserted, I believe that the references to "fractals" (introduced p44–46) all the way to "fractal spaces of flows" (p283), are incorrect and misleading and should be deleted.

Noted as a point of discussion: Although the term 'fractal' is not the most accurate word for describing Khutsong Section's urban fabric, the author found it most useful when seeking to understand the organic and non-Euclidean urban form. This term has also been used by other academics like Eglash (1999), Salingaros (2005) and Barabasi (2002) as an attempt to describe the nature of irregular and organic urban fabrics similar to Khutsong's.

Please also note that the terms, 'space of flows', 'space of places' and 'fractal' are defined in the List of Terms.

3) If there already is a strong sense of place (p54) and strong social bonds (p170), then what evidence is there for the need for a design that builds social relationships within the settlement (p278)? … What purpose would building stronger bonds within the settlement serve?

Yes, but through the process of design, the existing spatial character and social bonds are reinforced through the proposed interventions and facilitation so as to achieve economic upliftment and empowerment of the community. The study also encourage a further the dynamics of the underlying social economy.

4) Lastly, the visual research method used to inform the design of Khutsong Section (p281 and 283), at best, seems poorly articulated with the "policy framework" of Addendum 5 (p303) or, at worst, Addendum 5 is at odds/misplaced (if the aim of the thesis is methodological). A better explanation is needed to resolve this issue and should be considered in the light of the comments about the misapplication of the concept of fractals, listed above.

Addenda 5 was generated through the activities of the study, following the extensive re-work of the first submission of the thesis, the 'policy framework" is now recorded as the archive of the study.