UNIVERSITEIT VAN PRETORIA
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REBUILD

RE-CONCEIVING A SENSE OF PLACE IN AN INDUSTRIAL WASTELAND

Architectural Design Dissertation by
Leoné Pieters

University of Pretoria
2017

PROJECT SUMMARY

PROGRAMME
School for the built environment based in artisan training.

SITE DESCRIPTION
Vereeniging Refractories Ltd.
Semi-abandoned and derelict industrial complex, historically used for the manufacturing of refractory products, with supporting offices, training centres and storage spaces.

SITE ADDRESS
Barrage Road, Vereeniging, 1939

GPS COORDINATES
26.6963° S, 27.8949° E

RESEARCH FIELDS
Environmental Potential and Heritage & Culural Landscapes

Figure on cover page: Drawing of site of demolished fire clay plant, with vegetation breaking through cracked concrete slabs and rubble (Author, 2017).

Submitted in fulfilment of part of the requirements for the degree of Magister in Architecture (Professional).

Department of Architecture,
Faculty of Engineering, Built Environment and Information Technology.
University of Pretoria
November 2017

COURSE COORDINATOR
Prof. Arthur Barker

STUDY LEADER
Prof. Piet Vosloo

This dissertation was completed with the financial aid of the Carl & Emily FUCHS Foundation, awarded to winners of the annual Prestige Prize in Architecture.

All the glory and gratitude to the
Architect and Creator of it all.

To Prof. Vosloo,
thank you for your knowlege, patience
and encouragement.

To Berend,
thank you for listening, no matter what.

To my family,
thank you for always believing.

Special thanks to Louise Le Roux for
allowing access to the site and the stories
generously shared.

T^2
may this be only the beginning.

I hereby declare that this dissertation, which is submitted for the degree Master of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for this degree at this or any other tertiary institution.

I further declare that this degree is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is specified and fully acknowledged in the text and in the reference list included.

Leoné Pieters

ABSTRACT

Architecture is a complex, multi-layered phenomenon, with the ability to impact people and place both negatively or positively.

The dissertation offers a contribution to contemporary discourse which is greatly concerned with the environmental impact of the built environment. It grapples with issues of man's identity, a reading of place and the relationship between the habitat and inhabitants, by considering how a post-industrial site, namely the Vereeniging Refractories, can be regenerated.

The project investigated the various layers informing place, through the lens of regenerative theory. The purpose is to develop a narrative that is sensitive to the site's environmental, social and economic context, yet can weave the past, present and potential future together.

Various responses to three main design drivers, are explored. Narrative (or heritage), environment and programme were weighed up against each other as architectural informants, to establish the most appropriate hierarchy guiding the architectural product.

As programme a vocational college for the built environment is envisioned. In terms of the larger scheme for the site, this will be the first implementation which will facilitate the development of the campus to accommodate various interrelated fields of vocation. Co-dependence, collaboration and integrated learning through doing hands-on activity is explored as a means to build a new relationship between man and environment (as a complete set of ecosystems & narratives) – a relationship rooted in a state of well-being, not one of exploitation and inequality.

The approach alternated between qualitative and quantitative research and responses, synthesizing decisions into a balanced response.

The programme raised a number of challenges that critically influenced decisions throughout the design process. Accommodation of spaces for academic activities parallel to workshops housing traditional and technologically aided construction largely determined the spatial organization of the project. Iterations based on environmental response and the requirement of the intervention to act as catalyst for future development justified the proposal.

The transformation of the skin of a portal frame structure was explored, in order to optimize the building's response to the natural elements, whilst creating optimal interior spaces. This transformation embodies the narrative and meaning of the place, through integration of different re-claimed brick types and vegetation into the skin of the architecture.

The architectural response takes the user on a journey through the transformation from a post-industrial place-less space towards, a place that connects the various layers present, towards the ideal of a dynamic human and natural relationship of well-being.

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Chapter I

INTRODUCTION

1.1. BACKGROUND

The site chosen for the investigation of a regenerative approach in this disseration, is rooted in the author's personal background. Growing up in Vanderbijlpark, regular trips were made past the site – often on the neglected, dangerous route along the Vaal River (taken only as an emergency shortcut). From between the Eucalyptus trees along the Barrage Road on the other side, only bits and pieces of the complex were visible, merely hinting at some of the activities that used to occur there.

Initially the southern edge of the site was of interest, posing the opportunity of an intervention that could create an interface with the river. However, an increased understanding of the history and significance of the larger area, led the author to the *Verref* site as the heart of the wasteland.

Fig. 1.1. Reservoir between trees on *Verref* site (Author, 2017).

1.2. PROBLEM STATEMENT

1.2.1. GENERAL ISSUE

The industrial revolution marked an evolutionary change in the continuum of man's interaction with his environment. New mechanization and transport methods empowered this age of industry and manufacture which in turn birthed new cities and a new level of domination over natural resources (Hart-Davis 2015:285).

Because industrial processes are resource-based and these resources are mostly finite, technology evolve and development shift to more suitable locations. This results in abandoned post-industrial sites, left to exist in liminality – a state of neither fully alive and functioning nor completely abandoned. Layers of history, industry and natural ecosystems are all blurred together and haphazard, leading man to perceive it as places without value, inaccessible and dangerous.

Even though the depletion of natural resources, due to continued industrial and urban processes, results in an increase in industrial wastelands, areas offer the opportunity to re-establish places where people can not only live in harmony with natural ecosystems, but be instrumental in the regeneration thereof.

Fig. 1.2. Collage by artist Oleg Borodin (http://olegborodin.com/Collages-1 accessed 7 March 2017).

1.2.2. URBAN ISSUE

The birth of the town of Vereenging is the result of a number of industrial endeavors located advantageously close the Vaal River. One of these original companies was the *Vereeniging Brick & Tile Company*, later known better as *Vereeniging Refractories*. The site is located between the main road through Vereeniging CBD (Barrage Road) to the north and the Vaal River to the south. Situated on the western periphery of Vereeniging, the post-industrial site lays claim to a large portion of the riverfront, rendering it 'lost' to local residents in-between elite residential and recreational riverfront developments in both Vereeniging and adjacent Vanderbijlpark.

Regeneration of the site can transform it into an accessible, useful and valuable asset to the surrounding communities including Sharpeville and Sebokeng.

Since its first brick manufactured in 1890, *Vereeniging Refractories* has been expanding and adapting to fit the changing needs of the industry and evolving technology. However, a general decline in the local refractory demand, as well as technological needs beyond

Figure 1.3. - 1.5. Location and larger context of the site of the investigation. Diagram indicates location of Vereeniging in Gauteng, the location of the site in the town of Vereeniging and the site in its surrounding context (Google Earth Images edited by author 2017).

economic solutions, forced the company to cease manufacturing processes and to start demolishing structures from 2015 onwards, for reprogramming and new developments within the complex.

Currently most of the existing buildings on the site are rented as office space and most of the large industrial structures are left empty or used for storage; while industrial ruins and damaged landscape dominate the largest portion of the site.

As part of their environmental responsibility and the critical need for rehabilitation and re-development, *Vereeniging Refractories* have started to cover and vegetate smaller dumping areas on the site. Recently, the company has started to reopen some refractory dumps for sorting and extraction of materials for possible reuse off-site, by external companies. *Verref* intends to expand and maintain rehabilitation of their site environment, but also introduce new developments to once again contribute economically and socially towards the larger Vaal region (Le Roux, 2017).

Trading as *Vereeniging Properties and Investments* since 2016, *Verref*, together with the Department of Higher Education, are envisioned as the clients for the architectural intervention proposed in this dissertation.

1.2.3. ARCHITECTURAL ISSUE

Together with the critical increase in resource consumption within the built environment, perceptions of the green movement and 'green achievements' are not yet positioned to allow design from and for place (here referring to all the ecosystem services including cultural systems). Current 'green building' practice cannot be efficient if it is stuck in a 'mechanistic' worldview, based in machine analogies. Rather, a shift towards the 'ecological' worldview (Mang & Reed 2012:23) is necessary in the way we design.

Examples of regenerative architecture are increasing throughout the world, as the realization of the responsibility of the built environment spreads. Large-scale urban regeneration of landfills and post-industrial sites have been successful in reinventing places such as the *Landschaftspark*, by Peter Latz in Duisburg-Nord, Germany, completed in 1991; and the *FreskKills Landfill* in New York, undergoing rehabilitation since 2012 into an urban park for people and wildlife, commissioned by New York City Department of Parks and Recreation.

Still, the design of architecture that regenerates and reimagines the relationship between man and environment, remains a challenge.

1.3. RESEARCH QUESTIONS

The investigation is based in the following questions:

How can an architectural intervention reclaim places perceived as wasteful and void, re-establishing an urban contribution and sense of place, value and significance?

Within the global crisis of degenerated environments and resources, how can the architectural profession be instrumental in the pursuit of a more holistic approach to the development of urban spaces and communities?

How would the way we build need to change, in order for architecture to make a positive impact, not merely aim to reduce negative impacts?

1.4. RESEARCH OBJECTIVES

Research and investigations on the topic of 'wasted space' and *urban void* in the academic field of architecture, have been a growing interest. However, the focus is often on dense city locations or in completely abandoned/derelict industrial sites, removed from urban fabric. Investigation done in this dissertation aims to consider the less-dense 'town' urban fabric and the interstitial space between residential, natural and industrial areas.

The dissertation proposes a means of replacing the forgotten value of the natural resources on which Vereeniging and its surrounding settlements were built, through reinvention and rehabilitation of the post-industrial wasteland into a place that is valued and used. The focus of the research is on architecture with future change and development as part of a larger natural ecosystem in mind.

1.5. RESEARCH METHODOLOGY

The investigated theoretical context and literature form the basis of the research process, informing other decisions. Interpretation of the literature is structured into chapters one to five of the dissertation, read as an article, in order to determine and describe the specific contribution of the architectural proposal to the discipline. The contribution serves as the backbone argument for the second part, which deals with the design of an appropriate response and application within the chosen design laboratory.

All data necessary are collected, either from the site, or externally, and serve as critical informants in the application of the theoretical approach. Iteration and conclusion of the application are documented as part of the process of developing a detailed architectural response (chapters seven to eight) that represents the intentions.

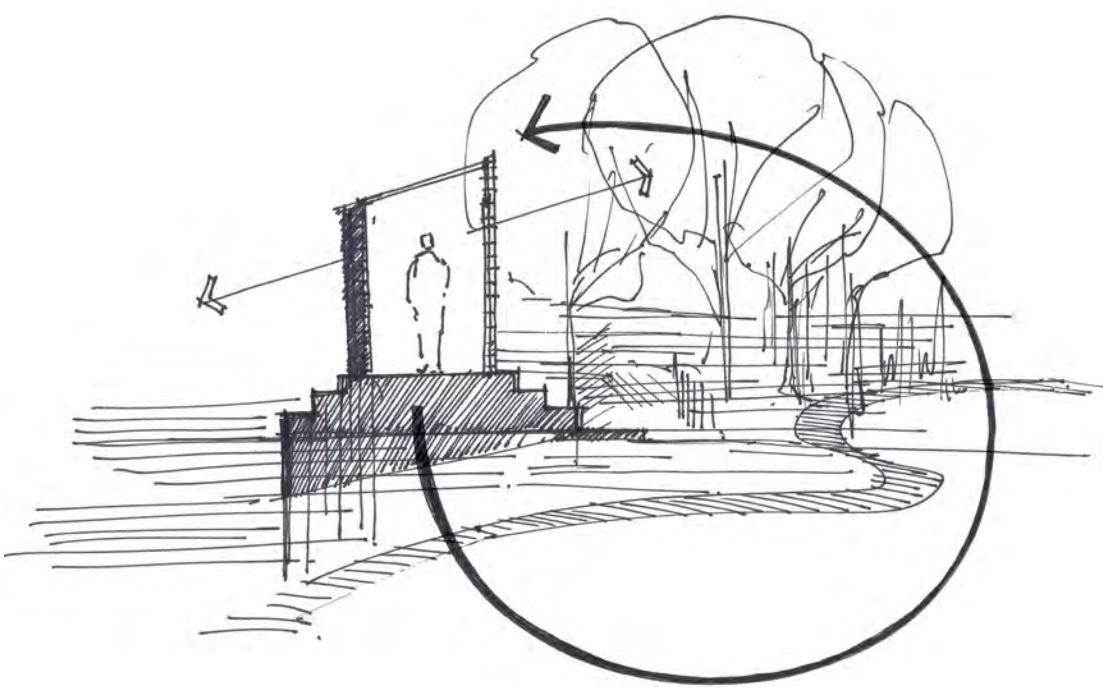


Fig. 1.6. Regeneration of man's relationship to his built and natural habitat (Author, 2017).

Fig. 1.7. Current state of the site of the demolished Fire Brick Plant (Author, 2017).

1.6. DELIMITATIONS

The focus of the architectural investigation is on reinvention of place and function through transformation of new structure, rather than on reuse or appropriation of existing buildings, which will be evaluated and curated primarily as part of the larger site vision and their possible contribution to the intention of the precinct vision.

It is not the aim of this dissertation to propose new methods of construction, but rather to consider different applications of materials in the pursuit of construction that connects man with natural ecosystems and environments.

The proposed new developments on the site are too extensive to allow detail resolution of the entire site development, therefore only selected elements are focused on, and the rest merely designed on precinct- and site scale (including additions and alterations of existing built fabric). The focus of the architectural investigation is rather on the relationship between man, narrative and environment in the creation of architecture as contribution to the reconstruction of a specific place.

The program proposed is used to inform the spatial organization and collaboration of disciplines within the typology of a training college, therefore the dissertation does not aim to reinvent systems and process within workshops spaces, but rather focus on the spatial accommodation of these activities.

1.7. ASSUMPTIONS

Based on historical information, clay reserves have not been mined on the site in the last few decades. Clay (and other required minerals such as Magnesite, Chromite and Silica) was however mined there in the early years around the 1900s, but was soon sourced from Springs and Hammanskraal and transported to the site, where products were merely manufactured. The assumption is that due to the fact that the clay resource has been depleted early on, damage to the natural soil composition is not as extensive.

Due to the lack of detail information of the industrial processes that occurred on the site, it is assumed that the soil is not chemically contaminated, but merely damaged, removed or eroded, and can therefore be rehabilitated through a basic process of remediation, replacement of topsoil and revegetation.

It is further assumed that all manufacturing processes on the site have ceased and only a few select buildings remain rented out as office space or industrial warehouses. A number of the buildings on site face possible demolition due to structural danger and lack of use. The Fire Brick Plant building that occupied the site chosen for the detail intervention were demolished in February 2015, for exactly these reasons.

The assumption is made that all the materials found on site are available for re-use in a new architectural intervention, and that the bricks reclaimed from the demolished building cannot be used in structural brick construction due to uncertainty of their structural integrity.

1.8. LIMITATIONS

Complete access to all buildings within the Verref complex were not possible and assumptions drawn from historical sources informed the understanding of the functions housed within, as well as the development of the complete site over time.

Current soil conditions and natural biodiversity were not investigated, but responses were informed by impressions of the condition of the landscape and species found on the site.

No access to any building- or site plans were possible. Existing built fabric was analyzed and measured by the author during a series of site visits.

1.9. DEFINITIONS

Place

the unique, multi-layered network of ecosystems within a geographic region that results from the complex interactions through time of the natural ecology (climate, mineral and other deposits, soil, vegetation, water and wildlife, etc.) and culture (distinctive customs, expressions of values, economic activities, forms of association, ideas for education, traditions, etc.) (Mang & Reed, n.d.:2).

Ecosystem

“the interactive system of living things and their non-living habitat” (Tansley, cited in Mang & Reed, n.d.:1).

Regenerative design

a system of technologies and strategies, based on an understanding of the inner working of ecosystems that generates designs to regenerate rather than deplete underlying life support systems and resources within socio-ecological wholes (Mang & Reed n.d.: 2).

1.10. DISSERTATION OBJECTIVES & SIGNIFICANCE

Intrigued by stories, meaning and heritage, but in search of a more relevant, holistic contribution to the architectural discipline, the author aims to use this dissertation to explore the possibilities of a ‘sustainable building approach’ as another informing layer. These layers as a whole are perceived as critical informants of the function, narrative and meaning of the architecture created.

The dissertation provides the author with the opportunity of grappling with not only the discipline of architecture, but also the integration with landscape. Through research and application, the dissertation is constructed to contribute towards the larger discussion of regenerative architecture and principles.

By the investigation of a site located outside of the usual urban areas of study, the author wishes to expand research on post-industrial sites in South Africa. Research generated from the investigation also contributes towards the knowledge of the history of Vereeniging and its role in the industrial development of the country.

PART I

INTRODUCTION

Sustainability is not enough anymore. Reducing waste and creating 'self-sufficient' net-zero buildings are only attempts at doing less damage, not trying to fix it. We are delivered to a state of facing the consequences of consumption and exploitation of the natural resources that make up our habitat, grappling with our own man-made environments. Just as significantly as we are responsible for the destruction, we could be instrumental in the reversal thereof.

Through the use of the regenerative theories of Mang & Reed, a post-industrial site will be approached, in an attempt to explore answers to the research questions.

The ultimate intention of the investigation is the process of understanding environmental reclamation, aiming to recover health and enrich biodiversity of natural ecosystems, but also to renew the imagination and spirit of those who use and inhabit it. Loures and Panagopoulos (2007:796) call this the creation of 'Lifescape'; a partnership between mankind and 'place' (referring to the larger dynamic composition of supporting, natural and cultural ecosystems) that offers the fuel for regeneration, inherent in the living systems.

Chapter II

THEORETICAL CONTEXT

2.1. MAN & ENVIRONMENT

Our history and our inevitable progression
Our blind repetition
Layers of icons migrate, stagnate, and dictate
Standing guard against ambiguous plains.
Conductors and Spectators
Bleak skies and collapsing horizons
Adding and subtracting,
Concealing and revealing,
Reflecting and repeating,
Attempting to root oneself in that which is not solid.
(Curlowe et al. 2017)

Fig. 2.1. *Watching, waiting, calculating* by Andy Curlowe. Acrylic, pencil, enamel, latex and collage on canvas. 2011. (http://curlowe.com/section/403273-2010-2015.html, accessed 7 March 2017) (edited by author).

The issue of people, nature and the built environment has been analyzed and described in architectural theories in many different ways. One could almost argue that this debate becomes an ever-present underlying element to most, if not all, theories. The relationship between man's self-made or built environment and the natural environment has been either one of sympathy, harmony and integration or one of hostility and exploitation (Nesbitt 1996:30). These different relationships often develop into man's wish to dominate the natural world and in effect glorify human ingenuity and creation; the wish to preserve and glorify the natural environment and ecosystems or activities through keeping man from the natural world; or the wish to co-exist, establishing a symbiotic relationship in which mankind becomes part of the natural environment itself (Righini 2009:246).

Laugier's famous 'primeval hut' captures the original relationship between man and nature, in architecture made from natural resources in a natural setting (Sanya 2012:8). Even though this seems like a small impact on the environment, it is prophetic of how mankind would eventually 'subject nature in pursuit of architecture'. The driving ideas of the Enlightenment and the growing acceptance of science critically removed man from nature, applying a mechanistic perspective to nature, leading to exploitation of a 'separate' source. The consequences of this thinking eventually resulted in the Industrial Revolution, marking the peak of a culture conquering nature (Sanya, 2012:8). From this point, resources were extracted, processed and consumed, generating pollution and waste; and as industrial processes became obsolete, often left post-industrial wastelands.

> In the pre-industrial past, the production of meaning in Architecture relied upon structured references to and associations with nature. Modern architecture embraced the machine analogy, rather than the organic analogy (Nesbitt 1996:48).

'In the triumph of Modernism, regionalism and environmental identity were ignored', hence the term 'International Style', suggesting that architecture across many countries, had most things in common (Trancik 1986:21).

Critical Regionalism, according to Frampton, is 'dwelling in an architecture of greater experiential meaning', thus referring to regional, vernacular building and its sensitivity to light, wind and temperature as elements characteristic to particular place. Being critical of the mass-produced building products common of the later Modernism, he proposed that the Modern movement needs to be redirected. He suggested a resistance to homogenization of the visual environment through particularities of mediated, local building traditions (Nesbitt 1996:50).

Only during the 1960s the human impact on the environment became a critical enough concept and sustainable thinking started mainstreaming in the discourse of architecture (Sanya 2012:9). The theory behind the green building movement aimed at developing a less antagonistic relationship with nature. 'Environmental ethics' supported the phenomenological ideal that a relationship with nature is essential to full human self-realization on this planet (Nesbitt, 1996). Heidegger articulated the relationship between building and dwelling, being, constructing, cultivating and sparing in his work: *Building Dwelling Thinking* (Nesbitt 1996:29). The meaning of dwelling here, referring to a relationship of 'staying *with* things' (author's italics), thus combining earth, sky, the mortal and the divine (Nesbitt 1996:29).

The relationship between man and nature has only started to show a shift in thinking in recent years again, with theorists like Ian McHarg and John Lyle Tillman. The idea that man is part of the sets of ecosystems that sustain life on planet earth, places a responsibility on mankind, to not only live less antagonistic towards nature, but to rather acknowledge the necessity of understanding and partnering with the natural environment that sustains life.

A plea for regeneration in the way we design, is central to the work of William McDonough — a major spokesperson for the sustainable design approach. He proposed new definitions of prosperity, productivity and quality of life, stating that we need to come 'to peace with [our] place in the natural world.' (Nesbitt 1996:62). When we understand that nature is not fixed in its totality, we take on 'an attitude of integration with and a commitment to renewing and restoring the earth and its living systems' (Nesbitt 1996:62).

The construction of architecture that regenerates is exemplified by ecologist, urbanist and architect, Ken Yeang, who pursues ecomimetic architecture that integrates the natural environment in a physical, systemic and temporal way (Pasternack 2009). Benefits in the production and regulation of ecosystems, growing of food and the improvement of water and air quality, have been realised and architecture moves toward 'living buildings'.

2.2. REGENERATIVE THEORY

2.2.1. THE PROBLEM WITH THE GREEN BUILDING MOVEMENT

Current 'green building' practice is measured and regulated by various green building assessment tools, awarding architectural projects for their contribution towards a less negative impact on the environment. Principles like effective use of resources through recycling, use of natural building materials and the design of self-sufficient buildings, generating solar energy and harvesting water, guide these tools.

In critique of this, Cole (cited in Boonzaaier 2015:14) writes that components should be evaluated as complete interconnected systems, not individual element, because technical performance of natural elements limits the potential performance of nature as a system. He argues that achievements based on weighted scores do not allow for the comprehensive understanding of natural systems and their workings, because it is a linear approach and does not take cycles of nature into account. Therefore, the incorporation of natural systems is not really the main focus of these tools and the approach is merely techno-centric.

Similar to the descriptions used in social and political systems, the green building movement, guided by assessment tools, takes a 'top-down' approach, focusing more on the application of strategies that only take the project's aims and needs into account, whereas the regenerative approach asks for 'bottom-up'. Strategies and decisions grow from an in-depth understanding of place and specific environment, which in return enables 'sustainability' beyond merely doing 'less harm' into the realm of contribution towards the regeneration of life cycles. The essence of the shift in thinking is thus to not strive towards *no impact* on the environment, but rather a positive impact.

Sustainable building assessments tools like BEST (Built Environment Sustainability Tool), developed in South Africa, are indicators of the winds of change in the thinking about 'green building' attributes and principles, moving towards the inclusion of cultural and social impacts in the evaluation, and moving away from a weighted outcome, towards a more complex charted outcome (Refer to table 8.6. in Chapter 8).

Mang & Reed (2012:23) propagates a change from the 'mechanistic' worldview to an 'ecological' one, questioning how the built environment – with a global impact on resources and both natural and cultural ecosystems – can be instrumental in this transformation.

2.2.2. THE NEED TO REVERSE DEGENERATION OF NATURAL & CULTURAL ENVIRONMENTS

In their work, *Designing from place*, Patricia Mang and Bill Reed propose that practitioners in the built environment have the opportunity to develop new methodologies from an understanding of a 'regenerative sustainability paradigm'. Their focus is thus on the reshaping of a worldview that would influence practice, and have developed a regenerative methodology for integrated systems (2012:23). According to Ray Cole (cited in Mang et al. 2016:xxvii) the main objective of a regenerative approach is to 'design the capability of the constructed world to support the positive co-evolution of human and natural systems', thus designing 'buildings that can support sustainable patterns of living' rather than designing objects.

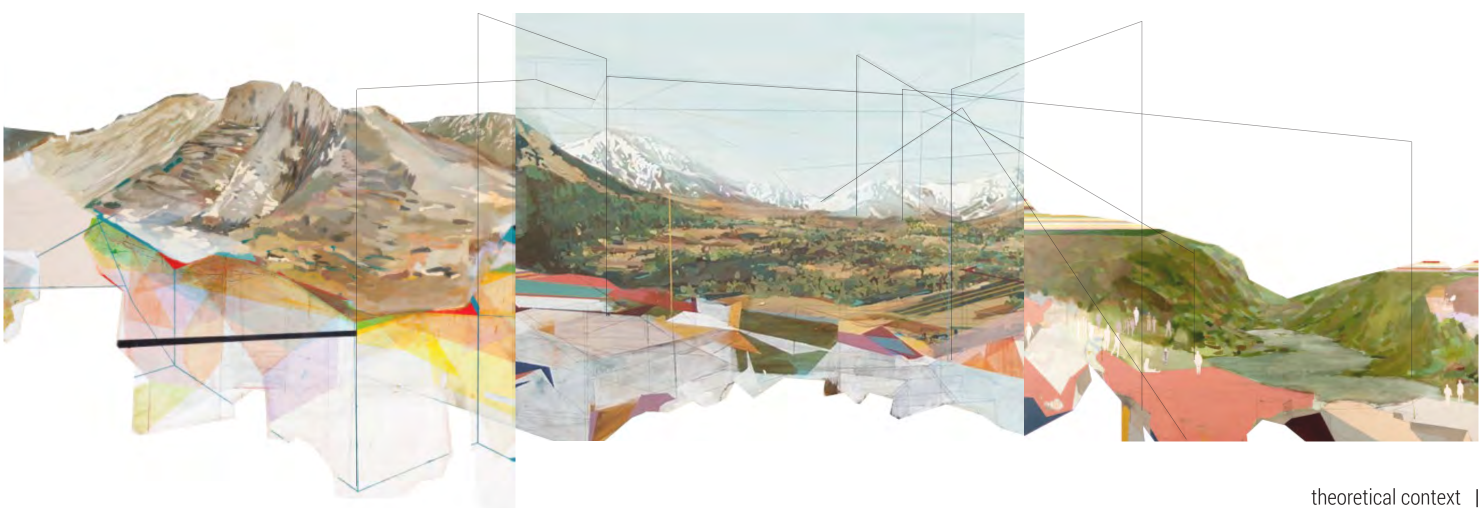
2.2.3. PLACE & POTENTIAL (ECOSYSTEM SERVICES)

The theories of the Regenesis Group postulate the importance of understanding the true unique character and qualities of a place. The inter-relationships between the different ecosystems form the core of the composition of a place. Analysis and conceptualization of this composition and inherent dynamics of the particular context, reveal the potential of the ecosystem services present.

Ecosystem services are 'the benefits people obtain from ecosystems', responsible for the sustenance and informing of all processes of natural ecosystems. They are critical elements in the maintenance of the biodiversity directly supporting life on planet earth (Daily 1997:3). The benefits obtained from ecosystems are categorized as supporting, provisioning, regulating and cultural services (Alcamo *et. al.*, 2003:3). Supporting services ensure the production of the other three services and include soil and nutrients. Provisioning services are those natural resources obtained from nature such as food, water, fibre etc. Regulating services include climate, disease and water systems, and cultural services focus on non-material elements such as spiritual, recreational, inspirational and educational benefits.

The process of designing with regenerative theory is based on the identification of the 'right phenomena' within these four categories of services, that would inform the realization of the greatest systemic potential and to introduce the co-creators or ongoing stewards of project and place. Thus, identifying the necessary actions to ensure the well-being of the place and the people dependent upon these services.

Fig. 2.2. Collage of *Mount Olympus*, *Litsooi dook'o'oosliid* and *Prime Real Estate (two)* by Andy Curlowe. Acrylic, pencil and enamel on canvas. 2010-2012. The image hints at all the underlying factors that determine the composition of the place (Author, 2017).



2.2.4. CAPACITY GOALS

From the full understanding of the place and its potential, goals can be set for realizing the capacity to support the regeneration of life. Three different categories of 'capacities' need to be addressed:

a. Operational
The possible capacity to enable the evolution of life through the supporting and provisional ecosystem services.

b. Organizational
The definition and consideration of 'who' a place is – not only the core of how it functions as a living system,

c. Aspirational
The integration of human aspiration with the various ecosystems, adding the drive for the regeneration of place.

2.2.5. PARTNERING WITH PLACE

Optimizing the presence of people in a landscape by harmonizing with the larger pattern of a place, becomes a key to the process. Emotional resonance with a place creates a connection that in turn generates 'the will required to follow through on decisions' of reversing the degeneration of an environment. In order to understand and care for the environment, people need to connect with 'who' it is as a person, establishing a reciprocal relationship that offers the opportunity for both the natural environment and its inhabitants to become more whole and more alive.

Human inspiration is thus considered the fuel for regeneration of a place. The Regenesis group (Mang et al. n.d.:19) speaks of 'harvesting/harnessing inherent human creativity and aligning it with the creativity of nature'. This creates opportunities for communities to experience the ability to 'make significant and meaningful contributions to their place'.

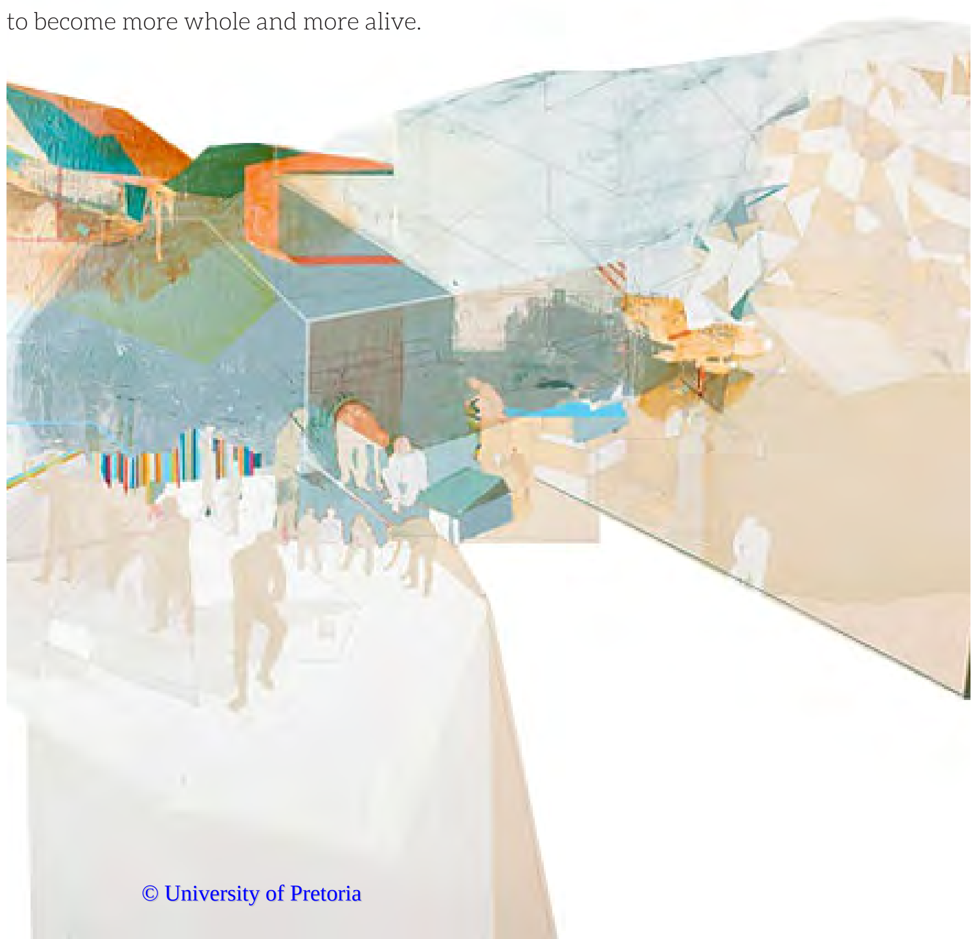


Fig. 2.3. *Razed Dream House* by Andy Curlowe. Acrylic, pencil and collage on canvas. 2012. (http://curlowe.com/section/403273-2010-2015.html, accessed 7 March 2017) (edited by author, 2017). The artwork evokes a sense of dreaming about the possibilities of a community that developes in partnership with the environment.

2.2.6. CONCLUSION

Through the creation of narrative, Mang & Reed, propose 'sets of performance', determined in line with the intended contribution of the built environment to the regenerative capacity of a larger living context. These performance sets are site specific, evolutionary (enabling growth and change) and include elements beyond mere quantitative functional performance, addressing the qualitative or cultural dimensions that shapes human aspiration and the capacity and will to care for an environment and place.

Through a more poetic perspective, Norberg-Schulz (cited in Nesbitt 1996:49) claims the architect's responsibility is to discover the *genius loci*, and design in a way (place-making) that accounts for his singular presence; he calls for man's intervention to intensify the natural attributes of the place.

The ultimate aim of the process of regenerative design is to reach a progressive harmony of a particular place, that could sustain the ongoing evolution of life. This evolution of life on a site can be categorised into two types of processes.

The process of actualizing capacity, which includes nourishing, growing a habitat and the establishment of value-adding partnerships; and the process of realizing value, achieved through inspiration, an evolving vocation towards the project and the appreciation of culture (Refer to fig. 2.4).

Figure 2.5. (on the opposite page) indicates an altered diagram with a dynamic reciprocal relationship between place and project. The crucial role of people and human aspiration as the ultimate sustaining source of activity, is the starting point of the dynamic process of realizing value and actualizing capacity. If we can attempt to understand nature and become better acquainted with the natural processes and patterns, an approach of devotion could develop, eventually leading to safe-guarding and caring for our habitat. Through this process, man inhabits land rather than occupies it, committing to completely live *with* nature, not merely living 'on the earth lightly' (Reed, 2010).

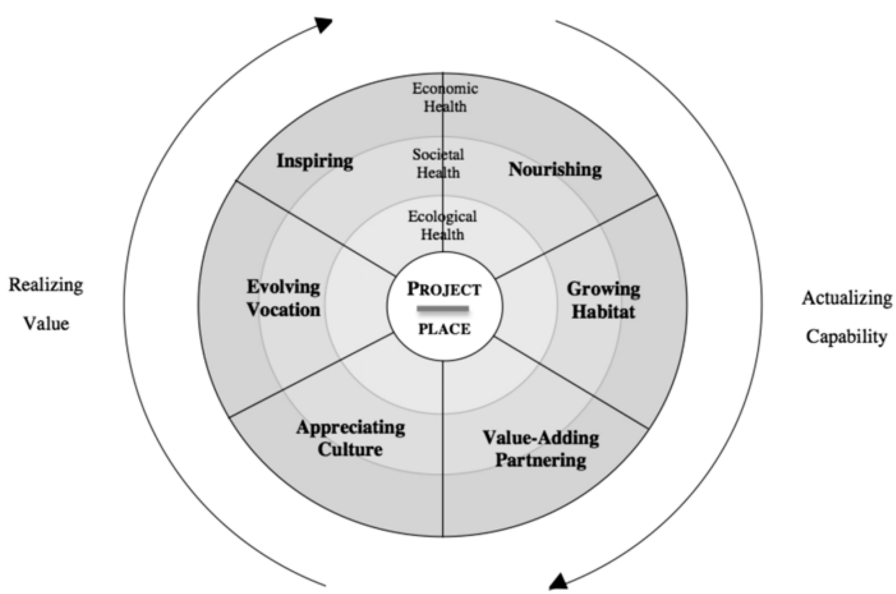


Fig. 2.4. Key processes supporting the evolution of life (Mang et.al. n.d.:27).

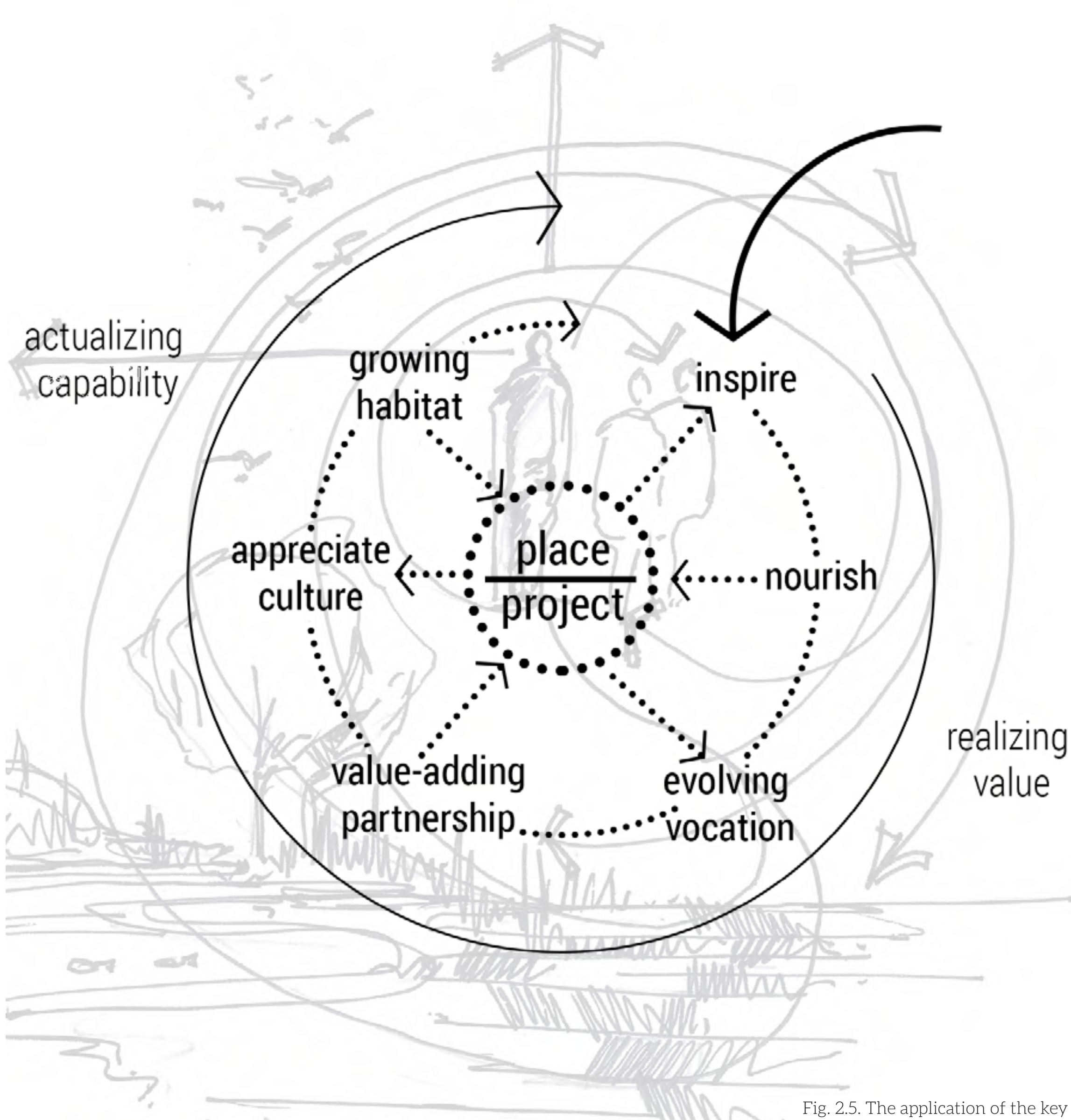


Fig. 2.5. The application of the key processes supporting the evolution of life to the reciprocal relationship between project and place, indicating an optimum point of departure (Author, 2017).

Chapter III

DESIGN LABORA-TORY

Vereening Refractories Plant
Barrage Rd
Vereeniging, 1939
-26.696110 S, 27.894842 E

3.1 LOST SPACE – AREAS IN NEED OF REGENERATION

Lost spaces are generally defined by Trancik (1986:3) as:

> ...the undesirable urban areas that are in need of redesign – anti-spaces, making no positive contribution to the surroundings or users. They are ill-defined, without measurable boundaries, and fail to connect elements in a coherent way.

This description defines the way we think about post-industrial places – the layers and elements present all become blurred and both nature and man-made become wilderness. As the decline of industry produce more of these in-between terrains, the future of 'lost spaces' become a critical point of discussion.

However, recent ecological studies found that the areas with the greatest diversity in natural species and land use patterns are those 'in the transition zone between the city centre and the outskirts where urban land use is associated with open spaces such as wastelands' (Hall 2013:8). Other areas include public spaces, roadsides and neglected industrial land (land left over from or adjacent to production and/ or extraction processes). Areas in close proximity to water naturally notes even greater diversity, especially the presence of more rare species (Bio Intelligence Commission 2007).

Apart from possible biodiversity, international research (Gandy, 2013) has shown that marginal spaces that became scientific and cultural places of interest resulted in new art mediums, increased awareness of ecological value and even positive change in the characteristics of some cities. Tim Edensor (2005:21) is of the opinion that post-industrial wastelands offer tremendous opportunities to the designer for urban redevelopment, creative infill, as well as the rediscovery of many hidden resources in our cities. Spaces like these offer opportunities for reclamation and design driven by regeneration, as they are manifestations of the environmental deterioration brought about by the industrial revolution.

Fig. 3.1. opposite: The site of the demolished fire clay plant lies under a sea of bricks, only hinting at

Fig. 3.2. Aerial photograph of the Vereeniging Refractories Complex with the town of Vereeniging in the distance. Date unknown.

3.2 DESIGN LABORATORY

The site chosen for investigation is located on the banks of the Vaal River, at the western edge of the town of Vereeniging. Historically dominated by the Vereeniging Brick and Tile company, which later became Vereeniging Refractories (abbreviated to *Verref*), and now trades as *Vereeniging Properties and Investments* since 2016.

Despite extensive horticultural and urban efforts in the establishment of a rich biodiversity along the river edge and in employee residential areas, lack of use and maintenance leave these introduced environments in a constant state of deterioration. The larger area now lies void of its productive function, while the degrading environment around it renders this part of a valuable river-edge wild, polluted and dangerous – in effect lost to the surrounding community and natural biodiversity.

3.2.1. Larger context & the birth of an industrial town

The Vaal Triangle on the southern boundary of the Gauteng Province is well-known for its role as one of the industrial centers of the country. Large companies such as Arcelor Mittal, SASOL and NATREF form heart of the region, still employing a large percentage of the local community and contributing largely to the industrial economy of South Africa to this day (Refer to Fig. 3.7. for a timeline of the development of the industry and the site).

The town of Vereeniging owes its origin to the availability of water from the Vaal River and considerable deposits of coal. The site's close proximity to the Witwatersrand convinced Sammy Marks in the late 1800s to turn Vereeniging into the Sheffield of South Africa. This dream transformed the 'popular riverine holiday' location into a centre for mostly industrial activities (Tempelhoff 2006:449).

3.2.2. The People

Residential communities are scattered around the site today; Sharpeville and Vanderbijlpark to the west, Three Rivers to the east and Sebokeng, Redan and Roshnee to the north. These areas, even though fragmented and sprawled, are connected to the Vereeniging CBD and industries via the railway and main roads, feeding the economy of the greater Sedibeng municipal area.

With the creation of the Black Land Act in 1913 the town of Vereeniging declared Toplocation as an area where the blacks and Indians working in the town and surrounding industries, could live from 1914 onwards. Before this time, black employees lived informally around the town. The rapid increase in job opportunities in the industries, resulted in overpopulation of Toplocation and the notorious township Sharpeville was established to the west in 1935, originally known as Sharpe Native Township. This later became the location of the historical events of March 1960, commemorated as the Sharpeville massacre, in the fight against the Apartheid regime (Müller, n.d.). Today the area originally named Toplocation exists as an established neighbourhood, known as Duncanville, with a much larger residential township to the north, Sebokeng — situated between Johannesburg and Vereeniging.

Black communities living and working in and around Vereeniging are predominantly Sesotho, originally from Lesotho. Many people still have family in Lesotho and travel there often. Most of the Indian community of Vereeniging live and trade in the city centre, but the largest Indian community lives in Roshnee, just north of Vereeniging. The rest of the Vereeniging neighbourhoods are mixed with English and Afrikaans, black, white and Indian residents.

During the 1960s Verref employed a labour force of 3800, providing accommodation to a selection of staff in 100 company houses. Recreation facilities provided for employees include the exclusive rights to the Vaal River, a clubhouse, tennis courts, bowling green, cricket field, swimming pool and squash court (Leigh 1968:121). Recreational and sports activities have always played an important role in all of the industrial towns in the Vaal Triangle, introduced and provided to the townspeople as part of the vision of balanced living and the tourism opportunities of the Vaal River.

Fig. 3.3. & 3.4. Two historic photographs of workers sorting through raw materials extracted from site and stacking fire bricks manufactured in the Vereeniging Brick & Tile warehouse (http://www.verref.co.za/index.php?page=gallery-history accessed 10 April 2017).

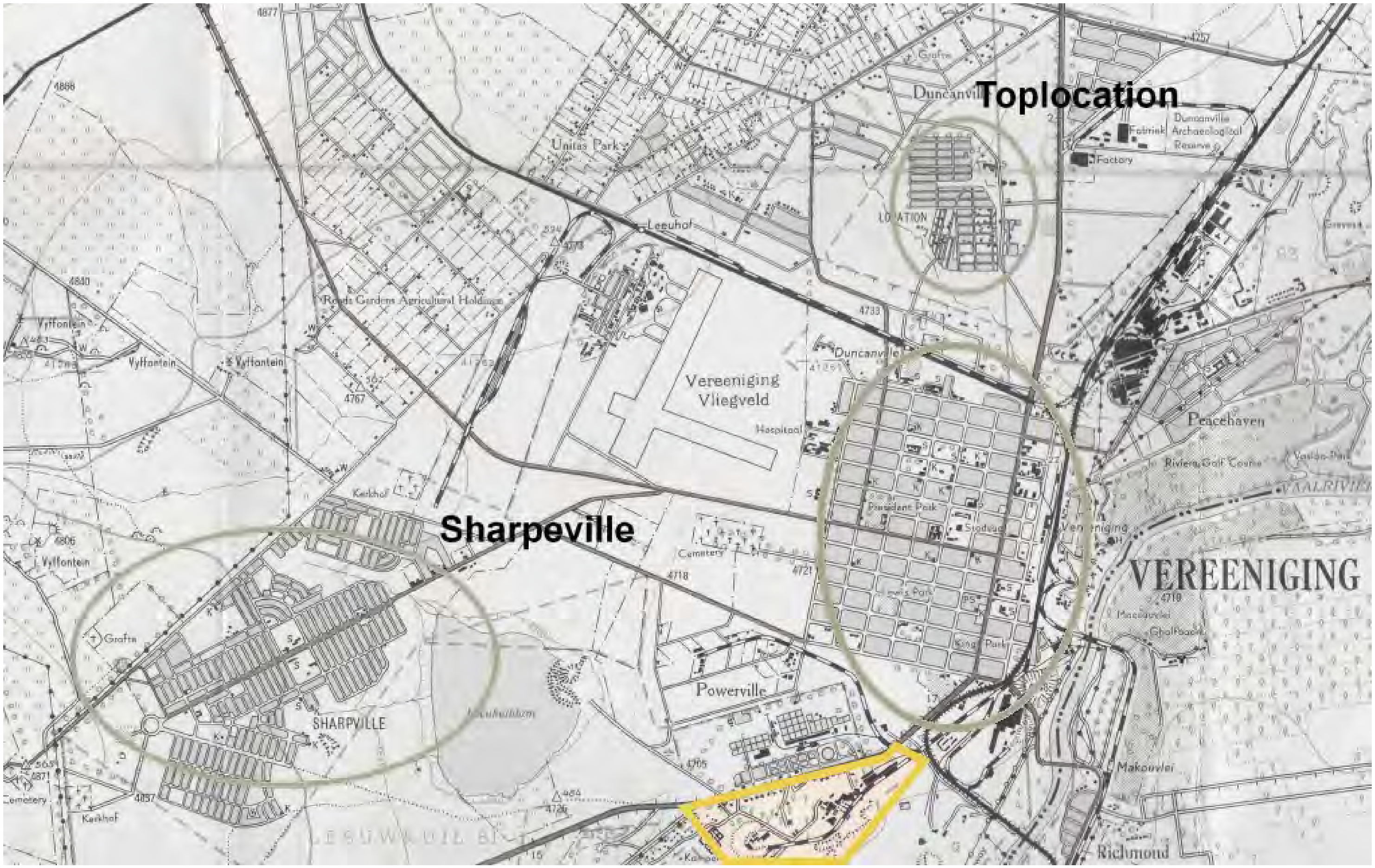
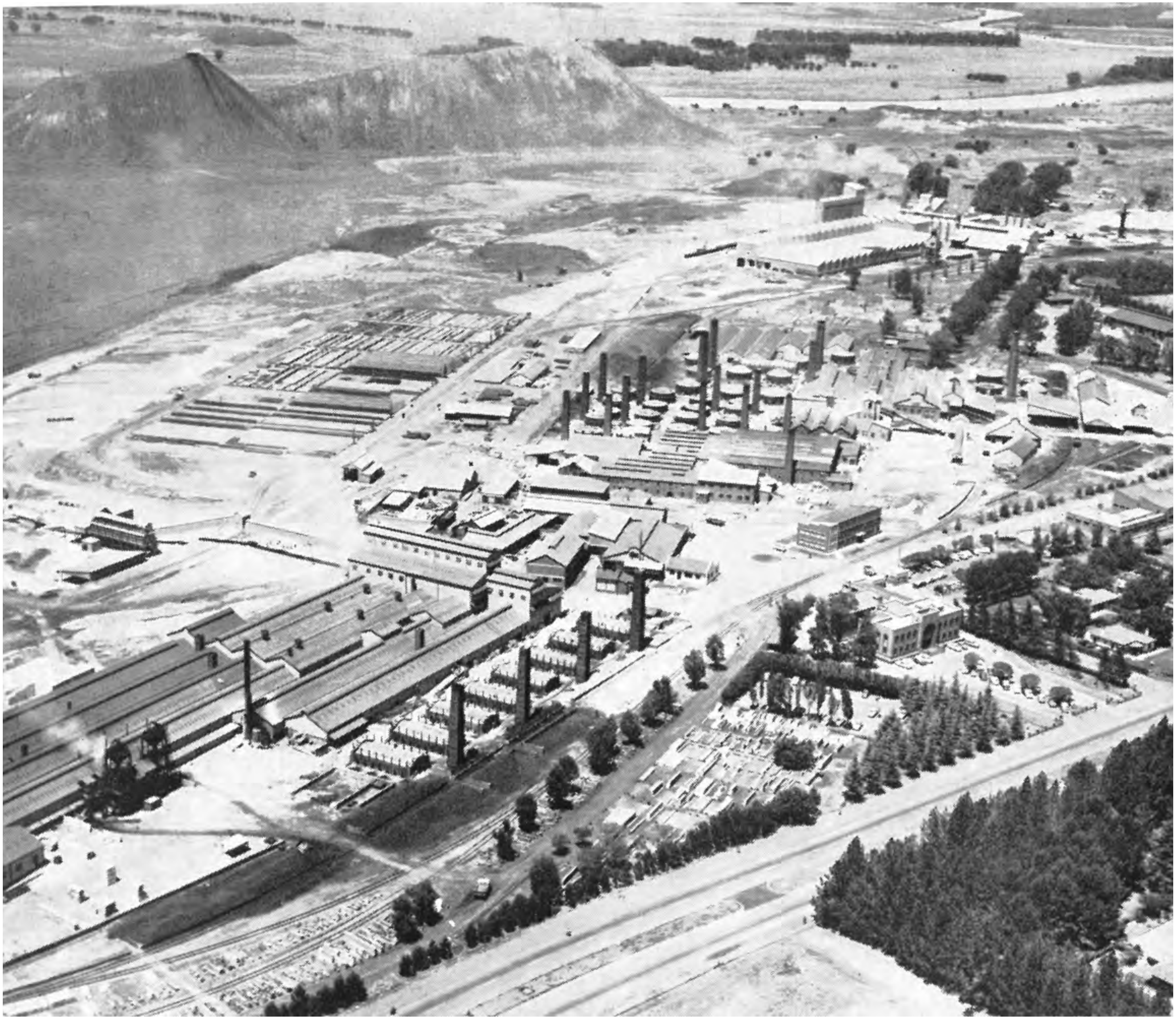


Fig. 3.5. above: Extract from a topographic map surveyed in 1954 indicating Vereeniging, Toplocation and Sharpeville, in relation to the site indicated in yellow at the bottom (http://www.ruralexploration.co.za/Sharpeville.html, edited by author).



3.2.3. History

With the discovery of coal reserves on the banks of the Vaal just south of the site, the *Vereeniging Brick & Tile Company* was established on the banks of the Vaal River — the town's first manufacturing company — and bricks were produced on site from as early as 1890. Machinery and technology enabled the production of red facebricks, after 1892, extending the market of the company further than just the colliery. By 1937 a quarter of the buildings, furnaces and factory had been erected. In 1967, the name of the company changed to *Vereeniging Refractories Limited* and by 1968 the company was the largest refractory supplier to the copper industry and also manufacturing speciality products, such as mortars, plastics, and high temperature insulating materials exported to a number of African and even Scandinavian countries. At this time, the company employed 3800 workers and operated its own railway with three locomotives. Technological improvement and expansion already left industrial structures as ruins as early as 1968, by which time the old kilns were no longer fired, but merely used as storage space.

The site, at its greatest point of productivity consisted of the basic brick plant (1890 and 1944), the pipe and glazed earthenware plant (1903) and a silica brick plant (1937). These structures gave the site its characteristic rhythmic composition of kilns and smokestacks (Refer to Fig. 3.6.). Engineering and carpentry workshops and small office buildings were built throughout the extent of the complex, most of which are still in good condition.

In the 1960s the fire clay plant constructed in 1938, was replaced by a 'new' technologically advanced and highly mechanised plant, with the assistance of A.P. Green Fire Brick Company, from Missouri, USA (Leigh, 1986). This building was demolished in 2015, due to structural dangers and for 'provision of new developments' on the site (Du Plessis, 2015).

A six storey steel portal structure and chemical storage warehouse, constructed to the north of the new fire brick plant some time after the 1960s, still stands and is hired out for training in welding, forklifting and overhead crane management. The site of the demolished Fire Brick Plant building is the focus of the design investigation.

Fig. 3.6. opposite: Historic aerial photograph of the Verref Complex with description: "The Company's Works on the Vaal River. The basic brick plant is seen at the top, and below it (centre) the silica brick plant and glazed earthenware and pipe plant. Below these buildings

NATIONAL INDUSTRIAL DEVELOPMENT

1844
Maccauvlei Farm bought on the banks of the Vaal

1855
Pretoria established

1878
Coal discovered at Vereeniging, Bedworth Colliery established by Lewis & Marks

1881
Ore Smelting in PTA district contracted with Transvaal Government by Nellmapius

1884 - 1895

Railway construction Lorenco Marques to Orange Free State transporting steel & iron good to Witwatersrand

1886
Johannesburg established due to gold rush

1892

Largest NZASM railway bridge over the Vaal River at Vereeniging connects mainline between Cape Town & Johannesburg

1893
Vereeniging established as a Town

Otto Brandmuller began afforestation at Maccauvlei introducing African fauna & flora

1896
Johannesburg bigger than Cape Town in population

1897
Vereeniging Estates Ltd formed by Sammy Marks

1899 - 1902
Between 1892 and the turn of the century, the gold mines and railways consumed the greatest proportion of imported iron and steel.

Coal mining operations ceased.

Anglo-Boer War

1902
'Vrede van Vereeniging' Peace treaty negotiated on site of Verref

1903
RAND WATER
Rand Water Board estab-

1905
Weir built in the

1910
Formation of South African Union

Bedworth Colliery mine closed due to decline and competition, but still produced coal for Power Station south built in 1912.

1911
Union Steel Corporation (USCO) started production in Vereeniging under responsibilities of Sammy Marks

1912

First Power Station in banks of the Vaal River

1913
First Steel ingot in SA, at Vereeniging northern banks of Vaal River. Vereeniging from here on to be turned from Coal Villiage to Industrial town.

1914 - 1918
WWI resulted in decrease of imports and expansion of engineering industry in SA

1914
Top Location declared area for 'blacks' and 'indians' working in Vereeniging & industries

1915
Farming operations at Maccauvlei developed into largest of the kind in SA

Gholf course established

1920
ISCOR
The South African Iron and Steel Corporation Ltd (ISCOR), was formed

1923
Construction of Vaal Barrage (since 1915) completed, providing sufficient water supply to the Witwatersrand area

Farming operations at Maccauvlei ceased

SITE DEVELOPMENT

1882
Vereeniging Refractories established as Zuid-Afrikaansche en Oranje-Vrystaatsche Kolen en Mineralen-Mijn-Vereeniging mining coal

1890

Primitive refractory brick production starts at 'Verref'

1892
Machinery & Technology introduced at Verref Basic Brick Plant for facebrick manufacturing

6 million pines, oaks , willows and eucalyptus trees planted by Brandmuller along dirtroads and banks of the Vaal River

1902
Name changed to Vereeniging Brick & Tile Company

1903
Pipe & glazed earthenware plant built at Verref.

1911

Roof tiles from Verref delivered at Union Buildings

1921
Verref employs 27 white and 500 native employees

Fig. 3.7. Timeline compiled from various sources, indicating the development of the site parallel to

1928
South African Iron & Steel Act


Construction of the Vaal Dam south of Vereeniging

1929
Riviera Hotel built at the banks of the River due to increasing tourists at Vaal

1934
ISCOR blast furnace in Pretoria blown-in

1935
Sharpe Native Township established to West of Vereeniging - Sharpeville

1937
African Metals Corporation (AMCOR) established near Vereeniging

1939 - 1945
WWII and ISKOR turns from Peace-time to War-time.

Within this climate new land a few miles west of Vereeniging was planned for complete new steelworks, town and industrial centre - Vanderbijlpark

1945
Anglo American Corporation takes over Lewis & Marks Co. including Vereeniging Estates Ltd.

1946 - 1950

Over 45 000 persons employed in the metal industry. Post-war expansion due to the wartime developments

1947
Expansion at Vanderbijlpark can accommodate population of 200 000

1948
National Party elected and Apartheid implemented

1950
The town of Sasolburg established to provide in the housing needs for the first synthetic fuel manufacturing plant in South Africa

Group Areas Act

1951

Vanderbijlpark Steel Works open with 27 000 inhabitants in the new town

1960
21 March 1960 Sharpeville Massacre

1964-1969
Major expansions and modernizations at ISCOR Vanderbijlpark

1972-1977
Biggest expansion of ISCOR at Vanderbijlpark

1982
ISCOR Pretoria forced closure of 2 oldest blast furnaces due to international steel crisis period (1970s & 1980s)

1989
ISCOR privatized

1991
ISCOR bought USCO's steel division

1994
End of Apartheid regime
First Democratic elections

2004
ISCOR Ltd renamed Ispat ISCOR Ltd

2005
MITTAL
Ispat ISCOR Ltd. trading as Mittal Steel South Africa Ltd.

2006
Arcelor Mittal established through merger of Arcelor and Mittal Steel
ArcelorMittal

1937

Silica brick plant constructed

1938
Fire clay plant constructed

1944
Basic brick plant rebuilt - two smokestacks & other ruins still remains on site

1949
Concrete roofing tiles manufactured

1960s

A.P. Green Fire Brick Co. in Missouri, USA assists in construction of new firebrick plant

1967
Vereeniging Brick & Tile Company changed to Vereeniging Refractories Ltd. employing a labour force of 3800 with accommodation for white staff in over 100 company houses

Verref

1968
Old kilns no longer fired - used as storage

1989
Verref Group wholly owned by Amcoal Colliery & Industrial Operations Ltd.

1997
Sale of non-core businesses to Coverland & Vitro

1999 - 2001
Verref Group wholly owned by Anglo Operations Ltd.

2001
Vereeniging Refractories trading as Verref

Verref

2015
Demolition of Firebrick plant

2016
All manufacturing by Verref ceased on site and name changed to Vereenigin Properties & Investments Pty (Ltd)

3.2.4. What remains today

The various layers of architectural and structural development of the *Verref* complex constitute such an intricate palimpsest, that it is difficult to clearly define it on a timeline. A few historic photographs were used as indicators of the overall growth and stylistic characteristics were analyzed to identify the era in which a number of the buildings still standing were built. These become important artefacts in the architectural heritage of Vereeniging.

Sadly, due to rapidly changing technology and an overall decline in the demands of industry, all manufacturing of refractory products ceased over time and most of the implements and machinery were removed over the last two decades. Throughout the years many of the original works, structures and buildings have been demolished due to lack of maintenance and structural danger, leaving the complex mostly fragmented and empty with a few structures hinting at what it might have been. The main basic plant warehouse and tower still remain together with 2 smokestacks and various structural ruins (Fig. 3.28.-3.29.).

Other important buildings still remaining, include the Verref Headquarters office building[1] (Fig. 3.8.), an office building (Fig. 3.10.) in the style of Dutch Brick School, a number of company houses and the 'clubhouse' located at the cricket field to the west (Fig. 3.30.-3.31.). Right next to the cricket field, one of Vereeniging's most important heritage sites is located – the house where the Peace treaty was negotiated during the Anglo-Boer War (Fig. 3.32)..

A series of photographs taken on site by the author throughout 2017 follows:

Fig. 3.8. Verref Main office building (currently rented out).
Fig. 3.9. Office building to north-west of the site.
Fig. 3.10. Office building at the entrance of the site.
Fig. 3.11. View of 1910s building at the entrance to the site.
Fig. 3.12. Existing brick building and warehouse buildings, originally used as workshops on the Verref site. The site chosen for the detailed intervention lies to the left in the photo.

Fig. 3.13. Existing brick paving surfaces and rubble on the site of the demolished Fire Brick Plant.
Fig. 3.14. View towards the site chosen for detail intervention from the north-western street edge - training of crane operation currently occurs on the rubble terrain.
Fig. 3.15. Existing warehouse building part of the Fire Brick Plant that was not demolished, and is currently used for training in forklift and mechanical crane operation.
Fig. 3.16. Clusters of Eucalyptus trees planted to the north-western street edge of the site.
Fig. 3.17. View south-east towards the site chosen for the detail intervention from the window of the main office building (Figure 3.8.). The large vegetated minedump is visible from most areas of the site.

Fig 3.18. View towards site of detail intervention, with existing warehouse building in the distance and ruins from the demolished Fire Brick Plant in the front.
Fig. 3.19. Ruins from the demolished Fire Brick Plant covered by vegetation.
Fig. 3.20. View of the landscape, where vegetation have started to cover the wasteland site (on the south-eastern edge of the site).
Fig. 3.21. Cattle grazing informally along the railway line on the far north-eastern edge of the site.
Fig. 3.22. A water tower covered by trees further off towards the large Basic Brick Plant on the southern edge of the industrial complex.
Fig. 3.23. Large trees shadowing warehouse structures to southern edge of the complex.
Fig. 3.24. Watertower at the edge of the cricket pitch
Fig. 3.25. View towards the Basic Brick Plant from the western entrance.
Fig. 3.26. Rubble-dump fill currently being sorted for recycling, just below Basic Brick Plant.
Fig. 3.27. Existing built structure from the first brick manufacturing plant accessible from the western entrance to the complex.

Fig. 3.28. Basic Brick Plant with only two existing furnace towers and kiln ruins viewed from western entrance.
Fig. 3.29. Basic Brick Plant structures viewed from the south-east (most of the structure stands empty, with a small percentage rented out for storage).
Fig. 3.30. *Verref* clubhouse (with the letters VBT inscribed for *Vereeniging Brick & Tile Company*).
Fig. 3.31. *Verref* cricket pitch.
Fig. 3.32. House where the Vrede of Vereeniging were negotiated, next to the *Verref* cricket pitch (Verref historical gallery).

Fig. 3.33. opposite page: Drawing of remaining wall and structures on the site of the demolished fire clay plant (Author, 2017).

[1] This building was apparently constructed as a smaller replica of the Anglo American Headquarters building in Johannesburg. It can be concluded that it was built during the period that the company was


3.8.


3.9.


3.10.


3.11.


3.12.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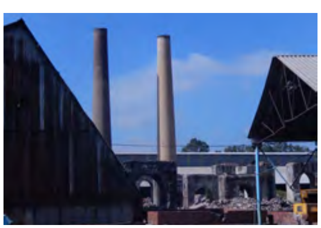

3.28.


3.29.


3.30.


3.31.


3.32.

Chapter IV

LEARNING BY DOING

TRAINING ARTISANS IN THE BUILT ENVIRONMENT

4.1. INTRODUCTION

Within the understanding of the importance of the site in the development of the industry in South Africa, the future programme of the proposed design laboratory should act as a catalyst for the process of actualizing the social, urban and ecological potential inherent in the site. Historically the *Verref* plant contributed greatly to the building, innovation and technology of the industries in the country. The future function and purpose thereof need to acknowledge the history of the place, but more importantly consider cultural and social activities that resonate with and fulfil the goals identified for the regeneration.

The broad programme of education and training have been identified as the most suitable catalyst for both the physical rehabilitation and rebuilding of the site, as well as the establishment of a society inspired towards a more regenerative relationship with their environment.

4.2. EDUCATION FOR WELLBEING

Lorenzo Fioramonti, professor of Political Economy at the University of Pretoria, explains the title of his new book, *Wellbeing Economy*, as follows:

> In the wellbeing economy, development lies not in the exploitation of natural and human resources but in improving the quality and effectiveness of human-to-human and human-to-ecosystem interactions, supported by appropriate technologies (2017:13).

He describes the theory behind a wellbeing economy in contrast to the current GDP, growth-driven economy, stating that 'the wellbeing economy model is designed' to focus on the strengthening of 'social and natural capital' whilst engendering human development. The model creates a 'virtuous circle', measuring value in terms of wellbeing, while feeding improvement of 'human and natural capital' which is what the value itself is based on. He further states that in the wellbeing economy, growth is not focused on increased material output, but rather on the 'value generated through improving human relations and their connection with nature (Fioramonti 2017:46).

Blaming the current economic model for a loss of meaning and purpose, 'undermining the wellbeing' of today's generations, he is of opinion that a 'politics of collaboration and peer-to-peer cooperation' is necessary to combat this crisis that reduced us to 'mere consumers' (2017:158). He continues to predict that in the future, more people will become what he refers to as "prosumers" (in contrast to *consumers*), who utilize 'local systems of co-production', small business networks and 'a new kind of post-industrial artisanship' to fulfill their needs. This, he states, 'is the only way to escape' total unemployment brought about by large-scale automation of the production sectors (Fioramonti 2017:165).

This reminds us of the criticism of Leon Krier against standardization and industrialization, stating that industrialization has not improved conditions of workers, but rather 'reduced manual labour to a stultifying and enslaving experience', degrading an optimistic or visionary craft to 'a socially alienating exercise' (cited in Nesbitt 1996:56).

4.3. SKILLS IN SOUTH AFRICA AN URGENT PRIORITY

Declaring 2013 'the year of the artisan', the Minister of Higher Education and Training, Dr Blade Nzimande, placed specific focus on the critical need for qualified and competent artisans as part of South Africa's strategy towards job creation and dealing with skills shortages (Artisan Development Academy, 2017).

The Department of Higher Education stated in 2015 that artisan trades and apprenticeships have traditionally been the pathway to qualifications" but the apprenticeship system in the country has been deteriorating 'since the mid-1980s, resulting in the current extreme shortage of skills in the fields of construction and engineering. The re-establishment of good artisan training systems is 'an urgent priority' (DHET 2017:55).[1]

[1] The country's target, according to the National Development Plan, is to deliver more than 30000 additional artisans every year until 2024, as part of the 'decade of the

4.4. COLLABORATING, CREATING, CULTIVATING

With the rising popularity of artisanal products, the movement towards organic home-grown produce and dramatic annual increase in participators to 'social experiment-like' events such as Burning Man, and its South African version AfrikaBurn, it is clear that people want to have a space to make, build, experiment, collaborate and share creativity. Concepts of self-sustaining medieval villages or hippie communities of shared skills and resources create the foundations of these kinds of events, often characterized by a search for eco-systemic and interdependent relationships between communities living, cultivating and creating within the natural environment.

Historical examples of self-sufficient cities are well-known for their utopian ideologies and designs, with the 'ecosystem city' designs of Ebenaezer Howard as some of the most famous. Similar ideologies have been applied in the partially built city of the architect Paolo Soleri, called *Arcosanti (Fig.*. As part of an experimental vision based on the combination of architecture and ecological resources, the city was built in 1959 (Waldman 2016). With around 80 residents living on-site and working for the town, *Arcosanti* also holds construction workshops and public events throughout the year to raise funds to continue construction of the rest of the design based on the core principles of compact construction and use of buildings that use the least amount of non-natural energy and ultimate communal self-reliance.

A very different example is *The Open City* of Ritoque in Chile, initiated as an experimental town for various creative disciplines by the Valparaiso School for Architecture in the 1950s. The focus of the project was based more in community-based learning and 1:1 scale experimentation, promoting innovative 'artisanal building techniques'. The concept involves innovation, teaching, creativity and research. In contrast to the utopian design of *Arcosanti*, the improvisational and flexible nature of *The Open City* allows existing buildings to be enlarged through fresh interventions, new works to absorb former remains and materials to be recycled. With a deliberately lacking masterplan, the focus is on the response to the site (Van der Westhuizen 2012:25).

Fig. 4.1. Continuous construction of Paolo Soleri's city of *Arcosanti* by residents (https://alastairgordonwalltowall.files.wordpress.com/2013/04/arcosanti-broad-view.jpg, accessed 25 May, 2017).

Fig. 4.2. The ceramics studio doubles as a stage for performing arts and conferences (http://www.designboom.com/architecture/arcosanti-experimental-desert-town-arizona-paolo-soleri-05-19-2016/, accessed 25 May 2017).

Fig. 4.3. 'The workshop of Hospedería', The Open City, Ritoque, Chile (http://www.amereida.cl/obras/hospederia-del-taller-de-obras/, accessed 30 May 2017).

Fig. 4.4. Entrance to the Frank Lloyd Wright School for Architecture at

4.5. ARCHITECTURE FOR EDUCATION

Frank Lloyd Wright's school for architecture at Taliesin (Western campus, Arizona, USA) was built in 1937. With the concept of the co-existence of man-made structure and natural elements, he sought to create a place where students or "apprentices" could learn by doing. The student community is responsible for the care of vegetable gardens and animals as well as all the daily activities in a system of shared responsibilities, learning experientially and formally about social community, the natural environment and architecture.

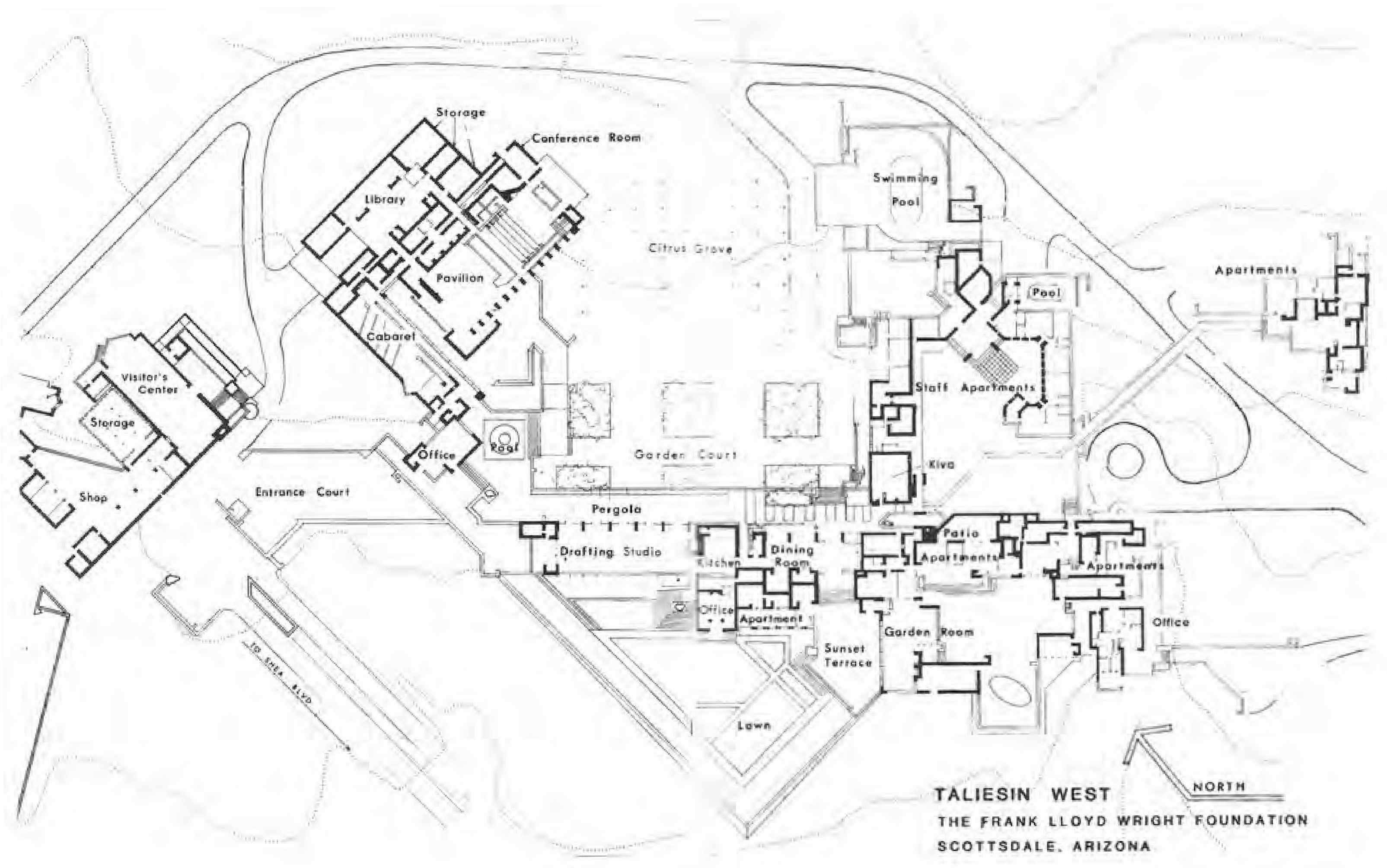
The campus reveals and encourages students to use the entire environment, learning about the complex desert ecology, the significance and power of landscape and architectural teachings from nature, through a seamlessly integrated relationship of structure and desert (Taliesin n.d.).

The buildings at Taliesin West include draughting studios, which provide workspaces for students and faculty, classrooms, study rooms, the William Wesley Peters Library, and exhibition spaces. Two theaters provide space for theatrical performances, concerts, music and dance rehearsals, as well as space for videos, films, visiting lecturers, special events, and formal dining. Workspace and equipment are available for woodwork, metal work, painting, printing, photography, sculpture, pottery, and model making (Taliesin n.d.).

Taliesin (Western campus), Arizona, built in 1963. Photo by Paul Vanderveen (http://franklloydwright.org/wp-content/uploads/2017/06/twestpetro.jpg, accessed 10 October 2017).

Fig. 4.5. Draughting studio at Frank Lloyd Wright School for Architecture at Taliesin (https://i.pinimg.com/originals/92/56/ed/9256ed55dac79a22f8d908afe8496939.jpg, accessed 26 May 2017).

Fig. 4.6. opposite: Plan of Taliesin West campus, Scottsdale, Arizona (https://hikearizona.com/t2011/05/18/5929-888888_1305704426-07.jpg, accessed 11 July 2017).


Storage
Conference Room
Library
Pavilion
Cabaret
Citrus Grove
Swimming Pool
Pool
Apartments
Staff Apartments
Visitor's Center
Storage
Shop
Office
Pool
Garden Court
Kiva
Entrance Court
Pergola
Drafting Studio
Kitchen
Dining Room
Patio
Apartments
Apartments
Office
Apartment
Garden Room
Office
Sunset Terrace
Lawn
TO SHEA BLVD
NORTH
TALIESIN WEST
THE FRANK LLOYD WRIGHT FOUNDATION
SCOTTSDALE, ARIZONA

4.6. CONCLUSION

Together with an understanding of the needs and opportunities of the design laboratory within the greater context, a narrative of the incremental development of a campus focusing on 'learning through doing', including a variety of subject fields and disciplines, is proposed. The narrative is built on the vision of transforming this post-industrial complex into a place contributing towards ecological rehabilitation and the creation of shared knowledge, resources and social development.

A school for the built environment would greatly gain from and contribute towards on-site training and collaboration in the process of rebuilding the site into a campus, whilst rehabilitating the adjacent land.

From precedents studied, the understanding of the architectural demands of a school for artisans in the built environment is to provide spaces for formal and informal learning, collaboration and cross-disciplinary activities, such as vegetable gardens, workshops and gathering spaces that can serve a larger campus and urban community.

Chapter V

ARCHITECTURAL CONTRIBUTION

5.1. THE STORY OF PLACE

5.1.1. MEANING & NARRATIVE IN ARCHITECTURE

Gathered from the theoretical literature study in Chapter two, human will-power and inspiration, can be harnessed by a shared narrative, guiding the objectives of a regenerative project. Understanding the fact that narrative is a fundamental way in which people experience and understand landscapes, it is used to link time, memory and other intangibles with the physical elements of a place (Potteiger 1998:ix). This connection to the meaning and 'story of a place' is a powerful tool of transcending cultures and a project acquires the ability to integrate communities through activity, experience and the regeneration of the natural environment.

Consideration of the expression of meaning and narrative becomes a key element in the design for the spiritual and cultural restoration of a place. Joe Osae-Addo is a Ghanaian architect whose work is known to reflect architecture's ability to 'create meaning through the everyday and the specific'. He is of opinion that materials can be used intuitively to evoke meaningful responses that cannot be quantified. 'The "meaning", he says, derives from the way that materials like to express the physicality of the local environment' (Constable 2012:44).

Fig. 5.1. & 5.2. Museum Park Louvre Lenz, Paris (Mosbach 2016).

5.1.2. RESTORATION & REGENERATION

In line with a continuum and ever-evolving narrative, Kermode (cited in Potteiger 1998:228) writes:

> There are those who seek to restore something authentic but lost and those who conclude that the nature... of narrative in general is to be 'open' – continuously modified, indeterminate, provisional.

This same point of view can be applied to the consideration of physical and natural restoration of the site. The environment cannot be restored to an original state, due to the resulting influences of complex natural and industrial processes, but the aim is to restore it to a state of enabling self-organization and evolution (thus the ability to sustain life), 'viewing all the extensions of life and restoring them in parallel' (Reed cited in Boonzaaier 2015:26).

Various strategies used for restoration and regeneration in landscapes are described by Potteiger (1998: 229-234):

1. Juxtaposition – as the transition between past and future, natural and cultural, with an introduction of interplay and negotiation with the context.

2. Gathering – because spatial and temporal connections of a wasteland are usually fragmented and dislocated, restoration is often about the re-creation of a sense of wholeness, even if it is merely in miniature form.

3. Revealing – some would argue for the acknowledgement of the whole tragic history of wastelands, rather than concealing them in the argument that technological guilt can too easily be hidden under a 'mantle of green'. An approach of restoration with the revelation of the wasteland is a much more difficult narrative, but deals with 'reversal and reminder'.

4. Integrating Waste – using left-over follies of the wasteland as anchors in the new narrative.

5. Recycling – rather than re-creating nature, it integrates with ongoing human activities. Recycling reconnects the rupture between consuming and wasting, often disguised by restorations or parks, so that restoration not only heals the past but reconnects cultural practices with natural processes of energy flows and decomposition, for mutual benefit.

A layered narrative (refer to point 3 above) is not only more truthful to the place, but also resonates with the theories of Mang & Reed in the consideration of both past and present core functions and the significance of a place that plays a role in its future story and evolution. Landscape artist Catherine Mosbach cleverly applies an approach of revelation in her design for the Museum Park Louvre Lens, in Paris (refer to Fig. 5.1.-5.2.), "preserving", integrating and layering surfaces, forms and geographic elements from the past life of the site into a new park, almost like 'extracts of living memory' (Mosbach 2016).

Fig. 5.3. -5.5. Landschaftspark, Duisburg-Nord, Germany, designed by Peter Latz in 1991 (http://www.latzundpartner.de/en/projekte/postindustrielle-landschaften/landschaftspark-duis-

Another famous example of natural regeneration of a post-industrial site is the Landschaftspark designed by Peter Latz at Duisburg-Nord in Germany (refer to Fig. 5.3.-5.5). Applying restoration through juxtaposition, revelation, integration and recycling, 'park' and 'poison' are both instrumental in the making of 'place' (Taljaard 2013:33). Weaving of elements on the site through interlinking spaces and landscape runs parallel to the weaving of different pasts, linking through visual, functional or imaginary elements.

Ultimately the most applicable approach to a wasteland in the considerations of regenerative theory encompasses the following:

> ...restoration engenders a range of possible stories: preserving remnants, retelling origins, revealing and critiquing the wasteland, reworking the ends and beginnings of the cultural narrative of progress, integrating processes of decomposition and decay, or inventing new stories of interdependence. All these stories effectively end the wasteland not by denying it but by lifting the cordons of fear and shame and engaging it (Engler in Potteiger 1998:225).

5.2. BIOTIC & ABIOTIC ELEMENTS

5.2.1. ORGANIC VS MECHANISTIC

Pre-historic architecture evolved slowly from mere temporary shelters made of leaves or the use of caves and rocks into the first mud-brick houses built in 8000 B.C. indicating signs of more permanent small settlements, built with the bricks made through extraction of clay from the earth.

Around 6500 B.C. mud-brick houses were shaped more intellectually, with considerations of how to keep water out and improve interior 'liveability'.

The 4th millennium B.C. indicated an understanding of the climatic effect on structures and shelters were designed to be waterproof, through applying mud plaster over bundles of reed.

The Egyptians introduced the use of stone, cut and stacked to create architecture of a lasting tradition, visible in the monumental pyramids. Around 200 B.C. the Greeks started using cement as a structural material – made from a combination of lime, sand, water and clay.

The Romans improved this material through adding volcanic rock instead of clay, making the cement the strongest in history (Gascoigne n.d).

Industrialization proved to be the pivotal point in the use of natural resources, with the extraction of coal, iron ore and other metals to produce steel, heralding the shift from manual to machine production methods.

The 1800s brought about new technological wonders in the built environment through fabricated materials, standardization and the use of oil and other combustible fuels as alternatives to coal (Speight cited in Boonzaaier 2015:10). These developments led the way for a Modernist era of mass-production and machine inspiration.

Various post-modernist movements responded with disdain, proposing the return to vernacular materials and methods, of which Critical Regionalism is the most enduring. In Africa, architect Hassan Fathy produced inspiring architecture with local materials and labour, and traditional construction and passive-design methods as far back as 1926. Similarly, the British Arts and Crafts movement avoided the 'debasement' of the mass production through industry, preferring craftmanship of local labour and raw-materials' (Sanya 2012:8).

In response to the universal, machine-like buildings of the Modernists, William McDonough also stated that the approach resulting from Modernism ideals of 'a machine for living in' is design for the machine itself, not the people living in it. He proposed that we refocus our attention to the needs of the inhabitants of space, concentrating on clean water, safe materials and durability (Nesbitt 1996: 398-407).

Because architecture is a composition of 'mass and membrane' the challenge is thus to combine light, temperature and wind with mass and membrane in order to provide optimally in the needs of the people.

5.2.2. ARCHITECTURE WITH A POSITIVE IMPACT

In order to understand how the way we construct buildings can be altered to result in an architecture that positively contributes towards the regeneration of its environment, it is necessary to consider the elements that make up a building.

Frank Duffy explained that a building is made up of four "independent" layers, namely shell, service, scenery and set. Of these, the shell becomes the most important layer, as it is supposed to last the lifetime of the building and often needs to accommodate more regular change of the other three layers. The shell or 'envelope' involves both the structure and what Stewart Brand would later call the 'skin' of the building (the exterior surfaces or cladding) (Refer to Fig. 5.6.), serving the purpose of protecting the interior from the elements (Brand 1994:13).

Applying the aims of regeneration to this layered model, the challenge becomes the design of 'shells' that not only provide optimally sustainable interior spaces, but also consider the accommodation and ecological improvement of the exterior environment. Depending on the specifics of a site, the main resources that needs enhancement, filtering or addition include water, air (due to pollution and dust) and soil or vegetation - replacing the 'living capacity' thereof (Refer to Fig. 5.7.-5.8.).

Architecture needs to also take into account the continued evolution, seasonal cycles and expansion that would result from regenerated systems, adapting easily.

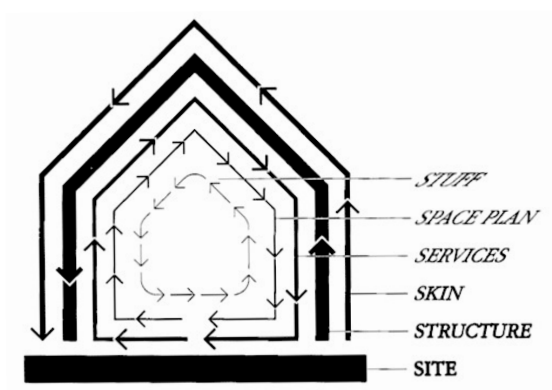


Fig. 5.6. The different layers of a building changes at different rates (digram by Stewart Brand) (http://www.shelterarchitecture.com/wp-content/

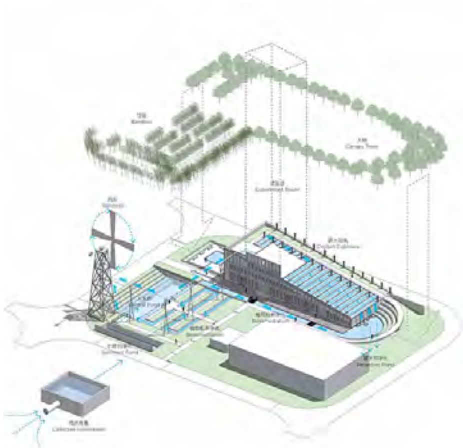
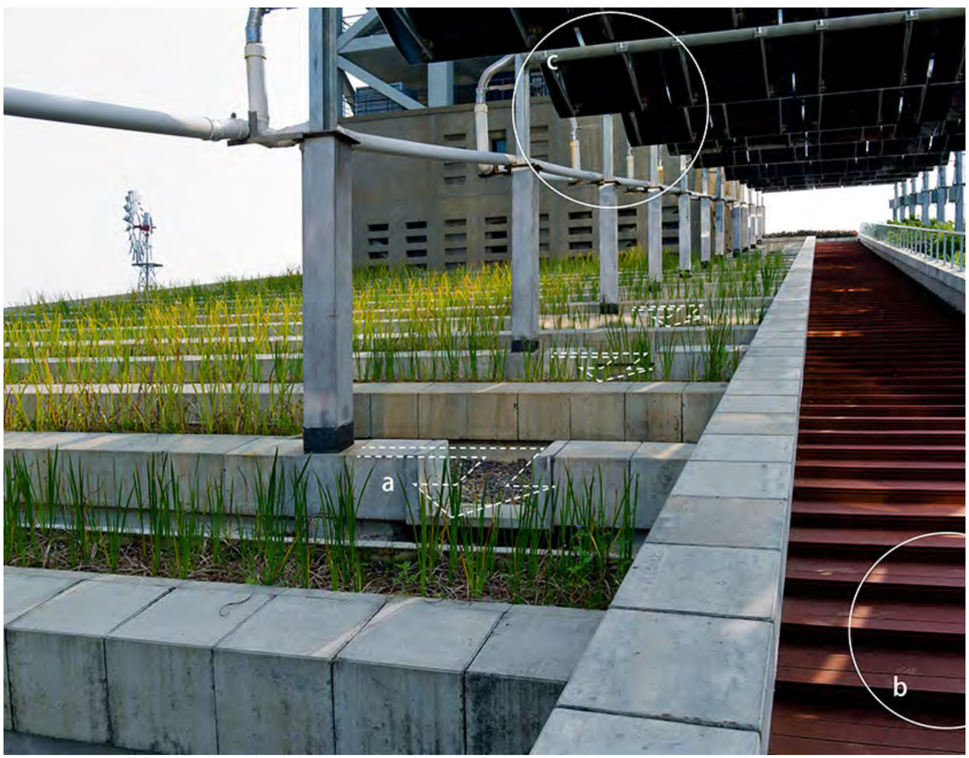


Fig. 5.7-5.8. Purification of water is integrated into the roof structure of a building at Vanke Architecture Research Centre in Dongguan,



CONCLUSION TO PART I

In the crisis of degenerated landscapes, resources and urban spaces, a shift in thinking about sustainability is necessary. Practitioners in the built environment are in a position to express and utilize an approach of creating positive impact and reversing degeneration through wholistic and place-specific strategies.

The relationship between people, place and time is the core of my understanding of architecture and its significance. Architecture becomes the backdrop to life, but it also reflects the lives of its inhabitants, becoming an expression of time, people and place - a communication of narrative. If the process of making architecture could be 'an act of care' within a 'region of concern' (Auret 2015), it could be instrumental in the accommodation of life in all its forms, and have an immeasurable positive influence on those who use, appropriate and live in it. The design of educational spaces and places for collaborative learning and innovation, offers the opportunity to explore architectural typology through the lens of living systems.

The architectural challenge of regeneration lies in the re-establishment of a connection to and care of the natural environment in the way we build – rooting man firmly within the life-sustaining resource complex, rather than above it. Space- and placemaking should be aimed at positioning man as inhabitant, cultivator and creator, within an understanding of the dynamic living forces of place. Materiality and construction should consider design that contributes significantly to the lifecycles of both the inhabitant and the habitat.

PART II

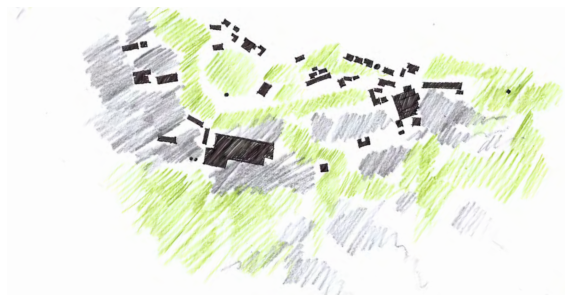
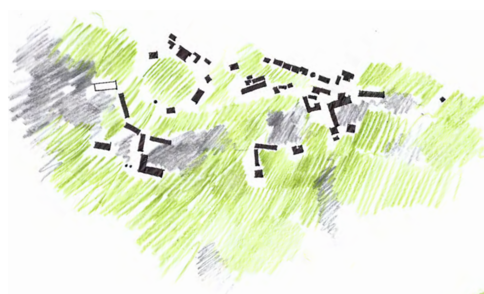


Fig. 6.1. A series of diagrams of the long-term vision for the site precinct (Author, 2017).

Historical built up fabric, land mined and natural vegetation.
Current built up fabric, land mined and natural vegetation.
Process of breaking down larger built fabric.
Defining development niches for built and natural growth.
Future vision of rehabilitated environment in co-existence with built.



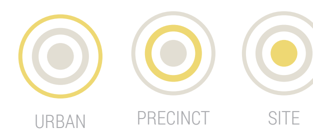
Chapter VI

CONCEPT DEVELOPMENT

CONTENT

INTRODUCTION

Applying the intentions set out in Part One, a concept is developed for the design response that combines the relevant data gathered as informants from the context and the theoretical premises. This chapter aims to analyse, highlight and synthesize the informants on three different scales: urban, precinct and site scale in order to develop appropriate responses to each.



The concept developed will be the guiding element in decisions regarding design from site scale down to technology & detail, discussed respectively in chapters seven and eight.

Fig. 6.2. Map of the larger context surrounding the site chosen as design laboratory, indicating the Rand Water Vereeniging to the north of Barrage road, Vereeniging

6.1. ANALYSIS OF THE MAN-MADE LANDSCAPE

In order to understand the dynamics of the supporting and provisional ecosystem services inherent to the site, a comprehensive analysis is necessary.

VEGETATION & LANDSCAPE FEATURES

The area of investigation falls within the Soweto Highveld Grassland biome and is made up of highly productive sourveld grasslands, characterized by long-lived grasses that favour re-sprouting (SANBI 2013:58). The landscape is dominated by the *Themeda triandra*, also known as the Soweto Highveld Grass (see Figure 6.6.), which is good for grazing and can be used for thatching, basketry and paper pulp. Other species like the *Heteropogon contortus* (see Figure 6.6.), which is good for erosion control are common to the area (Mucina & Rutherford 2006:397).

GEOLOGY & SOIL

Shale, mudstone and sandstone is found within the coal-bearing Madzaringwe Formation that feature prominently in the area. Soil is mostly deep and reddish on flat plains, and somewhat favourable to arable land if the climate permits. Moderate swelling clay is most commonly found (Mucina & Rutherford 2006:397).

CONSERVATION & TRANSFORMATION

Sadly, the biodiversity of the biome is considered endangered, with only a few areas that are conserved, either statutorily or privately. Most of the area that the biome covers have been transformed by urban sprawl, mining, infrastructure and cultivation or grazing (Mucina & Rutherford 2006:397).

HYDROLOGY

> The Vaal, which extends over a distance of more than 1300 km from the Mpumalanga Highveld in the east, to the arid Kalahari environment in the west, has played an extraordinary role in South African History. (Tempelhoff 2006:433).

According to Tempelhoff, the Vaal River can be regarded as the 'hardest-working river in South Africa', but the intensive industrial development in the Vaal Triangle is responsible for the great decline in the Vaal River's environmental and water quality (Tempelhoff 2006:450).

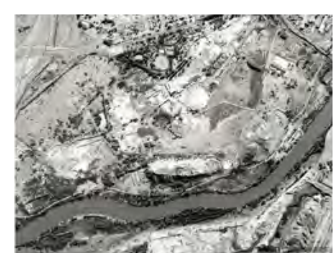
Figures 6.3. tot 6.6. indicate the decrease of vegetation cover and the increase of mine dumps and soil disturbance spreading over the larger area of the Verref site over a period of twelve years. This erosion processes, increase sedimentation into the Vaal River, depositing silt which causes degradation of water quality and aquatic habitat, reducing the biodiversity of the river (Water Encyclopedia, n.d.).

Fig. 6.3.-6.6. Series of aerial photographs indicate how degradation

6.3.

6.4.

6.5.



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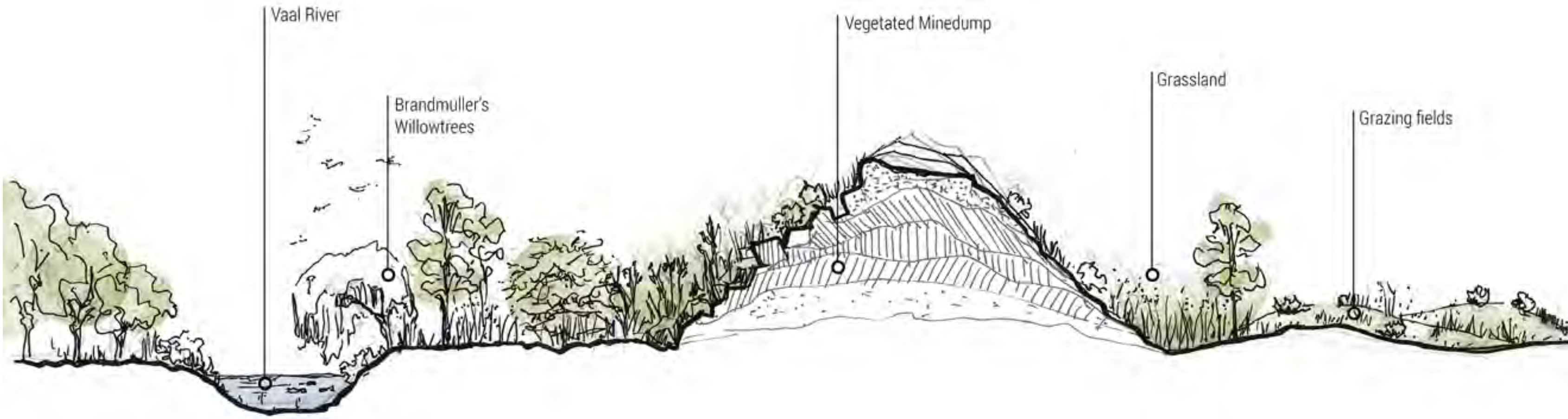


Weeping Willow

NEMBA - Control by area
CARA - Permit, if site does not fall in riparian zones, however site is situated just outside with sufficient bufferzone.

Pampas Grass

CARA Category 1 Weed

Themeda triandra
(Soweto Highveld grass)

Good grazing grass and can be used for thatching, basketry and paper pulp.

Eragrostis variablis

Heteropogon Contortus

Can be used for thatching, weaving and erosion control.

Cymbopogon Caesis
(Common Turpentine grass)

Aromatic grass
Can be used for thatching, oils and medicines

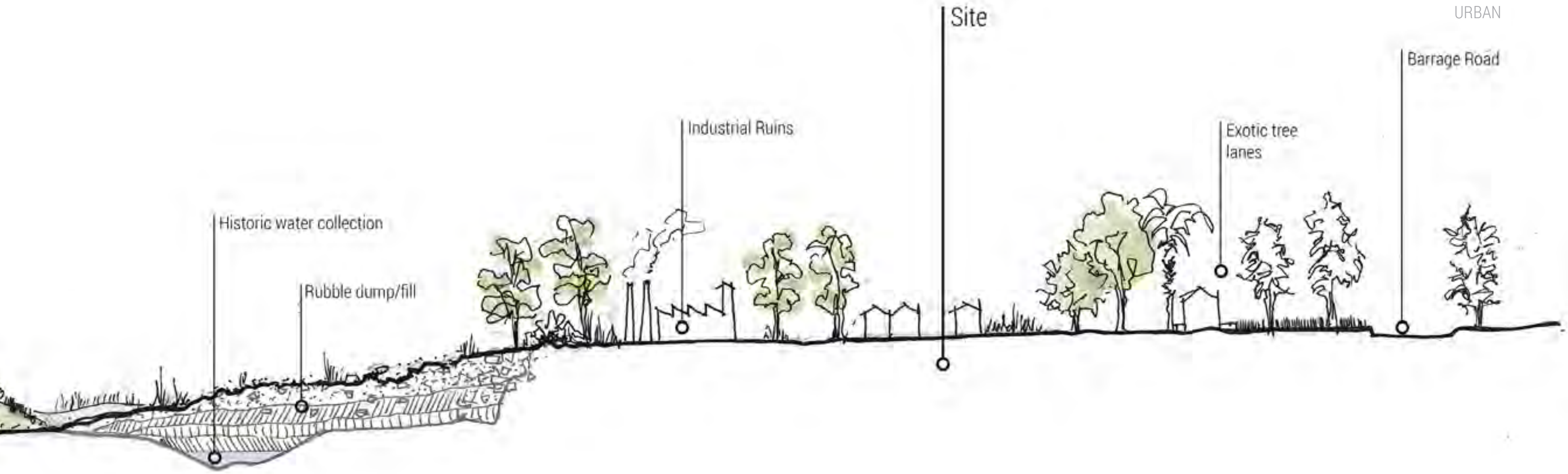
Tagetes Minutae
(Khakibos)

Known invasive, but not listed on CARA.

Stray grazing cattle

Fig. 6.7. Diagrammatic section of the larger area within which the site is located. The drawing combines information from various historic sources and site visits, mapping vegetation and animal life

URBAN

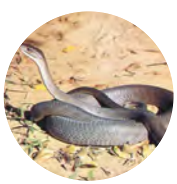


Cynodon dactylon
Common 'kweekgras'

Eucalyptus tree

NEMBA - Control by area
CARA - Permit, if site does not fall in riparian zones, however site is situated just outside with sufficient bufferzone.

Round poplar



Various snakes

Patula Pine
or Cluster Pine (pinaster)
Yellowoods could be planted instead

Exotic planted trees like palmtrees, acacia etc.

African masked weaver

6.2. URBAN NARRATIVE: RECLAIMED RIVER-EDGE

Fig. 6.8. Impressionistic urban map of the surrounding context with the town of Vereeniging to the north, Vanderbijlpark to the south-west and Sharpeville to the

6.2.1. ANALYSIS OF URBAN ISSUES

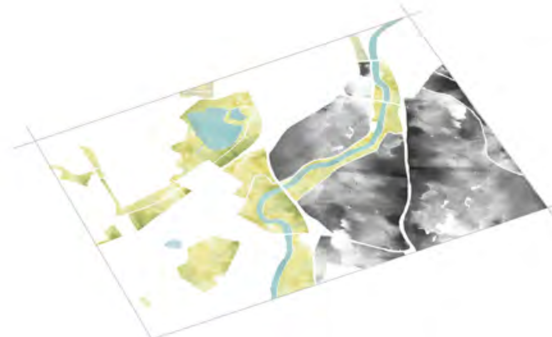
URBAN MAP LEGEND

- Urban Fabric
- Urban Green Space
- Industrial Landscape
- Wasteland
- Waterbody

A. DEGRADED RESOURCES

Due to industrial wasteland between Vanderbijlpark & Vereeniging fronting the Vaal River, the natural environments are often degraded and further used as dumping sites.

Even though it may comprise high natural biodiversity, the perception of these areas is of a dangerous and useless wilderness.



B. FRAGMENTATION

Industrial areas located close to water and resources resulted in fragmented urban development of residential and commercial sectors.

The Apartheid regime resulted in 'labour settlements that were located on the peripheries of the urban fabric, resulting in sprawl.

C. EQUAL ACCESS

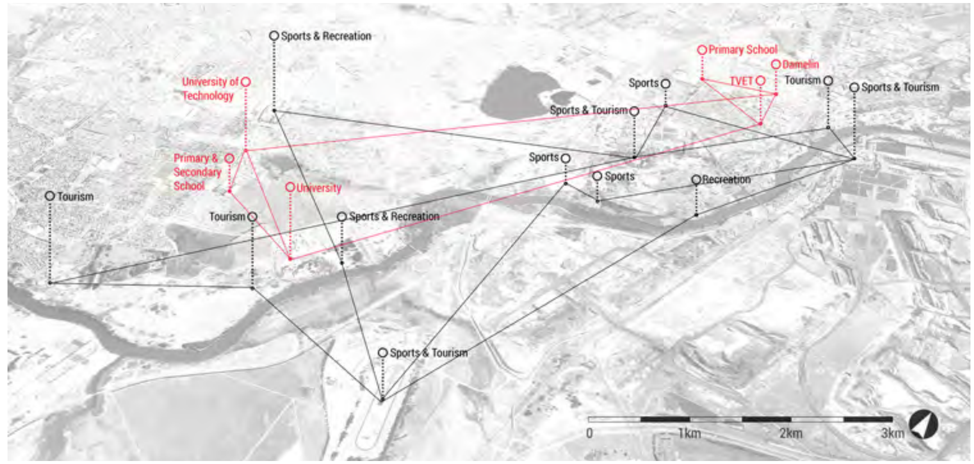
A pattern of privatized or institutional ownership and access to riverfront is observed, which means that large residential communities like Sharpeville, Vereeniging CBD and even students in the area do not have safe public access to the river and surrounding environment.

Fig. 6.9. 'Wasteland' open space highlighed in relation to waterbodies and areas of industrial degraded land (Author, 2017).
Fig. 6.10. Fragmented urban fabric highlighted in relation to waterbodies and areas of industrial

6.2.2. ANALYSIS OF CULTURAL ECOSYSTEM SERVICES

A greater understanding of the possible cultural ecosystem services of the larger area of Vereeniging, Vanderbijlpark and Sharpeville aids in appropriate decisions regarding future regeneration of the site. Due to the proximity to the river, abundant activities of ecotourism and recreation can be found, including a wildlife park, watersports, extreme outdoor sports, golfing and entertainment. Three tertiary institutions surround the site, namely North-West University Vaal Campus, Vaal University of Technology and Sedibeng TVET.

The larger site is rich in various layers of heritage and memory, either encapsulated in the man-made landscape (mine dumps and excavations), industrial ruins or merely stories related to specific parts of the site.



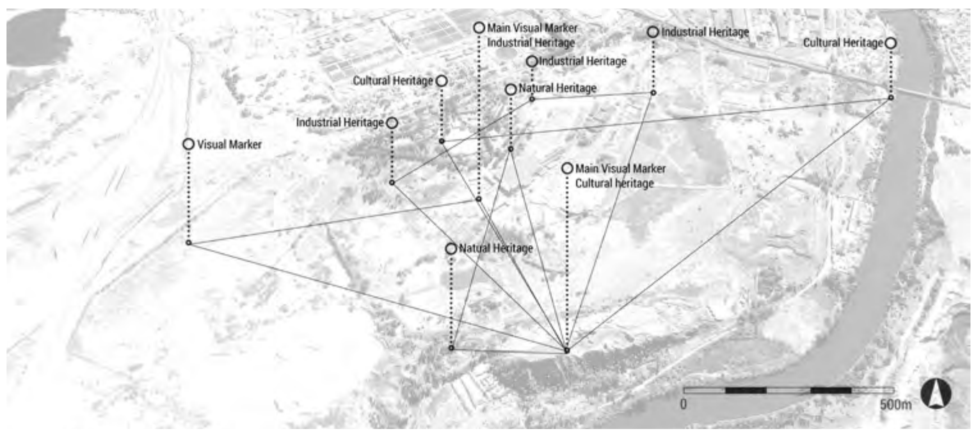


Fig. 6.12. top: Map of current cultural ecosystem of the surrounding area (Author, 2017).

Fig. 6.13. bottom: Map of points of

6.2.3. REGENERATION OF WASTELANDS: INTERNATIONAL PRECEDENTS

FRESHKILLS LANDPARK
New York City Department of Parks and Recreation
Staten Island, NY
2012 Partial completion

The rehabilitation of the site known as the largest landfill in New York, includes a process of dynamic staging and cultivation of new ecologies. The objective of this project is not natural rehabilitation, but also social regeneration in the creation of a diverse reserve for wildlife, cultural activities and active recreation.

RESPONSE

Even though the scale of this project is vast in comparison to the site investigated in this dissertation, the approach of establishing different processes, activities and ecologies over time is applicable to the urban scale design vision within which a regenerative proposal can be rooted.

Fig. 6.14. View of an area of the Fresh Kills landfill, rehabilitated (http://freshkillspark.org/wp-content/uploads/2013/07/5-parks-e1394725019550.jpg, accessed 15 March 2017).

Fig. 6. 15. Plan indicating the various parks that make up the *Fresh Kills Park* project (http://freshkillspark.org/, accessed 15 March 2017).

QUEENS PLAZA BICYCLE & PEDESTRIAN IMPROVEMENT PROJECT
Margie Ruddick Landscape
Queens, NY
2010

In the creation of a reimagined urban space, previously lost between various heavy means of transport, the approach considered recreation of how people move through the site, how people perceive the space and how it functions on every level.

RESPONSE & CRITIQUE

The combination of the various considerations provided an intervention with a more complete answer to the core problem of the site. It is however difficult to understand how the intervention is connected to its surroundings.

Fig. 6.16. View a gathering space within the Queens Plaza (http://www.mparchitectsnyc.com/work/urban/queens-plaza/, accessed 8 March 2017).

Fig. 6.17. Aerial photograph of Queens Plaza (http://architizer.com/projects/queens-plaza-bicycle-and-pedestrian-improvement-project/, accessed 10 March 2017).

6.2.4. STRATEGIES FOR RECLAMATION

Reclamation of the river-edge holistically aims to build the political, social and natural resource capacities necessary for more sustainable communities around the *Verref* complex.

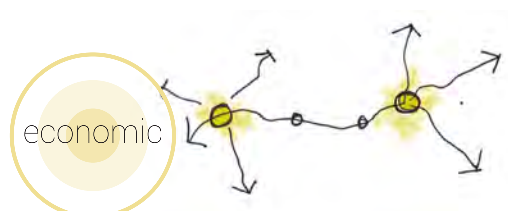
Within the understanding of the site's historic developments and specific role players who built the town and industry on the banks of the Vaal – from the Anglo-Boer war and through the Apartheid regime – the site offers the opportunity to start a process of restitution. Ownership of land-use, resources and development could be organized towards a shared vision of restoration of the ecological value of the landscape, whilst constructing economic opportunity, skills and job creation (Refer to Appendix A & B for municipal proposals studied).

The following strategies proposed consider the order of regeneration necessary to successfully transform the industrial wasteland site.

A. REHABILITATION

Ecological restoration through removal of harmful elements and alien invasive species on site.

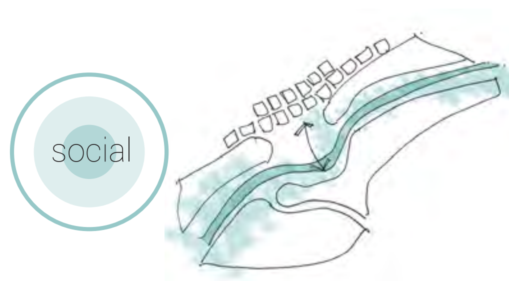
Implementation of new indigenous species with the necessary protection and maintenance to ensure growth.



B. ANCHORS & FLOWS

Diversification and establishment of stable anchor activities at points of greatest economic and social energy.

Densification of corridors already created by main transportation roads and railway.



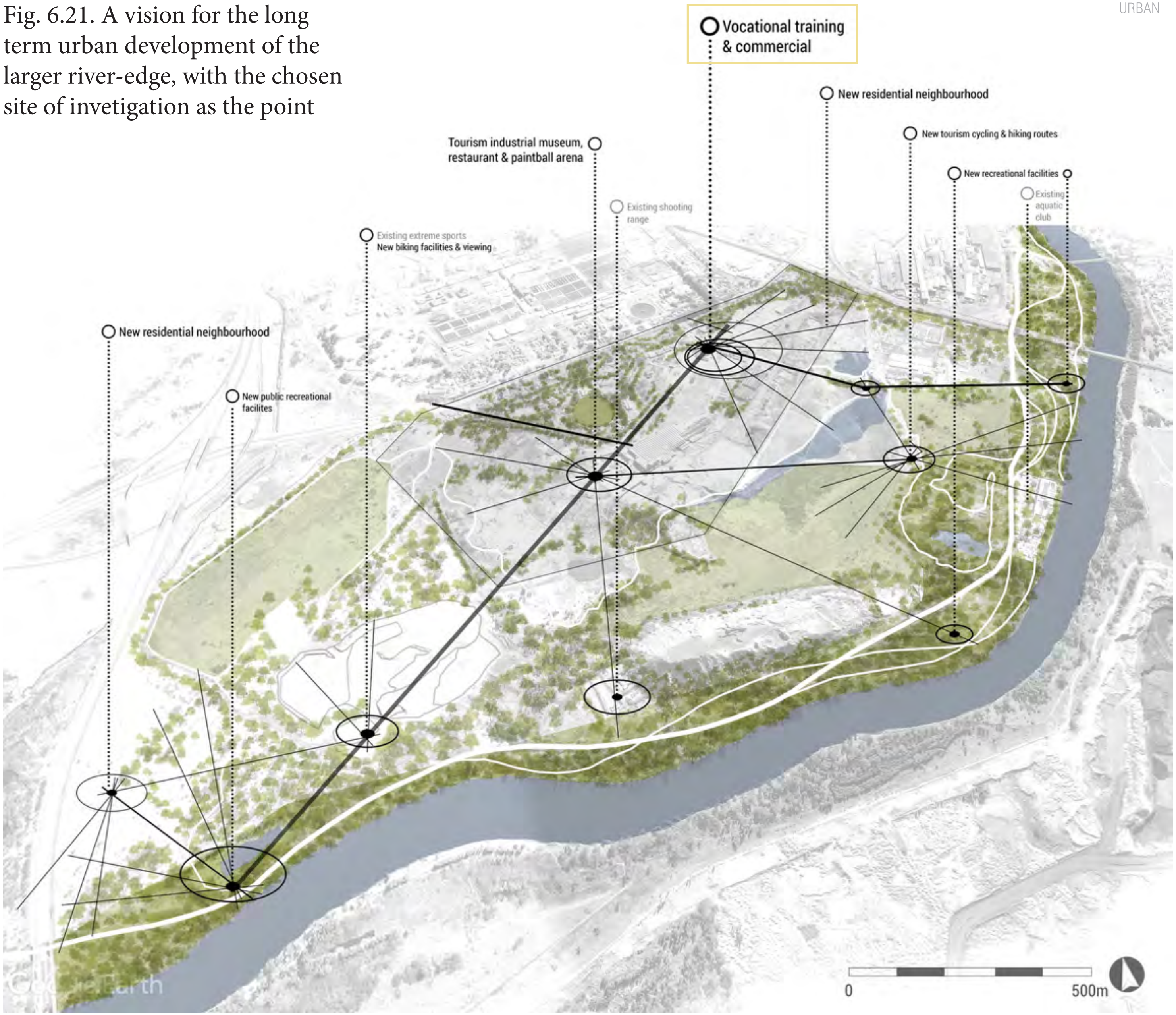
C. ACCESS

Creation of safe points of recreational access to riverfront for public.

Routes and ease of access to them from residential and commercial areas of larger surrounding region.

Fig. 6.18. top: Rehabilitation of the ecological systems (Author, 2017).
Fig. 6.19. middle: Creating economic and anchors (Author, 2017).
Fig. 6.20. bottom: Creating access to the riverfront for the larger social community (Author, 2017).

Fig. 6.21. A vision for the long term urban development of the larger river-edge, with the chosen site of invetigation as the point



6.3. PRECINCT NARRATIVE RE-ESTABLISHING SIGNIFICANCE

6.3.1. HERITAGE SIGNIFICANCE

Cultural significance, according the BURRA Charter, means that something has specific 'aesthetic, historic, scientific, social or spiritual value for past, present or future generations'. It can be 'embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects' (ICOMOS 1999:2).

Identification of this significance aids in the determination of the value of a place. Places of significance often help towards the understanding of the past, enrichment of present experience or possess possible value for future generations (ICOMOS 1999:12).

In a response to sites of cultural significance, the *BURRA CHARTER*, advises succinctly:

> do as much as necessary to care for the place and to make it useable, but otherwise change it as little as possible so that its cultural significance is retained (ICOMOS 1999:1).

Fig. 6.22. - 6.27. A series of photographs of various processes and structures, from the time of active development of the Vereeniging Brick & Tile Co. (as Verref was known previously). The photograph bottom left shows the Fire Brick Plant that used to occupy the site chosen for the detail intervention

6.3.2. INTERPRETATION OF BUILT FABRIC

As explained in chapter four, the significance of the *Verref* complex is not only rooted in its important contribution to the development of the town of Vereeniging and the national industry development, but also in the built fabric that became important artefacts in the architectural heritage of Vereeniging. (Refer to Appendix C for a comparative study of the various times and 'styles' present in, and influential to the existing built fabric of the *Verref* Complex).

Apart from the industrial heritage, some of the few examples of the 'Cape Dutch' expression or early Herbert Baker movement in the Vereeniging area are located on the Verref site and the adjacent Arcelor Mittal (Previously ISCOR) Vaal Works.

The most dominant style in the Vereeniging area is the application of Art Deco motifs to Brick Modernism, as can be seen in the *Verref* Head office building on site (refer to figure 6.30 on opposite page).

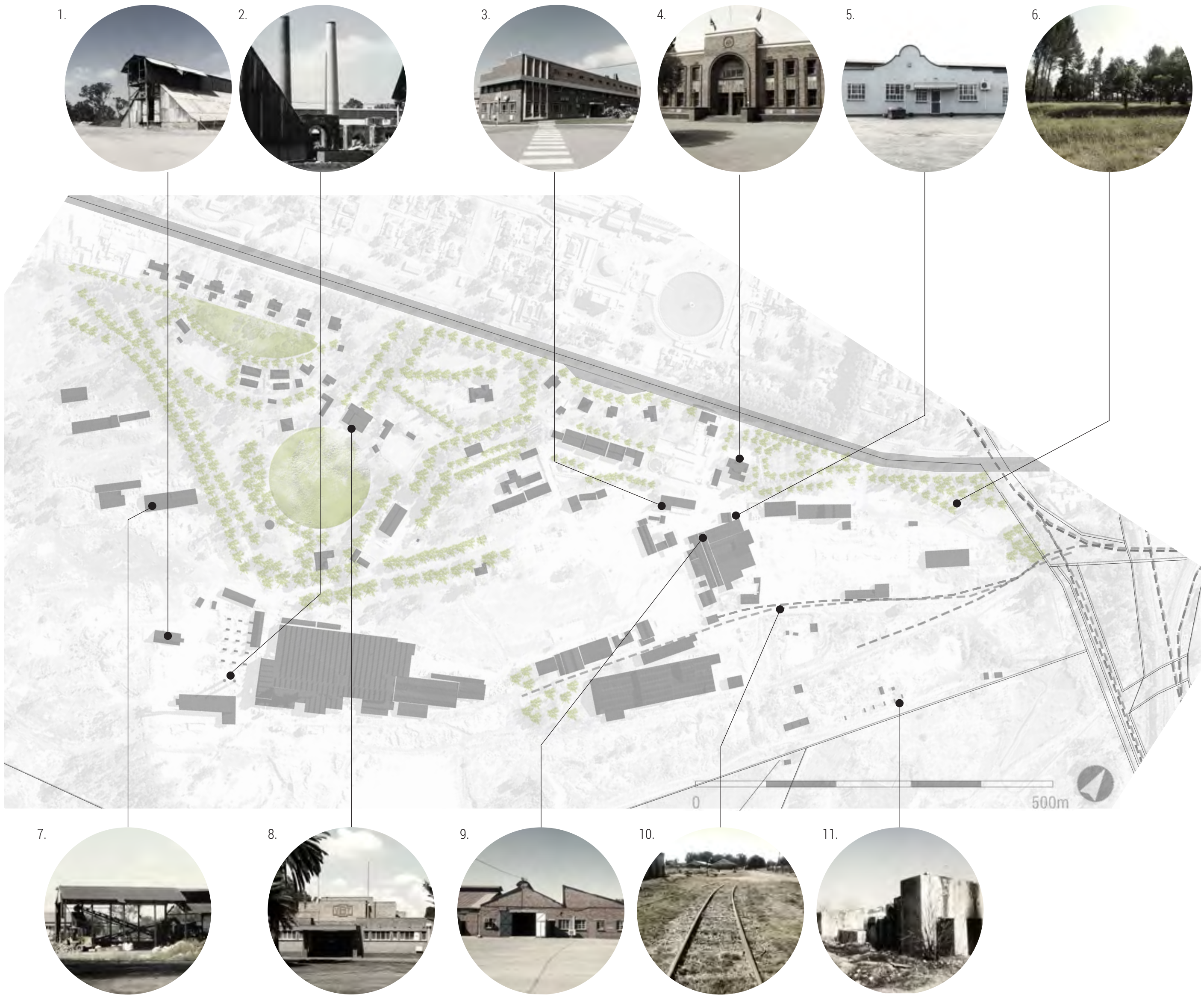
The *Verref* Head Office building (currently rented out) boasts to be a smaller replica of the *Anglo-American* headquarters building on Main Street, Johannesburg. The latter, designed in 1938 by Sir John Burnet, Tait and Lorne from London, was designed as a 'quiet, dignified and monumental' building, "setting a new trend in commercial architecture in SA" (44 Main, 2016).

The Ficksburg freestone facing of the Verref replica was replaced by face bricks manufactured on site. Even though the architects intended the building to be 'entirely without mannerisms of any sort' in order to be timeless, the simple treatment of 'modern requirements' together with 'classical principles' and delicate brick details position the building between the art deco motifs and early modernism.

Fig. 6.28. Anglo-American Offices building, Johannesburg, designed by Sir John Burnet, Tait and Lorne in 1938 (http://myjhb.co.za/wp-content/uploads/2015/08/6260487948_3308c5c7a9.jpg?w=640, accessed 10 April 2017).

Fig. 6.29. Vereeniging Refractories Head Office (http://www.verref.co.za/index.php?page=gallery accessed 10 April 2017).

6.3.3. HERITAGE ELEMENTS ON SITE



6.3.4. APPROACH & STRATEGIES

Fig. 6.30. opposite page: Map indicating the location of the various elements of heritage value on the site with photographs by Author (2017).

6.30.1. Empty raw materials warehouse.
6.30.2. Basic Brick Plant with only two existing furnace towers and kiln ruins.
6.30.3. Office building at the entrance of the site.
6.30.4. Verref Main office building.
6.30.5. View of 1910s building.
6.30.6. Clusters of Eucalyptus trees planted to the north-western street edge of the site.
6.30.7. Existing built structure from the first brick manufacturing plant.
6.30.8. Verref clubhouse.
6.30.9. Extended warehouse building of workshops.
6.30.10. Railway line still in tact on site.
6.30.11. Industrial ruins left from the Fire Brick Plant (demolished in 2015).

The approach taken for the design of the redeveloped site and the understanding of its story can be described through a scale that varies from total demolition to re-use and adaptation (Vosloo, 2015). According to the Burra Charter, three strategies are identified in the response to heritage sites, namely:

1. Preservation (merely keeping it in its existing state and preventing decay)
2. Restoration (restoring it to a pre-determined earlier state, using only existing materials)
3. Reconstruction (restoring it to a pre-determined earlier state, but with the introduction of new materials)

Figure 6.31. describes the continuum of responses to existing fabric or industrial ruins. Through analysis, research and interpretation, appropriate responses have been applied to the various existing buildings within the complex. A complete understanding of the historic importance and value of the individual buildings informs a determining datum in the curation of the built fabric and the specific response. Important historic buildings are kept and re-used, with some proposed for alteration or addition, whilst many of the buildings are demolished and some of the materials reused.

The existing designed landscape (or what is left of it) reveal a distinct geometric layout in which lanes of trees and vegetation, act as ordering and orientation devices throughout the complex, marking important routes and places, such as the cricket field and residential green space (see figure 6.30). Trees planted and vegetation introduced by the horticulturist Otto Brandmuller during the first couple of decades of the town of Vereeniging are of significant historical value. Eucalyptus and pine trees were introduced in great numbers to change the town from a dusty mining town to a beautiful riverine tourist destination (Leigh 1986). These become critical elements in the historic reading of the industrial complex and are kept and strengthened or complemented.

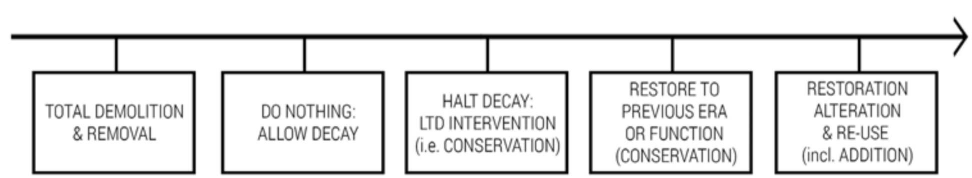
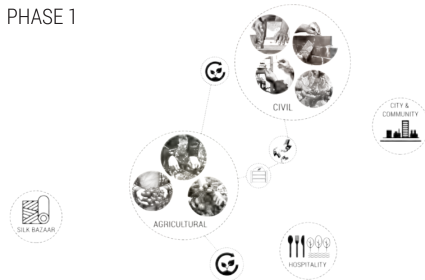


Fig. 6.31. below: A continuum of approaches in dealing with ruins (Scott in Vosloo 2015:40).

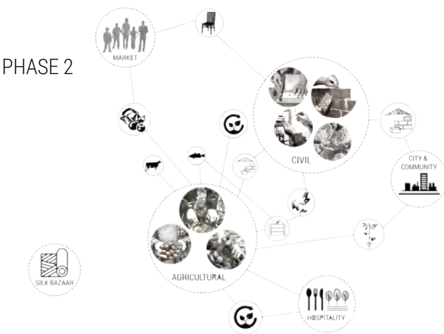
6.3.5. PRECINCT VISION

The precinct is envisioned as a vocational training campus. Due to the size and composition of the site, it offers the opportunity to accommodate various other enterprises (external companies or new companies growing from and supporting the centre), as well as residential areas, public services and recreation. The architectural proposal aims to focus on the heart of this development.

PHASE 1



PHASE 2



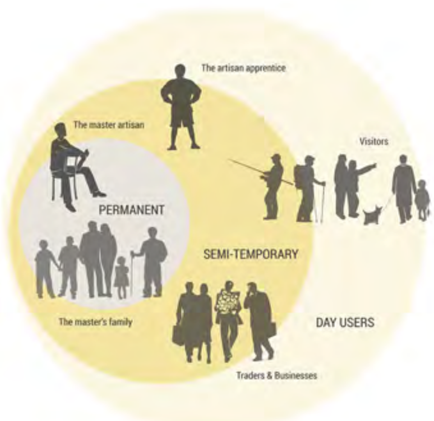
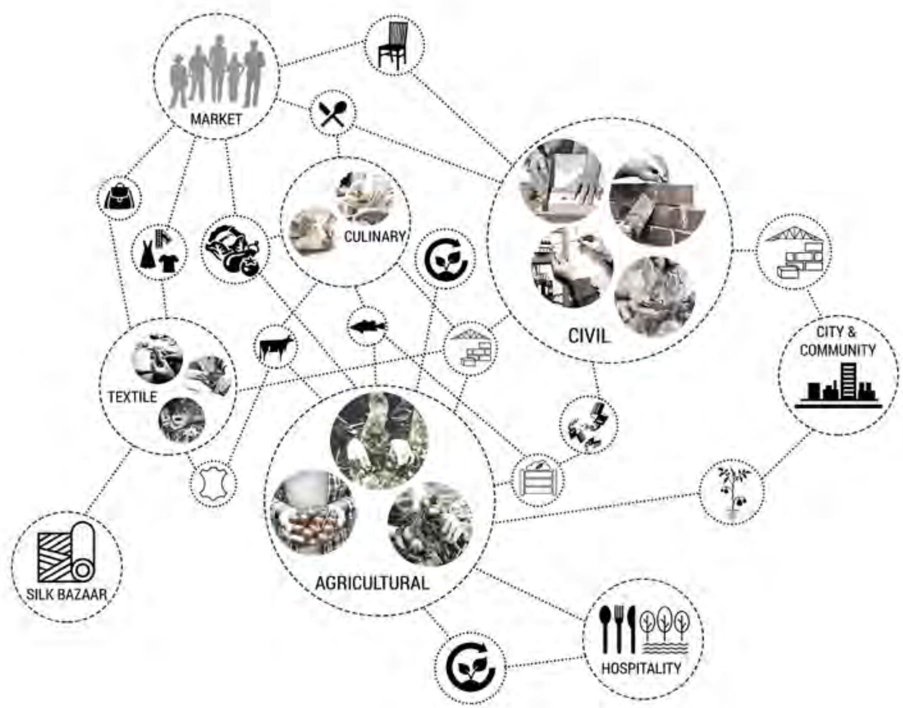
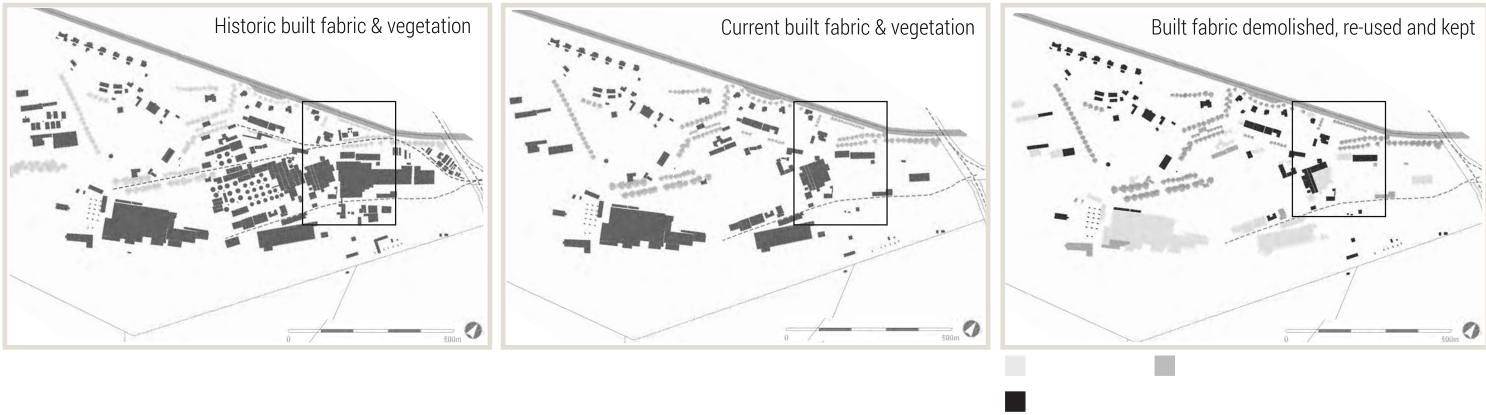


Fig. 6.32. directly above: Diagram of the various users of the proposed precinct informing organization and movement of the site (Author, 2017).

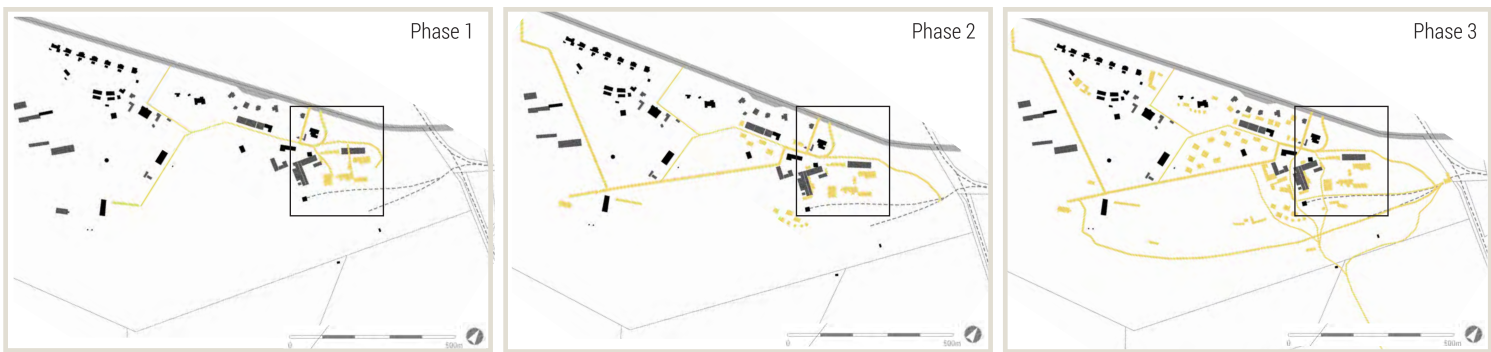
PHASE 3



BREAKING DOWN



BUILDING UP



PHASE 1

Phase 1 will provide the following facilities:
- School for the built environment built.
- Greenhouses built as part of the Agricultural Training School and phyto-remediation of landscape done in preparation for agricultural activity.
- New entrance, drop-off and parking area implemented.
- Industrial ruins re-appropriated into public attraction.
- Existing building appropriated into restaurant and kiosk.

PHASE 2

Phase 2 will provide the following facilities:
- Existing buildings appropriated for fresh produce-and artisan products market.
- Existing buildings appropriated as library.
- Student centre and administration building built at new entrance and drop off.
- Agriculture Training School built.
- Residential development for both students and staff with families, through appropriation of existing buildings.

PHASE 3

Phase 3 will provide the following facilities:
- Culinary Artisan School building built.
- Restaurants and cafés added to the market.
- Textile Artisan School built.
- Expansion of agricultural lands.
- Expansion of residential development with new built fabric.

Fig. 6.36. above: The process of breaking down and building up the site is proposed in incremental rehabilitation and development of the precinct with the site of the


PRECINCT
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
A
B
C
0
500m

Fig. 6.37. opposite page: Vision of long term development of precinct with site of detail intervention indicated (Author, 2017).

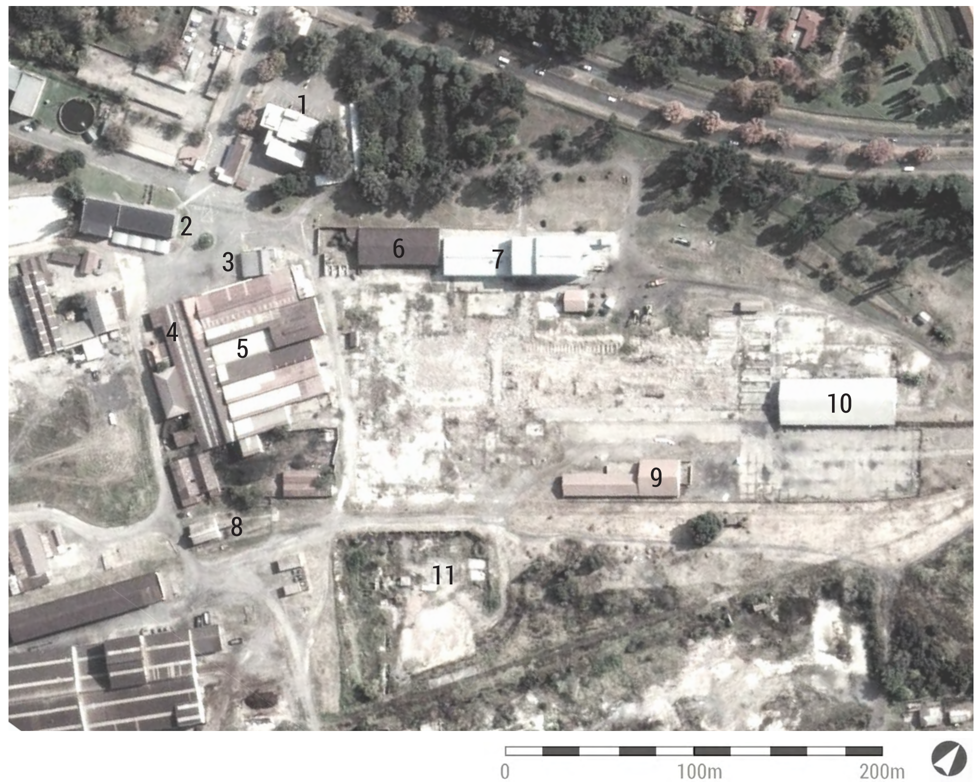
1. Secondary entrance
2. Industrial ruins visitor centre, restaurant and paintball area
3. Densified neighbourhood
4. Vrede of Vereeniging
5. Sports precinct
6. Commercial development
7. Gym & outdoor gym
8. Hotel & guesthouse
9. Residences
10. Staff & family residences
11. Fresh produce & craft market
12. Main entrance
13. Student centre
14. School for Textiles
15. Culinary school
16. School of the Built Environment
17 Building yard
18. New Station
19. Restaurant
20. School of Agriculture
21. Bird Viewing

Fig. 6.38. top: View of re-appropriated industrial ruins into restaurant and paintball arena (indicated on map as view A) (Author, 2017).

Fig. 6.39. middle: Existing warehouse appropriated into an indoor and outdoor gym as part of the sports precinct around the cricket pitch (indicated on map as view B) (Author, 2017).

6.4. SITE NARRATIVE RE-BUILDING THE CORE

Fig. 6.41. above: Aerial photograph taken in 2010, with Fire Brick Plant building still intact (Google Earth 2017).



1. **Headquarters building** (rented out as office space)
2. **Office building** (rented out as office space)
3. **1920s building** (Vereeniging Properties & Investments admin)
4. **Engineering and Woodwork workshops** (rented out as storage for packaged charcoal)
5. **Engineering and Woodwork workshops** (empty and derelict)
6. **Old chemical store for Fire-brick plant** (storage space)
7. **Old warehouse for Fire-brick plant** (rented out for welding, forklift and overhead crane training)
8. **Old Locomotive Warehouse**
9. **Old ablution facility for fire-brick plant labour** (empty)
10. *Open structure* (storage)
11. **Ruins from fire-brick plant processes**

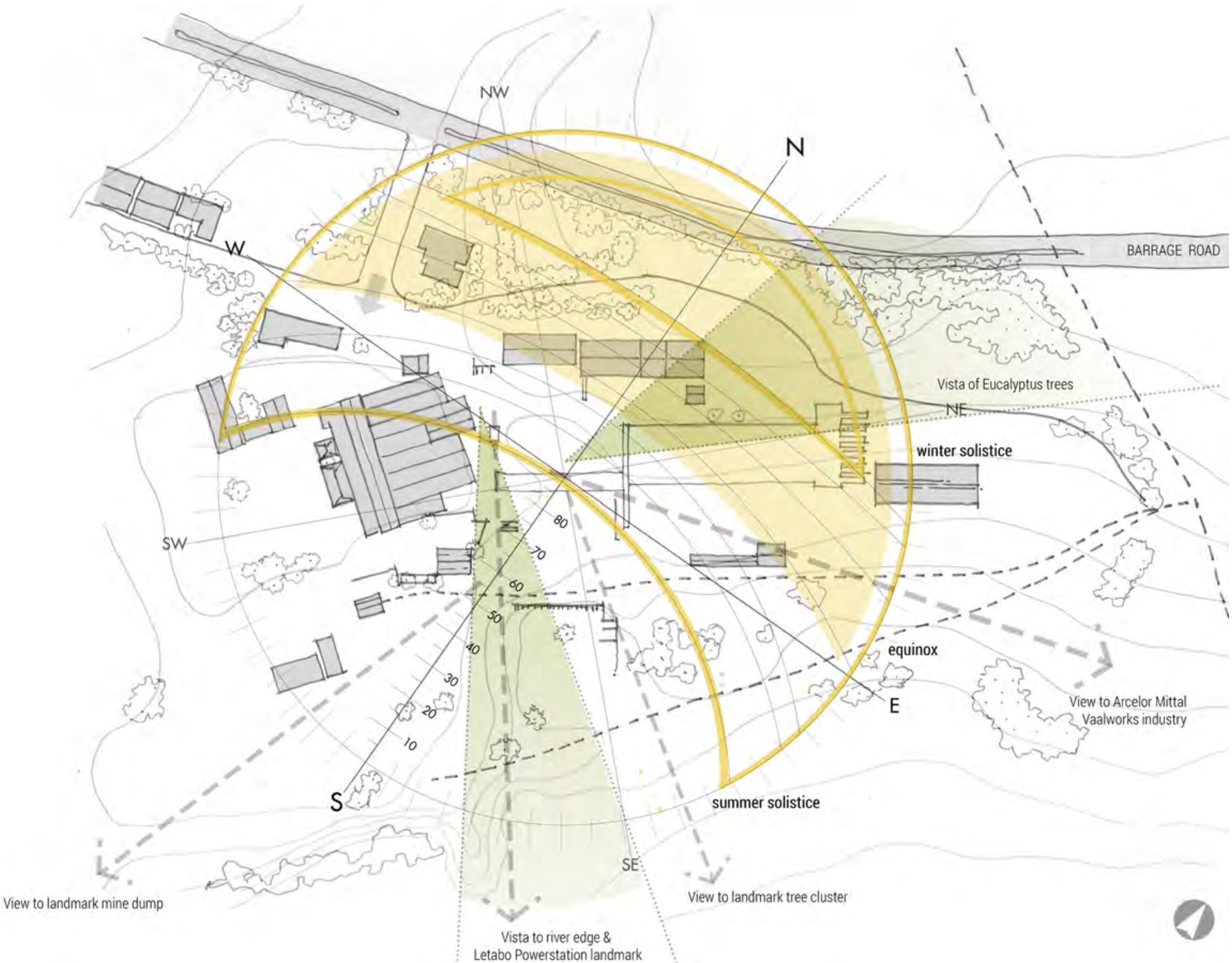
6.4.1. SITE ANALYSIS

The specific site chosen for a detailed design intervention is located on the site of the demolished fire clay plant (built in 1938 and demolished in 2015). To the south-east, an area of richer natural biodiversity has started to develop, occupying and covering ruins from the fire -brick plant.

The terrain is covered with a large amount of scattered construction material left from the demolition, including various different types of firebricks, clay bricks, paving bricks and concrete foundations, trenches and floor slabs.

Fig. 6.43. Collage of photographs taken on site, showing natural environment, industrial ruins, materials from demolition and interior of existing structures (Author, 2017).

Fig. 6.44. Diagram of site analysis, indicating contours, sun move-



6.4.2. CLIMATIC DATA

Vereeniging falls within the SANS 204-2 climate zone 1: *Cold Interior*.

The area experiences cool-temperate climate with high extremes between maximum summer temperatures and minimum winter temperatures. Summer temperatures can rise to about 32 ˚C, and winter temperatures drop to rarely below -2˚C.

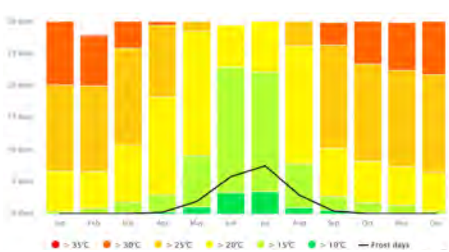
The summer rainfall season ranges from around 14 October to 28 March, with a mean annual precipitation of 662 mm (Mucina & Rutherford, 2006:363 & 397). Dry winters are also characterized by frequent occurrence of frost.

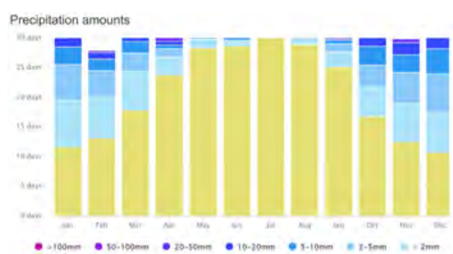
The area experiences the most wind during August to December with average wind speeds of about 8-10 km/hour. During February the wind is mostly from the east, whilst spring and summer winds are mostly from the north. Winter winds are most often from the west (Weatherspark n.d.).

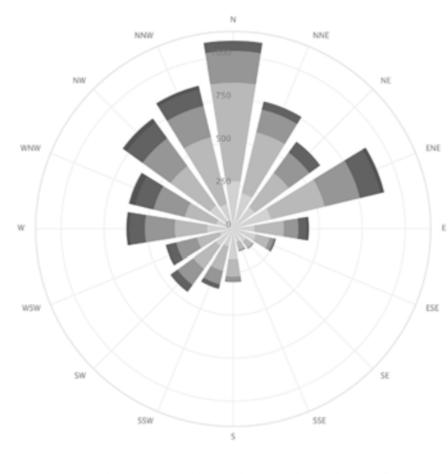
The south-eastern part of the site has the potential of beautiful views of the rehabilitated grassland stretching as far as the river-edge. Existing Eucalyptus trees have been planted in clusters and lanes on the northern edge of the site, creating areas of natural shade contrasting the rest of the harsh industrial landscape.

Fig. 6.45. Monthly temperatures & frost indication chart (Meteoblue, n.d.).

Fig. 6.46. Average temperatures & precipitation (Meteoblue, n.d.).







6.4.3. PROGRAMME REQUIREMENTS

ABLUTION & WASHROOMS

female: 12 WC, 9 HWB, 6 showers
male: 4 WC, 9 urinals, 9 HWB, 6 showers
disabled: 3 WC, 3 HWB, 1 bath

Requirements:
- water provision - cold and hot.
- removal of grey- and blackwater.
- lighting: 100 lux
- effective ventilation: passive or assisted

OFFICES

8 Staff & researcher offices @ 15m²
1 Reception office @ 9m²

Requirements:
- lighting: 500 lux
- effective ventilation: passive or assisted
- thermal comfort: assisted or passive
- electrical and internet services
- acoustics: controlled quiet environment

BASIC TRAINING & PUBLIC WORKSHOP

2 workshops @ 100m²

Requirements:
- lighting: 800 lux
- effective ventilation: passive or assisted
- thermal comfort: assisted or passive
- electrical services
- acoustics: absorbative and/or isolation of noise

MEETING ROOMS & LOUNGE

Staff room @ 36m²
Lounge @ 44m²

Requirements:
- lighting: 300 lux
- ventilation: passive or assisted
- thermal comfort control: passive or assisted
- provision for projection and screens
- access to kitchenette

LECTURE ROOMS

4 Lecture rooms @ 54m²
2 Lecure rooms @ 81m²

Requirements:
- lighting: 500 lux,
- effective ventilation: passive or assisted
- thermal comfort: assisted or passive
- electrical and internet services
- acoustics: controlled quiet environment

CARPENTRY & JOINERY

1 workshop @ 216m²

Requirements:
- lighting: 800 lux
- effective ventilation: passive
- thermal comfort: passive
- electrical services
- acoustics: absorbative and/or isolation of noise
- dust control or removal

SERVER ROOM & SOLAR PLANT ROOM

Server room @ 9m²
- lighting: 100 lux
- heat extraction
- ease of access for maintenance

Solar plant room @ 18m²
- lighting: 100 lux
- ease of access for installation & maintenance

AUDITORIUM

Auditorium of 180m² can accommodate 200 people

Requirements:
- lighting: 500 lux, with specific lighting control
- acoustics: specifically designed for effective sound
- effective ventilation: passive or assisted
- thermal comfort: assisted or passive
- electrical and internet services
- more than one point of exit and/or entry

MATERIALS LIBRARY

80m2

Requirements:
- lighting: 300 lux
- effective ventilation: passive and/or assisted
- thermal comfort: passive and/or assisted
- electrical services
- storage & exhibition of materials

STORAGE & OUTDOOR BUILDING YARD

Storage space for materials and tools used in workshops and building yard.

- Roof cover
- Security control
- Areas for timber storage should be kept dry
- Easy access for delivery and refuse removal

COMPUTER & 3D PRINTING LAB

Computer lab: 100m² accommodating 50 students
Printing and Maker's lab: 80m²

- lighting: 630 lux, designed to prevent glare
- effective ventilation: assisted or mechanical heat removal
- thermal comfort: assisted
- electrical and internet services
- ease of access for maintenance and 'machine' entry

ELECTRICAL WORKSHOP & DRAUGHTING STUDIO

2 studios @ 80m2

Requirements:
- lighting: 800 lux
- effective ventilation: passive or assisted
- thermal comfort: assisted or passive
- electrical services
- acoustics: absorptive and/or isolation of noise

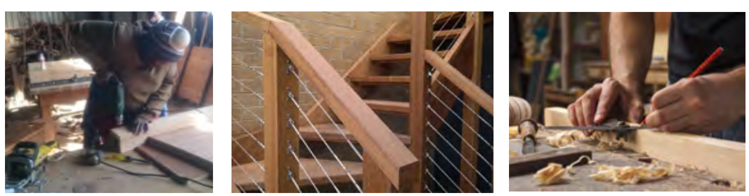
Fig. 6.48. opposite: Collage of activities proposed, to be accommodated as part of the programme (Author, 2017).

MASONRY CONSTRUCTION

SYSTEMS & SERVICES

CARPENTRY

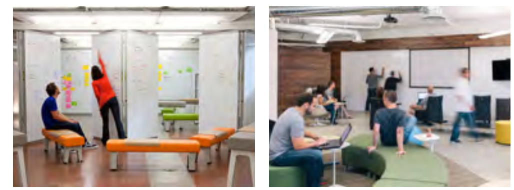
JOINERY



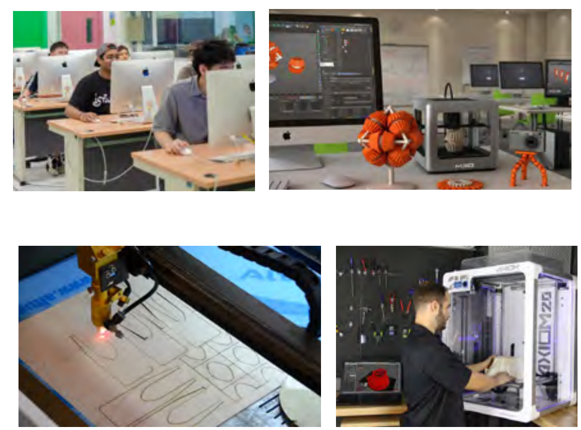
LANDSCAPE, EXTERNAL WORKS AND HORTICULTURE

EDUCATION

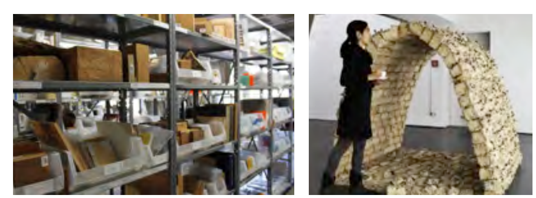
COLLABORATION



TECHNOLOGY



RESEARCH



6.5. CONCEPTUAL RESPONSE

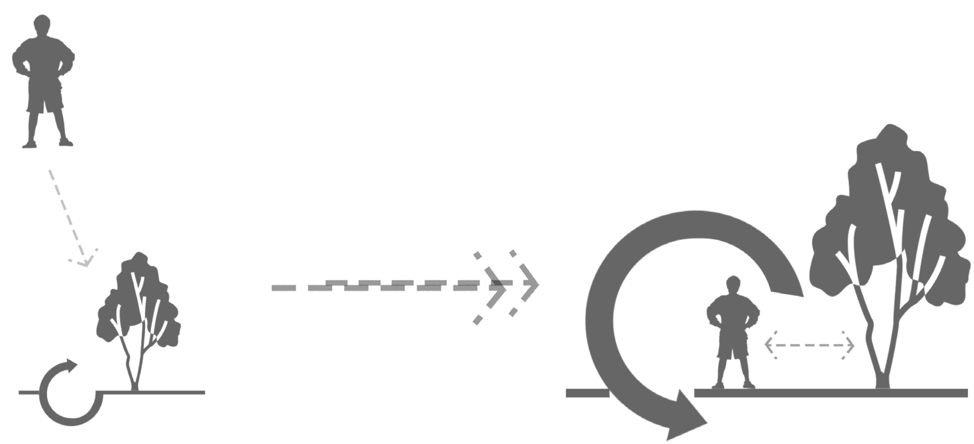
The shift in relationship from man placing himself above the 'natural environment' and ecosystem services, to man realizing his place within the dynamic ecosystem of biotic existence, underlies the regenerative approach to the site.

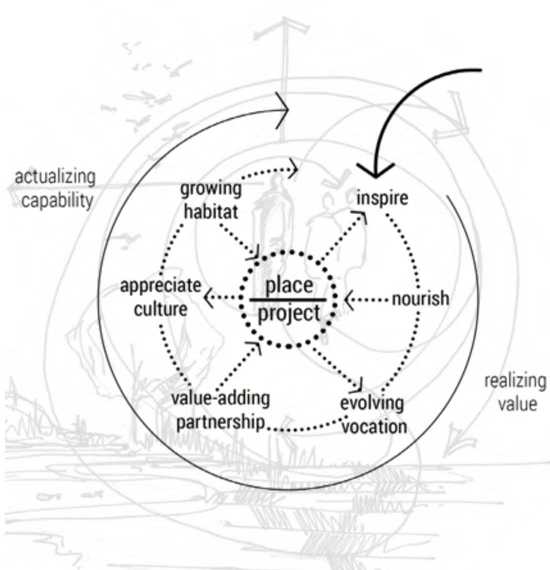
From the theoretical premises of regenerative theory (as discussed in Chapter two), a process of actualizing capacity and realizing value is applied to the architectural development of the site. The complete intervention aims to inspire through an integrated system that nourishes both the user and the natural environment.

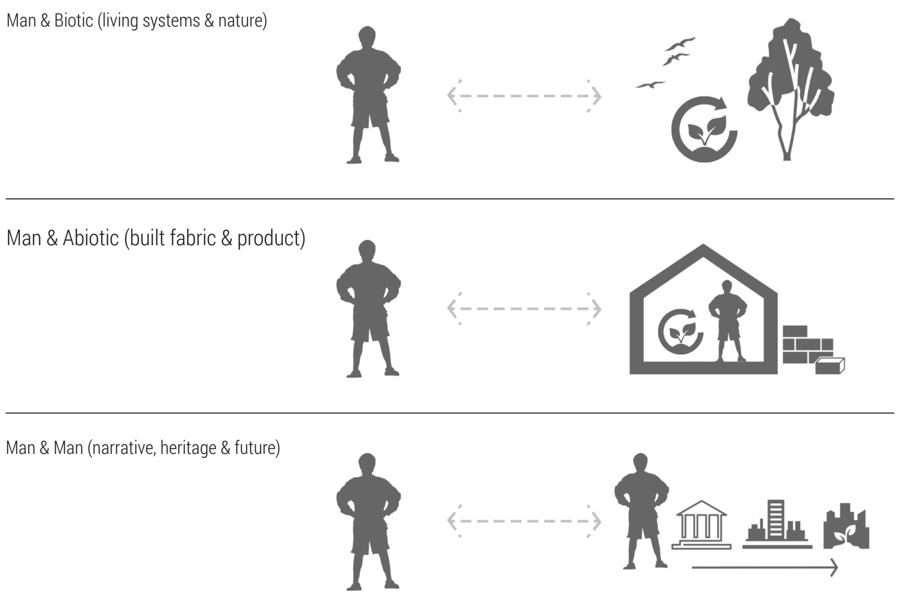
The programme of education of the built environment is explored to establish an evolving vocation and value-adding partnership between the user and the built and natural environment. These are envisioned as the first steps in the process towards a new culture and habitat.

This dynamic process, applied to the site, is completely dependent upon a set of relationships, described by figure_ on the opposite page. The conceptual response aims to define these three relationships as design drivers (narrative, environment and programme).

Fig. 6.49. below: A shift in world-view (Author, 2017).
Fig. 6.50. opposite page top: The key processes supporting the evolution of life from Chapter two (Author, 2017).
Fig. 6.51. below: Sets of relation-ships informing the design process (Author, 2017).







The architectural application of the processes identified as key to the evolution of life (figure _) are discussed below:

INSPIRE
Visual and experiential integration of landscape and built environment as an complete ecosystem.

NOURISH
Building becomes an integral part in the ecosystems created, aiding where the land cannot support life.
Focus on water harvesting and filtration and soil regeneration.

EVOLVING VOCATION
Learning spaces reveal themselves for users to see and understand, in order to develop a need to improve construction methods and co-habitation of built and natural.

VALUE-ADDING PARTNERSHIP
Workshops and practical training allows students to develop a partnership with their surroundings.

APPRECIATING CULTURE
Both public and educational spaces designed to enhance experience and the benefits of regenerative thinking.

GROWING HABITAT
Built environment and landscape can together foster life and learning.

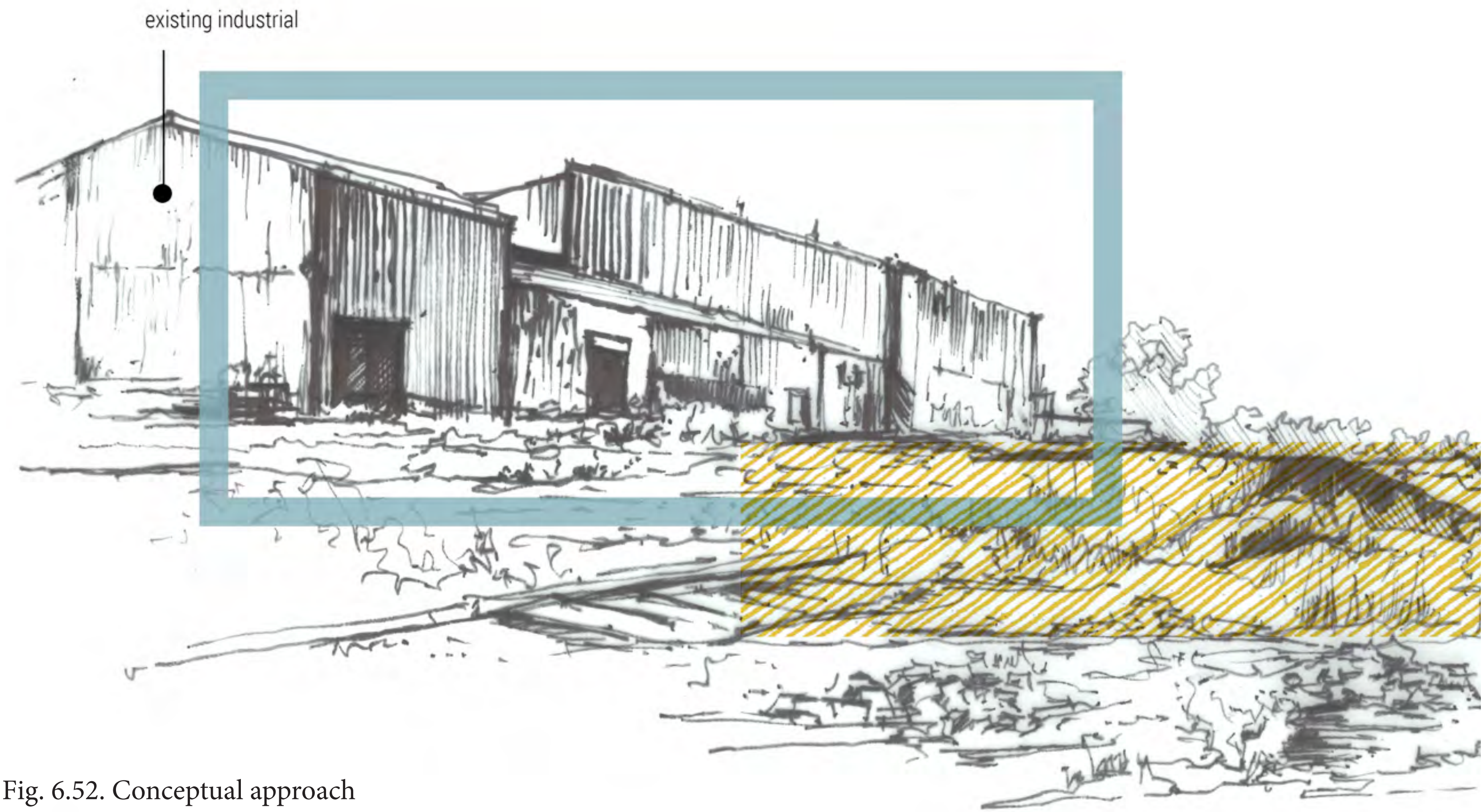
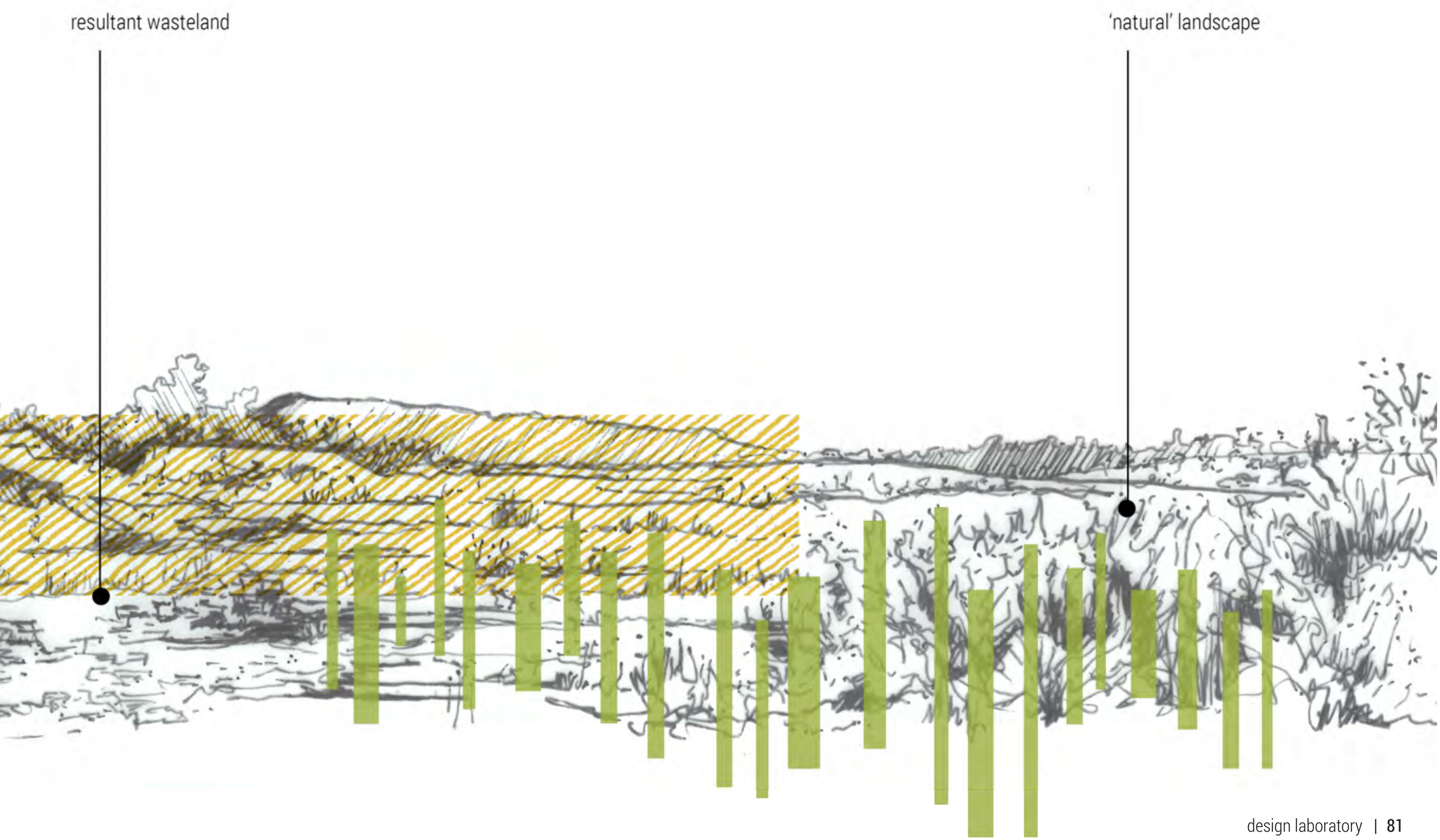


Fig. 6.52. Conceptual approach applied to the site (Author, 2017).

VALUE-ADDING PARTNERSHIP

APPRECIATING CULTURE

GROWING HABITAT



6.6. DESIGN DRIVERS

NARRATIVE

Regeneration on a cultural level, using specific strategies of contrast, reveal, gathering and recycling to integrate the historic into the narrative of the proposed architecture, but also to indicate the possibilities of future stories of interdependence between man and his environment.

ENVIRONMENT

Rehabilitation of the natural environment, as it becomes integrated with the architecture, providing services the land is currently unable to, such as clean water and healthy topsoil. Specific climatic considerations are used as drivers in design decision and iteration.

PROGRAMME

The nature of a school for the built environment based in trade and practical skill, requires a co-existence of two typologies: educational and industrial workshop. Apart from light and thermal requirements, these typologies require very different spatial organization and above all acoustic designs. These differences will greatly inform the technical resolution of the design.

The educational component of the programme also requires architecture that communicates the specific methods of construction and design decisions applicable to the context (e.g. orientation, structure and material choices), serving as education through experience.

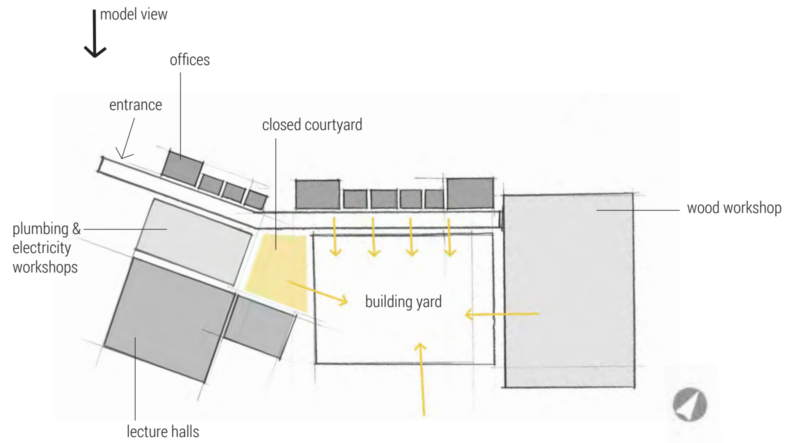
Chapter VII

DESIGN DEVELOPMENT

This chapter documents the evolution of the design from three different approaches, each guided by one of the design drivers. The design was then synthesized and iterated into an appropriate response.

Fig. 7.1. Initial impression sketch of the response to the site viewed from the landscape (Author, 2017).

7.1.1. CONCEPT 1 | OPEN CENTRAL PIVOT



DESIGN DRIVER

The composition of the programme and movement through the most important spaces identified, like workshops and practical classrooms, guided this initial concept.

SUCCESSFUL ELEMENTS

Devolution of the architectural language from a small, dense scale into larger, open spaces creates a successful transition from the existing built fabric to the vast landscape. The larger workshop volumes responds well to the existing warehouse building in size, with clear circulation and hierarchy throughout the spaces.

CRITIQUE

The relationship to the existing fabric is arbitrary and does not inform the space to the south-east. Offices facing north-west could be problematic.

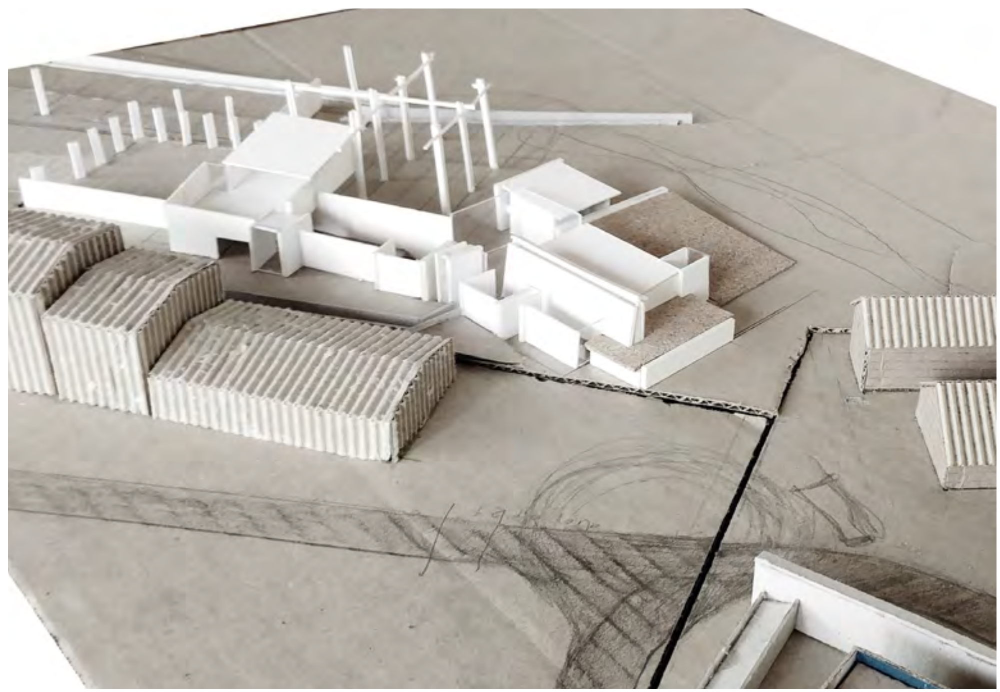
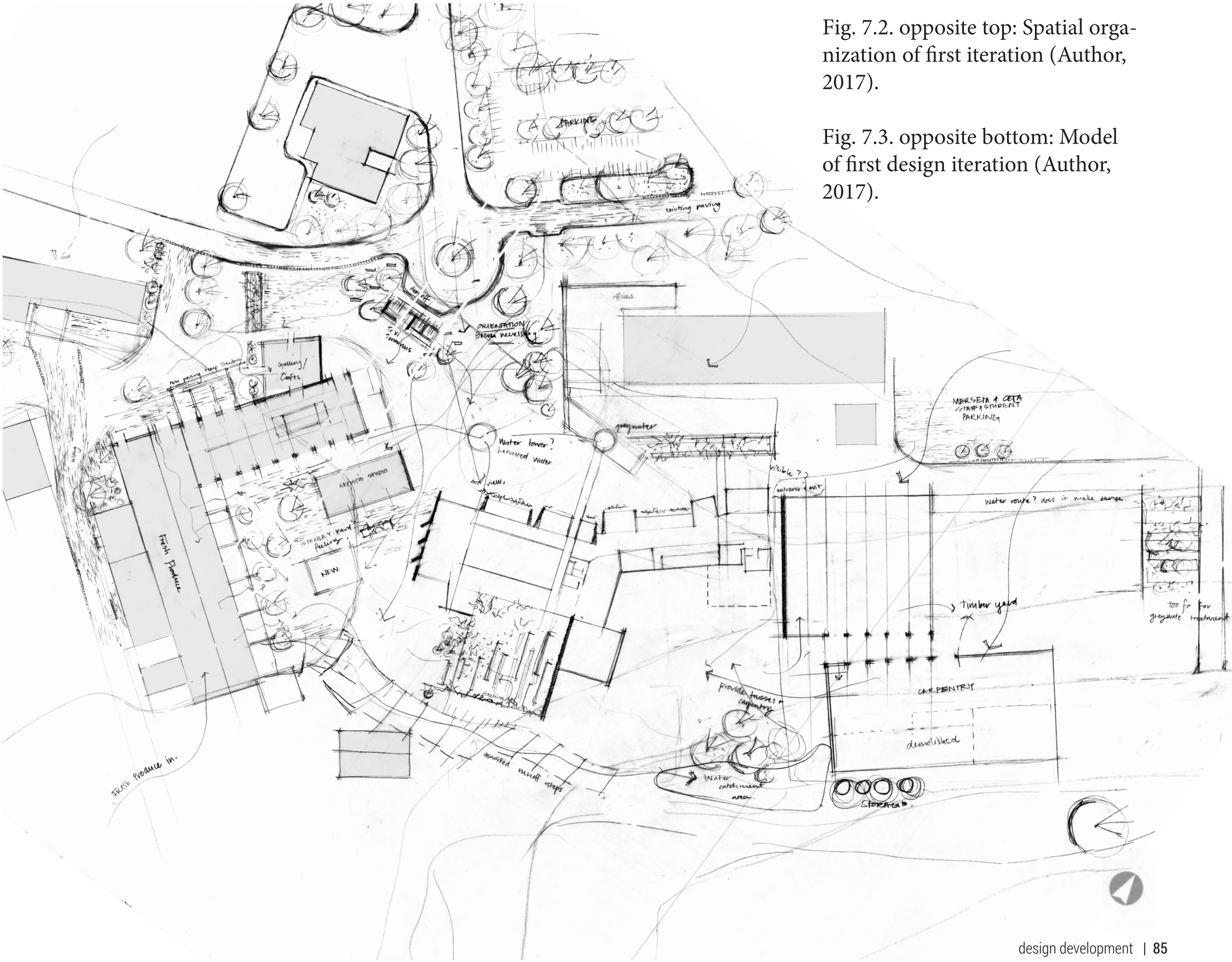


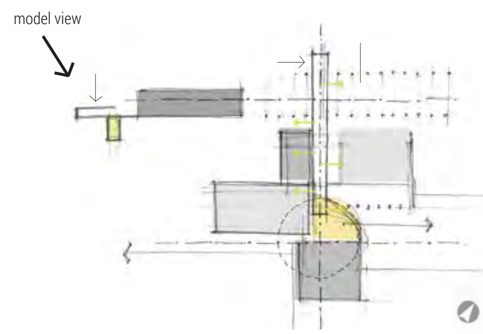
Fig. 7.2. opposite top: Spatial organization of first iteration (Author, 2017).

Fig. 7.3. opposite bottom: Model of first design iteration (Author, 2017).



7.1.2. CONCEPT 2 | ELEMENTS ALONG AN AXIS

Fig. 7.5. below: Model of second design iteration with spatial orga-



DESIGN DRIVER

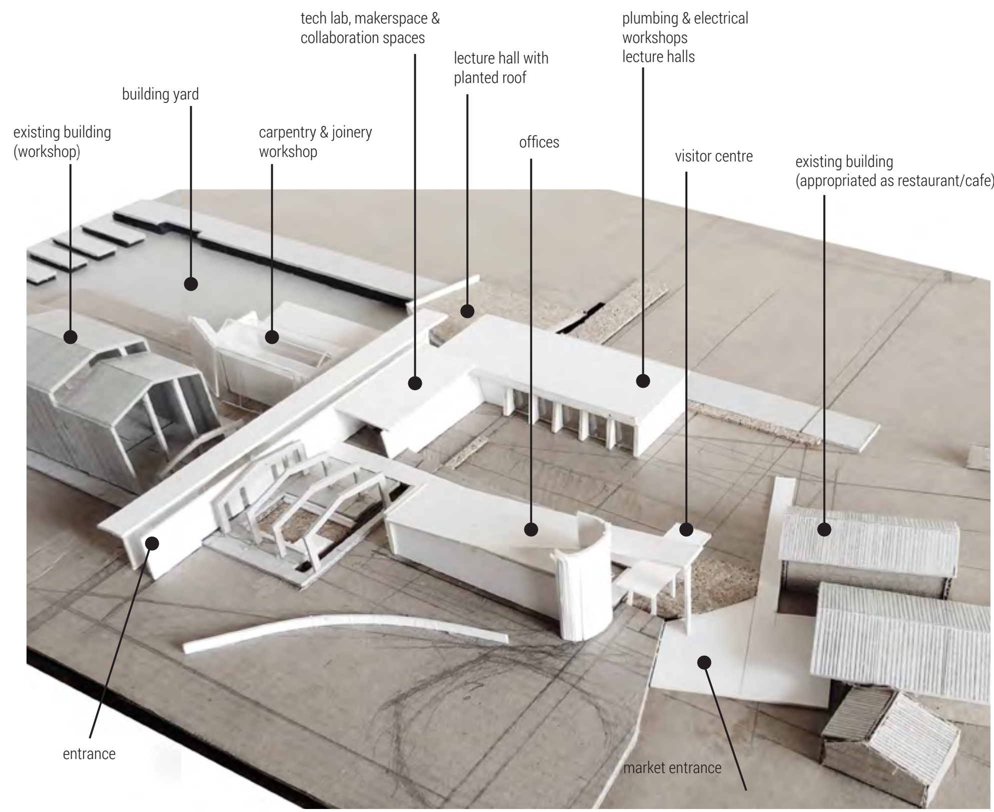
The relationship to the existing buildings and lines picked up from the site surface guided the second iteration, creating a connection between the existing industrial and the natural landscape being rehabilitated.

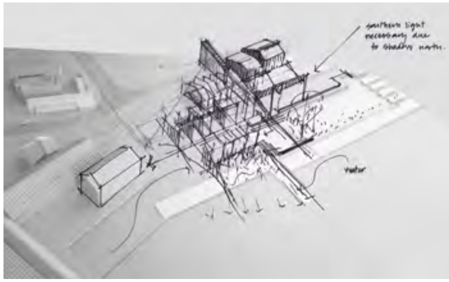
SUCCESSFUL ELEMENTS

Spatial linking to the existing structures and transformation thereof through removal of some of the skin elements, integrates the new design successfully.
Definition and framing of a space between the existing and new fabric creates opportunity for the integration of landscape and social activities.
The main circulation divides spaces of quiet, theoretical learning from workshops and outdoor practical learning areas, with the opportunity to view all the activities.

CRITIQUE

Integration with the landscape to the south is not effective enough. User orientation is confusion due to two different entrances.





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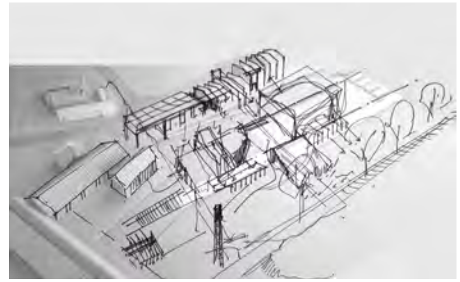
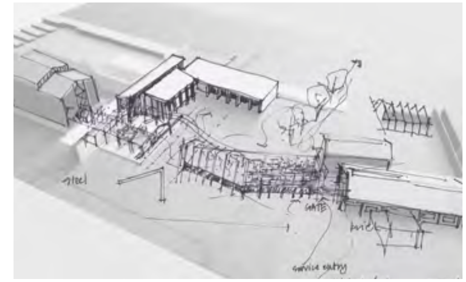
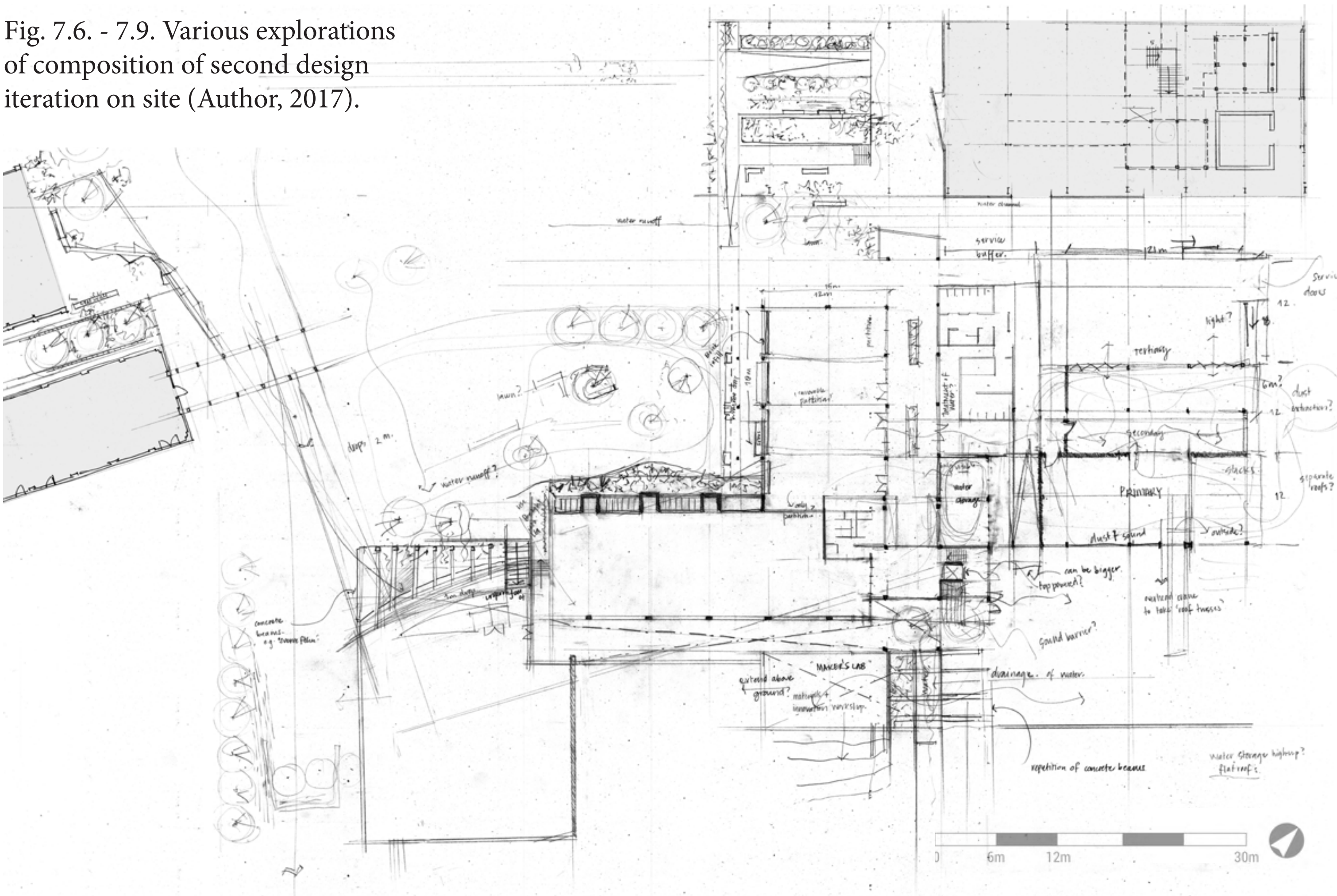


7.7.



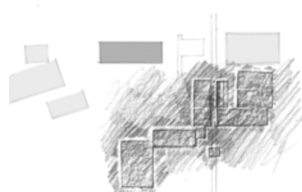
7.9.

Fig. 7.6. - 7.9. Various explorations of composition of second design iteration on site (Author, 2017).

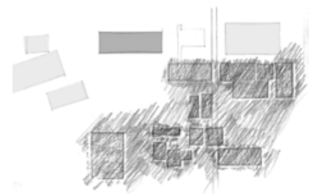


7.1.3. CONCEPT 3 | INTEGRATING NEGATIVE SPACE

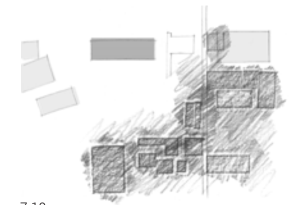
Fig. 7.11. - 7.13. right: Exploration of the negative space as design generator (Author, 2017).



7.11.



7.12.



7.13.

DESIGN DRIVER

Design iteration three focuses on the spatial integration with the natural landscape and the application of passive building strategies.

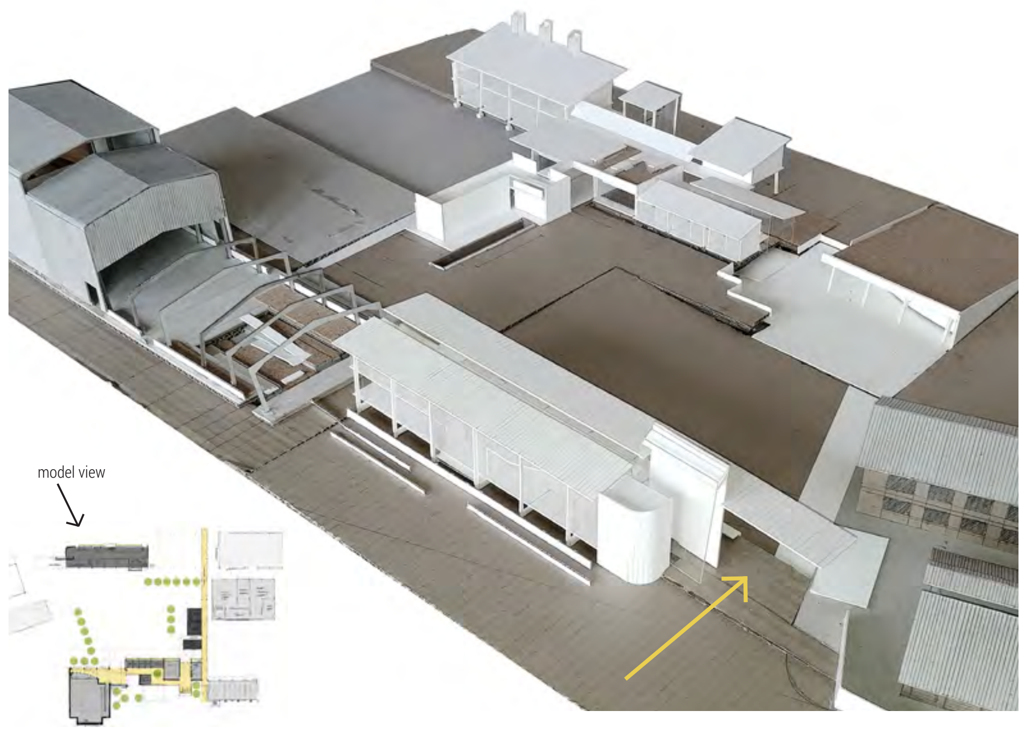
SUCCESSFUL ELEMENTS

The front office building creates an elegant entrance, with the rhythmic structural composition as a visual link between the existing and the new building. Entrance to the Built Environment building is clear and the large auditorium facing the public square is located more successfully.

CRITIQUE

The square created between the buildings is too vast and unprogrammed and lack of hierarchy between the buildings make circulation and user-orientation of the space confusing.

The geometry and architectural language of the Built Environment building is too complex and arbitrary.



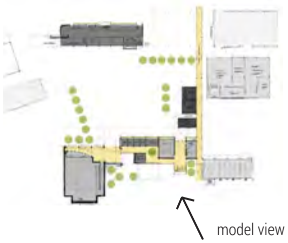
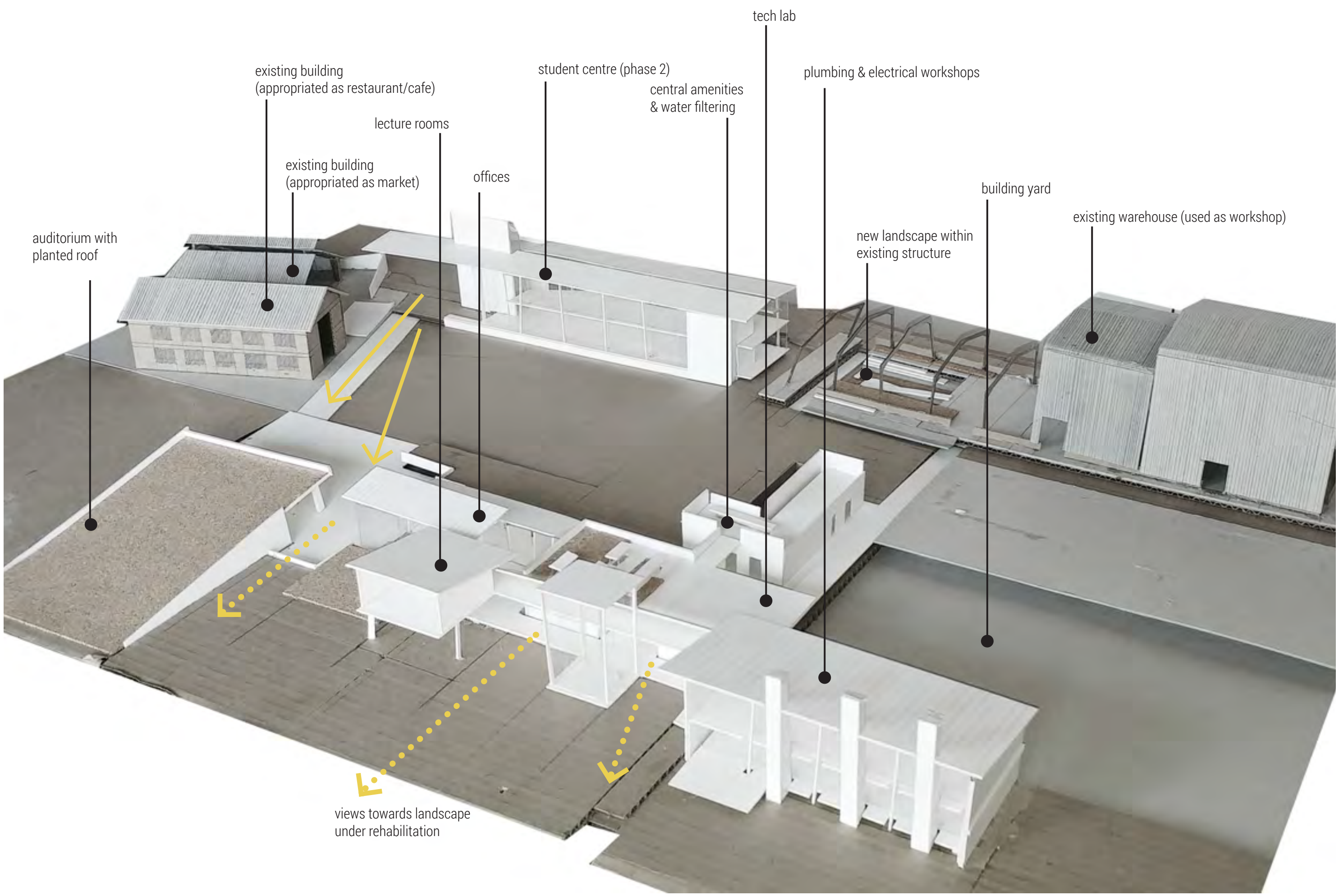
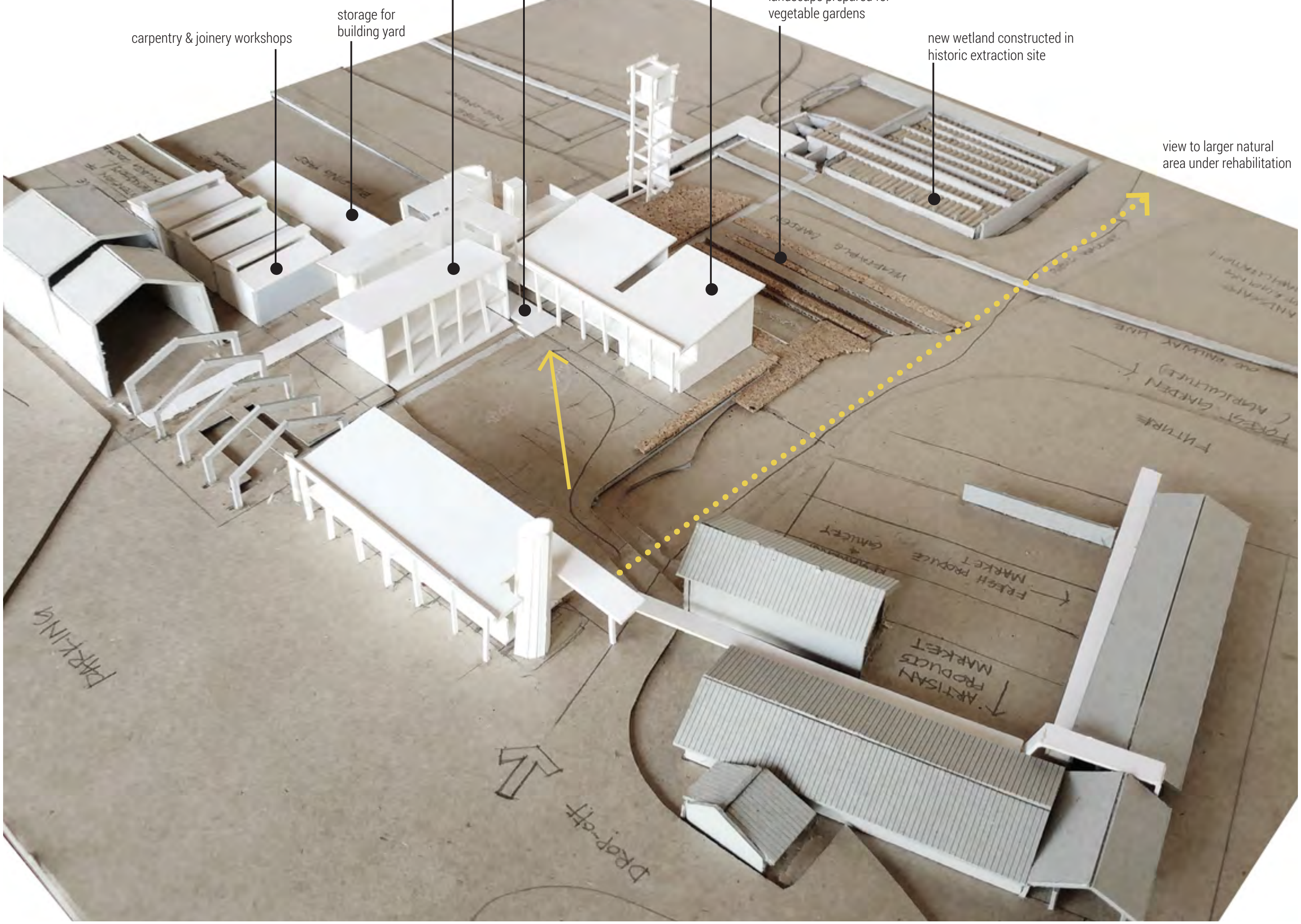


Fig. 7.15. below: Model of third design iteration presented in June, with spatial organization indicated (Author, 2017).

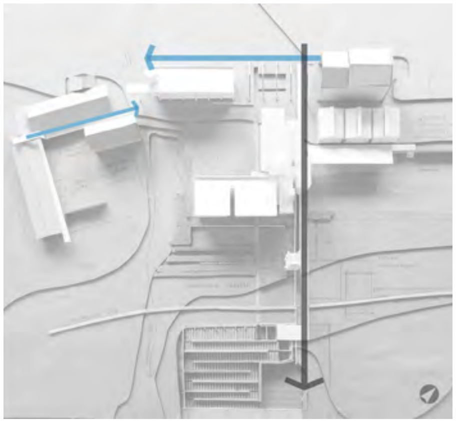


7.1.4. SYNTHESIS

Combining the successful elements of the three previous designs, a response is generated applying all three design drivers in hierarchy and appropriate balance.

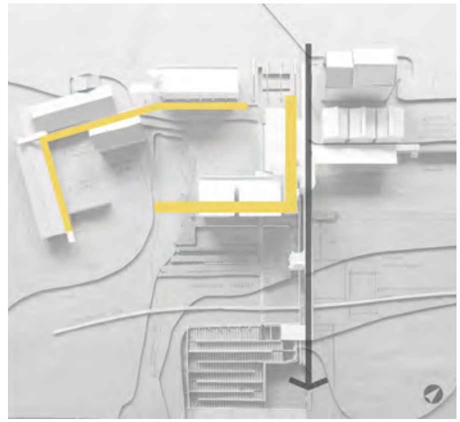


7.2. SPATIAL APPLICATION OF THE THEORETICAL CONCEPT



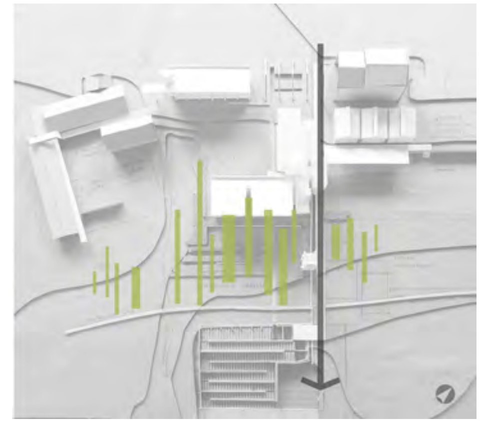
LINK & CONTINUE

The application of the conceptual approach to the site redevelopment manifests in the procession of actions along a 'narrative route' or axis, creating a transition from existing industrial structures to architecture integrated with the landscape.



FRAME

By framing the existing fabric, the architectural intervention continues the narrative of the site through the positioning of the new buildings and open spaces complimenting the existing fabric and new activities proposed within them.



INTEGRATE

Transformation of the wasteland into a space for collective education, innovation and practice, and the establishment of a spine of systems and services, enables the possibility of the site to sustain lifecycles and enable future development according to the precinct vision. Rehabilitation of the wasteland is created through the integration of the landscape, both programmatically and architecturally.

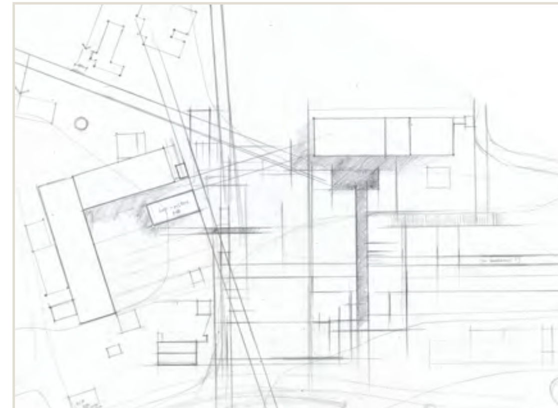
Fig. 7.16. opposite page: Model of the final design iteration to be iterated based on technical resolution (Author, 2017).

Fig. 7.17. above left: Diagram of the proposed building creating a visual continuation of the existing structures (Author, 2017).

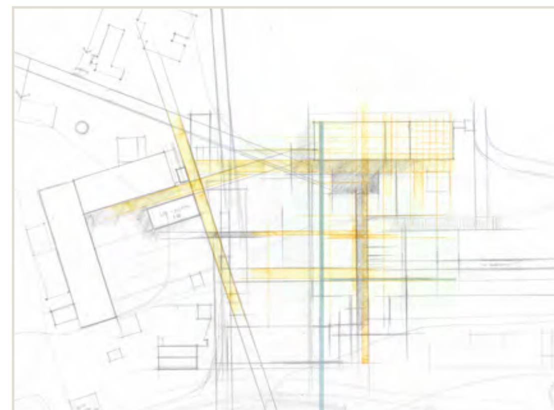
Fig. 7.18. above middle: Diagram of how the new building frames the existing, creating a protected central open space (Author, 2017).

Fig. 7.19. above right: Integration of the architecture with the landscape, where the building becomes the threshold to the natural environment being rehabilitated (Author, 2017).

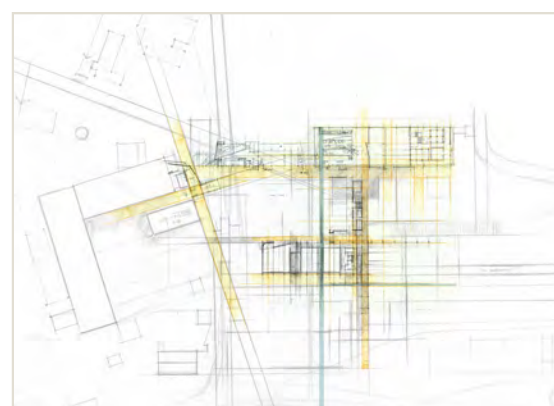
7.4. ITERATION OF THE PLAN



IDENTIFYING EXISTING LINES ON SITE

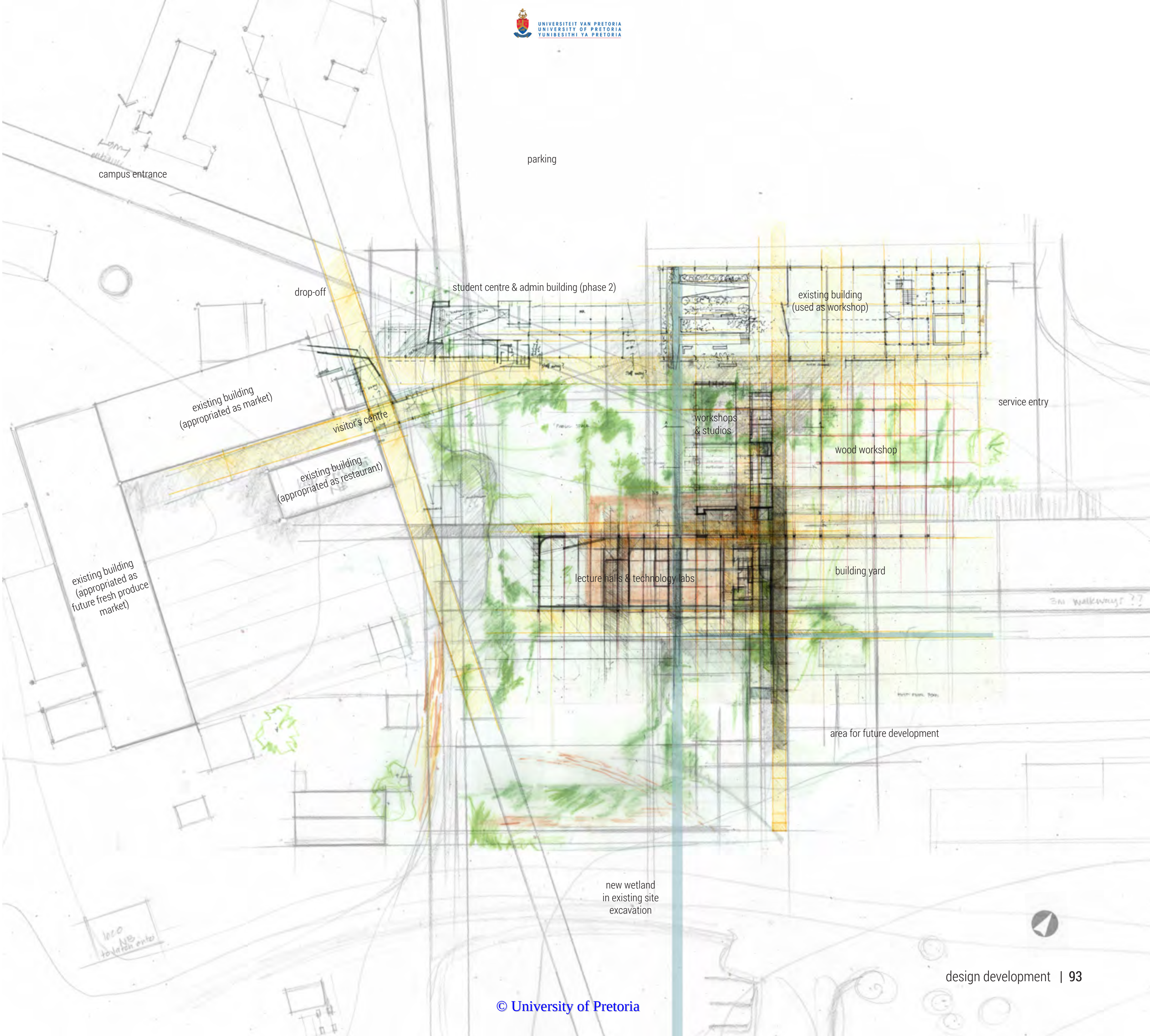


ESTABLISHING IMPORTANT ROUTES



ORGANIZING SPACES ACCORDINGLY

Fig. 7.20. This page: Series of three stages of developing the plan (Author, 2017).


campus entrance
parking
drop-off
student centre & admin building (phase 2)
existing building
(used as workshop)
existing building
(appropriated as market)
visitor's centre
existing building
(appropriated as restaurant)
workshops
& studios
wood workshop
service entry
existing building
(appropriated as
future fresh produce
market)
lecture halls & technology labs
building yard
area for future development
new wetland
in existing site
excavation

7.3. SKETCH PLANS

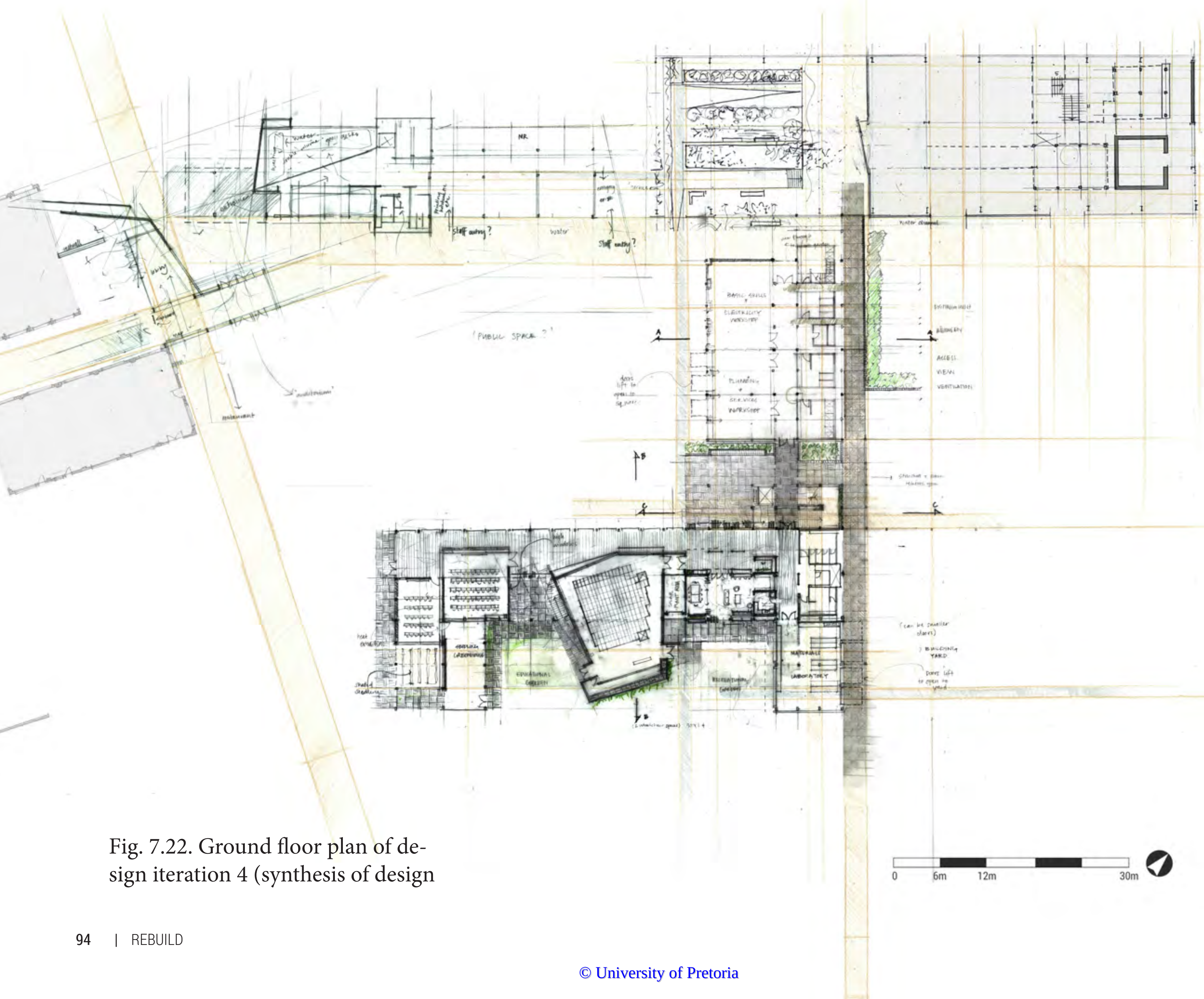


Fig. 7.22. Ground floor plan of design iteration 4 (synthesis of design

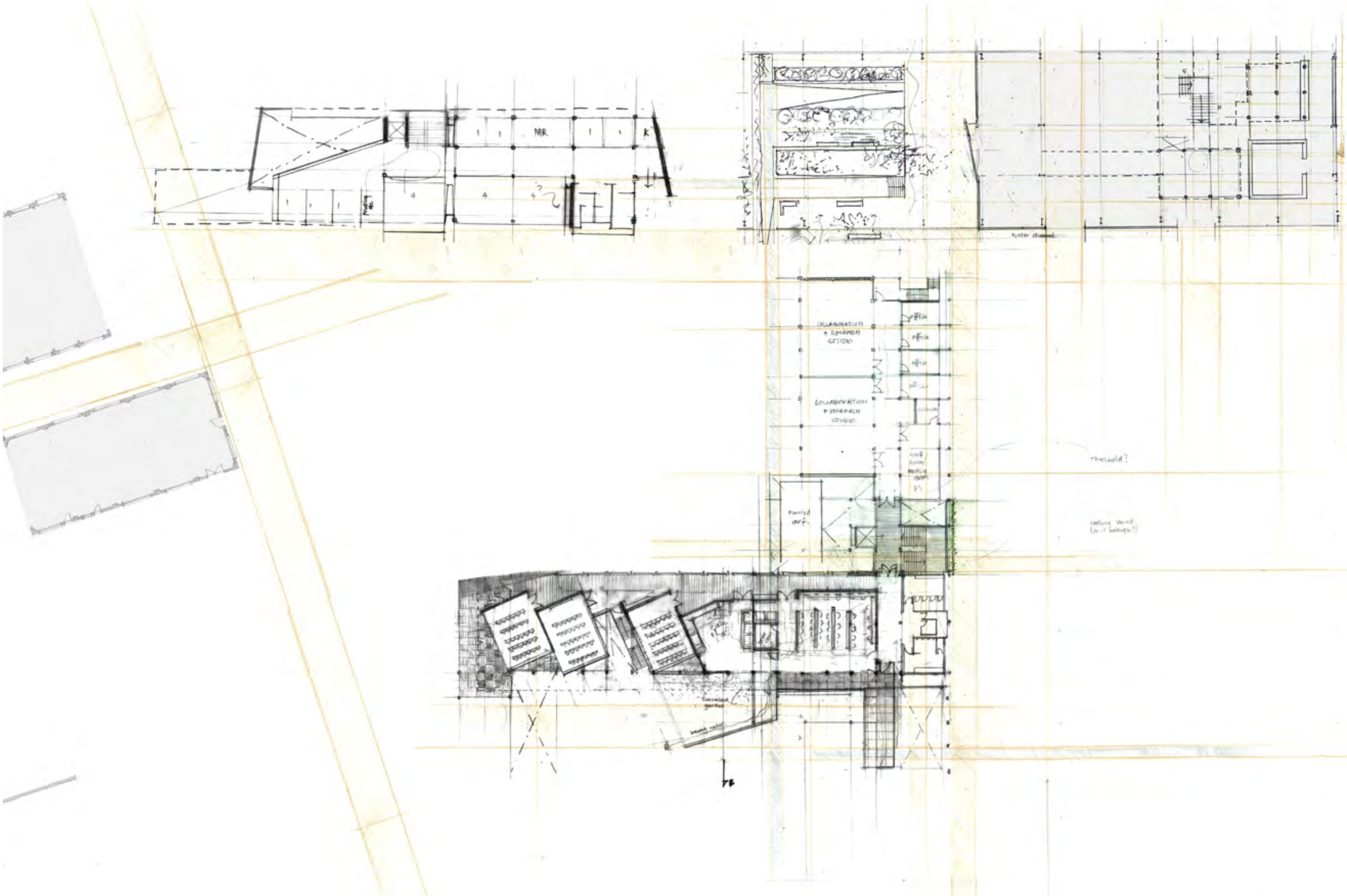
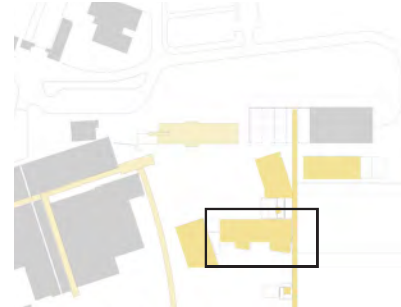
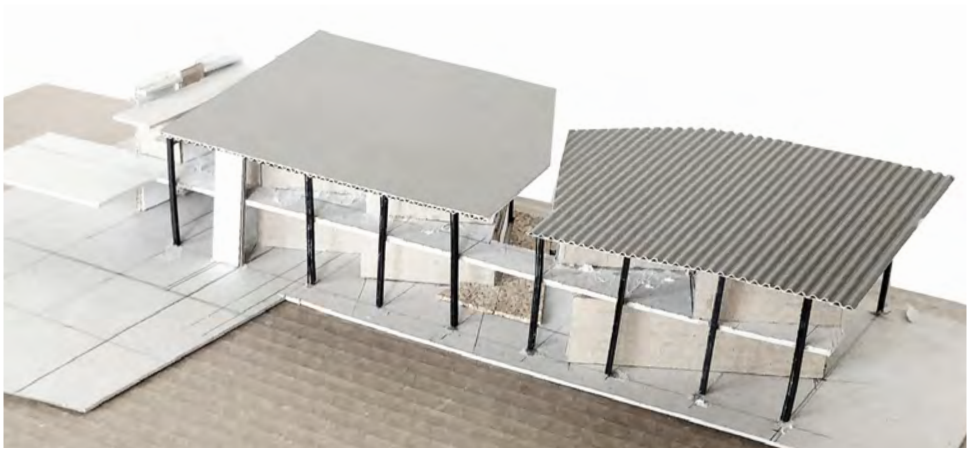


Fig. 7.23. First floor plan of design iteration 4 (synthesis of design

7.3.1. ITERATION OF THE PLAN





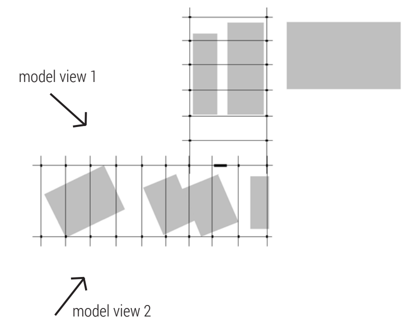
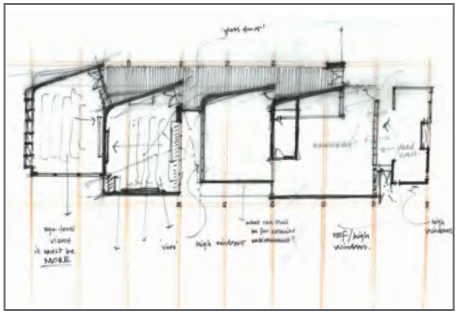
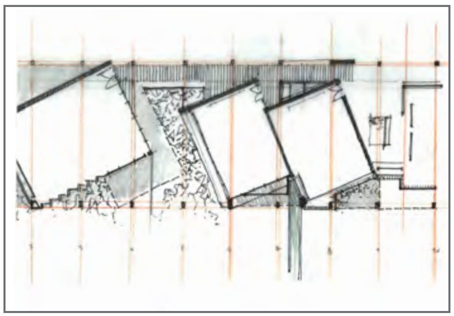


Fig. 7.24. top: Keyplan indicating area of plan iterated through models & drawings (Author, 2017).
Fig. 7.25. bottom: Parti diagram of the plan iterated (Author, 2017).

Fig. 7.26. - 7.27. left: Model testing the spatial quality of interior spaces that are independent of the pri-



7.28.



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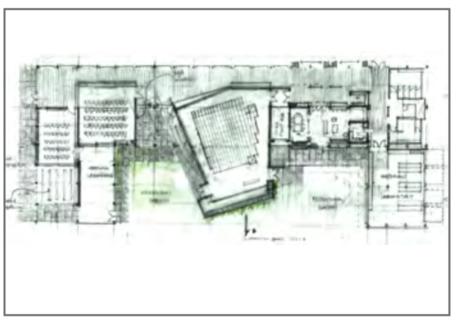
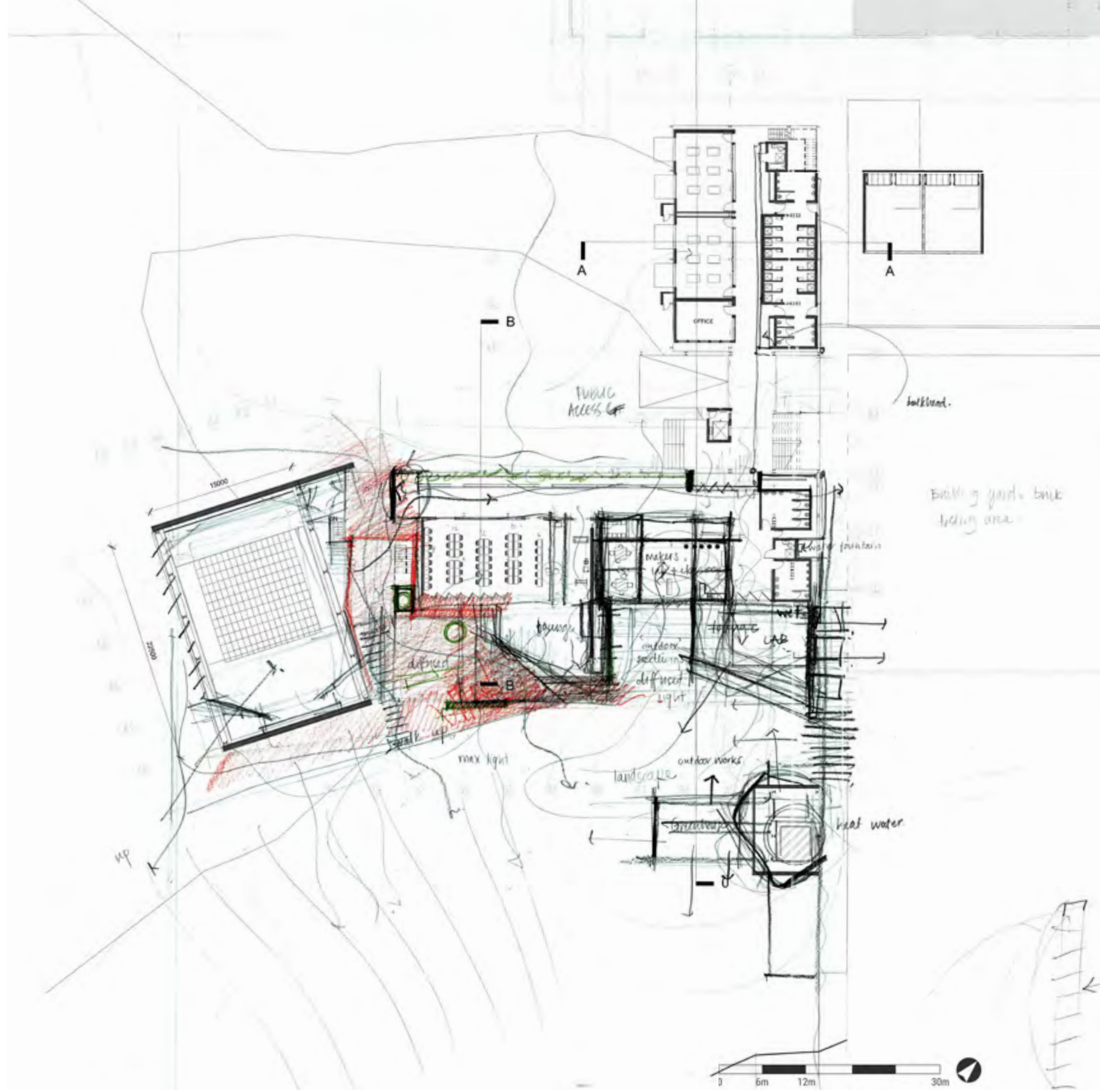


7.30.

Fig. 7.28. - 7. 30. Iteration of the southern wing accommodating lecture rooms and technology labs, based on light and integration of the landscape, within the contingencies of the structure (Author, 2017).

Organization of spaces in a logical relationship to adjacent current or future activities and spaces, together with optimum location for solar exposure, views and clustering of similar services, guides the development of the plan.



7.3.2. SPATIAL ORGANIZATION & MOVEMENT

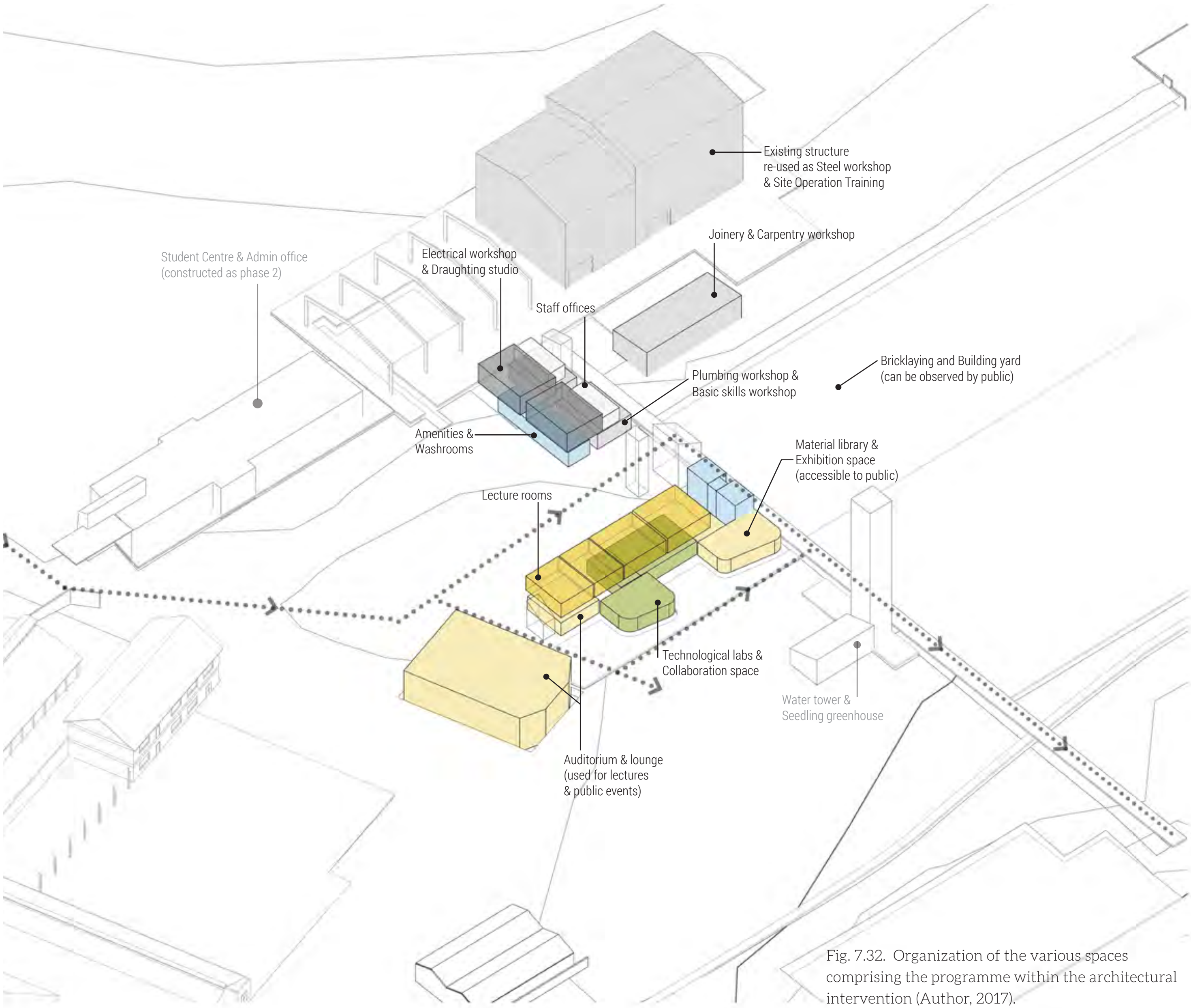


Fig. 7.32. Organization of the various spaces comprising the programme within the architectural intervention (Author, 2017).

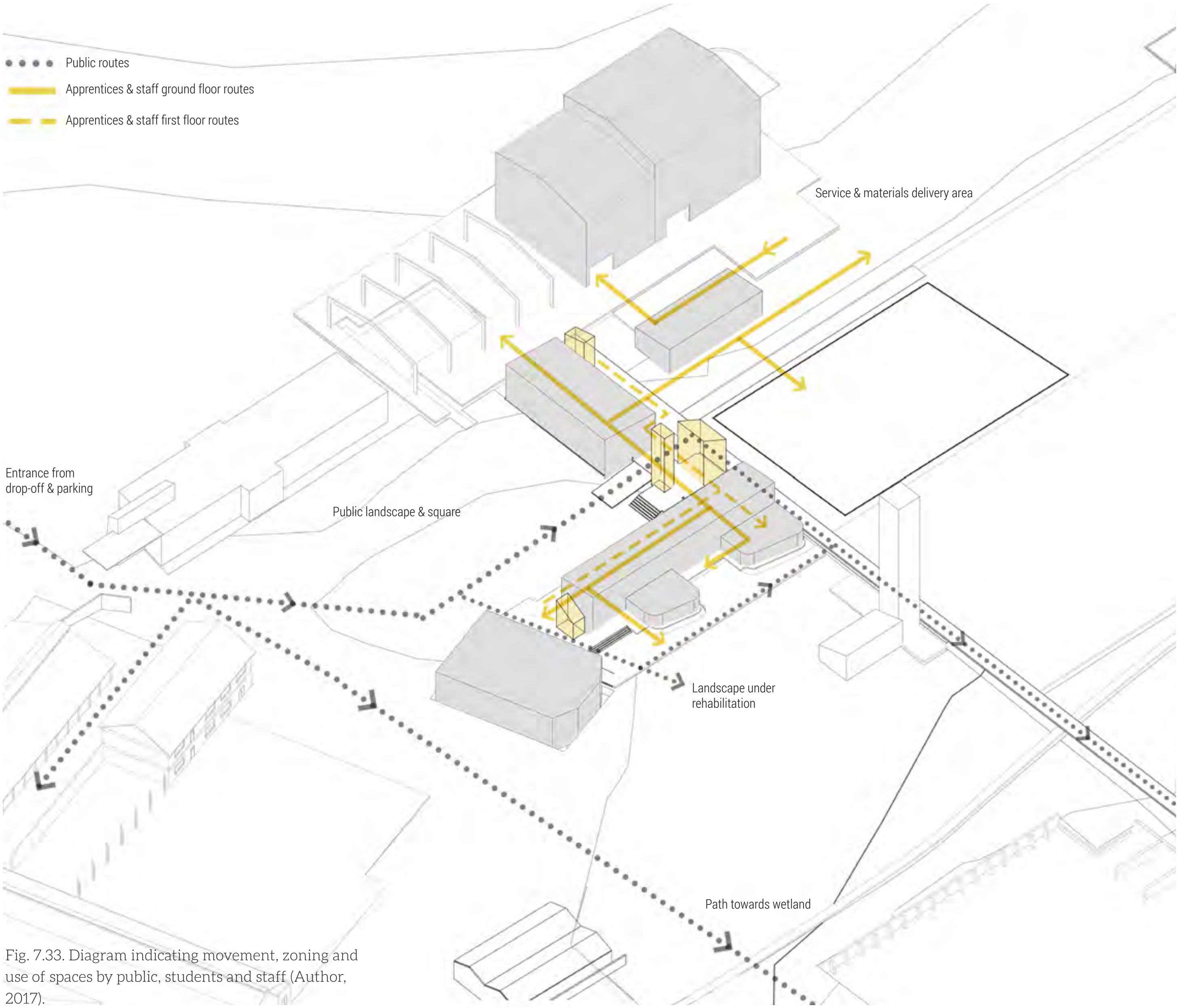


Fig. 7.33. Diagram indicating movement, zoning and use of spaces by public, students and staff (Author, 2017).

7.5. ITERATION OF THE SECTION

Iteration of the section is done in an attempt to create interior spaces with maximum natural light, integrating the building with the landscape and optimum reliance on passive systems for the provision of interior thermal comfort.

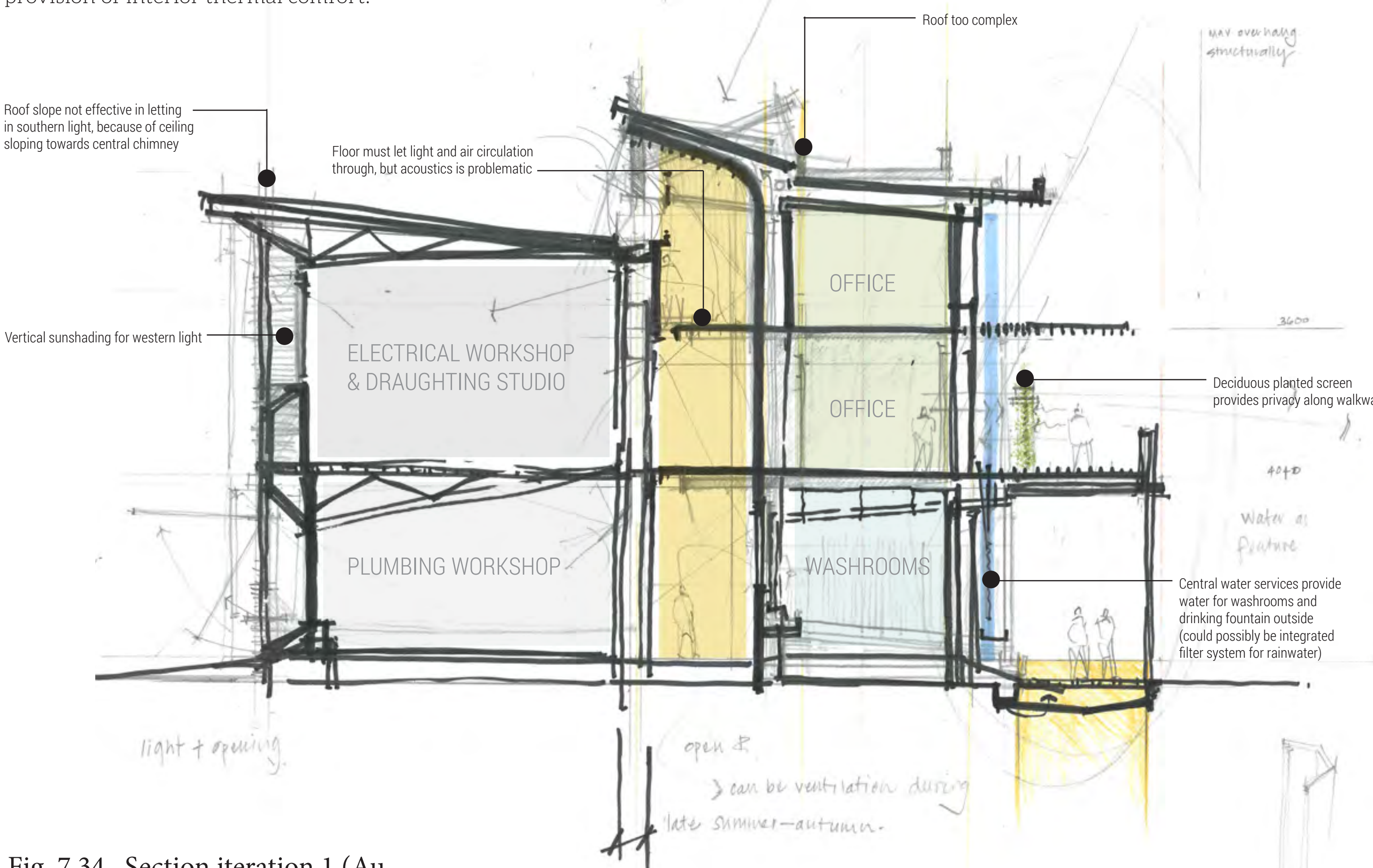
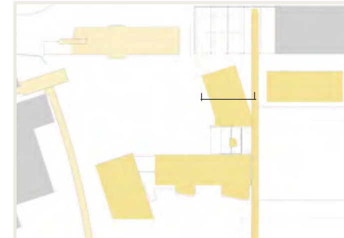


Fig. 7.34. Section iteration 1 (Au-



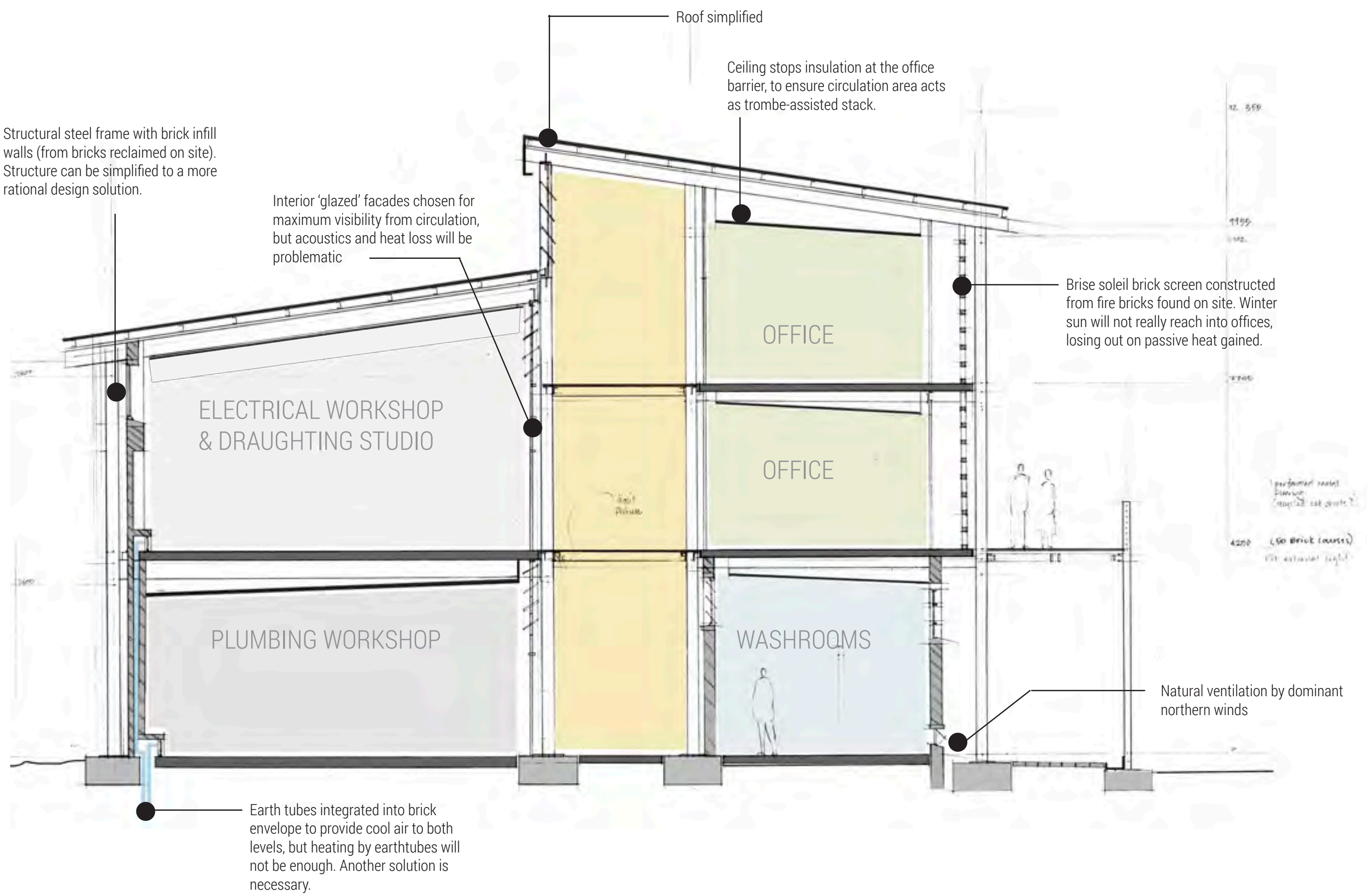
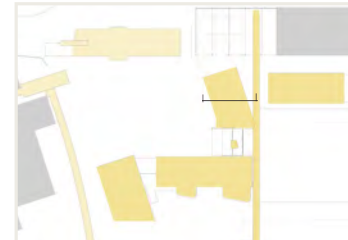


Fig. 7.35. Section iteration 2, with a simplified roof



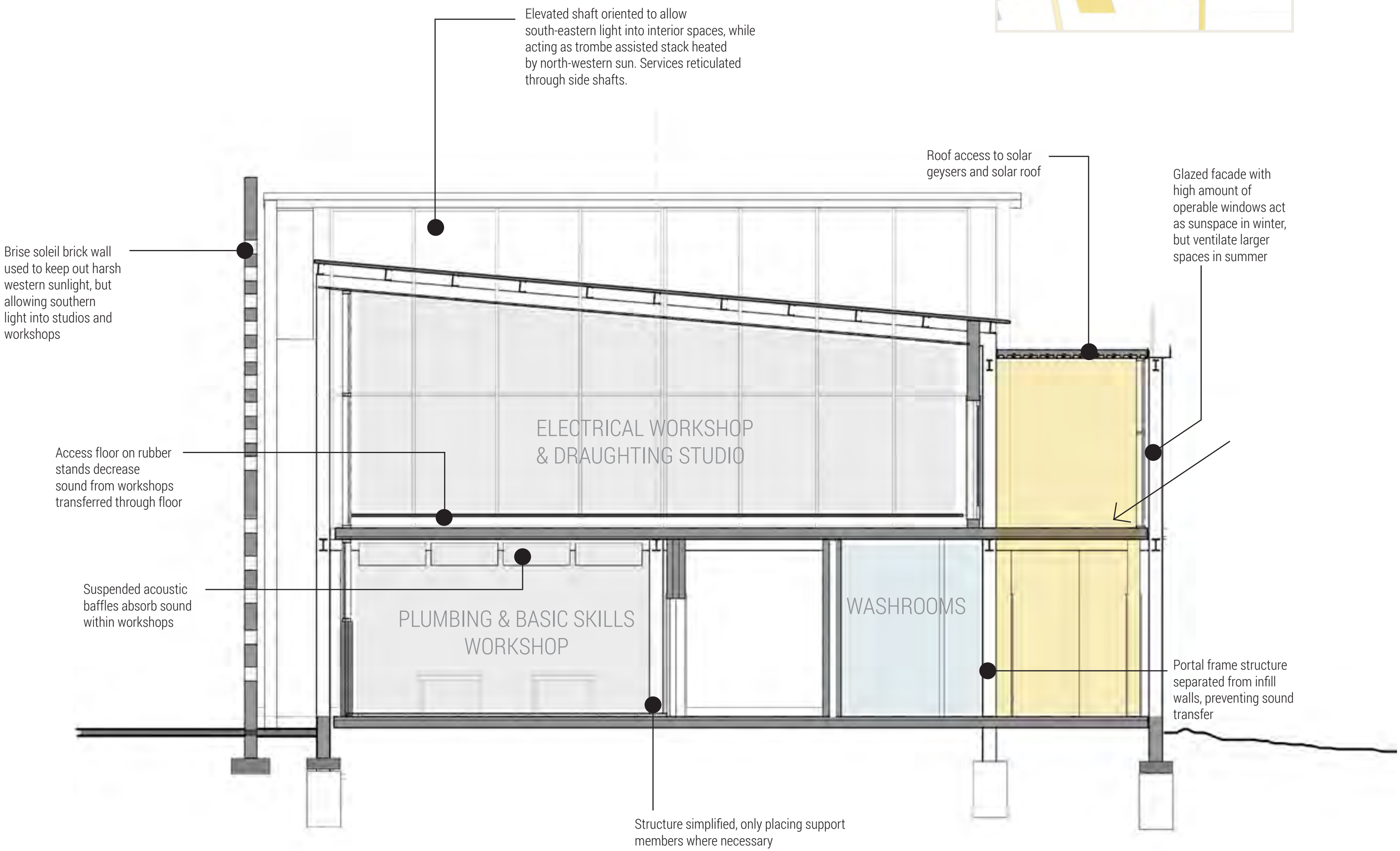


Fig. 7.36. Section iteration 3 with

Chapter VIII

TECHNICAL DEVELOPMENT

INTRODUCTION

The purpose of the following chapter is not the documentation of a set of construction drawings, but rather a discussion of the approach and resolution of the tectonic intentions of the architecture. The exploration of the concept continues in informing decisions of detailed construction, technology, materiality and services of the design.

8.1. TECHNICAL CONCEPT & INTENTIONS

Tectonic expression is centred around the relationship between building, man and nature. This relationship is explored in a variety of combinations of the materials and technology to create the optimum conditions required for different situations.

The skin of the building becomes the element that allows this relationship to be adapted and changed as necessary. Transformation of the skin as a process allows the building to become the catalyst of change from the existing industrial typology to a more integrated and responsive building typology.

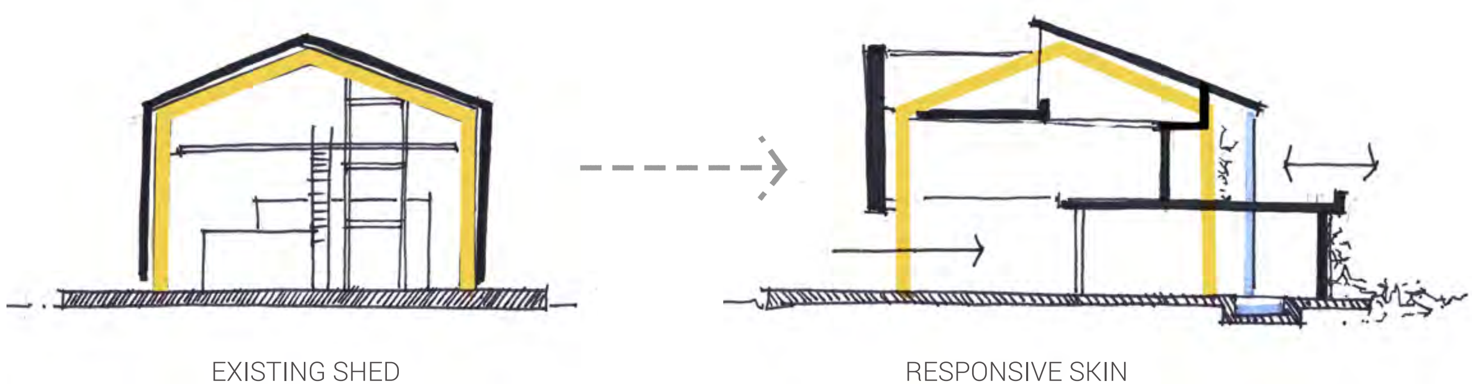
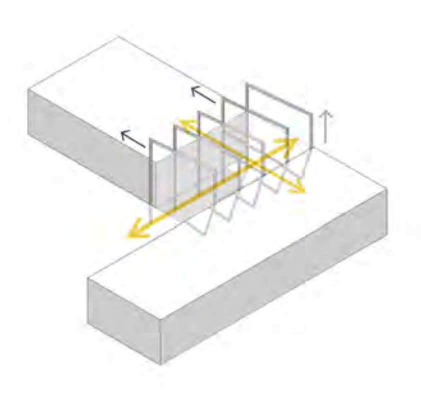


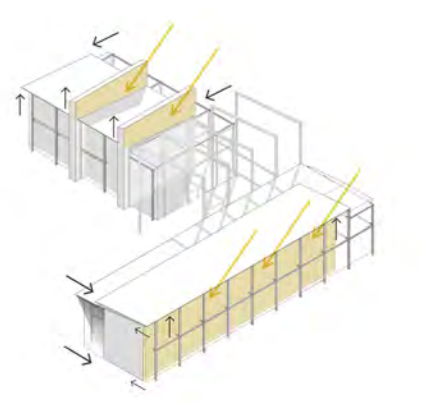
Fig. 8.1. Intention of the tecnical concept (Author, 2017).

REVEAL



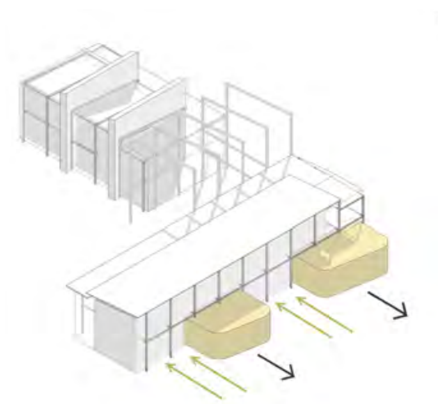
Pulling away the 'skin' reveals the bare structure and services as the 'insides' of the building. As a point of entry to the two wings and a throughfare from the public square to the building yard, it becomes the first space in the didactic experience.

LIFT & RETREAT



The roof is instrumental in controlling natural light and glare in the interior spaces, allowing more even light on the south-eastern facades and creating larger overhangs on the north-western facade. Light chimneys allow light into the less ideally oriented wing.

EXTEND & INTEGRATE



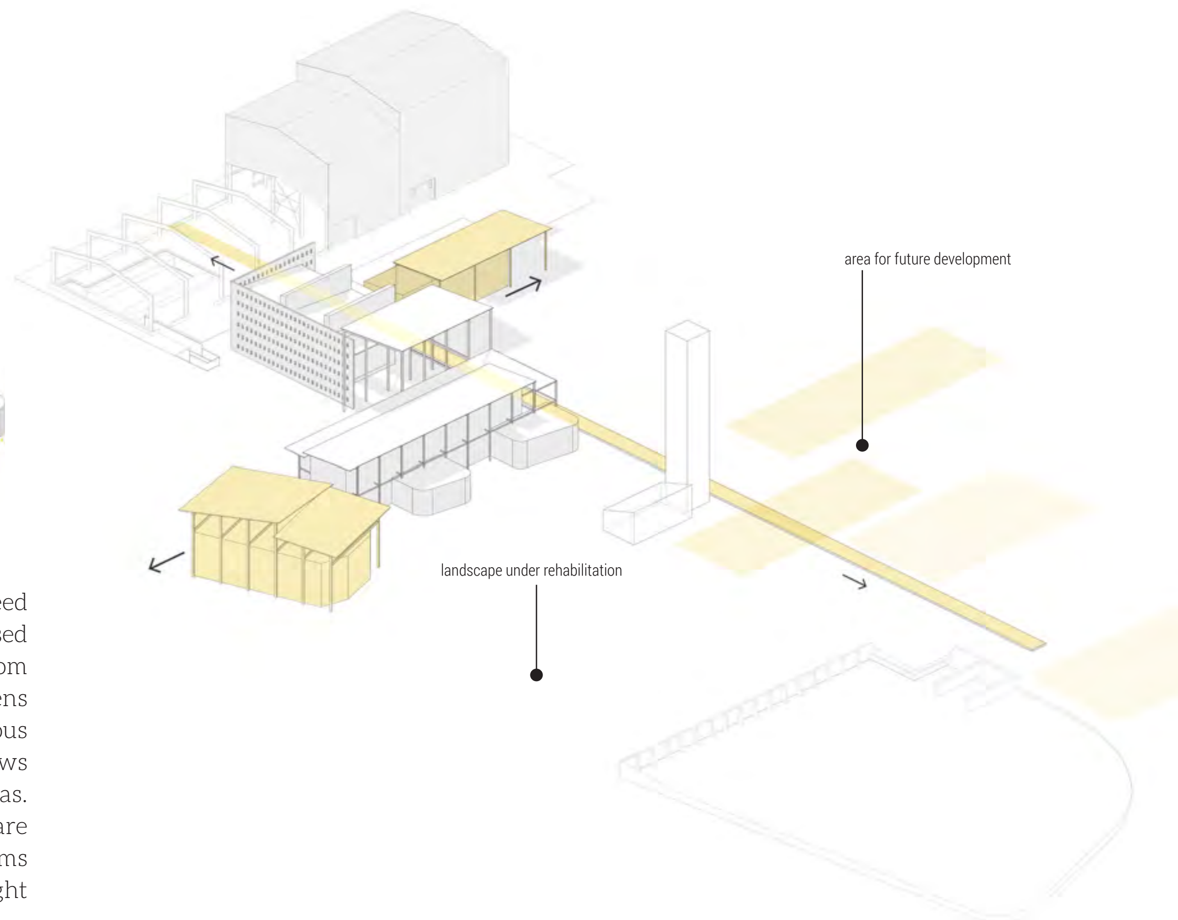
Towards the landscape threshold the skin acts as the integrating element, extending the building out towards the landscape and pulling the natural environment into niches created.

Fig. 8.2. - 8.6. above and opposite page: Series of diagrams indication the process of transformation of the skin (Author, 2017).

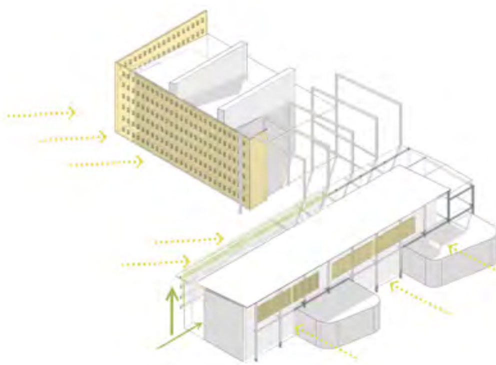
LINK & EXPAND

Connection with the existing industrial fabric and the rehabilitated landscape is established along a clear axis, from which services can be fed into buildings and the larger narrative can be read and experienced.

Expansion of the building occurs in response to the two wings created and further future expansion could link to the axis, sharing in and contributing to services and systems.



PROTECT & CONTROL



A 'double skin' is added to areas in need of specific protection. All facades exposed to western sunlight are protected from the hot low angle sun through screens that still allow natural light. A decidious planted screen on the north-west allows winter sun to heat up circulation areas. Vertical louvres that can be changed are added to south-east facing classrooms for maximum control of interior light conditions.

8.2. STRUCTURE

8.2.1. PRIMARY STRUCTURE

Steel portal frame construction are often used in industrial, storage, retail and commercial architecture, due to its effectiveness in enclosing large volumes with the least amount of material for the structural requirements. The strength of the system lies in the support of the haunches to enable a continuous frame of one steel section to support the loads of a usually uniformly clad envelope of corrugated metal roofing and siding that covers the structure (Ching 2008:6.07).

Due to uncertainty of the structural integrity of reclaimed bricks, a primary structure supporting the loads of floors and roofs independent of the brick walls is necessary. The portal frame structure is therefore used for its ability to support an 'overall skin' and accommodate independent spaces and elements on the inside. The primary structure supports the floors, roof and selected external skin elements (tertiary structure) and allow the construction of a building that can easily be added to, taken away from or altered over time.

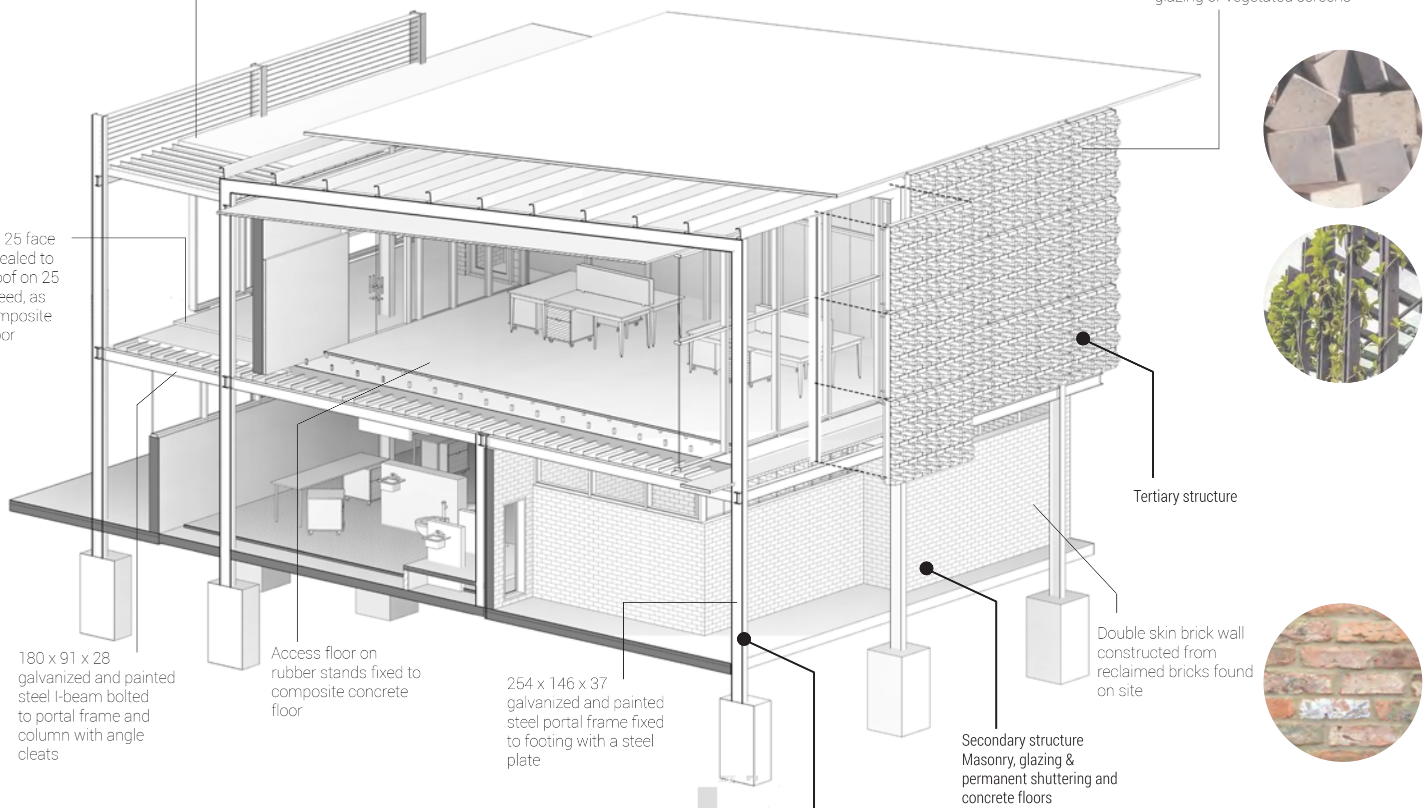
8.2.2. SECONDARY STRUCTURE

A variety of brick walls, glazing and composite planted walls comprise the secondary structure. Special attention is given to the expression of the separate secondary structure that can either be fixed to the primary structure or be completely independent of it. The insertion of strip windows visually separates brick walls from the composite concrete floor, but also provides natural light ventilation to spaces.

8.2.3. TERTIARY STRUCTURE

A responsive skin including elements such as louvres, screens and services can be attached to the primary structure where necessary. These structures are critical in façade treatment for light and thermal control and are either able to be manipulated by the user, deciduous planted elements or panels that can be removed or replaced.

Fig. 8.7. opposite page: Diagram indicating primary, secondary and tertiary structure and materials (Author, 2017).


Composite concrete floor cast in-situ on galvanized steel permanent shuttering sheets fixed perpendicular to I-beams to optimize structural properties.
1530 x 2250 panel constructed from steel z-section frame fixed to channel supported by portal frame. Frame holds 265 x 70 x 75 fire bricks fixed together with structural silicone, but could also be filled with glazing or vegetated screens
230 x 110 x 25 face brick tiles, sealed to be waterproof on 25 cement screed, as finish to composite concrete floor
Tertiary structure
Double skin brick wall constructed from reclaimed bricks found on site
180 x 91 x 28 galvanized and painted steel I-beam bolted to portal frame and column with angle cleats
Access floor on rubber stands fixed to composite concrete floor
254 x 146 x 37 galvanized and painted steel portal frame fixed to footing with a steel plate
Secondary structure
Masonry, glazing & permanent shuttering and concrete floors
Primary structure
Steel portal frame

8.3. MATERIALITY

8.3.1. MATERIAL CHOICE

Material choices are based on both the availability of materials on site and the expression of the concept and intentions of the architecture. Bricks from the demolished fire brick plant are used as the key representation of the narrative, visually reminding the user of the history of the site, but also inspiring students and visitors alike to continue innovation of its application.

Steel is chosen for the primary structure, because of the availability within the area. It represents the core of the structure, hinting at the steel industry on which the Vaal Triangle's economy was built. Roof materials include corrugated steel roof sheeting and composite concrete slabs.

Materials used in interior and 'room specific' applications are chosen for their distinct thermal, acoustic and surface properties and performance.

8.3.2. FIREBRICKS VS REGULAR BRICKS

A large percentage of the reclaimed bricks used from the site are firebricks, which are different from regular bricks in size, colour and composition. These differences in properties are important to consider in the application of the bricks. According to the Columbia Encyclopedia (2016), the composition of firebrick is much more dense than regular clay bricks. Two different fire bricks can be distinguished: dense, heavy bricks with low porosity or highly porous bricks.

The thermal conductivity of firebrick is much lower than regular brick, making it more energy efficient with a higher insulating value. It is due to the ferric oxide, ceramic and other chemical additives that absorb high temperatures, that firebricks can withstand high temperatures. Firebricks are naturally white, but can be tinted during manufacturing (Burns n.d.).

The application of firebricks on facades exposed to western sun are thus more effective than regular bricks, as the thermal massing does not need to be so thick to absorb heat gained in the afternoon. However, in areas where thermal massing strategies are applied for the storage of heat to be released later, regular bricks would be more efficient.

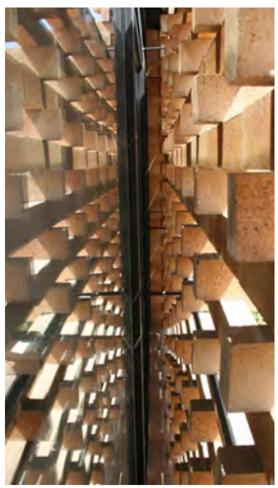
Fig. 8.8. top: Red facing bricks and hollow-core bricks of various sizes found in demolition rubble on site (Author, 2017).
Fig. 8.9. middle: 200 x 250 x 65 mm white firebricks found on site (Author, 2017).
Fig. 8.10. bottom: 220 x 110 x 75 mm porous firebricks found on site (Author, 2017).

8.4. TECHNICAL DESIGN PRECEDENT

BRICK PATTERN HOUSE

Alireza Mashhadimirza
Tehran, Iran
2011

Inspired by traditional architecture, the architect created a 'tri-dimensional' wall designed to moderate glare and sunlight as a low-budget solution to a building that needs energy-saving walls, good acoustic performance, earthquake resistance, fire safety and efficient services. Constructed with limited and primitive construction equipment by local labour with no knowledge of construction methods, a system of precast sized and drilled bricks were devised to 'weave' the brick skin with steel rods (Mashadimirza, 2012).



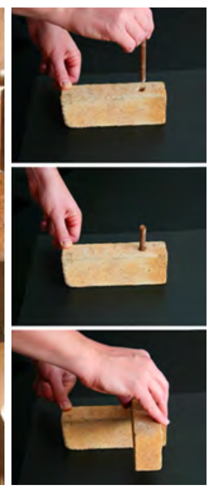


Fig. 8.11. above left: Facade view of the brick pattern house (Mashadimirza, 2012).
Fig, 8.12. above middle: View inside the brick screen (Mashadimirza, 2012).
Fig. 8.13. above right: Construction method (Mashadimirza, 2012).

EXPERIMENTAL BRICK PAVILION

Estudio Botteri-Connell
City Bell, Buenos Aires Province, Argentina
2016

Self-supporting brick brise-soleil panels are created through dry construction, using pins and a steel frame to make up the facade of the pavilion. The lightweight experience of the brick skin is emphasized even further by the mobility of the panels along the façade, for maximum light and privacy control (Botteri-Connell Studio 2016).

Fig. 8.14. right top: Elevation of the pavilion (Botteri-Connell Studio 2016).
Fig, 8.15. Experimenting with the mobility of the screen on a steel frame (Botteri-Connell Studio, 2016).
Fig. 8.16. far right: Construction method of the brick screen (Botteri-Connell tudio 2016).

RESPONSE

A three-dimensional brick screen could be highly effective in protecting interior spaces from glare. Supporting brick with a steel frame is necessary, due to the lack of structural integrity of the brick, however, if fire bricks are used in the construction of the screen, it would be better to fix them with structural silicone.

8.5. ENVIRONMENTAL CONSIDERATIONS

8.5.1. COOLING & VENTILATION

Earth tubes or underground heat exchangers are used to ameliorate the temperature of the air supplied to the usable interior spaces. The system extracts and filters outside air, and drives it through underground tubes that allow air to assume the constant temperature of the soil, after which it is supplied to lecture rooms, offices and studios in regular air change intervals. Hot air is extracted through passive-assisted stack effect created at the highest point of interior ceilings. Natural ventilation is used in summer months for ground floor workshops and all circulation spaces, with air cooled minimally through vegetated screens.

8.5.2. HEATING

Heat is supplied to interior spaces in the early mornings in cold seasons, through dedicated radiators integrated within the interior walls, circulating liquid heated mechanically. North and north-west facing corridors act as sunspaces in colder months, transferring heat to adjacent lecture rooms and studio/workshop spaces. Workshops on ground floor are heated in the afternoons by radiators circulating liquid heated in solar collectors throughout the morning.

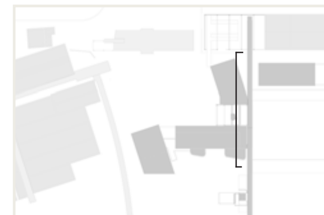
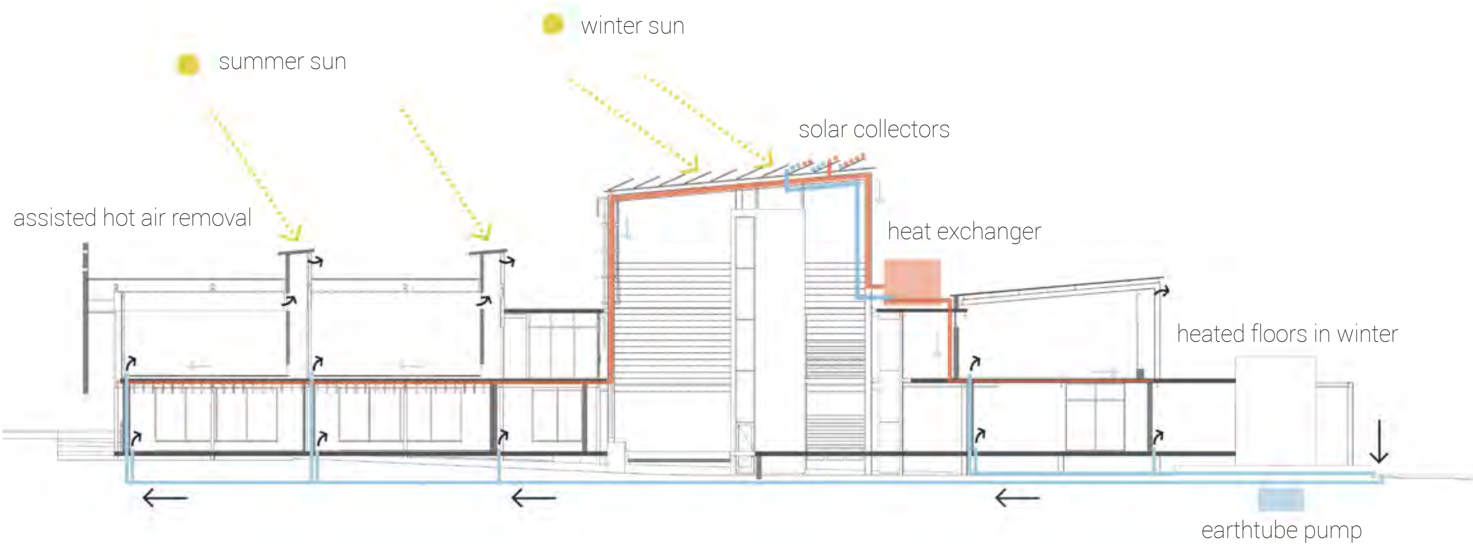


Fig. 8.17. above: Keyplan indicating diagrammatic section (Author, 2017).

Fig. 8.18. below: Diagram indicating thermal amelioration within the building through earthtubes and trombe-assisted stacks, as well as heating of interior spaces through radiator tubes within floors (Author, 2017).

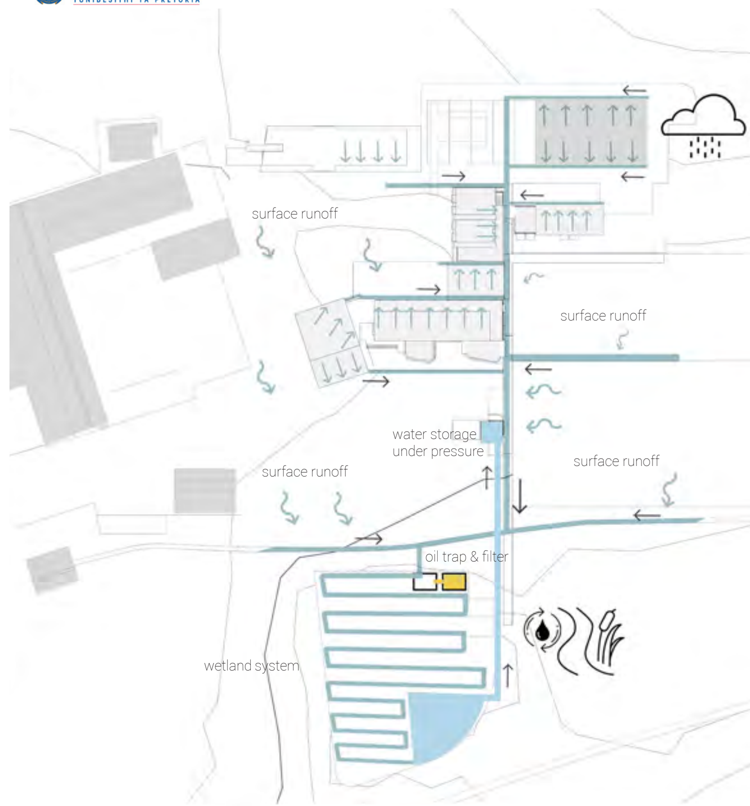


8.5.3. RAINWATER HARVESTING & WATER RECYCLING

Water harvesting, runoff filtering and treatment of grey water integrate both existing and new built elements. Rainwater harvested from all of the roof areas are transported together with water-runoff from hard surfaces in channels towards the wetland on the lowest point of the site.

The wetland is constructed within an existing depression created through previous clay extraction on site and filters all the rainwater, runoff and grey water from the surrounding buildings. Due to the industrial context of the site, all the water needs to be filtered from pollutants to be used for WC flushing, cooling and irrigation.

Landscape design considers the prevention of runoff from reaching areas of high erosion vulnerability through efficient storm water management.



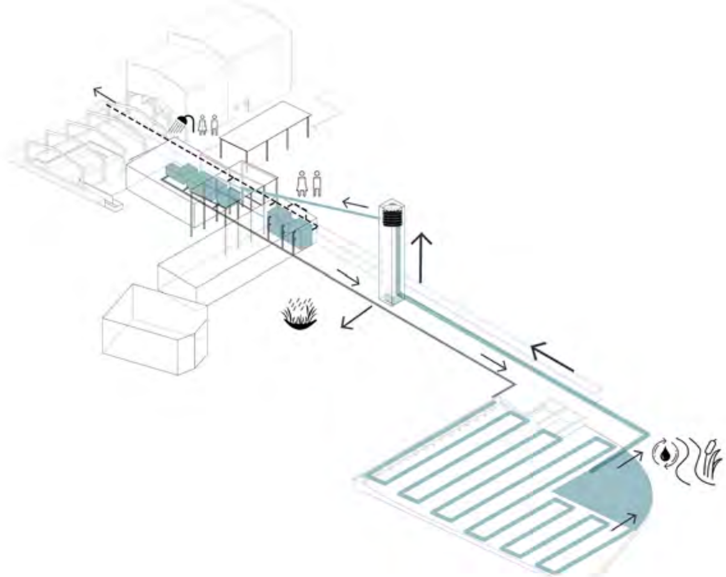


Fig. 8.19. top: Diagrammatic plan indicating rainwater-harvesting and filtering of runoff through a new wetland constructed (Author, 2017).

Fig. 8.20. bottom: Diagram indicating water provision and recycling of grey-water along the services 'axis' (Author, 2017).

8.5.4. OPTIMAL NATURAL LIGHT

NATURAL LIGHT ITERATION THROUGH SEFAIRA SOFTWARE

The workshops and studio spaces located in the northern wing of the building, are not ideally oriented with the longer facade facing north-east. The aim of iteration is to ensure as much natural light in both spaces, while retaining the geometric integrity of the design.

Sefeira ™ software is used to determine the differences between iterations, aiming to improve the amount and quality of natural daylight, whilst illuminating glare factors.

The amount of natural light entering the space is evaluated based on the Spatial Daylight Autonomy (sDA) figure given. This indicates the percentage of area which received efficient amount of daylight to conform to the required lux levels (400 lux for drawing studios and offices).

Glare percentage is tested through a direct sunlight simulation and annual sun exposure (ASE) figures are used for the quantifiable analysis. Iterations are compared on the fixed settings of the percentage of rooms receiving direct sunlight throughout the year from 08:00 to 18:00 (with a minimum of 1 hour glare).

Orientation and integration of the light shafts together with a screen or solid facade as in iteration 4 (see table 8.5) proves to ensure the best performance in natural daylight with the least amount of glare.

Fig. 8.21. below left: Key plan indicating area of the design iterated (Author, 2017).

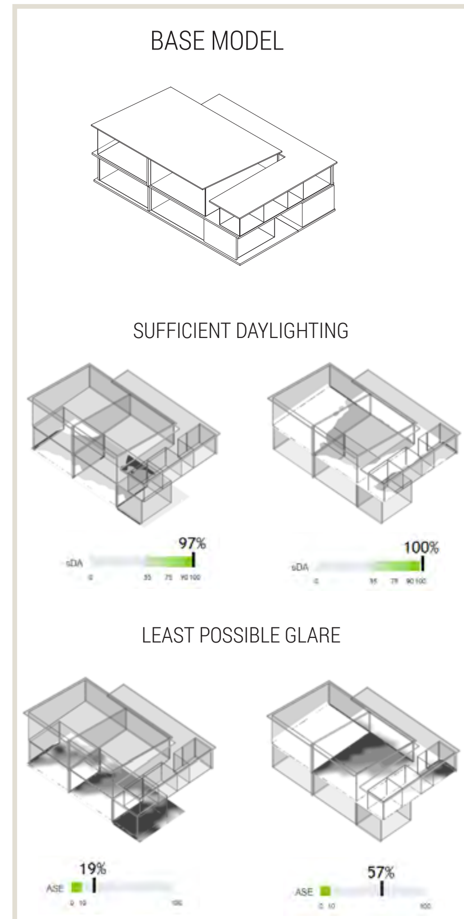
Table 8.1. Graphic simulation of daylighting and glare of the base model (Sefaira, 2017).

Table 8.2. opposite page: Graphic simulation of daylighting and glare of iteration 1 (Sefaira, 2017).

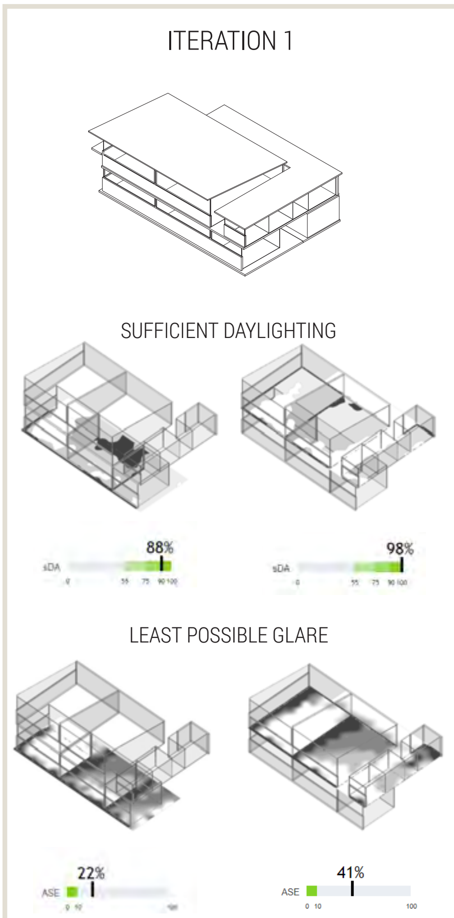
Table 8.3. opposite page: Graphic simulation of daylighting and glare of iteration 2 (Sefaira, 2017).

Table 8.4. opposite page: Graphic simulation of daylighting and glare of iteration 3 (Sefaira, 2017).

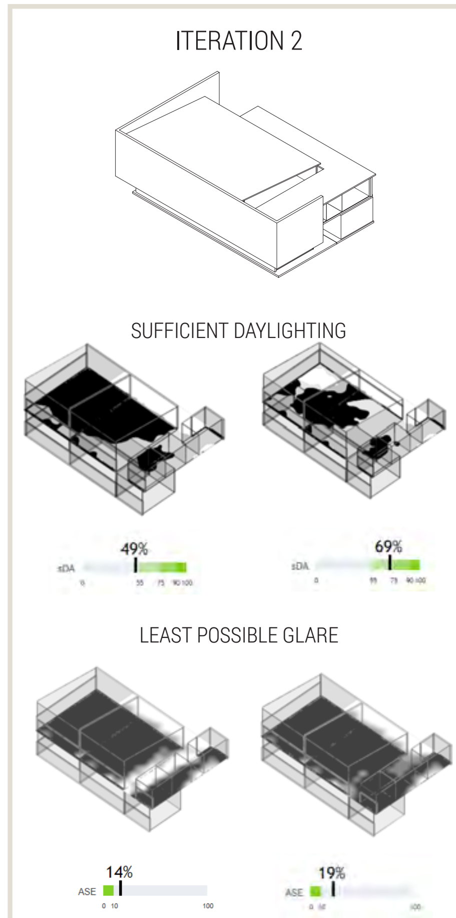
Table 8.5. opposite page: Graphic simulation of daylighting and glare of iteration 4 (Sefaira, 2017).



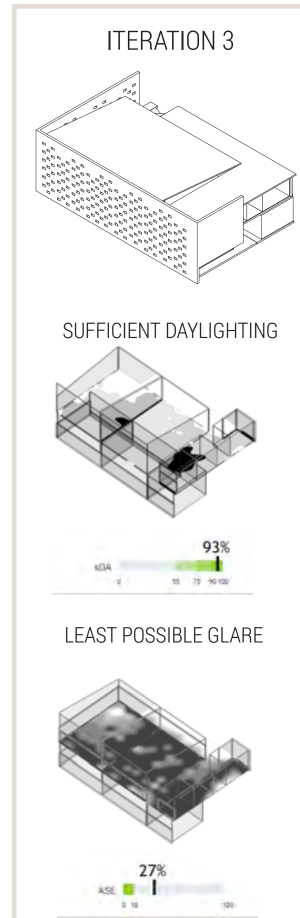
8.1.


ITERATION 1
SUFFICIENT DAYLIGHTING
88%
sDA
98%
sDA
LEAST POSSIBLE GLARE
22%
ASE
41%
ASE

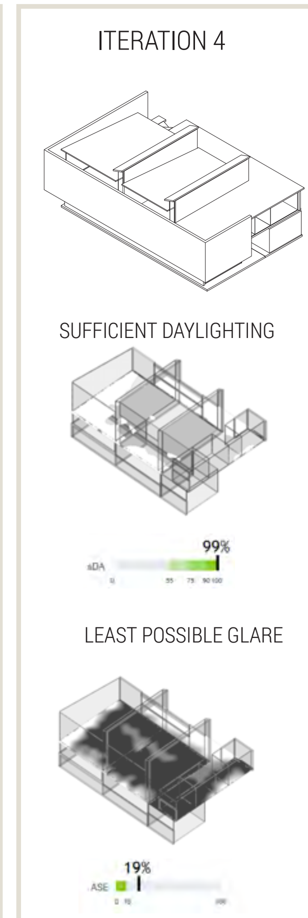
8.2.


ITERATION 2
SUFFICIENT DAYLIGHTING
49%
sDA
69%
sDA
LEAST POSSIBLE GLARE
14%
ASE
19%
ASE

8.3.


ITERATION 3
SUFFICIENT DAYLIGHTING
93%
sDA
LEAST POSSIBLE GLARE
27%
ASE

8.4.


ITERATION 4
SUFFICIENT DAYLIGHTING
99%
sDA
LEAST POSSIBLE GLARE
19%
ASE

8.5.

The final iteration of the northern wing is based on a rotation of 18˚ north-west to decrease the amount of western sun experienced on the long south-western façade. This decision allows for the success of a 3-dimensional brick screen to completely block direct sunlight in the afternoons, whilst allowing efficient natural light to interior spaces.

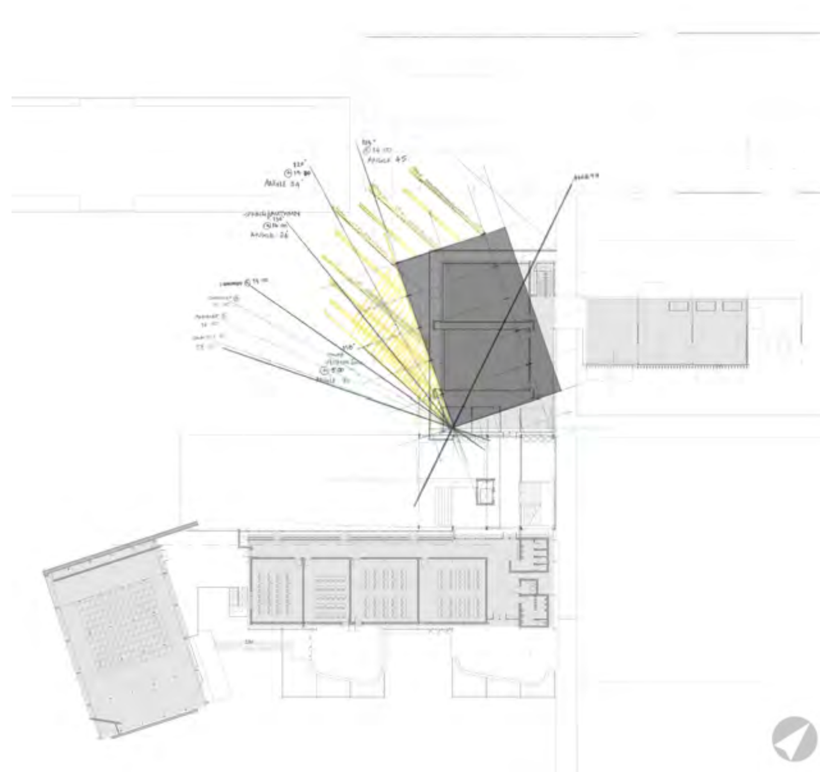
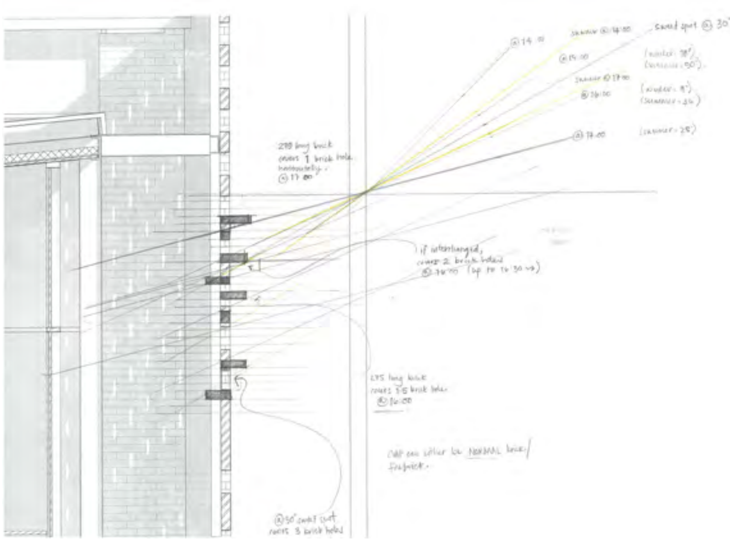


Fig. 8.22. right: Plan of the final iteration of the northern wing rotated for less exposure to western sunlight (Author, 2017).

Fig. 8.23. below: Iteration of the section to ensure the brick skin blocks all direct sunlight, but allows daylight into glazed studio and workshop spaces (Author, 2017).



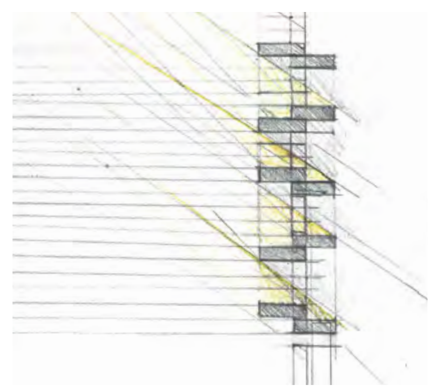


Fig. 8.24. Plan view of fire brick screen pattern arranged to block western sunlight at afternoon hours (Author, 2017).

8.5.5. BUILDING SUSTAINABILITY ASSESSMENT TOOL REPORT

		Achieved
SB	**SBAT REPORT**	**2,8**

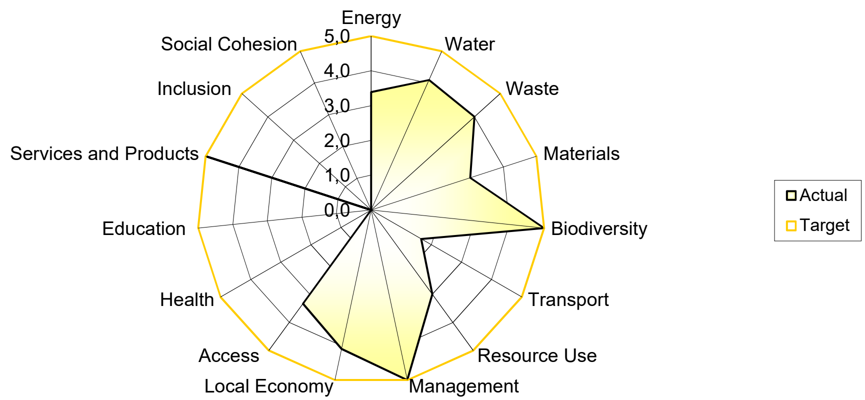
SB1 Project

Rebuild: School for the Built Environment

SB2 Address

Barrage Road, Vereeniging

SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	3,9
Economic	3,4
Social	1,0
SBAT Rating	2,8

SB5 EF and HDI Factors	Score
EF Factor	3,6
HDI Factor	1,0

SB6 Targets	Percentage
Environmental	78
Economic	68
Social	20

Table 8.6. Report of the project generated by the Sustainable Building Assessment Tool (Gibberd, 2017).

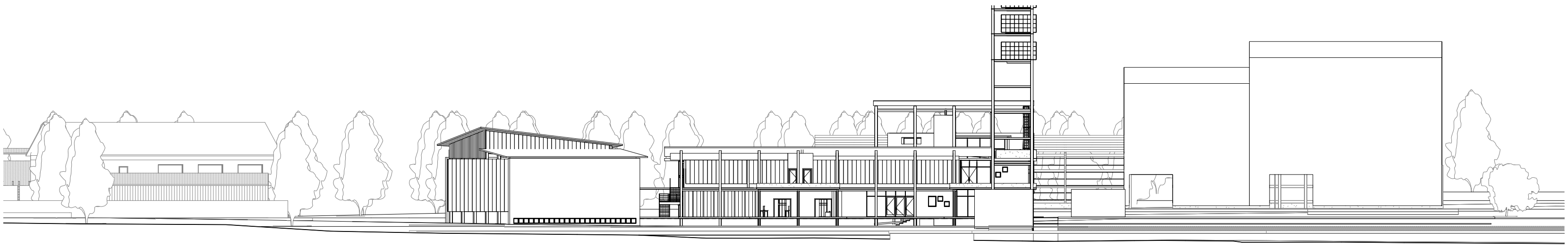


Fig. 8.25. South-eastern elevation (Author, 2017).

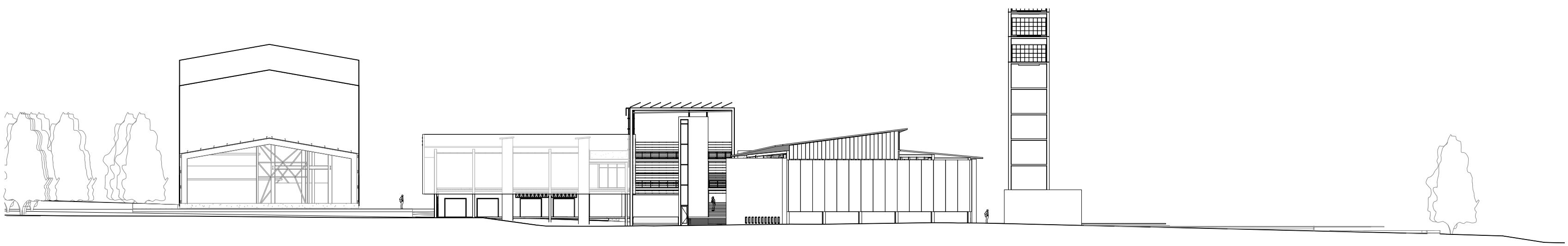


Fig. 8.26. South-western elevation (Author, 2017).

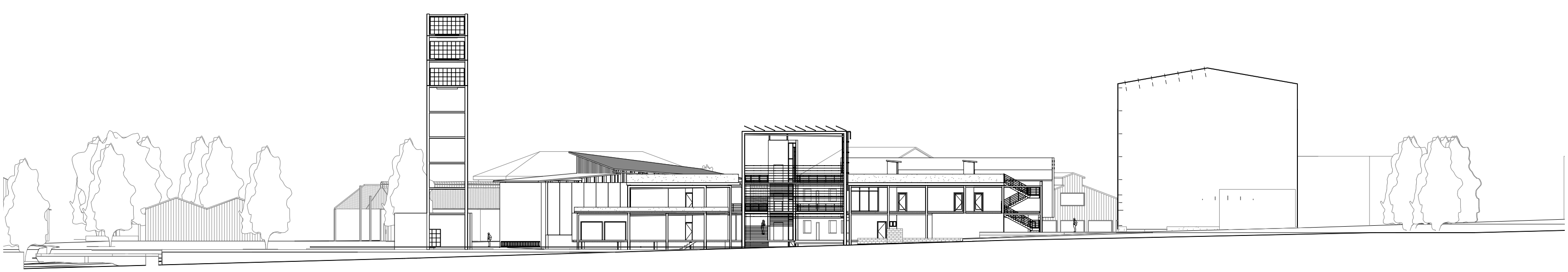


Fig. 8.27. North-eastern elevation (Author, 2017).

Fig. 8.28. Site plan (Author, 2017).

Fig. 8.29. Ground floor plan (Author, 2017).

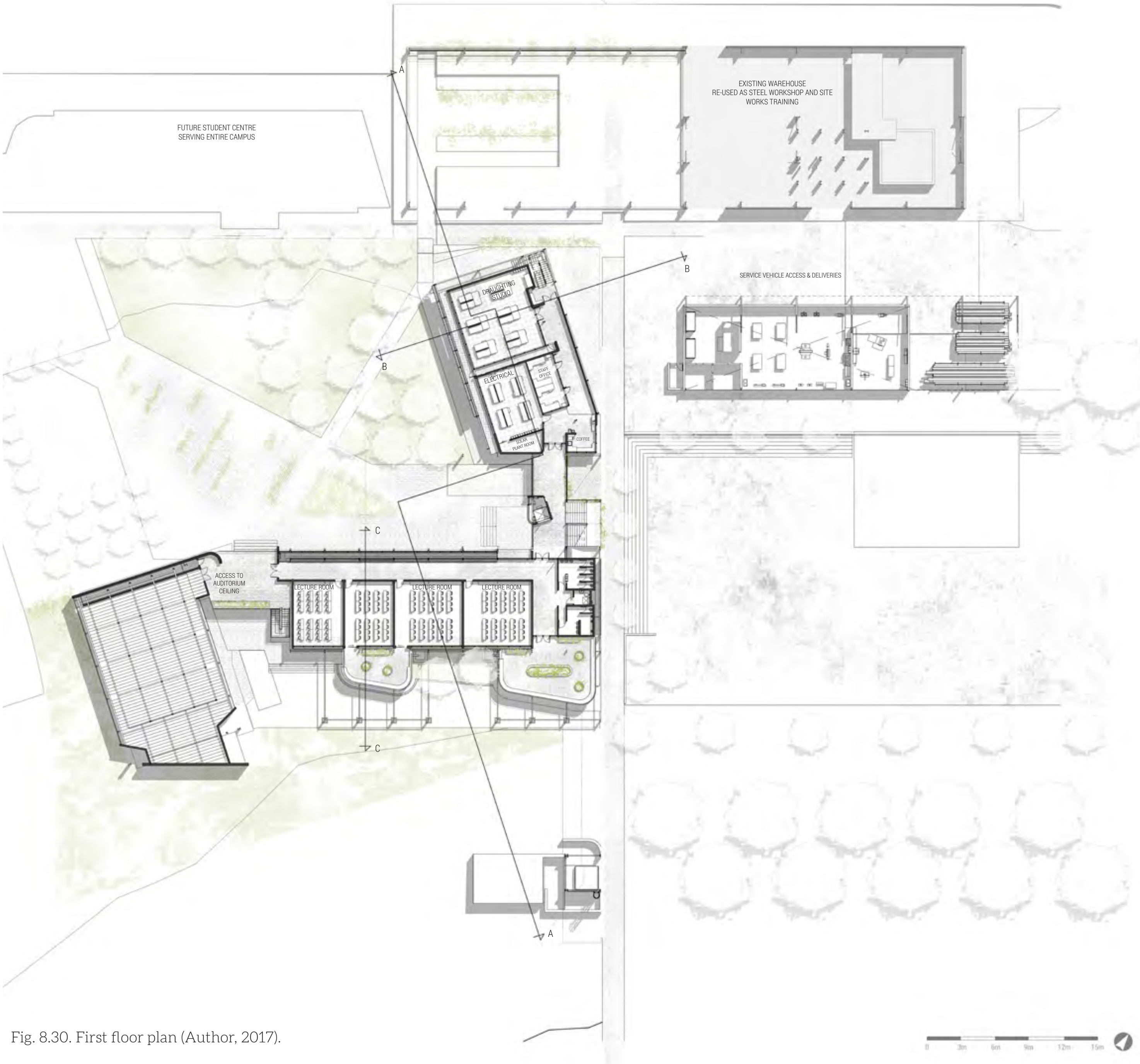


Fig. 8.30. First floor plan (Author, 2017).

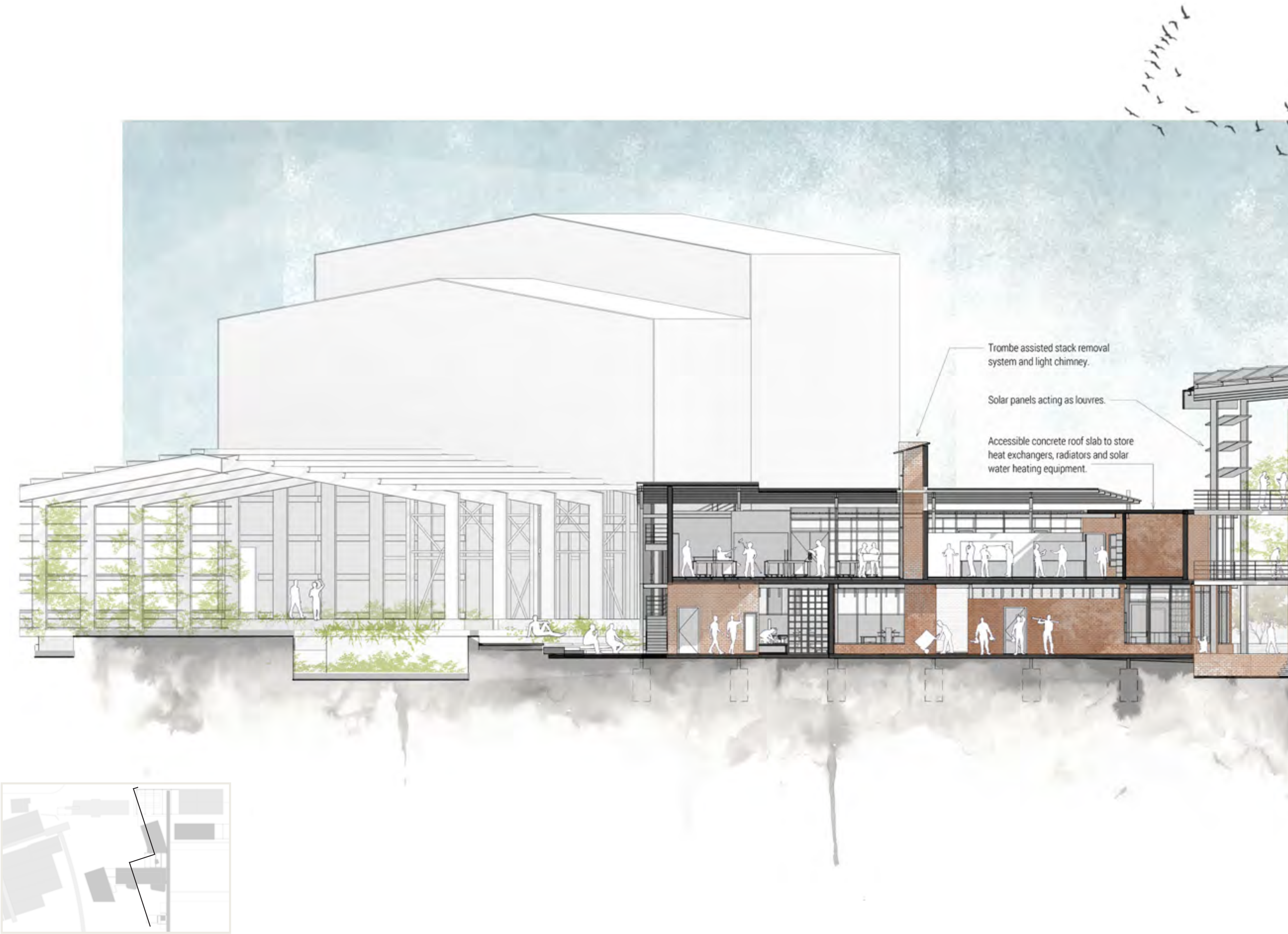
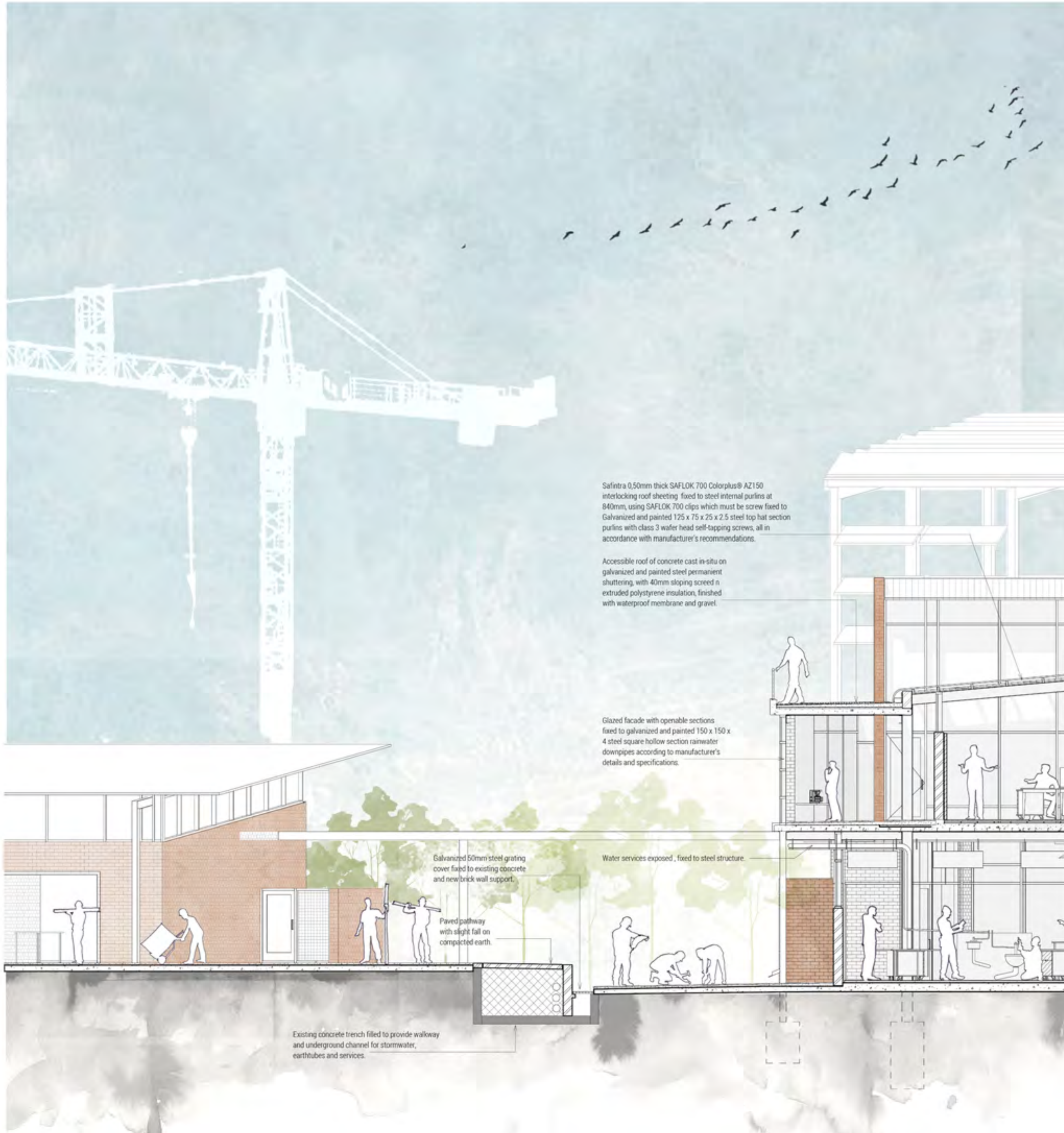


Fig. 8.31. Section AA (Author, 2017).


Solar panels and tube solar collecors fixed to galvanized Safintra SAFLOK 700 roof to manufacturer's specifications and details.



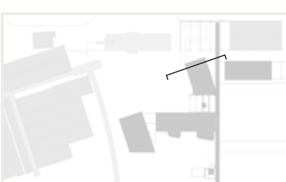
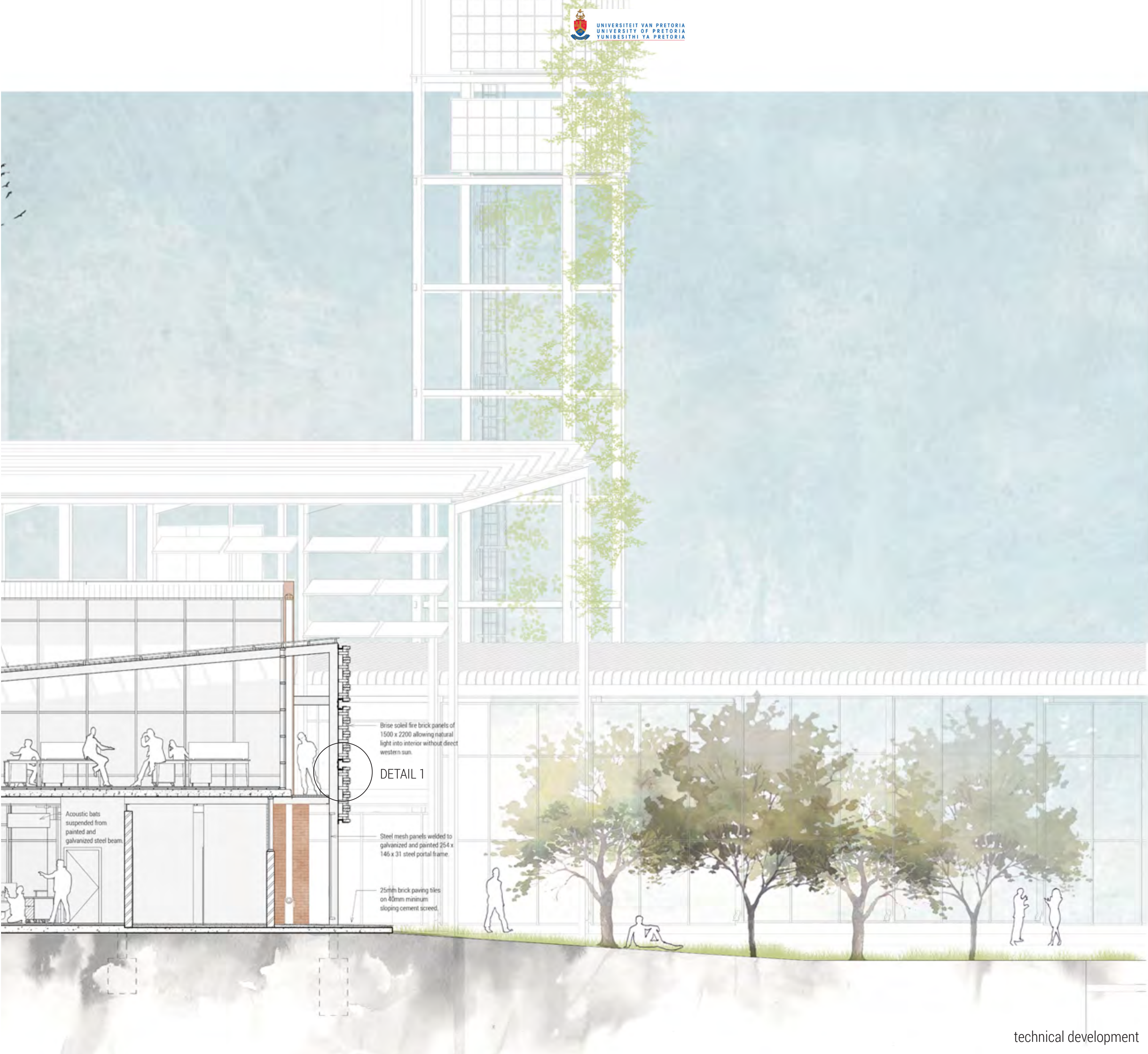


Fig. 8.32. Section BB (Author, 2017).


Brise soleil fire brick panels of 1500 x 2200 allowing natural light into interior without direct western sun.
DETAIL 1
Acoustic bats suspended from painted and galvanized steel beam.
Steel mesh panels welded to galvanized and painted 254 x 146 x 31 steel portal frame.
25mm brick paving tiles on 40mm mininum sloping cement screed.

8.6.1. DESIGN & CONSTRUCTION PROCESS

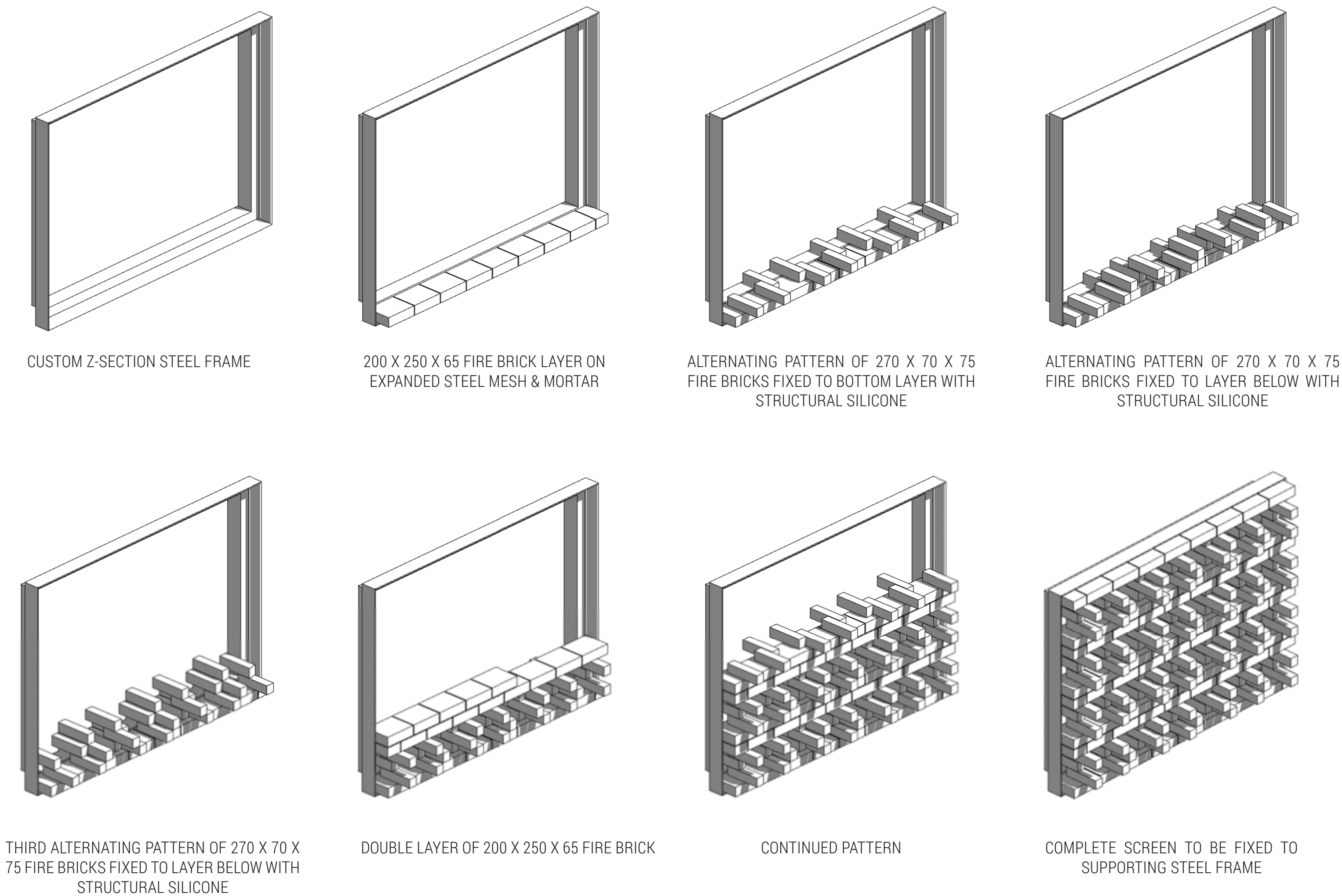


Fig. 8.33. Series of diagrams explaining construction process of the brick brise soleil screen (Author, 2017).

8.6.2. DETAIL 1 | BRICK SCREEN PANEL

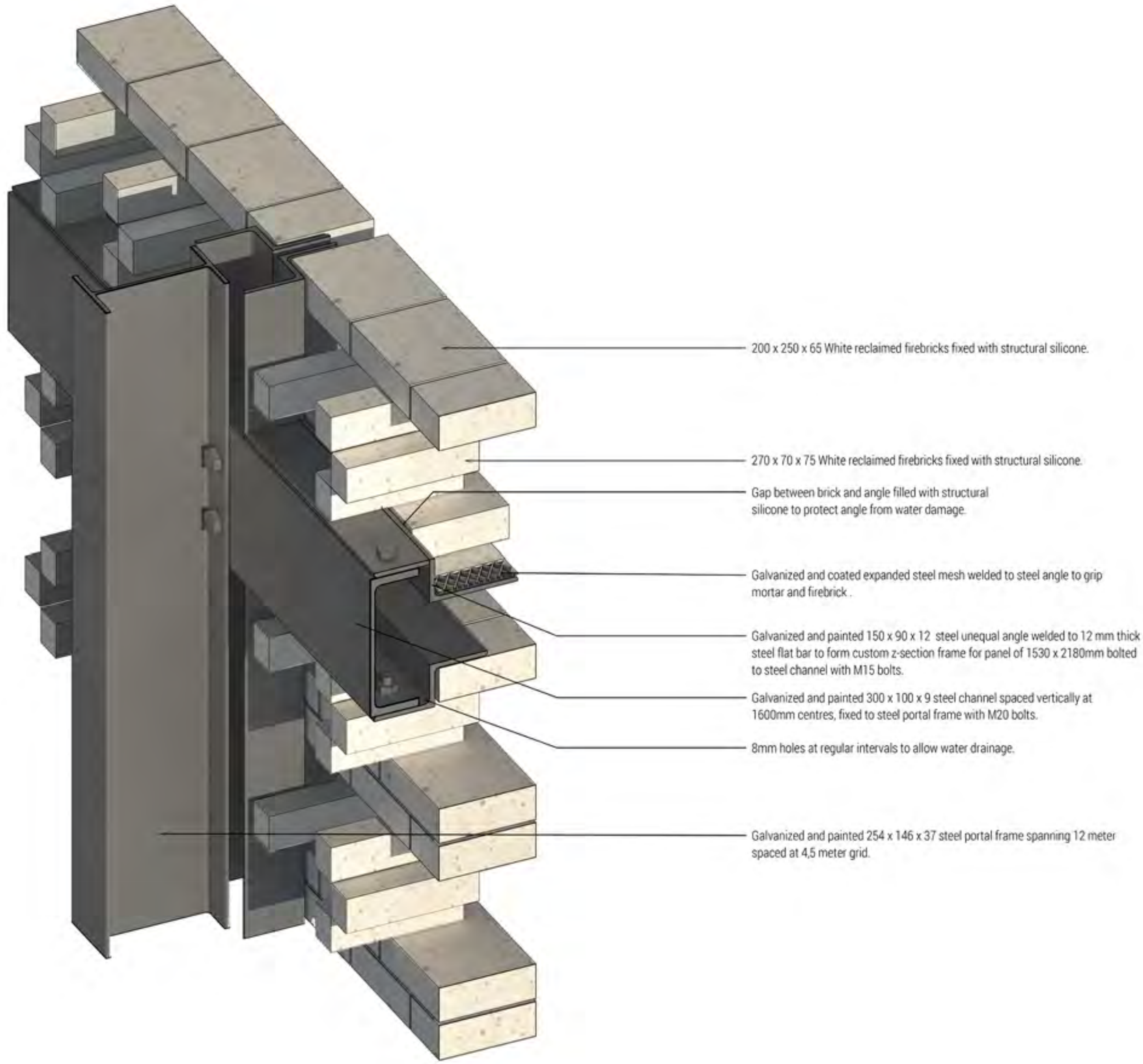


Fig. 8.34. Three-dimensional detail of fire brick screen panel construction (Author, 2017).

8.6.3. DETAILED SECTION SHOWING CONSTRUCTION & FINISHES

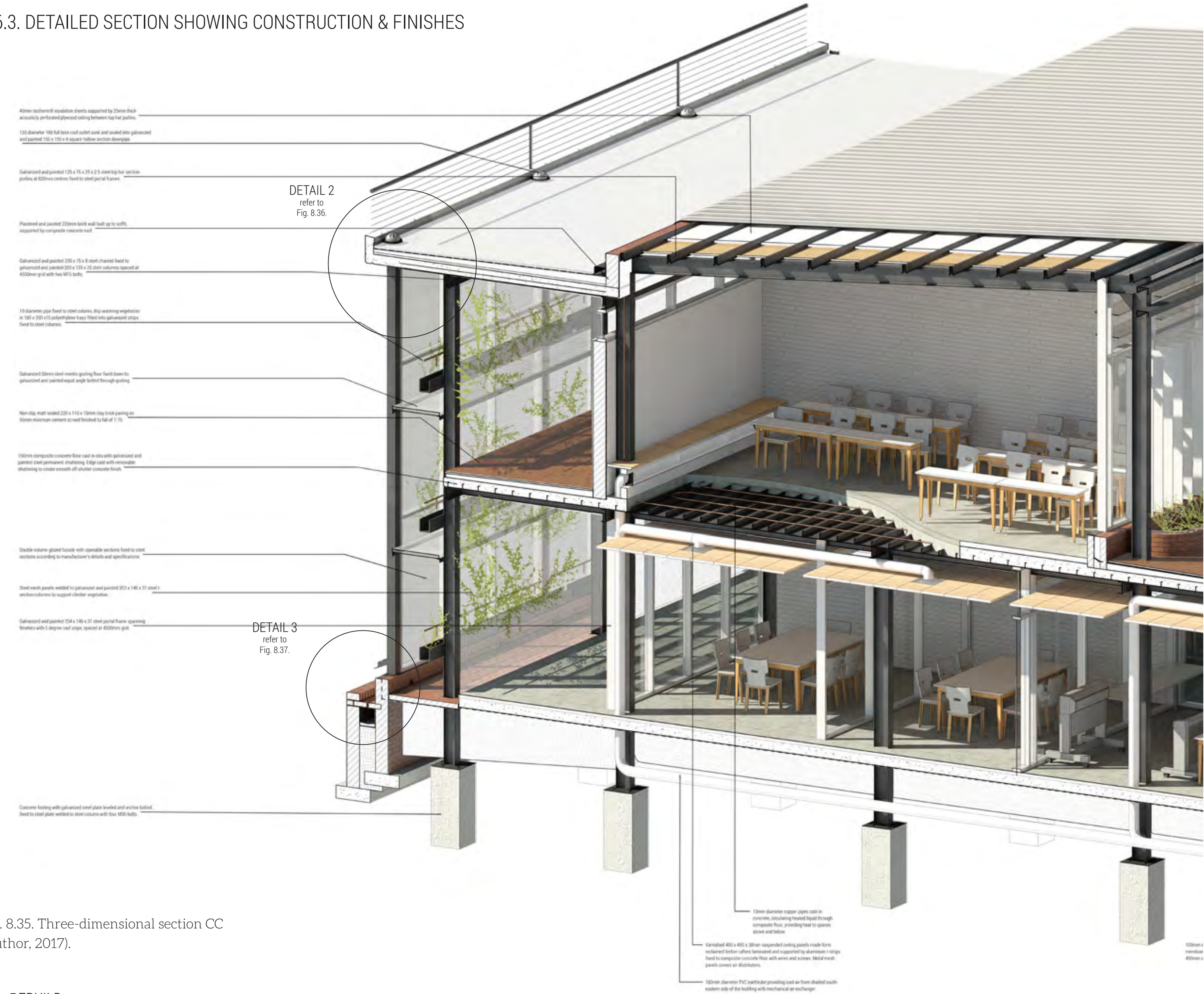


Fig. 8.35. Three-dimensional section CC (Author, 2017).


Safintra 0,50mm thick SAFLOK 700 Colorplus® AZ150 interlocking roof sheeting, fixed to steel internal purlins at 813mm, using SAFLOK 700 clips which must be screw fixed to steel purlins with class 3 wafer head self-tapping screws, all in accordance with manufacturer's recommendations.
Standard vertical louvre system as per supplier installed and fixed to steel portal frame structure.
Galvanized and painted 203 x 133 x 25 steel bolted to steel channel with angle cleats.
Galvanized and painted 254 steel channel bolted to endplate welded to galvanized and painted 254 x 146 x 37 steel i-section column.
Existing concrete slab cut to serve as walkway for new building.
Brick paving fills hole cut into slab t cast concrete footing.
New brick wall.
DETAIL 4
refer to
Fig. 8.38.
100mm concrete floor on 0.25 polyolefin membrane laid on layers of maximum 450mm compacted fill.
0.375 polyolefin damp proof course on concrete cast in situ to fill cavity.

8.6.4. DETAIL 2 | ROOF EDGE & RAINWATER DOWNPIPE

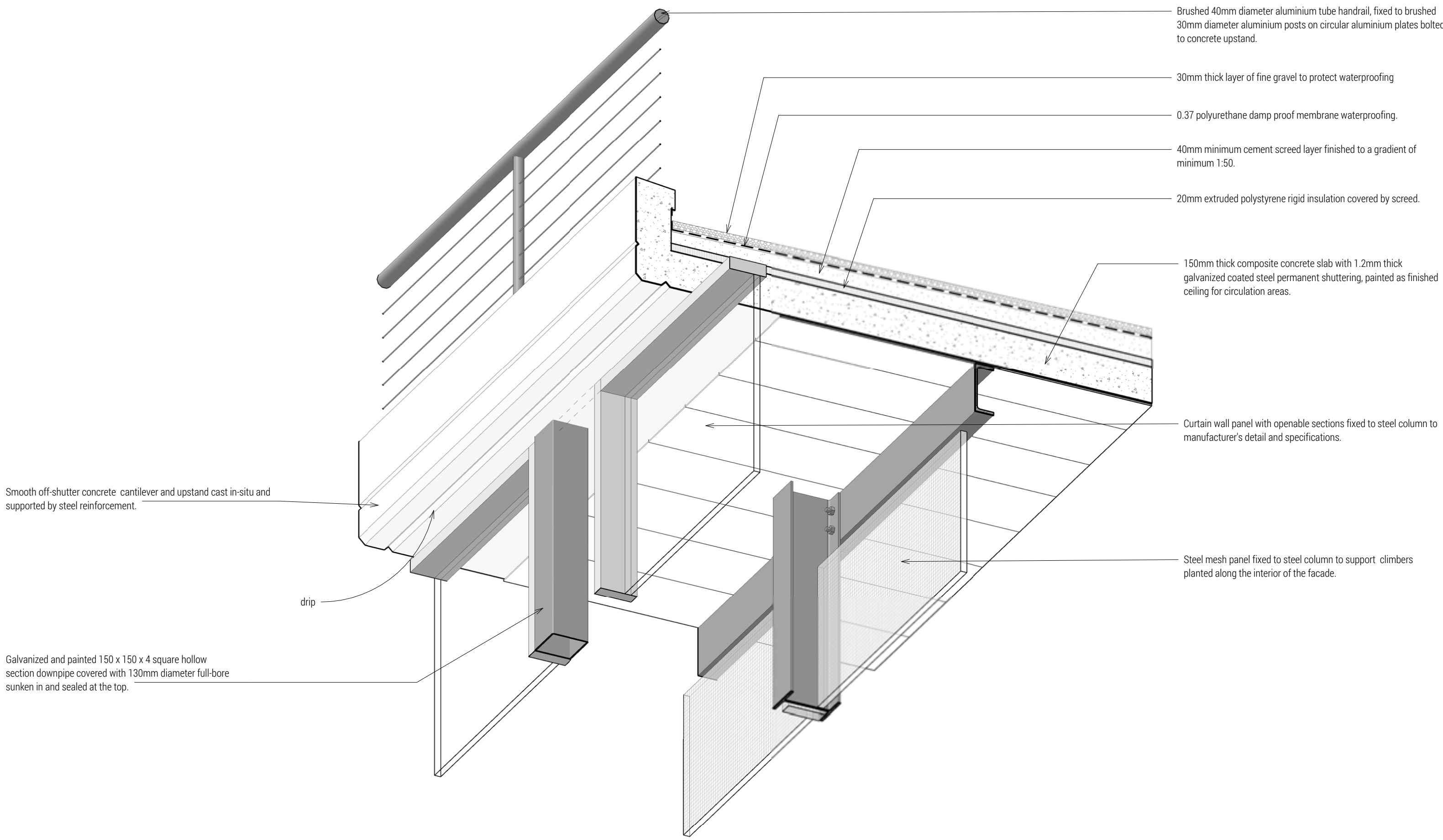


Fig. 8.36. Three-dimensional detail drawing of roof-edge with rainwater downpipe and glazed facade (Author, 2017).

8.6.5. DETAIL 3 | RAINWATER DOWNPIPE AND WATER CHANNEL

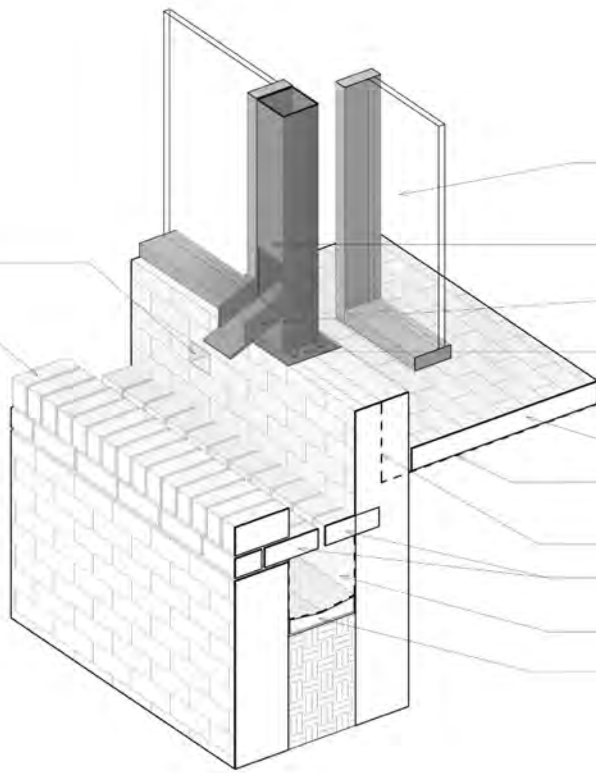


Fig. 8.37. Three-dimensional detail drawing of rainwater downpipe structure and water channel (Author, 2017).

8.6.6. DETAIL 4 | PLANTED BRICK WALL AND WINDOW

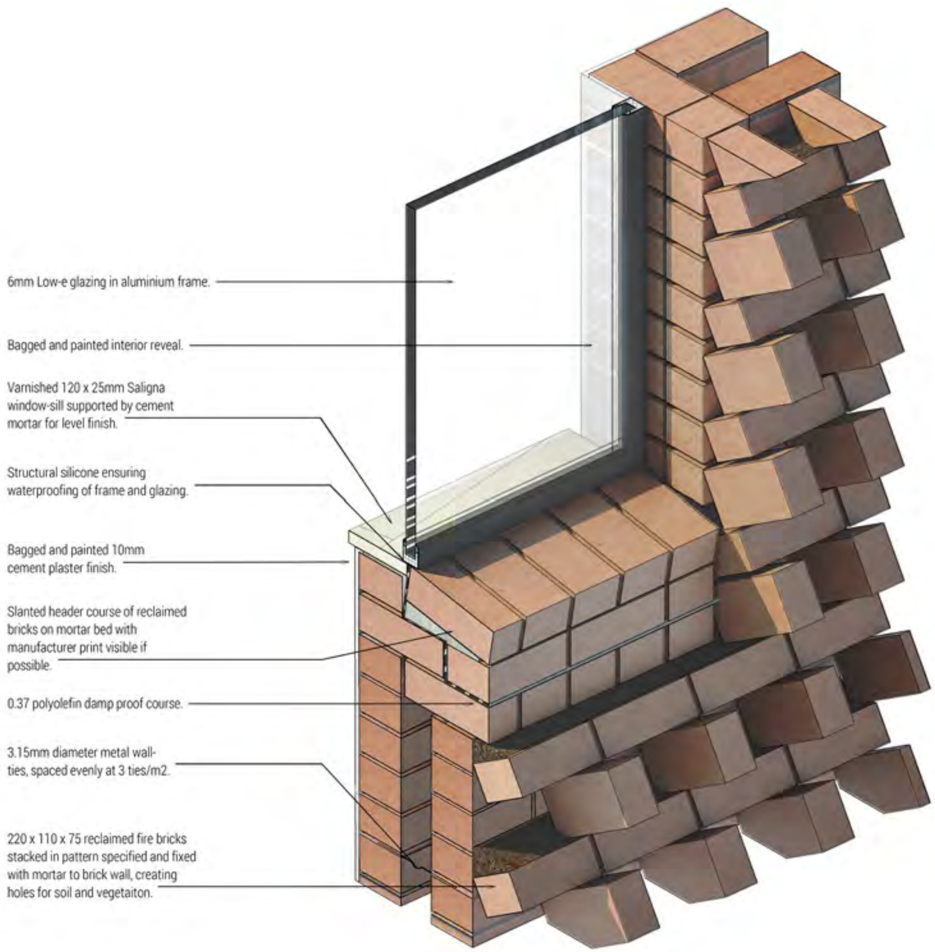
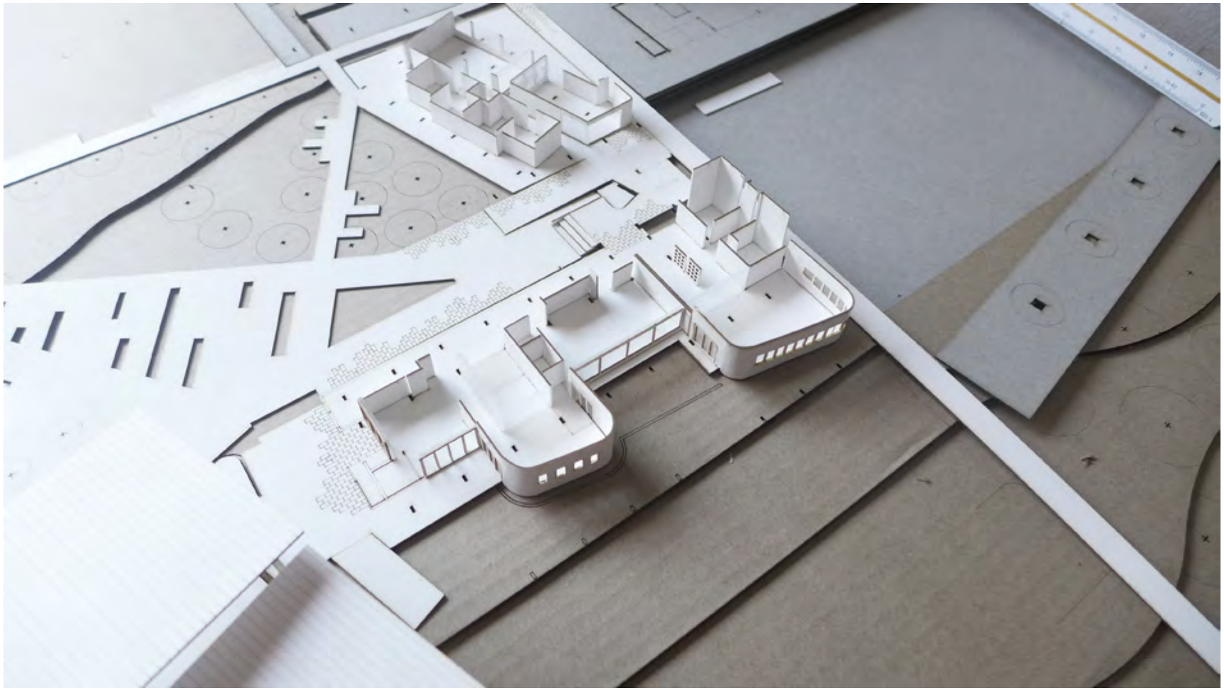


Fig. 8.38. Three-dimensional detail drawing of planted wall built from reclaimed bricks found on site (Author, 2017).

Fig. 8.39. Perspective view of entrance to Built Environment Building from public square (Author, 2017).



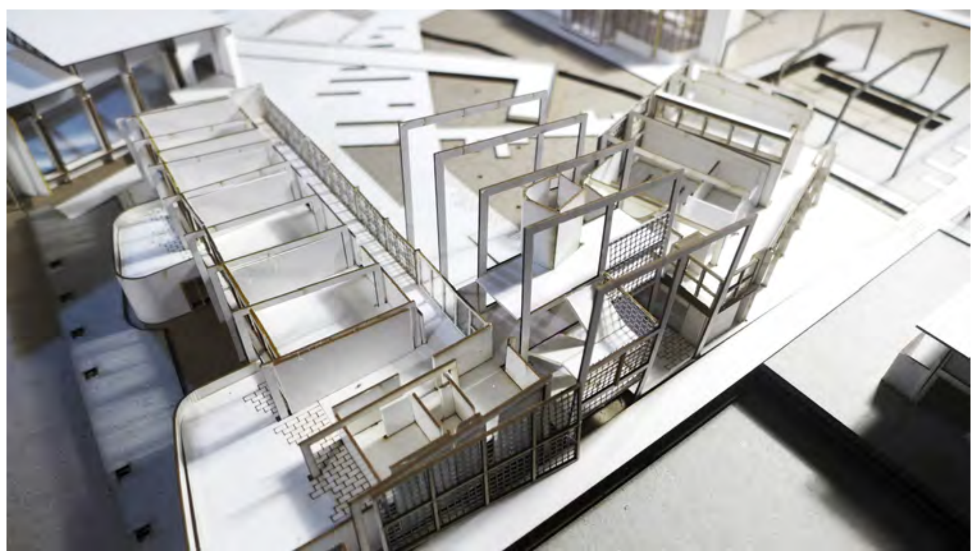


Fig. 8.40. above: Ground floor view of model in process (Author, 2017).
Fig. 8.41. right: First floor view of model in process with exposed portal frame structure (Author, 2017).

Fig. 8.42. left: Model view of south-eastern facade opening up to landscape (Author, 2017).
Fig. 8.43. below: Model view of north-eastern facade and building yard amphi stairs (Author, 2017).
Fig. 8.44. opposite page: Model view of central square and surrounding buildings (Author, 2017).

CONCLUSION

The intention of this dissertation is to explore the role of architecture in the rehabilitation of post-industrial wasteland sites.

Through the study and application of regenerative theory and the understanding that a 'green building' merely as a self-sufficient building is not enough, the relationship between man and habitat is established as the overall architectural informant.

Harnessing the willpower and ingenuity of man in the regeneration of ecosystems, a narrative is created as a means to remind man of the history of the site, but to establish new and inspiring partnerships in the process of growing a habitat where man and environment are part of one ecosystem.

As one of the first implementations of a campus for vocational training, a school for the built environment catalyses development of an interdependent natural habitat, built environment and cultural community as complete ecosystem. In line with the historic significance of producing the very 'building blocks' of the national industrial sector, the site can once again contribute through the education and training of skills that build South African environments, its economy and communities.

Parallel to the rebuilding of the site, long-term rehabilitation of the natural grassland biodiversity that stretches towards the river edge aims to coherently regenerate the various ecosystems present.

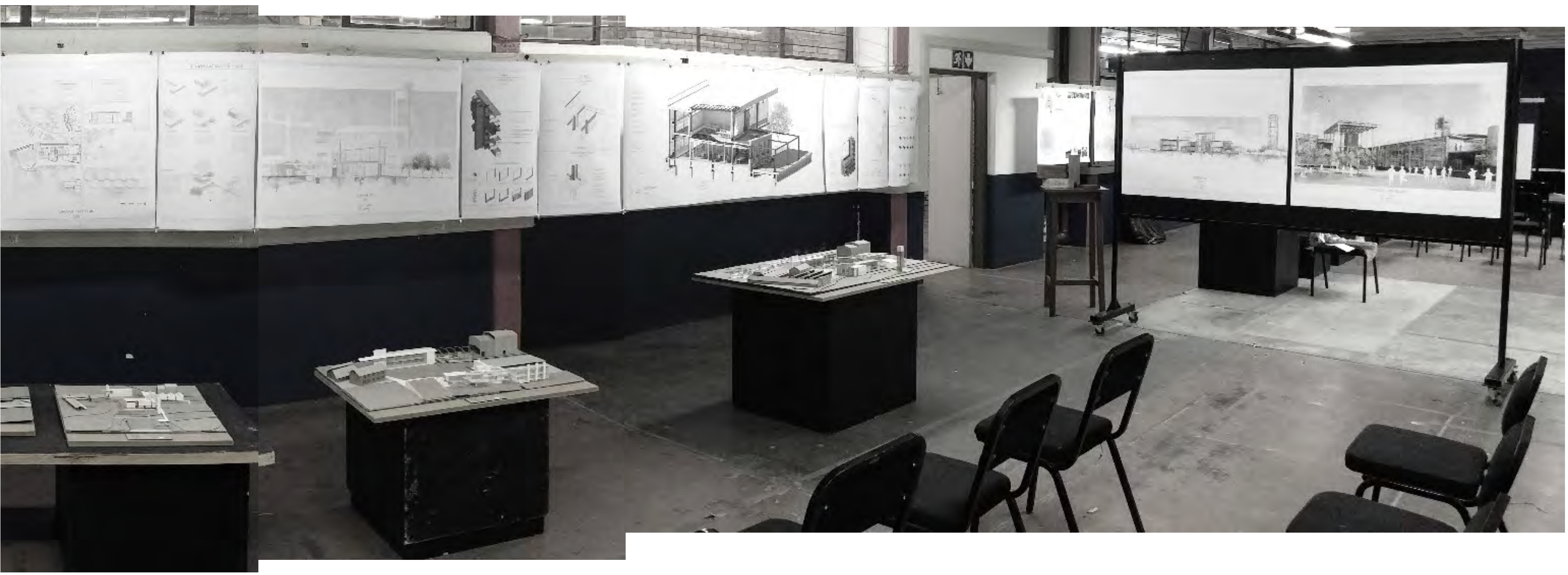
The creation of a public-focused core framed by the first new building sparks the social and economic activity on site. A 'backbone' axis of services links the new building to the existing, and allows for future developments to be added.

The design of a building that becomes the transition between the existing industrial fabric and the rehabilitated landscape, poses the challenge of architecture that responds to both past and future worldviews. Through exploration of the skin of the building, technology and materials are used as educational and experiential elements in the realization of the spaces.

Through the creation of a building that houses the user as passively as possible, whilst also contributing to the environment, the process of regeneration is set in motion — inspiring the community to participate and learn about the nourishment of resources. In this way a partnership that adds value to both man and environment can be created, establishing a sense of vocation in man as he appreciates a new culture created and works towards the growth of his habitat.

Fig. 9.1. opposite page: Photograph taken during design examination, 22 November 2017 (Senekal, 2017).

Fig. 9.2. Photographic collage of final examination presentation, November 2017 (Author, 2017).



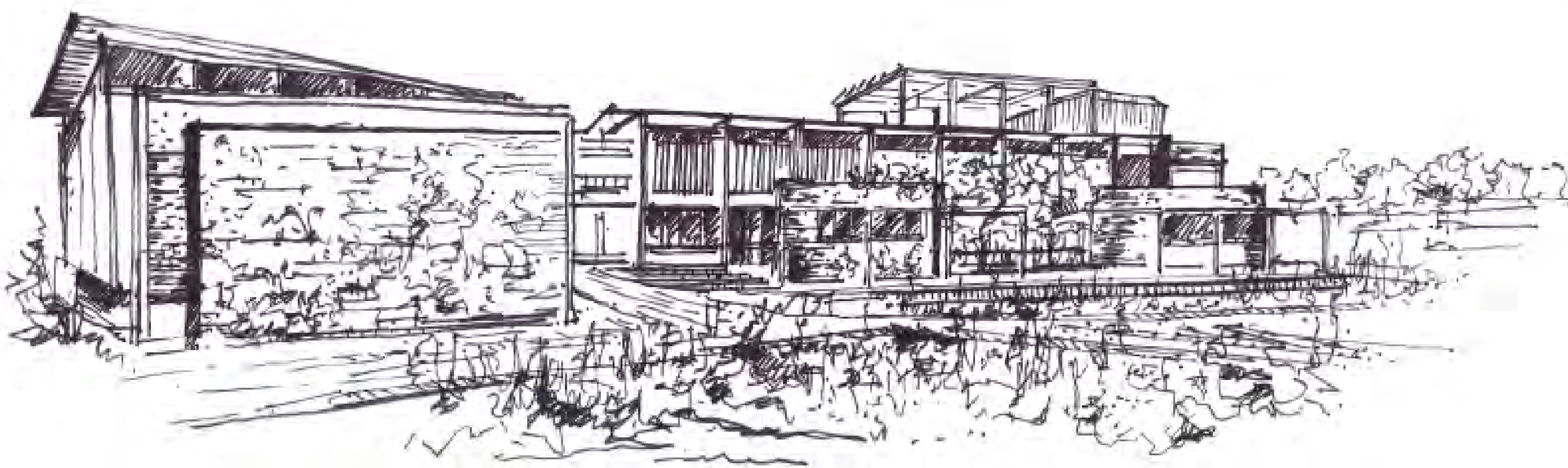


Fig. 9.3. Drawing of south-eastern facade integrating building with landscape (Author, 2017).

APPENDICES

APPENDIX A: URBAN DESIGN PRECEDENT
'WATERFRONT PRECINCT' PROPOSED URBAN PROJECT

As part of a number of flagship projects by the Sedibeng District Municipality under the *Vaal21 Rivercity Initiative*, the Waterfront Precinct project was proposed prior to 2010. The goal behind the development is the provision of adequate public access for recreation and leisure (Sedibeng n.d.).

In order to exploit the full potential of the Vaal River as a tourist destination, the repositioning of the CBD towards the riverfront would unlock the riverfront for economic development opportunities, whilst safeguarding public access along the Vaal. An integrated regional vision is required for the Vaal Riverfront, which would include the following interrelated precincts: (refer to figure 6.17.)

- *Dickenson Park Recreation Hub*
- *The Business Park*, linking the CBD with the Vaal River
- *The Waterfront Promenade*, covering the riverfront between the CBD and the R59 freeway.
- The *Water Tourism Hub*, between Dickenson Park and the R59 freeway.

The last two of these focus on the area adjacent to the site investigated in this dissertation. These precincts were proposed with the following objectives in mind:

- To bring the Vaal River front back to the people.
- To provide high quality recreation to all members of the public by providing access to the riverfront, its facilities and river activities.
- To exploit the full potential of the Vaal River as a tourist destination.
- To enable controlled sustainable management of environmentally sensitive areas.
- To create a catalyst for urban regeneration and economic development along the Vaal River.
- To improve accessibility to the riverfront from the north and west of Vereeniging, in order to unlock the development opportunities of a significant area of the Waterfront.
- To enable education, skills transfer and long-term job creation.

RESPONSE & CRITIQUE

The specific proposal only considers the area adjacent to the Verref industrial complex, while a more complete vision would be necessary to truly regenerate the area sustainably and ensure future use and growth.

Even though the objective is to bring the river 'back to the people', the programs proposed (refer to figure 6.18.) do not really support this vision, as it caters mostly for mid- to high-income communities.

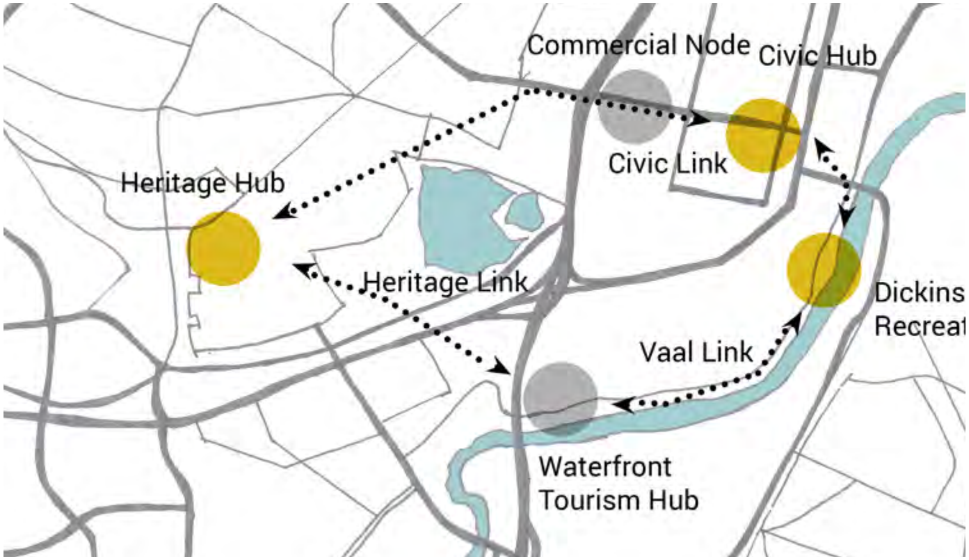


Fig. 10.1. Urban scale diagram of hubs and links proposed in the *Waterfront Precinct* project (http://www.sedibeng.gov.za/flagship_programmes.html, accessed 14 March 2017) (image edited by author).

Fig. 10.2. Vision of the *Water Tourism Hub* (http://www.sedibeng.gov.za/flagship_programmes.html, accessed 14 March 2017).

1. Vaal Riverfront
2. 2010 World Cup viewing site/fan park
3. Station interchange
4. Extreme Sports/adventure park
5. Riviera Aquatic club
6. Public recreational facilities
7. Luxury residential development
8. Aquatic sports hub & African sports school
9. Luxury spa/health clinic
10. Existing vegetated mine dump

APPENDIX B: MUNICIPAL FRAMEWORKS

1. JUSTICE IN ACCESSIBILITY
Densification and infill development along functionally active nodes and corridors.

2. SUSTAINABILITY
Upgrading of existing settlements and definition of boundaries to prevent urban sprawl, thus compactness.

3. EFFICIENCY
Optimization through strategic infrastructure and transport systems supporting specific precincts.

4. RESILIENCE
Flexible land-use development plans.

5. INTEGRATED ADMINISTRATION
Integrated functionality and land-use development plans.

The following strategies are proposed:

A. CORRIDOR DEVELOPMENT

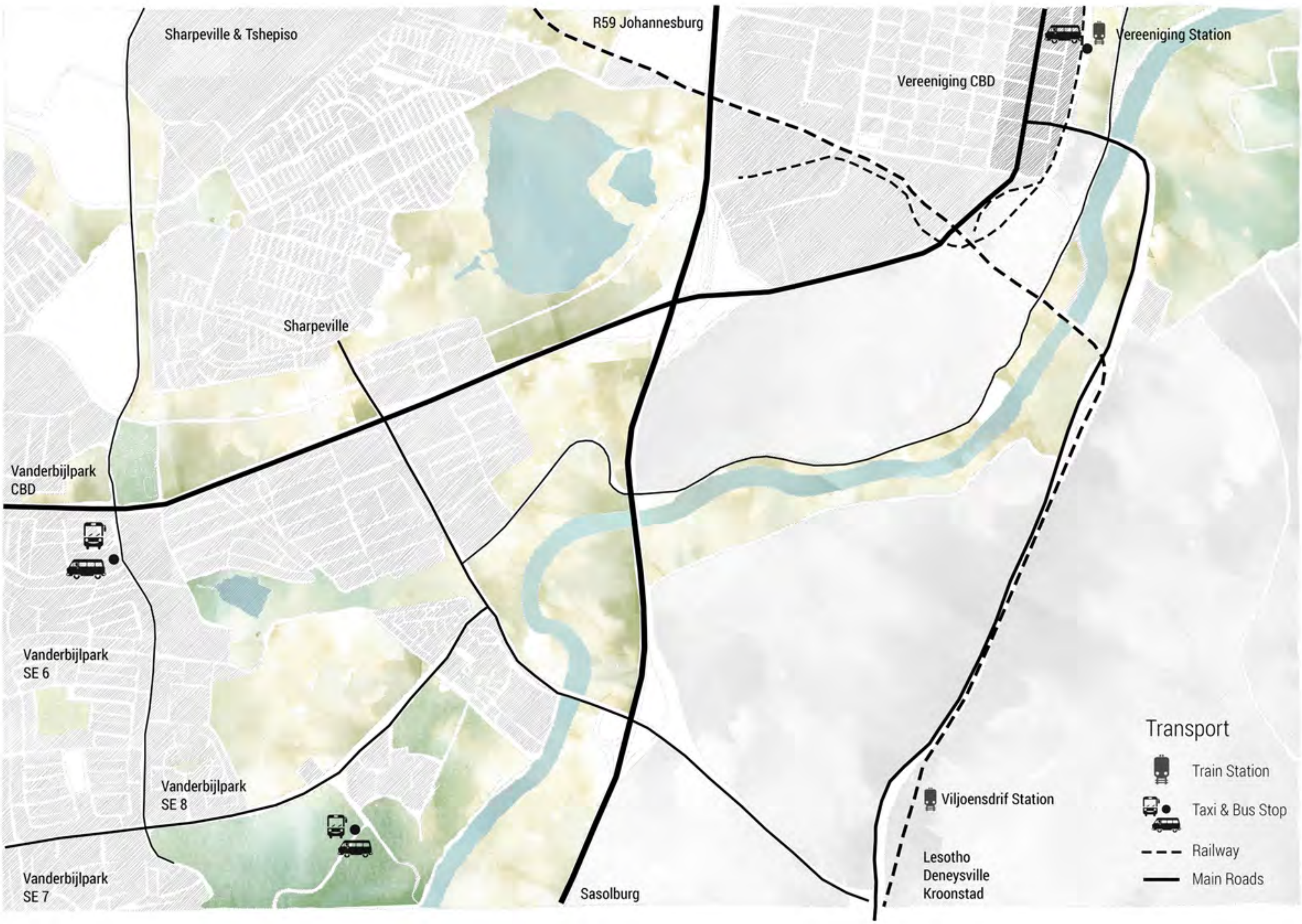
B. URBAN DENSIFICATION

C. INTEGRATION OF PUBLIC TRANSPORT & HIGH DENSITY NODES

Fig. 10.3. Collage by artist Oleg Borodin (http://olegborodin.com/Collages-1 accessed 7 March 2017).

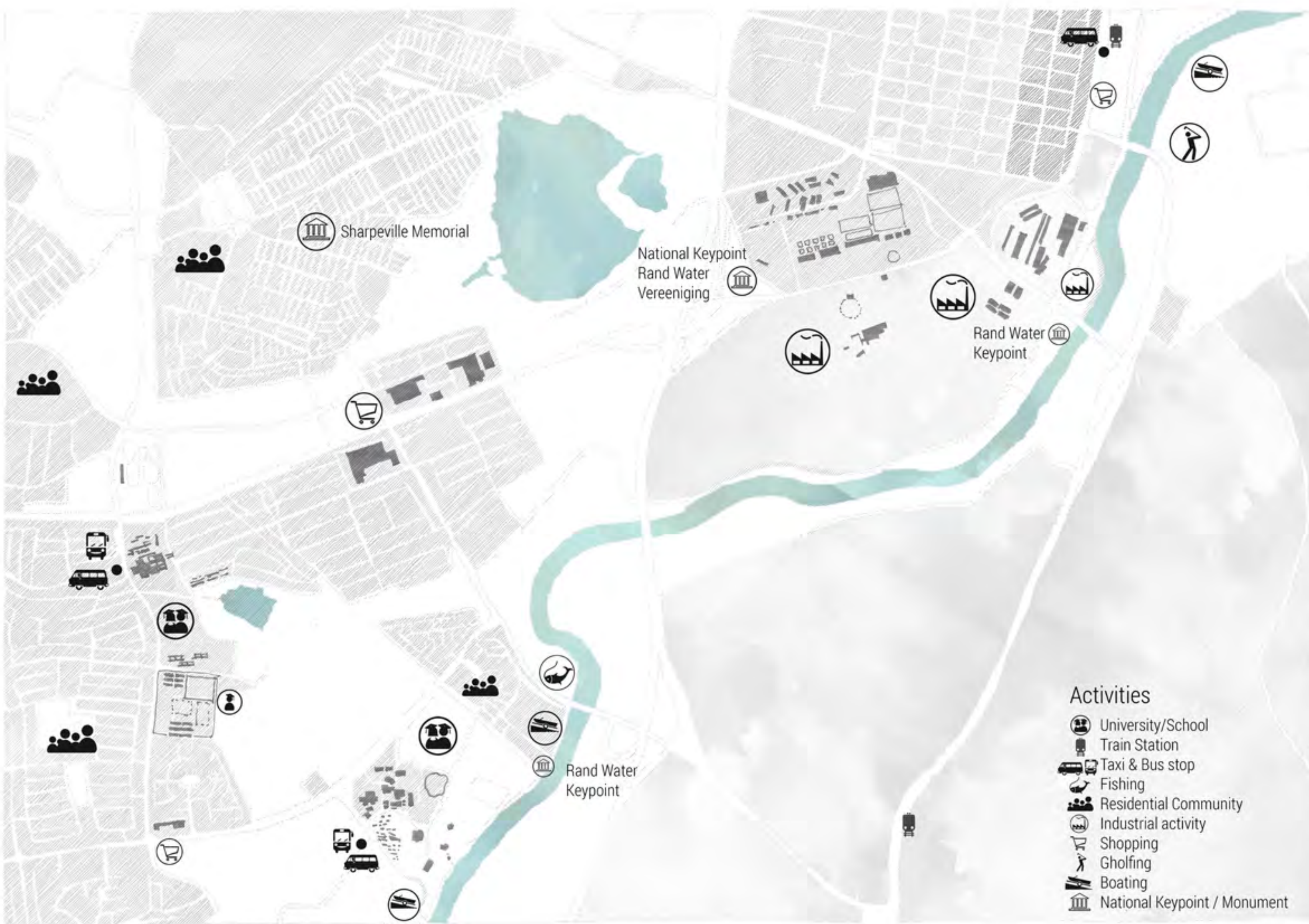
APPENDIX C: MAPPING

MAJOR ROUTES & TRANSPORT

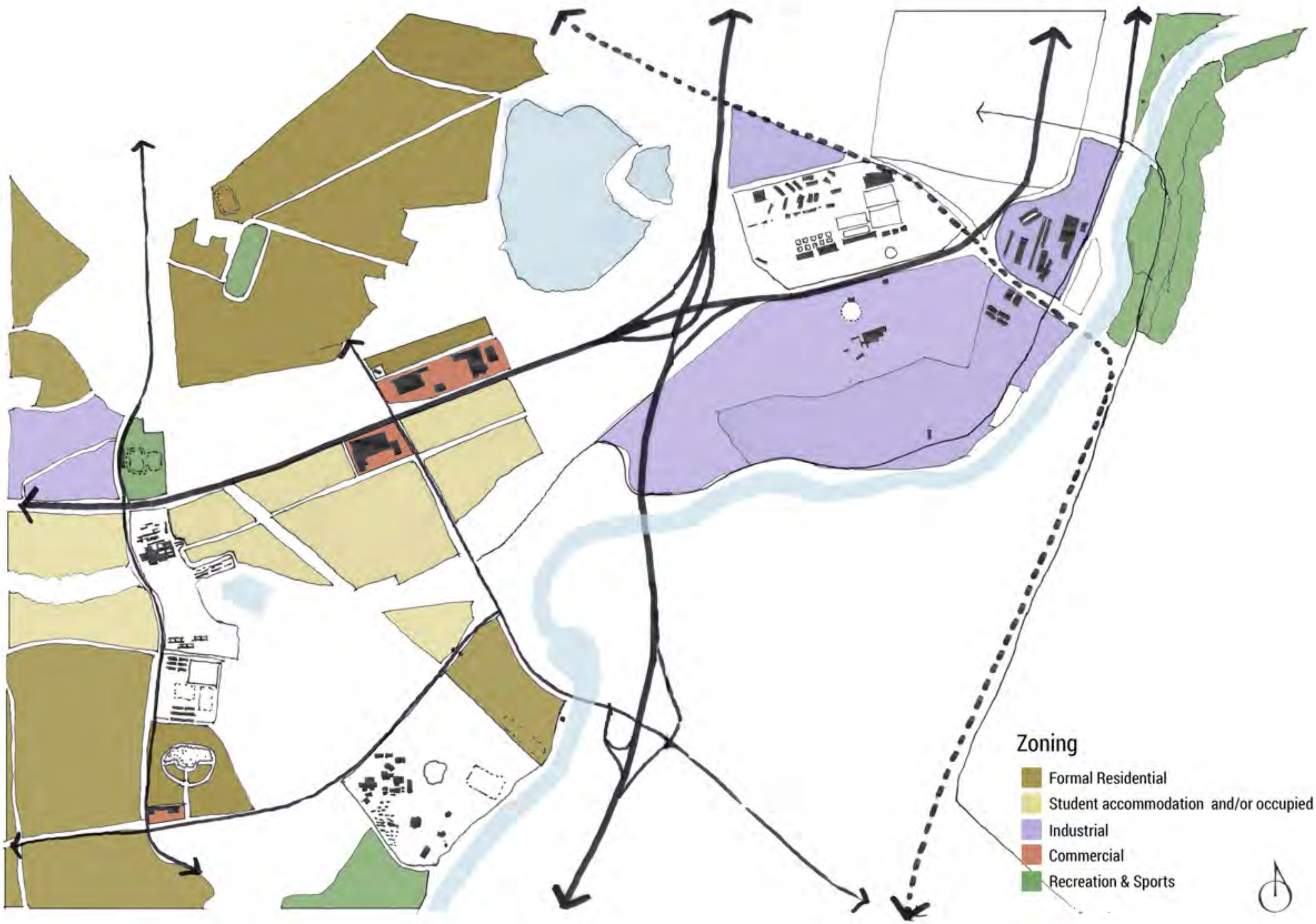


PHOTOGRAPHIC MAPPING

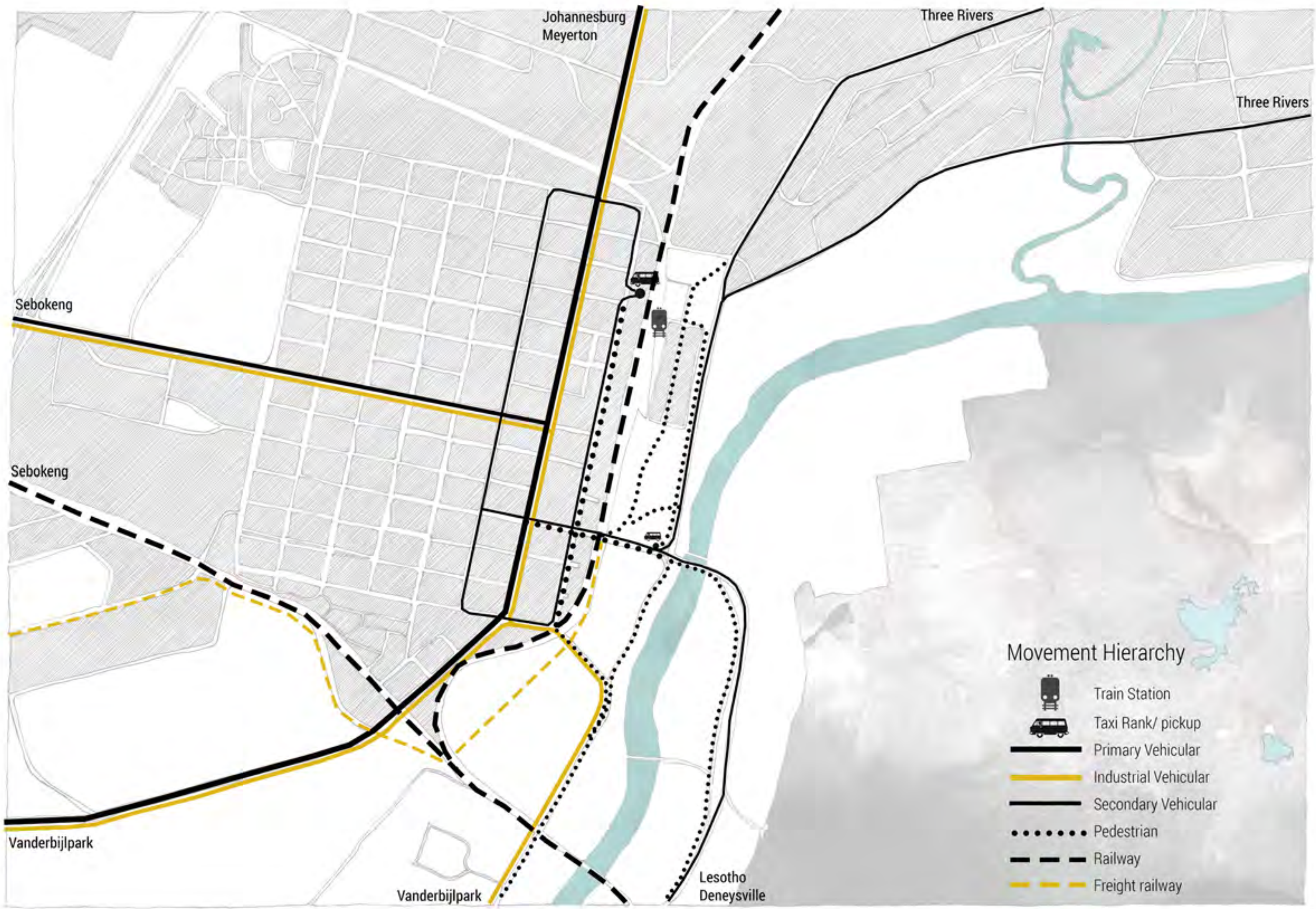
ACTIVITIES & EDUCATION



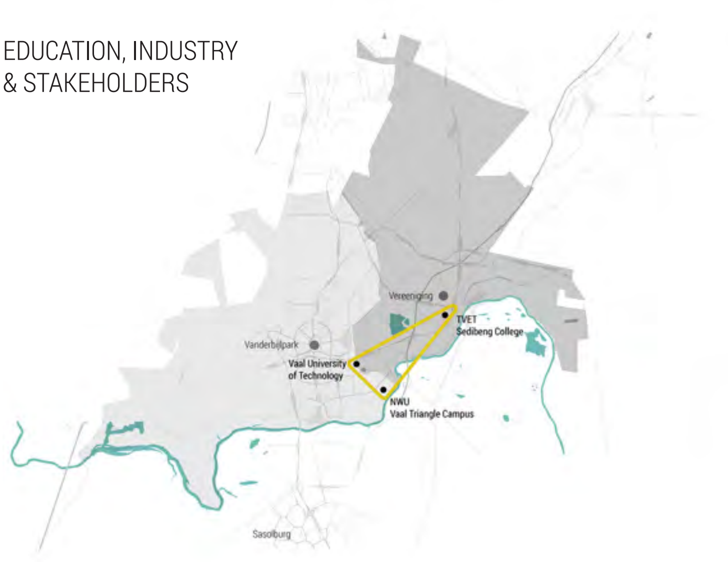
MUNICIPAL ZONING

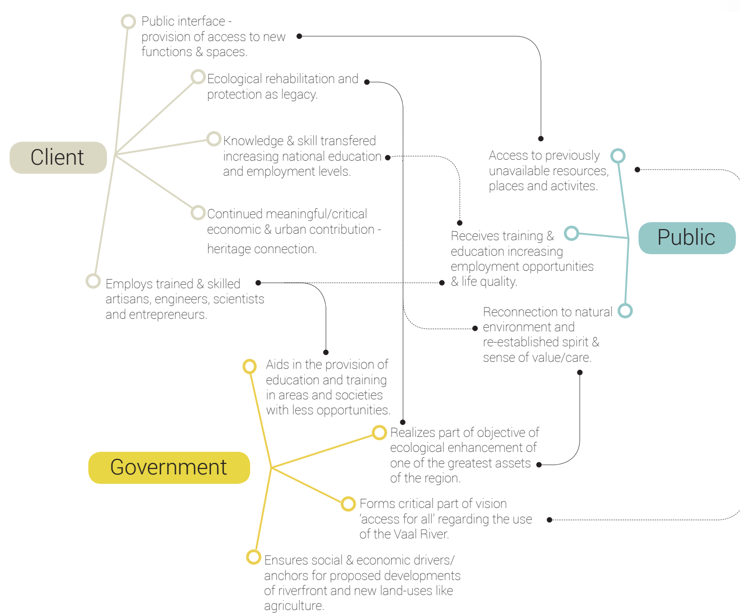


HIERARCHY OF MOVEMENT TO VEREENIGING

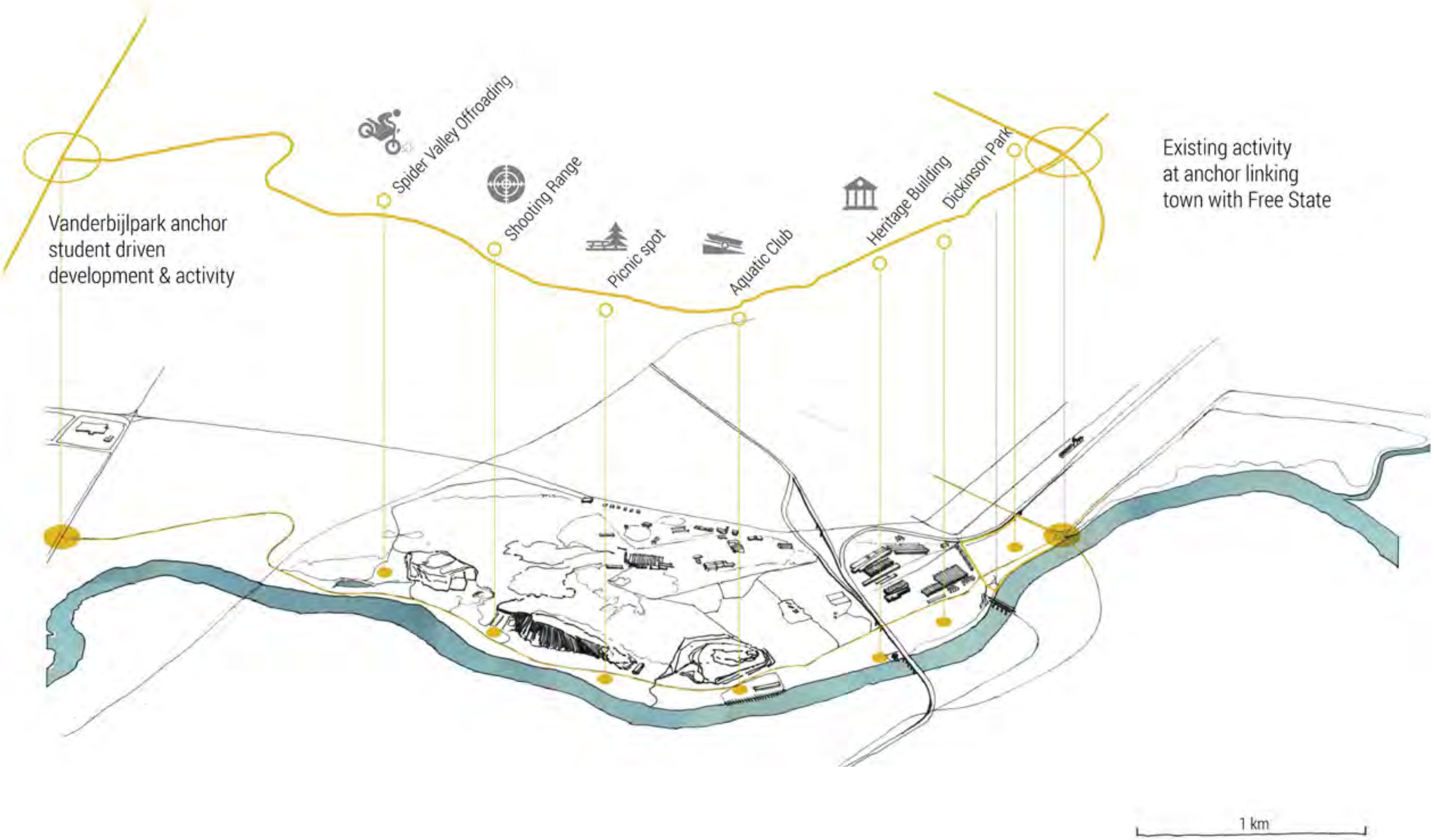


EDUCATION, INDUSTRY & STAKEHOLDERS

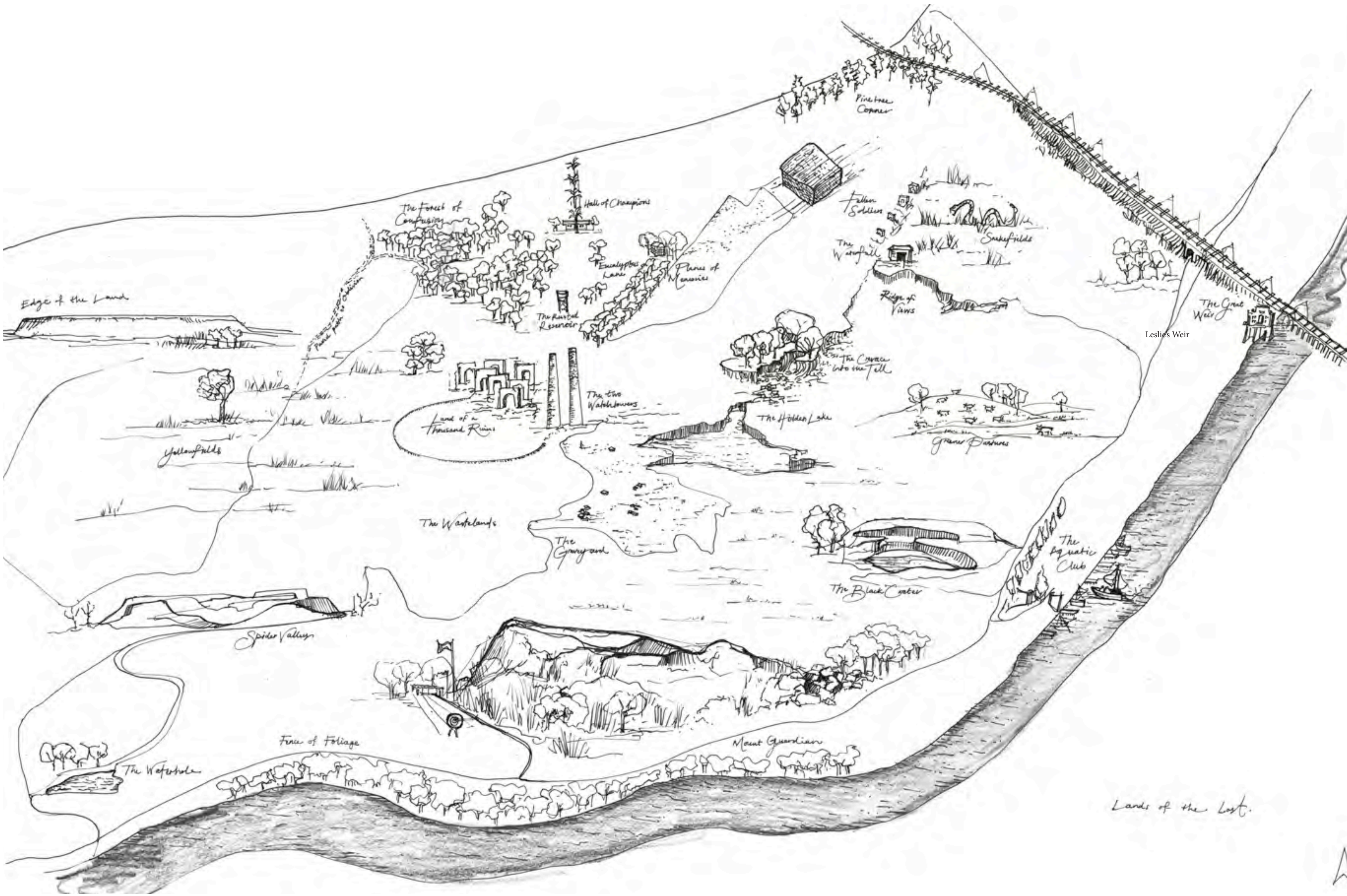




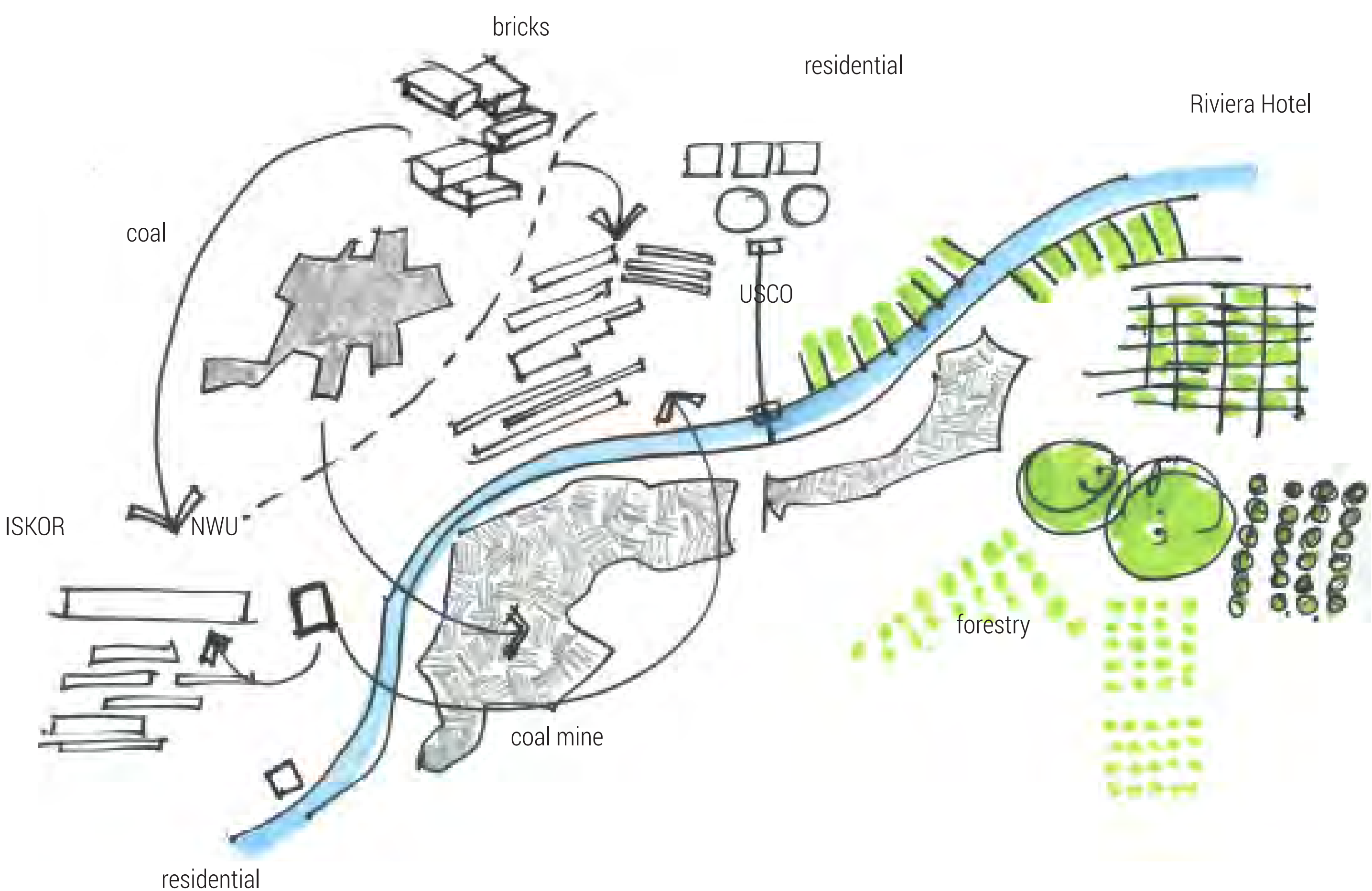
ACTIVITY ALONG SECONDARY RIVER-ROUTE
(indicating opportunities for development)



NARRATIVE/MYTHICAL MAPPING



HISTORICAL ABSTRACTION OF VEREENIGING AREA



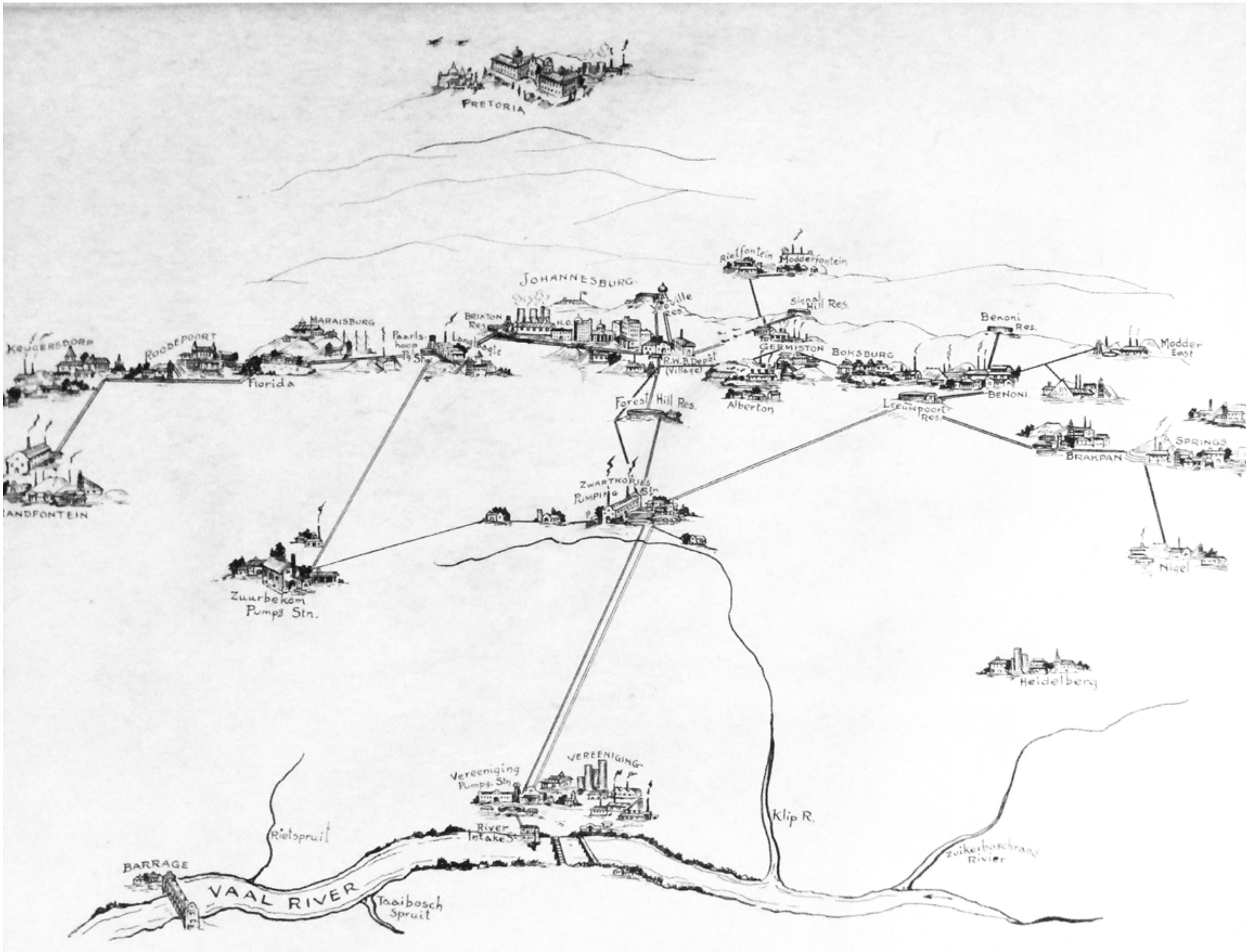


Fig. 10.3. Map drawn of the industrial towns, resources and connections in South Africa (Teknorama Museum, Vereeniging, n.d.).

APPENDIX D: ARCHITECTURE IN VEREENIGING

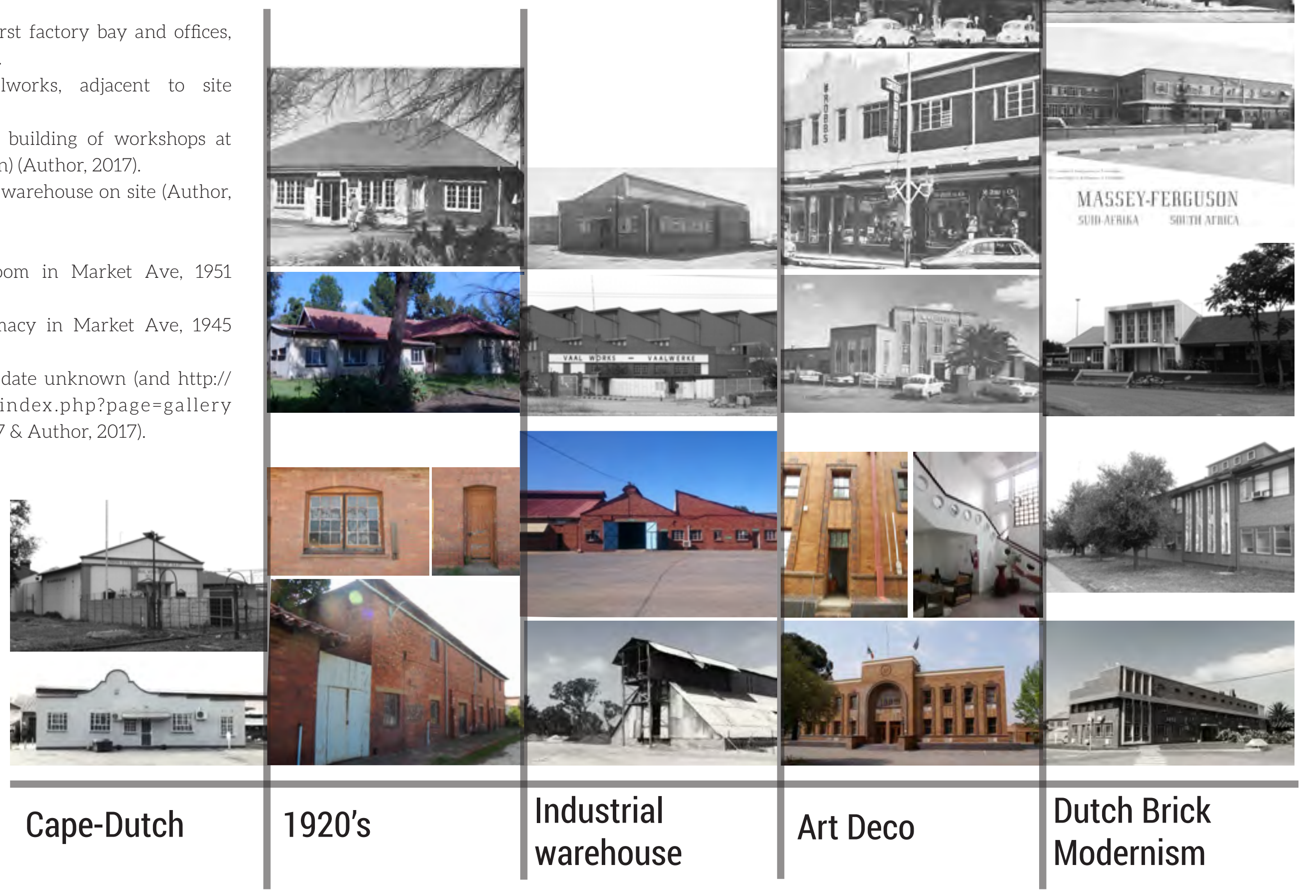
Fig. 10.4. Timeline of *Verref* built fabric in relation to various architectural styles present in Vereeniging (Author, 2017).
Images from top to bottom, left to right column:
USCO Building, built 1912.
Original Office at Verref (date unknown) (Author, 2017).

Vereeniging Library Building in Beaconsfield Ave (Leigh 1968:94).
Verref training centre building and old basic works building (date unknown) (Author, 2017).

ECC South Africa's first factory bay and offices, 1954 (Leigh, 1968:226).
Arcelor Mittal Vaalworks, adjacent to site (Author, 2017).
Extended warehouse building of workshops at Verref (date unknown) (Author, 2017).
Empty raw materials warehouse on site (Author, 2017).

Lubner Bros showroom in Market Ave, 1951 (Leigh, 1968:290).
McRobb & Co Pharmacy in Market Ave, 1945 (Leigh, 1968:251).
Verref Head Offices, date unknown (and http://www.verref.co.za/index.php?page=gallery accessed 10 April 2017 & Author, 2017).

Mercury Dry Cleaners, 1945 (Leigh, 1968:282).
Reunert & Lenz Mining supplies, 1951(308).
Phylco Engineering, 1962(324).
Massey Ferguson, 1961(242).
Vereeniging Station building replacing original facebrick station in 1953 (Author, 2017).
Office building on USCO Vaalworks adjacent to site (author, 2017)
Office building on Verref site (Author, 2017).



APPENDIX E: CALCULATIONS

U-VALUE CALCULATIONS: FLOORS

U - Value						
	1	2	3	4	5	
Type of Material	cork	concrete	steel			
Material tickness (mm)	3	200	1,2	0	0	
k - Value	0,1	1,5	16	1	1	
R material	0,03	0,11	0,00	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	0,88					
U Value	1,13	W/M2(k)				

U - Value						
	1	2	3	4	5	
Type of Material	brick paving	mortar	concrete	steel		
Material tickness (mm)	25	20	200	1,2	0	
k - Value	1,6	1,73	1,5	16	1	
R material	0,02	0,01	0,13	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	0,88					
U Value	1,14	W/M2(k)				

U - Value						
	1	2	3	4	5	
Type of Material	cement screed	concrete	steel			
Material tickness (mm)	30	200	1,2	0	0	
k - Value	1,73	1,5	16	1	1	
R material	0,02	0,13	0,00	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	0,88					
U Value	1,14	W/M2(k)				

U - Value						
	1	2	3	4	5	
Type of Material	concrete	polystyrene	steel			
Material tickness (mm)	200	30	1,2	0	0	
k - Value	1,5	0,03	16	1	1	
R material	0,13	1,00	0,00	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	1,85					
U Value	0,54	W/M2(k)				

For non-hardwearing workshop floors, cork is chosen due to acoustic properties. First and second floors over circulation have extruded polystyrene between concrete and cement screed to achieve better u-values. Roofs with Isotherm insulation achieve the best u-values.

U-VALUE CALCULATIONS: ROOFS

U - Value						
	1	2	3	4	5	
Type of Material	cork	cement screed	concrete	steel		
Material tickness (mm)	0	40	200	1,2	0	
k - Value	0,1	1,73	1,5	16	1	
R material	0,00	0,02	0,13	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	0,88					
U Value	1,14	W/M2(k)				

U - Value						
	1	2	3	4	5	
Type of Material	steel	plywood				
Material tickness (mm)	1,2	38	0	0	0	
k - Value	16	0,17	1	1	1	
R material	0,00	0,22	0,00	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	0,94					
U Value	1,06	W/M2(k)				

U - Value						
	1	2	3	4	5	
Type of Material	steel	cork board				
Material tickness (mm)	1,2	30	0	0	0	
k - Value	16	0,43	1	1	1	
R material	0,00	0,07	0,00	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	0,79					
U Value	1,27	W/M2(k)				

U - Value						
	1	2	3	4	5	
Type of Material	steel	isotherm	plywood			
Material tickness (mm)	1,2	40	38	0	0	
k - Value	16		0,17	1	1	
R material	0,00	0,88		0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	1,60					
U Value	0,62	W/M2(k)				

U - Value						
	1	2	3	4	5	
Type of Material	steel	isotherm	timber			
Material tickness (mm)	1,2	40	38	0	0	
k - Value	16		0,14	1	1	
R material	0,00	0,88	0,27	0,00	0,00	
R-inside	0,6					
R-outside	0,12					
R Value	1,87					
U Value	0,53	W/M2(k)				

ELECTRICITY DEMAND CALCULATIONS

LIGHTING REQUIREMENTS											
ROOM	AREA	LUX REQUIRED	LUMENS	LIGHT TYPE	LUMENS/ UNIT	WATT/ UNIT	QUANTITY/AREA	TOTAL WATT	AMOUNT OF ROOMS	HOURS USE/DAY	TOTAL POWER DRAW (Watt/Hours/ day)
Kitchenette	8,0	300	2400,0	LED Globe	300,0	3,0	8	24,0	2	2	96,00
Lobby 1	32,0	75	2400,0	LED Globe	300,0	3,0	8	24,0	1	6	144,00
Lobby 2	80,0	75	6000,0	LED Globe	300,0	3,0	20	60,0	1	8	480,00
Major Passages	123	100	12300,0	Round Ultra-Thin Panel Light (LED)	880,0	11,0	14	153,8	1	8	1230,00
Vertical Circulation	60,0	100	6000,0	High Bay Warehouse Light (LED)	6700,0	60,0	1	53,7	2	6	644,78
Printing/Collab room	100,0	300	30000,0	LED Panel Light	3256,0	44,0	9	405,4	1	10	4054,05
Computer Lab	105,0	500	52500,0	LED Panel Light	3256,0	44,0	16	709,5	1	10	7094,59
Studios	85,0	500	42500,0	High Bay Warehouse Light (LED)	6700,0	60,0	6	380,6	2	9	6850,75
Offices	50,0	500	25000,0	LED Corn Bulb	880,0	80,0	28	2272,7	1	9	20454,55
Meeting Room 1	18,0	300	5400,0	LED Panel Light	3256,0	44,0	2	73,0	1	1	72,97
Lecture room	52,0	500	26000,0	LED Panel Light	3256,0	44,0	8	351,4	2	4	2810,81
Lecture room	75,0	500	37500,0	LED Panel Light	3256,0	44,0	12	506,8	2	4	4054,05
Lecture room	300,0	500	150000,0	LED Panel Light	3256,0	44,0	46	2027,0	1	4	8108,11
Electric & Plumbing workshop	50,0	800	40000,0	High Bay Warehouse Light (LED)	6700,0	60,0	6	358,2	2	6	4298,51
Wood workshop	250,0	600	150000,0	High Bay Warehouse Light (LED)	6700,0	60,0	22	1343,3	3	9	36268,66
Material Library	75,0	300	22500,0	High Bay Warehouse Light (LED)	6700,0	60,0	3	201,5	1	8	1611,94
Ablutions Female	34,0	100	3400,0	LED Corn Bulb	880,0	80,0	4	309,1	2	3	1854,55
Ablutions Male	26,0	100	2600,0	LED Corn Bulb	880,0	80,0	3	236,4	2	3	1418,18
Ablutions Disabled	8,0	100	800,0	LED Corn Bulb	880,0	80,0	1	72,7	2	3	436,36
Changeroom Female	34,0	100	3400,0	LED Corn Bulb	880,0	80,0	4	309,1	1	1,5	463,64
Changeroom Male	34,0	100	3400,0	LED Corn Bulb	880,0	80,0	4	309,1	1	1,5	463,64
Changeroom Disabled	5,0	100	500,0	LED Corn Bulb	880,0	60,0	1	45,5	2	1,5	136,36
Server Room	8,00	100	800,0	LED Tube	1120,0	8,0	1	5,7	1	0,5	2,86
Emergency Escape Stairs	12,00	100	1200,0	LED Globe	300,0	80,0	4	320,0	2	6	3840,00
	1624,00							10552,3			106889,35 W/day
									Total		106,889 kW/day

Watts per m² **6,50**

ELECTRICITY DEMAND

Item/Appliance	Power draw/ item (W)	Amount of appliances	Total Power draw (W)	Average hours run time/ week	Total hours run time per week	Watt-Hours per week	KWh per week
Laptop	60	70	4200	40	2800	11760000	11760
LED Display 32"	50	6	300	12	60	18000	18
Computer server	400	1	400	168	168	67200	67,2
Laser Jet Printer	250	4	1000	5	20	20000	20
Alarm System	40	1	40	84	84	3360	3,36
Wi-Fi Router	6	1	6	40	40	240	0,24
Cordless Phone	2	2	4	40	80	320	0,32
Coffee Machine	800	1	800	10	10	8000	8
Microwave	1000	1	1000	5	5	5000	5
Bar Fridge	77	2	154	10	20	3080	3,08
Fridge	180	0	0	10	0	0	0
Freezer	200	1	200	12	12	2400	2,4
Electric tankless heater	8	2	16	6	12	192	0,192
Rechargable powertool	13	15	195	30	450	87750	87,75
3D printer	50	1	50	30	30	1500	1,5
CNC Machine	1000	1	1000	30	30	30000	30
Band Saw	1100	1	1100	30	30	33000	33
Belt Sander	1000	1	1000	30	30	30000	30
Circular Saw	900	1	900	30	30	27000	27
Drill	250	2	500	30	60	30000	30
Dust Vacuum	1500	2	3000	30	60	180000	180
Carpentry machinery			0	7	7	0	175
					Total watt hours /week:	12307042	12482

Electricity demand	12 500 KWh/month
	409,8 kwh/day
Lighting	107 kwh/day
Total	516,8 kwh/day

source <http://energyusecalculator.com/calculate_electrical_usage.htm>
https://www.wholesalesolar.com/solar-information/how-to-save-energy/power-table

http://www.charlstonlights.com/led-light-requirement-calculator

ELECTRICITY DEMAND CALCULATIONS

SOLAR POWER GAIN

Roof area (m2)	Tile area (m2)	No of tiles	Power gain/ tile(W)	Total Power gain (W)	
504,4	1,94	260	285	74100	
108	1,94	56	285	15866	
90	1,94	46	285	13222	
108	1,94	56	285	15866	
		417,7319588		119054	120 kW

http://www.exsolar.co.za/products/pv-panels/exsolar-245w-250w-255w-275w-280w-285w/
http://www.exsolar.co.za/products/pv-panels/exsolar-25w-30w-35w/

Rooftiles 1960 x 991 x38 — 285 W per panel
586 x 410 x 25 — 35 W per panel

ANNUAL SOLAR GAIN

Month	Ave. monthly sunhours	Power gain(kWh)	Total Power Gain (KW)	Total Power demand/month (W-hours)	Total Power demand/month (KW)	Nett Power gain/loss
January	290	120	34800	54150984,8	54150,98	-19350,98
February	270	120	32400	49228168	49228,17	-16828,17
March	260	120	31200	54150984,8	54150,98	-22950,98
April	250	120	30000	51689576,4	51689,58	-21689,58
May	270	120	32400	54150984,8	54150,98	-21750,98
June	230	120	27600	51689576,4	51689,58	-24089,58
July	280	120	33600	54150984,8	54150,98	-20550,98
August	310	120	37200	54150984,8	54150,98	-16950,98
September	300	120	36000	51689576,4	51689,58	-15689,58
October	300	120	36000	51689576,4	51689,58	-15689,58
November	260	120	31200	51689576,4	51689,58	-20489,58
December	300	120	36000	54150984,8	54150,98	-18150,98

Conclusion: Theoretical learning spaces can be powered by solar energy alone. Woodwork and steel workshops can be powered by solar energy only if more solar panels and solar roofs are added to existing buildings or a separate solar plant is created elsewhere on the site.

A separate solar farm is viable as there is ample space. It could be an advantage to the surrounding community, and add to income feeding the campus as a whole.

WATER CALCULATIONS

A WATER RESOURCE INFORMATION (YIELD, m^3)

A1 RAIN WATER HARVESTING DATA

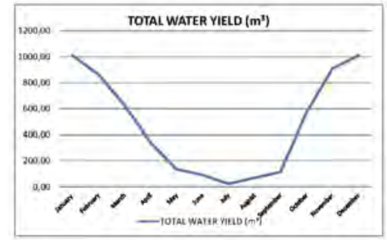
DESCRIPTION	AREA (m^2)	RUNOFF COEFF. (C)
Roof structures	4000	0,9
Paving A	6000	0,8
Paving B	4000	0,7
Lawn	1500	0,1
Other		0,9
TOTAL AREA (A)	15500,00	
WEIGHTED C		0,73

A2 RECYCLED / ALTERNATIVE WATER SOURCE

MONTH	Greywater	
	WEEKLY YIELD (m^3)	MONTHLY YIELD (m^3)
January	0,01	0,04
February	0,01	0,04
March	0,01	0,04
April	0,01	0,04
May	0,01	0,04
June	0,01	0,04
July	0,01	0,04
August	0,01	0,04
September	0,01	0,04
October	0,01	0,04
November	0,01	0,04
December	0,01	0,04
ANNUAL AVE.		0,48

A3 TOTAL WATER YIELD

MONTH	AVE RAINFALL, P (m)	CATCHMENT YIELD (m^3) (Yield = PxAxC)	ALTERNATIVE WATER SOURCE (m^3)	TOTAL WATER YIELD (m^3)
January	0,09	1010,15	0,00	1010,15
February	0,08	862,60	0,00	862,60
March	0,06	624,25	0,00	624,25
April	0,03	340,50	0,00	340,50
May	0,01	136,20	0,00	136,20
June	0,01	90,80	0,00	90,80
July	0,00	22,70	0,00	22,70
August	0,01	68,10	0,00	68,10
September	0,01	113,50	0,00	113,50
October	0,05	567,50	0,00	567,50
November	0,08	908,00	0,00	908,00
December	0,09	1010,15	0,00	1010,15
ANNUAL AVE.	0,05	5754,45	0,00	5754,45



B WATER DEMAND

B1 LANDSCAPE IRRIGATION DEMAND (m^3)

DESCRIPTION:	Rehab (m^2):	2000	Landscape (m^2):	200	Lawn (m^2)	960	
MONTH	WEEKLY IRR. (m)	MONTHLY DEMAND (m^3)	WEEKLY IRR. (m)	MONTHLY DEMAND (m^3)	WEEKLY IRR. (m)	MONTHLY DEMAND (m^3)	TOTAL MONTHLY IRR. DEMAND (m^3)
January	0,02	160	0,008	6,4	0,005	19,2	185,6
February	0,02	160	0,008	6,4	0,005	19,2	185,6
March	0,02	160	0,008	6,4	0,005	19,2	185,6
April	0,02	160	0,008	6,4	0,005	19,2	185,6
May	0,02	160	0,008	6,4	0,005	19,2	185,6
June	0,02	160	0,008	6,4	0,005	19,2	185,6
July	0,02	160	0,008	6,4	0,005	19,2	185,6
August	0,02	160	0,008	6,4	0,005	19,2	185,6
September	0,02	160	0,008	6,4	0,005	19,2	185,6
October	0,02	160	0,008	6,4	0,005	19,2	185,6
November	0,02	160	0,008	6,4	0,005	19,2	185,6
December	0,02	160	0,008	6,4	0,005	19,2	185,6
ANNUAL TOTAL		1920		76,8		230,4	2227,2

B2 Built Environment

MONTH	PERSONS	WATER/ CAPITA/ DAY (l)	DOMESTIC DEMAND (m^3/month)
January	100	15	39
February	100	15	36
March	100	15	39
April	100	15	37,5
May	100	15	39
June	100	15	37,5
July	100	15	39
August	100	15	39
September	100	15	37,5
October	100	15	39
November	100	15	37,5
December	100	15	39
ANNUAL TOTAL			459

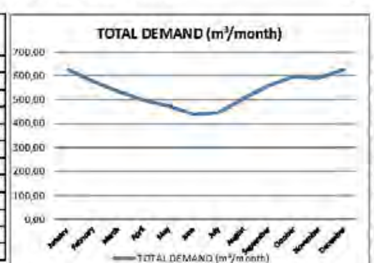
B2 VISITOR / ALT DEMAND

MONTH	PERSONS	WATER/ CAPITA/ DAY (l)	DOMESTIC DEMAND (m^3/month)
January	520	10	161,2
February	520	10	145,6
March	520	10	161,2
April	520	10	156
May	520	10	161,2
June	520	10	156
July	520	10	161,2
August	520	10	161,2
September	520	10	156
October	520	10	161,2
November	520	10	156
December	520	10	161,2
ANNUAL TOTAL			1898

B3 EVAPORATION LOSS (For 'open' reservoirs)

35mm - 45mm/week in summer

AREA OF RESERVOIR (m^2):		1500	
MONTH	EVAPORATION RATE (m/week)	EVAPORATION RATE (m/month)	TOTAL LOSS (m^3/month)
January	0,04	0,16	240
February	0,035	0,14	210
March	0,025	0,1	150
April	0,02	0,08	120
May	0,015	0,06	90
June	0,01	0,04	60
July	0,01	0,04	60
August	0,02	0,08	120
September	0,03	0,12	180
October	0,035	0,14	210
November	0,035	0,14	210
December	0,04	0,16	240
ANNUAL TOTAL	0,32	1,26	1890,00



B4 TOTAL WATER LOSS & DEMAND

MONTH	TOTAL DEMAND (m^3/month)
January	625,80
February	577,20
March	535,80
April	499,10
May	475,80
June	439,10
July	445,80
August	505,80
September	559,10
October	595,80
November	589,10
December	625,80
ANNUAL TOTAL	6474,2

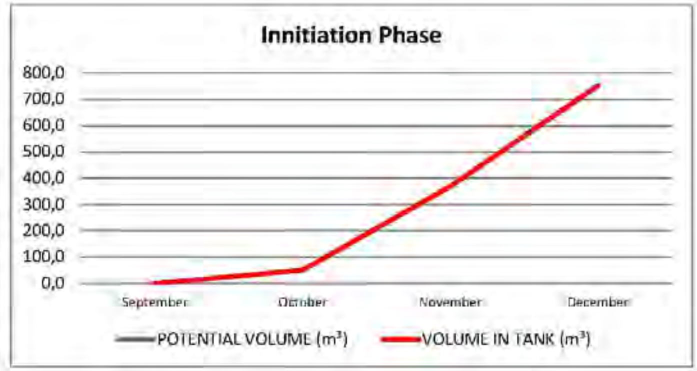
WATER CALCULATIONS

C WATER BUDGET

TANK CAPACITY (m^3): 1600
MIN VOLUME (m^3): 50

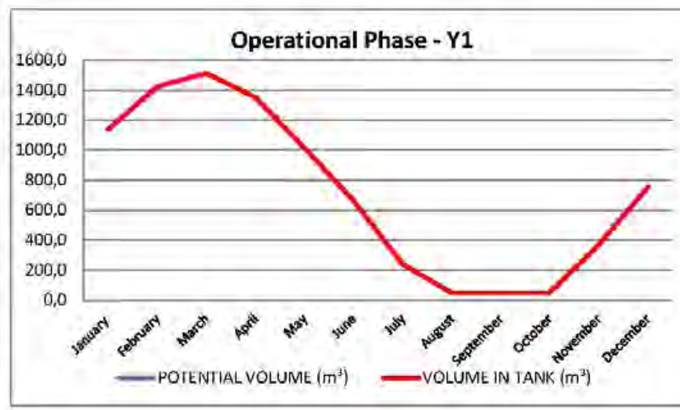
C1 WATER BUDGET INNITIATION PHASE

MONTH	YIELD (m^3/month)	DEMAND (m^3/month)	MONTHLY BALANCE	POTENTIAL VOLUME (m^3)	VOLUME IN TANK (m^3)
September	113,5	559,1	-445,6	**0,0**	**0,0**
October	567,5	595,8	28,3	**50,0**	**50,0**
November	908,0	589,1	318,9	**368,9**	**368,9**
December	1010,2	625,8	384,4	**753,3**	**753,3**
	2599,2	2369,8	229,4		



C2 WATER BUDGET YEAR 1

MONTH	YIELD (m^3/month)	DEMAND (m^3/month)	MONTHLY BALANCE	POTENTIAL VOLUME (m^3)	VOLUME IN TANK (m^3)
January	1010,2	625,8	384,4	**1137,6**	**1137,6**
February	862,6	577,2	285,4	**1423,0**	**1423,0**
March	624,3	535,8	88,5	**1511,5**	**1511,5**
April	340,5	499,1	-158,6	**1352,9**	**1352,9**
May	136,2	475,8	-339,6	**1013,3**	**1013,3**
June	90,8	439,1	-348,3	**665,0**	**665,0**
July	22,7	445,8	-423,1	**241,9**	**241,9**
August	68,1	505,8	-437,7	**50,0**	**50,0**
September	113,5	559,1	-445,6	**50,0**	**50,0**
October	567,5	595,8	28,3	**50,0**	**50,0**
November	908,0	589,1	318,9	**368,9**	**368,9**
December	1010,2	625,8	384,4	**753,3**	**753,3**
ANNUAL AVE.	5754,5	6474,2	-719,8		



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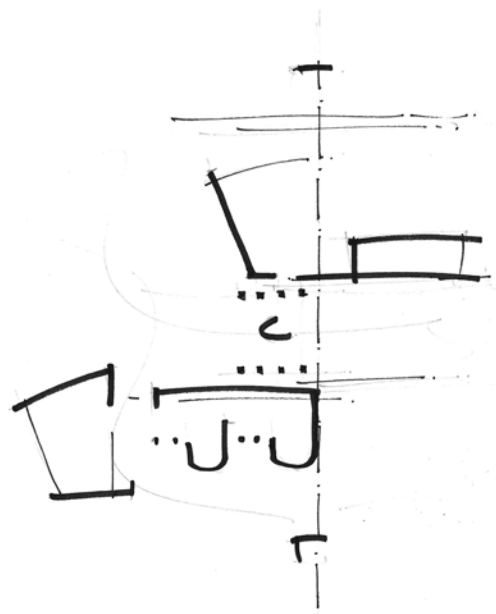

REBUILD

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