

An architectural design dissertation by Johann H. Boonzaaier

# NURTURING ARCHITECTURE

SHIFTING CONVENTIONAL ARCHITECTURAL APPROACHES  
TOWARDS REGENERATIVE ARCHITECTURE

AN EDUCATIONAL ENTOMOLOGY RESEARCH FACILITY  
IN THE FORGOTTEN ORIGINS OF PRETORIA CENTRAL



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REGENERATIVE ARCHITECTURE

AN EDUCATIONAL ENTOMOLOGY RESEARCH FACILITY  
IN THE FORGOTTEN ORIGINS OF PRETORIA CENTRAL

By Johann H. Boonzaaier

Submitted in fulfillment of part of the  
requirements for the degree of **Master in  
Architecture (Professional)**

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

**Course Coordinator /**

Dr. Arthur Barker

**Study Leader /**

Dr. Arthur Barker

Pretoria 2015

## PROJECT SUMMARY /

### **Programme /**

Educational entemology Research Facility

### **Site Description /**

Eastern boundary of the Pretoria Zoo, south of the Apies River, Located west of the Prinshof School.

### **Site Location /**

Prinshof 349-JR portion 64 R/61

### **Address /**

1 Prinshof St, Pretoria, 0084

### **GPS Coordinators /**

25° 44' 11.57" S; 28° 11; 39.75" E

### **Research Field /**

Environmental Potential

### **Theoretical Premise /**

Regenerative theory focusing on the conservation of insects and their habitats

### **Architectural Approach /**

Finding a relationship between human, building and nature by adapting steward Brand's 6 'S' with regenerative theory, by incorporating site as a main building layer.

## ACKNOWLEDGMENT /

I would like to thank Dr. Arthur Barker for his support and encouragement this year, helping me to stay motivated and passionate.

A special thanks to my father, Johann Boonzaaier for his unending love and support throughout this year.

Thank you to Lizann Keuler for the editing of this dissertation.

Furthermore I thank my family and my friends that helped me stay calm in pressured situations.

Last but not least I would like to thank our Lord, blessing me through this incredible journey.

In accordance with Regulation 4[e] of the General Regulations [G.57] for dissertations and theses, I declare that this thesis, which is hereby 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 a degree at this or any other tertiary institution.

I further state that no part of my thesis has already been, or is currently being, submitted for any such degree, diploma or any other qualification.

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

Johann Boonzaier

NURTURE /

[nur-cher]

Verb:

To feed and protect

To support and encourage, as during the period of training or development

To bring up; train; educate

Noun:

Rearing, upbringing, training, education, or the like.

Development

Something that nourishes; nourishment; food.

NURTURING ARCHITECTURE /

Architecture as a vessel to protect the growth, stabilization and enhancement of ecosystems in the form of nourishment and educational development

## ABSTRACT /

The natural world consists of incredibly complex and integrated systems. Ecosystems and biodiversity all work cohesively to sustainably maintain the basis of our very existence on the planet. These interrelationships form the foundation of all living things and have zero impact on the natural environment. Mankind hugely influences “natural systems” through its introduction of “technological systems”. This influence is traceable to the unsustainable extraction of natural resources, which became wide-spread in the industrial era.

Since the start of the industrial era, city borders have rapidly expanded often leaving the inner-city decentralized. Such expansion has made its mark on the central business district of Pretoria, where natural voids have been created in the city fabric. The environment in the CBD, through the impact of human activities, is in a state of decay, which is a threat to the very existence of the ecological environment. Architecture needs to return to its roots and find a

spatial condition to co-exist with the natural realm in a regenerative manner. Thus utilizing nature’s ability to solve problems that we currently struggle with. This dissertation focuses on regenerative architecture. The ecological environment, and certain insects in particular, provides us with countless solutions. Unfortunately, we sometimes mistake the innovation and services of insects as the aggravation of pests. The proposed program therefore centers on the research of these insects and on learning what they can provide for the greater good of humanity’s future; a future where humans and nature have a mutually beneficial relationship.

This project also taps into the closed-loop-system of the regenerative theory in which, nothing is seen as a single entity, but rather as a system where anything is beneficial and interrelates to everything. This theory can only strengthen and densify Pretoria’s inner city, filling the voids with systems and contributing positively towards the regeneration of resources.



## UITTREKSEL /

Die natuurlike omgewing bestaan uit geweldige komplekse geïntegreerde sisteme. Die ekosisteme en biodiversiteit funksioneer in noue verband om ons bestaan op die planeet volhoubaar te ondersteun. Hierdie inter verwantskappe, is fundamenteel tot alle vorme van lewe en onderhou 'n gebufferde balans in die dinamiese funksionering van die natuurlike omgewing. Die mensdom oefen 'n groot impak op die natuurlike sisteme uit deur sy najaag van ontwikkeling en tegnologiese instellings. Hierdie impak word opgespoor in die nie-volhoubare onttrekking van natuurlike hulpbronne, wat wyd verspreid voorkom en algemene kennis geword het, veral in die industriële era. Sedert die begin van die modern industriële era, het stads grense vinnig gedentraliseer uitgebrei wat die binne stads area leeg van ontwikkeling en aantrekkings gelaat het. Sodanige uitbreiding het sy merk op die sentrale besigheids distrik van Pretoria gelaat, waar dit onnatuurlike leemtes in die stads weefsel geskep het. Die sentrale besigheids distrik omgewing het deur die impak van menslike aktiwiteite in verval geraak wat uiteindelik 'n wesentlike bedreiging vir die voortbestaan van die biodiverse ekologiese omgewing inhou.

Argitektuur het nodig om na sy wortels terug te keer deur die herontdekking van ruimtelike omstandigheds posisionering om met die natuurlike rykdom in 'n

vernuwende wyse saam te kan bestaan. Dit is moontlik deur die gebruik en nabootsing van die natuur se vermoë om probleme waarmee ons worstel, op te los.

Hierdie navorsings verslag, fokus op vernuwende argitektuur. Die ekologiese omgewing en spesifieke insekte, bied talle oplossings aan ons. Ongelukkig egter word die innovasie en dienste wat deur insekte verskaf word, misken en gesien as 'n uitbreiding van 'n plaag. Hierdie voorgestelde projek daarenteen sentreer op navorsing op bepaalde insekte en om te leer wat hulle kan aanbied vir die groter welvaart van die mensdom se toekoms; 'n toekoms waar die gesamentlike voordelige verhouding tussen mens en natuur meer krities raak.

Hierdie projek sluit ook aan by die "geslote-terugvoerstelsel" van die vernuwende teorie, waarin geen deel daarin as 'n enkel entiteit beskou word nie maar eerder as 'n sisteem van sisteme, waarbinne elke element voordelig en inter-afhanklik van die ander sisteem komponente funksioneer. Hierdie teorie kan daarom die sentrale stad area van Pretoria laat herleef en versterk deur die herskepping van leemtes en 'n positiewe bydrae lewer tot die vernuwende van natuurlike en mens gemaakte hulpbronne.

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# PROLOGUE

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# 1 / INTRODUCTION

## 1.1 / PROBLEM STATEMENT

### 1.1.1 GENERAL ISSUE

The threat of global warming has made news headlines for decades, and although numerous research projects have been launched to help counter this crisis, there has not been any significant change in the restoration of earth's resources.

Global warming is a result of human activity. The process of extracting minerals and resources from the planet's crust is destroying natural systems and so minimizes the biosphere. These extracted resources are processed through excessive "heating, beating and treating"<sup>1</sup> to mold and shape the product. During this process, large quantities of carbon dioxide are released into the atmosphere. This forms part of an invisible layer, making it impossible for heat to escape and ultimately causing the earth's surface to increase in temperature. Global warming strains natural systems.

Climate change is anticipated to increase environmental disturbances (Wells, et al, 2010). Drastic measures must therefore be taken to minimize disturbances in the future development and planning of cities. Current building regulations, like the SANS 10400-XA and SANS 204<sup>2</sup>, achieve a certain sense of sustainability. They will, however, not achieve a regenerative solution as the standards set for buildings to be deemed 'sustainable' are very low (Littman, 2009: 8). Sustainability in architecture is inadequate to fulfill the future's need for regenerating

the planet's biosphere, as it only stabilizes energy efficiency.

The natural world is an automatic system that 'recycles' and 'uses' resources in a closed loop, everything is connected as a whole and nothing is seen as a stand-alone entity. But we are abusing the resources in our biosphere at a rate faster than they can regenerate (Littman, 2009: 8). The built environment has a linear, one-way-flow. Its process of dealing with waste and resources and this closed de-generative structure results in the rejection of the entire system of the natural world. This rejection leads to the disturbance and degradation of the environment (Littman, 2009: 8).

We need to step back and accept that our current way of thinking about building processes and methods is insufficient. It needs to be adjusted, our time and energy must be refocused on shifting ideas from sustainability to new and innovative ways of dealing with our current problem. The world is changing rapidly with the development of new technologies and materials, but at a cost. People must understand how nature controls their environment and learn to adapt to nature's way of solving solutions.

### 1.1.2 URBAN ISSUE

To the settlers of Pretoria and the Ndebele tribes residing

<sup>1</sup> "Heat, beat and treat" is a term used by Janine Benyus to describe the intense energy and processing required to create a product (Pawlyn, 2011: 35).

<sup>2</sup> SANS 10400-XA and SANS 204 regulations attempt to regulate energy use and encourage energy efficiency in buildings (SANS Document).

in the area before them, the Apies River was a source of life. Farmers who settled here extracted water from the Apies River to sustain their farms. The river later played a significant role in Pretoria's establishment and formed the eastern boundary of the central district in 1879 (Jordaan, 1989: 27). Over time Pretoria extended its boundaries past the Apies River. The city's rapid development and expansion placed extensive pressure on Pretoria's water supply and has polluted the Apies River immensely leaving the once natural beauty that defined Pretoria a mere waste channel. Urban sprawl caused the decentralization of Pretoria's CBD as many of the old buildings in Pretoria did not meet the requirements for commercial use. This, and the search for up-to-date office space, has left certain parts of urban space without ownership. It has resulted in the decay of buildings and spaces between buildings due to a lack of maintenance.

The spaces thus formed in certain parts of the CBD have been occupied with informal activities, which led to the establishment of a crucial informal transport structure currently operating within the city central. This means that the development proposal for the Pretoria CBD, which focuses on the CBD but neglects the decayed spaces, must be reconsidered. Focus should be on densifying the city's original closed-grid-system by incorporating aspects of regenerative development into Tshwane's 2055 development proposal<sup>3</sup>.

### 1.1.3 ARCHITECTURAL ISSUE

A regenerative architectural approach aims to reverse the degeneration of natural systems by providing technical and passive systems able to co-exist with the natural. These two systems should therefore promote the mutual benefits gained from each other in order to develop a greater overall expression of resilience and life (Mang & Reed, 2012: 3).

How can the combination of 'technical and passive systems' with 'natural systems' create a spatial quality for the human condition? Furthermore, how can humanity co-exist with nature? In the relationship between a building and its immediate natural environment there exists a borderline. It represents the very edge where these two components meet and inform each other where they overlap or combine. The transition between these spaces must be designed in a reciprocal manner, indicating a mutual exchange of knowledge (Company, 2013: 1). Architecture influences, modifies and shapes the landscape but the landscape should also influence, modify and shape the architecture.

The shift is thus for the architect to design without following the principles of conventional methods, and to rather design functionally beyond carbon neutrality, by finding inspiration in nature (Pawlyn, 2011: 1).

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<sup>3</sup> Refer to chapter 4, Pretoria context

## 1.2 / RESEARCH QUESTIONS

- Can architecture facilitate human institutions that create opportunities for creative participation in the cycle of natural systems?
- Is it possible to apply 'regenerative design' principles<sup>4</sup> to the practice of revitalizing destroyed or abandoned natural habitats, to accommodate for a mutually beneficial habitat to both humans and nature?

Current urban conditions are generally detached from natural systems and all the beneficial 'services' they can provide humans.

- Can architecture create awareness and initiate an involvement to contribute towards an ecological paradigm<sup>5</sup>?
- Can architecture become an educational platform for the awareness of natural systems and the services they offer?

## 1.3 / RESEARCH OBJECTIVES

A primary objective is to determine the reconfiguration of Steward Brand's '6 S' theory towards an integration of the 'site, structure, skin and services'. The 'site' represents the characteristics of natural ecosystems and their benefits in creating a habitable space for human life. The 'skin' is the contribution of technical systems to the creation of a habitable space for insects in their natural environment. The aim is to holistically create a mutually beneficial environment where humans and insects can co-exist.

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<sup>4</sup> These principles will be discussed in Chapter 3.

<sup>5</sup> The Ecological stream will be discussed in the Chapter 3



#### 1.4 / RESEARCH METHODOLOGY

LITERATURE / Theoretical studies relating to concepts of regenerative architecture are investigated to appreciate the complex issues regarding ecosystems and the desire to go beyond sustainability.

MAPPING / Appropriate site investigation and mapping within the urban framework informed the development of a master-plan and group framework. A study of Eco-mapping deals with environmental issues regarding the ecological and physical conditions, landform, relationships on the site, circulations and movement patterns, existing vegetation and climatic condition. This method is used to establish the site characteristics that led to the informants of a design approach

#### APPLIED RESEARCH/

Data / The data is then summarized and applied to relevant aspects in order to complete the requirements for the design. The collection of site photos is essential in the study of site characteristics, scale, existing habitats and ecosystems and enables an appropriate design response.

analysis / The relevant data collected is then turned into evidence that supports the development of the dissertation and its arrival at an appropriate conclusion. The data is analysed to obtain the most relevant evidence relating to an outcome of the project. The data analysis is completed in computer investigations through the building of models and the delineation of presentation formats

#### 1.5 / DISSERTATION OBJECTIVES

The objective of this dissertation is to encourage people to recognize the potential of natural ecosystems and how these can not only benefit our way of living, but also contribute to the resilience of Pretoria's CBD and lead to a more regenerative future.

The growth and expansion of city development leaves little room for ecosystems to continue their natural cycle. This proposal will safeguard ecosystems on the intended site, creating an enhanced natural environment with a platform that educates the public by making information freely available. The proposal will also make use of on-site resources, such that it gives back more than what is taken out.

The main objective of the dissertation is to explore ways of dealing with conventional methods of regulating temperature in a building using the 'skin' with nature being the primary source of inspiration. This is done through the combination of natural and technical systems. These systems thus form one component of a building that uses various materials in assorted ways and in heterogeneous climatic conditions.

## 1.6 DELIMITATIONS

The dissertation does not focus on the proposal of changing and altering the Apies River, although it is mentioned in the urban vision. The main focus is rather the distribution and discharge of water to the Apies River from the proposed site.

It is not the aim of the study to propose new building methods. The aim is, instead, an exploration of new possible ways of using materials. We have developed a world where it is impossible to build without modern day technology, thus conventional methods of building are not excluded in this dissertation.

The program of the scheme is too large to explore in this dissertation. Therefore, detailed focus is only on a certain part of the design. The rest of the program is designed at an urban level in the group framework and is the explanation of, and response to, the urban vision for the entire site. The entomology department focuses on specific insects relevant to the program of the building, which is the insect 'order' of pollinators, no other insect species are investigated. This is not a biomimicry project, therefore no principles of the inner workings of the insects are used as design informants. The principles of ecosystem conservation for the insects are the main focus.

## 1.7 ASSUMPTIONS

It is assumed that the effects of the proposed water filtration that feeds into the Apies River will be implemented in various sections along the River, and will have a positive eco-systemic effect downstream, where the river flows through Pretoria North and terminates at the Pienaars River. A further assumption is that the soil on site, which is excavated and re-used as a part of the group framework, will be adequate for the use of berms or rammed earth as construction methods. It is also assumed that a new entrance to the zoo will be created in addition to the proposed new department in this dissertation. Two abandoned buildings located in the zoo area are to be demolished and their materials used for the proposed construction.

A final assumption is that the sports grounds on the school property will be altered to create a new zone for the proposed research building, and that relevant regulation will be implemented to create new sports field for the school.

## 1.8 IMPORTANCE OF STUDY

The importance of the study is; the reaction to the search for a regenerative future and to the way the built environment is one of the leading contributors to global warming. The crux is to find an alternative reconfiguration of building materials; enabling the building 'skin' to create a habitable space that does not damage natural ecosystems and regenerates the earth's resources. The proposal follows a principle of giving back to the environment more than what is taken away. The project creates new ways of exploring sustainability in the architectural field, as well as in other fields such as landscape architecture, entomology research, and ecosystem conservation. A critical outcome of this dissertation is to establish that collaboration between architecture and many other fields is required to achieve a sustainable future, research fields cannot function as separate entities, but must work together to achieve a shared goal.