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CRAFTING SUSTAINABLE FUTURES

Re-imagining the South African architectural language through the reintroduction of craft and *timber tectonics*

School of Craft:
A Timber Construction School
in Silverton, South Africa

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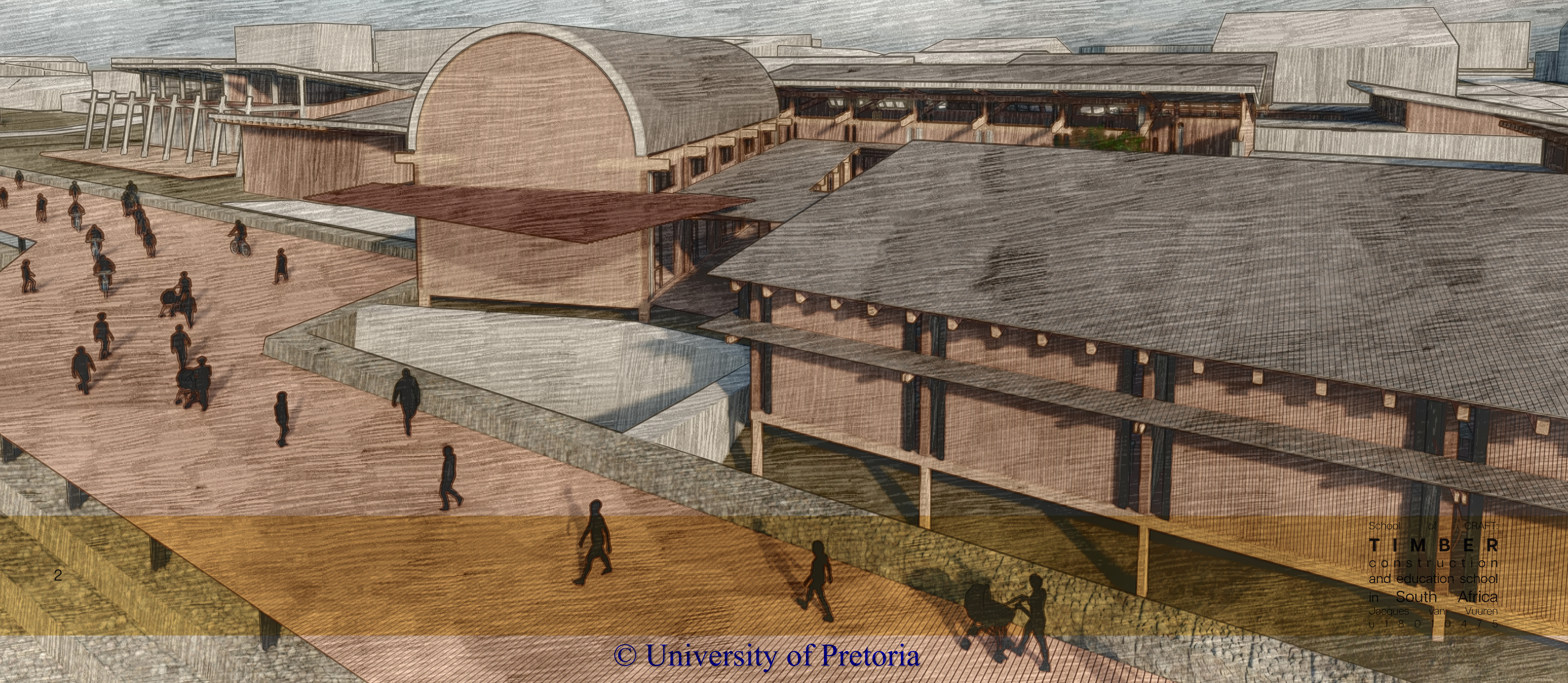
Abstract

This architectural master's dissertation investigates the transformative potential of timber construction and regenerative architecture in the South African context, through the establishment of the School of Craft in Silverton, Pretoria. The building industry in South Africa is experiencing a shift towards sustainable practices and the adoption of emerging building technologies, driven by the need to address climate change, celebrate cultural identity, and foster innovation. Timber construction, as a versatile and sustainable building material, is at the forefront of this transformation. The dissertation investigates the emergence of mass timber construction (MTC), which introduces new technologies, including digital design and CNC machining, to harness the full potential of timber as a structural material. The core theory of regenerative architecture guides the design principles of the School of Craft, emphasising conservation, performance optimization, and a deep understanding of natural and living systems in architectural design. In addition to timber the project integrates green building elements, such as green roofs, water collection and reuse systems, and energy-efficient strategies, to create a sustainable and regenerative learning environment.

The School of Craft serves as a hub for timber construction education, offering a comprehensive program that combines traditional craftsmanship with modern techniques, catering to both full-time students and professionals in the building industry. The project's design promotes accessible green- and recreational spaces, allowing the public to interact with the educational facilities and appreciate the students' work through exhibitions. The intended outcome of this project is to foster sustainable and regenerative practices in South African architecture, emphasising the importance of designing for disassembly to adapt to evolving needs and times. By merging the traditional art of craftsmanship with innovative timber construction methods and regenerative architectural principles, the School of Craft in Silverton aims to be a catalyst for a more sustainable and harmonious built environment in South Africa. This dissertation contributes to the discourse on timber construction, regenerative architecture, and the future of architectural education in South Africa, offering insights and recommendations for architects, educators, and policymakers interested in advancing sustainable and inclusive design practices.



Dedication

Eerstens wil ek God bedank vir hierdie geleentheid en seën om argitektuur te studeer en my passie te volg. Hierdie jaar sou nie sonder God se genade en heerlikheid kon plaasvind nie. Dit is alles tot eer van God en om sy genade, krag en oneindige liefde te wys. Tweedens, my ouers, Christo en Linda, is ek ewig verskuldig aan julle ondersteuning, liefde en hulp. Dankie dat jul my universiteit toe kon stuur en my kon help met my studies, van naby en ver. My suster, Li-Mari, dankie vir jou ondersteuning en motivering deur al die laat aande en moeilike voorleggings. Vir my vriende, om saam met julle te studeer was die beste ervaring in 'n opvoedkundige aspek en ek sal nooit die geselskap, laataandsessies, koffies, ondersteuning, inspirasie en motivering vergeet nie.

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Firstly, I want to thank God for this opportunity and blessing to study architecture and follow my passion. This year would not have been able to take place without God's grace and glory. This is all for the glory of God and to show his grace, power, and never-ending love. Secondly, my parents, Christo and Linda, I am forever indebted to your support, love, and help. Thank you for being able to send me to university and help me with my studies, from near and far. My sister, Li-Mari, thank you for your support and motivation through all the late nights and difficult submissions. For my friends, studying with you has been the best experience in an educational aspect and I will never forget the company, late night sessions, coffees, support, inspiration and motivation.

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To my special person Simoné, thank you for the endless video calls, motivation, and help. You are a big part of my success. The long nights and difficult times were always made easier with you there to help me. Here at the start of the journey, definitely there for the rest. I appreciate you and all you have done for me.

Jacques van Vuuren
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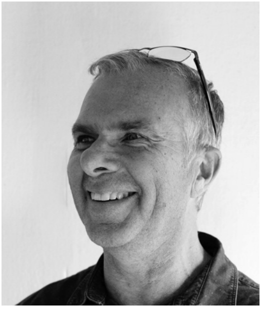
van Vuuren, Malan, Dauth, van Schalkwyk family members

Simonê Myburgh

Louis, Hendrik, Adrienne, Natasha, Cecelia, Megan, Mari, Kyla

Cobus Bothma
Study leader



Dr. Arthur Barker
Mentor and inspiration

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CONTEXT

Introduction & Background

South African Architecture

South African architecture has undergone numerous social and political changes and has been influenced by both local and international factors, resulting in a diverse blend of culture and history. The rural landscape of South Africa features a mix of traditional and European-influenced African architecture, which has greatly impacted modern architectural work (Conradie, 2021). South Africa's history of European political and economic dominance since the 17th century significantly impacted indigenous traditions. This control began with Jan van Riebeeck's arrival in 1652 under the Dutch East India Company, followed by conflicts involving Britain, France, and the Boers, shaping the country's urban development through colonisation (Dainese, 2015: 444). According to Sanders (2000: 68) nearly all of South Africa's architectural traditions have been influenced by European and American principles. Taking into consideration the influence of heritage and the prevailing state of affairs, the architectural landscape of South Africa during the 1800s witnessed the emergence of public works projects and private residences characterised by the Dutch, Victorian, and Edwardian architectural styles. Catalogue construction materials were transported to these locations and put together in colonial interpretations.

Moving into the present state of the building industry and architectural environment, the architecture and building technology of South Africa finds itself at a crucial juncture, and this state of affairs may have persisted for quite a while. According to Wu, Wei & Peng (2019: 8) building technology can be defined as the combination of materials, techniques, and structural systems. In the realm of contemporary "commercial" architecture, there seems to be a lack of progress, as it remains stagnant (Sanders, 2000: 70). Furthermore Kloukinas (2014: 58) also describes the state of building technology in the architecture industry and built environment in South Africa as being stagnant and stuck in its ways. On the other hand, contemporary community and civic architecture, driven by social and political motives, are unearthing designs that draw inspiration from the local culture, essence, and craft. It is within these realms of advancement that we can find optimism for the future (Sanders, 2000: 70). Current building practice, over time, has developed a "reputation for its slow uptake of technology compared to other industries such as manufacturing, agriculture and entertainment" (Calitz & Wium, 2021: 1).

According to Ampofo-Anti (2017: 2) the majority of the building sector in South Africa uses conventional building technologies, which are brick and mortar structures, which take a long time to construct in part because wet work requires lengthy curing times . It has been challenging for the building industry to evolve due to its segmented structure, site-based operation, and the professionals' reluctance to transformation (Osunsanmi et al., 2018: 150). In South Africa, historical construction methods were tailored to suit the unique climate and topographical conditions of the region. However, contemporary building practices have fallen into a pattern of repetition and a constrained use of technology, limiting their potential for innovation and adaptation to diverse environments (Bothma, 2023: 2). The construction process linked to traditional building technologies, such as brick and mortar, is characterised by a slow pace primarily because of the technological demands involved. These demands include the need to use a wide variety of building systems, products, and components that are assembled on the construction site (van Wyk, 2013: 1-2).

Building industry in South Africa

In recent years, there has been a growing trend towards a change in the architecture and building industry, as an example green building practices. In South Africa, many builders and developers are adopting sustainable building practices such as using environmentally friendly materials, implementing energy-efficient designs, and incorporating renewable energy sources. The necessity to minimise carbon emissions and the growing awareness of climate change have motivated this (GBCSA, 2021).
According to the Sustainability Institute (2021) there are a number of causes for the need for change in South African architecture, here are a few of them: Climate change: The effects of climate change, such as rising temperatures, droughts, and flooding, are particularly dangerous for South Africa. Designing buildings that are energy-efficient, employ sustainable materials, and are built to endure extreme weather events can help with climate change mitigation and adaptation. Cultural identity: It is possible to express and celebrate South Africa's rich cultural past through architecture. Architects may foster a sense of place and a link to the neighbourhood by incorporating regional materials, building methods, and architectural aspects into structures. Innovation and creativity: Both the economy and the creative sector are thriving in South Africa. By encouraging innovation and creativity in design and construction, architecture can support this growth. In general, the push towards sustainability, inclusivity, and innovation in the built environment is reflected in South Africa's desire for change in its architecture (Nkuna, 2021). By addressing these challenges, architects can create buildings and spaces that better serve the needs of South Africans and contribute to a more sustainable and equitable future (van Wyk et al., 2021).

While South Africa may face some challenges in terms of innovation in the architecture and building industry, the country has made significant progress in adopting sustainable building practices and promoting local innovation (GBCSA, 2021). South Africa has a growing industry in the development and production of innovative building materials, such as recycled materials, lightweight concrete, and prefabricated components. South Africa has a unique set of challenges and opportunities that require localised solutions. This has led to a growing focus on community-based design and the integration of local materials and building techniques (Wessels & Fataar, 2021). South Africa has several reputable architecture schools that are producing talented and innovative architects (SAIA, n.d).

Emerging Building Technologies

Use of alternative building technologies

Although the reluctance is evident, organisations such as Agremènt and the CSIR (Council for Scientific and Industrial Research) are pushing the boundaries of South African Architecture and the introduction of innovative building solutions (Conradie, 2014). In recent years, there has been a growing fascination with Innovative Building Technologies (IBT) in South Africa. Notably, in 2013, the CSIR (Council for Scientific and Industrial Research) proposed to the Presidential Infrastructure Coordinating Commission that IBTs should be embraced for enhancing social infrastructure delivery in the country (Olojede et al., 2019: 170).

Emerging Building Technologies

In the context of contemporary projects, the utilisation of alternative methods or approaches can be seen as the advancement of emerging building technologies. The incorporation of these nascent building technologies largely relies on the preferences of the architect or the client's specific demands. Notably, these emerging building technologies bring distinct advantages to the built environment, particularly in the case of South Africa, where persistent challenges have been mentioned earlier. The rationale behind adopting these emerging building technologies can be categorised into four primary values:

Economical: An alteration in the current practices aimed at expanding the utilisation of emerging building technology offers the potential for the South African built environment to become more "versatile, economical and contextually responsive" (Bothma, 2023: 2). Other benefits associated with implementing innovative building technologies for project delivery are described by Ampofo-Anti (2017: 2) to be reduced construction expenses, a decrease in the construction timeline, and improved building quality.

Versatile: As an example, utilising a building technology that centres around the precise assembly of factory-manufactured components represents a practical and significantly more reliable approach to attaining the desired performance levels of construction projects. In contrast, traditional construction methods, characterised by uncertainty and inconsistency, do not present a comparable prospect for achieving the same level of certainty. (van Wyk, 2013: 4)

Socially responsive & Contextually responsive: The limited and dependable access to transportation and the challenges of reaching remote construction sites often hinder the deployment of promising technologies and skilled labour. The portability of certain emerging building technologies, however, proves to be beneficial as it allows these innovations to reach and benefit a wider population (Mehta and Bridwell, 2005: 74).

Understanding what these emerging building technologies are will add to the discourse by having a better understanding of what practices are possible and successful to the extent where they can serve as examples on how to design and build in South Africa in the present and the future. The unconventional, alternative and/or innovative characteristics of these emerging building technologies provide information on materials, techniques and structural systems that we know little to nothing about.

Timber construction in South Africa

Architecture can be defined as either stereotomic or tectonic. Described by Schwartz (2016: 47), "stereotomic construction is characterised by piled or stacked mass elements such as stone, brick, or earth" and tectonic construction "refers to lightweight, assembled structures". When examining the building practices of South Africa, one cannot ignore the influence of conventional construction methods that have shaped the nation's architectural landscape. The term stereotomic aptly characterises the prevailing approach, both in its literal reliance on specific construction materials and in its figurative resistance to change. The essence of South Africa's conventional construction, can be described as the use of brick-and-mortar, concrete, stone, and emerging earth-based structures that have become increasingly popular.

The primary objective of this study centres around investigating the tectonic architecture of buildings in South Africa, with a specific emphasis on timber construction as a prominent and burgeoning building technology that holds immense potential for sustainable and eco-friendly development in the region. As the demand for environmentally conscious and resource-efficient structures grows (Aigbavboa et al., 2017: 3005), the exploration of timber's structural capabilities and its integration into contemporary construction practices becomes ever more crucial. According to Burdzik & Van Rensburg (1991: 287) the timber construction sector has been excessively comfortable in its standing in the construction industry. Burdzik & Van Rensburg (1991: 291) has the opinion that if the industry's annual revenue is taken into consideration, very little money has been invested in research into the development of new structural applications and the enhancement of current products.

South Africa's architectural landscape is witnessing an exciting evolution with the introduction of new timber construction methods. Timber, as a versatile building material, is now being explored across a spectrum that stretches from low-tech to high-tech approaches. This classification is influenced by both the composition of the material itself and the innovative methodologies employed in its processing and manipulation. In this dynamic environment, traditional timber sections crafted through conventional methods are juxtaposed with cutting-edge alternatives like mass timber, including Cross Laminated Timber (CLT) and Glue Laminated Timber (GLT), as well as digital production techniques such as CNC milling and laser cutting, which have emerged as novel modes of fabrication. The fusion of old and new techniques in timber construction is reshaping the architectural scene in South Africa, providing architects and designers with an array of possibilities to create sustainable, efficient, and aesthetically pleasing structures.

KEY THEORY

Regenerative architecture

Regenerative architecture embraced the natural world as both the medium and source of inspiration for the creation of buildings. It actively harnesses and integrates the inherent living and natural systems present in a site, which serves as the fundamental elements of the architecture. This approach to architecture entails two main objectives: prioritising conservation and optimising performance by deliberately minimising the environmental footprint of a building.

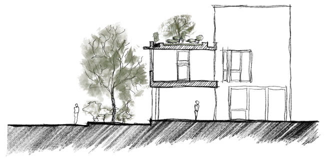
The current standard of building sets a low bar for environmental sustainability (Littman, 2009, 7). Regenerative architecture, as outlined by Littman (2009), presents an alternative approach that views the natural world not just as a backdrop but as an active participant in the creation of architecture. This approach utilizes the living and natural systems present on a site as fundamental elements, emphasizing conservation and performance through reduced environmental impact (Littman, 2009, 7).

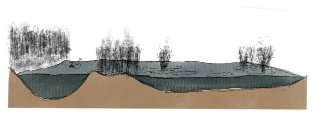
Central to regenerative architecture is the comprehensive understanding of natural and living systems in design (Mang and Reed, 2012, 26). This involves considerations such as material selection, reduced energy consumption, and intelligent design. The significance of treating the environment as an equal shareholder in the architectural process is paramount, marking a departure from traditional approaches (Littman, 2009, 7). In contrast to conventional building standards, regenerative architecture seeks to integrate the environment's inherent wisdom, drawing on millions of years of engineering and evolution to create sustainable structures.

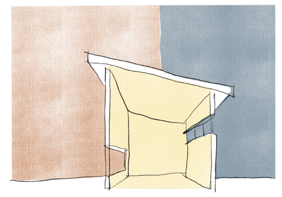
Furthermore, regenerative design goes beyond mitigating the impact of human activity; it seeks integration with evolving natural systems (Mang and Reed, 2012, 26). This involves recognizing the potential arising from human presence on Earth and aligning human communities with life processes. Unlike conventional eco-efficient design, regenerative development focuses on continual cultural evolution in harmony with life's evolution (Mang and Reed, 2012, p. 26). Achieving success in regenerative practice necessitates a fundamental shift in mindset, requiring a new world-view and paradigm for approaching every aspect of the building process (Littman, 2009, 7). Designers in this context are akin to gardeners, consciously shaping ecosystems to foster healthy growth within the broader natural context. To excel in regenerative practice, designers must possess ecoliteracy, understanding how living systems work, and cultural literacy to engage communities co-creatively in the design process (Mang and Reed, 2012, 26).

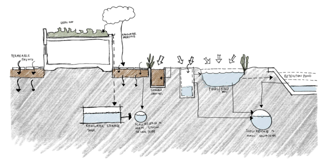
Architectural regeneration transcends mere physical structures, encompassing a holistic integration of elements beyond the confines of the built environment. It extends to the surrounding context, including the site, systems, energy dynamics, biodiversity, and more. In essence, regenerative architecture is a seamless incorporation into the very fabric of the site itself, as articulated by Littman (2009, 10).

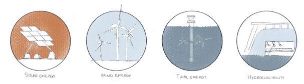
Embracing a paradigm shift in the context of contemporary built environments, one that aspires to reconcile, if not synchronise, with the natural world, holds the potential to address the prevailing disconnection (Lobos, 2018, 12). Regenerative architecture emerges as a viable strategy for achieving this harmonious coexistence with the environment

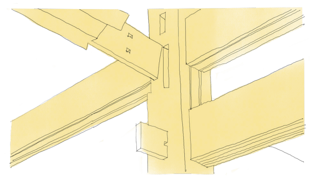

Green roof systems

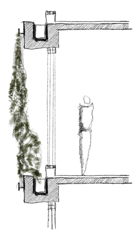

Restoring and creating opportunities for new biodiversity

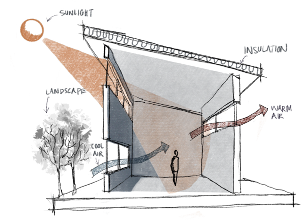

Ability to adapt to weather conditions

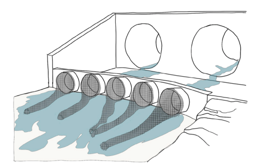

Water harvesting and storage systems

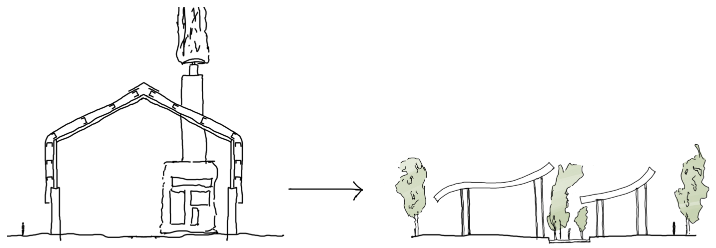

Creating and storing energy


Materiality of building more sustainable


Green skin or envelope systems


Solar heating principles and passive cooling systems


Adressing pollution


Regeneration of the industrial / educational building typology

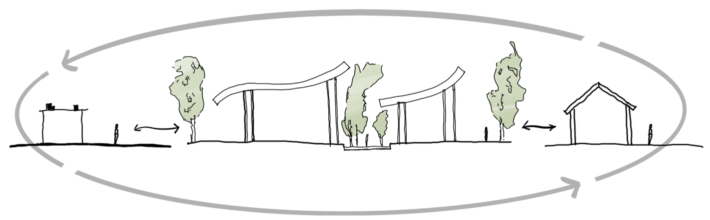

Regeneration of the environment through the new building and the programme

Figure 1: Regenerative architecture principles (Author, 2023)

Designing for Disassembly

Designing for disassembly (DfD) is a critical consideration in the architectural process, driven by several key principles and a deep understanding of the environmental and technical aspects of building design. The rationale behind DfD is summarised by Crowther (2009, 7) into three core themes:

1. Holistic Environmental Sustainability: Building design should embrace a holistic model of environmentally sustainable construction. In our current linear model of resource consumption, materials are extracted, processed, manufactured, used once, and then disposed of, contributing to environmental degradation. DfD offers an alternative by promoting a circular approach, where building materials and components can be recycled or reused, reducing the burden on natural resources and minimising waste. This transition from a linear to a circular model is essential for the sustainability of our built environment.
2. Layered Approach: A fundamental principle of DfD is recognizing buildings as compositions of various layers, each with distinct service lives. Typically, the structural frame endures while space-making components and services evolve and change. This layered approach allows for adaptation over time, as interior components are removed and replaced to suit evolving spatial needs. By considering these layers, we can design for disassembly of components with shorter service life expectancies, enhancing flexibility and reducing waste.
3. Recycling Hierarchy: DfD incorporates a recycling hierarchy that acknowledges the cost-benefits of different end-of-life scenarios. Four primary recycling scenarios emerge: building reuse or relocation, component reuse or relocation in a new building, material reuse in the manufacture of new components, and the production of new materials. These scenarios are not equal in terms of environmental impact; for instance, reusing a building component is more environmentally desirable, requiring less energy and resources compared to recycling base materials. This hierarchy guides sustainable decision-making throughout the design process.

Designing for disassembly principles

Provide permanent identification of component type.	Minimise the number of different types of components.	Allow for parallel rather than sequential disassembly.
Use mechanical connections rather than chemical ones.	Use a minimum number of fasteners or connectors.	Design joints and connectors to withstand repeated use.
Use construction tech compatible with standard building practice & common tools.	Use prefabricated sub assemblies and a system of mass production.	Separate the structure from the cladding, internal walls, and services.
Use recycled and recyclable materials.	Use lightweight materials and components.	Use a structural grid.

Figure 2: Timber detailed column connection ("Nest we grow" by Kengo Kuma)

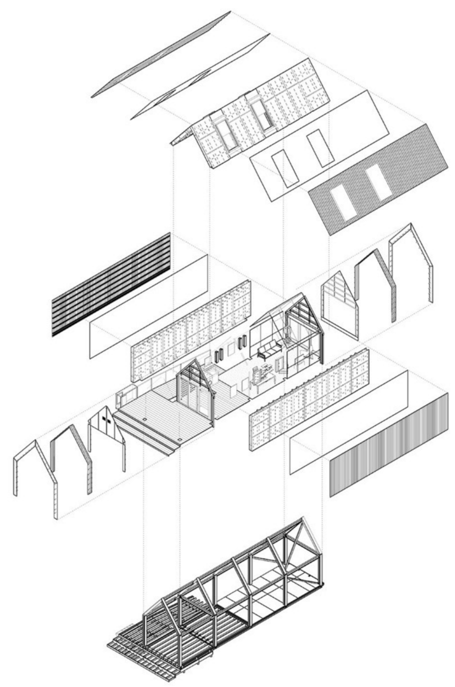


Figure 3: Construction diagram of The Circular Building (Arup Associates, 2016)

Craft

Our built environment has developed together with the evolution of our toolkit since the first time that wood was used "as a material for craft" and was initially cut with primitive cutting tools like stone and bone (Hanlon, 2017: 10). In the realm of modern architectural history, architects have often construed craft as a mere act of execution, signifying the completion of a predefined proposal. Nonetheless, a more profound interpretation of craft reveals its potential for fostering an open-ended and dynamic engagement with both material and process.

In this context, craft transcends conventional boundaries and assumes the role of an evocative journey, where it becomes inseparable from the process of discovery, intertwining with the pursuit of mastery (Stein, 2011: 49). The essence of craftsmanship in architecture resides within the intricate interplay of connections established by a building or space. These connections manifest on two distinct levels: firstly, internally, as they bind together the constituent elements, and secondly, externally, as they define the structure's interaction with its surrounding environment (Forker, 2015: 10).

From this basic substance, new technologies sparked change, creativity, and the creation of new shapes (Hanlon, 2017: 10). Architecture is described by Louw (2021: 24) as being posited as a craft, that is, as the hands-on implementation of "established knowledge" with rules of the various levels of intervention. Barker (2013: 2) argues that three things are necessary for craft expertise: "knowledge, skill, and aptitude". This can be seen as the knowledge about the materials worked with, skills the craftsman has with the tools he uses and the aptitude of the craftsman to work with the combination of knowledge, skills, materials and tools.

The idea of architecture as a craft, or as the actual application of "accepted knowledge" through principles for various levels of intervention, is put forth by Frampton (2001: 3). The mediaeval centuries was when our contemporary conceptions of "craft and handiwork" first emerged, with the artisan gaining dignity more comparable to artists than to labourers (Hanlon, 2017: 24). Art and craft share an overlapping nature as they both represent expressions of creativity. A key component of a craft-based design approach in the architecture we should design is "knowledge of building traditions, local materials, technological advances, culture, climate, and place" (Barker, 2013: 2).

Craftsmanship and art have existed for ages. The ability of the artist or craftsman to create a tangible product or work back then depended on the mediation between the head and mind. Since the start of the Industrial Revolution, this idea has been viewed as being in peril (Greyling, 2020: 40) because machines and technology can now be used to produce and make things. The "building crafts" can be broken down into two basic processes: "stereotomics of the earthwork", in which mass and volume are both formed through the repetitive piling up of heavyweight components, and "tectonics of the frame", in which lightweight, linear parts are assembled so as to encompass the spatial framework (Frampton, 2001: 5).

Figure 4: Hand planing of timber (Author, 2023)

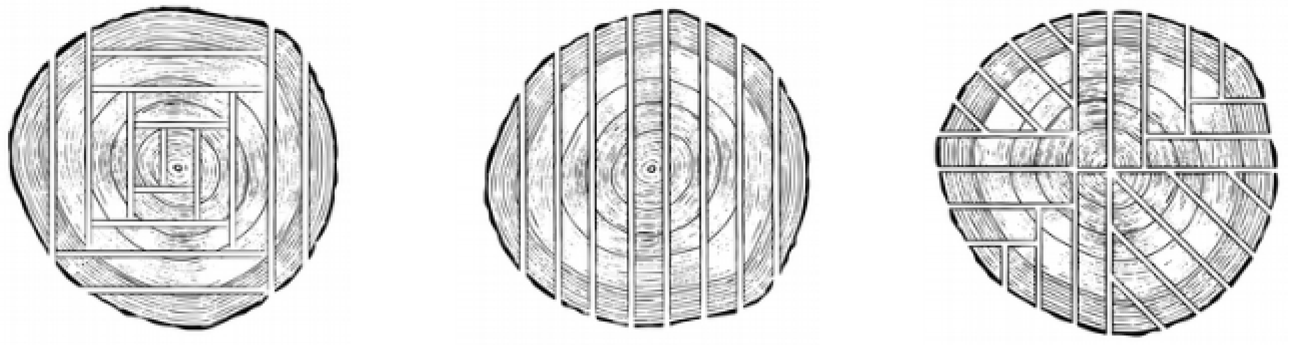
Timber Construction

Timber is a fundamental component in construction. Part of what gives timber an innate link with humans is the basic nature of the act of felling a tree, milling it, and combining its components into a larger architectural body (Richardson, 2013: 26). The main application of structural timber produced domestically in South Africa is the building of residential roof trusses. In the local building industry, structural wood makes up more than 70% of the material. The majority of the Pinus species used for structural lumber in South Africa is South African pine (Crafford et al., 2017: 1). The majority of the time, structural timber is also chosen because of its advantages for the environment, availability, affordability, and structural effectiveness (Louw, 2021: 101).

Since the dawn of architecture, wood, one of the earliest building materials ever employed by man, has been a part of the built environment (Golański, 2018: 760). A number of things caused the utilisation of timber as the primary building material to gradually dwindle. The flammable quality of wood is the most noteworthy. Noted by Greyling (2020: 27) during the pre-Renaissance eras, urban densification led to numerous large urban fires. The trend toward using increasingly non-combustible materials like bricks, concrete, and steel was fuelled by historical fires like the Great Fire of London (1666), the Great Chicago Fire (1871), and the Boston Fire (1872).

Although it had a rebirth and renaissance in the late 1960s and early 1970s, traditional timber framing and heavy timber building still faces the special issue of having to deal with either smaller sections and dimensional timbers or working with engineered or laminated wood (Hanlon, 2017: 33).

The utilisation of timber as a primary building material in the 19th century in South Africa had been severely restricted, primarily reserved for applications such as roof trusses, interior cladding, and decorative elements and this limited use of timber has played a role in the diminishing significance of timber culture (Greyling, 2020: 29). A specific reason for the lack of timber construction in the beginning of the formation of architecture in South Africa and this is described below by Radford (1998: 4-7):



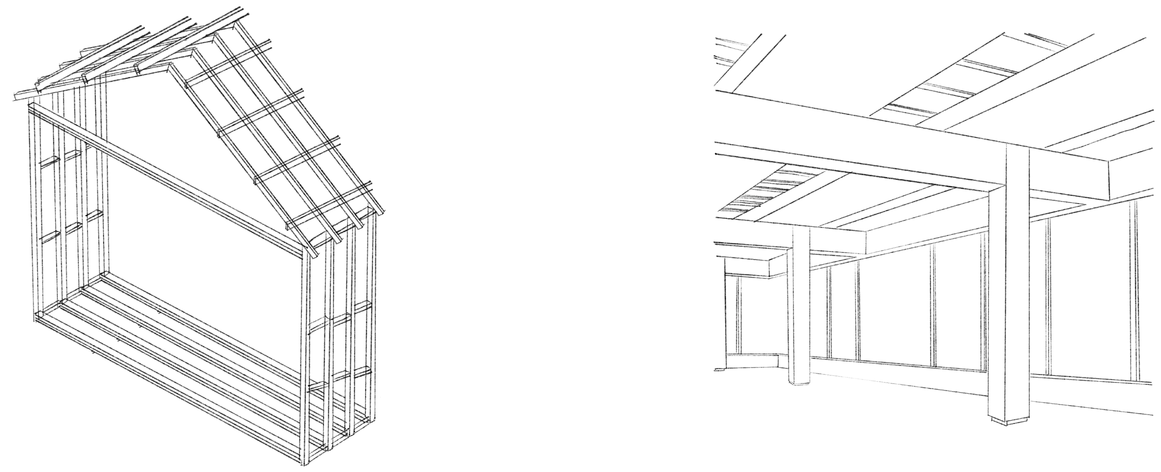
Tangential cut *Flat-sawn* *Quarter sawn*

Figure 5: Timber sections examples (Hanlon, 2017: 34)

The utilisation of timber as a primary building material in the 19th century in South Africa had been severely restricted, primarily reserved for applications such as roof trusses, interior cladding, and decorative elements and this limited use of timber has played a role in the diminishing significance of timber culture (Greyling, 2020: 29). A specific reason for the lack of timber construction in the beginning of the formation of architecture in South Africa and this is described below by Radford (1998: 4-7):

> *During the late 19th century, several building bye-laws were introduced in South Africa to regulate construction in emerging towns and settlements. Natal's Pietermaritzburg was among the first to control building materials, prohibiting anything below sun-dried brick in 1856. However, these early laws did not mention the use of wood and iron in construction. The first mention of wood and iron in building regulations was in Section 69 of Durban's bye-laws, gazetted in November 1878. But a significant change occurred with the revised set issued in June 1895. This new set explicitly prohibited the construction of new buildings made of wood and iron within 20 feet of the street line, regardless of their intended use as a dwelling house or for any other purpose.*

Many South African structural engineers view timber as a sub par building material that may be employed by relatively inexperienced labourers but lacks the durability of concrete or steel (Burdzik and Van Rensburg, 1991: 1). Even though they weren't contemporaneous, timber construction techniques developed over time to become what we are familiar with today: the timber frame system (Figure 15) as well as the post-and-beam system (Figure 16) (Greyling, 2020: 27).



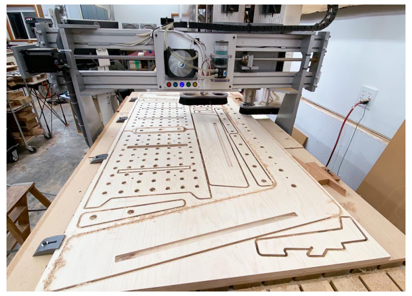
Timber frame system *Post-and-beam system*

Figure 6: Timber construction systems (Author, 2023)

Timber Construction

Burdzik and Van Rensburg (1991: 4) believe that the timber building sector has been far too complacent about its status in the construction market. If the industry's annual revenue is taken into account, very little money has been invested in research into the development of new structural applications and the enhancement of current goods. Following a time of relative contraction, wooden structures are once again popular (Golański, 2018: 760) due to their physical qualities, ease of shaping, and uncomplicated production process, as well as their remarkable ecological potential. In the realm of architecture, timber serves as a versatile building material and system that can be classified along a spectrum ranging from low-tech to high-tech.

This classification hinges on both the composition of the material itself and also building methods/techniques employed in its processing and manipulation. In the realm of low-tech approaches, one encounters the familiar conventional timber sections, which are well-established and typically worked on using traditional methods such as hand planing and sawing. On the other end of the spectrum, the high-tech domain features advanced alternatives like mass timber, encompassing Cross Laminated Timber (CLT) and Glue Laminated Timber (GLT), as well as digital production techniques such as CNC milling and laser cutting, which have emerged as novel modes of fabrication.



CNC machining (Technology based)

Holzbau Hess - hand crafting and clamping (Hand based)

Figure 8: "Timber techtonics"

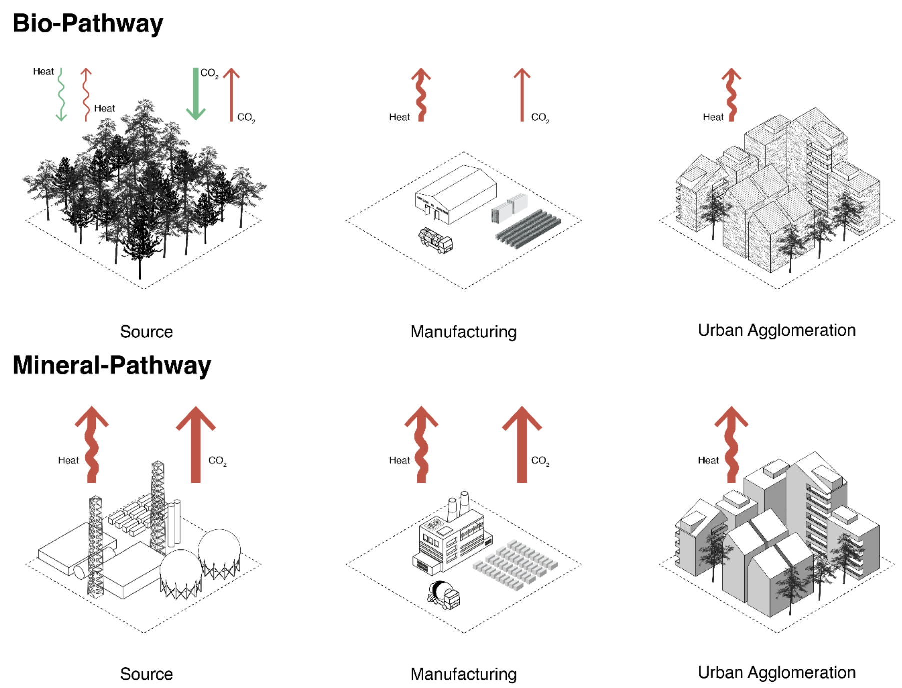


Figure 9: Atmospheric effects of materials in building production and urbanization(Churkina and Organschi, 2022)

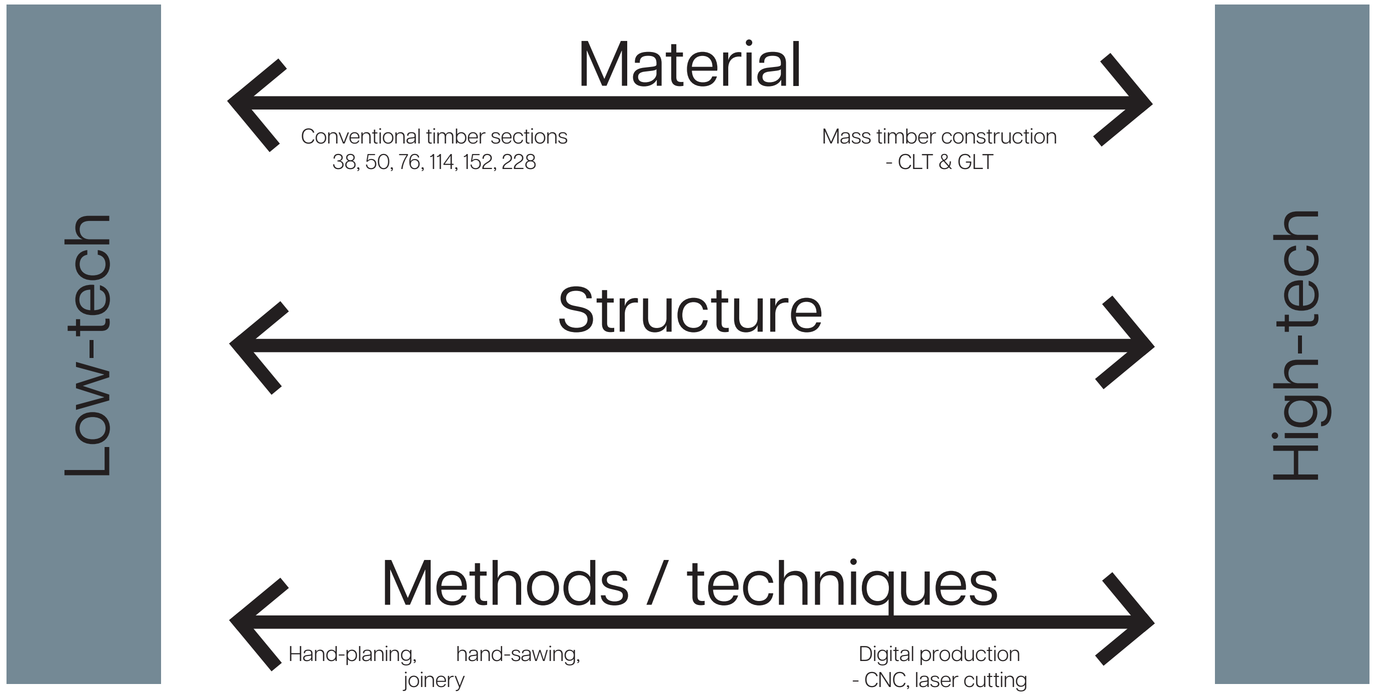


Figure 7: Modern day timber scale (Author, 2023)

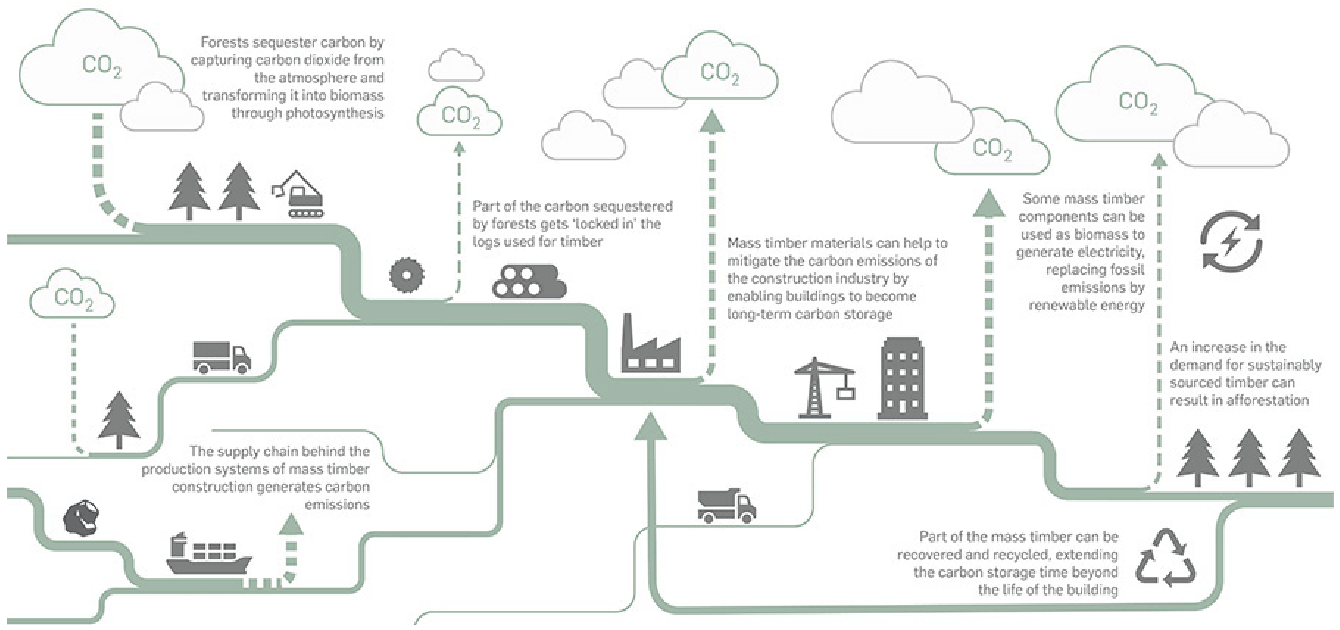


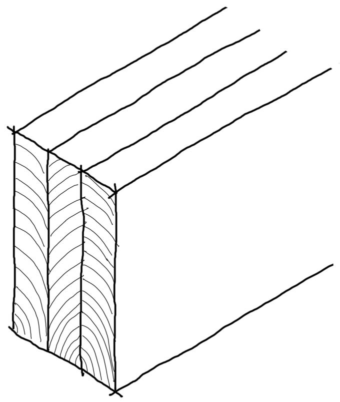
Figure 10: The embodied emissions and carbon sequestration potential of mass timber construction materials (Bunster n.d)

Mass Timber Construction

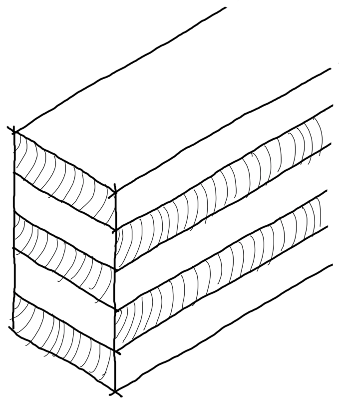
Throughout the 19th and the most of the 20th centuries, high-rise buildings did not realise the use of timber as a primary structural component until 1990. Mass timber construction (MTC) is a brand-new idea that was created by companies in Europe and North America (Greyling, 2020: 27). Given its ease of machining, Golański (2018: 761) argues that wood "makes an ideal material for digitally controlled processing portals," which has caused it to assume the position of a high-tech material. Greyling (2020: 27) states that cross laminated wood (CLT), laminated veneer lumber (LVL), and laminated strand lumber (LSL) are a few examples of engineered wood products used by MTC. This might be applied to a building's complete construction, including all of its structural and aesthetically pleasing components.

Stronger than steel, glue laminated timber is a truly exceptional material (Kumru, 2017: 14). The applicability of wood structures has been marvellously broadened by digital design (Menges et al., 2017: 2). Utilising glulam material and employing wood as the main building material, CNC production and laser cutting in combination with glulam timber allow designers to create intricate forms (Kumru, 2017: 14). Timber construction composed of engineered wood products is once again gaining popularity due to the global demand for environmentally friendly construction. The use of wood in construction is a reflection of processing technologies over time. There isn't a construction technique that more clearly demonstrates how architectural design, processing technologies, and fabrication procedures relate to one another (Golański, 2018: 760).

The introduction of computer numerically controlled (CNC) equipment and the creation of engineered wood have altered the scope, pace, and style of wood construction as well as how wood is harvested and turned into building materials. Our built industry is changing as a result of the integration of digital fabrication and representation into architectural design, education, and construction work flows. This has also had a big impact on what we think is feasible and viable to build with wood (Hanlon, 2017: 10).



Glue-laminated timber section



Cross-laminated timber

Figure 11: Mass timber types (Author, 2023)

Advances in timber manufacturing

Modern architecture offers designers new opportunities for sculpting architectural shapes because of the development of digital design tools, computer technology, and CNC woodworking (Golański, 2018: 761). The convergence of technology and craft, often referred to as techno and techê, is becoming increasingly intertwined. Considering digital design or manufacturing as equal to traditional craft disregards the significance of physical engagement that defines craftsmanship. However, rejecting the notion of digital craft outright neglects the potential for a revitalised craft in the digital era (Louw, 2021: 38). With the introduction of CAD tools, a new process for architectural design called "digital tectonic design" arose (Golański, 2018: 760).

It is possible to combine industrial manufacturing and craft to reap their combined benefits. It can also be said that, "after two centuries of being conceptually severed," technology and craft are starting to intersect once more (Louw, 2021: 38). High-strength connections, digital fabrication, glulam (glued laminated timber), CLT (cross laminated timber), LVL (laminated veneer lumber), PSL (parallel strand lumber), LSL (laminated strand lumber), OSL (oriented strand lumber), and roof and floor trusses are examples discussed by Golański (2018: 760) of recent technological advancements that have made it possible to use timber in previously unheard-of ways.

A new tectonic paradigm for architects is suggested by the connections between the computational power of parametric design and CAM and CNC building technology. A building's precision and efficiency can be greatly increased by the integration of innovative architectural expressions and structural technologies using digital tectonic design (Golański, 2018: 768).

Figure 12: CNC machine in GUAJA Sapucaí (Flat27, 2021)

PROJECT BRIEF

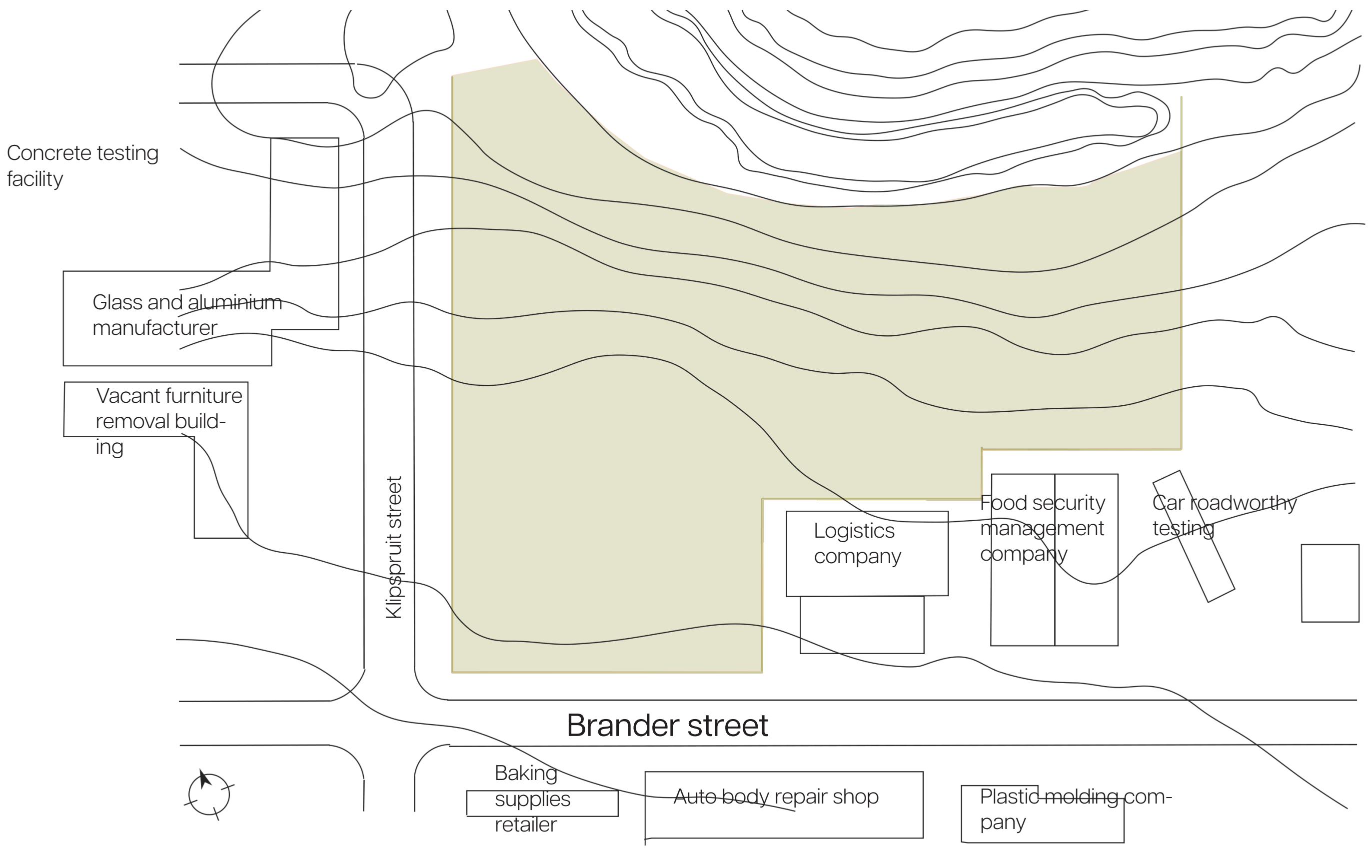
Project brief

Site

Located on the periphery of the industrial district in Silverton/Silvertondale, Pretoria, this site is nestled amidst a transitional zone that separates industrial and residential areas. The site is intersected by the Moreleta Spruit, a watercourse that flows from south to north, ultimately feeding into the Roodeplaat Dam to the north. The immediate context is dominated by imposing industrial structures, devoid of any meaningful human interaction, characterized by tall and unwelcoming façades. The absence of accessible and secure green spaces within the community significantly compromises the residents' overall quality of life.
The prevailing industrial character of the Silverton built environment, along with the nature of activities carried out in the vicinity, contribute to an unsustainable and uninviting atmosphere. The surroundings are marred by the presence of industrial and everyday waste, further exacerbating the challenges. The Moreleta Spruit itself is rendered inaccessible due to the overgrowth of reeds and weeds, exacerbated by pollution seeping into its waters. This site comprises a neglected concrete platform that once served as a parking lot for neighbouring structures. Over time, the relentless forces of nature have taken their toll, as the ecosystem seeks to reassert itself, gradually reclaiming the concrete surface with resilient vegetation flourishing through every available crevice.

Pretoria, South Africa

Silvertondale / Jan Niemand Park



Site in Silvertondale / Jan Niemand Park

Figure 13: Site plan diagram (Author, 2023)

Site in Silvertondale / Jan Niemand Park

Figure 14: Aerial site photos (Author, 2023)

Project brief

Programme

The School of Craft—a timber construction institution strategically located in Silverton. This technical and vocational school aims to be a hub where students not only gain practical experience in working with timber but also delve into the nuances of designing, working, and building with timber, specifically tailored for the South African context. The woodworking education offered is a harmonious blend of traditional craftsmanship encompassing timber joinery and steam bending, and modern techniques involving CNC machining and laminating to create mass timber structures.

This school environment transcends traditional boundaries, incorporating not just workshops but also classrooms for theoretical teaching, private and public libraries to disseminate knowledge to both students and the public, an auditorium for expert lectures, and exhibitions open to the public—a crucial conduit for knowledge transfer. Nestled within a tree-filled green space in the heart of an industrial precinct, a dining hall overlooks the Moreleta Spruit, offering a space where individuals, both from the school and the public, can connect with each other and nature. The overarching goal of this project is to weave a connection between the people of Silverton and the green space, an oasis often overlooked and inaccessible, transforming the language of industrial and educational typologies to forge more human-centric architectures that prioritise the user and the environment over mere products.

Silverton, renowned as a hub for the automotive and building industries in Pretoria, offers an ideal location for the implementation of a program that has the potential to significantly influence the construction sector. This program aims to facilitate the transfer of knowledge and expertise from experienced practitioners into the building industry, fostering innovation and advancement within the field.

Users

To facilitate a nuanced understanding of the varied user demographics inherent in this architectural project, consider a spectrum of stakeholders navigating the designed space. Students and educators, equipped with unfettered access to the entirety of the facilities, traversing the architectural landscape seamlessly. Concurrently, the public, a diverse amalgamation of families, local residents, industrial labourers, and day visitors, would encounter a more restricted access, tailored to specific on-site programs. The student body manifests in two distinct cohorts. Firstly, full-time students, freshly graduated from high school, seeking comprehensive immersion in the educational milieu. Concurrently, the workshops and classrooms open their doors to part-time students who, on weekends or specified time slots, engage with the educational offerings. This subset comprises individuals already in the building industry, including but not limited to contractors, builders, architects, and engineers, enriching the academic ecosystem with their practical insights and professional experience. The academic faculty, comprising adept artisans specializing in the timber trade, assumes the role of educators, imparting not only theoretical knowledge but also the invaluable wisdom acquired through hands-on experience. Their expertise becomes a cornerstone for fostering a learning environment that transcends the conventional boundaries of academia. Extending the accessibility horizon beyond the confines of the educational enclave, the auditorium, dining hall, and the public library—dual-functioning as an exhibition space showcasing the students' work—extend an invitation to the broader public. This strategic openness aims to weave the community into the fabric of the educational institution, creating an interface where the local populace can engage with and appreciate the endeavours of the students. In essence, the envisioned design encapsulates a dynamic interplay between students, educators, and the wider community, fostering an inclusive and collaborative atmosphere conducive to learning, skill development, and cultural exchange.

Intended outcome

In addressing critical issues such as sustainability, the natural environment, and emerging building technologies, the project embraces the theoretical framework of regenerative architecture. This holistic approach integrates elements such as green roofs, water collection and re-use systems, a meticulous understanding of the natural environment and its rehabilitation, energy capture through solar panels and hydroelectricity generation, and the incorporation of courtyard-type spaces to naturally cool buildings while introducing greenery into and around built structures. The water collection and re-use systems refer to the water that is collected and used again in the buildings' grey water systems, the water for the steam bending and the water bodies that offer evaporative cooling. Timber, as the primary structural component, not only serves as an exhibition element but also emerges as a solution to combat depleting resources, CO2 emissions, and the creation of non-renewable buildings and structures. A pivotal design principle is the emphasis on designing for disassembly, enabling the project, program, and site to regenerate into different configurations and solutions, adapting seamlessly to the evolving times.

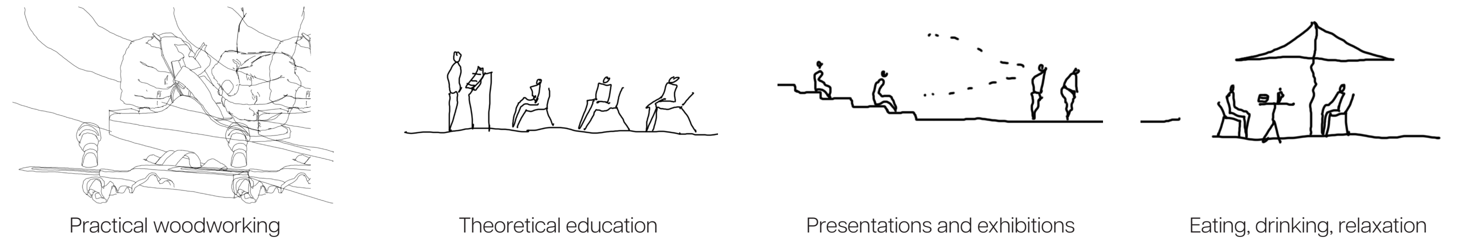


Figure 15: Programmes diagram (Author, 2023)

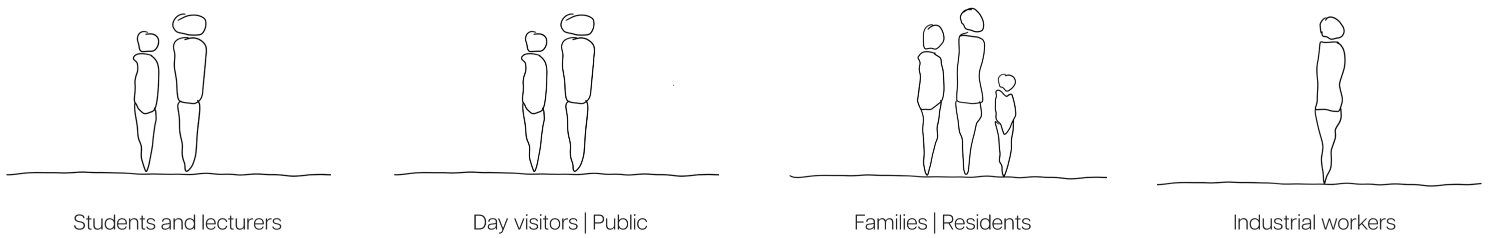


Figure 16: Users diagram (Author, 2023)

KEY DESIGN INFORMANTS

Informants - Macro scale

In the context of Gauteng, an exploration was undertaken to delineate the landscape of the building industry, focusing on the manufacturers and suppliers of conventional building materials. This mapping effort revealed the emergence of two distinctive clusters: the CBD cluster situated on the left and the Silverton cluster on the right. The CBD cluster is characterized by a concentration of technical colleges, imparting mostly theoretical knowledge. However, a notable disparity arises as the CBD cluster is not in close proximity to the actual manufacturers and suppliers of building materials, thereby creating a potential gap between theoretical learning and practical exposure.

Upon closer examination of the Silverton cluster, a distinct pattern unfolds. This area is predominantly populated by steel manufacturers and suppliers, along with a notable presence of timber suppliers. A significant revelation emerged during this analysis – the conspicuous absence of Technical and Vocational Education and Training (TVET) colleges within the Silverton cluster. This observation opens up possibilities for the envisaged project and program. The lack of technical colleges in the Silverton cluster not only underscores an untapped potential for educational institutions but also suggests a strategic alignment with the prevalent industry focus in the region. Consequently, this presents an opportune setting for the proposed project and program to bridge the gap between theoretical knowledge and practical application, fostering a symbiotic relationship between academia and industry within the vibrant Silverton cluster.

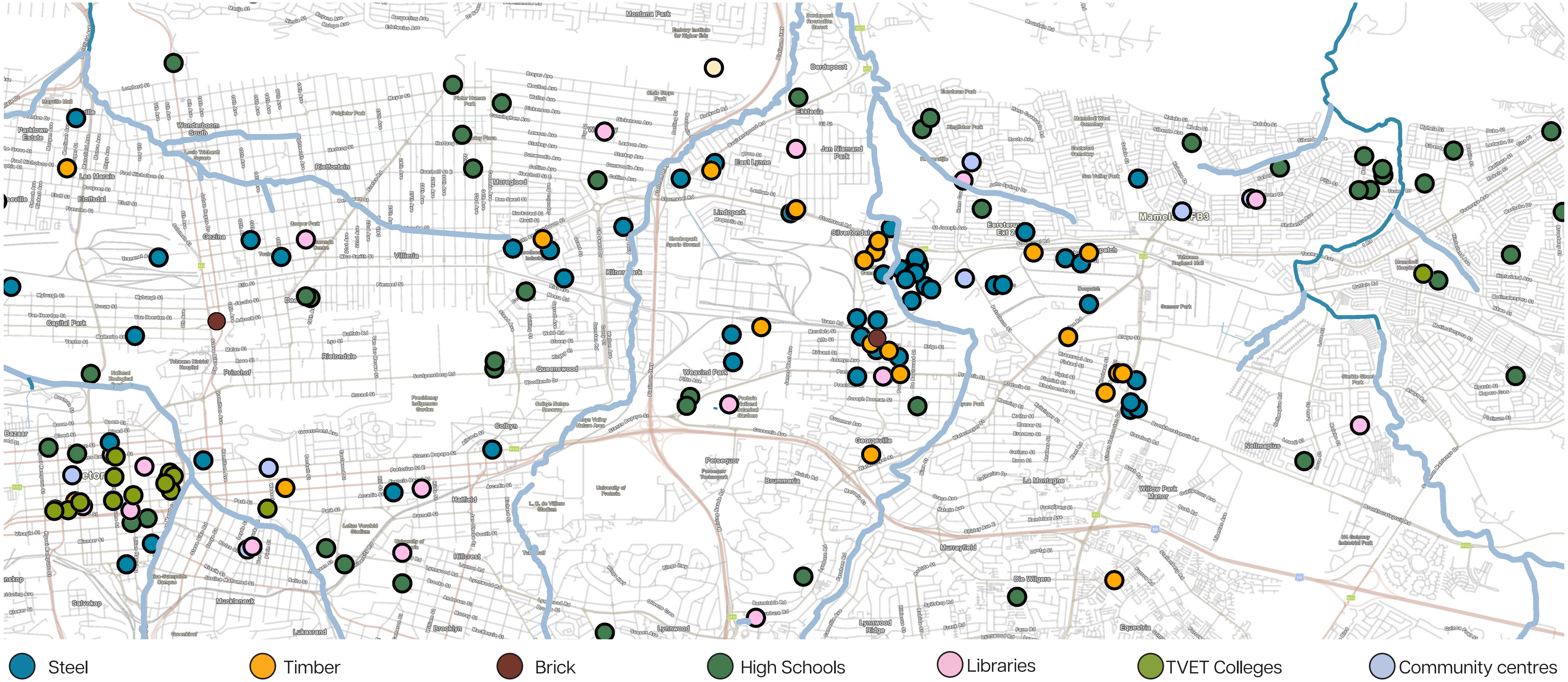


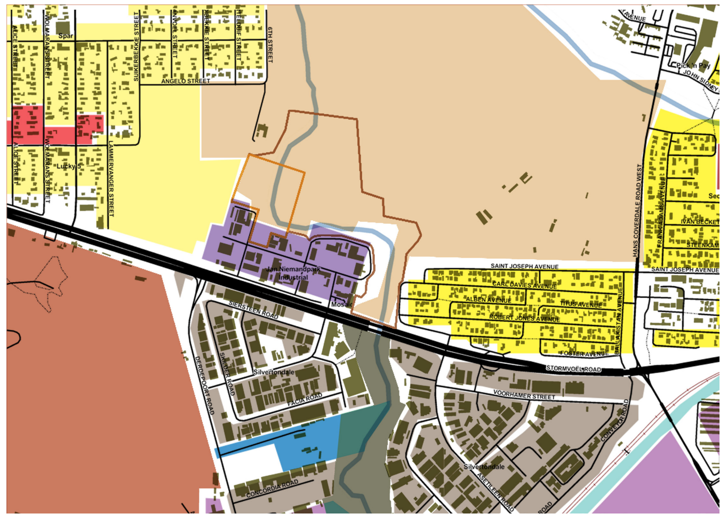
Figure 17: Combined layer of building industry plotting (Author, 2023)

Informants - Meso scale

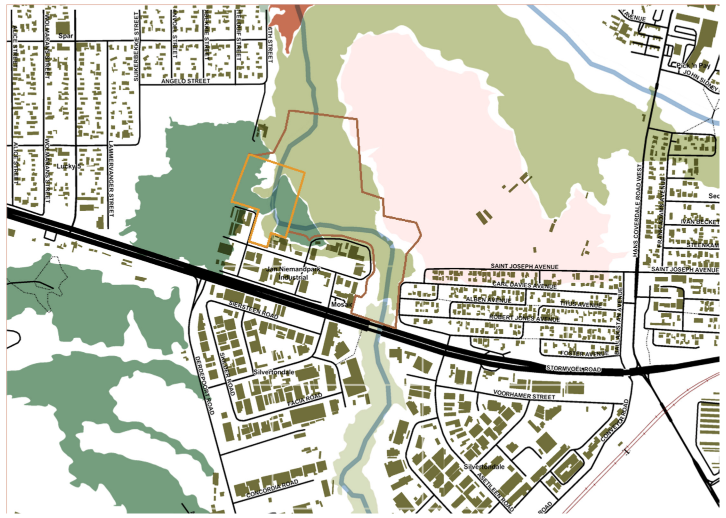
A significant aspect worth noting pertains to the potential extension of Derdepoort Drive. This proposed extension, as outlined in the Municipal Spatial Development Framework (MSDF) of 2021, would have traversed the western region adjacent to the research site. It is crucial to highlight that this road extension has since been incorporated as part of the intervention strategy. Importantly, it creates a unique opportunity for the establishment of a public transport hub at the periphery of the research site, thus shaping the broader urban landscape.

The site showcases an impressive array of natural biomes, encompassing a spectrum ranging from areas devoid of any discernible biome–illustrated by the presence of a disused concrete slab–to ecological support zones, and ultimately, critical biodiverse regions closer to the river. This inherent ecological diversity significantly influences several key facets of the project, notably the selection of suitable foundation types and the intricate process of rehabilitating and relocating vital vegetation. Of particular note among the vegetation is the presence of wild grasses, which, wherever feasible, will be preserved in situ and carefully transplanted and rejuvenated when deemed necessary to ensure minimal ecological disruption.

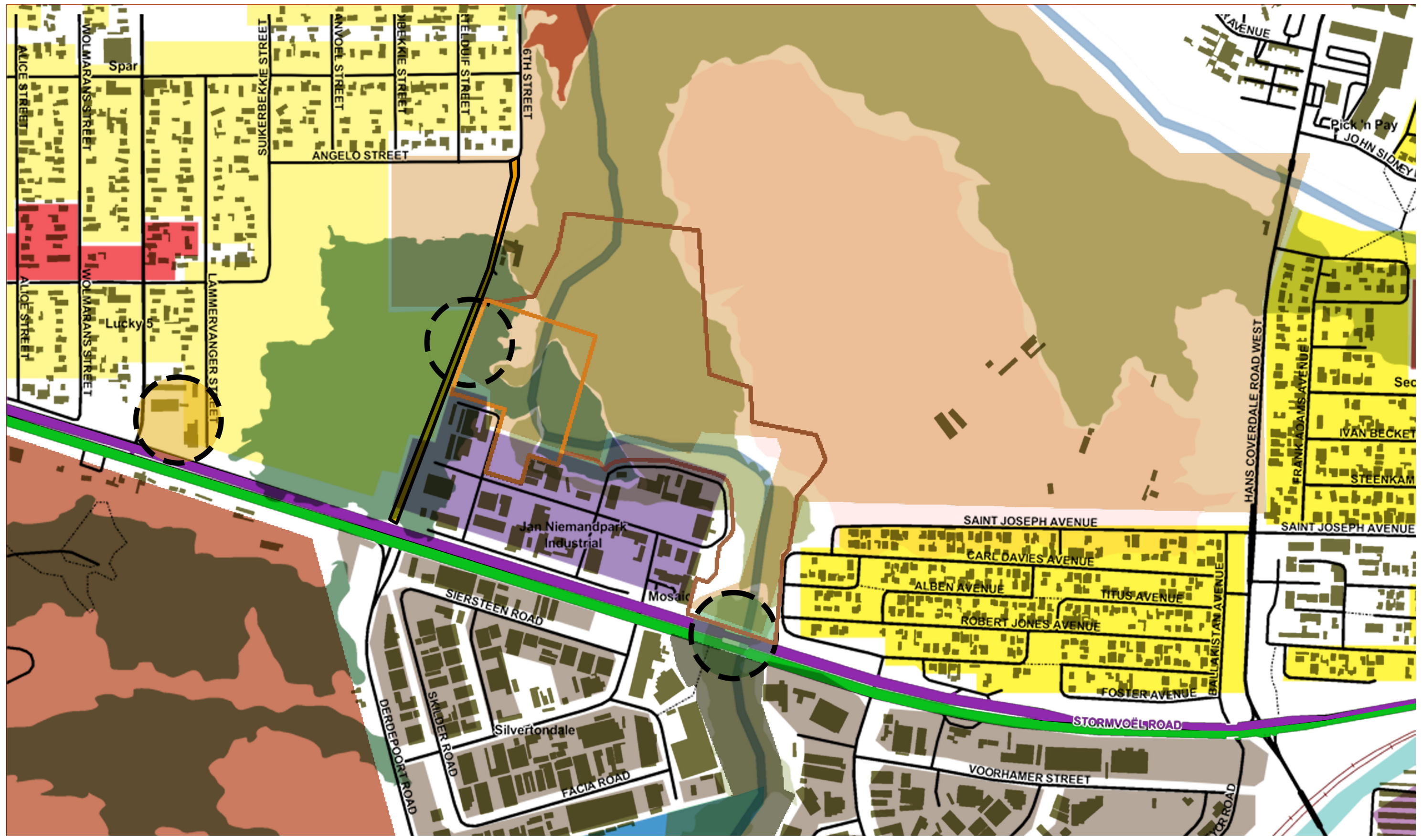
The zoning regulations within the broader urban context exhibit a dynamic composition, encompassing residential, municipal (graveyard), special, and business designations. However, it is essential to emphasise that, within the confines of the site, zoning remains undetermined for the green space component while the desolate concrete slab portion is designated for industrial use. Furthermore, it is imperative to recognize that height restrictions imposed under the industrial 1 zoning category dictate that any structures erected on the site must not exceed a height of 15 metres, a critical consideration that significantly influences the architectural and planning aspects of the project.



Tshwane zoning

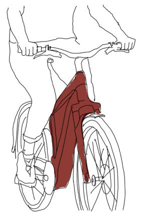


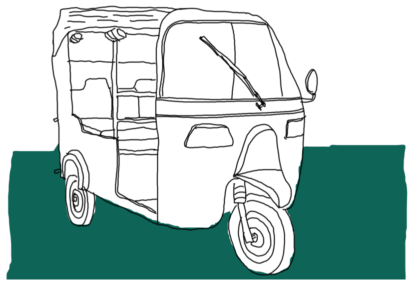
SANBI biodiversity

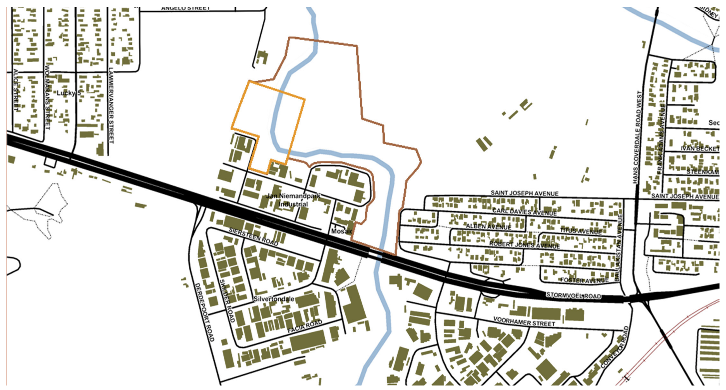


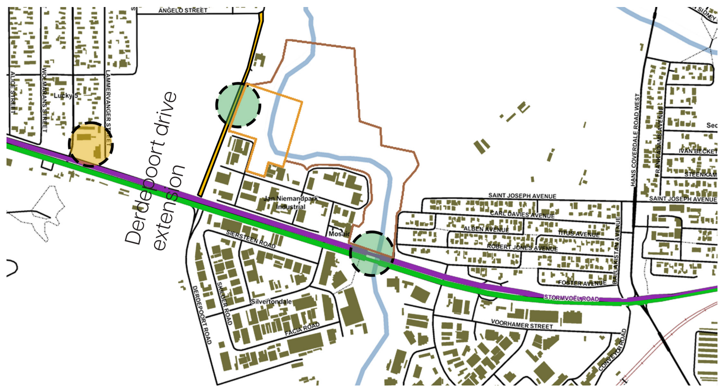
Combined meso scale informants


Aryeng bus system


Bicycle lanes


Tuk Tuk system


Moreletta spruit



Current and future public transportation planning

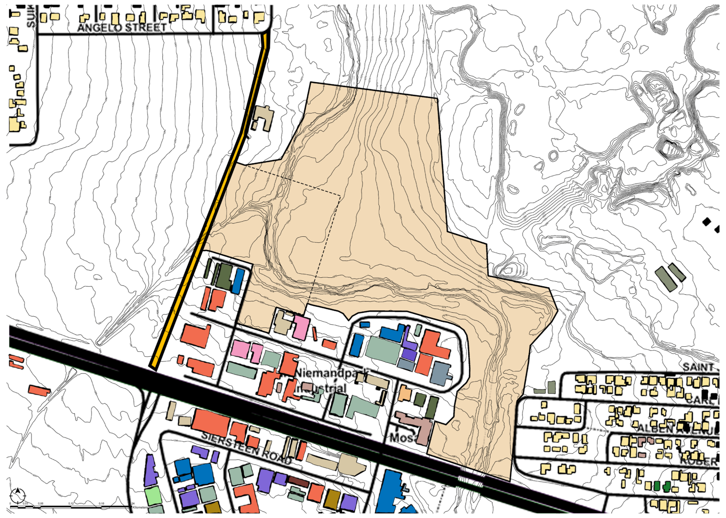
Figure 18: Meso scale informants (Author 2023)

Informants - Micro scale

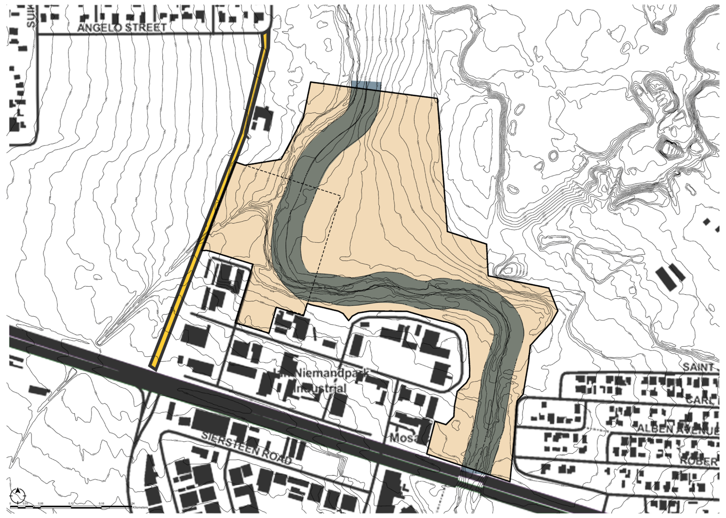
Specific pedestrian pathways originating from residential areas to workplaces or educational institutions intersect and traverse the proposed site, underscoring its prominence in terms of accessibility. The delineation of these pedestrian routes can significantly inform the spatial layout of the site. The overarching objective is to facilitate public movement through designated areas, thereby enhancing accessibility to specific programs while fostering a transparent environment where the public can observe and engage with the activities transpiring on the site—a pivotal element contributing to the knowledge transfer dimension of the project.

Presently, the site serves as a repository for garden refuse and construction materials, concealed by dense vegetation, rendering it imperceptible from the adjacent street. The nearby river, marred by pollution and hindered access due to overgrown vegetation and dumping, necessitates restorative measures. Addressing these concerns involves eradicating invasive plant species and weeds, coupled with the revitalization of grasslands through an integrated landscape design approach.
The site is embedded within a multifaceted urban context encompassing residential enclaves, food and building industries, and supermarket zones. This configuration not only provides access to diverse industries within close proximity but also presents an opportunity to cultivate a cohesive community. Adhering to the contextual cues from the surrounding industries, the proposed program aligns itself by incorporating materials from local suppliers, engaging services such as a food security business for the dining hall, and leveraging logistics expertise for the transportation of timber supplies to an abandoned building across Klipspruit street, repurposed as a storage facility for the workshops.

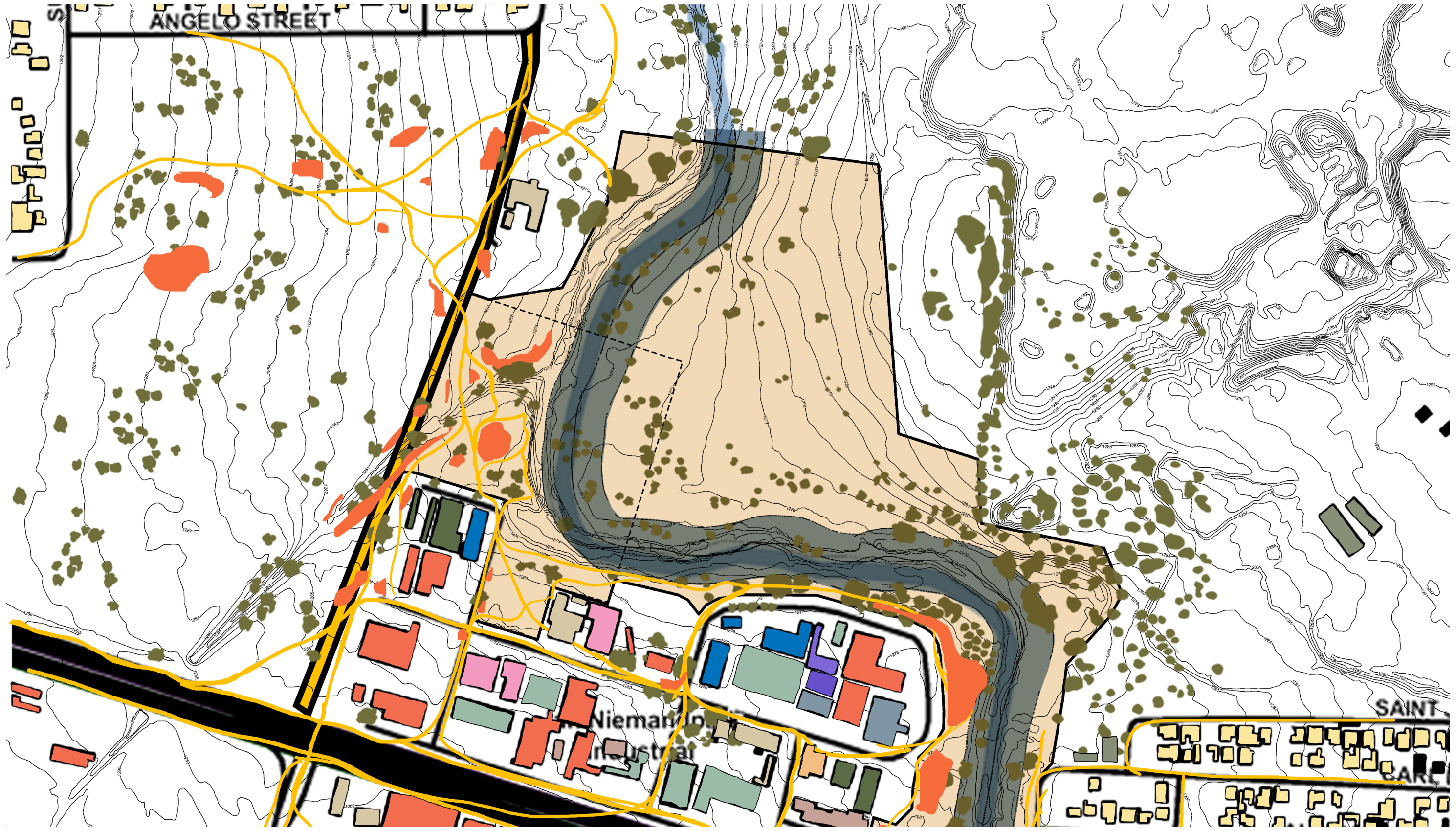
Given the absence of flood line information, a conservative approach is adopted, incorporating a minimum 30-meter buffer line as a constraint during the design process to mitigate risks associated with the proximity to the river. Additionally, elevating the structures on stilts serves as a precautionary measure against potential 50- and 100-year floods, ensuring the resilience and longevity of the built environment.



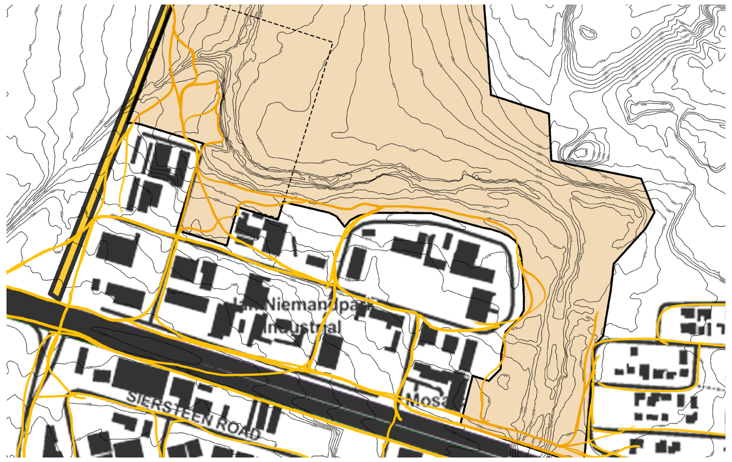
Context's surrounding industry



30m buffer from river centre line



Combined micro scale informants



Pedestrian movement

Site dumping

Figure 19: Micro scale informants (Author 2023)

Informants - Context

Deriving inspiration from and aligning with the industrial form typologies inherent to the context constitutes a valuable exercise for gaining insights into the nuanced interplay of lighting, volumes, and spatial configurations within specific buildings. Upon scrutinizing the contextual structures, a prevalent observation emerges: a noticeable absence of human-centric connections between façades and the transitional zones delineating interior and exterior spaces. This deficiency may be attributed to a predominant focus on product or industry-oriented design principles. Consequently, this project endeavours to strike a harmonious balance, rendering the built environment conducive to both industrial functionality and human-centric considerations.

The residential typologies within and proximate to the context indicate a demographic predominantly comprising individuals from lower-income brackets. Notably, the architectural configurations appear less attuned to the natural surroundings, prioritizing shelter provision for residents. Central to the project's objectives is the elevation of natural landscapes and the creation of healthy exterior spaces, positioning the well-being of context residents as a paramount concern. The project's success hinges, in part, on the effectiveness of achieving these objectives. Diverse user groups characterize the surrounding context, encompassing residents, industrial workers, high school students, day visitors seeking products or services, and building industry entities linked to industrial complexes through product and service interactions. This multifaceted user profile underscores the need for a holistic design approach that caters to the varied requirements of these stakeholders.

To create a symbiotic relationship with the immediate context, the proposed campus programs will engage with the businesses in the vicinity. The vacant building will be re-purposed as a long-term storage facility for workshop supplies, while a logistics company will facilitate the transportation of timber from plantations to this storage unit. A food security management company will oversee catering arrangements for the daily dining hall and special events. The glass and aluminium manufacturer will produce all glass and aluminium components required on the campus. Utilizing discarded concrete cubes sourced from a nearby concrete testing facility is a way to address the issue of waste in the area. The emphasis is on re-purposing these concrete elements, thereby contributing to a reduction in carbon emissions by obviating the necessity to manufacture additional components. This site presents a unique opportunity to transform an underutilized space into a sustainable, interconnected campus that not only addresses the existing challenges but also contributes positively to the surrounding environment and community.

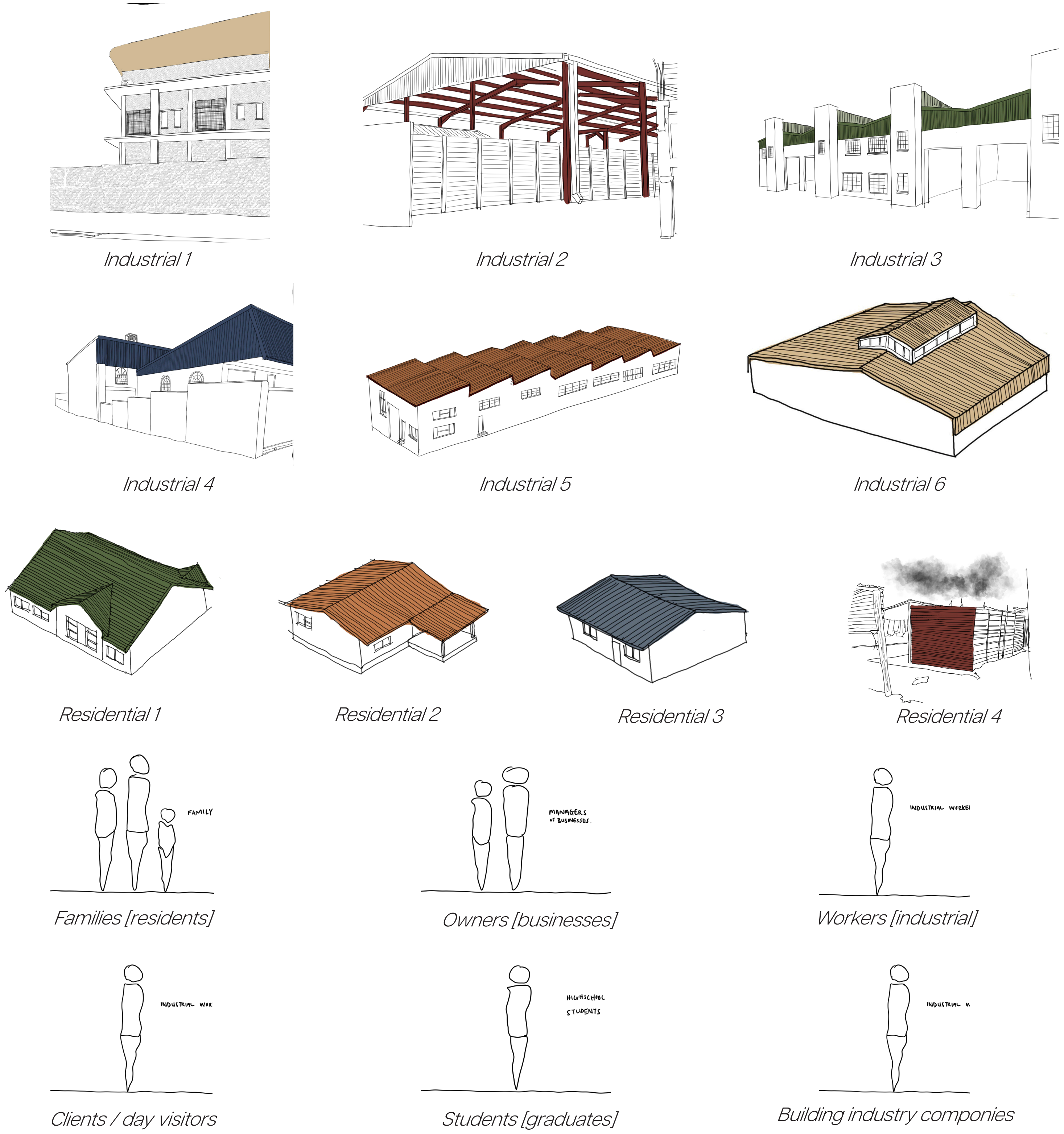


Figure 20: Building and user typologies (Author 2023)

Informants - Context

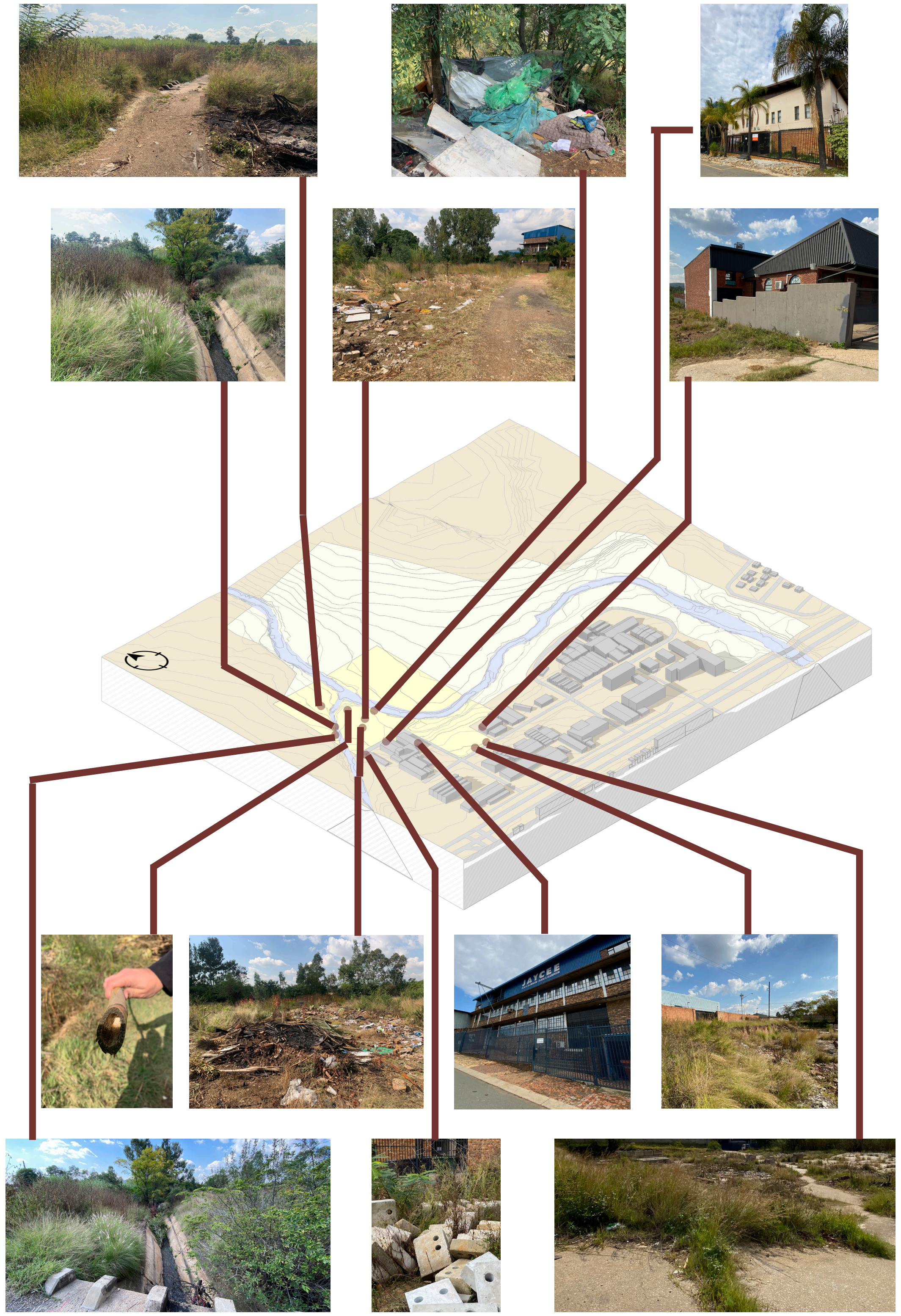


Figure 21: Site photos (Author 2023)

Figure 22: Building and user typologies (Author 2023)

MASTERPLAN

Masterplan

The masterplan / urban symphony meticulously composed for the expansive canvas of Jan Niemand Park's greenbelt. This blueprint seamlessly intertwines elements that transcend mere design; it's a narrative of sustainability, education, recreation, and community engagement. At the one end, this masterplan orchestrates the integration of a water purification centre—a nod to environmental stewardship—whose presence not only underscores the commitment to ecological well-being but also serves as an educational beacon, enlightening visitors about the vital role of sustainable water management.
For the younger users of the nearby crèche, the design thoughtfully weaves in vibrant play areas, injecting the green expanse with youthful energy and providing a nurturing environment for the community's tiniest members to flourish.

The recreational spaces, strategically positioned to offer panoramic views of the meandering river, beckon residents and visitors alike to bask in the tranquillity of nature. These spaces become communal canvases for relaxation, fostering a sense of connection with the environment and enhancing the overall well-being of those who partake in the experience.

Nestled within this verdant expanse is the School of Craft, a bastion of creativity and skill development. Here, the architectural vision extends beyond traditional educational boundaries, becoming a dynamic hub where craftsmanship is cultivated, and the next generation of artisans is nurtured. Two public transport nodes stand sentinel at the entrances, seamlessly linking the greenbelt to the wider urban tapestry. This strategic connectivity not only enhances accessibility but also transforms the park into a vibrant crossroads of movement and interaction.

At the other end of this masterplan lies a pivotal entity—the resource centre. More than a mere repository of knowledge, it stands as the epicentre for the amplification of the school's teachings. Here, the products crafted within the educational enclave find a larger canvas, making a tangible impact on the built environment and the expansive canvas of the building industry. It becomes a conduit for innovation, a hub where ideas evolve into tangible solutions, and where the ethos of the School of Craft permeates the very fabric of the surrounding community.

In essence, this masterplan is a testament to the convergence of education, environmental consciousness, and community vitality—a blueprint that transforms a greenbelt into a living, breathing testament to the potential of architecture to shape not just spaces, but the very essence of communal living.

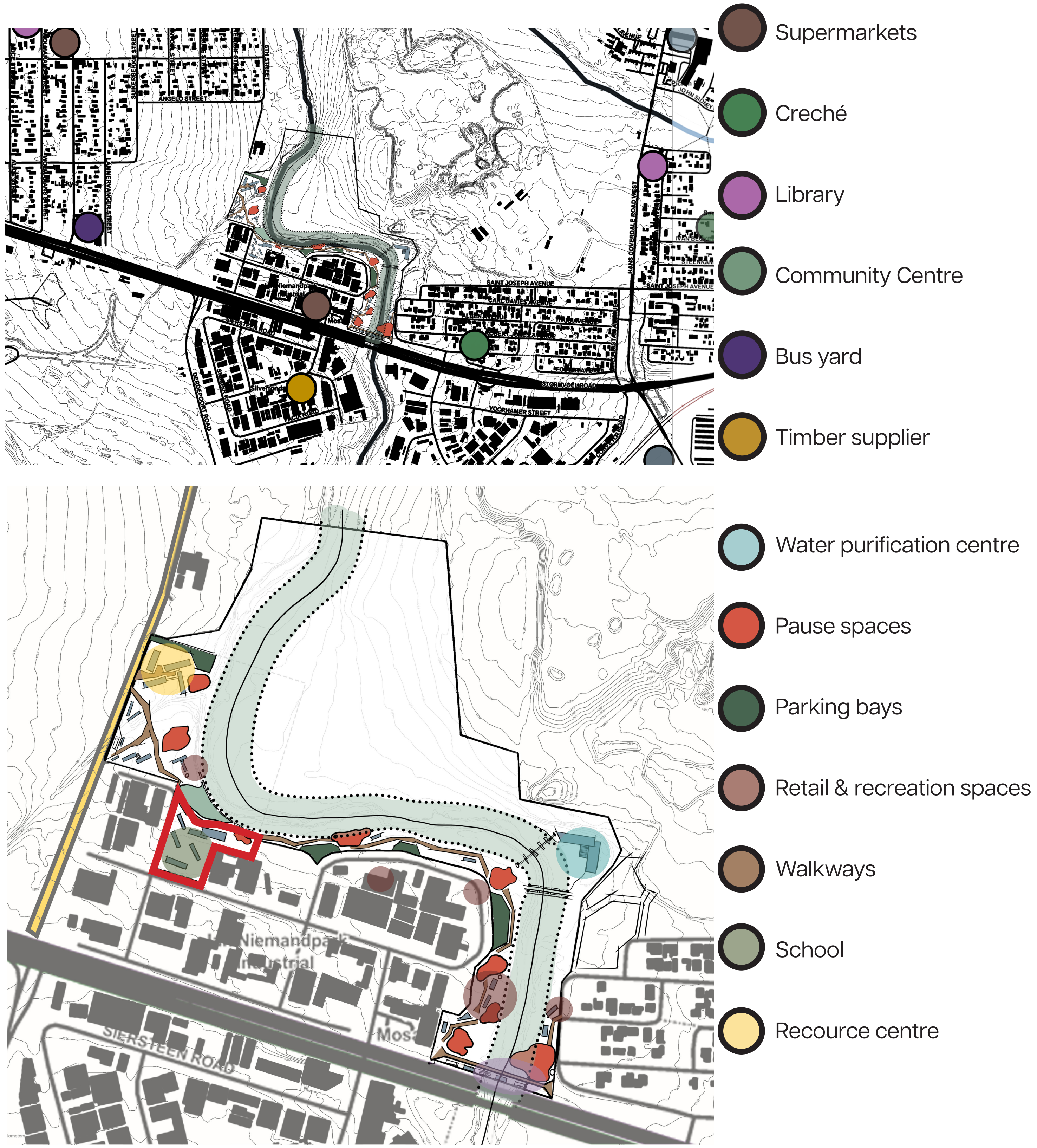


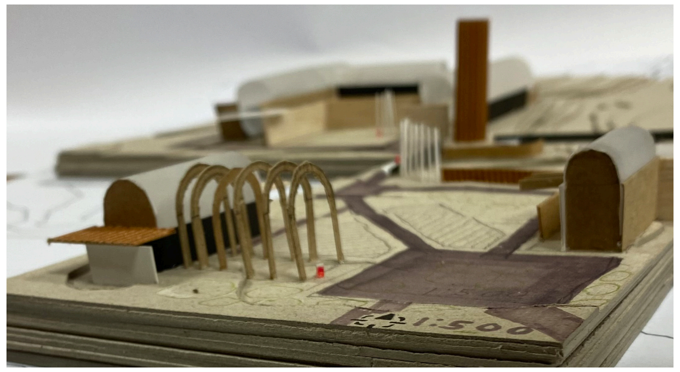
Figure 23: Masterplan vision (Author 2023)

PROCESS

Design development

Iteration 1

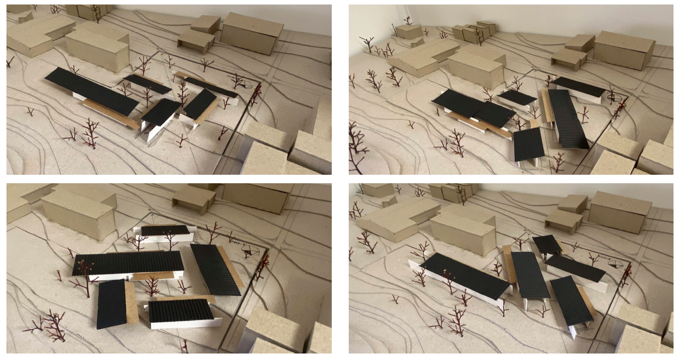
The exploration of the vault due to the thinking of using curved glulam beams as the structure - post and beam construction. Exploring site zoning through adding pathways, locating the school most North and then the public plaza with mixed use spaces most South. A constructed wetland formed where the contours best indicated it could work for storing water as well as creating a feature for the users.



Conclusion:
- Vault is radically different from context.
- Using existing pedestrian movements as good informants for building placement.
- Zoning and placement of programmes could be reconsidered.

Iteration 2

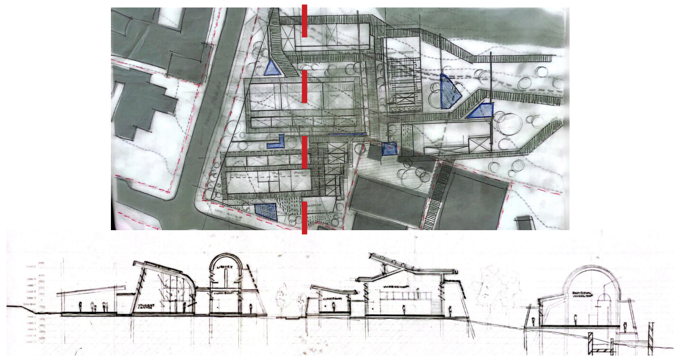
The exploration of pedestrian movement through buildings investigated. Breaking up buildings into specific programmes to allow courtyard type spaces to be formed.



Conclusion:
- The in-between spaces created connects to the regenerative architecture theme to include greenery in the project, cross ventilation, and natural lighting to all internal spaces.
- The movement through the buildings will be taken further to allow public to move through site and experience the different programmes visually.

Iteration 3

Placing noisier programmes toward the street edge and the more public and quiet programmes towards the river.



Conclusion:
- Good threshold / layered approach to buildings ie. Exterior - walkway - building - walkway - exterior.
- Buildings look the same height - no hierarchy.

Iteration 4

Orientating the buildings according to the grid of the site and context made more sense. Workshop roof took shape of sawtooth roof for southern light due to it being orientated north to south in length.

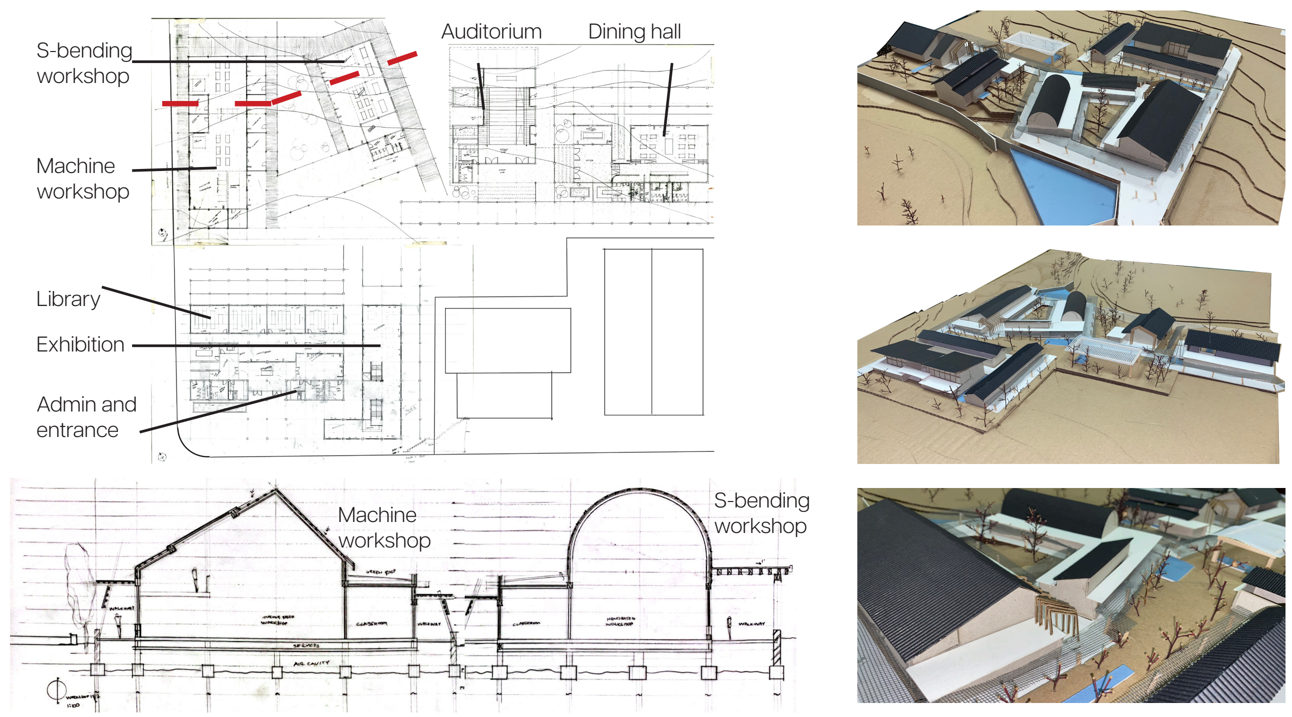
Conclusion:
- Street- and building edges more successful because of grid placement.
- Different roof configurations causes disconnect between buildings - addressed by uniform covered walkway connecting the buildings.

Figure 24: Design development - Iteration 1 - 4

Design development

Iteration 5

This design iteration took a comprehensive approach to the site, emphasizing the integration of buildings, the interstitial spaces, and the overarching principles of regenerative architecture and connectivity. The positioning of the machine workshop along the street frontage and the accompanying steam bending workshop, flanked by classrooms, was strategically planned to foster a cohesive learning environment. The connecting pathway between the workshops acts as supplementary classroom space, enhancing the seamless transition between different educational functions. The seamless integration of the workshops and classrooms was facilitated by the incorporation of connecting walkways on the sides of the structures. However, the current roofing design of the workshops obstructs the desired influx of southern light, limiting the workshop's access to the beneficial natural illumination.



Iteration 6

In this design iteration the arrangement of spaces were reconfigured by relocating the classrooms and the machine workshop. This positions the workshop with a longitudinal facade oriented north to south. This alteration was a deliberate choice to better align with the site's overall design language and the architectural theme of the projects. The section of the machine workshop has been optimized to allow southern light to filter into the workshop space. To create a more effective separation between the classrooms and the sound-intensive workshop areas, all the classrooms have been consolidated into a single designated area. Additionally, two distinct libraries—one private and one public. The private library offers a more secluded and focused learning environment, while the public library encourages interaction and collaboration among students. This approach enables the school to offer private areas for education while also promoting social and communal learning spaces.

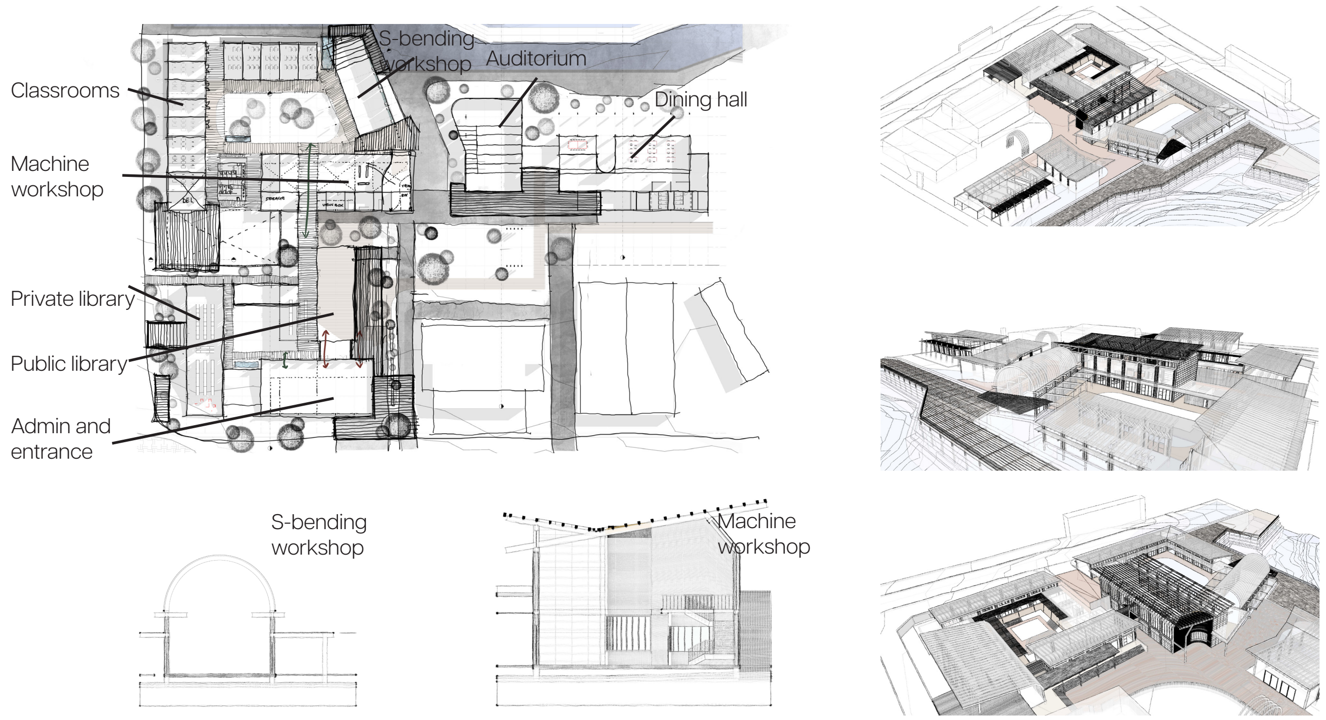


Figure 25: Design development - Iteration 5 & 6

INTEGRATED DESIGN AND TECHNICAL INVESTIGATION

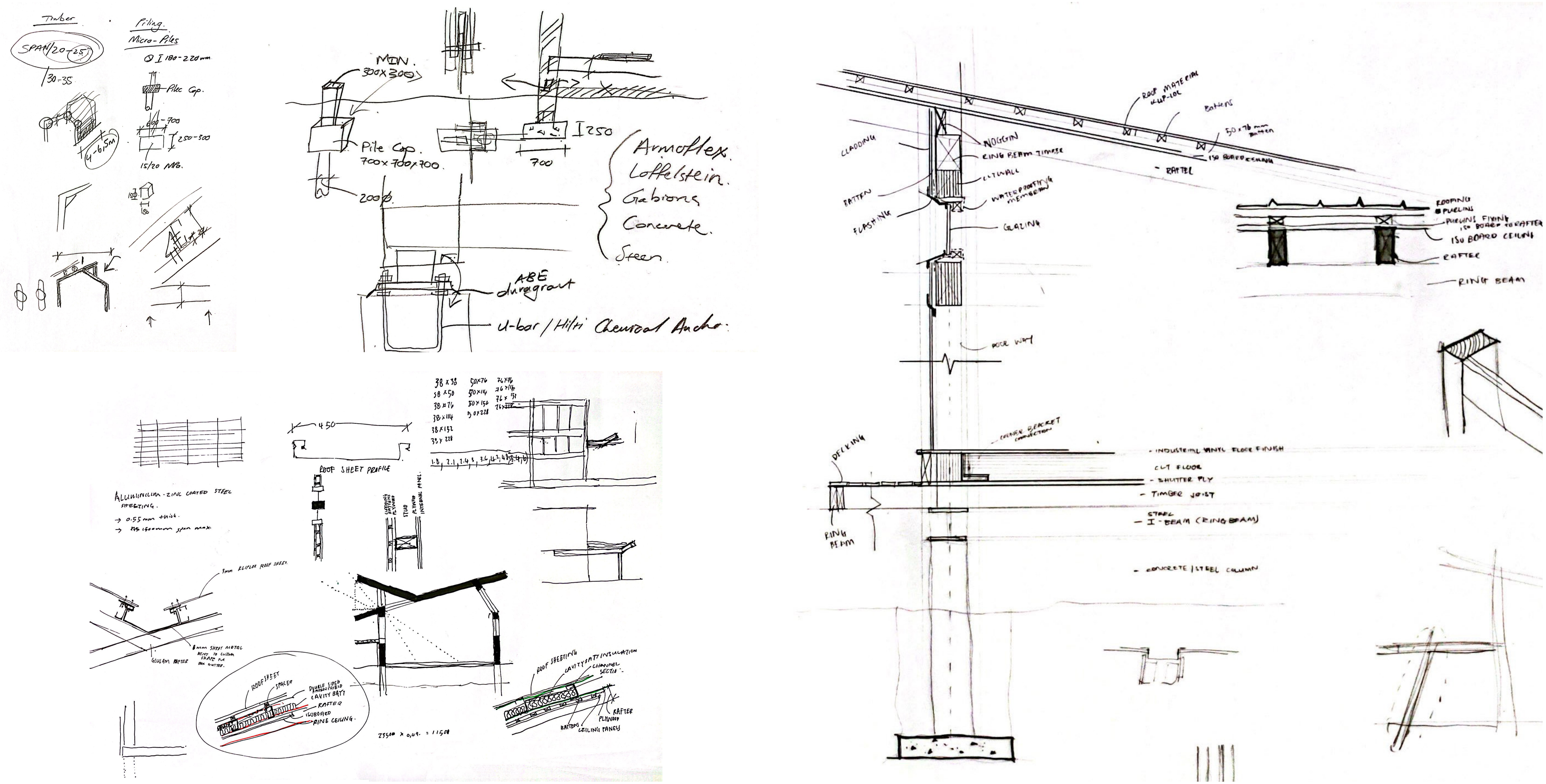


Figure 26: Technical sketches (Author, 2023)

Technical integration

The primary emphasis in the technical integration aspect of this project lies in the artistry of connections and structures, with a deliberate intention to not conceal the structural elements of the building, but rather to accentuate and showcase them. This approach serves to transform the building into a platform for exhibiting the potential of South African Architecture, particularly when the intricate connections are meticulously crafted and detailed to demonstrate innovation, craftsmanship, and the fusion of traditional methods with modern materials.

An extensive exploration was undertaken to identify methods for highlighting and safeguarding the structural glulam columns, ensuring their visibility from the building's exterior while shielding them from environmental elements. This particular approach to detailing and design planning underscores the pivotal role played by the structural components within the design, emphasizing the need to not only acknowledge their significance but also to adopt a craftsmanship-oriented perspective during the design process.

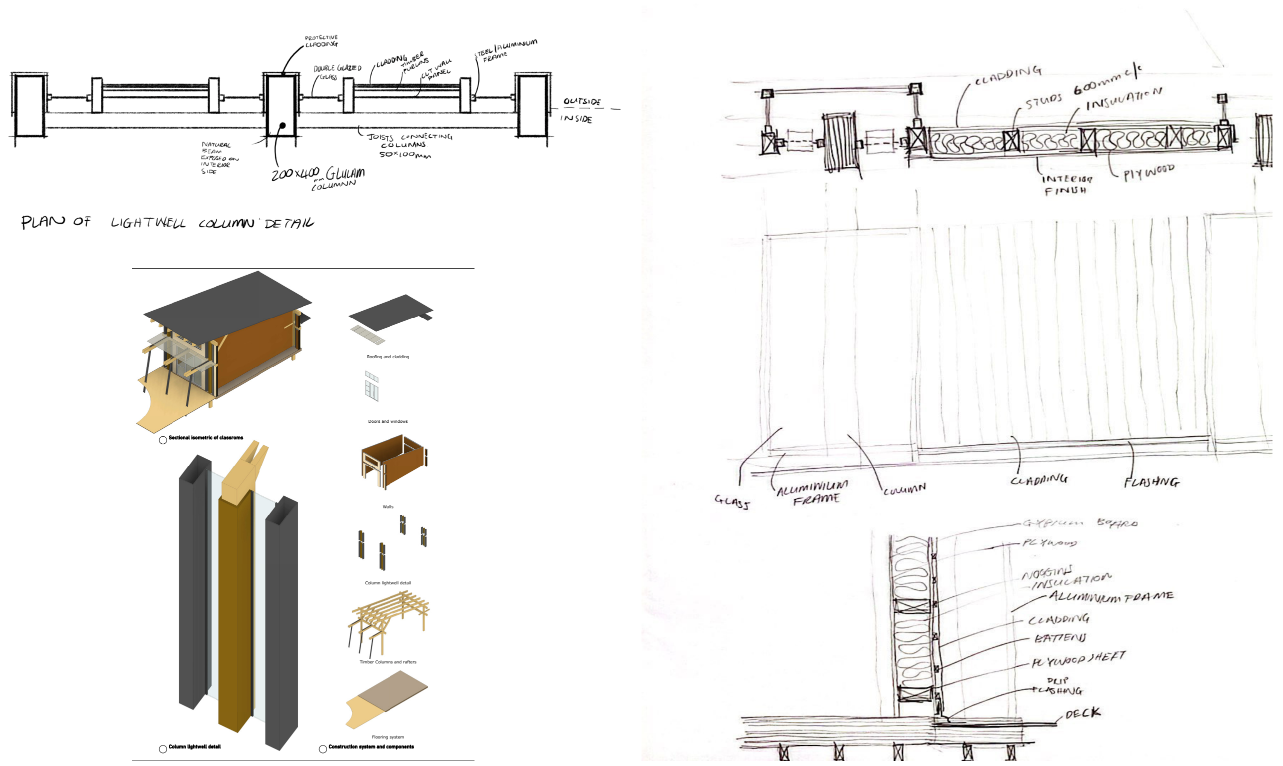


Figure 27: Column glazing details (Author, 2023)

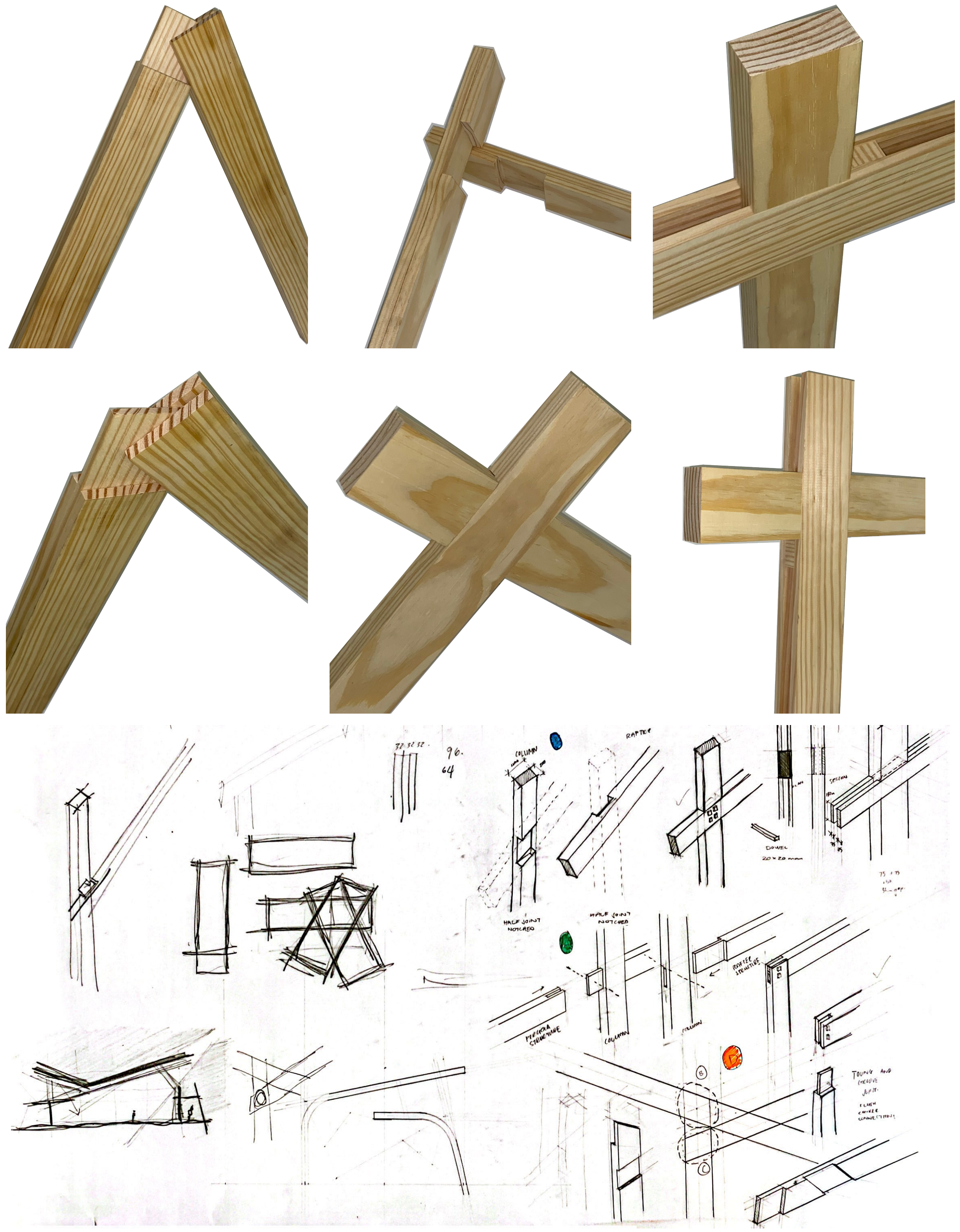


Figure 28: Timber connection joints (Author, 2023)

Technical integration

Regarding the architectural design and technical integration of the structure, the primary load-bearing elements consist of glulam portal frames arranged on a 5-meter grid. Complementing these portal frames are additional rafters, spaced at 1-meter intervals, which enhance the overall structural integrity. To ensure the structural stability and resilience of the buildings, the columns are securely affixed to concrete micro piles. This strategic elevation from the ground serves multiple purposes, including safeguarding against flooding, preventing insect intrusion, and protecting against adverse weather conditions.

Between the glulam columns, the building's envelope is composed of prefabricated wall panels, employing conventional timber frame construction systems. These panels are constructed using timber studs with plywood sheeting on both sides, which act as cross-bracing elements to provide essential lateral stability to the structure. Horizontal noggins are strategically placed between the studs to further reinforce the panels, and insulation material is inserted in the spaces between the noggins to enhance thermal performance and energy efficiency. These prefabricated wall panels are precision-engineered to include openings in precisely the required locations, ensuring seamless integration with the overall building design. After the installation of these panels between the glulam columns, waterproofing measures are applied to protect against moisture infiltration, and vapour barriers are added to regulate the indoor climate. Finally, the panels are enclosed with the appropriate cladding materials, contributing to the aesthetic and functional aspects of the building's exterior. This integrated approach to architectural design not only ensures structural robustness but also optimizes energy efficiency and environmental performance, making it a comprehensive and sustainable solution for the specified building project.

Furthermore, the connections between the glulam columns and rafters, as well as between the columns and panels, have been carefully designed to allow for disassembly without compromising structural integrity. This design approach aligns with the principles of regenerative architecture, which emphasizes the use of sustainable, reusable materials and systems. By facilitating the disassembly and reconfiguration of these building components, the design not only promotes resource efficiency but also allows for future adjustments and updates to the building, reducing the environmental footprint and supporting a regenerative approach to the built environment. This forward-thinking design strategy aligns with the broader goal of creating structures that contribute positively to the surrounding environment while minimizing waste and promoting long-term sustainability.

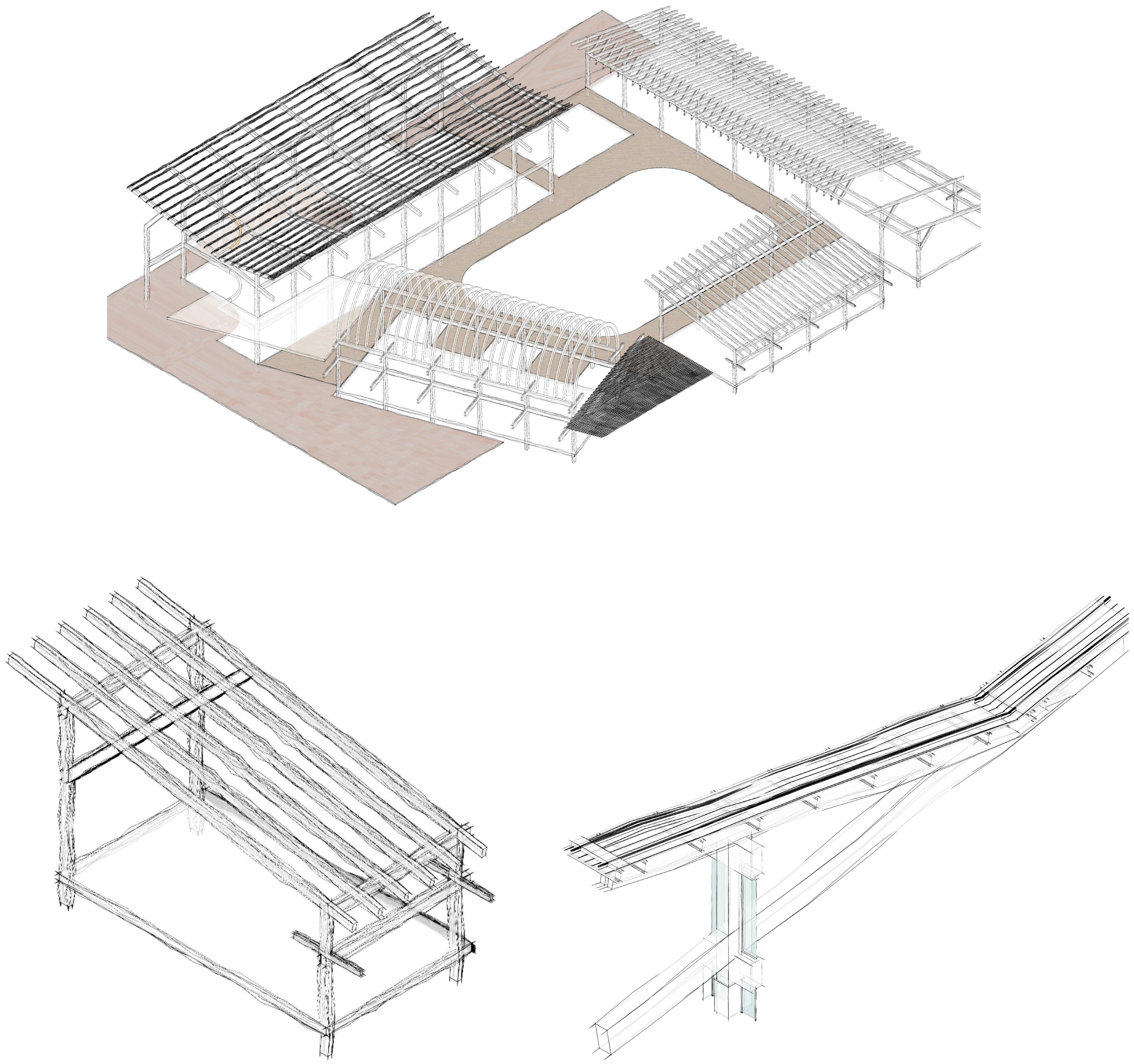


Figure 29: Main timber structure diagrams (Author, 2023)

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Plan

The campus typology has undergone a meticulous iterative design process, emphasizing both user movement within buildings and a commitment to regenerative principles. The deliberate segmentation of structures into distinct blocks serves the dual purpose of optimizing internal spatial illumination and fostering a symbiotic relationship with the natural environment. This segmentation results in the creation of interstitial courtyard spaces situated between the buildings, imparting a unique character characterized by layered façades and thresholds—a departure from the prevailing industrial typology within the contextual milieu.

The integration of these courtyards not only enhances the visual appeal of the campus but also facilitates the infusion of greenery and vegetation into the interstitial spaces. This strategic landscaping not only aesthetically enhances the surroundings but also contributes significantly to thermal regulation, thereby fostering a more sustainable and environmentally conscious campus typology. The interplay of light, shadow, and green elements serves as a testament to the departure from conventional architectural norms, elevating the campus to a harmonious integration of nature and built form.

The overall campus is thoughtfully organized into three distinct blocks, each serving a specific function—administration, education, and recreation. These blocks are intelligently interconnected by means of a uniform covered walkway. Beyond its functional role as a linkage element, this walkway stands as a unifying design feature, reinforcing the cohesion of the campus while concurrently respecting the imperative for differentiated access control and programmatic segregation among the diverse blocks.

The covered walkway symbolizes the intricate web of relationships between individuals and their built environment, showcasing a seamless integration that facilitates movement and interaction. Its uniformity not only ensures architectural consistency but also highlights the underlying interconnectedness of spaces, fostering a sense of community and shared experience. In essence, the design choices made in delineating the campus structure reflect a sophisticated balance between functionality, aesthetics, and sustainability, epitomizing a forward-thinking approach to architectural innovation.

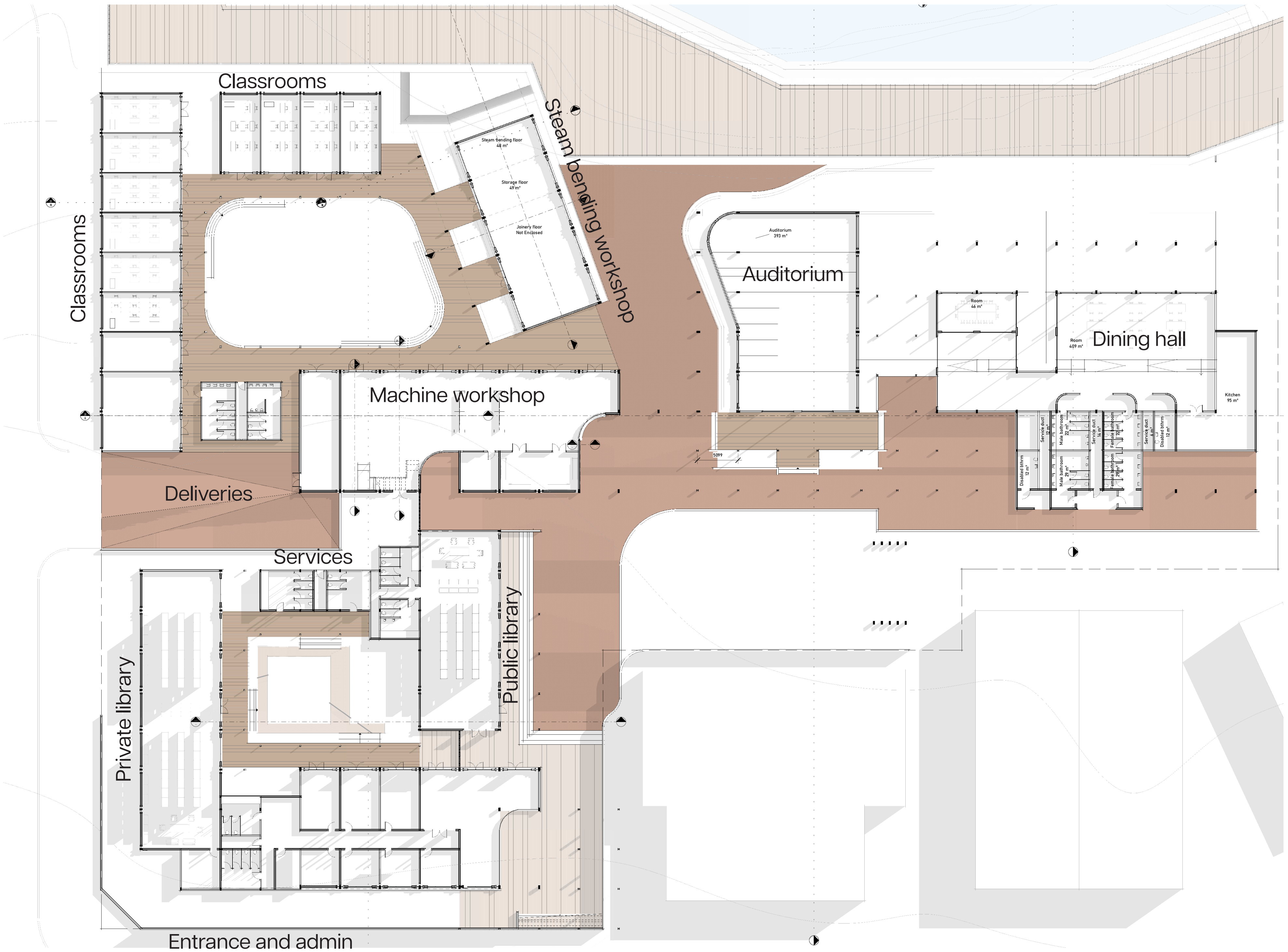
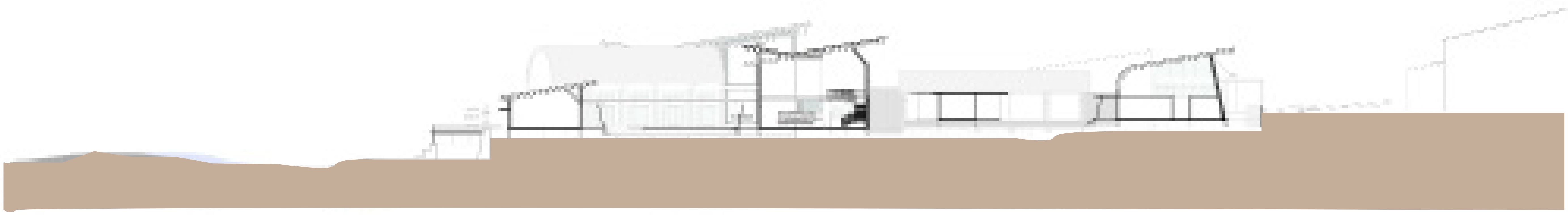
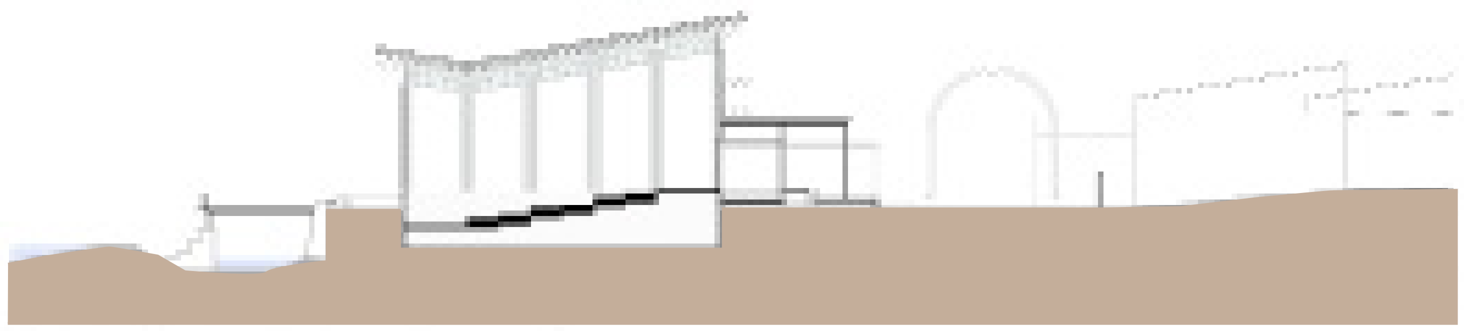


Figure 30: Floorplan (Author, 2023)

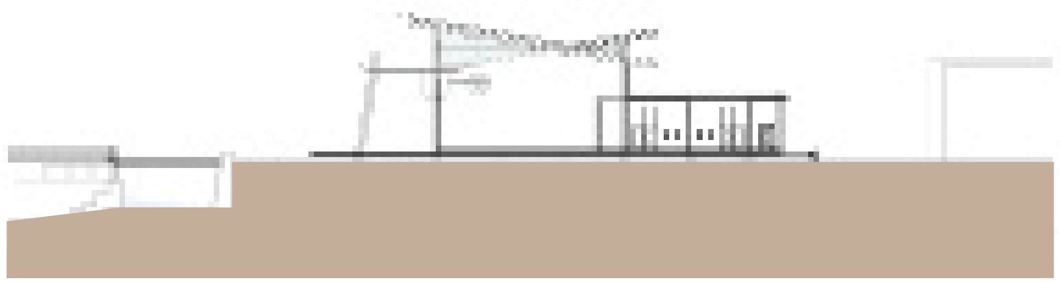
Sections



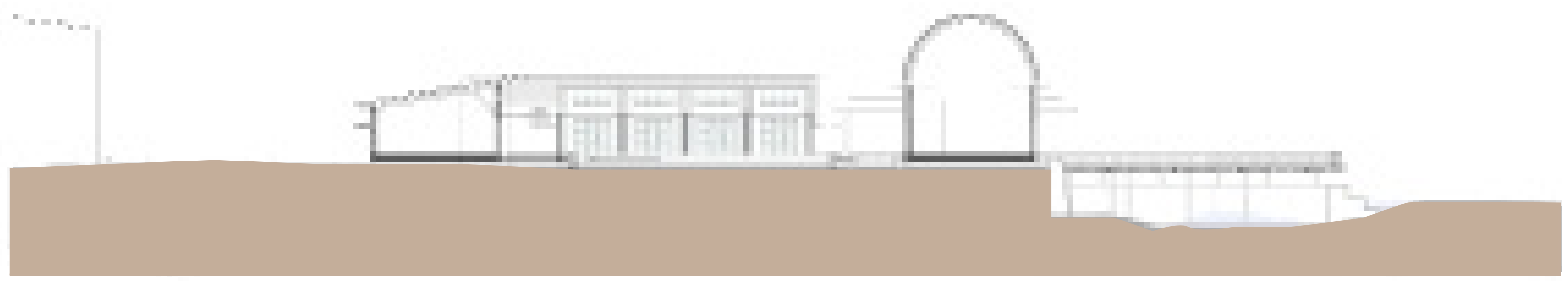
Classrooms *Machine workshop* *Entrance and admin*



Auditorium



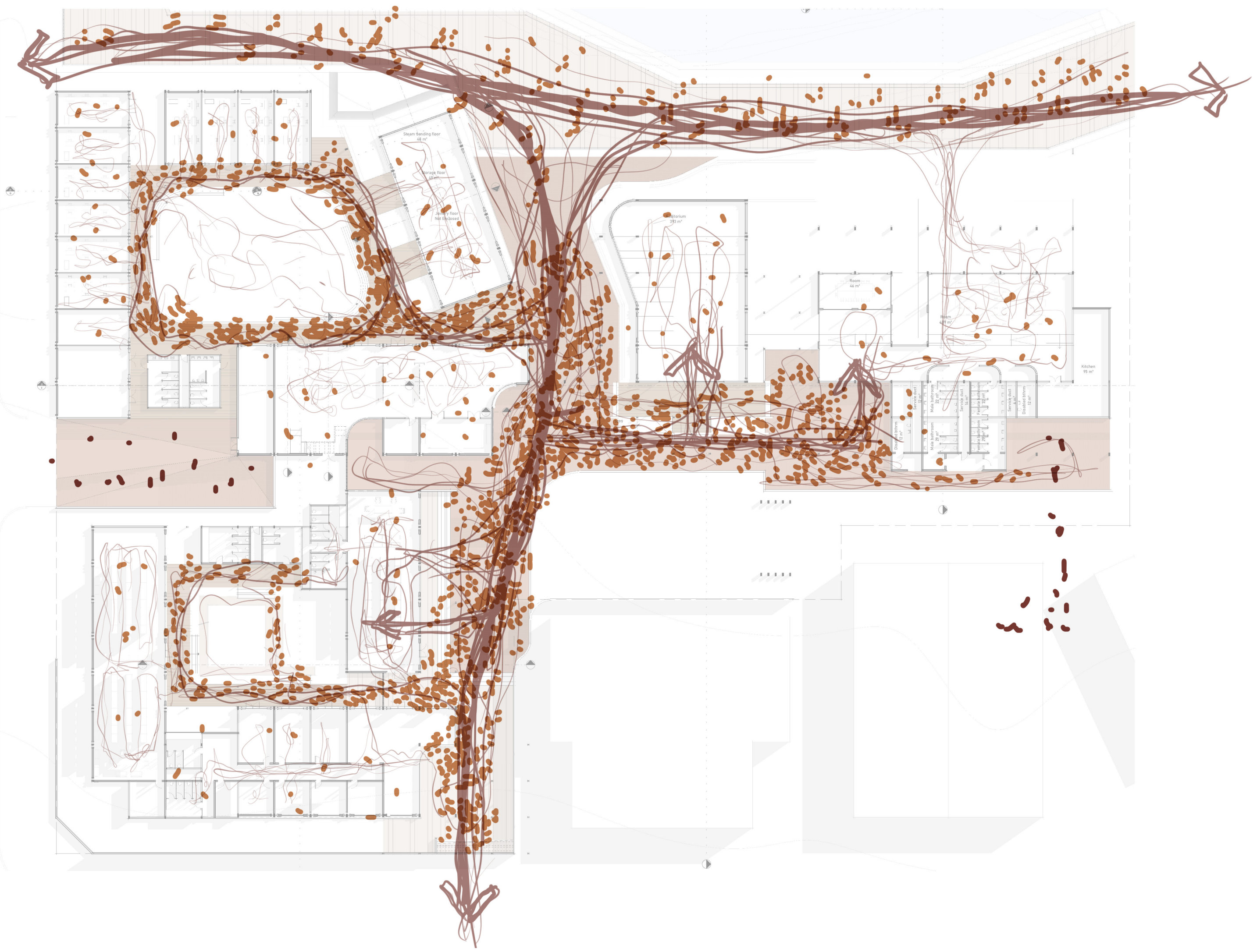
Dining hall



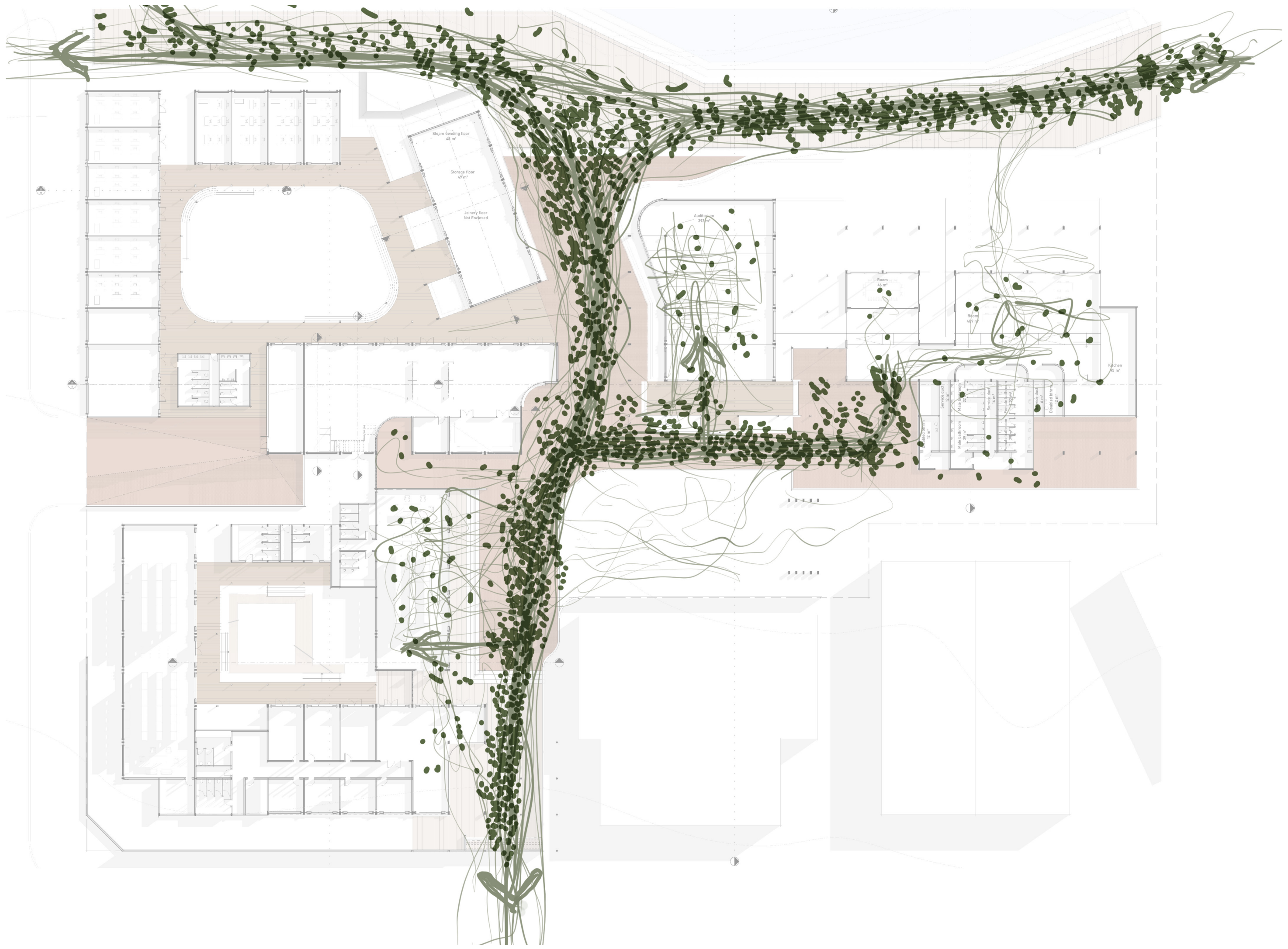
Classrooms and steam bending workshop

Figure 31: Sections (Author, 2023)

Diagrams



Private movement



Public movement

Figure 32: Movement and density on site (Author, 2023)

CRITICAL REFLECTION

Mini Project

The initiation of the mini project, centered around an exploration of my normative position, initially appeared an unconventional prelude to the commencement of my master's year. However, in hindsight, it became evident that this preliminary endeavour served as a pivotal catalyst and informant for the entire design project and subsequent research. My inclination towards malleable and pragmatic materials, coupled with a hands-on approach to understanding their intrinsic properties and innovative modes of connection, underscored the foundation of this investigation.

Derived from a fervent affection for connections and meticulous detailing, the abstract representation of scraps and off-cuts of timber elements emerged as an embodiment of my normative position. Arranged and fixed in a deliberate manner, these elements gave rise to diverse shadows, spatial configurations, and connections. This representation served to articulate my belief that the connections and mechanics inherent in architecture should be prominently showcased, and that materials ought to be celebrated in their natural form. The concept of material integrity emerged as a driving force in the design process, consistently serving as a fundamental idea, a compass guiding decision-making.

The freedom afforded by the abstract and artistic representation of ideas presented an unfamiliar terrain for someone grounded in rationalist principles, such as myself. The departure from a more rigid and analytical mode of thinking posed a challenge, yet proved transformative. This new-found freedom expanded both my personal boundaries and design perspectives, providing novel opportunities for exploration and ideation. It became a conduit for pushing the limits of my identity as both an individual and a designer, fostering a broader understanding of the potential within abstract thinking and application in architectural design.

Figure 34: Mini-project installation (Author, 2023)

Major Project

The culmination of this transformative year has been a crucible for both my architectural prowess and personal growth. Despite the challenges encountered, my master's architectural design project, centered on timber construction and the establishment of a School of Craft in Silverton, stands as a testament to my resilience as a designer committed to problem-solving. This endeavour has underscored my adaptability, demonstrating that while the solution may necessitate a shift in medium or perspective, I possess the capacity to surmount challenges.

A profound deepening of my understanding of timber and its associated techniques has been a notable outcome of this project, fostering an exponential growth in my affection for this material. Engaging with timber in a hands-on, technified manner, distinct from my prior experiences, has expanded my comprehension of its origins and the intricacies of its production processes. This new-found perspective has enriched my design process by imbuing it with a heightened sensitivity to the material's intrinsic qualities.

The integration of regenerative architecture principles and a commitment to designing for disassembly into the project demanded a departure from conventional approaches. Delving into the intricate theories underpinning architecture, I transitioned from regarding them as perfunctory check boxes to recognizing their role as informants and catalysts for design. This paradigm shift added a nuanced layer to my designs, elevating them beyond mere aesthetic considerations to encompass a holistic and informed approach.

Embracing intuitive design thinking, a departure from my conventional approach, not only challenged me as a designer but also significantly influenced the final outcome of the project. The realization that continual refinement is inherent to the design process became evident; however, it was imperative to discern when to make final decisions. Navigating this fine balance and taking ownership of the project at this scale highlighted the need for honing my design thinking further.

In essence, this project has been a crucible for personal and professional growth, accentuating my capacity to confront challenges, expanding my knowledge base in timber construction, and refining my design thinking process. It serves as a testament to the continuous journey of improvement and learning, signaling that, despite the accomplishments, there remains an extensive path ahead for the evolution of my design capabilities.

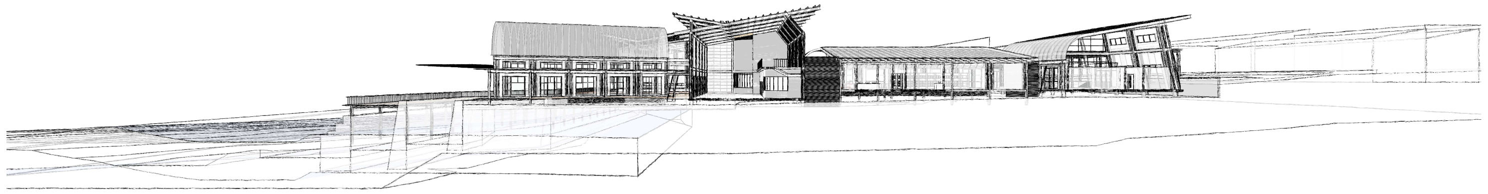


Figure 35: Sectional 3D through site (Author, 2023)

CONCLUSION

Conclusion

In conclusion, the master's dissertation, titled "Re-imagining the South African Architectural Language by Reintroducing Craft and Timber Tectonics," represents a significant contribution to the discourse on contemporary building practices in South Africa. The comprehensive exploration of emerging technologies, specifically the integration of mass timber, highlights transformative potential for the architectural landscape. The research not only identifies the benefits of timber construction, such as prefabrication and sustainability but also addresses the pressing challenge of a skilled labor shortage in the country's building industry. The proposed solution, "the new way of craft through the use of timber tectonics," goes beyond the conventional scope by envisioning the School of Craft in Silverton. This innovative educational institution is designed not only to bridge the skills gap but also to instill a holistic understanding of timber, encompassing both traditional craftsmanship and contemporary digital applications. The project's vision extends beyond the educational realm, aiming to create a positive impact on the community and the environment through regenerative architecture principles.

The integration of sustainable features in the masterplan for the Jan Niemand Park greenbelt, including a water purification center, recreational spaces, and public transport nodes, reflects a commitment to a broader environmental and human-centered approach. The design iterations of the School of Craft emphasize transparency in connection details, showcasing timber craftsmanship and promoting a sense of openness and education. The dissertation discerns users as both active participants and beneficiaries of the proposed interventions. Architects, builders, and craftsmen stand to gain valuable insights into the potential of timber construction, addressing a critical need for skill enhancement in the South African context. The envisioned School of Craft positions itself as an educational hub, not just for imparting technical knowledge but for nurturing a profound understanding of timber in its various applications. This, in turn, empowers future professionals to be agents of positive change within the industry.

In the wider architectural discourse, this dissertation fills a crucial gap by championing not only innovative construction techniques but also a pedagogical approach to sustainable design. It asserts the value of integrating craftsmanship and timber tectonics, not merely as construction methods but as cultural and educational assets. In doing so, it aligns with a global movement towards regenerative architecture and sustainable building practices, positioning South Africa as an active participant in shaping the future of the built environment. Structurally, the project's emphasis on glulam columns and beams underscores authenticity, while the incorporation of water capturing and filtration systems aligns with principles of resource efficiency and circular design. The intentional exposure of every detail and connection demonstrates a commitment to transparency, reflecting the project's core values of education and openness.

In essence, this dissertation project serves as a catalyst for redefining the South African architectural language, emphasizing the symbiotic relationship between craftsmanship, timber tectonics, and sustainability. By proposing the School of Craft and an integrated greenbelt masterplan, the project envisions a future where architectural education and practice contribute to positive societal and environmental change. It is a call to action for a new era in South African architecture, one that embraces innovation, addresses challenges, and fosters a harmonious relationship between the built environment and its inhabitants.

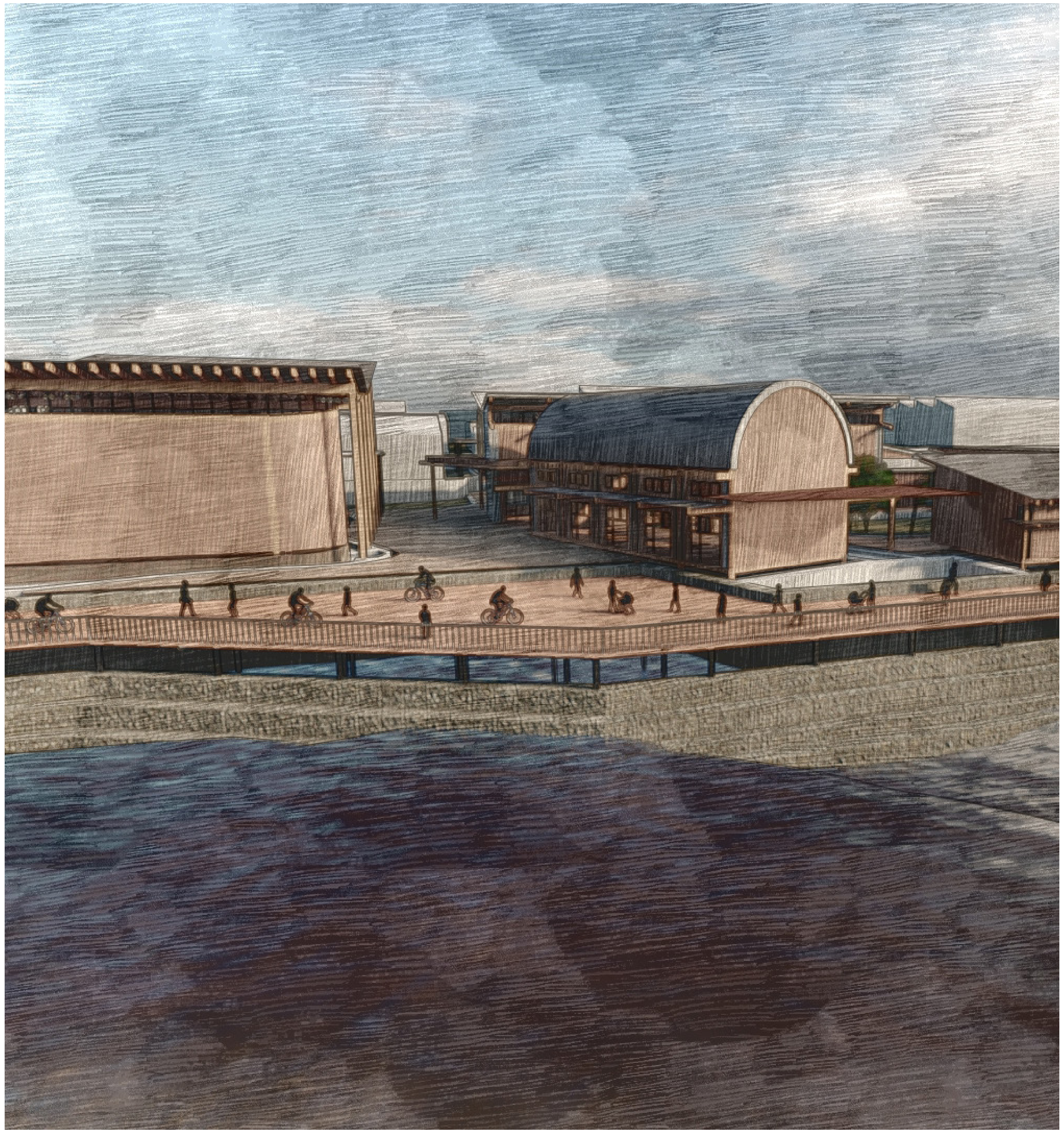


Figure 36: River-edge render (Author, 2023)

References

1. Aigbavboa, C., Ohiomah, I., & Zwane, T. (2017). Sustainable Construction Practices: “A Lazy View” of Construction Professionals in the South Africa Construction Industry. *Energy Procedia, 105*, 3003–3010. doi: 10.1016/j.egypro.2017.03.743.

2. Alfoldy, S. (2012). *The Allied Arts: Architecture and Craft in Postwar Canada*. Montreal: McGill-Queen’s University Press (McGill-Queen’s/Beaverbrook Canadian Foundation Studies in Art History).

3. Ampofo-Anti, N. L. (2017). *Delivering Construction Projects Using Innovative Building Technologies*. South Africa.

4. Barker, A. (2015a). A Mediated Modern Movement: Le Corbusier, South Africa, and Gabriël Fagan. *SAJAH, 30*(4), 69–89.

5. Barker, A. (2015b). *Extending Architectural Regionalism*.

6. Barker, D. A. (2013). Craft and Intellect: Materiality in the Domestic Architecture of Gawie Fagan. *SAJAH, 28*(2).

7. Bothma, C. (2023). *Extend Ways of Working: Design Processes and Emerging Technologies: Research Brief*. University of Pretoria.

8. Burdzik, W. M. G., & Van Rensburg, B. W. J. (1991). The Future of Engineered Timber Structures in South Africa. *Die Siviele Ingenieur in Suid-Afrika, August*, 287–293.

9. Calitz, S., & Wium, J. A. (2021). *A Proposal to Facilitate BIM Implementation Across the South African Construction Industry*. Master of Engineering in Civil Engineering. Stellenbosch University.

10. Castaldi, E. (no date). *African Village Huts* [Image]. iStock. Available at: https://www.istockphoto.com/photo/african-village-huts-gm698878820-129469423 (Accessed: 26 July 2023).

11. Conradie, D. C. U. (2014). The Performance of Innovative Building Technologies in South Africa’s Climatic Zones. *The Green Building Handbook, 6*, 165–188.

12. Conradie, J. (2021, November 15). *South African Architecture - A Brief History*. Draftek. Available at: https://www.draftek.co.za/post/south-african-architecture-a-brief-history (Accessed: 18 July 2023).

13. Crafford, P. L., Blumentritt, M., & Wessels, B. (2017). The Potential of South African Timber Products to Reduce the Environmental Impact of Buildings. *South African Journal of Science, 113*(9/10), 8.GB.

14. Dainese, E. (2015). *Histories of Exchange*. *Journal of the Society of Architectural Historians, 74*(4), 443–463. doi: 10.1525/jsah.2015.74.4.443.

15. de Klee, K. (2019). *The Barn-Inspired Conservatory House Is an Off-Grid Escape on a Farm* [Web article]. Dezeen. Available at: https://www.dezeen.com/2018/12/19/conservatory-house-off-grid-nadine-engelbrecht-architecture-south-africa/ (Accessed: 26 July 2023).

16. Fisher, R., et al. (2003). The Modern Movement Architecture of Four South African Cities. *Docomo Journal, 28*, 68–75.

17. Forker, T. J. (2015). *The Dialogue of Craft and Architecture*. University of Massachusetts Amherst. doi: 10.7275/7044176.

18. Frampton, K. (2001). *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture* (3rd ed.). Cambridge, Mass: M.I.T. Pr.

19. GBCSA (2021) *Gbcsa.org.za, Green Building Council South Africa*. GBCSA. Available at: https://gbcsa.org.za/wp-content/uploads/2022/08/GBCSA-2021-Integrated-Report.pdf. (Accessed: April 27, 2023).

20. Gerring, J. (2017). *Qualitative Methods*. University of Texas. Available from: https://www.annualreviews.org/doi/pdf/10.1146/annurev-polisci-092415-024158 (Accessed on 15 July 2023).

21. Golański, M. (2018). *Digital Tectonics and Dynamics in Designing of Wooden Architecture Envelopes*. In *Advanced Building Skins*. University of Zielona Góra, 759–769.

22. Greyling, C. (2020). *Rethinking the Making of Our Buildings: A Timber Construction Research Facility in the Pretoria CBD*. *Masters of Architecture*. University of Pretoria.

23. Hanlon, T. M. (2017). *An Exploration of Craft, the Tool, and Emergent Trends in Wooden Architecture*. *Masters of Architecture*. University of Washington.

24. Kloukinas, D. (2014). *Neolithic Building Technology and the Social Context of Construction Practices: The Case of Northern Greece*. School of History, Archaeology, and Religion, Department of Archaeology and Conservation, 30–34.

25. Kumru, A. M. (2017). *Adapting Vernacular Wood Tectonics to Contemporary Architecture via Parametric Modeling: Bosnia and Herzegovina Case*. *Masters in Architecture*. Bahcesehir University.

26. Loh, P. L. L. (2019). *Digital Material Practice*. *Doctor of Philosophy*. RMIT University.

27. Louw, M. P. (2021). *The Search for Hybrid Tectonics in Contemporary African Architecture: Encounters Between the Global and the Local*. University of Cape Town. Available at: https://open.uct.ac.za/handle/11427/35893.

28. McCoy, A., & Yeganeh, A. (2021). *An Overview of Emerging Construction Technologies*. *NAIOP Research Foundation, March*, 44.

29. Mehta, R., & Bridwell, L. (2005). *Innovative Construction Technology for Affordable Mass Housing in Tanzania, East Africa*. *Construction Management and Economics, 23*(1), 69–79. doi: 10.1080/0144619042000287769.

30. Menges, A., et al. (2017). *Fabricate 2017*. *UCL Press (Robotic Wood Tectonics)*. Available at: http://www.jstor.org/stable/10.2307

/j.ctt1n7qkg7 (Accessed: 31 May 2023).

31. Mohammed M. Shahda, M. (2018). *Vision and Methodology to Support Sustainable Architecture through Building Technology in the Digital Era*. *The International Journal of Environmental Science & Sustainable Development, 2*(1), 1–14. doi: 10.21625/essd.v2i1.169.g71.

32. Mohd Nawi, M. N., Baluch, N., & Bahauddin, A. Y. (2014). *Impact of Fragmentation Issue in Construction Industry: An Overview*. *MATEC Web of Conferences, 15*, 01009. doi: 10.1051/matecconf/20141501009.

33. Nkuna, N. (2021) *The innovation hub partners with the SA Innovation Summit, SA Innovation Summit*. Available at: https://innovationsummit.co.za/the-innovation-hub-partners-with-the-sa-innovation-summit-2021/. (Accessed: April 27, 2023).

34. Ofhouses (2021). *Ofhouses* [Tumblr blog]. Available at: https://ofhouses.com/post/648233522089410560/884-rex-distin-martienssen-house-martienssen (Accessed: 26 July 2023).

References

35. Olojede, O. A., Agbola, S. B., & Samuel, K. J. (2019). *Technological Innovations and Acceptance in Public Housing and Service Delivery in South Africa: Implications for the Fourth Industrial Revolution*. *Journal of Public Administration, 54*(2), 193.

36. Osunsanmi, T. O., Aigbavboa, C., & Oke, A. (2018). *Construction 4.0: The Future of the Construction Industry in South Africa*. *International Journal of Civil and Environmental Engineering, 12*(3).

37. O'Toole, S. (2018). *A Literary History of the Brick in Johannesburg*. *ArtAfrica*, 196–203.

38. Papo, M. (2017). *Fragmentation Challenges Amongst Construction Professional Members in South Africa*. *Master of Science in Engineering*. University of Witwatersrand.

39. Pillay, V. (2021). *The Famous Standard Bank Building in Cape Town Is Going Under the Hammer – Have You Got a Few Millions?* *Independent Online*. Available at: https://www.iol.co.za/business-report/companies/the-famous-standard-bankbuilding-in-cape-town-is-going-under-the-hammer-have-you-got-a-few-millions-17d29fd7-3ab8-49d1-8bc6-251f9335dab5 (Accessed: 26 July 2023).

40. Radford, D. (1998). *The "Anarchy of Iron", Official Attitudes to Wood and Iron Construction in South Africa*. *SA. Journal of Cultural History, 12*(1), 18.

41. Radford, D. (2023). *The Early History of the Tall Building in the South African City*.

42. RapidEye (no date). *Tourists Walk into the Old Manor House at Groot Constantia, Cape...* [Image]. iStock. Available at: https://www.istockphoto.com/photo/tourists-at-groot-constantia-wine-estate-in-cape-town-gm1151954216-312347039 (Accessed: 26 July 2023).

43. Richardson, L. (2013). *Adoration of the Joint: Investigation and Translated Application of Jointing Methods*. *Master of Architecture Professional*. Unitec Institute of Technology.

44. SAIA (no date) *Universities, Universities - South African Institute of Architects*. Available at: https://saia.org.za/page/about/Universities.php. (Accessed: April 28, 2023).

45. Sanders, P. (2000). *Defining a Relevant Architecture in South Africa*. *Architectural Research Quarterly, 4*(1), 67–80. doi: 10.1017/S1359135500002438.

46. Schwartz, C. (2016). *Introducing Architectural Tectonics: Exploring the Intersection of Design and Construction* (1st ed.). New York and London: Routledge. Available at: https://www.taylorfrancis.com/books/9781317564058 (Accessed: 31 May 2023).

47. Somekh, B., & Lewin, C. (2005). *Research Methods in the Social Sciences*. London; Thousand Oaks, Calif: SAGE Publications.

48. Stein, J. G. (2011). *Speculative Artisanry: The Expanding Scale of Craft within Architecture*. *The Journal of Modern Craft, 4*(1), 49–63. doi: 10.2752/174967811X12949160068811.

49. Sustainability Institute (2021) *Spring Update 2021, Sustainability Institute*. Available at: https://www.sustainabilityinstitute.net/wp-content/uploads/2022/08/SI-Spring-Update-2021-smaller.pdf. (Accessed: April 27, 2023).

50. Tapia, D. (2020). *Tree House / Malan Vorster Architecture Interior Design* [Web article]. ArchDaily. Available at: https://www.archdaily.com/873882/tree-house-malan-vorster-architecture-interior-design (Accessed: 26 July 2023).

51. Voortrekker Monument (2023). *Home*. VTM. Available at: https://vtm.org.za/en/home/ (Accessed: 26 July 2023).

52. Wienecke, M. A. (2010). *Promoting Alternative Technologies: Experiences Of The Habitat Research & Development Centre (HRDC)*. *Habitat Research & Development Centre Namibia, 21*.

53. Windapo, A. O., & Cattell, K. (2013). *The South African Construction Industry: Perceptions of Key Challenges Facing Its Performance, Development, and Growth, 18*(2), 65–79.

54. Wu, J., Wei, H., & Peng, L. (2019). *Research on the Evolution of Building Technology Based on Regional Revitalization*. *Buildings, 9*(7), 165. doi: 10.3390/buildings9070165.

55. van Wyk, L. (2013). *Accelerating the Green Agenda through Innovative Building Technologies*. In *Green Building Handbook of South Africa*. *Presidential Infrastructure Coordinating Commission (PICC)*, 173-186.

56. van Wyk, L., Kajimo-Shakantu, K. and Opawole, A., 2021. Adoption of innovative technologies in the South African construction industry. *International Journal of Building Pathology and Adaptation*, (ahead-of-print).

57. Wessels, S. and Fataar, R. (2021) *THE REBUILT CITY - Rising from crises of emergency governance to a more sustainable and resilient future, South African Cities Network. Available at: https://www.sacities.net/wp-content/uploads/2022/08/Final-Festival-Report_14-12-2021.pdf. (Accessed: April 28, 2023).