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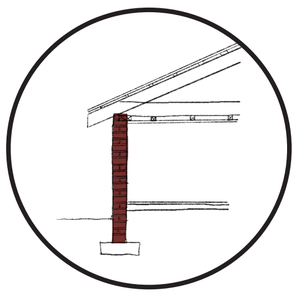
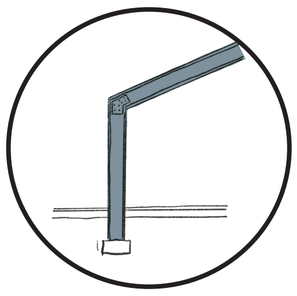
CURRENT BUILDING PRACTICE

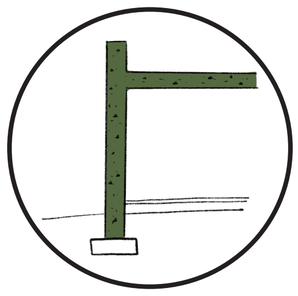
The term ‘current building practice’ refers to the present day use of conventional building technologies (CBT’s) (Ampofo-Anti, 2017: 2). This practice is associated with well-defined and well-developed means of construction that have been trusted and currently used by the construction industry.
Construction practices in South Africa predominantly rely on traditional brick-and-mortar, steel frame, and reinforced concrete techniques. Nevertheless, these conventional methods have been extensively utilised in the past without notable progress or inventive approaches. Several factors contribute to the reluctance to embrace change, including: lack of awareness, cost concerns, skills and training, regulatory barriers, risk aversion, supplier networks, and cultural factors. By recognizing and addressing these reasons for hesitance, South Africa’s construction industry can create an environment conducive to embracing advancements and innovative approaches that can bring about positive change.



Conventional brick and mortar



Steel frame



Reinforced concrete

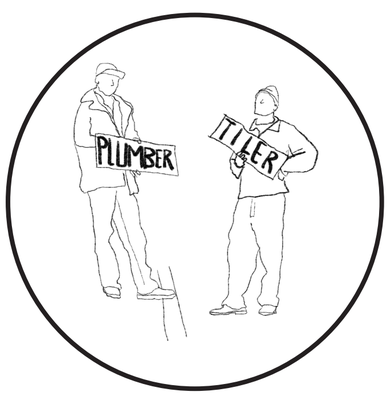
LABOUR AND UNEMPLOYMENT

Need for skilled labourers: The South African Institute of Architects (SAIA) (2019) reported that there is a scarcity of skilled workers in the country’s architecture business, particularly in the disciplines of architecture, urban design, and landscape architecture. More skilled labourers are also needed in the construction sector, especially for carpentry, electrical work, and plumbing. The lack of trained labour in the construction sector is a significant concern, particularly in rural areas, as stated in a report by the Construction sector Development Board (CIDB) (2019).

Unemployment: South Africa continues to experience growth as a nation, but unfortunately, the unemployment rate shows a corresponding upward trend. However, by fostering innovation and promoting social responsiveness, we have the potential to tackle this pressing social issue. By harnessing our existing skills and addressing the challenges of unemployment, we can propel both the country and the construction industry towards a prosperous future.



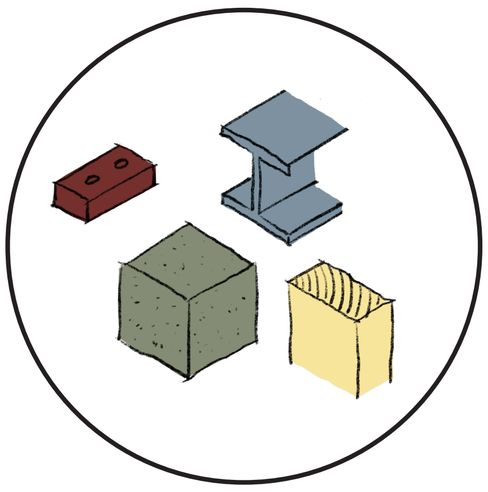
Unemployment



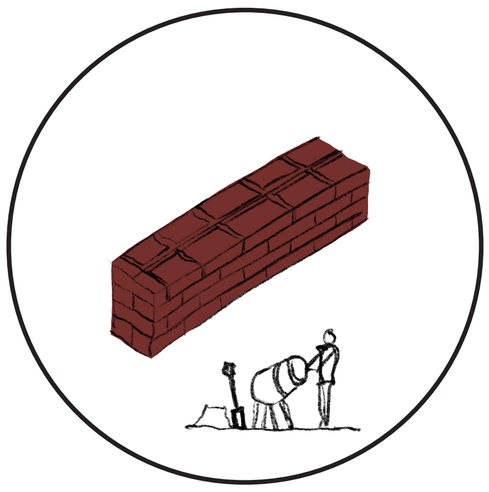
Unskilled labour

BUILDING TECHNOLOGIES

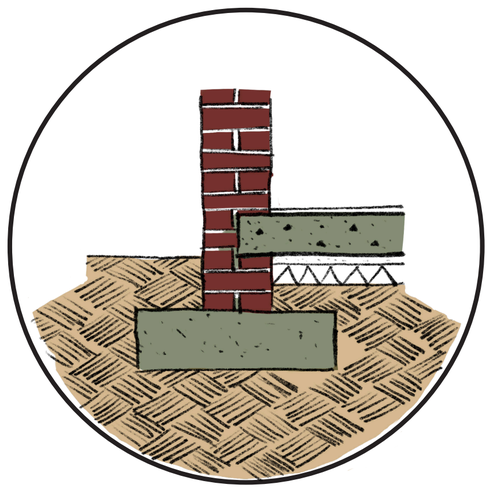
‘Building technology’ includes everything the construction industry requires to create buildings and other objects that make up our physical environment, subsequently it takes into account not only the requirements of the building industry but also those of all other sectors that directly and indirectly support it (Mohammed M. Shahda, 2018: 55).



Building materials



Construction process

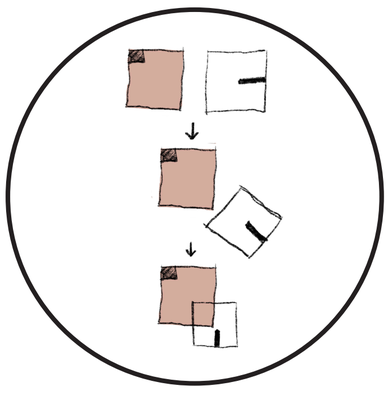


Structural system

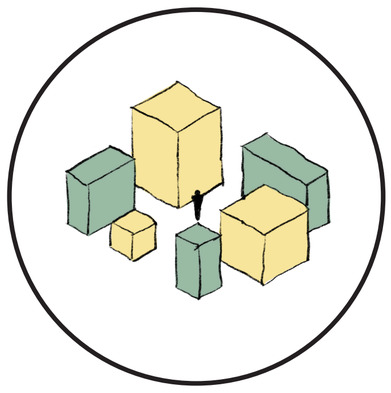
EMERGING BUILDING TECHNOLOGIES

Emerging Building Technologies can be defined as the realm of building material technology development which encompasses the sub- realms of non-conventional building technologies (Wienecke, 2010: 17 - 18)., Innovative building technologies and their corresponding innovative processes and forward thinking. These processes of forward thinking and building material development fall within a time frame as recent as 5 to 10 years (McCoy and Yeganeh, 2021: 6), while the narrative and rate associated with continual development is completely dependent on the region of focus and the current state of its construction industry (Wienecke, 2010: 17 - 18).

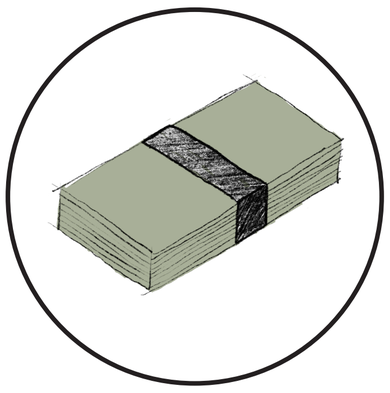
Values of EBTs



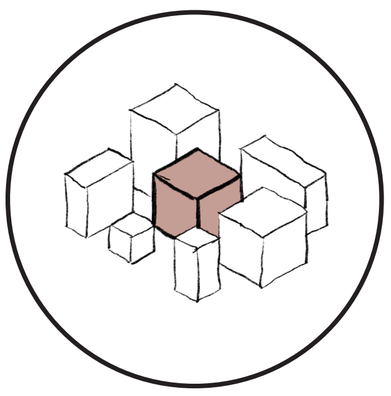
Versatile



Socially respomsive



Economical



Contextually responsive

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SOUTH AFRICAN BUILDING INDUSTRY

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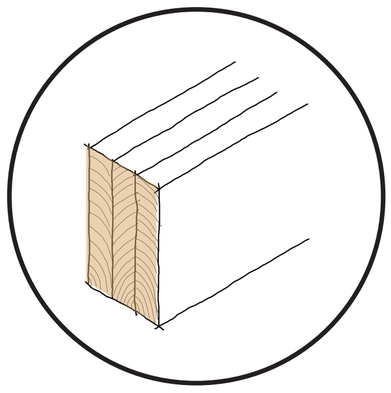
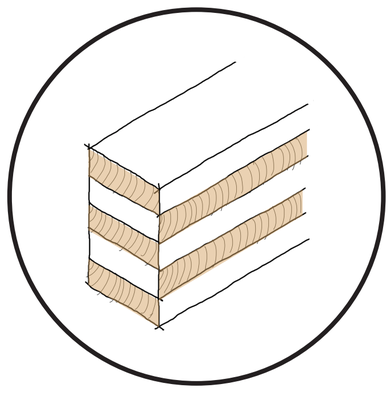
MASS TIMBER CONSTRUCTION

Mass timber

Mass timber refers to modified timber elements, such as glue laminated timber (GLT) and cross laminated timber (CLT). GLT involves the process of bonding layers of timber together under high compression, with the timber aligned in the same grain direction. On the other hand, CLT entails gluing layers of timber together under high compression, but with the timber arranged in the opposite grain direction.



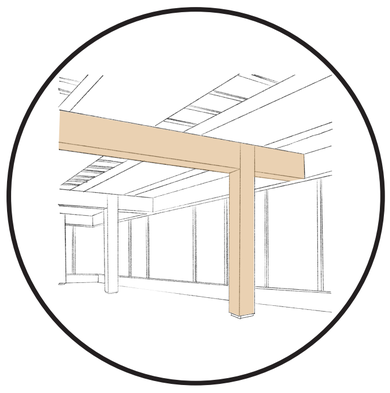
Glue Laminated Timber



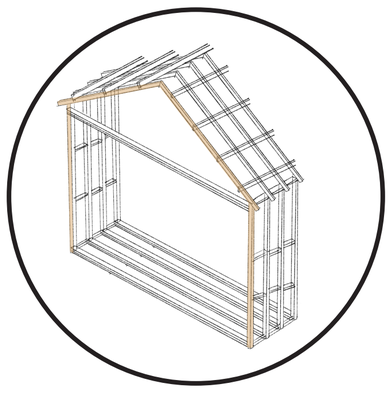
Cross Laminated Timber

Timber construction

Timber construction primarily employs two construction methods: post-and-beam and framed construction. Post-and-beam construction involves utilizing larger sections of timber, making it suitable for incorporating mass timber sections. On the other hand, framed construction relies on nominal section sizes such as 38mm, 50mm, 76mm, 114mm, 152mm, and 228mm.

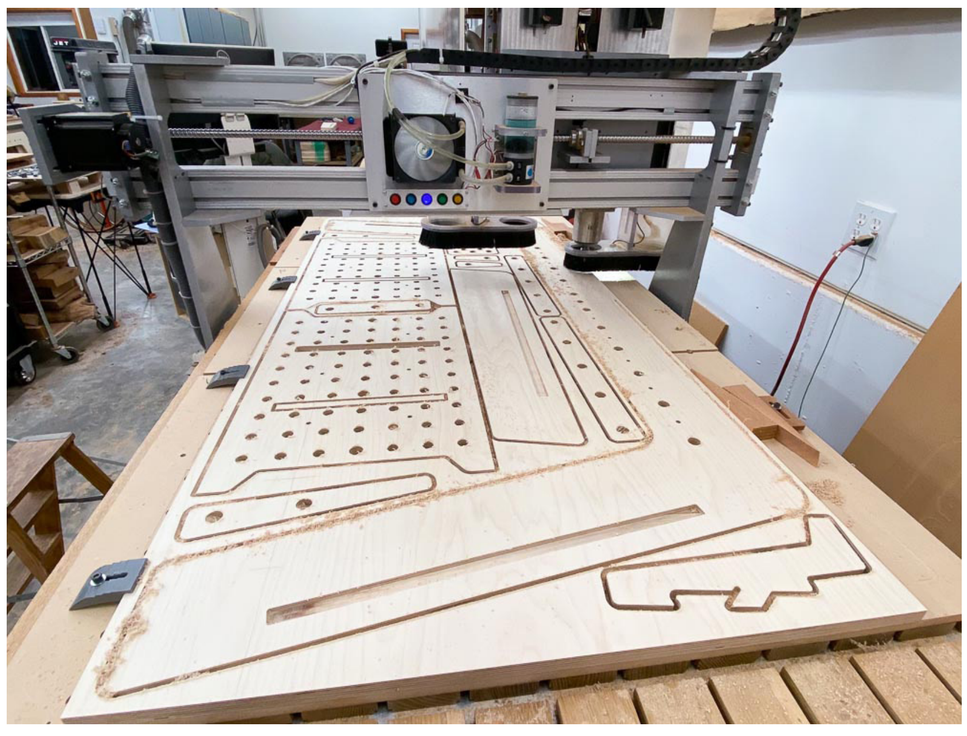


Post - and - beam construction



Frame or baloon construction

Mass timber qualities and benefits



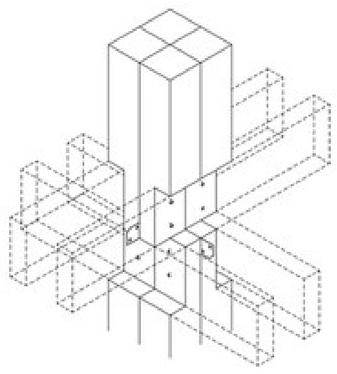
CNC machining (Technology based)

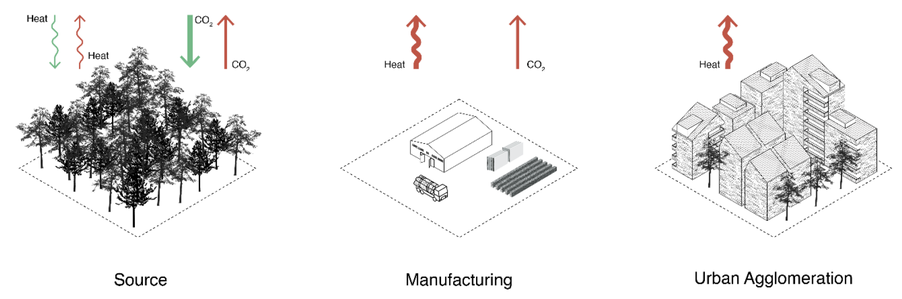


Hand crafting and clamping (Hand based)

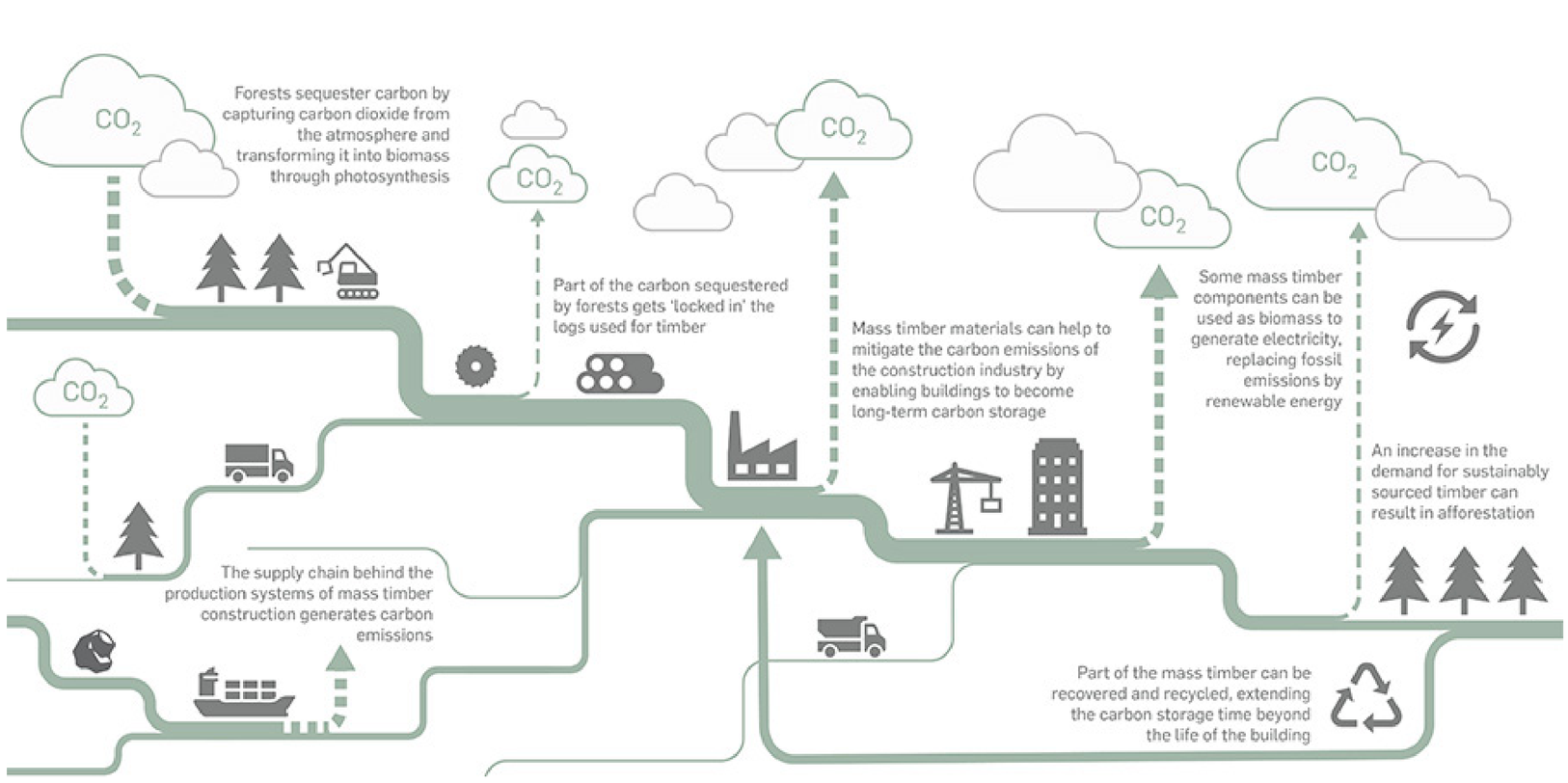


Designing for disassembly





Ability to change the building industry and environments



Climatically and sustainably effecient

SOUTH AFRICAN BUILDING INDUSTRY

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TIMBER
construction school in
South Africa
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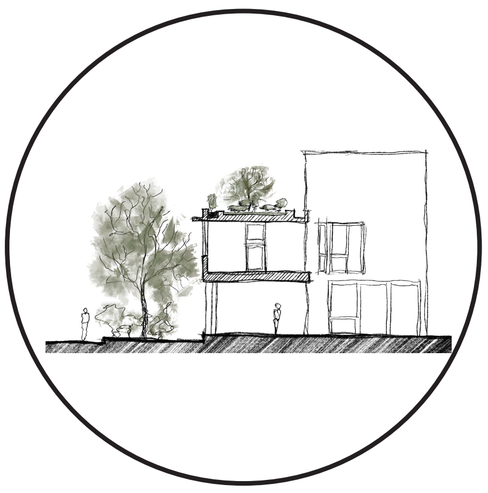
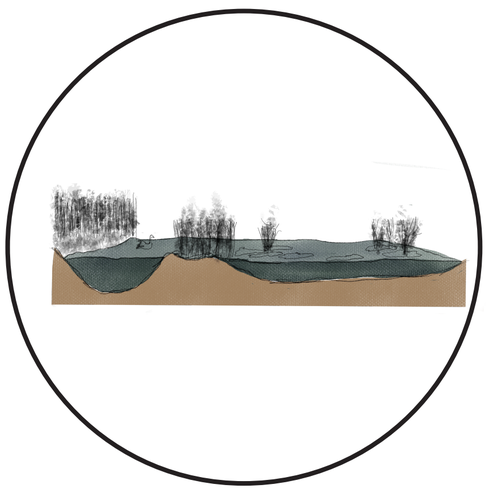
REGENERATIVE ARCHITECTURE

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.

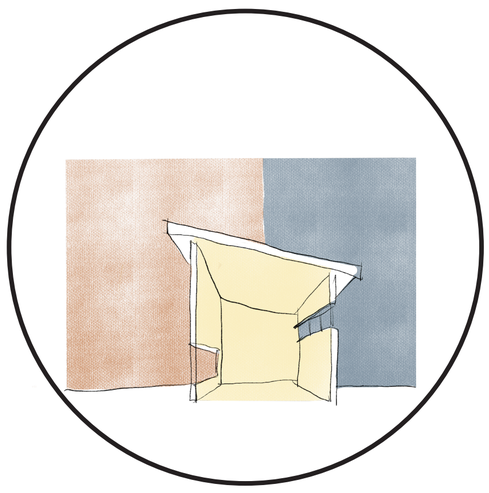
Regenerative architecture strategies



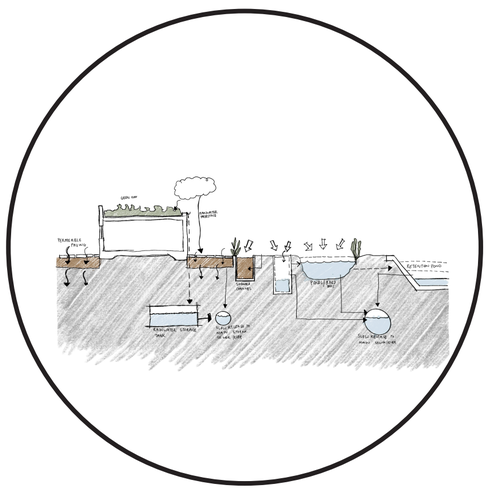
Green roof systems



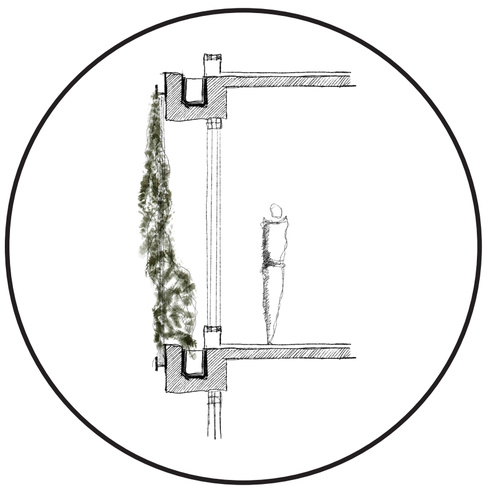
Restoring and creating opportunities for new biodiversity



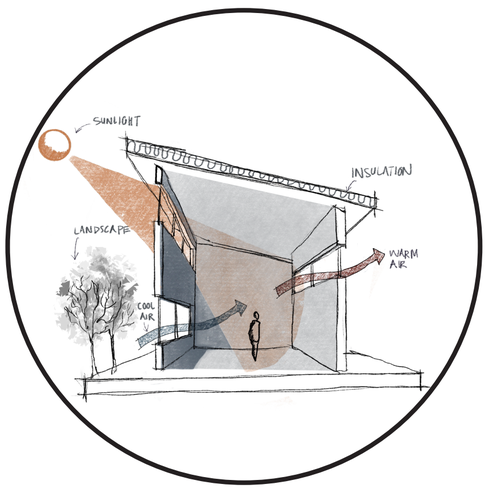
Ability to adapt to weather conditions



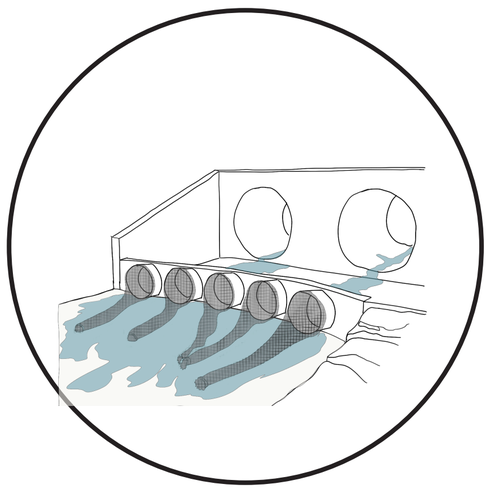
Water harvesting and storage systems



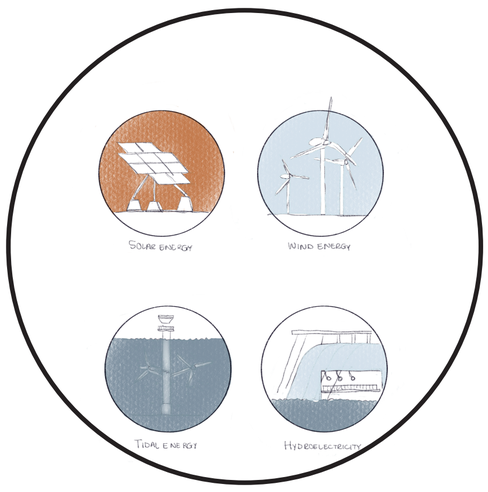
Green skin or envelope systems



Solar heating principles and passive cooling systems



Adressing pollution

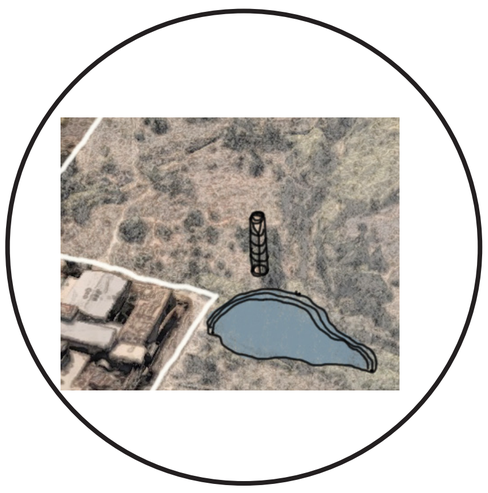


Creating and storing energy

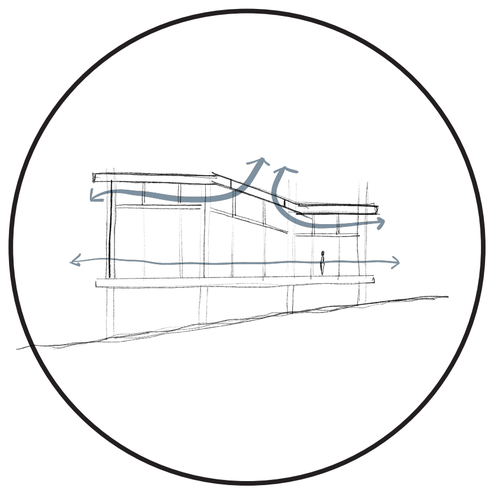
Regenerative architecture opportunities - site specific



Constructed wetland



Water tower for storage



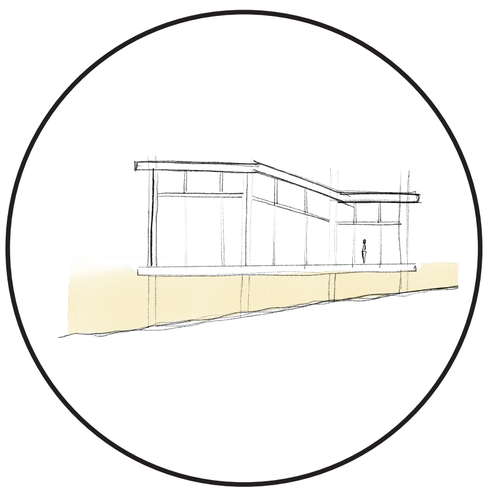
Passive cooling systems



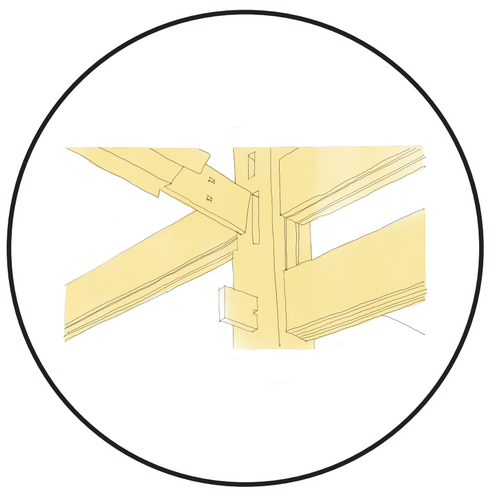
Purification and cleaning of the river



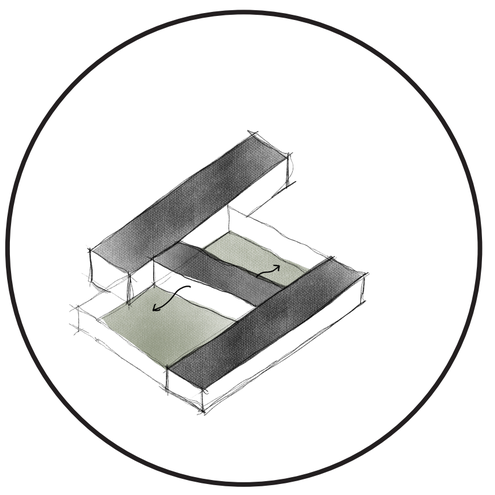
Hydro electricity with river



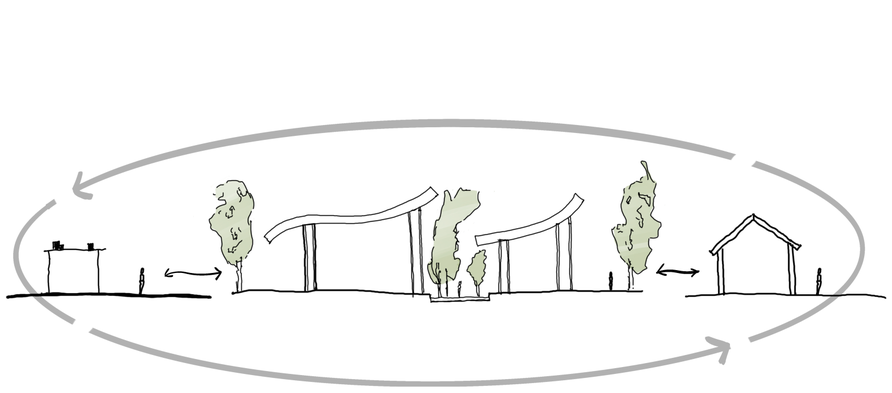
Raised buildings for minimal foundations



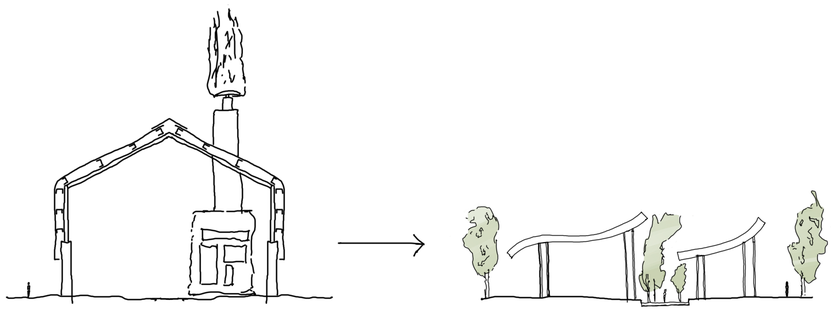
Materiality of building more sustainable



Courtyards - solar heat gain and natural light



Regeneration of the environment through the new building and the programme



Regeneration of the industrial / educational building typology

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THEORY

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SITE CHOICES

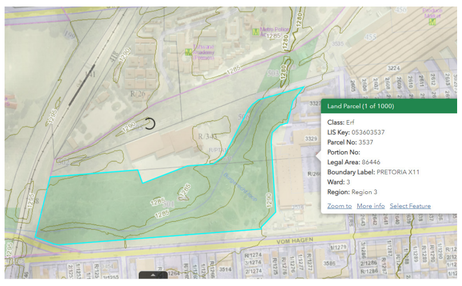
Skinnerspruit site



Gauteng, Pretoria, North East of Marabastad.

Pro's
- Next to a river / stream
- Close to Marabastad - foot traffic is ample
- good amount of space

Con's
- Marabastad known for only day visitors - do not want to add to this
- Removed from building industry
- Not close to a lot of schools - graduates can not interact that easily







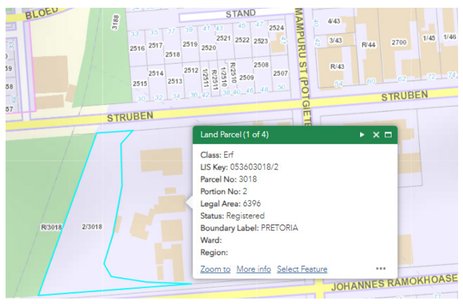
Marabastad site



Gauteng, Pretoria, South of Asiatic Basaar.

Pro's
- Next to a water
- In Marabastad - foot traffic is ample
- Informants around site ample

Con's
- Marabastad known for only day visitors - do not want to add to this
- Removed from building industry
- Water is channelised and not a river/stream
- Mobile culture and not educational







Jan Niemand Park



Gauteng, Pretoria, North of Silverton.

Pro's
- Next to a water
- Near Silverton - close to building industry
- Informants around site ample
- Between industrial, residential and nature

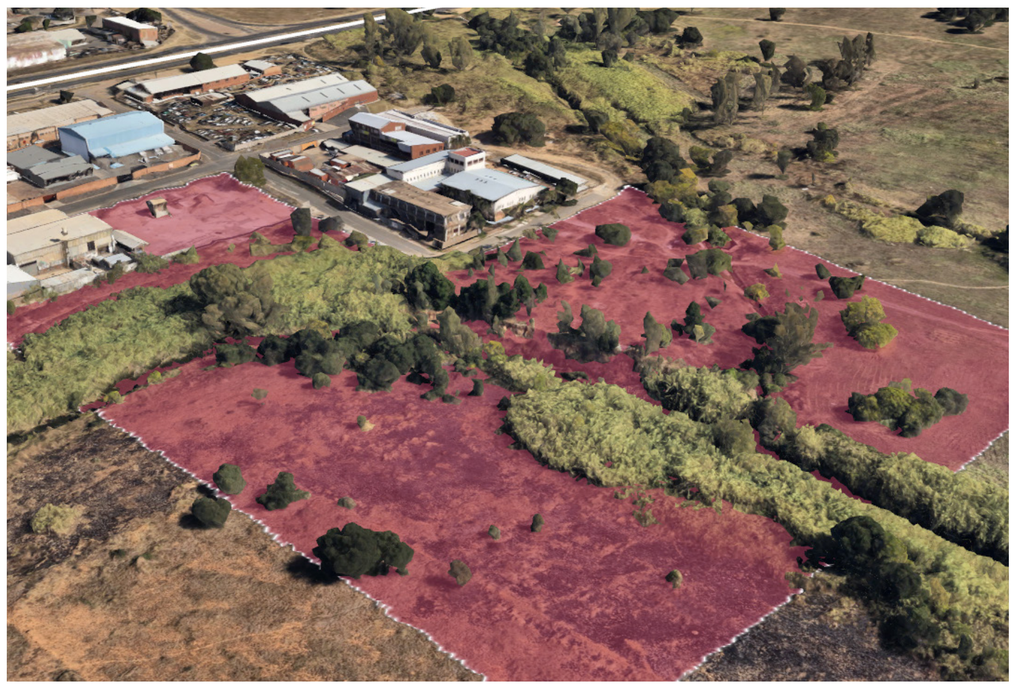
Con's

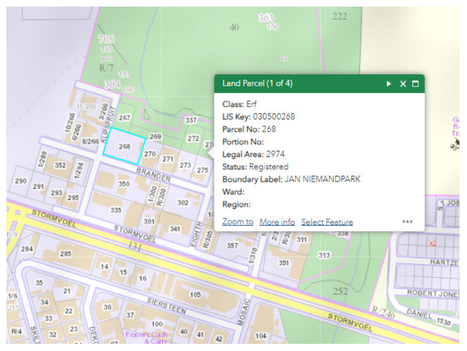
- Industrial culture - not humanised
- Natural environment overgrown and unsafe
- Could feel isolated

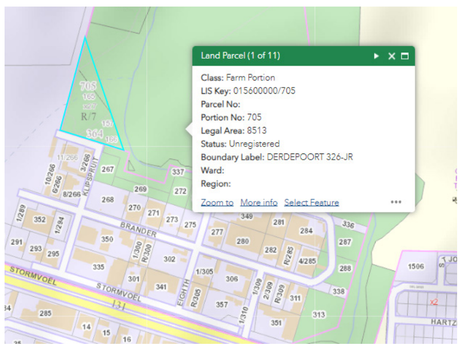


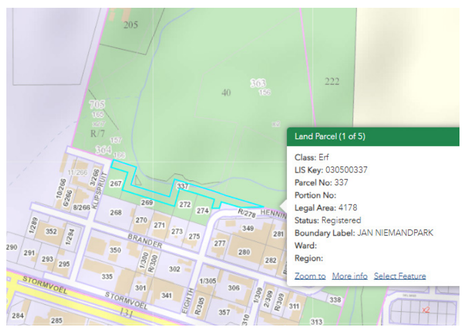


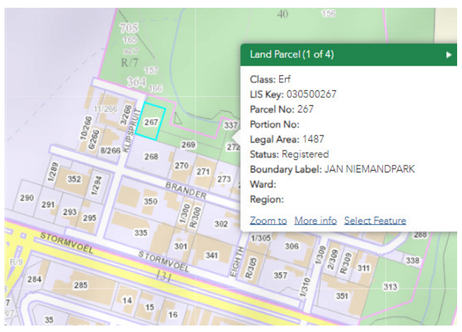












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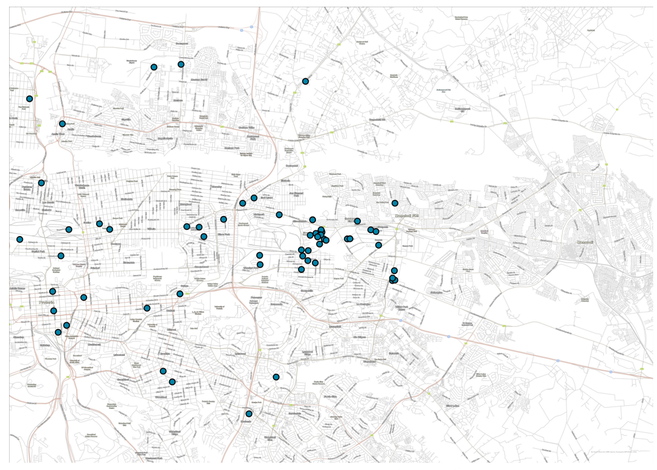
INFORMANTS - BUILDING INDUSTRY



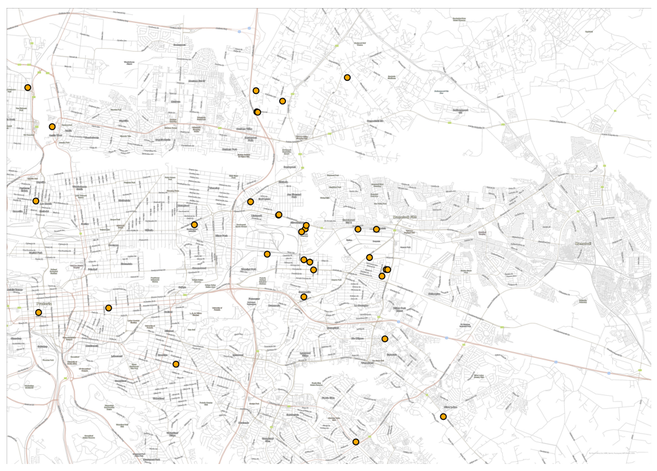
Brick suppliers
(Author, 2023)



Sand suppliers and quarries
(Author, 2023)



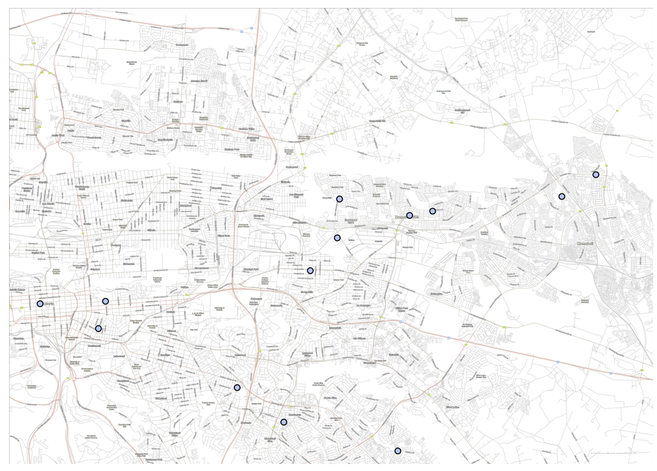
Steel manufacturers and suppliers
(Author, 2023)



Timber suppliers
(Author, 2023)



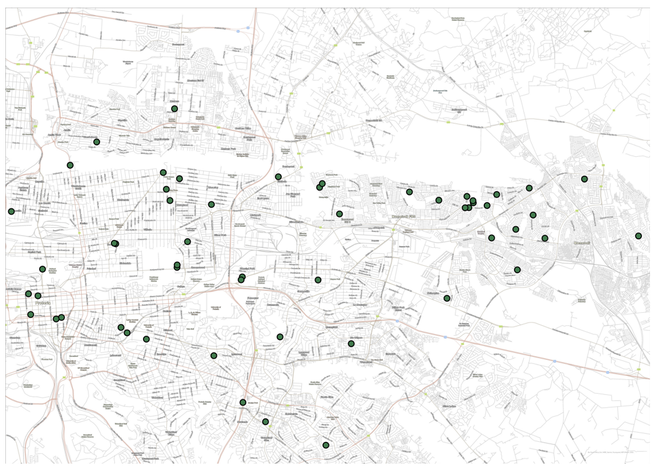
TVET colleges
(Author, 2023)



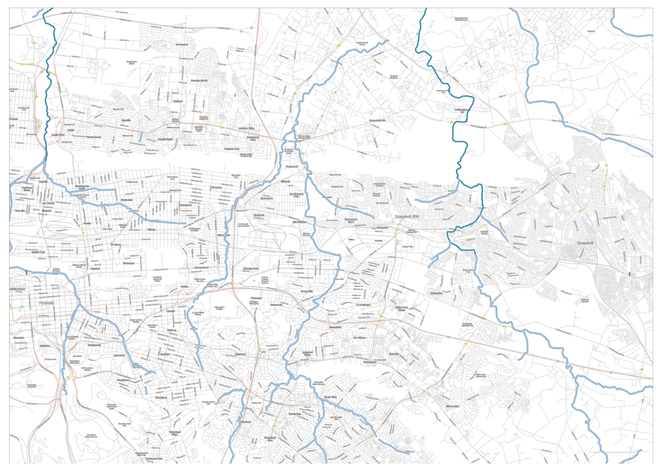
Community centres
(Author, 2023)



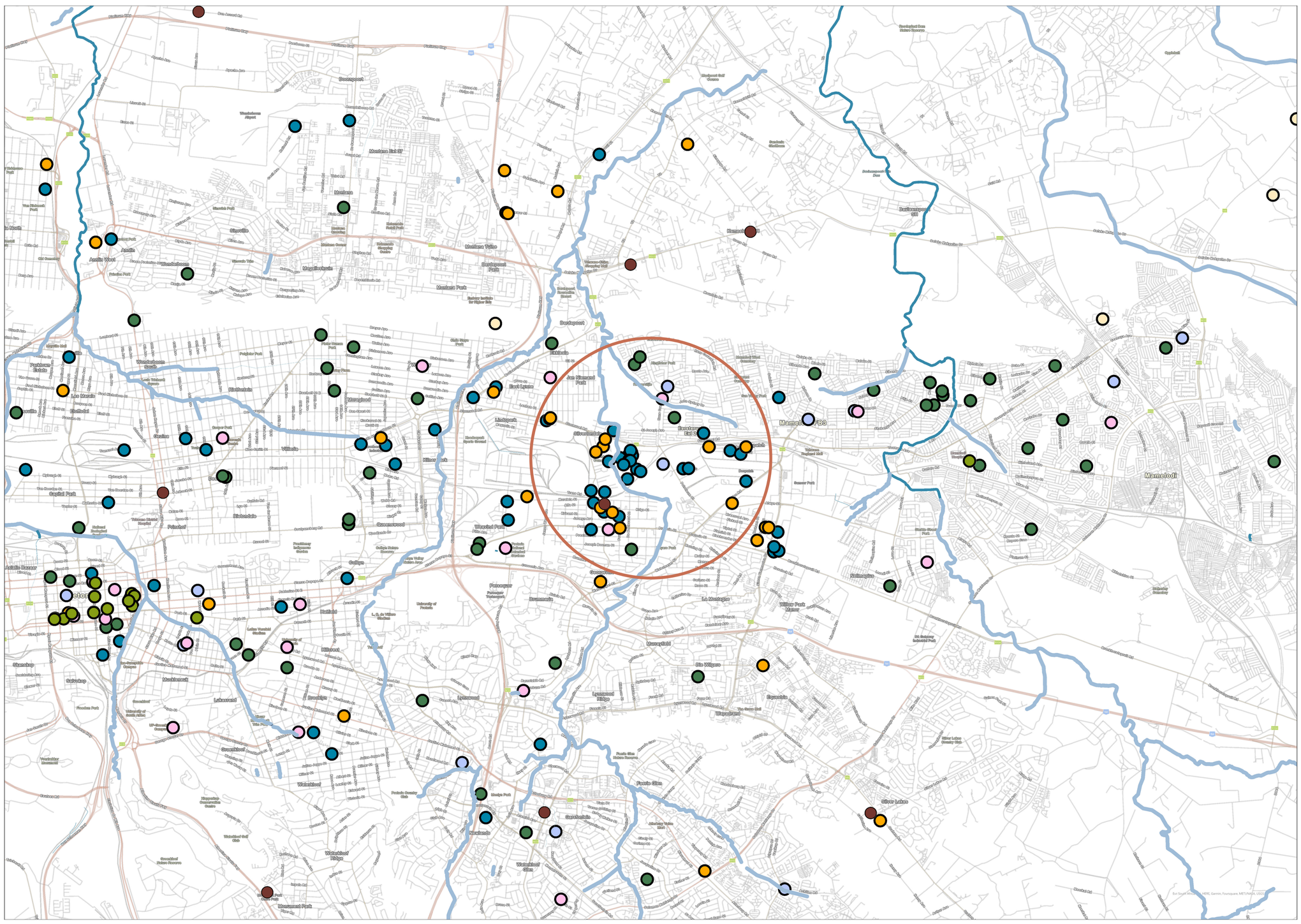
Libraries
(Author, 2023)



Highschools
(Author, 2023)



Waterways
(Author, 2023)



Combined with identified cluster
(Author, 2023)

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INFROMANTS | MACRO SCALE

School of CRAFT:

TIMBER
construction school in
South Africa

Jacques van Vuuren
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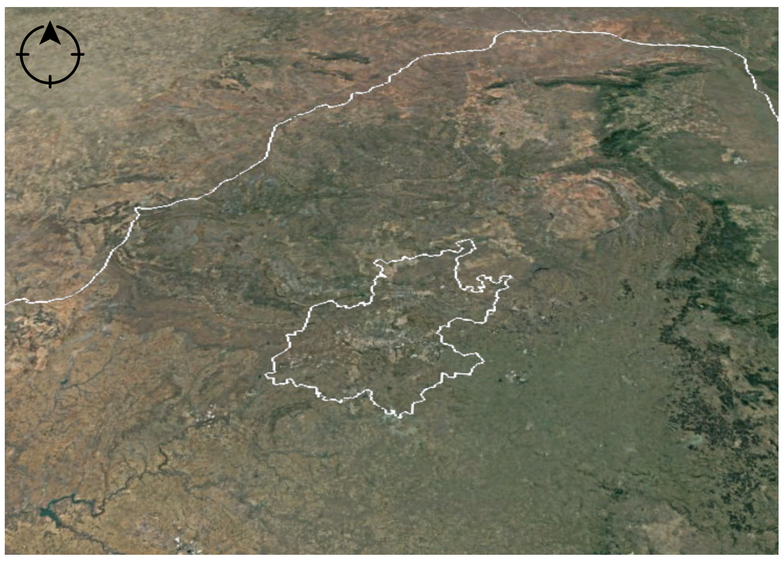
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

LOCALITY | SITE

25°42'50"S 28°14'40"E
270 Brander street, Jan Niemand Park, Pretoria, 0186
Ward 43



Aerial photo - Gauteng (Author + Google Earth, 2023)



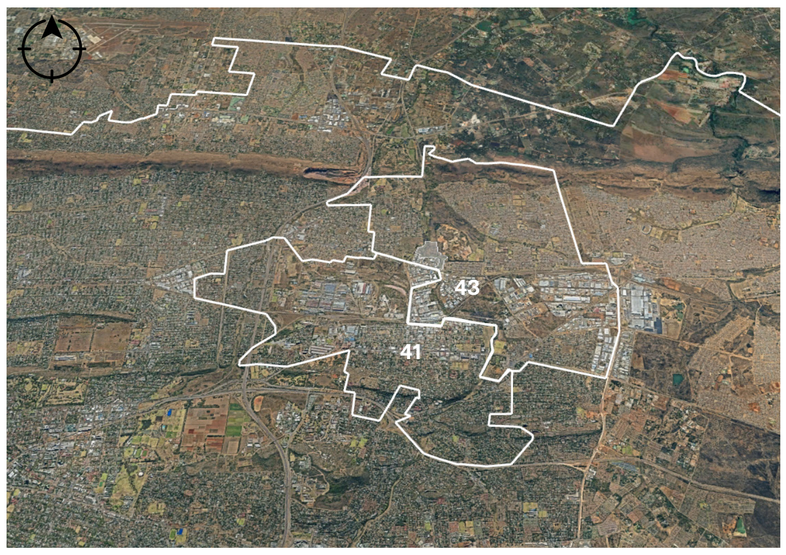
Aerial photo - Silverton / Silvertondale / Jan Niemand Park (Author, 2023)



Aerial photo - Pretoria (Author + Google Earth, 2023)



Aerial photo - Site in Silvertondale / Jan Niemand Park (Author, 2023)



Aerial photo - Wards 41 + 43 (Author, 2023)



Aerial photo - Site in Silvertondale / Jan Niemand Park (Author, 2023)



Aerial photo - Pretoria East (Author, 2023)



Aerial photo - Site in Silvertondale / Jan Niemand Park (Author, 2023)



Aerial photo - Silverton / Silvertondale / Jan Niemand Park (Author, 2023)

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Aerial photo - Site in Silvertondale / Jan Niemand Park (Author, 2023)

SITE | LOCATION

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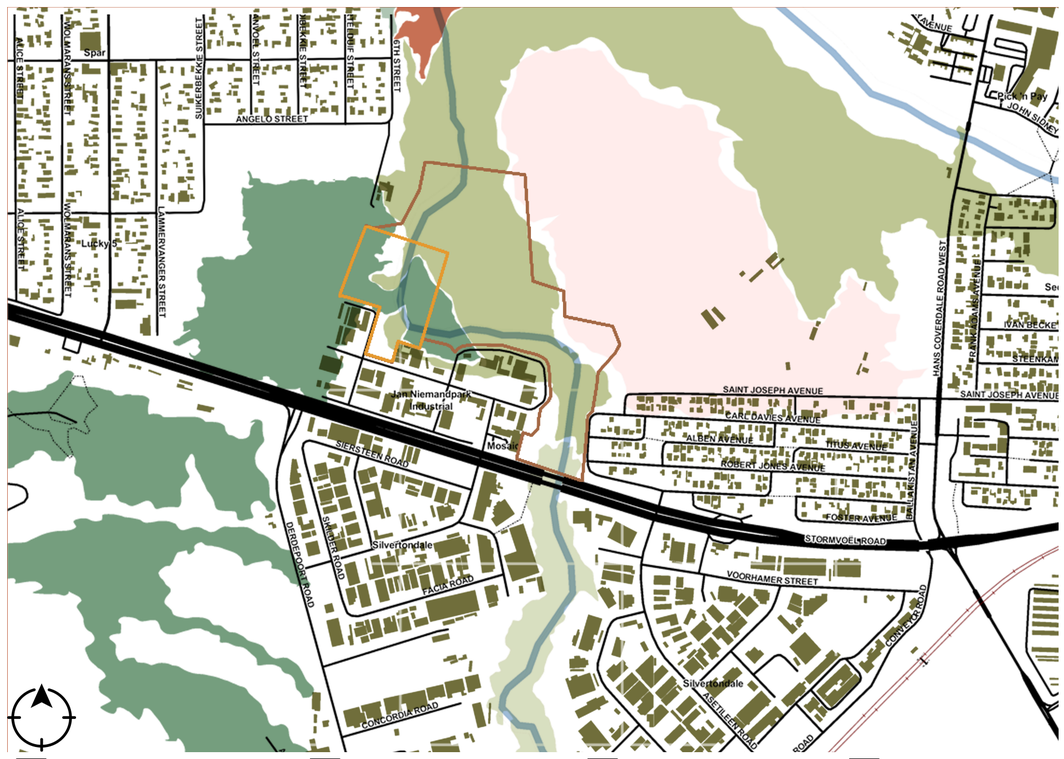
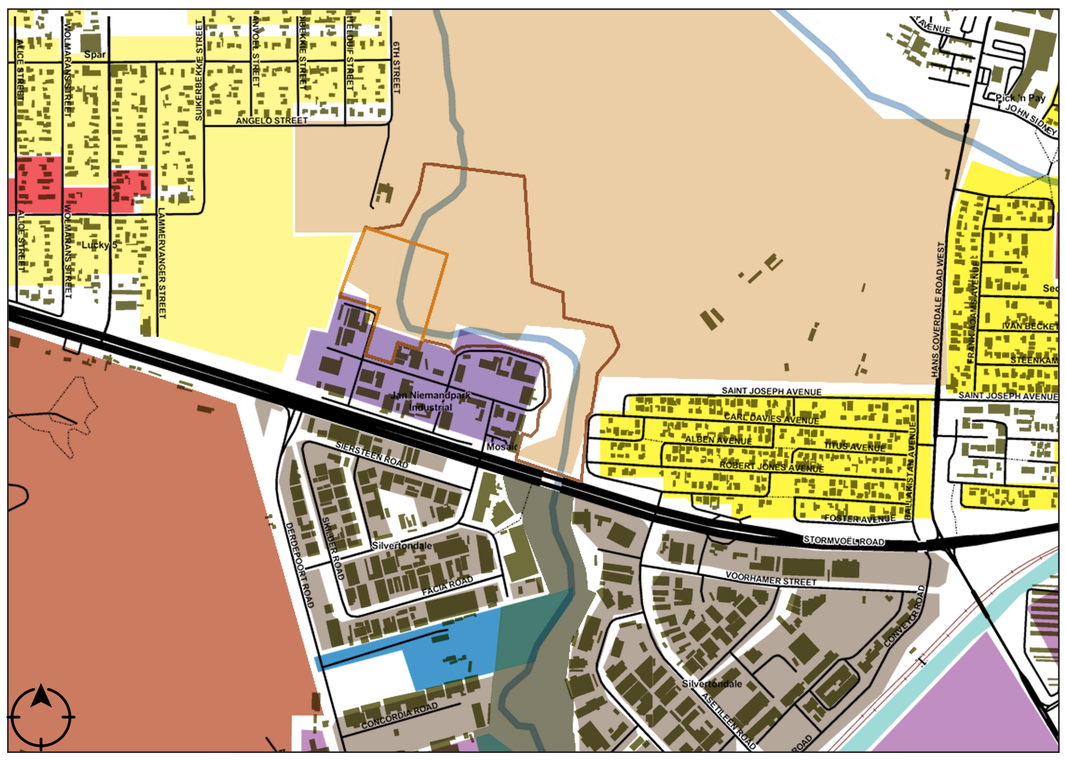
INFORMANTS



Surrounding industries
(Author, 2023)



SANBI biodiversity
(Author, 2023)



Tshwane zoning
(Author, 2023)



Current and future public transportation planning
(Author, 2023)



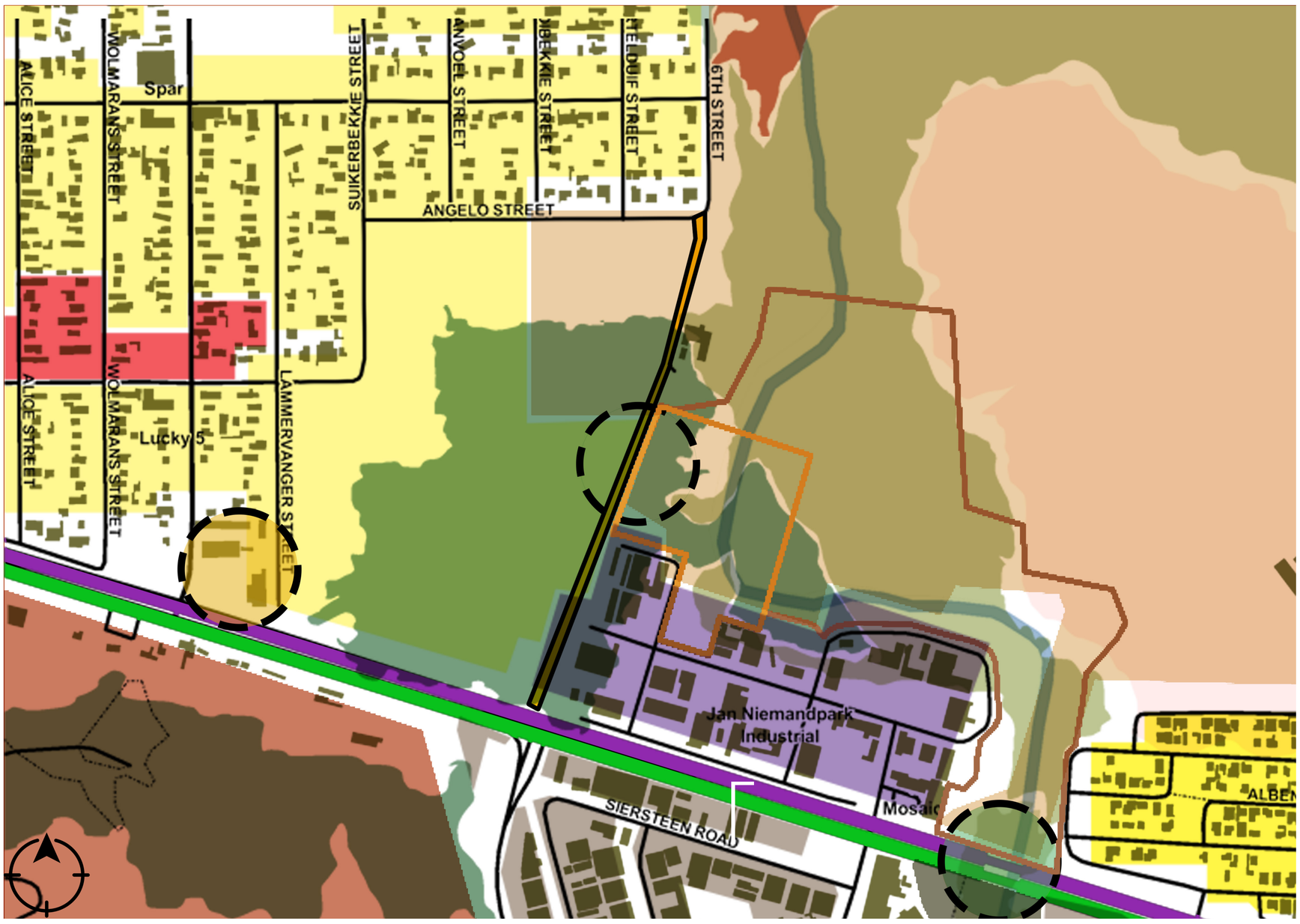
Bicycle lanes
(Author, 2023)



Aryeng bus system
(Author, 2023)



Tuk Tuk system
(Author, 2023)



Combined informants
(Author, 2023)

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SITE ANALYSIS

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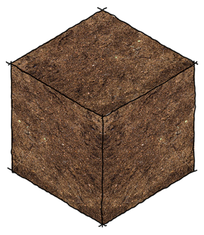
Ward 43

Biodiversity

Soil type



Red, yellow and/or grey soils with low to medium base status.

Associated classes of 1-14 undifferentiated structureless soil. + Associated classes of 13 and 16 undifferentiated shallow soils and land classes.

Ecological zones



- Ecological support area
- Critical biodiversity area

Moreleta spruit

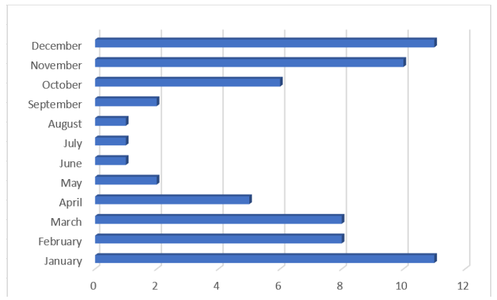
The Moreleta Spruit, located in the eastern suburbs of Pretoria, is a tributary of the Hartbees Spruit. Originating from the dolomite hills south of Pretoria, this perennial stream holds significant importance. It gracefully traverses two nature reserves, namely the Moreleta Nature Reserve and the Faerie Glen Nature Reserve, while creating a green belt pathway through Garsfontein. Continuing northward, it seamlessly merges with the Hartbees Spruit and eventually drains into the Roodeplaat Dam.

The maintenance and preservation of the Moreleta Spruit have primarily been entrusted to various Friends' Groups. These organizations voluntarily engage in clearing invasive alien vegetation and removing debris along the stream's banks.

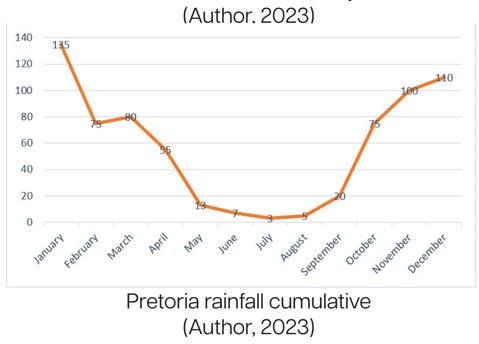


Moreleta spruit
(Author, 2023)

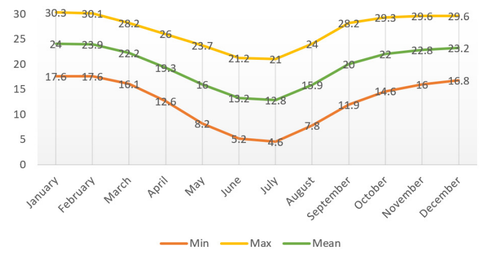
Temperature and rainfall



Pretoria rainfall monthly
(Author. 2023)

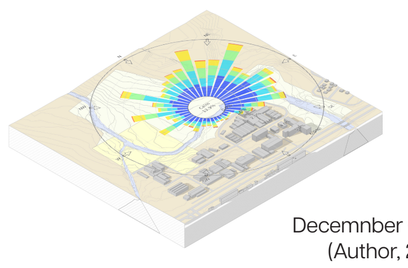


Pretoria rainfall cumulative
(Author, 2023)

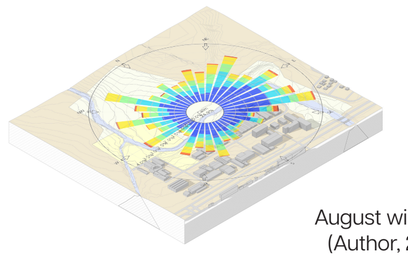


Pretoria temperatures
(Author, 2023)

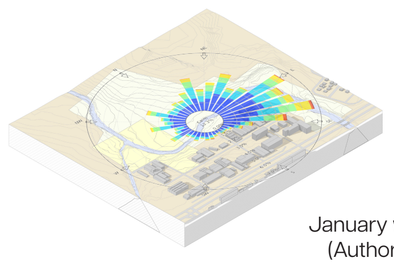
Windrose



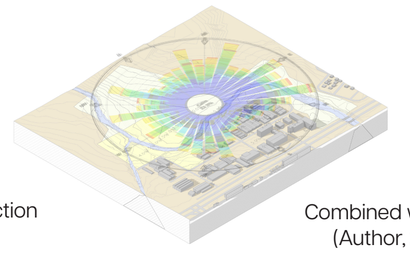
Decemnber windrose
(Author, 2023)



August windrose
(Author, 2023)

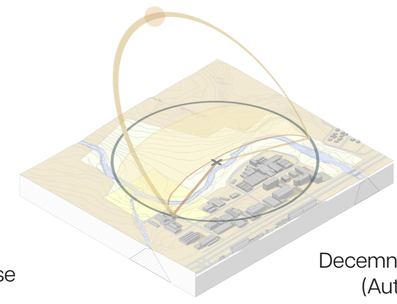


January windrose
(Author, 2023)

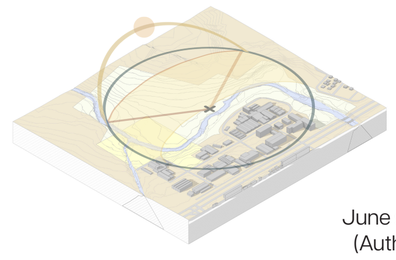


Combined windrose
(Author, 2023)

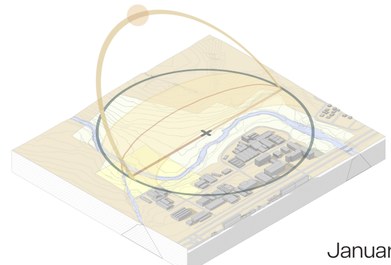
Solar diagram



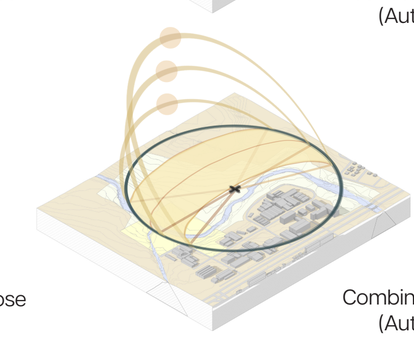
Decemnber solar angle
(Author, 2023)



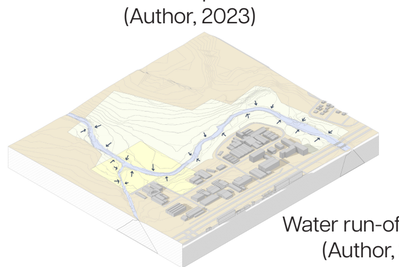
June solar angle
(Author, 2023)



January solar angle
(Author, 2023)



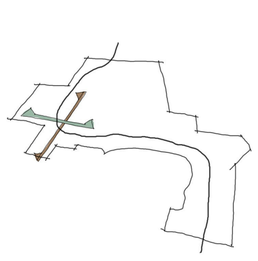
Combined solar angle
(Author, 2023)



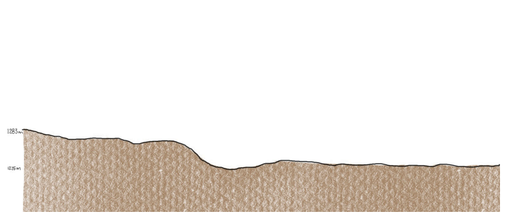
Water run-off direction
(Author, 2023)



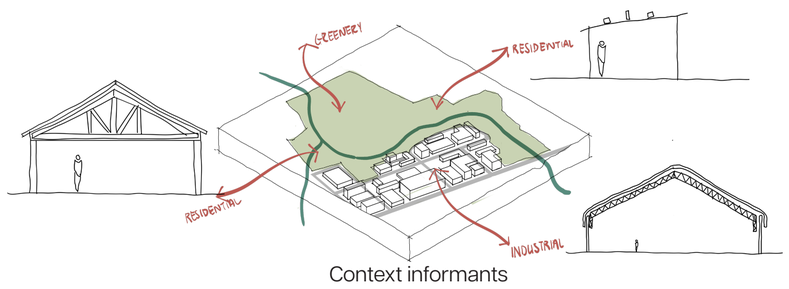
East-West section
(Author, 2023)



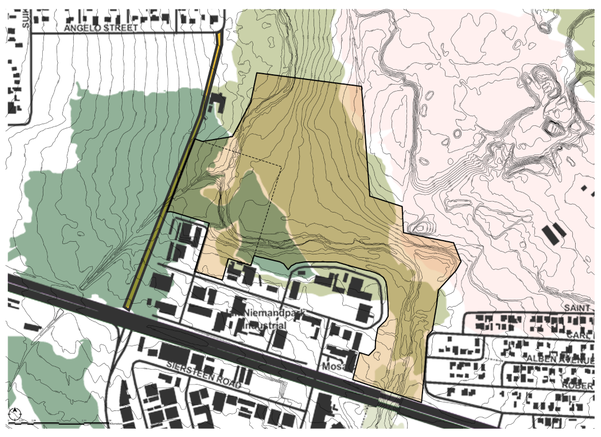
Contours
(Author, 2023)



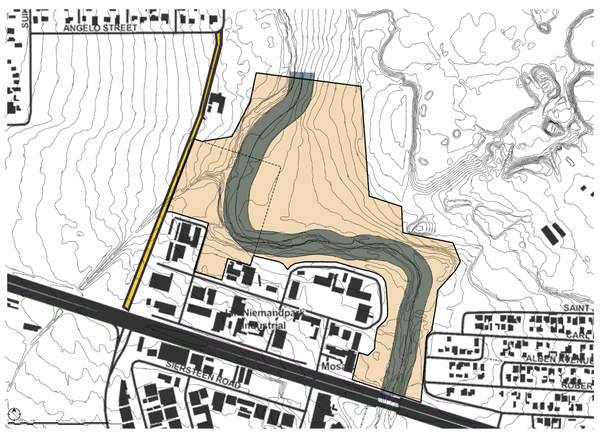
North-South section
(Author, 2023)



Context informants
(Author, 2023)



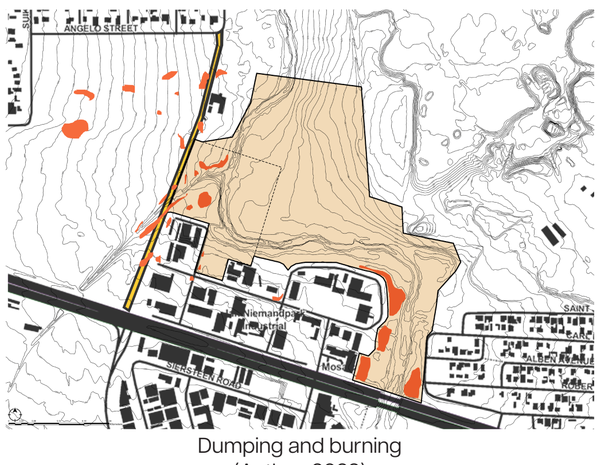
Biodiversity zones
(Author, 2023)



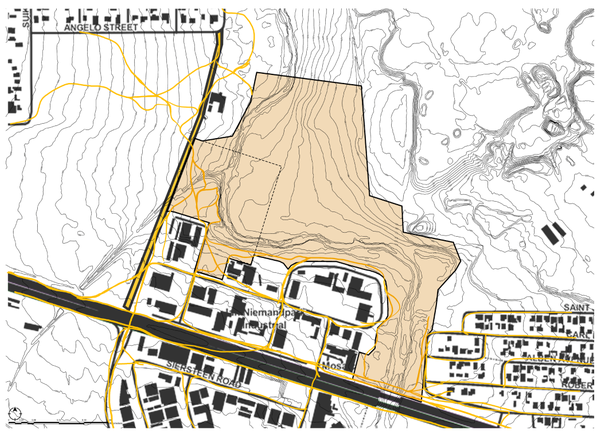
River - 30m buffer zone
(Author, 2023)



Trees and vegetation
(Author, 2023)



Dumping and burning
(Author, 2023)



Pedestrian movement
(Author, 2023)



Combined informants
(Author, 2023)

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270 Brander street, Jan Niemand Park, Pretoria, 0186
Ward 43



Pedestrian walkways
(Author, 2023)



Infromal dwelling on river bank
(Author, 2023)



Surrounding buildings - concrete testing
(Author, 2023)



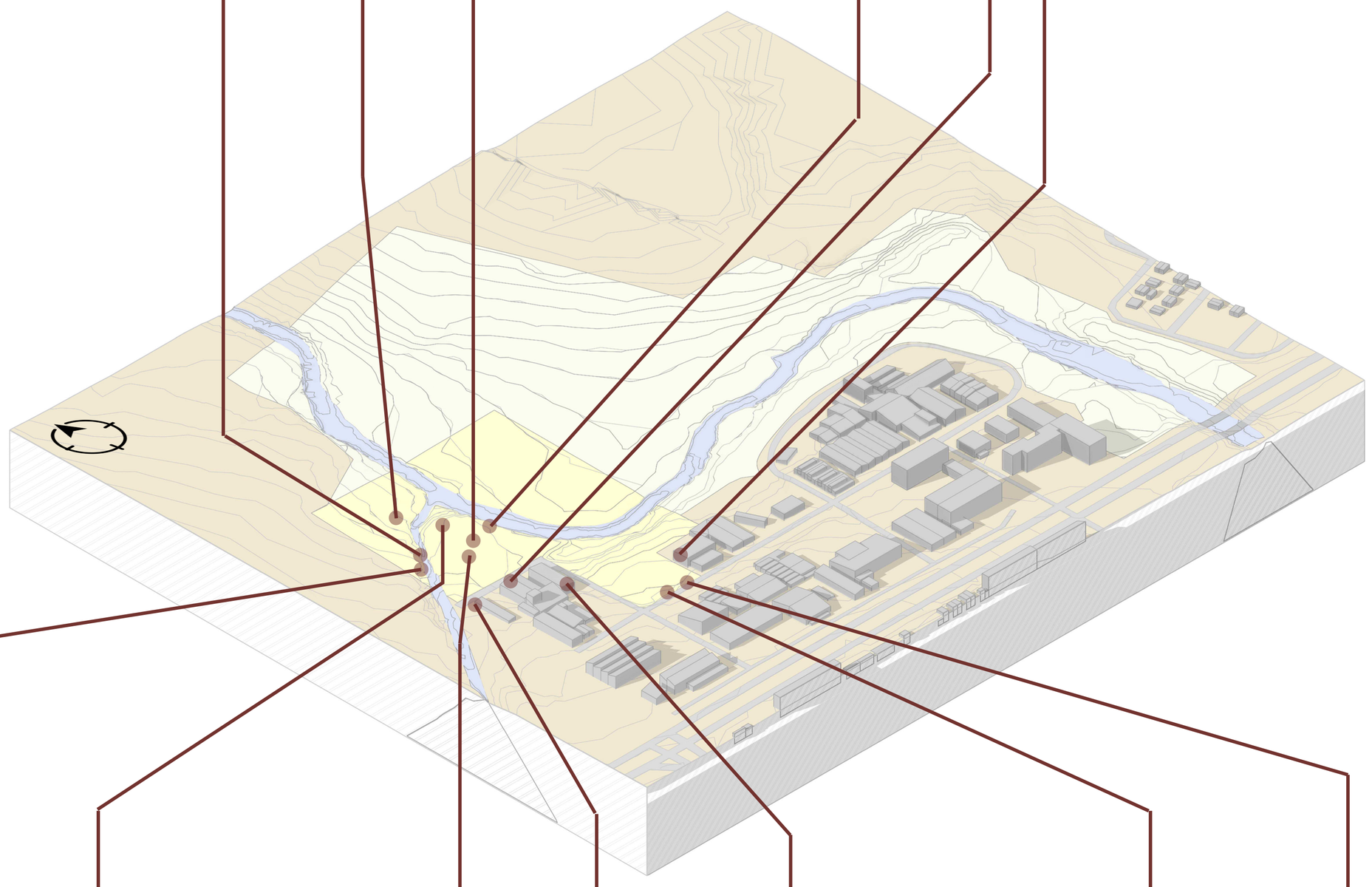
Overgrown stormwater channel
(Author, 2023)



Dumping on site + pedestrian walways
(Author, 2023)



Surrounding buildings - economic consultants
(Author, 2023)

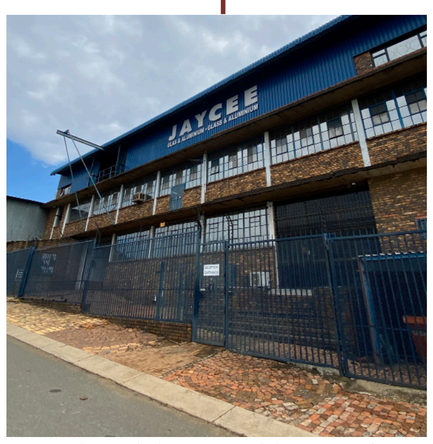




Reeds along the river
(Author, 2023)



Site used for dumping and burning
(Author, 2023)



Surrounding buildings - Aluminium manufacturer
(Author, 2023)



Overgrown site with broken concrete slabs
(Author, 2023)



Overgrown stormwater channel
(Author, 2023)



Discarded waste
(Author, 2023)



Overgrown site with broken concrete slabs
(Author, 2023)

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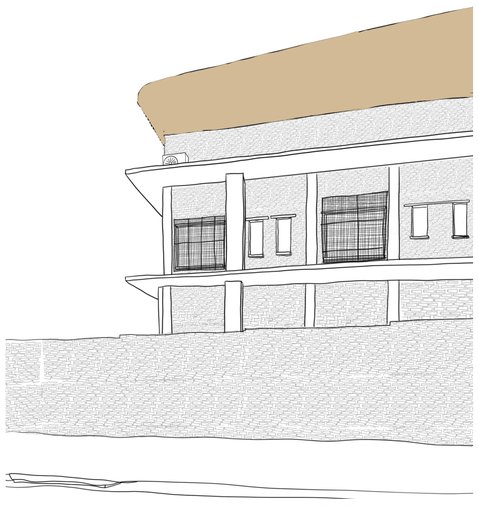
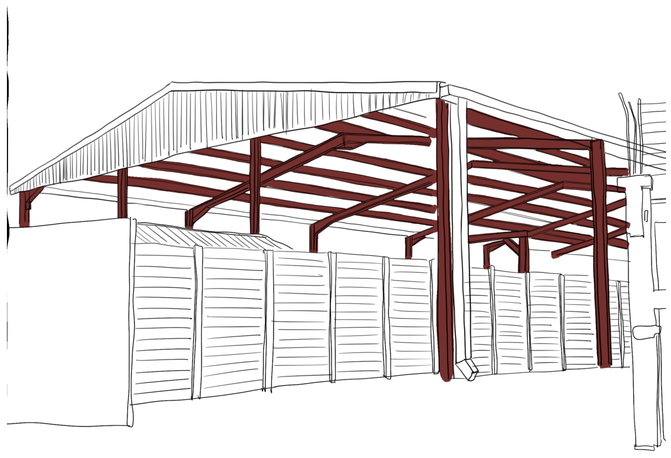
BUILDING TYPOLOGIES - CONTEXT



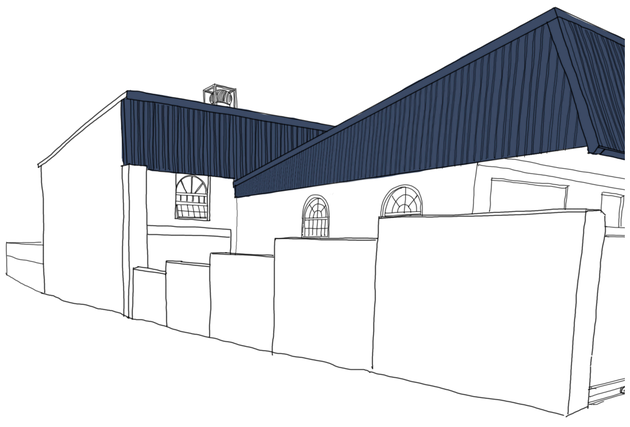
Industrial 1 (Author, 2023)



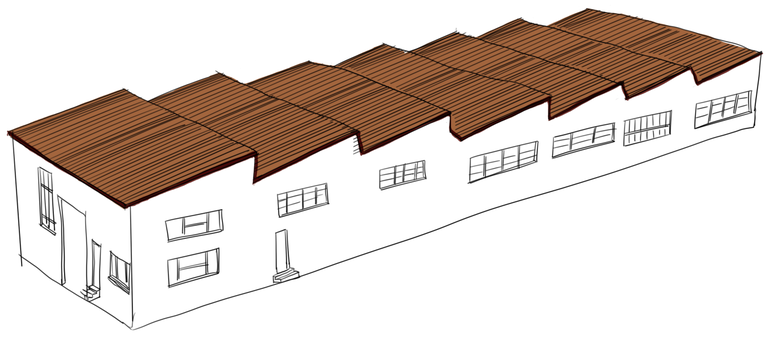
Industrial 2 (Author, 2023)



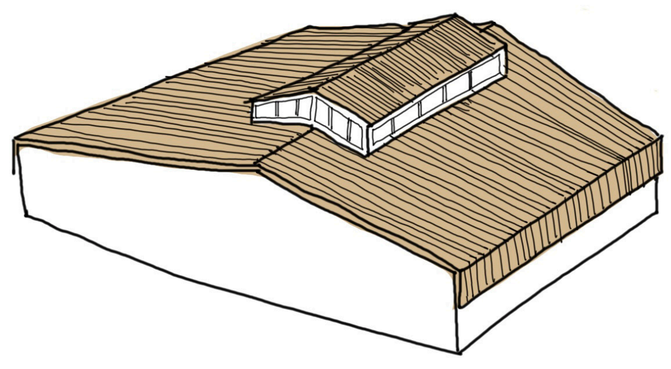
Industrial 3 (Author, 2023)



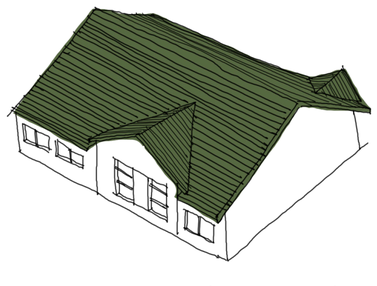
Industrial 4 (Author, 2023)



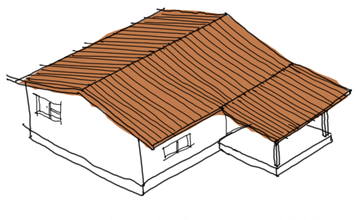
Industrial 5 (Author, 2023)



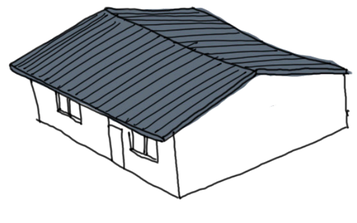
Industrial 6 (Author, 2023)



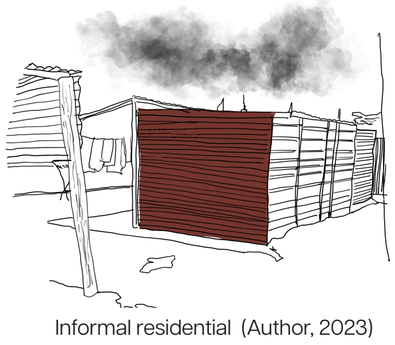
Residential 1 (Author, 2023)



Residential 2 (Author, 2023)



Residential 3 (Author, 2023)



Informal residential (Author, 2023)

USER TYPOLOGIES - CONTEXT



Families [residents]
(Author, 2023)



Owners [businesses]
(Author, 2023)



Workers [industrial]
(Author, 2023)



Clients / day visitors
(Author, 2023)

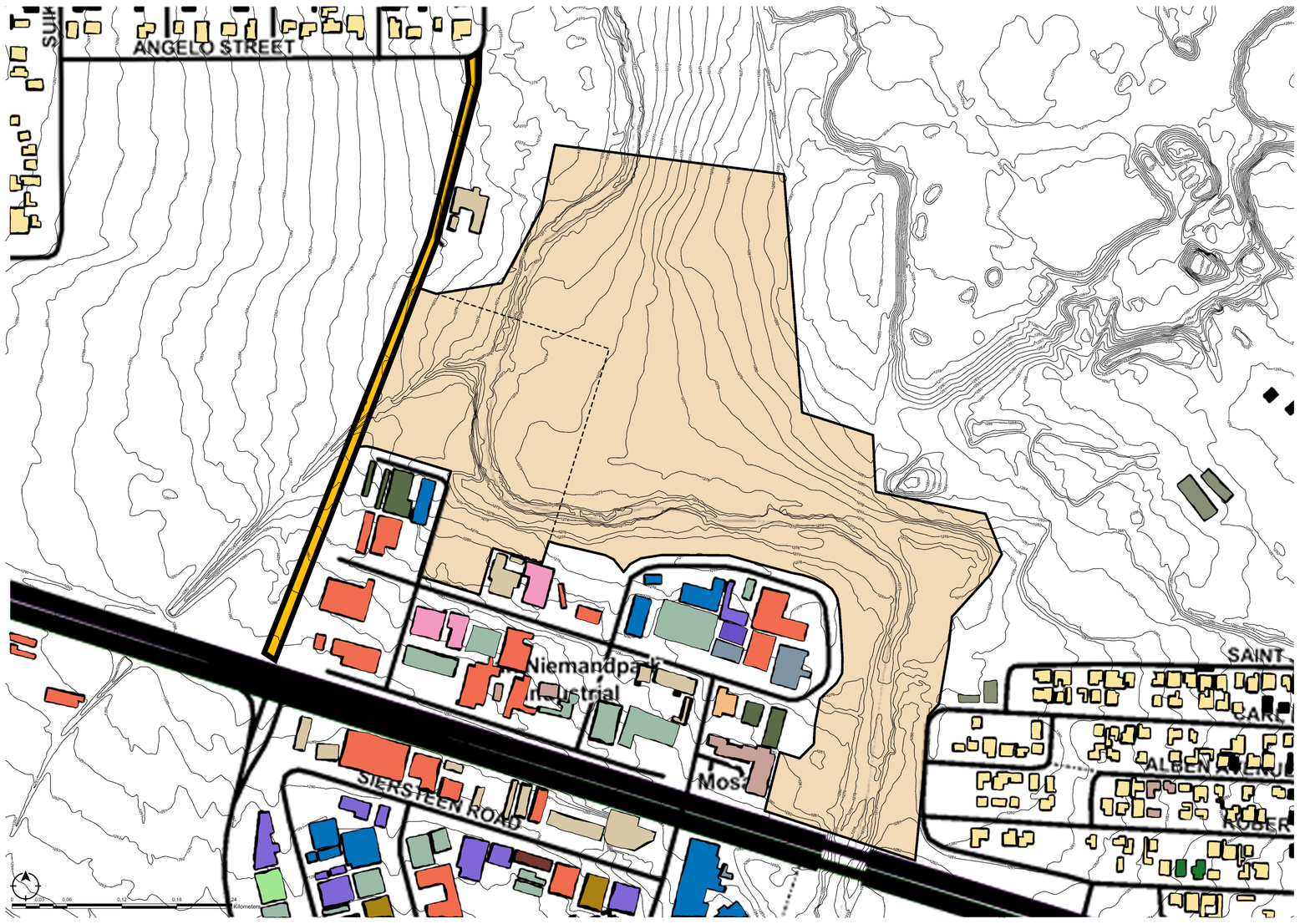


Students [graduates]
(Author, 2023)



Building industry companies
(Author, 2023)

INDUSTRY TYPOLOGIES - CONTEXT



Context - industries and trades
(Author, 2023)

- Residential
- Building industry - Manufacturing and Retail
- Logistics / Economics / Financial services
- Supermarkets
- Creche
- Aluminium / steel manufacturing and supliers
- Concrete testing and supliers
- Timber supliers
- Municipal services (garden refuse + Sport grounds)
- Automotive industry (testing / supplying / parts)
- Food industry
- Piano tuning
- Engineering

TYPOLOGIES

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USERS

PROGRAMME

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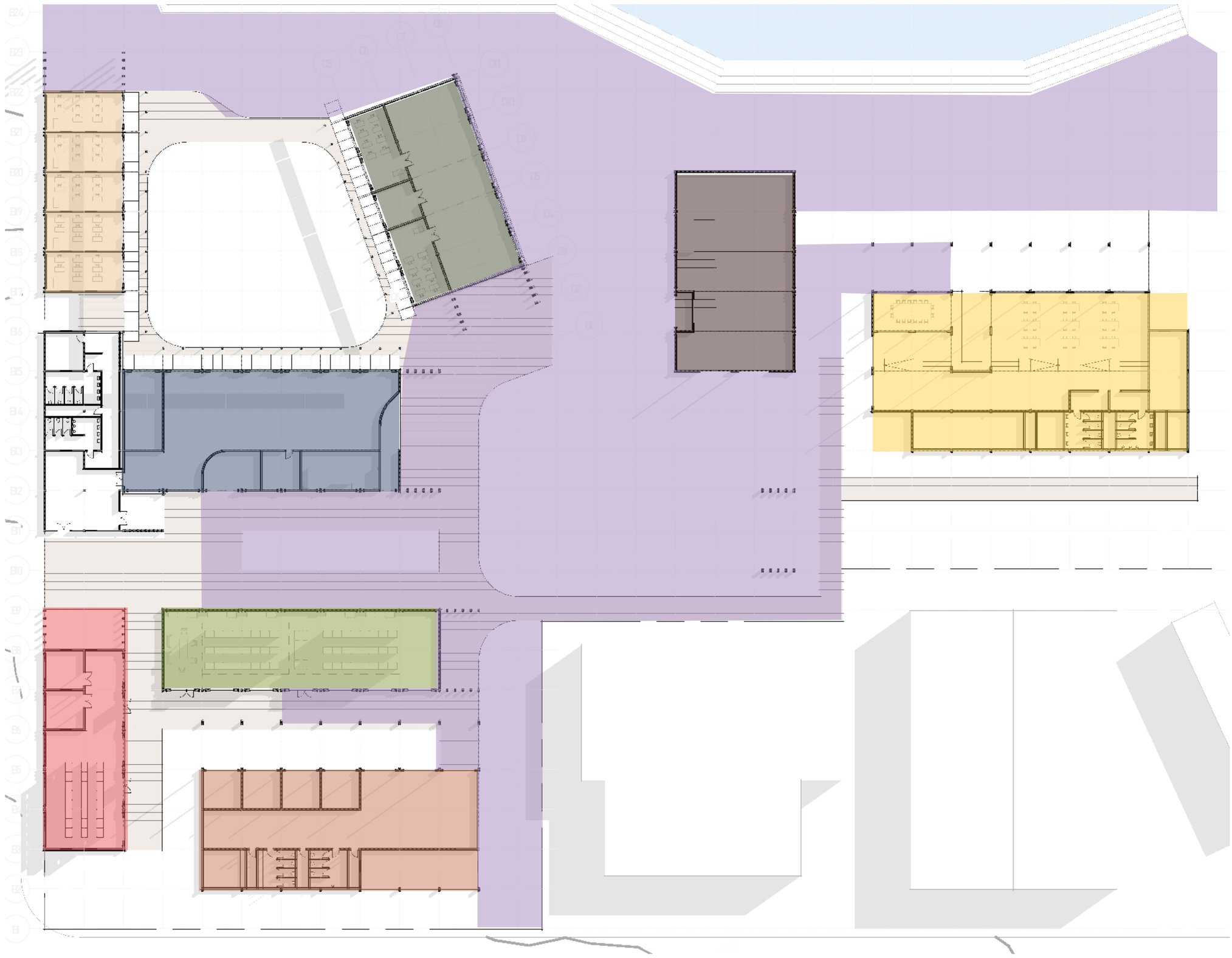
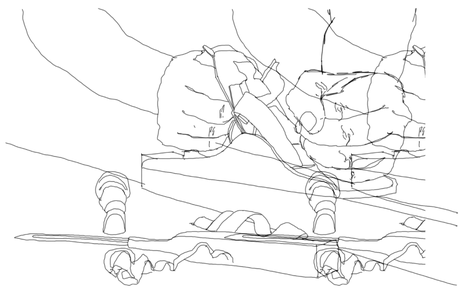


- Entrance and administration building
- Private library and meeting rooms
- Public library and exhibition space
- Classrooms
- Machine based workshop
- Handbased workshop and steam bending
- Auditorium
- Dining hall
- Public routes



Practical woodworking



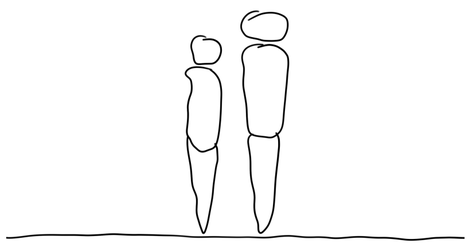
Theoretical education



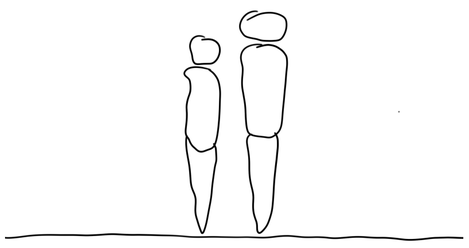
Presentations and exhibitions



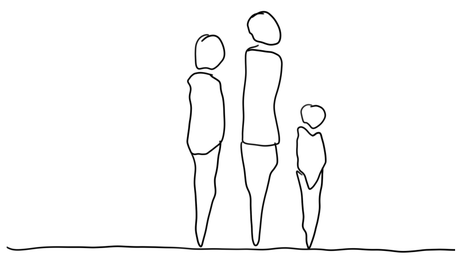
Eating, drinking, relaxation



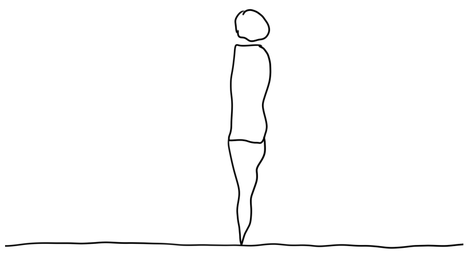
Students and lecturers



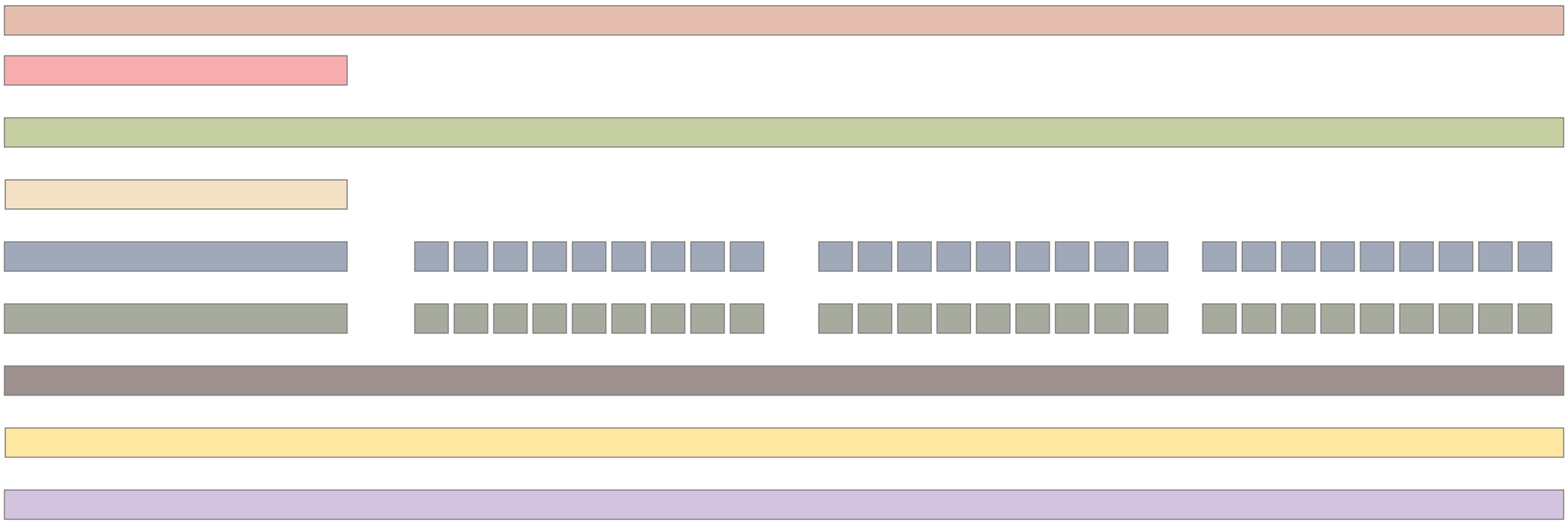
Day visitors | Public



Families | Residents



Industrial workers



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PROGRAMMES AND USERS

School of CRAFT:

TIMBER
construction school in
South Africa

Jacques van Vuuren
u 1 8 0 1 0 4 7 5

PLYKEA WORKSHOP - ERBAR MATTES

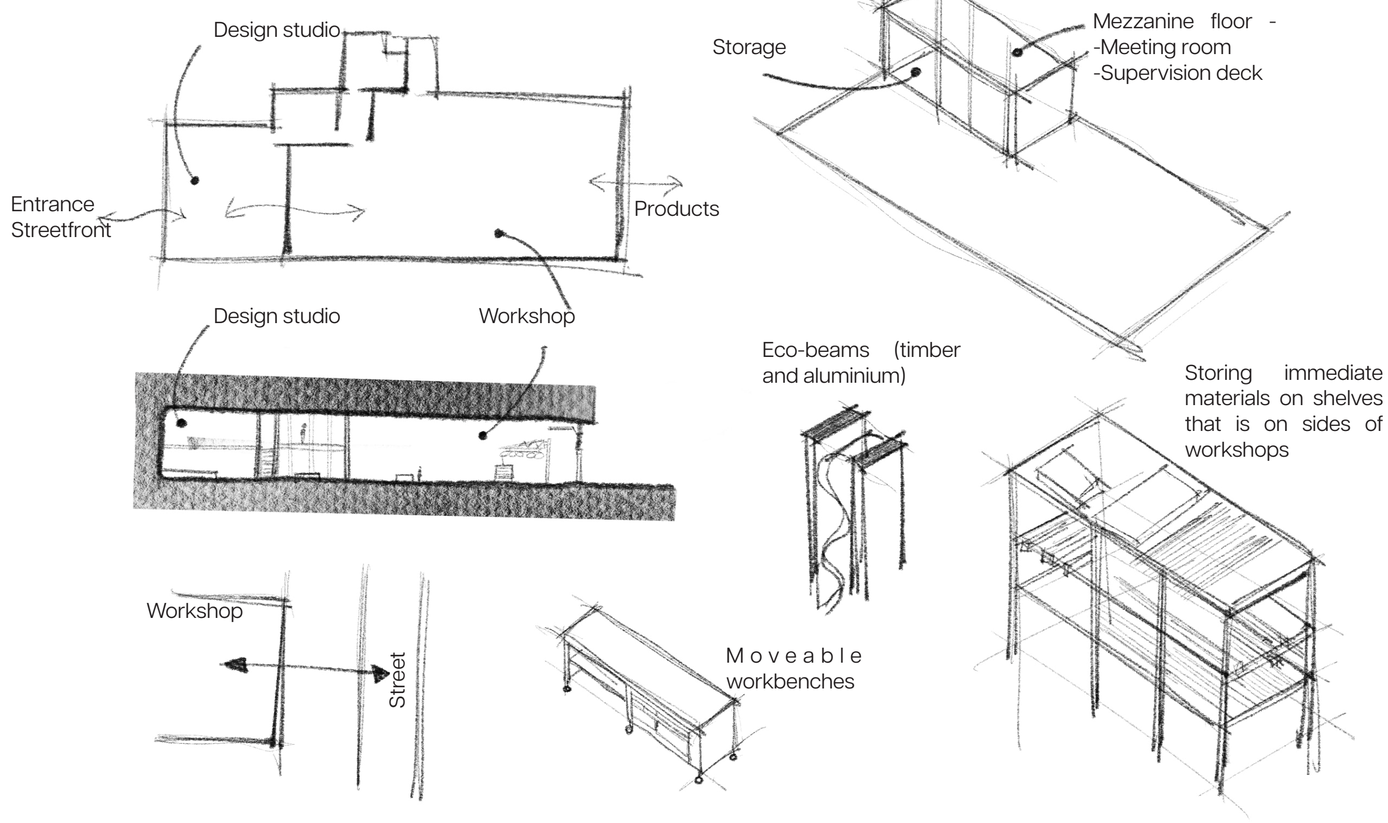
London, England - 2021



Plykea workshop interior
(Archdaily, 2021)

Rooms
- Workshop (CNC machines, belt sanders, mobile workbenches, vacuums)
- Showroom & design studio
- Ameneties

- Accoustic glazing between design studio and workshop
- Opaque wood wool insulation boards
- Views in and out of workshop - fosters an interaction and connection between public and workers



Plykea workshop Analysis sketches
(Author, 2023)

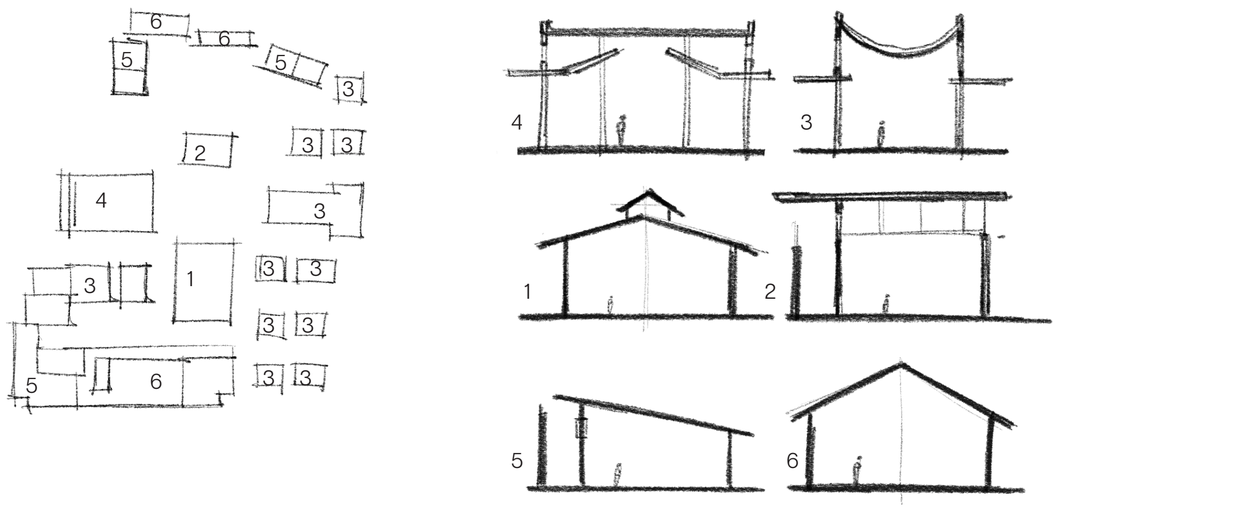
DINGSHU VOCATIONAL SCHOOL OF POTTERY - GENARCHITECTS

Wuxi, China - 2021



Dingshu Vocational School of Pottery
(Archdaily, 2021)

Roofs
1 - Main Workshop
2 - Secondary (smaller) workshops
3 - Classroms
4 - Multi-functional space (Auditorium)
5 - Exhibition spaces
6 - Admin



Dinshu Pottery school Roof typology analysis sketches
(Author, 2023)

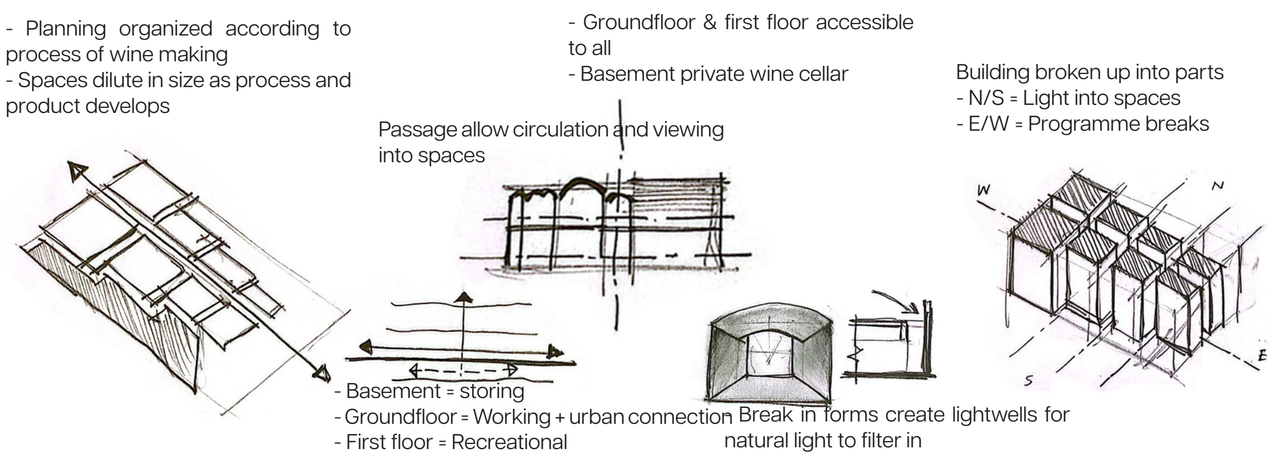
RICE WINE FACTORY - DNA

Lishui, China - 2019



Rice Wine Factory
(Archdaily, 2019)

Roofs
1 - Main Workshop
2 - Secondary (smaller) workshops
3 - Classroms
4 - Multi-functional space (Auditorium)
5 - Exhibition spaces
6 - Admin



Rice Wine Factory analysis sketches
(Author, 2023)

PRECEDENTS

SOLTECH ARTISAN TRAINING COLLEGE

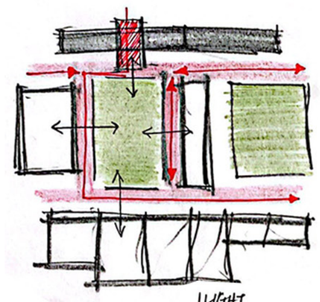
- JEREMIE MALAN ARCHITECTS + INTERIORS

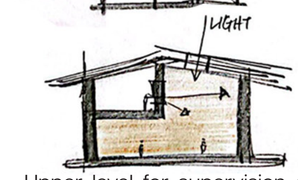
Centurion, Gauteng, 2021



Soltech Artisan Training College
(Archdaily, 2021)

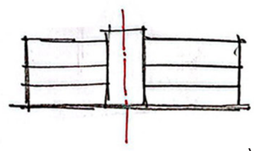
- Spaces planned around courtyard.
- Colonnade Act as threshold between building and courtard

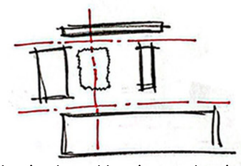




- Upper level for supervision and used for offices
- Light let in through skylights

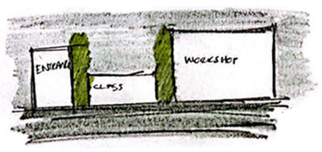
Volumes of spaces indicate privacy
- Change in volume = threshold



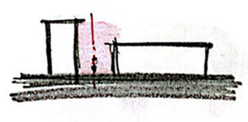


Vertical and horizontal axis

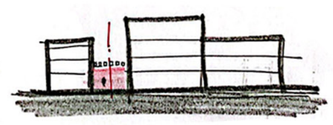
Openess and greenery used as connection and thresholds



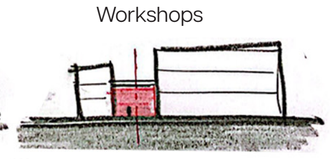
Entrance



Classrooms



Workshops

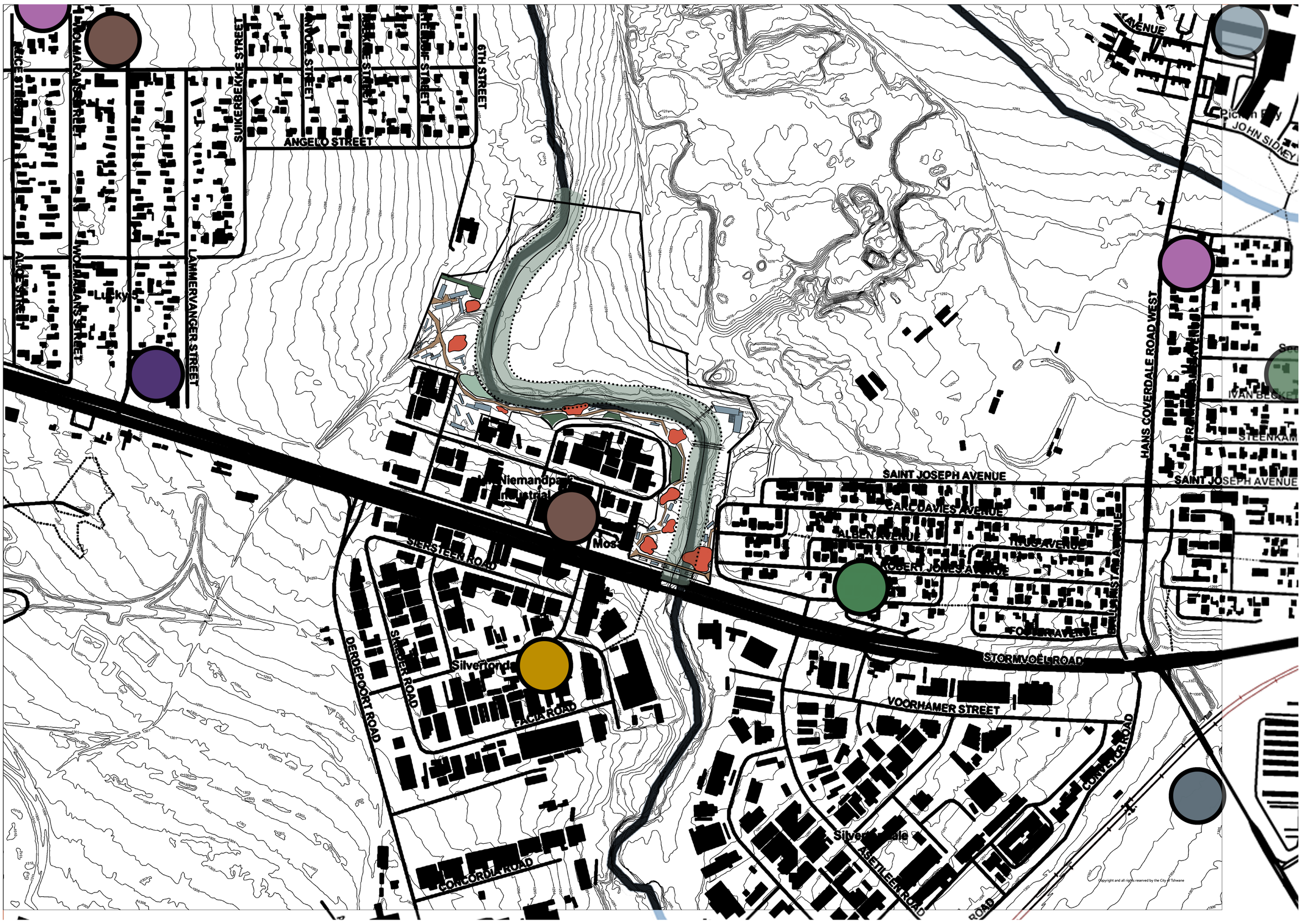


Connection spaces handled differently between different spaces

Soltech Artisan College Analysis sketches
(Author, 2023)

PRECEDENTS

MASTERPLAN



Masterplan - Area points of interest
(Author, 2023)

Masterplan Points of Interests

- Supermarkets
- Creché
- Library
- Community Centre
- Bus yard
- Timber supplier

Masterplan Nodes and elements

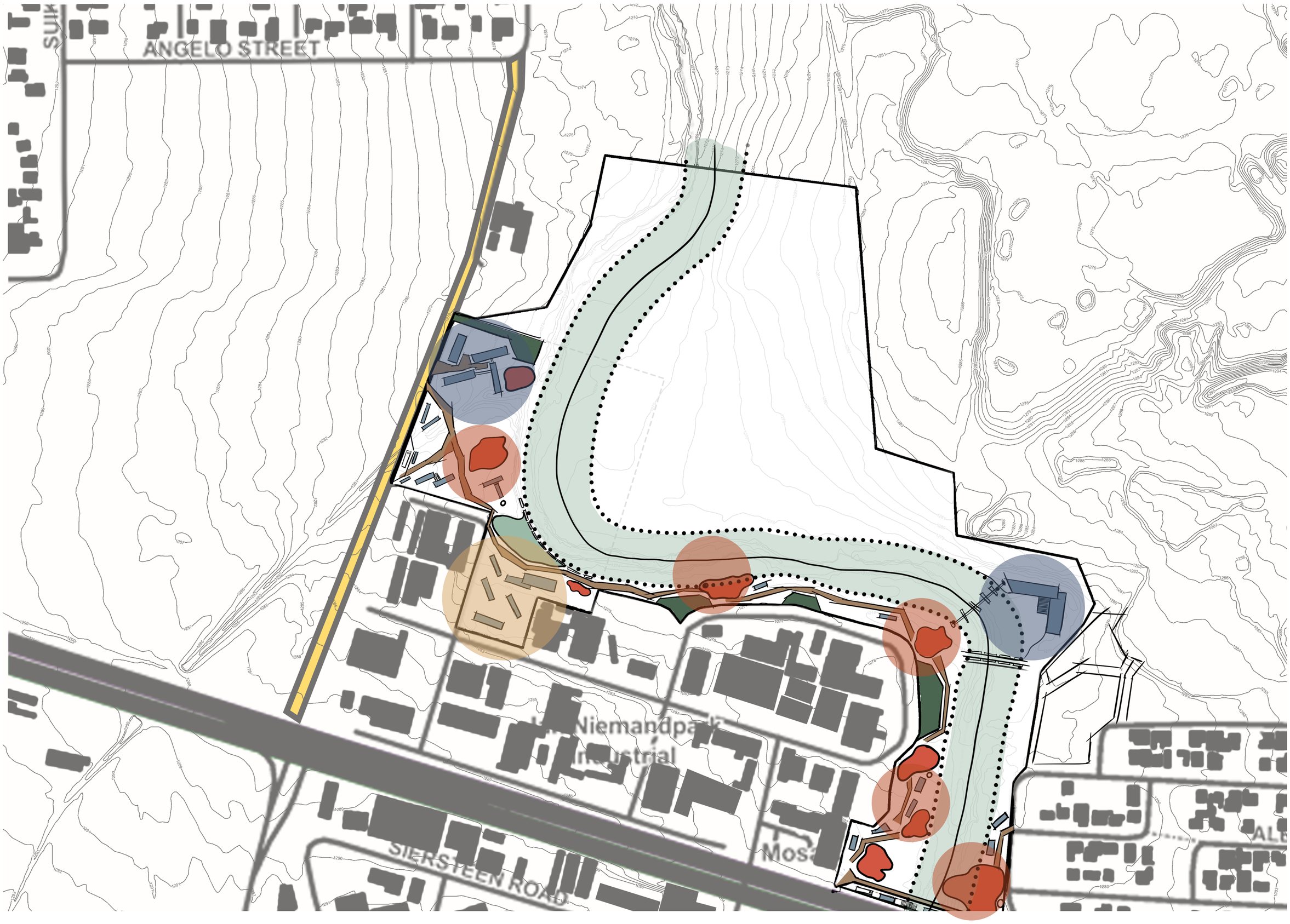
- Pause spaces
- Parking bays
- Water purification centre
- Retail and recreational spaces
- Walkways
- School
- Recource centre



Masterplan - zoomed in
(Author, 2023)

School of CRAFT:
TIMBER
construction school in
South Africa
Jacques van Vuuren | u18010475

PROGRAMME



Masterplan - zoomed in
(Author, 2023)

Primary : Education
School:
- Workshops
- Lecture rooms
- Offices
- Cafeteria + exterior spaces
- Library / Learning spaces
- Exhibition spaces
- Lecture Hall
- Ablutions

Secondary: Resource centre:

- Mini factory spaces that offer services such as CNC, laser cutting, Steam bending (everything that is taught at the school). Open for the public and the industry
- Water purification and cleaning centre with water storage.
- Hydro electricity

Tertiary: Recreation and retail:

- Walking paths
- Bus stops
- Food and beverages nodes
- Pause spots / transitional spaces
- Parking
- Vegetation and landscaping
- Timber plantation exhibition spaces
- Wetland / retention pond

Waterbodies (spatial elements and passive cooling)
Biodiversity protection and rehab areas - wild grasses

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ARCHITECTURAL CONCEPT

ARCHITECTURAL CONCEPT

School of CRAFT:

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construction school in
South Africa

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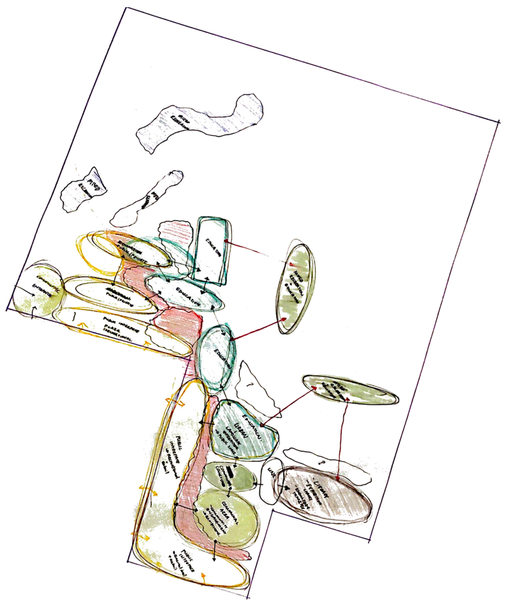
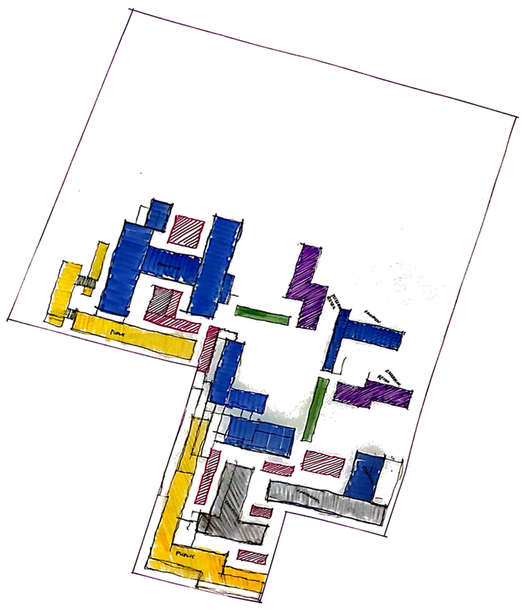
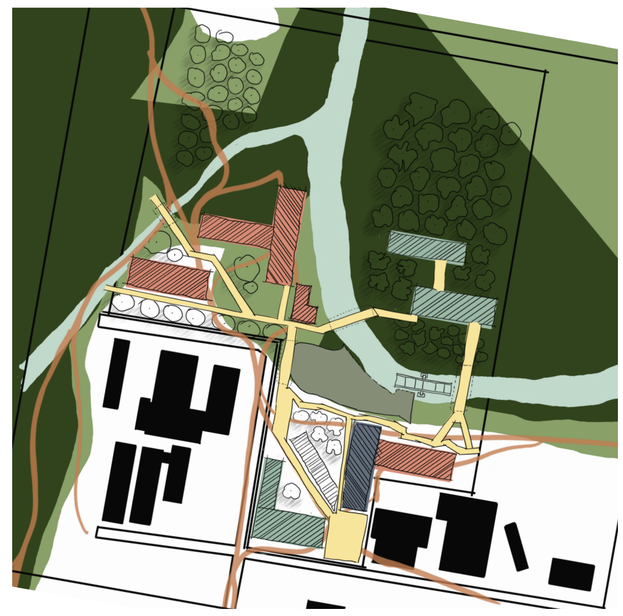
MAQUETTE / MODEL 1



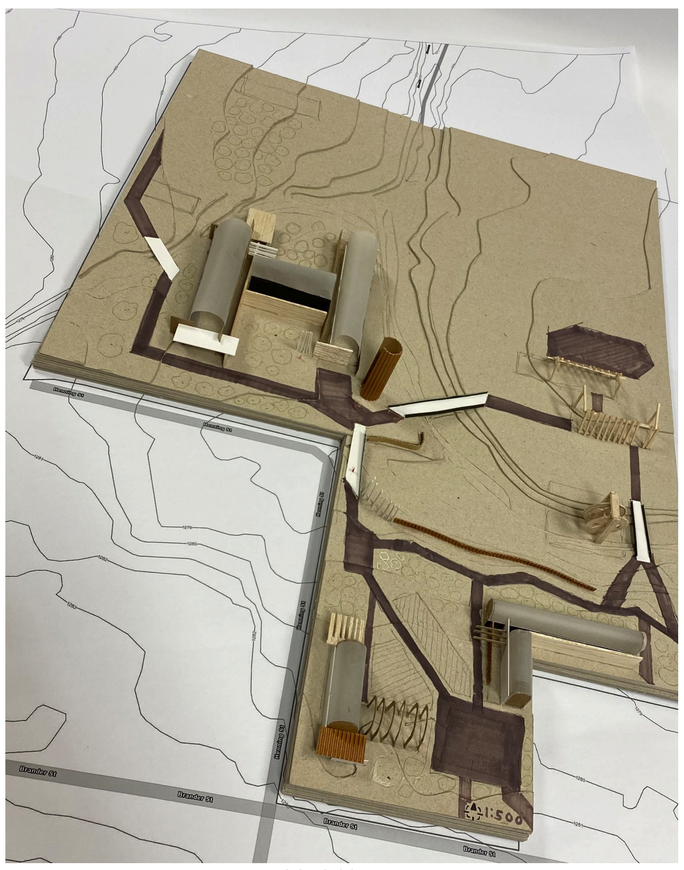
Zoning
(Author 2023)



Massing
(Author 2023)



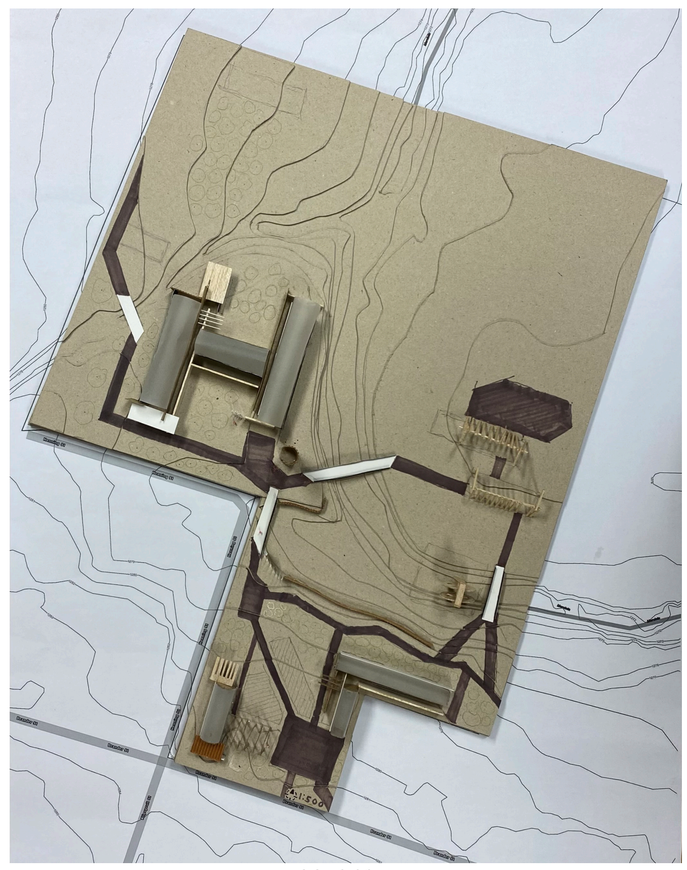
Concept plan
(Author 2023)



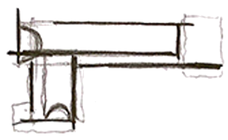
Model 1
(Author 2023)

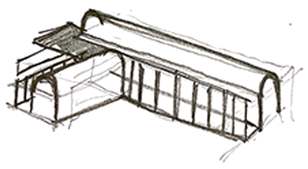


Model 1
(Author 2023)



Model 1
(Author 2023)





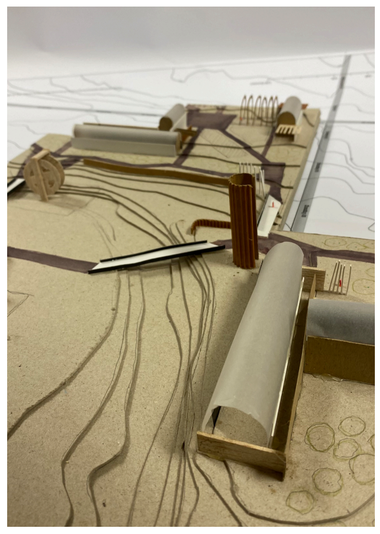


Sketch that lead to form
(Author 2023)

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. A water tower for storage near the wtland - circular process feeding eachother. Regenerative thinking through the waterwheel (hydroelectricity created and stored).



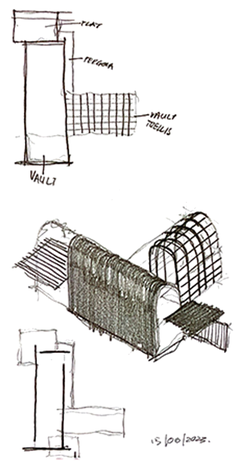
Model 1
(Author 2023)

Pro's of exploration

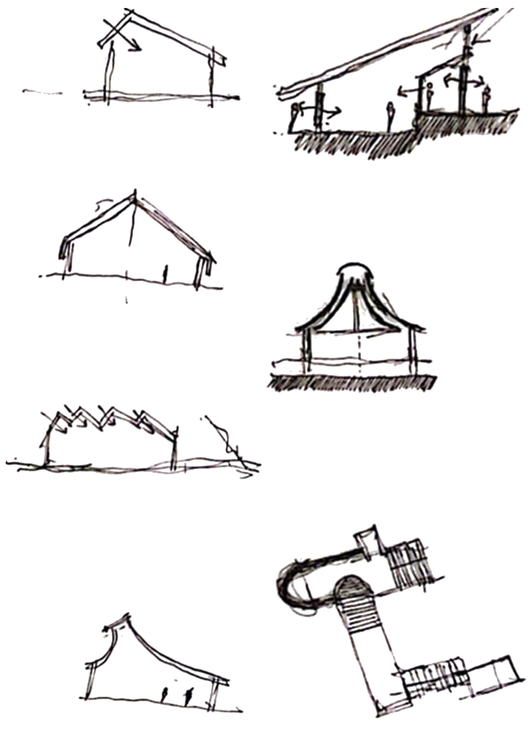
- good landscaping thinking
- vault is aestheticaly radically different from context
- using existing pedestrian movements as good informants for building placement

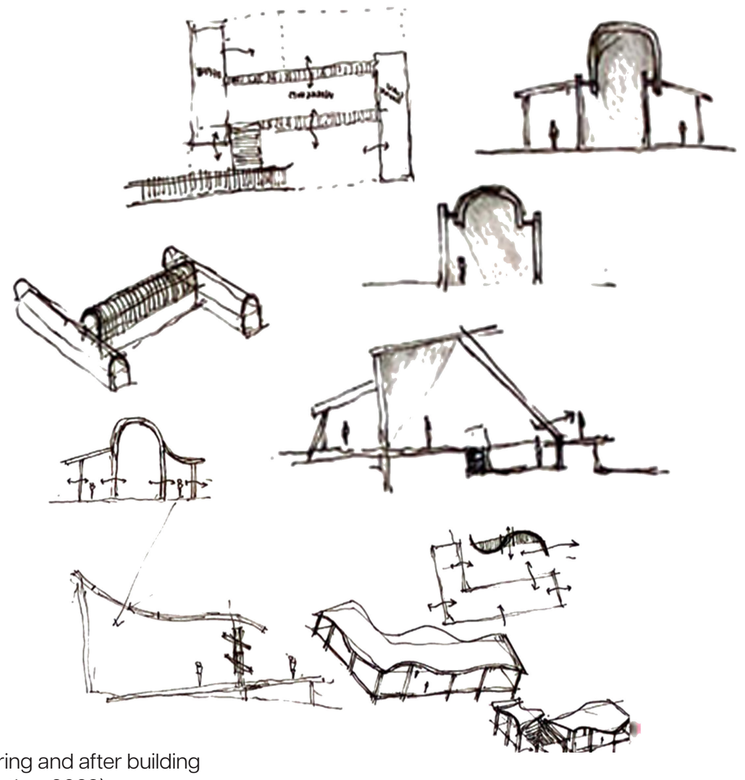
Con's of exploration

- context buildings not shown / responded to
- vaults may not work for workshop spaces (need southern light)
- scale not correct to show that buildings touch the landscape minimally.
- zoning and placement of programmes could be reconsidered.



Sketch that lead to form
(Author 2023)





Sketches during and after building
(Author 2023)

PROCESS

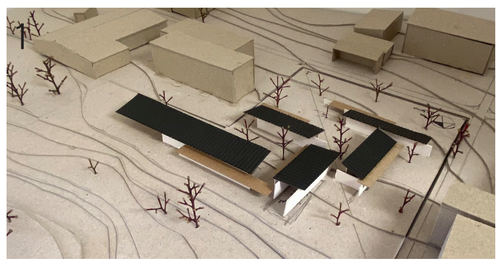
MAQUETTE / MODEL 2

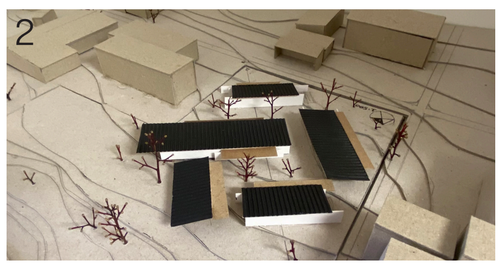


Organising the masses according to orthagonal grid of existing context

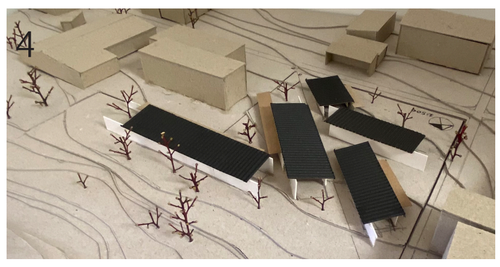
Pro's
- Works with the fabric of the built language in terms of rigidity and aesthetics
- Spaces in between masses create different languages and relationships between people and the buildings
- Takes desire line in consideration and allows people to walk through
- Works well with the contours and fall on the site

Con's
- Not orientated North - Buildings that need Southern light not receiving correct light
- Desire line walking straight through building that needs levels of privacy









Organising the masses according to the desire line and contextual grid

Pro's
- Takes the context built fabric and the desire line of pedestrians into account
- Some masses work well with the slope of the site

Con's
- Long masses orientated acording to desire line have minimal exposure to Southern light
- Masses are not orientated North (20') off
- Landscape feels closed of from the site and the masses
- No connection to the buildings around



Organising the masses according to the desire line (40' from context grid)

Pro's
- Takes desire line in consideration with orientation but alters the path people walk and allows people to walk through

Con's
- Not working with the slope of the site
- Works against the fabric of the built language in terms of orthogonality and aesthetics

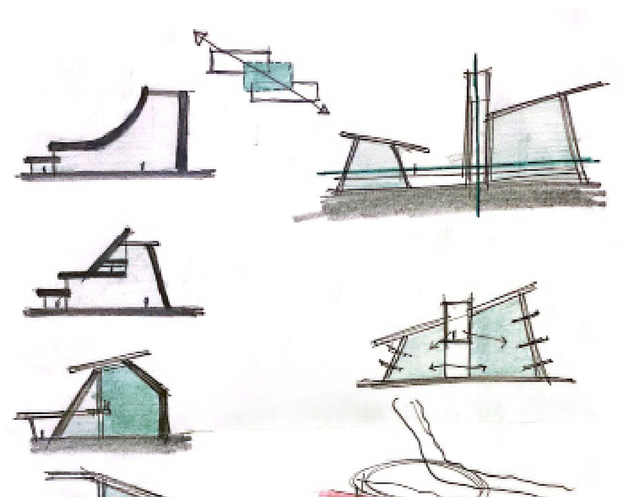


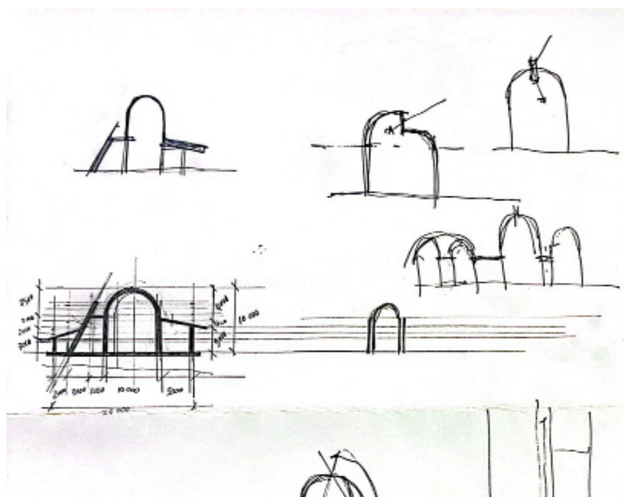


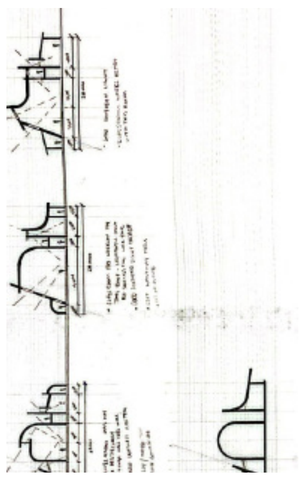
Overall comments and refelection

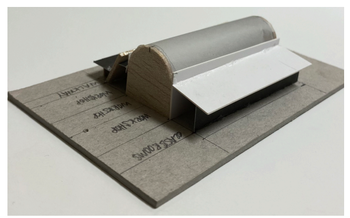
- Heigth too residential and not relating to industrial or institutional language
- Mono-pitch roofs simple and elegant but not deeply rooted in arguments for its use.
- A complete breakaway from the arch maybe premature
- Invistigate options to include the arch to showcase the glulam and steam bending of timber capabilities in the project
- Orientate buildings north and explore how that changes things and create spaces

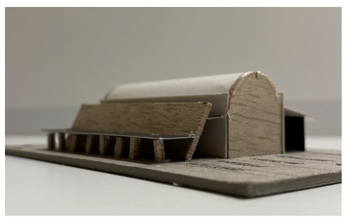
Further exploration with non-conventional shapes and the arch

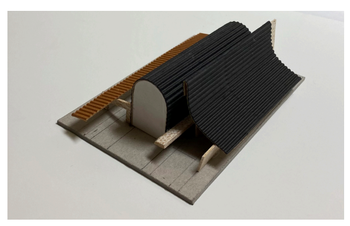


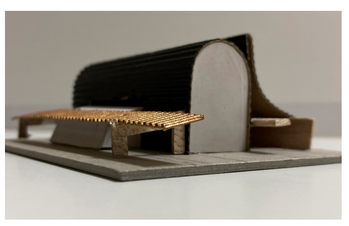








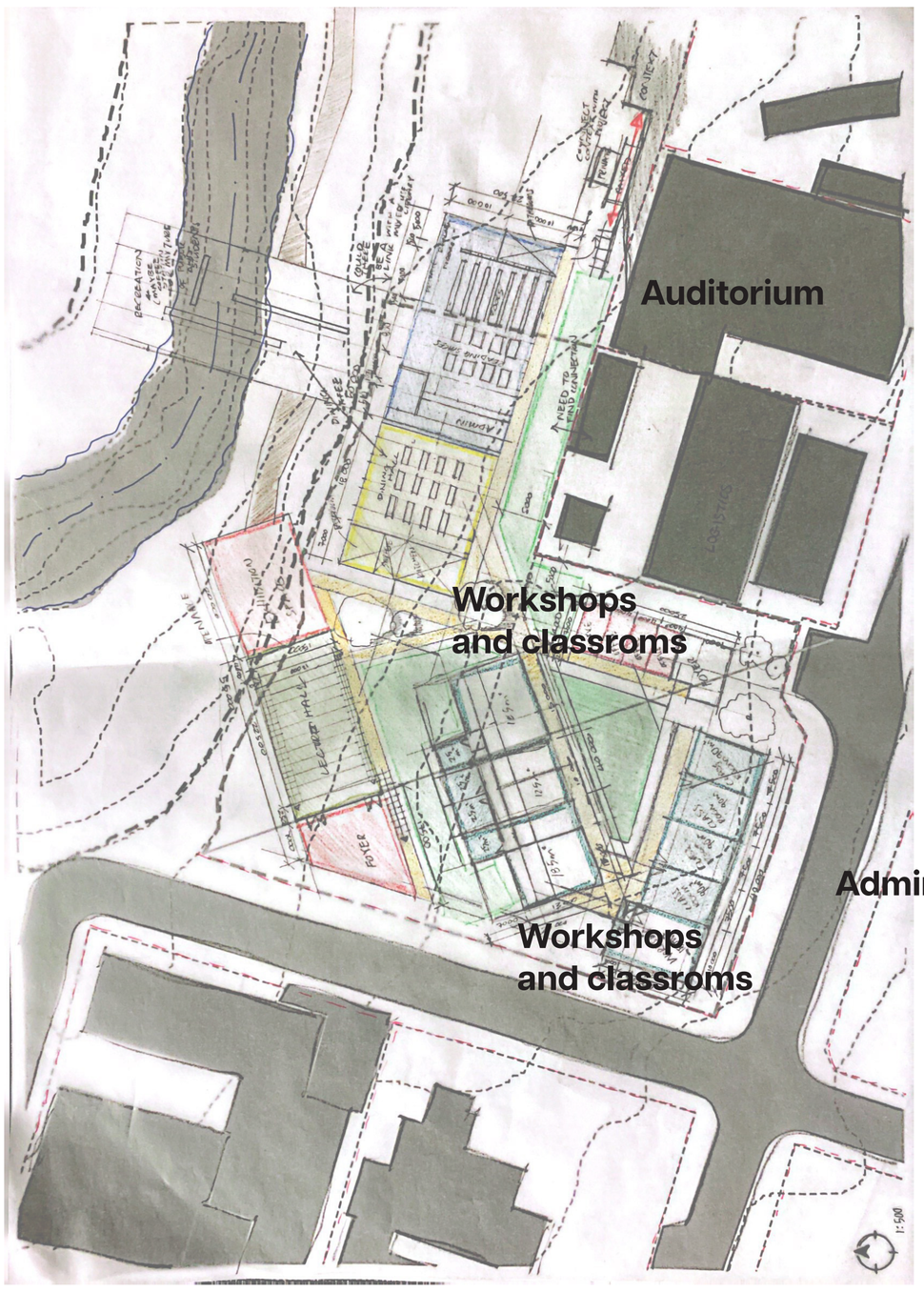




Overall comments and refelection

- Height starting to connect to the context and the industrial/ institutional language
- Diagonal element an exciting part to further explore
- Vault/arch a pleasing and simple form to further explore but not necessarily the final or chosen form
- Need to investigate what the spaces need in terms of light / volumes / accoustics / ventilation / circulation / scale
- Different programmes will have different roofs - make sure to connect these with eachother
-

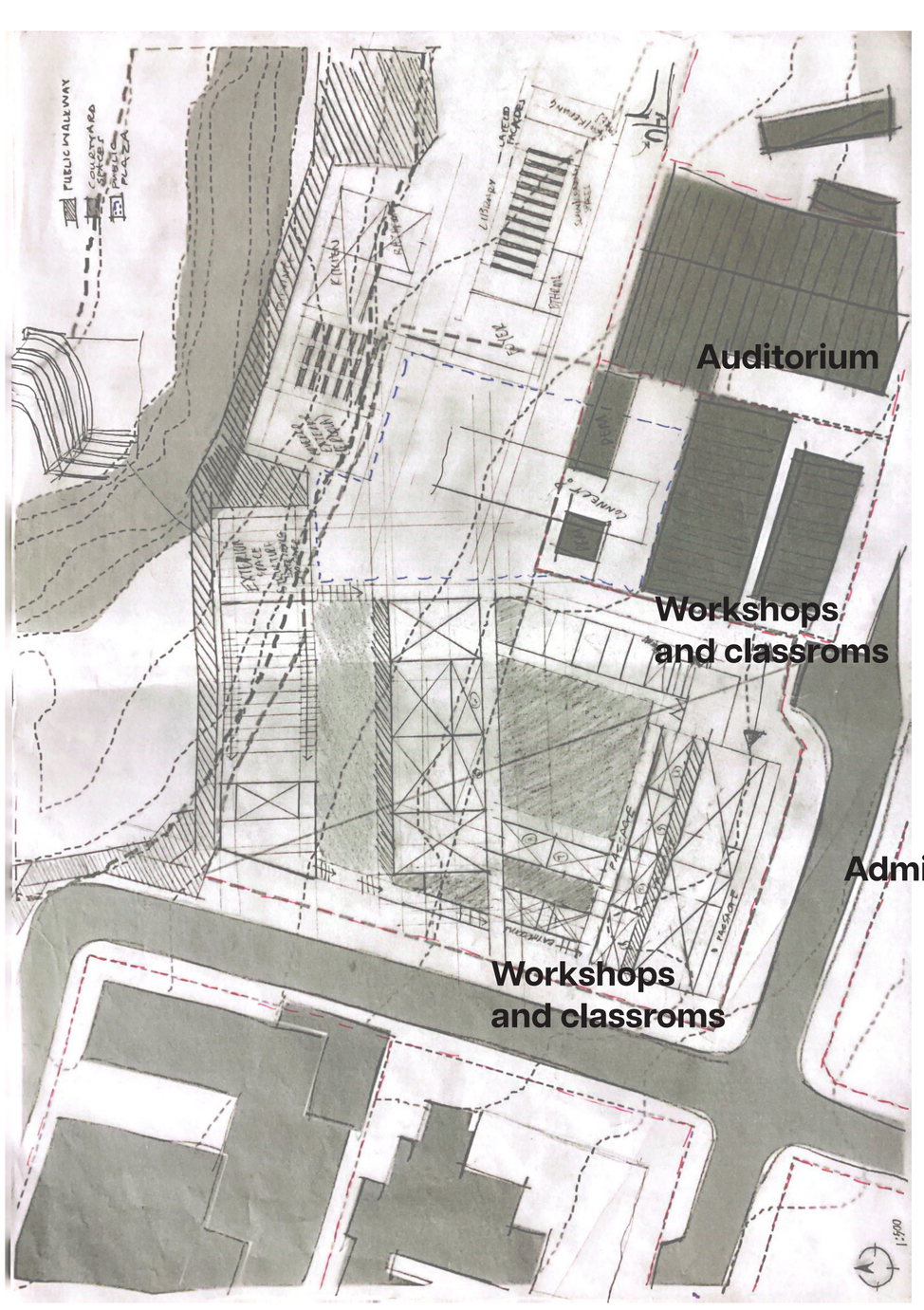
PLANNING / BUMF



Cafeteria &
dining hall

Library

Public
courtyard



Cafeteria &
dining hall

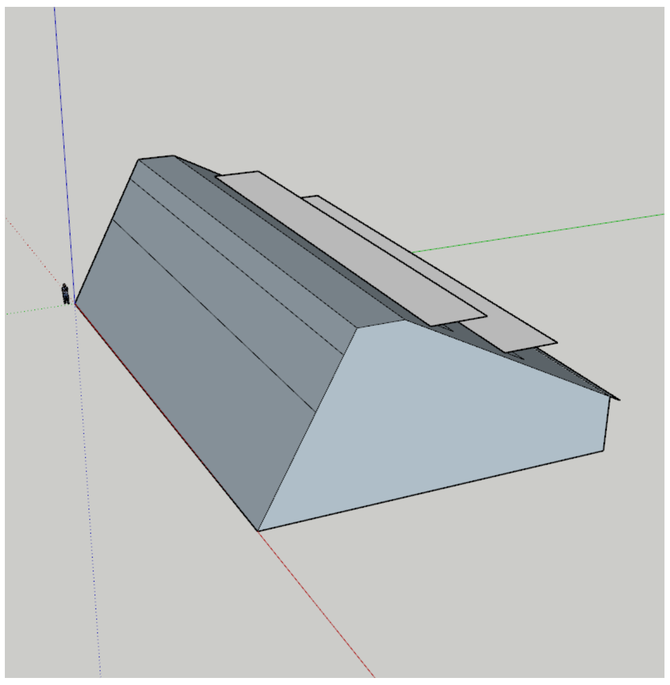
Public
courtyard

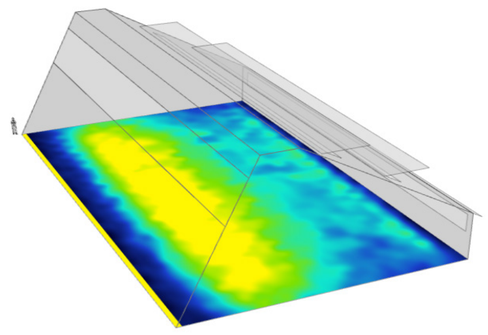
Library

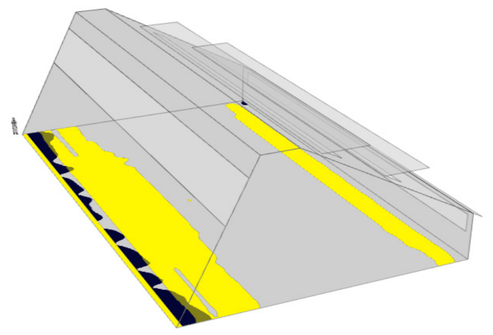
Overall comments and refelection

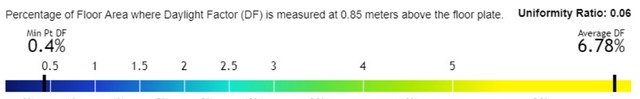
- Placing the school / more private programmes more towards the industrial end of the site makes sense - the sound creating programmes further away from the natural and public environments
- Rotating the buildings from 40’ to 20’ proved to be successful and created a bigger courtyard for the students and personel
- Library feels to far away and seperated from the rest of the programmes
- Switching the auditorium and library may be succesful
- The landscape is excluded and this is not the intention and aim of the project - explore how to bring in the landcape into the project more with the help of regenerative architecture which makees no appearence
-connect more with the surrounding buildings - spatially and programmatically
- deal with layers of thresholds to create privacy but also facilitate knowledge transfer through seeing and participating

LIGHTING TESTING

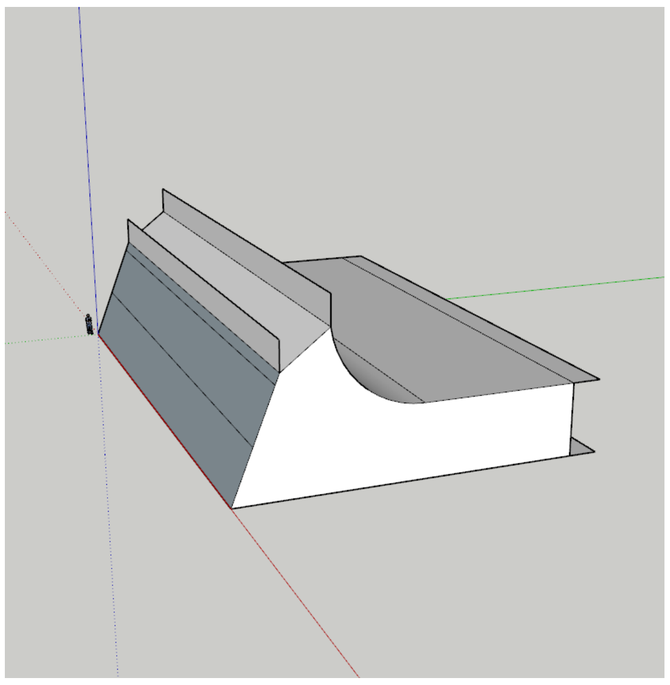


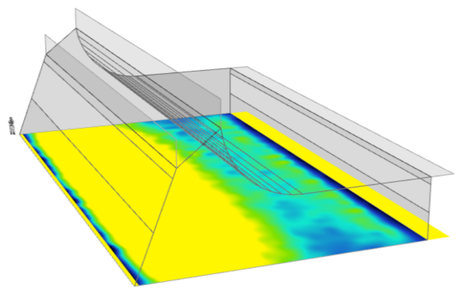


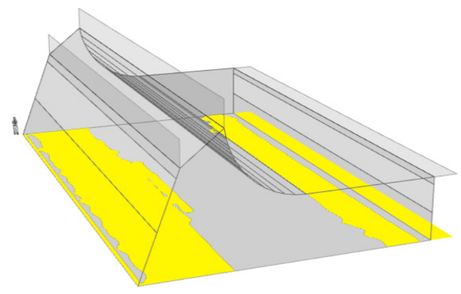


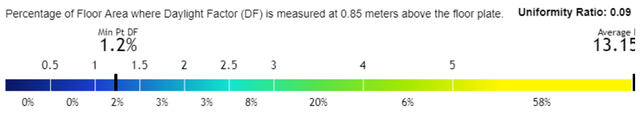




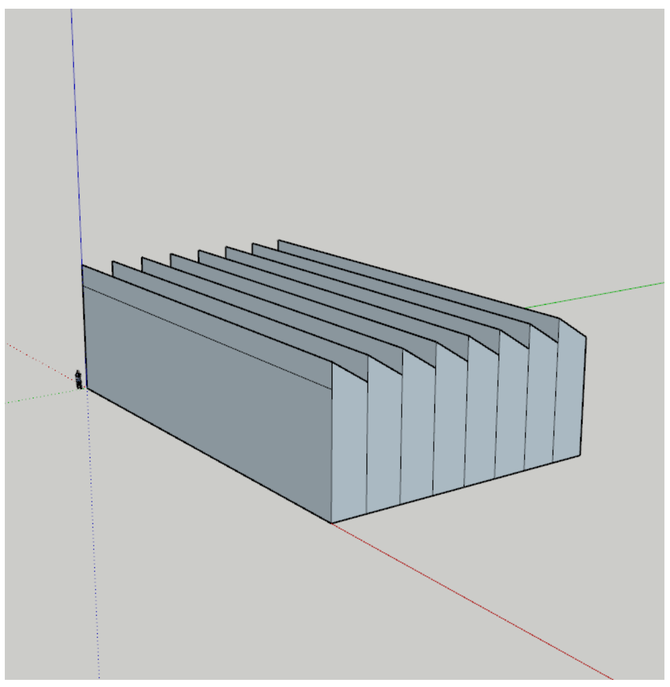


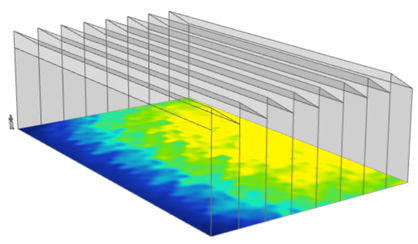


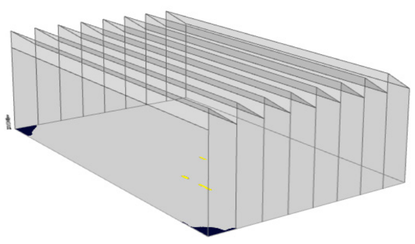


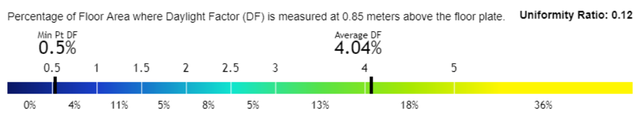




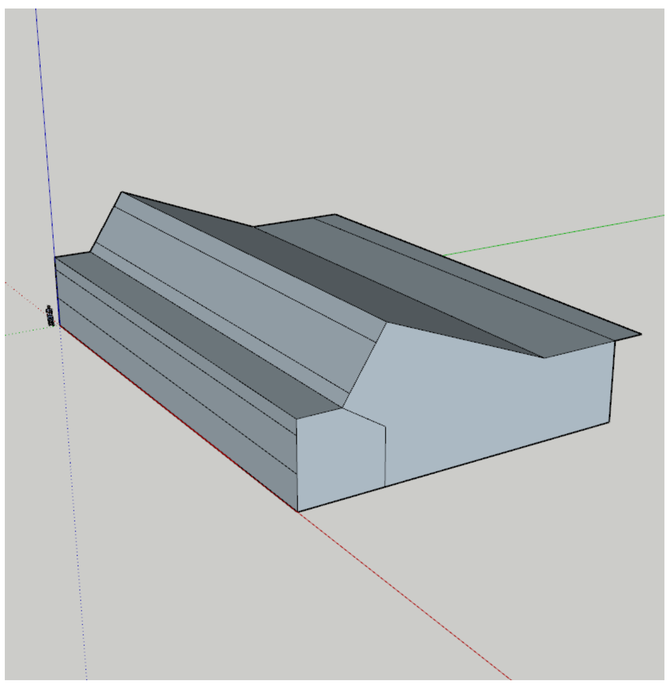


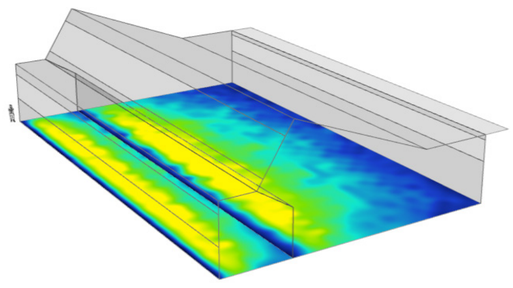


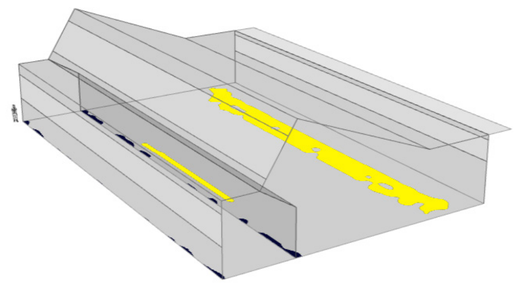


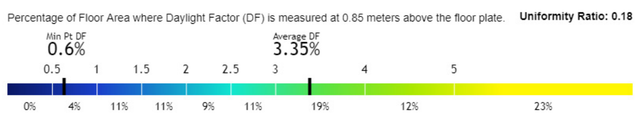


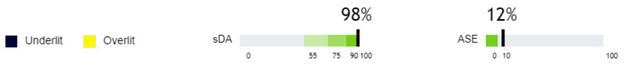






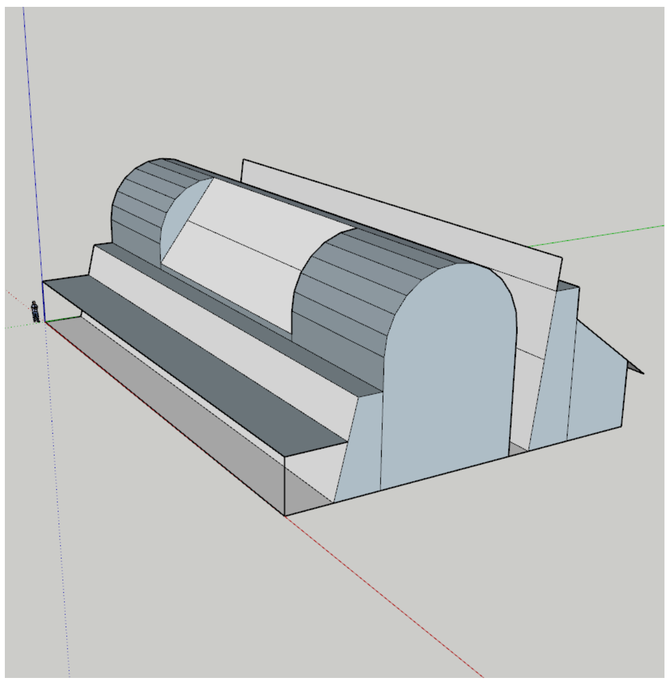


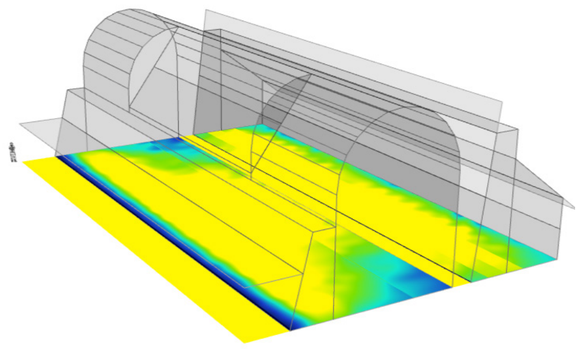


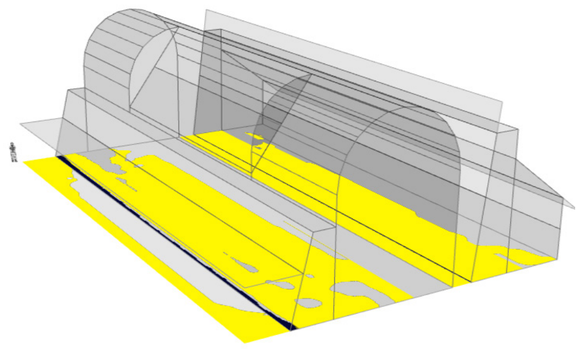


PROCESS

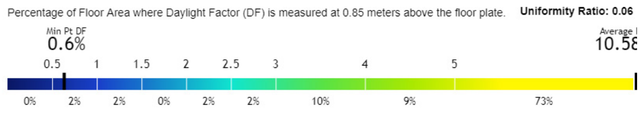
LIGHTING TESTING



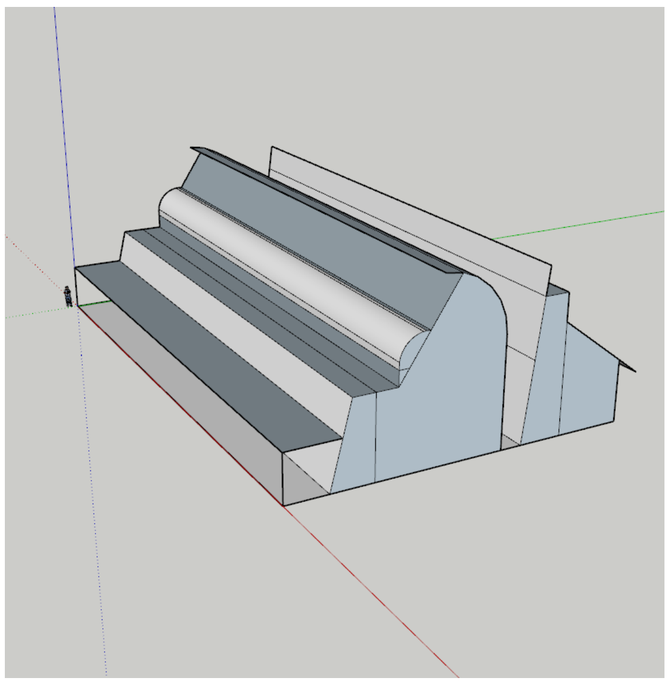


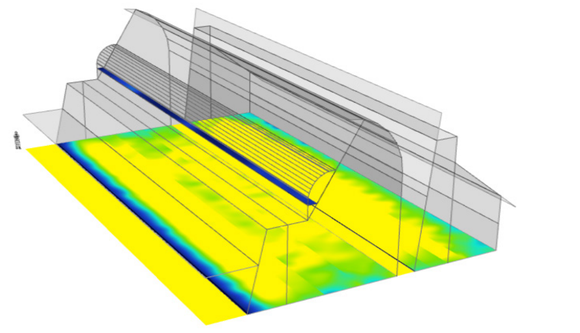


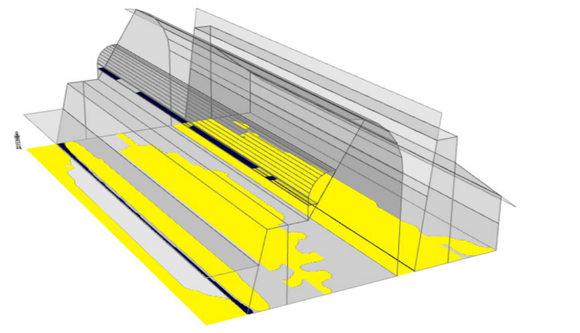
Percentage of Floor Area where Daylight Factor (DF) is measured at 0.85 meters above the floor plate. **Uniformity Ratio: 0.06**



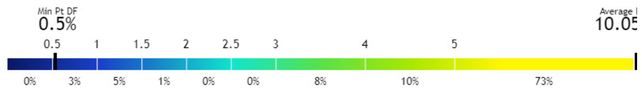




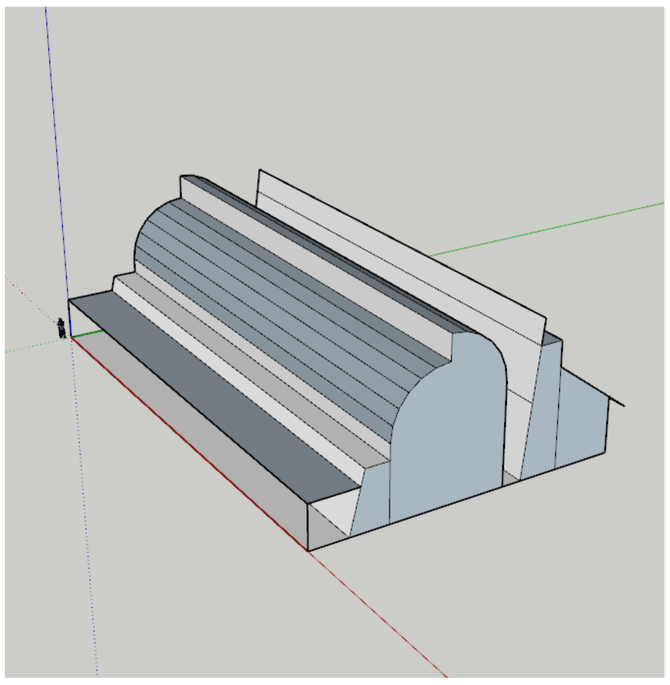


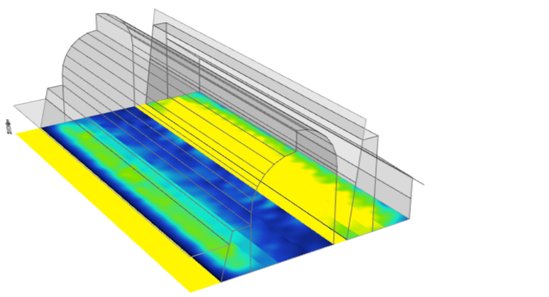


Percentage of Floor Area where Daylight Factor (DF) is measured at 0.85 meters above the floor plate. **Uniformity Ratio: 0.05**

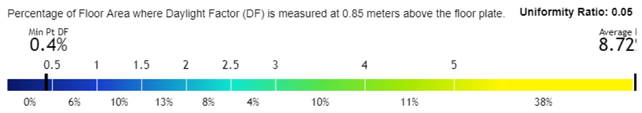


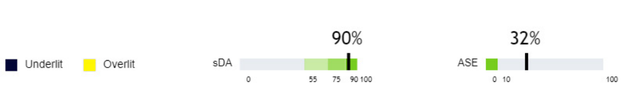


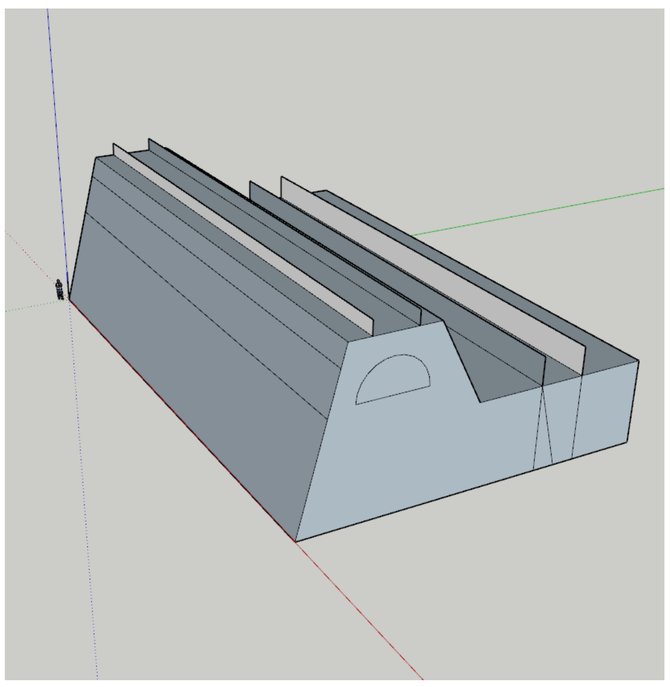


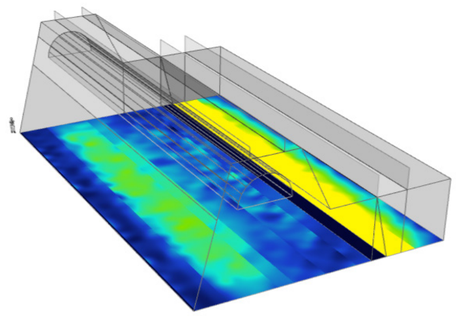


Percentage of Floor Area where Daylight Factor (DF) is measured at 0.85 meters above the floor plate. **Uniformity Ratio: 0.05**

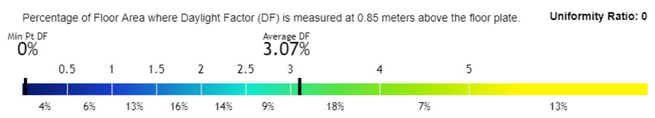


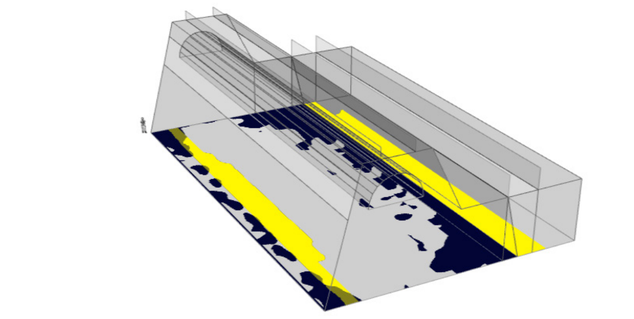






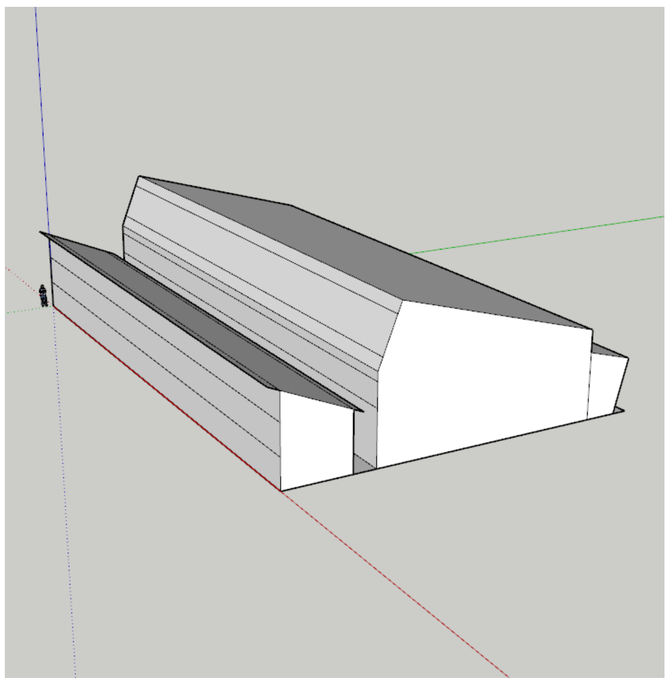
Percentage of Floor Area where Daylight Factor (DF) is measured at 0.85 meters above the floor plate. **Uniformity Ratio: 0**

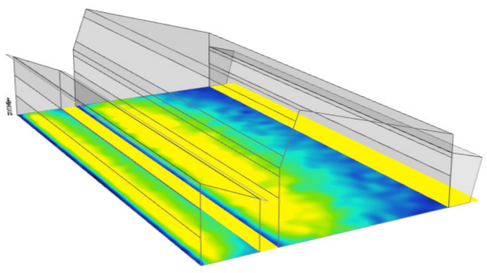


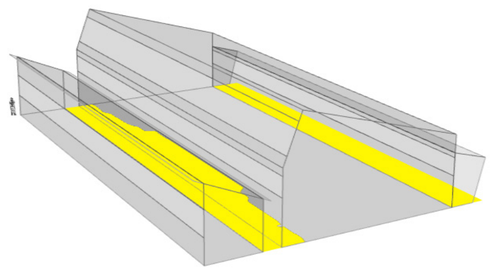


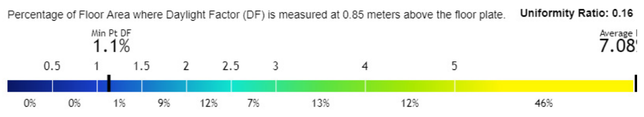
PROCESS

LIGHTING TESTING

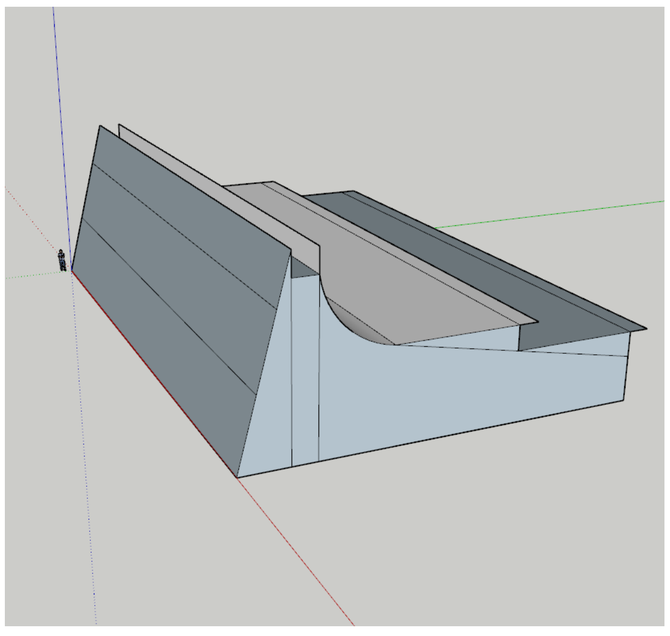


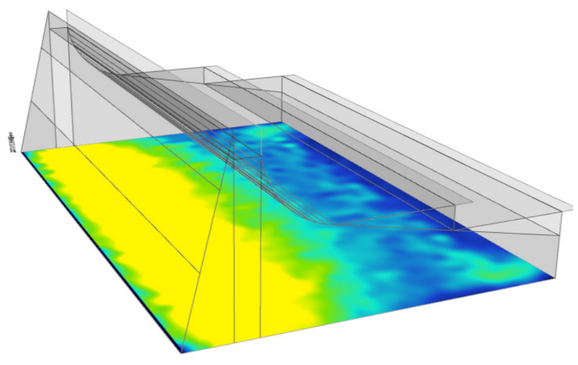


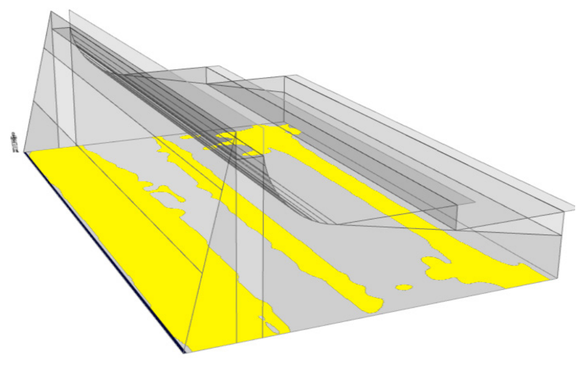


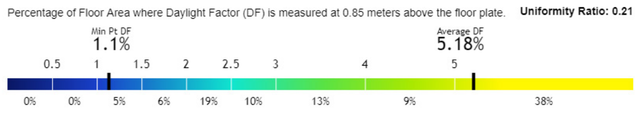














PROCESS

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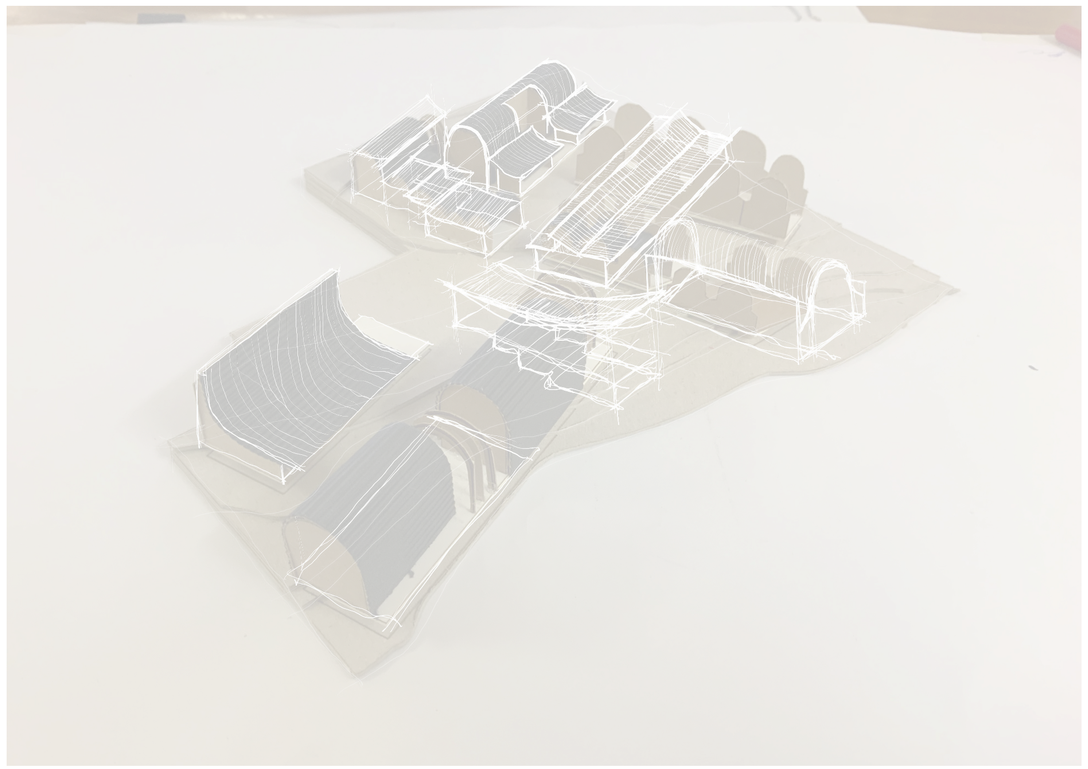
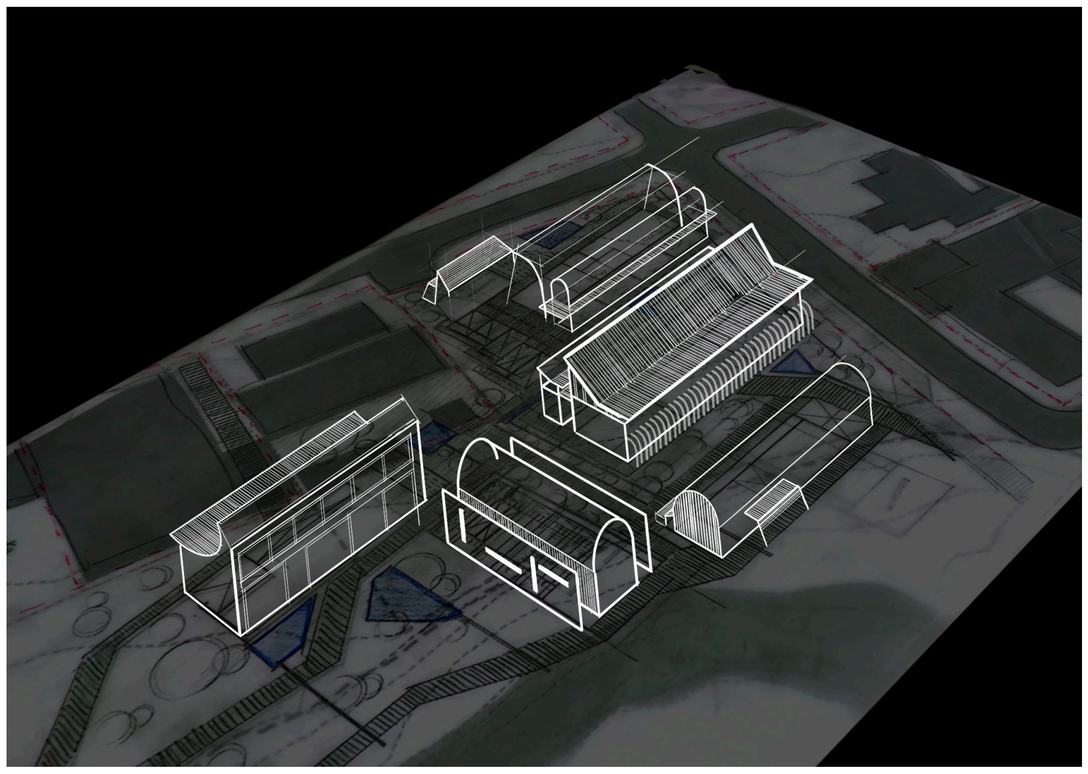
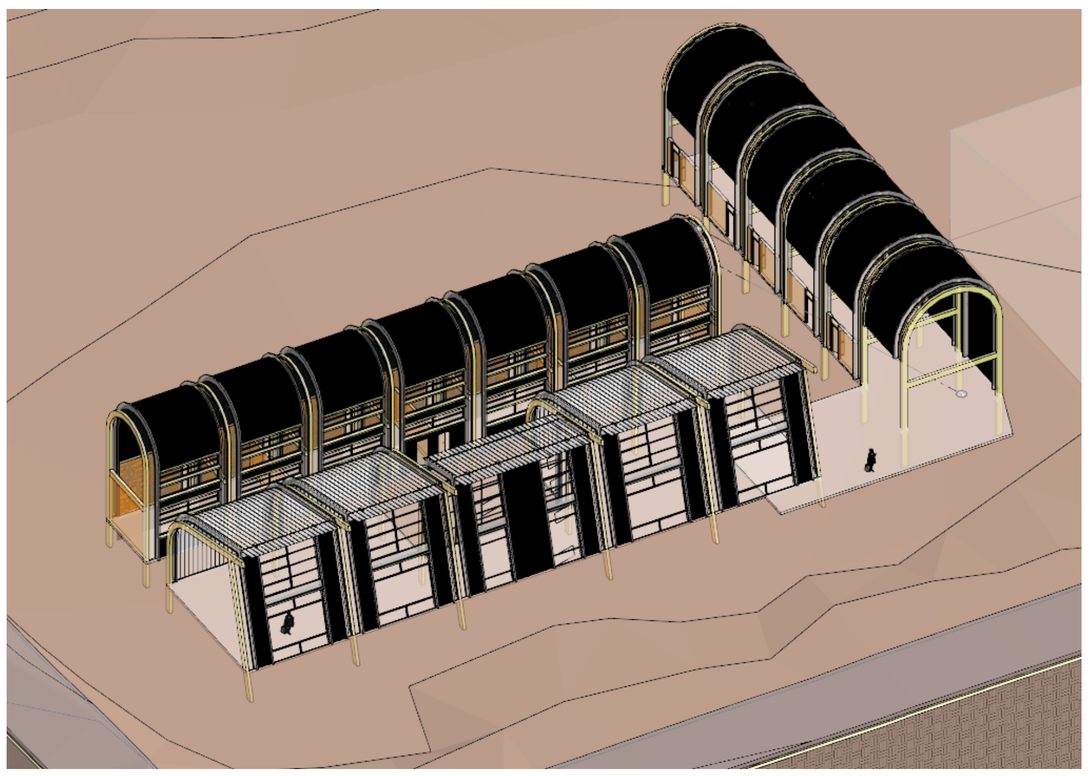
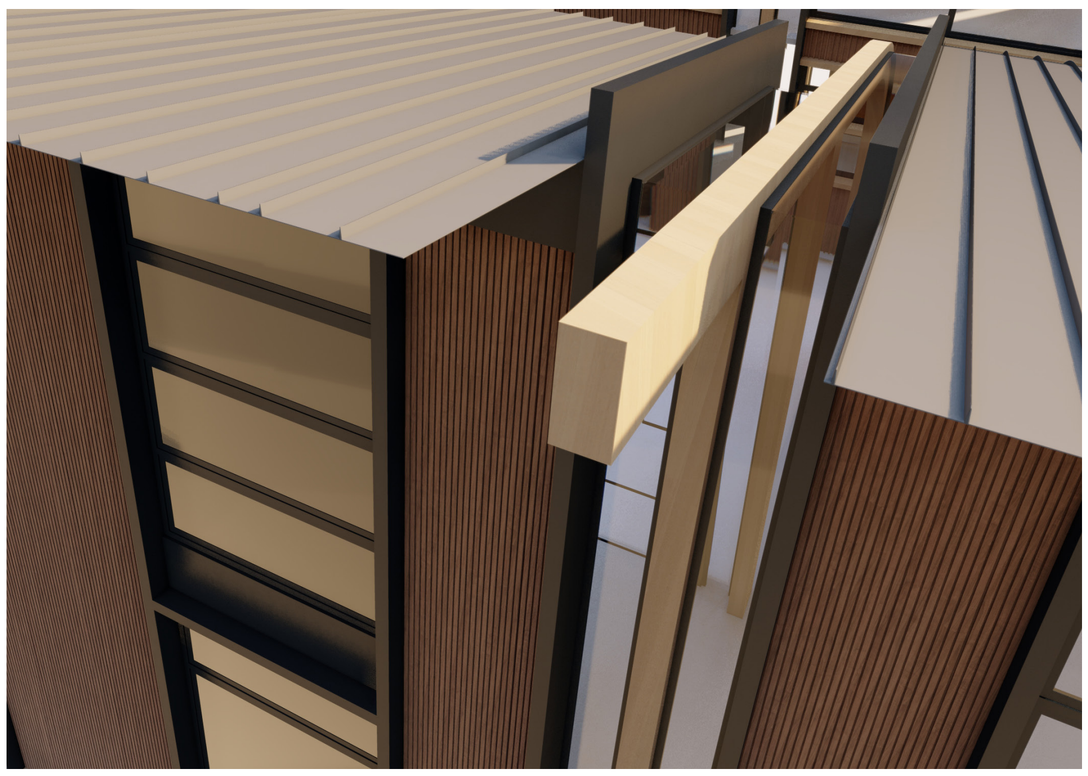
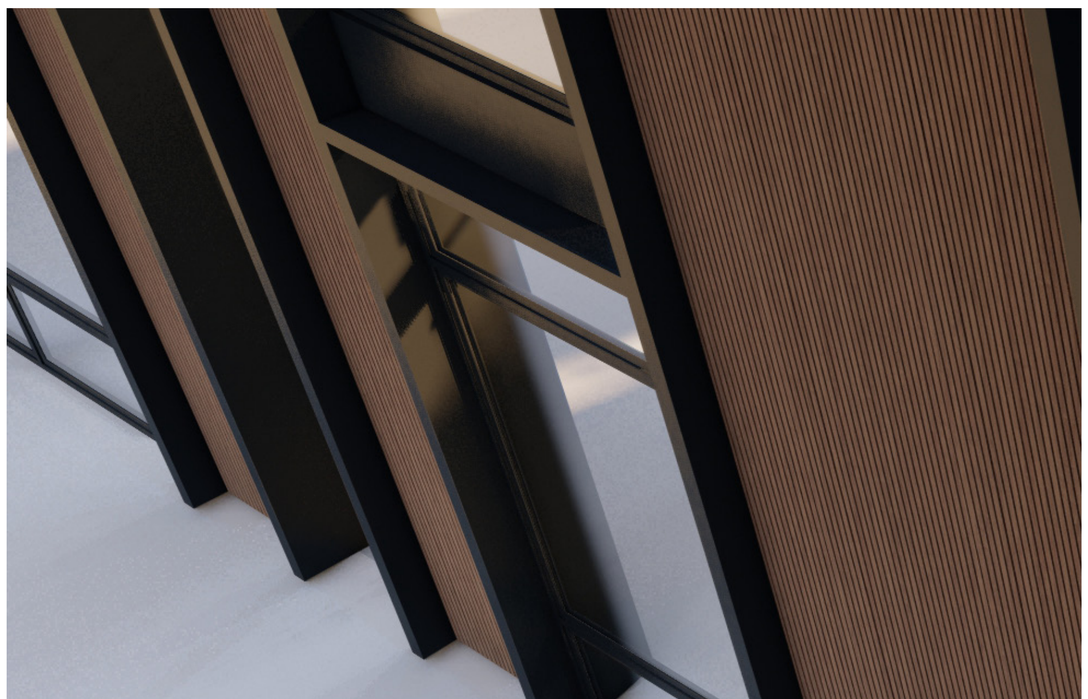
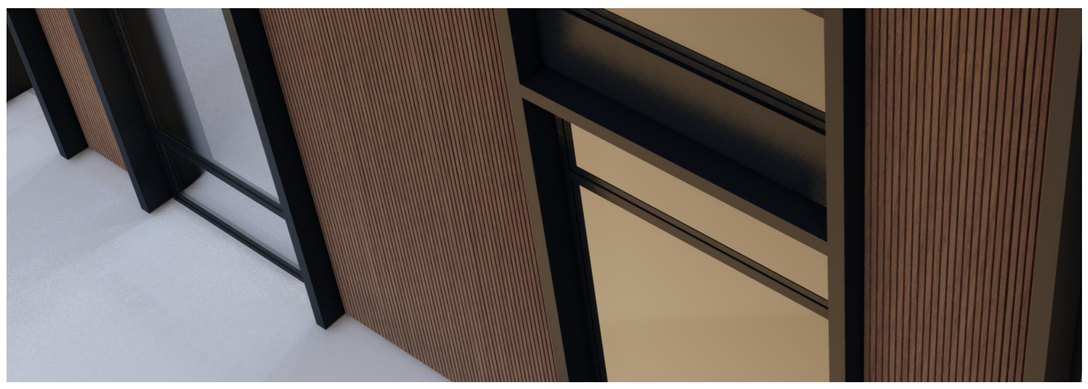








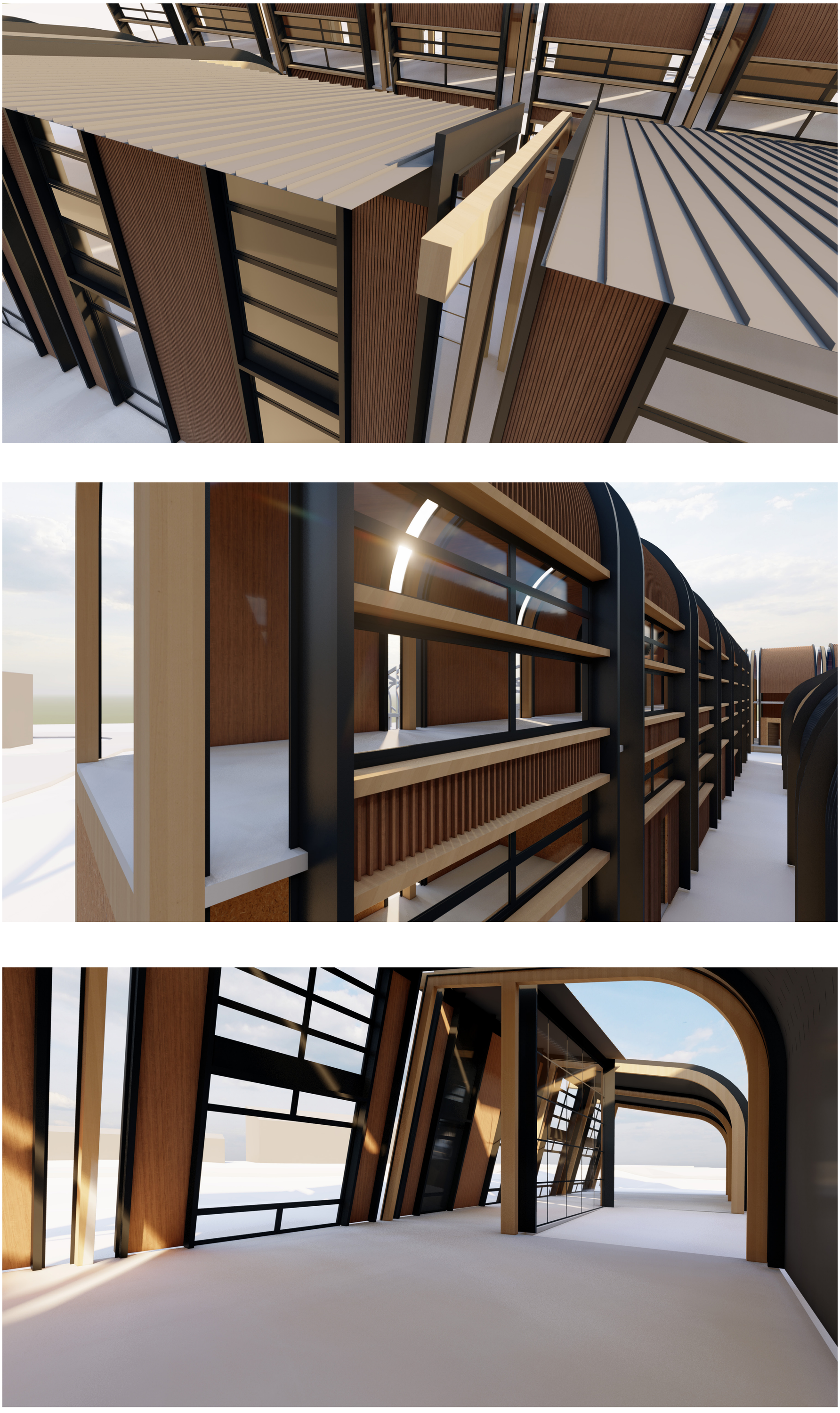






PROCESS

TECHNOLOGY THINKING



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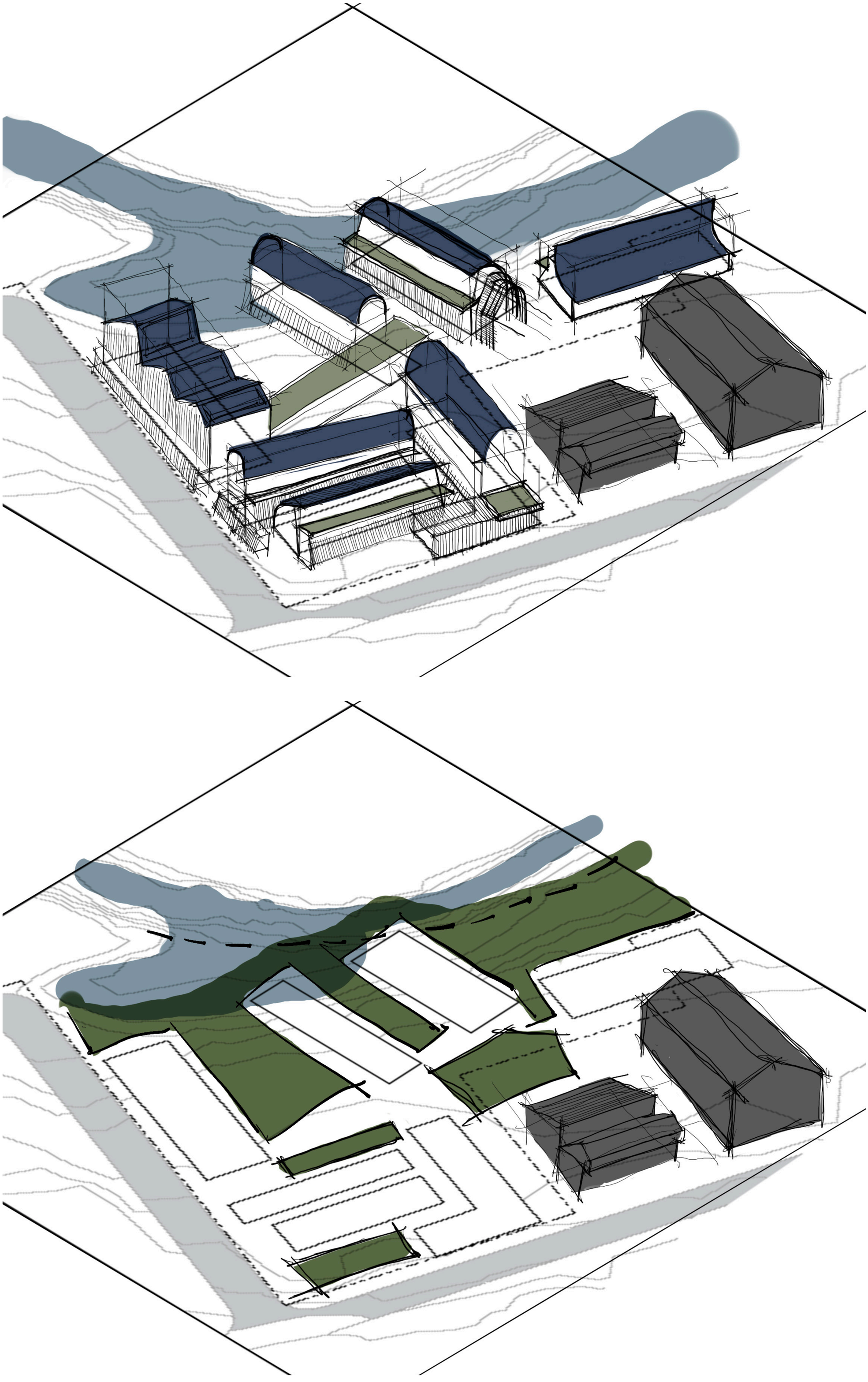
TECHNOLOGY THINKING



PROCESS

TECHNOLOGY THINKING



PROCESS

BUILDING PERFORMANCE

Daylight factor in a workshop space

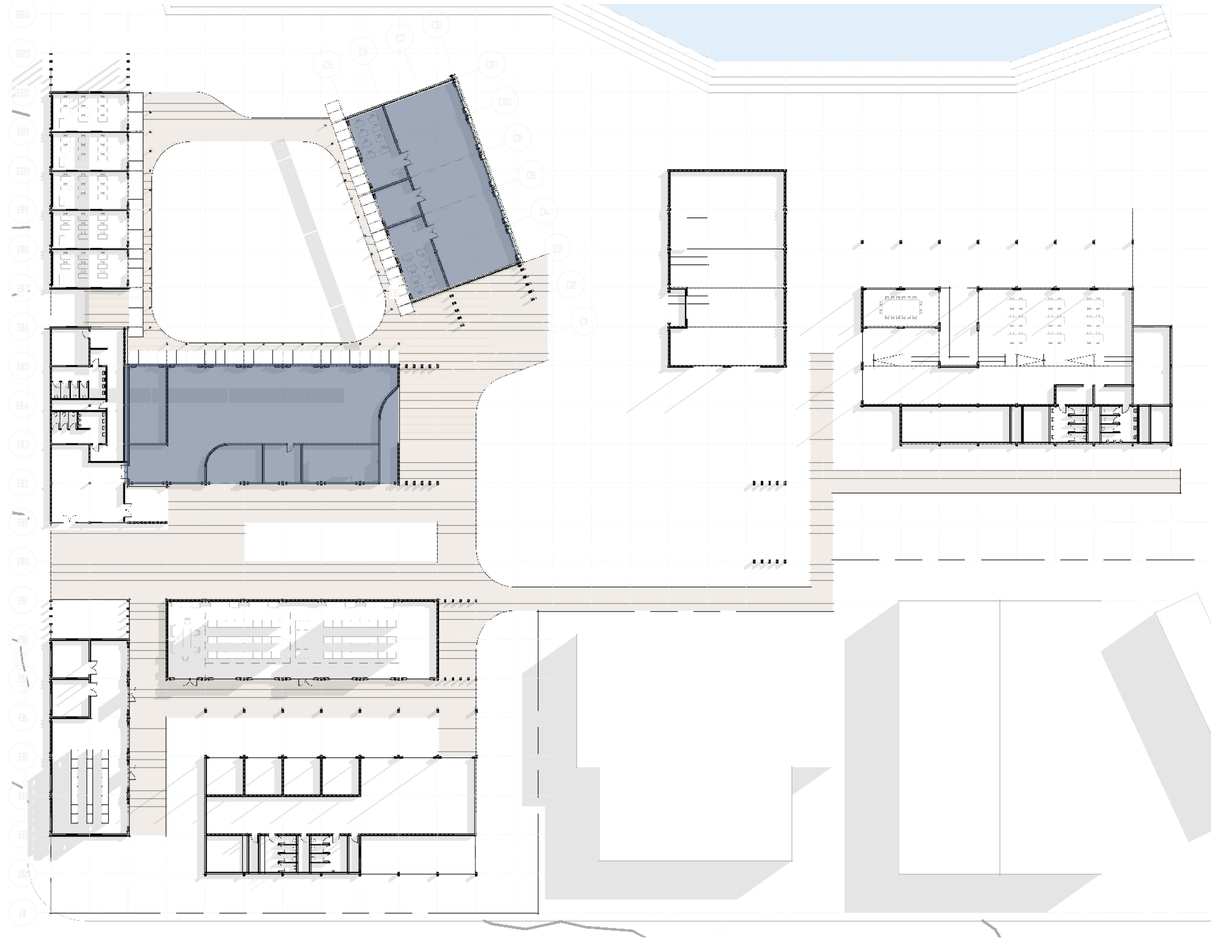
The segment of the project earmarked for evaluation involves the utilization of the Sefaira performance analysis platform. The primary objective is to assess and guarantee the compliance of the workshop spaces with established standards, particularly concerning lighting conditions, with the overarching aim of fostering enhanced learning and working environments.

In the context of workshop spaces, the lighting requirements deviate from the conventional norms observed in typical South African settings. Unlike general spaces that typically benefit from the ingress of northern light, workshops necessitate a distinctive approach. In this context, a preference for evenly distributed southern light is advocated. This choice is informed by the imperative to mitigate direct light exposure and the consequent formation of shadows, factors that could impede precision and finesse in intricate work processes.

The investigation will focus on Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE), with a particular emphasis on their application in the analysis and visualization of daylight within the workshop environment. This scrutiny aims to mitigate glare and enhance the optimization of natural light. Additionally, the examination will extend to the analysis of the daylight factor, a metric representing the ratio of indoor illuminance to outdoor illuminance.

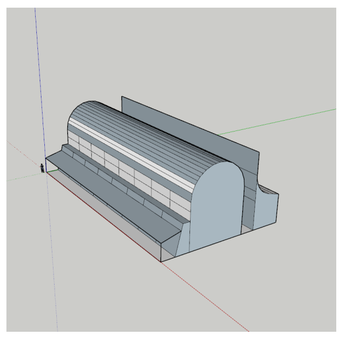
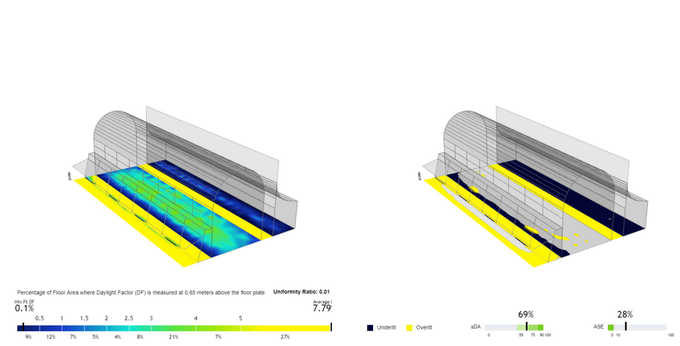
Specifically, the assessment of Direct Sunlight will be integral to the study. This facet isolates direct beam solar radiation, providing a comprehensive illustration of the areas on the horizontal workplane where direct sunlight is present during a user-defined time period. Such an approach ensures a thorough understanding of the spatial distribution of sunlight, allowing for targeted interventions to address specific areas of concern and optimize the overall daylighting performance within the workshop.

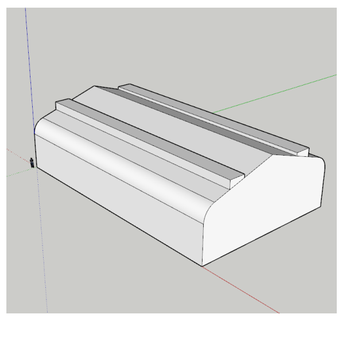
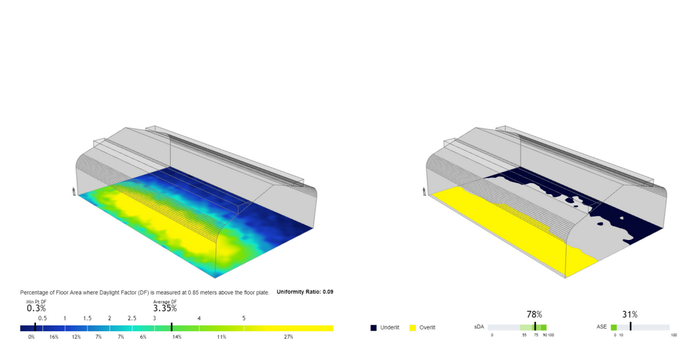
A workshop has differentiating required levels of lighting required, these include:
- General benchwork = 300-500 lux
- Machining | handwork = 750 - 1000 lux
- Small precise joinery = 1500 -2000 lux
- Ambient light = 600 lux

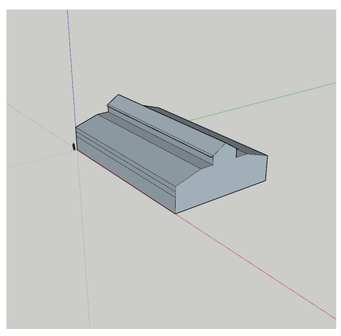
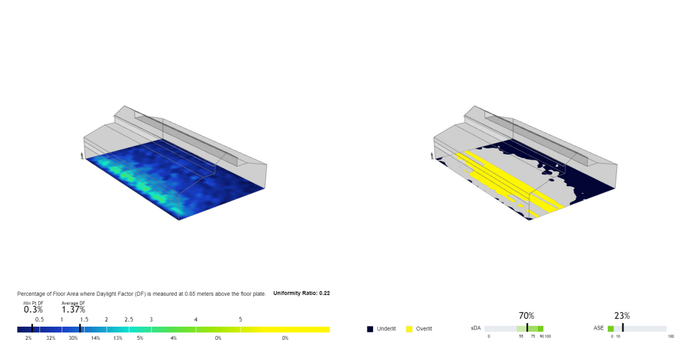


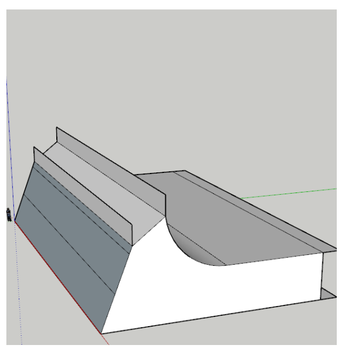
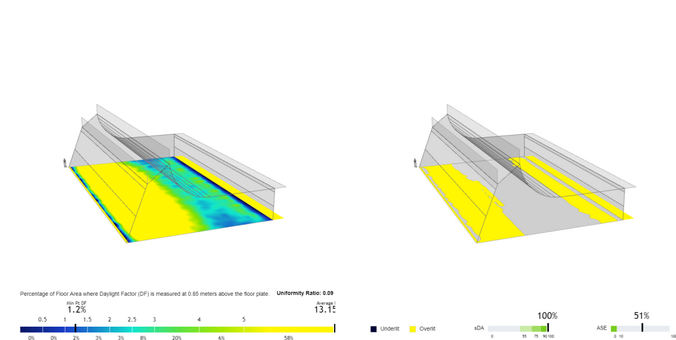
Conceptual iteration in the design phase

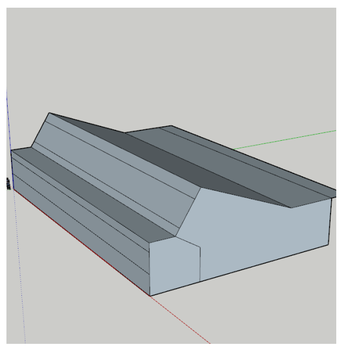
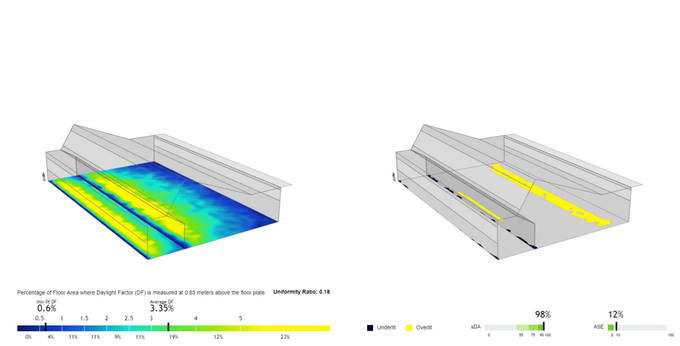
In the design phase, iterative processes were employed to address the conceptualization of form, specifically focusing on the incorporation of curves and strategically positioning southern windows. The objective was to optimize the infusion of natural light, thereby illuminating the space to its fullest potential.

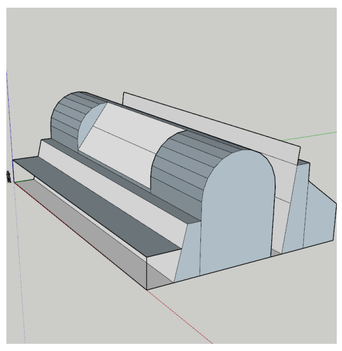
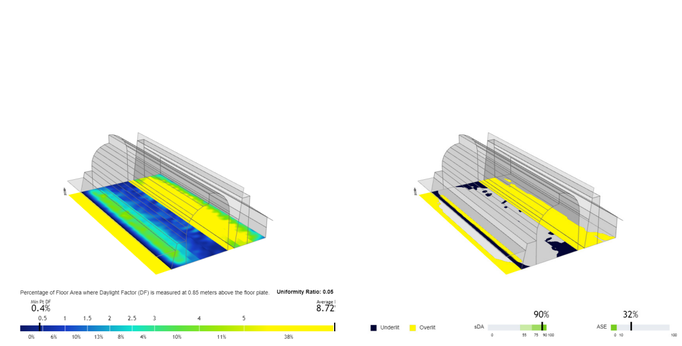



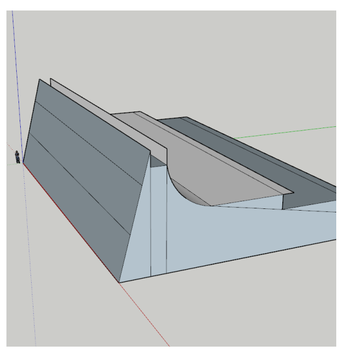
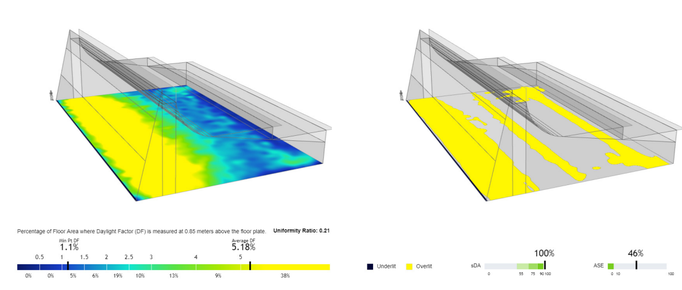



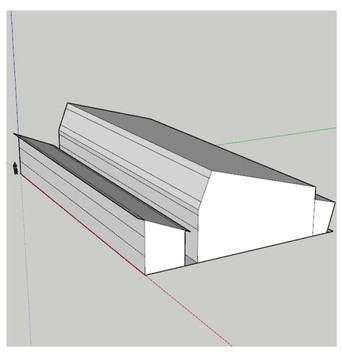
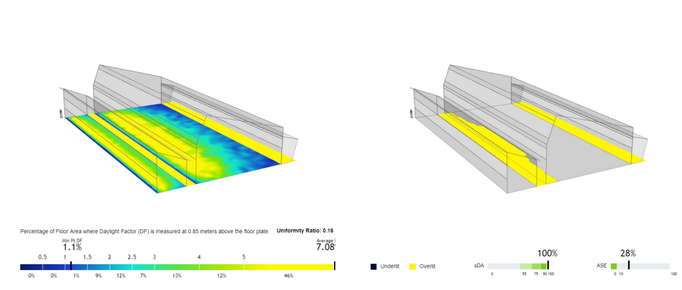



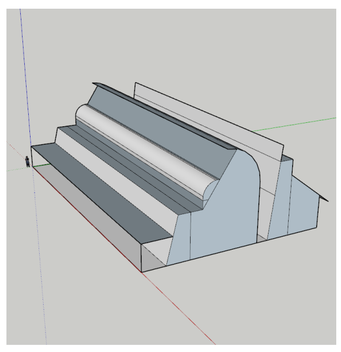
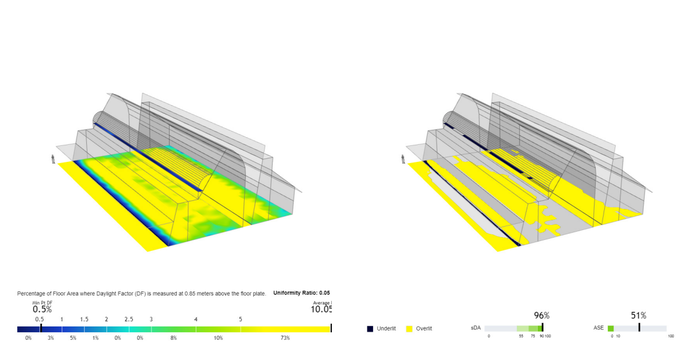



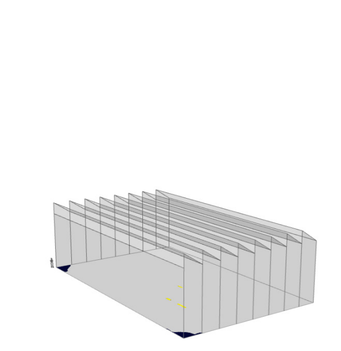
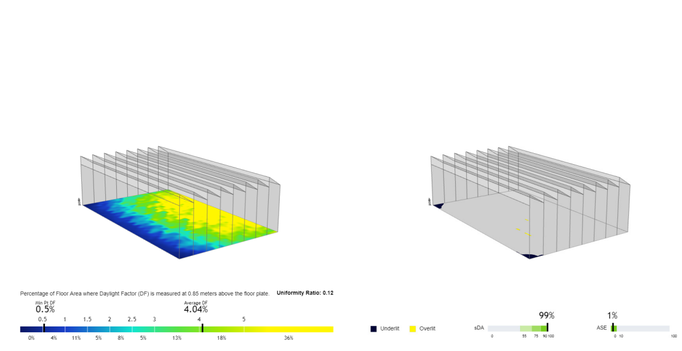



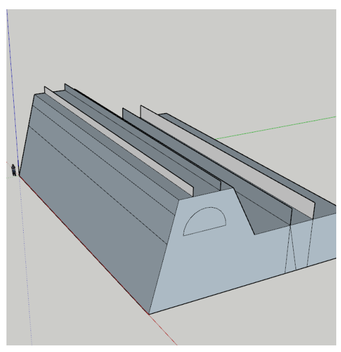
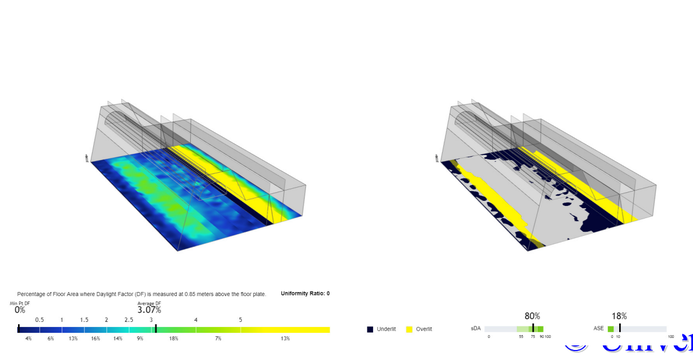



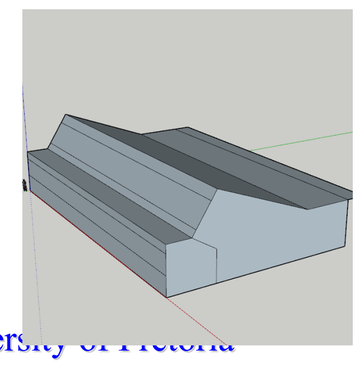
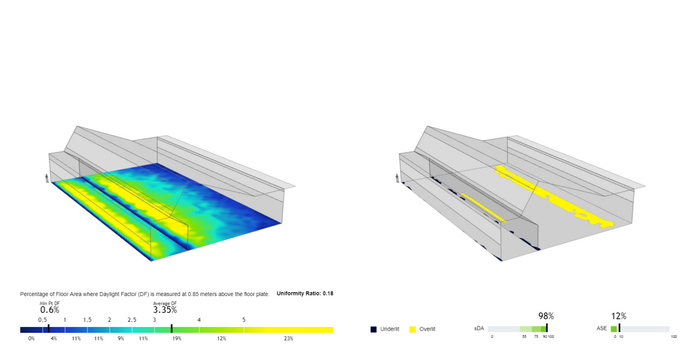



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construction school in
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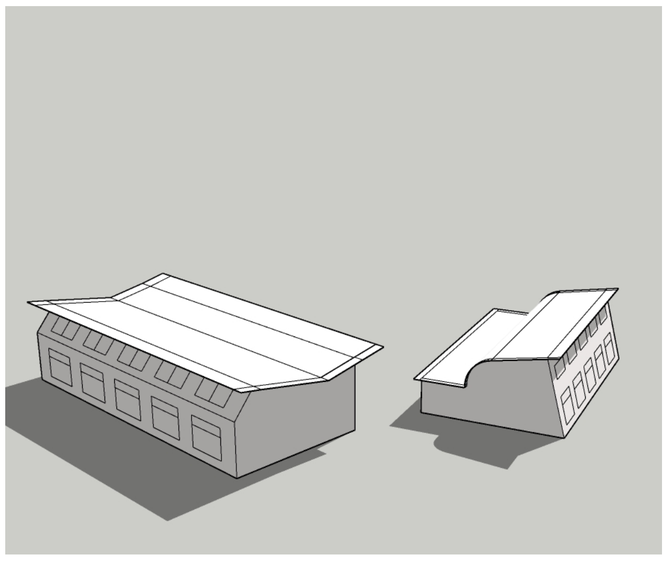
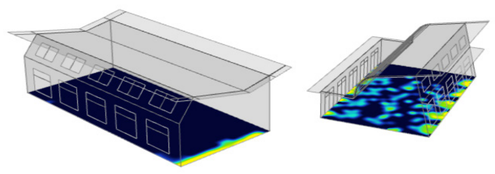
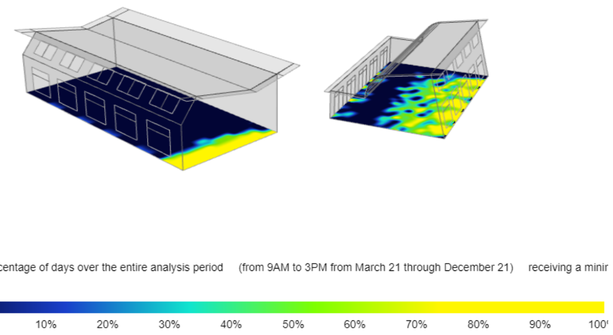
Base case scenario

The endeavor at hand involves addressing the challenge posed by two workshops—one characterized by an extensive south-facing facade, and the other distinguished by elongated eastern and western facades. The task at hand is to navigate this architectural puzzle in order to ascertain the optimal solution for both the individual spaces and the overarching design scheme.



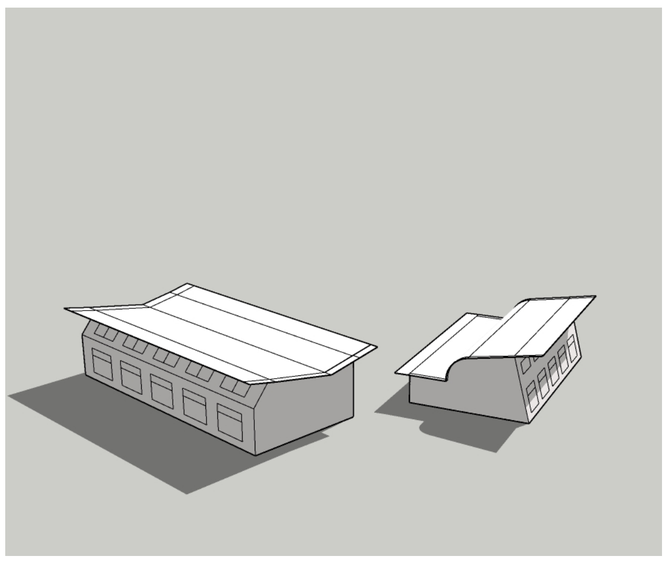


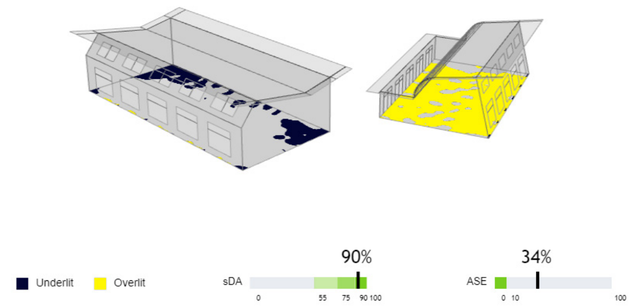


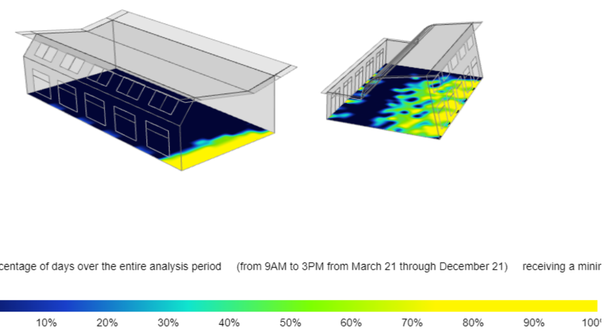
As depicted in the visual representations, the building on the right is subjected to an excessive amount of direct sunlight owing to its orientation. One plausible remedy for this issue could involve augmenting the roof's overhang.

Iteration 1

In the initial design iteration, an extension of the roof overhang is proposed for the eastern and western facades.



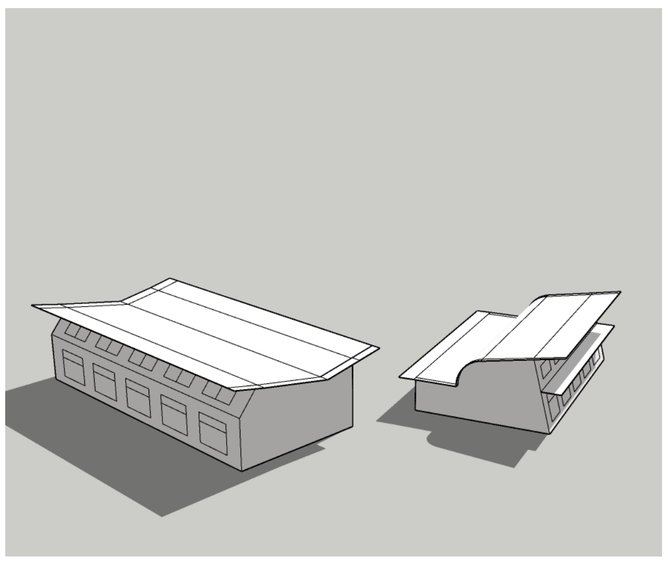


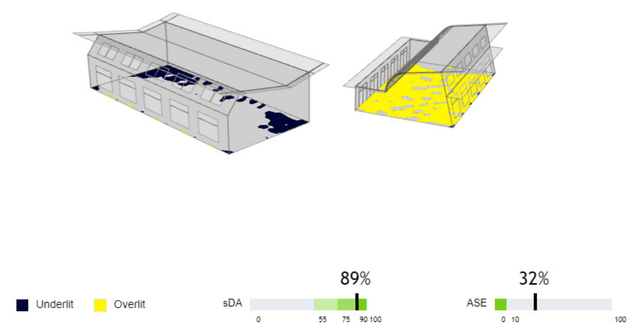


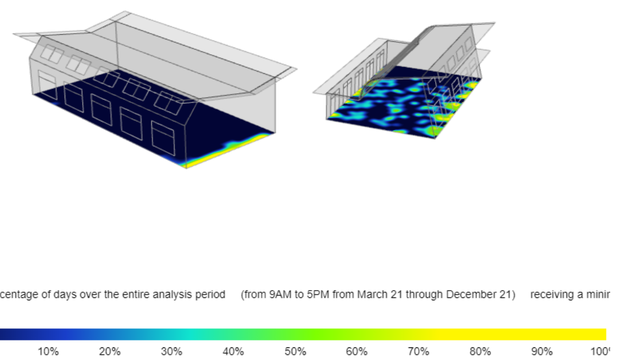
The extension of roof overhangs, though implemented, did not yield a sufficiently significant impact on mitigating direct sunlight penetration into the workshop spaces. The issue persists, leading to both overlit and underlit areas. This discrepancy, however, is deemed acceptable, as the overarching objective is to maximize the influx of natural light into the workshops.

Iteration 2

A shading device/lightshelve is introduced to shade the glazed areas of the eastern and western facades.



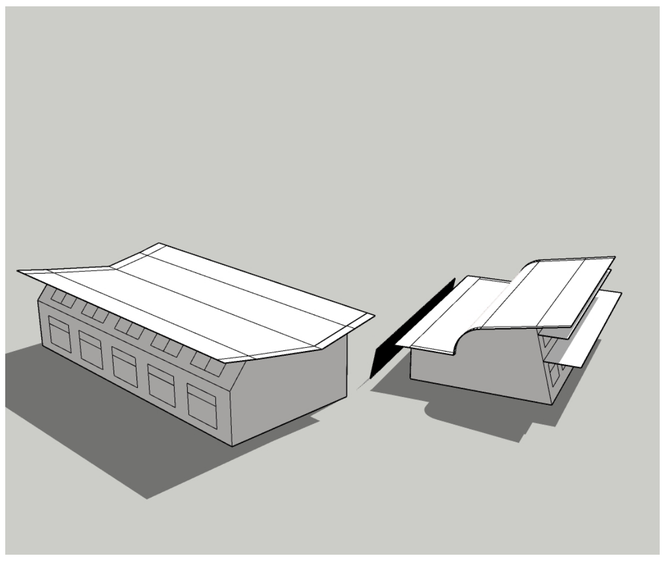


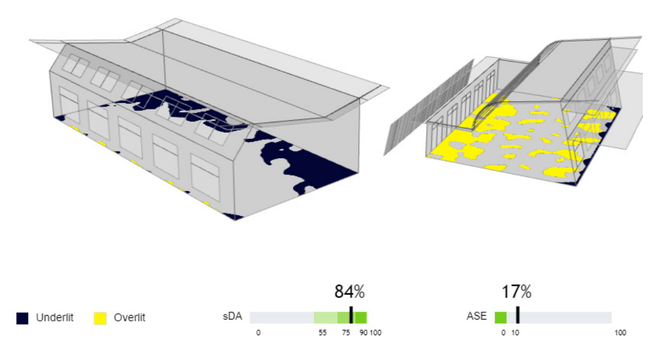


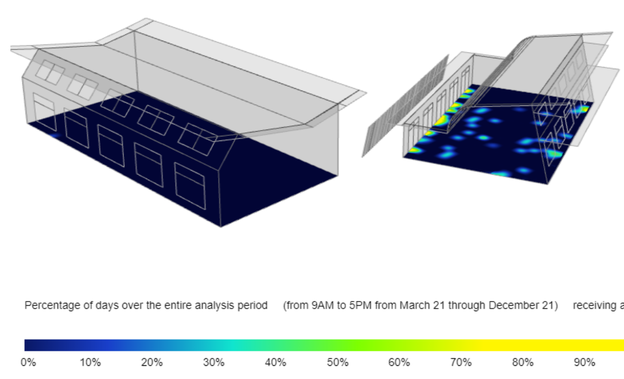
The lightshelve successfully lowered the direct sunlight entering the righthand workshop, although there is still too much direct sunlight and glare in the workshop.

Iteration 3

The endeavor at hand involves addressing the challenge posed by two workshops—one characterized by an extensive south-facing facade, and the other distinguished by elongated eastern and western facades. The task at hand is to navigate this architectural puzzle in order to ascertain the optimal solution for both the individual spaces and the overarching design scheme.







Adding a second lightshalve/shading device on the eastern facade, adding a vertical shading wall element on the western facade made a big difference to the amount of direct light that enters the workshops. The glare still is too high, further exploration will adjust this to have a lower glare amount.

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