THE PLIGHT OF THE PUBLIC HOSPITAL

MSc Architecture Design Report

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I N D E X

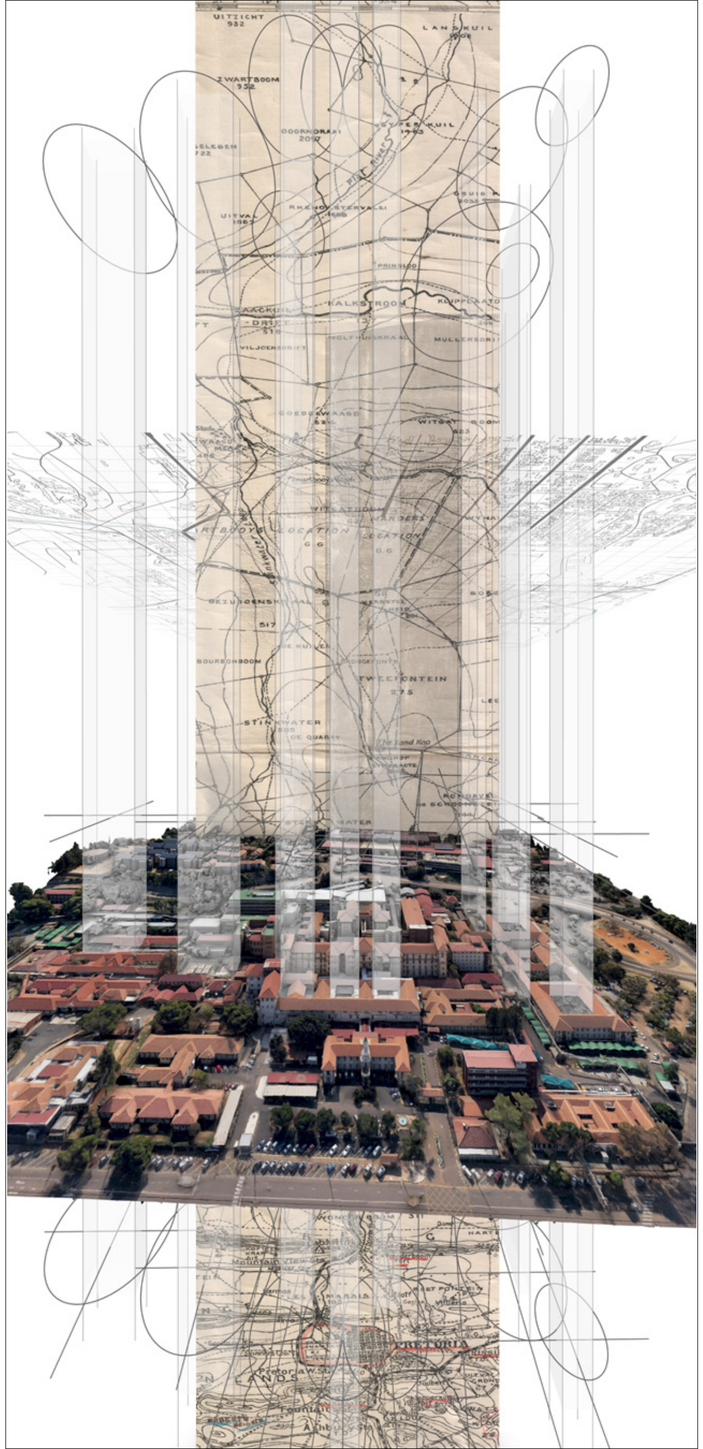
ABSTRACT

This dissertation project investigates the shortcomings and potential of the public health facilities in the City of Tshwane through the lens of the current diabetes epidemic. Various spatial, social, and institutional shortfalls are identified and dissected to inform possible architectural solutions. The disparate nature of services, urban sprawl, aging hospitals and lack of community engagement and education hinders healthcare for the majority of the population.

This proposal suggests a complex networked approach that envisions various architectural additions throughout the city and the existing healthcare nodes. These additions will improve service delivery and enable healthcare and community support where none existed before. To enable this network, a catalyst project is required: A core facility that researches, produces and tests these satellite interventions within a controlled environment before being deployed throughout the city.

To drive and manage the envisioned system and network, this facility will centralise administration, development, research and community engagement to effectively and radically change the healthcare fabric of the city. The centrally located Tshwane district hospital will host this facility within various underutilised existing buildings. This approach requires the adaptive reuse of significant heritage structures on a historically sensitive site. The architectural response is thus an investigation of appropriate interventions and additions within this sensitive context to achieve multiple layers of programmes. Combining the programmes of spatial research and medical services creates opportunities where user responses can be observed through multiple medical typologies. This spectrum of investigation is achieved by providing a broad set of medical services throughout the site.

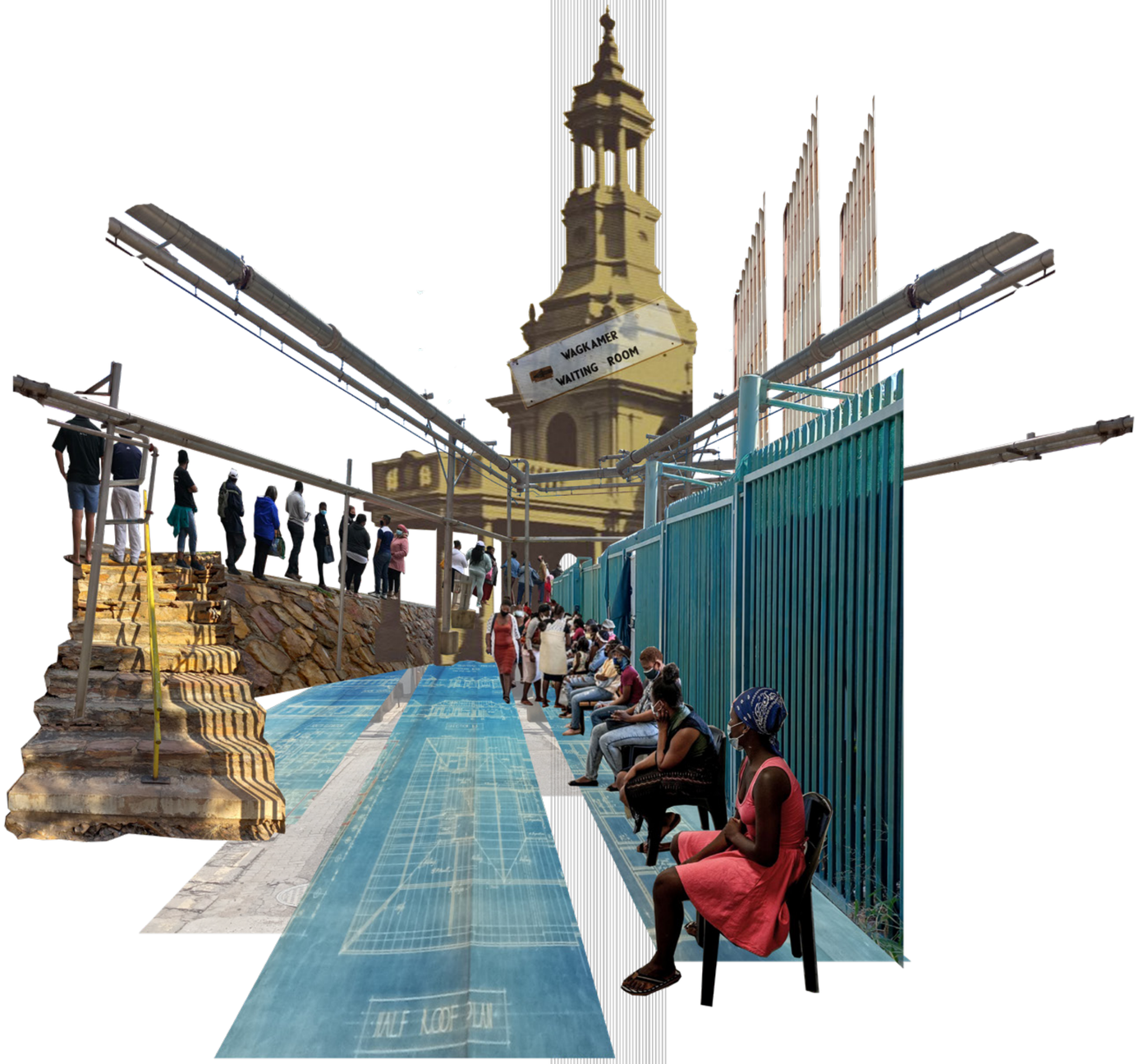
The architectural technological response of the project is a combination of structural insertion into existing buildings, internal reconfiguration and the restructuring and addition of public urban space around and through the site. Radical changes to the site is achieved with the project that envisions healthcare buildings as public spaces while providing rich opportunities to drive South African healthcare forward through research and education.



INTRODUCTION

As with many essential services in South Africa, healthcare is located on an unbalanced spectrum that heavily favours those who are privileged enough to make use of private enterprises. This leaves the majority of South Africans dependent on underfunded, underequipped, and inaccessible healthcare facilities. This project envisions architectural interventions across the fabric of existing healthcare facilities that will complement and empower current service networks by enabling collaboration between stakeholders within the City of Tshwane. These existing networks consist of state-provided services, infrastructure, various research groups, and non-profit organisations. This vast system of interconnected architectural additions, adaptations and interventions will address various public healthcare problems such as public education, rapid health status testing, consultation, medicine dispensing and community support.

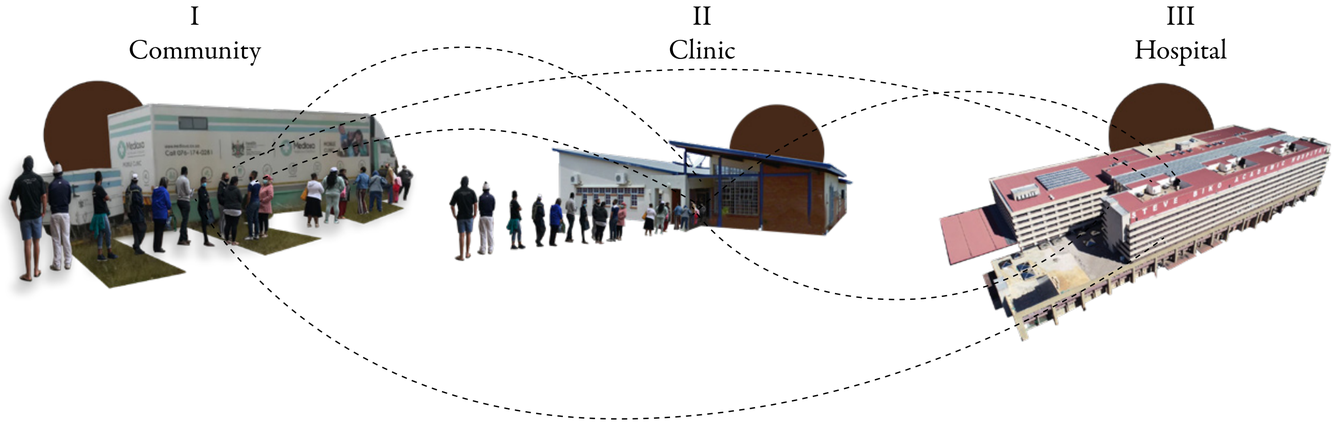
To enable this catalyst movement, an origin point is required. A strategic insertion into the existing layer of public healthcare can enable the needed propagation. This project proposes this trigger: a central medical and research facility connected to an established hospital that enables better patient care while producing medical and architectural research through the implementation of spatial prototypes throughout the various functions of the facility. By focusing on the urban integration of, and public collaboration with multiple levels of healthcare, this project defines the core



PROJECT BRIEF

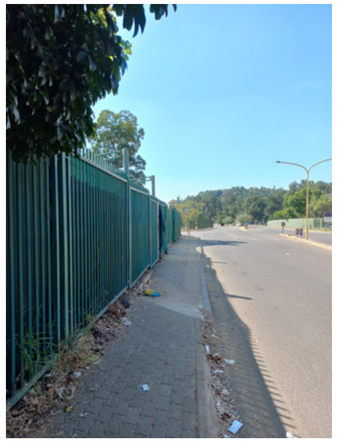
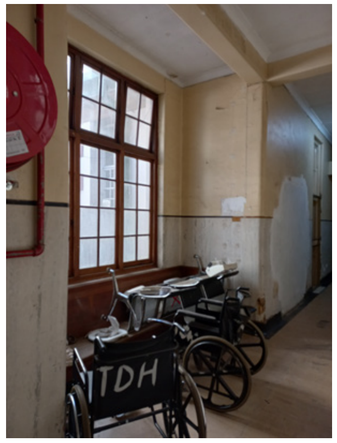
South African public Healthcare is divided into three main divisions, community healthcare, clinics, and hospitals (including district-, regional- and specialist hospitals). These levels serve the public in different ways that increase in medical complexity with every level. The resulting patient experience is a fragmented journey between facilities which are often located great distances from each other. Davis (2016) investigated the shortcomings and noted the following negative aspects of the public healthcare system:

1. Excessive travel distances
2. Excessive waiting times at all stages
3. Limited access to information and education
4. Insufficient facilities and capacity on all levels



In combination with these systemic and supply problems is the fact that the public healthcare facilities are in general in an aged and worn state. The authors research project investigated the architectural heritage and conservation of hospitals in Tshwane and concluded that many of the structures are unmaintained. Other noteworthy general architectural spatial problems noted are:

1. Building age and condition
2. Poor spatial, lighting and ventilation conditions
3. Poor patient spatial experiences
4. Insufficient accessibility in existing buildings
5. General disregard for architectural heritage

The multitude of challenges in the healthcare sector results in a poor patient experience, affecting compliance and medical effectiveness. Various stakeholders are prioritizing public healthcare quality through ground-up initiatives that target healthcare at a community level. Non-governmental organisations such as the Diabetes Alliance, research groups such as the UP Community Oriented Primary Care (COPC) unit, the Tshwane Insulin Project and the Department of Health run programs that target grassroots healthcare through community action and contact. This project aims to involve these stakeholders in a combined effort to improve healthcare through research-driven architectural interventions.

DIABETES ALLIANCE

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

SEMDSA
Society for Endocrinology, Metabolism and Diabetes of South Africa

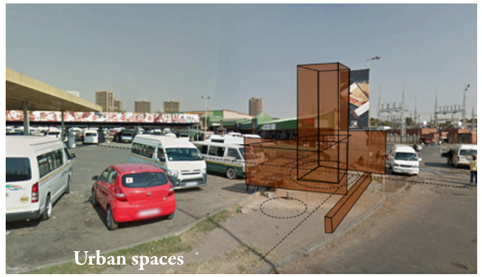
COMMUNITY-ORIENTED PRIMARY CARE
RESEARCH UNIT
Creating A Service Learning Research Platform

CITY OF TSHWANE
IGNITING EXCELLENCE

PROJECT BRIEF

To effectively combine these programs, a spatial intervention system is proposed by this project. The city-wide system consists of various architectural interventions, additions and alterations that modify existing healthcare facilities and infrastructure to align with the stakeholder aims of providing better primary, secondary and tertiary healthcare while providing the infrastructure and facilities for new ways of patient interaction and community influence. The function and form of these will be research-driven and will target relevant and current public health problems.

Architectural Intervention Examples



A complex network of various programs and functions that are constantly changing in a large city-scale context requires rigorous control and development to ensure resilience. It is this gap that the project focuses on with the proposal of a central facility located at the heart of medical service and research in the city. This administrative and development core facility requires integration into existing medical procedures and systems as well as direct contact with patients, medical staff and researchers to be able to adapt and influence public medical approaches through the intervention approach. The intent of this project is thus to create a central facility that manages and develops medical architectural interventions in the city while creating a holistic medical environment on the site. This bilateral focus achieves programmatic resilience and sustainability by utilizing the complexity of the site and placing strategic programs throughout to create a comprehensive and integrated system.

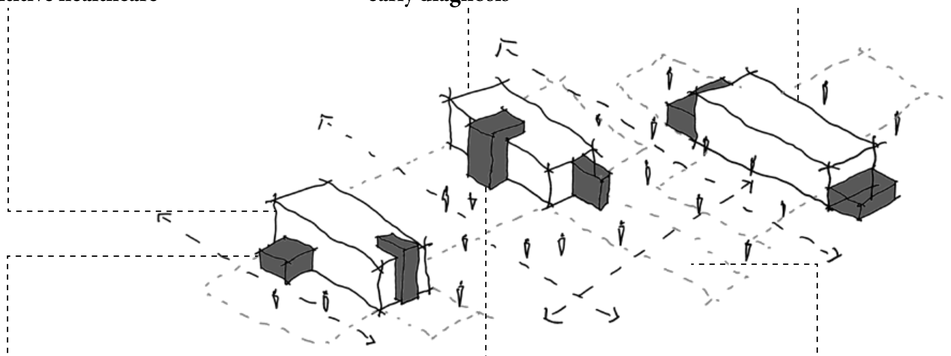
Augmentation Distribution Concept

Holistic Healthcare

1. Community healthcare and preventitive healthcare

2. Primary healthcare and early diagnosis

3. Intensive healthcare and recovery



1. Administrative and practical central control of community projects

2. Prototyping facilities of architectural interventions

3. Improvement of the hospital as a public and urban space

Development of Network

PROJECT BRIEF

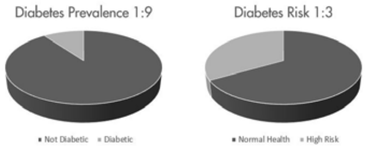
The improvement of the existing medical and supportive programs on the site reflects the existing hierarchy of healthcare services (community care, primary care, secondary care). These stages of healthcare are brought together in one location with the intent of simplifying and improving the patient experience. This project drives the development of external architectural interventions through the on-site creation and testing of spatial and architectural prototypes. These preliminary interventions are built, tested and refined on the hospital site before being implemented throughout the city. The project thus combines medical care with the research and development of medical architecture.

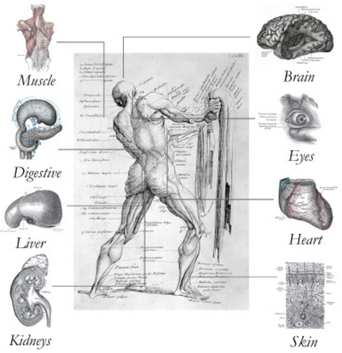
While most medical facilities provide flexible services to cover the largest possible spectrum of healthcare, the additions and alterations of this project focus on the treatment of the deadliest non-communicable disease in South Africa, Diabetes. This specificity aligns with the interests of the involved stakeholders and provides a uniquely wide scope of medical care for a specific disease. Diabetes is currently the fastest-growing non-communicable disease in South Africa. With 11.3% of the population diagnosed and a further 45% of diabetes sufferers undiagnosed, South Africa has the highest prevalence of the disease in the African continent. The effects of this disease carry a cost of R131 Billion per year in medical expenses. Most patients rely on the state healthcare system which serves 80% of the South African population and is severely underfunded and under staffed. To combat these problems, many organisations (government and non-government) focus on disease prevention and maintenance through the promotion of healthy living and medical education. This approach provides a unique opportunity where the success of these programs will benefit public health beyond a single disease as it promotes an overall healthy public lifestyle. This project aligns with these stakeholder goals and aims to provide medical facilities that can enable community and public healthcare by these stakeholders within the city of Tshwane as well as on the chosen site. Diabetes is largely a lifestyle induced disease that results in a long term journey as the effects progress over time. The medical scope involved in a patient journey starts at the community level and likely ends with palliative care and specialist intervention.

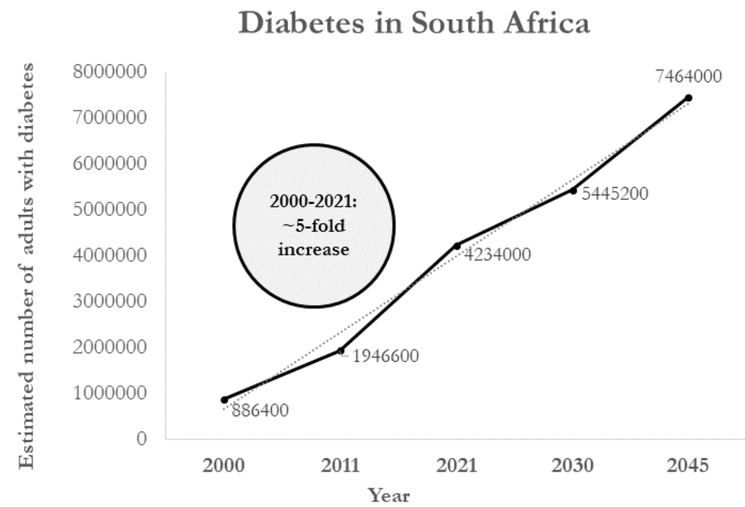
The current patient experience in the public healthcare sector is severely impacted by the physical and systematic shortcomings of the public healthcare sector. This, coupled with the systemic problems faced by vulnerable communities results in insufficient healthcare. Piotie et al. (2021) highlights a few of the problems namely:

- The lack of patient involvement in better management strategies.
- Underdiagnosis of patient deterioration.
- Limited contact with healthcare professionals.
- Lack of disease education in patients and the general public.
- Poor management of patients and patient data by professionals

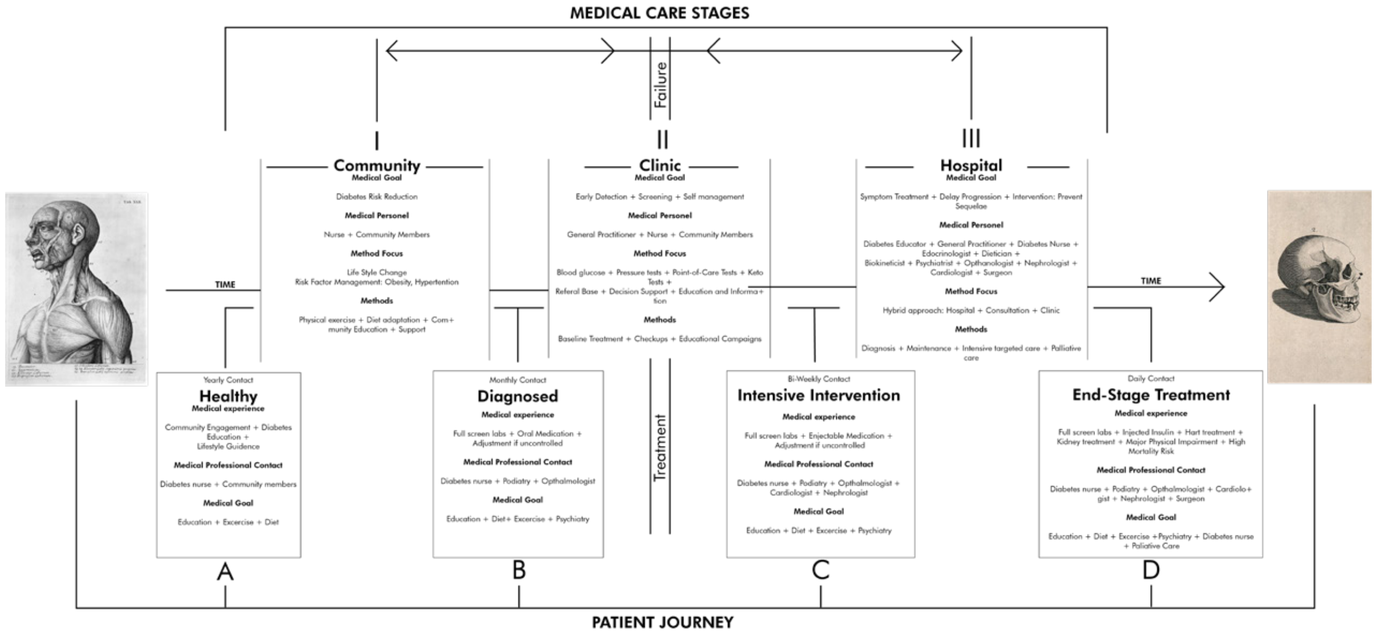
The ideal diabetes patient journey within the current healthcare system (comprising of standard governmental care and NGO programs) spans the entire spectrum of available healthcare. This system forms the basis of this project's focus on improvement and augmentation by providing the majority of services on the main site and researching and developing solutions to be implemented further afield. This ideal is however rarely reached due to the mentioned problems. The reality for thousands of underprivileged and sensitive patients is unfortunately the insufficient navigation of services that are overwhelmed, disconnected and sometimes inaccessible.







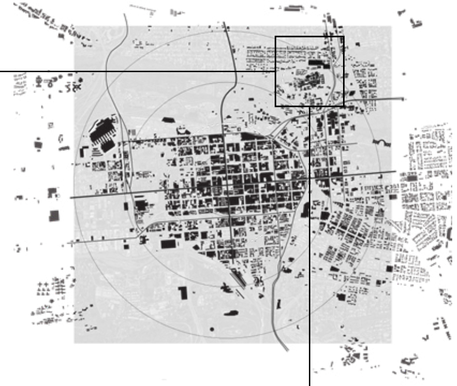
World Health Organisation (2016)



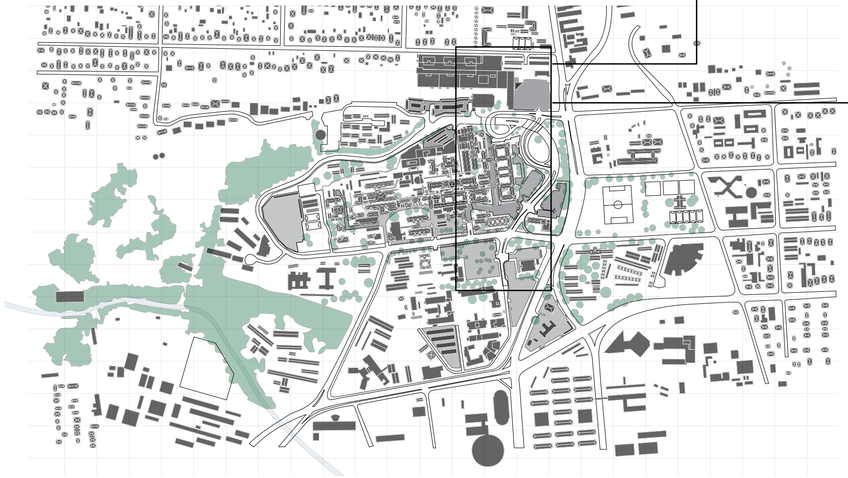
PROJECT LOCATION

The conceptual and programmatic centrality of the project requires a well established existing medical-focused site that houses the complex and varied functions required to achieve the aims of improving the public healthcare system. While the city contains multiple large public state hospitals as revealed in the authors research, one precinct stands out in potential and suitability. The Prinshof medical precinct located North of the city CBD was chosen as the location of the project. This precinct contains the Tshwane District Hospital, Steve Biko Academic Hospital and the University of Pretoria's medical campus. The majority of the institutional stakeholders involved with the project are located within the precinct. The combination of medical facilities, research programs and public engagement sets the ideal context for cross olination of programms and productive collaboration.

City of Tshwane



Pretoria CBD



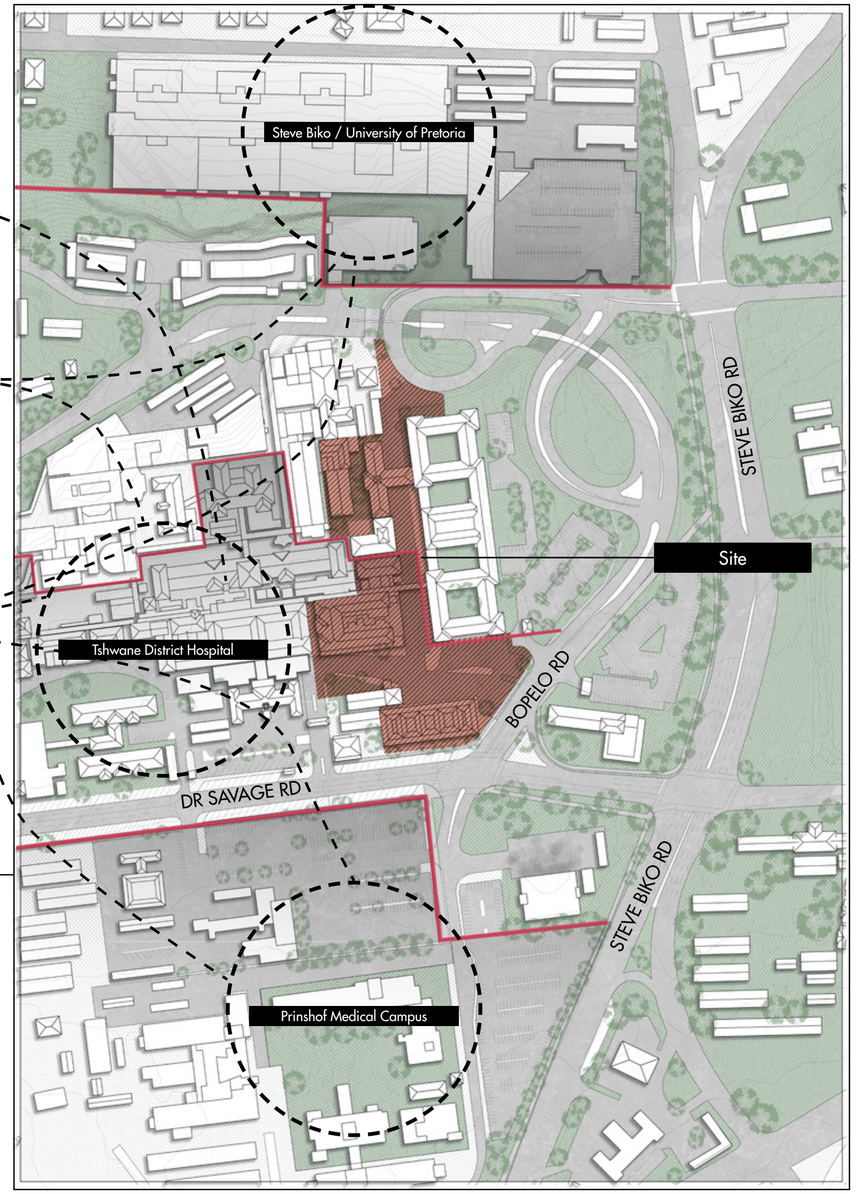
Prinshof Medical Precinct

Stakeholders on the site

CITY OF TSHWANE
IGNITING EXCELLENCE

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

COMMUNITY-ORIENTED PRIMARY CARE
RESEARCH UNIT
Creating A Service Learning Research Platform

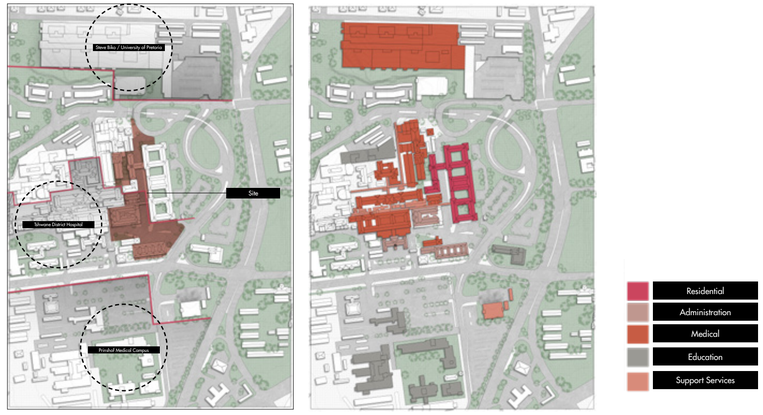


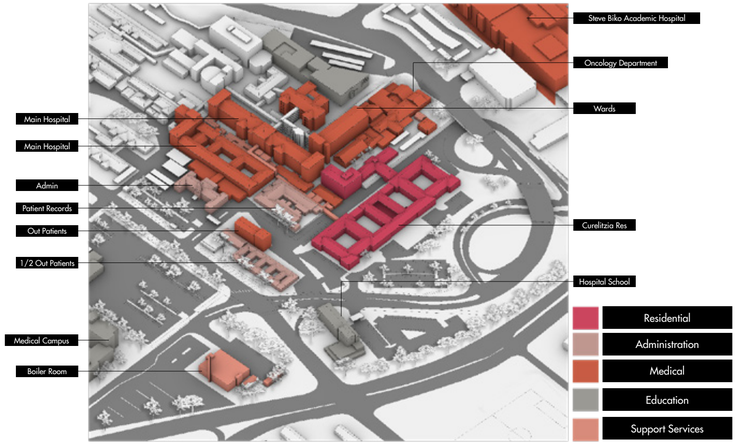
PROJECT INFORMANTS: SITE

The project is informed by differing scales of context, programs and technologies. The primary guide to the architectural response is the fact that the site has a complex existing context. By taking advantage of these existing aspects and with the project aims in mind, a clear project site is revealed. The focus site for the project is the Eastern edge of the Tshwane District Hospital. The site is located between the Steve Biko Hospital (North) and the UP Medical campus (South) which provides the opportunity to link these two academic and research sites.

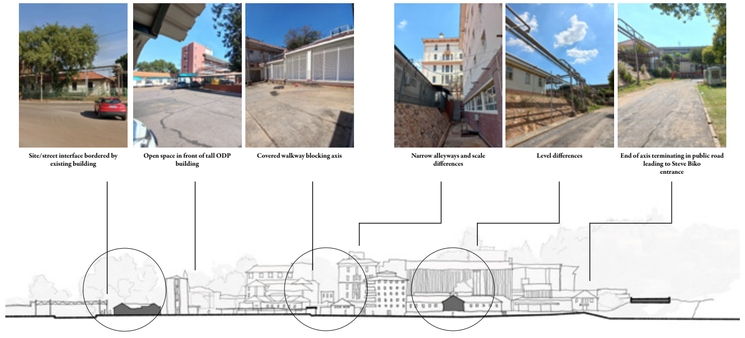
An in depth site analysis revealed many underutilized buildings are located along the site. This provides the opportunity for the adaptive reuse of the existing structures which aligns with important sustainability and heritage goals while improving the existing programs. The high importance placed on the reuse of existing buildings is a primary informant for the site definition and extent. Various medical and non medical programs are located on the site which provides the opportunities of connection and expansion of existing networks. The Urban fabric and public interface of the site was discovered to be severely lacking and detrimental to the sites accessibility and urban quality. While public transport is accessible, it is not integrated into the existing functions and public spaces.

Mapping the project stakeholders across the site through their daily activities reveals extensive usage networks and disconnected activities, this is due to the expansive nature of the existing architecture that was changed over time without a unifying vision or plan being implemented.





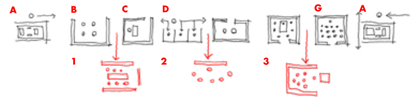
Pedestrian movement and access

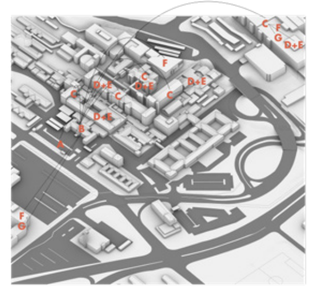


North South Section through the

Users - Health Practitioners

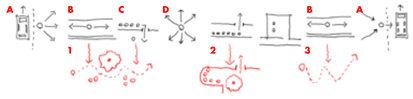
A : Arrive / Depart (Private Transport)
B : Group meeting
C : Office work
D : See patients
E : See isolated patients
F : Teach medical practical
G : Teach class / seminar

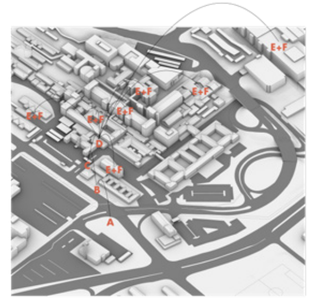




Users - Patients

A : Arrive / Depart (public transport)
B : Walk along boundaries
C : Wait for site entry
D : Directed
E : Wait for medical service
F : Receive medical service

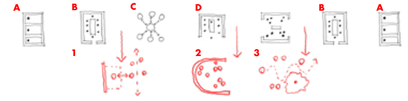


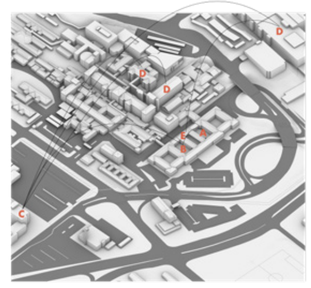


Users - Students

A : Private Room
B : Communal dining
C : Various Classes
D : Medical classes with patients
E : Socialising

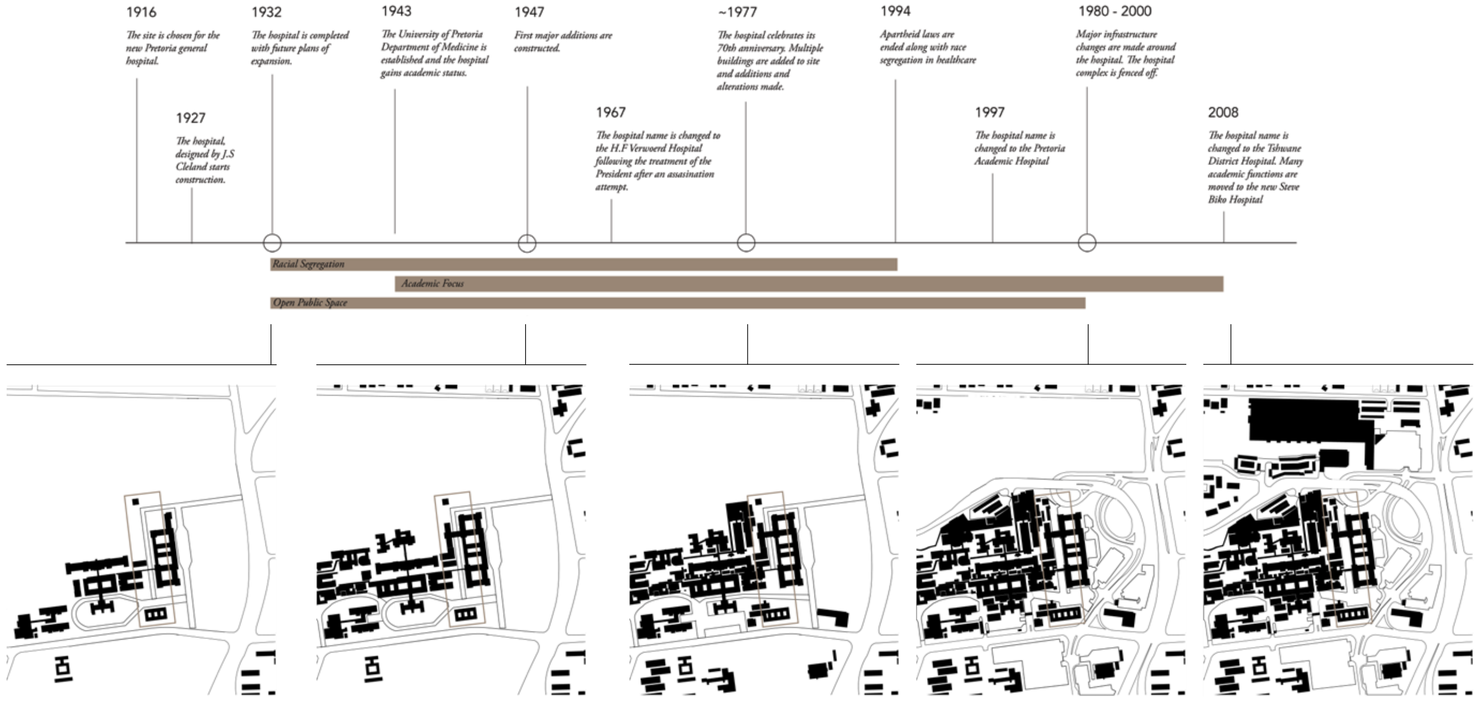
1 : Community work



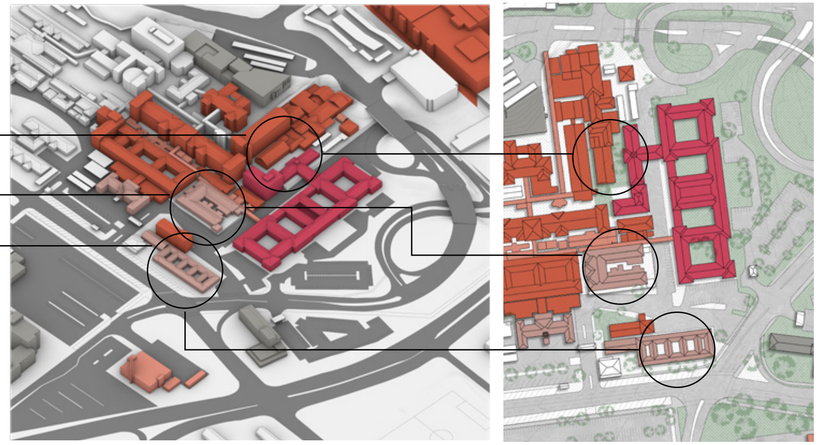


PROJECT INFORMANTS: SITE

The architectural and urban changes seen on the site are extensive and for the most part insensitive to the existing heritage and architectural narrative. The original hospital buildings on the site date back to 1932 and contain elements of significant heritage value. The buildings chosen for re-use harbor less historical importance while containing high usage value, value which is highly beneficial and sustainable if used correctly. The site contains noticeable layers of development forming a rich palimpsest that results in a fine-grained spatial quality of combined architecture, industrial infrastructure, and leftover spaces. The approach to this layered site is one of tabula plena, that celebrates the existing and preserves the narrative of the site.

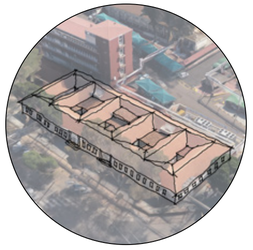


Development of the site over time. The complexity of the site increased over time and the urban intergration was negatively impacted with major infrastructure changes.



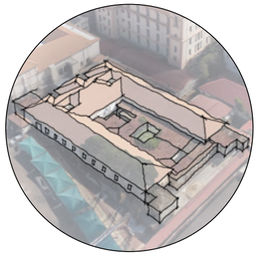
The heritage value and the use value of the existing buildings on the site provides opportunities for sustainable reuse that will add to the spatial quality of the site. The three main usable buildings are located in a sequencial order from South to North.

1



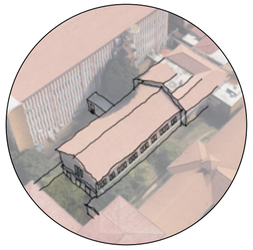
Building 1 is a part of the original complex constructed in 1932. It is half-used as an outpatient facility housing general practitioners and supporting functions.

2



Building 2 is also a heritage structure. It is currently unused and in poor condition.

3



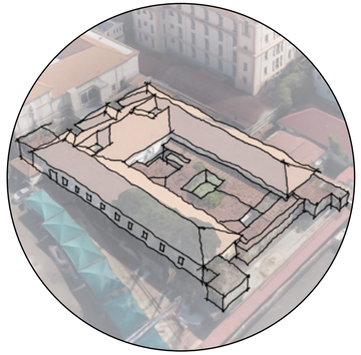
Building 3 was a part of the site expansion in the 1970s. It was formerly used as an oncology section but is currently unused.

PROJECT INFORMANTS: SITE

1

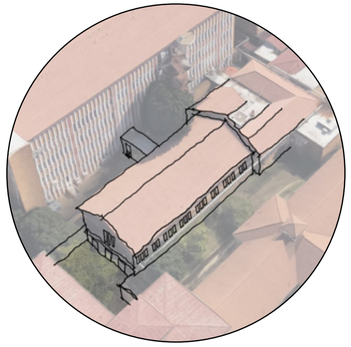
The outpatient building has been completely disconnected from the surrounding urban context when the street front was fenced off. The building entrance is now solely through neighbouring buildings as the original (racially segregated) entrances were bricked up. The valuable heritage elements are the facade paterns and orignal windows, facade details and courtyards. The courtyards were mostly roofed over.

2

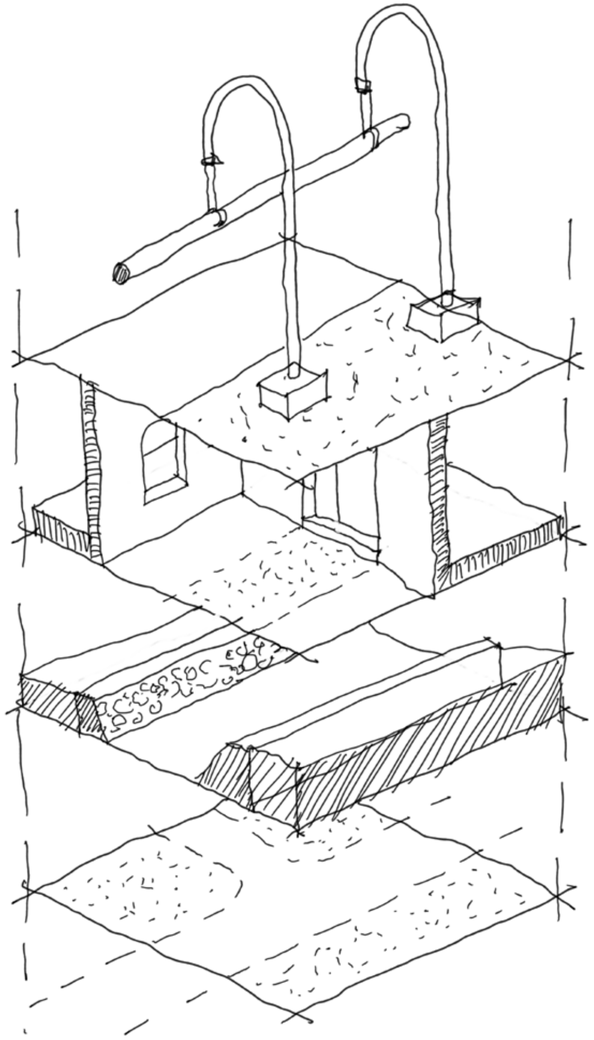


Building 2 currently serves as storage only and has no medical use. The facade rythm, original interior elements and the impressive interior verticallity are valuable characteristics of the building. An original large courtyard has been filled in with structures which cuts off natural light and ventilation in parts of the building. The building sits atop a retaining wall which isolates it within the site.

3



While the old oncology building does not contain remrkable heritage elements, it is positioned in a unique setting on the site. It is located in a quiet corner of the site, surrounded by greenery (which is sparce elsewhere) and is connected to a sunken courtyard with a half-basement level. The floor level of the building is significantly higher than the natural ground level providing the opportunity for private spaces.

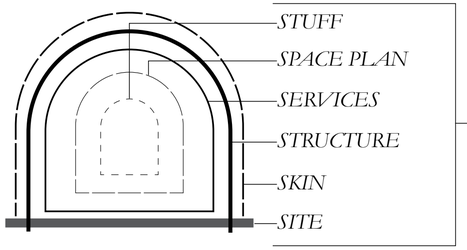


The site has clearly developed a great deal over time and now consists of multiple layers that was added to increase the effeciency of the services provided. This results in a complex site that interspersed with fragmented spaces and isolated buildings.

EXISTING CONTEXT

HERITAGE ANALYSIS

SHEARING LAYERS



VALUES

AGE

HISTORICAL

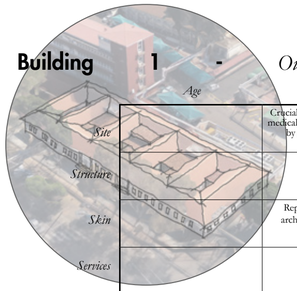
AESTHETIC

USE

CONFLICT

The architectural and urban changes seen on the site are extensive and for the most part insensitive to the existing heritage and architectural narrative. The original hospital buildings on the site date back to 1932 and contain elements of significant heritage value. The buildings chosen for re-use harbor less historical importance while containing high usage value, value which is highly beneficial and sustainable if used correctly. The site contains noticeable layers of development forming a rich palimpsest that results in a fine-grained spatial quality of combined architecture, industrial infrastructure, and leftover spaces. The approach to this layered site is one of tabula plena, that celebrates the existing and preserves the narrative of the site.

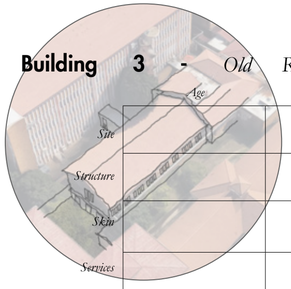
Building 1 - *Outpatients*



The outpatient building has been completely disconnected from the surrounding urban context when the street front was fenced off. The building entrance is now solely through neighbouring buildings as the original (racially segregated) entrances were bricked up. The valuable heritage elements are the facade paterns and orignal windows, facade details and courtyards. The courtyards were mostly roofed over.

Age	*Historical*	*Aesthetic*	*Use*	*Conflict*
Site	Crucial part of historically open medical campus. Was surrounded by pleasant public space	Greenery: the surviving trees create pleasant connections and spaces on the street facade	Critical location to connect the hospital to the streetscape	Current site conditions show conflict between public and organisation
Structure		Traditional masonry wall and timber roof construction. Thicker walls than normal	Structure is in tact	
Skin	Representation of Union architectural style with less embelishment	Details on facade: Plinth, pilasters, eave detailing	Building facade usable and adaptable	
Services				
Space Plan	Reflecting of the historical focus on the use of courtyards, hallways and formal entrances	Courtyards create focus sapces	Courtyard typology and linear plan layout carries potential for reuse	Original segragated entrances are bricked up but still decernable.
Stuff	Original furniture and windows present.	Unique built in furniture		

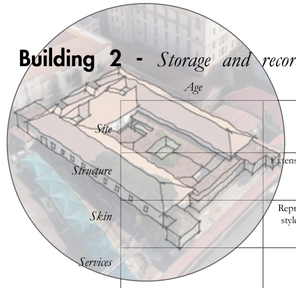
Building 3 - *Old Radiology / Empty*



While the old oncology building does not contain remrkable heritage elements, it is positioned in a unique setting on the site. It is located in a quiet corner of the site, surrounded by greenery (which is sparce elsewhere) and is connected to a sunken courtyard with a half-basement level. The floor level of the building is significantly higher than the natural ground level providing the opportunity for private spaces.

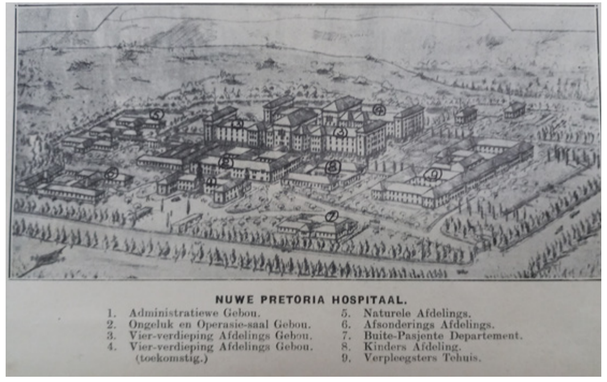
Age	*Historical*	*Aesthetic*	*Use*	*Conflict*
Site		Isolated site in the complex with trees and greenery	Isolated site condusive to private programmes. sunecken courtyard connected to building	
Structure			Masonry walls, timber truss roof and concrete floor slab useable. Semi basement useable	
Skin		Building facade references Ward building to the east. Materiality reflect Pretoria vernacular architecture	building facade can be adapted	
Services				
Space Plan			Central hallway typology can be used and adpted	
Stuff				

Building 2 - *Storage and records / Disused*



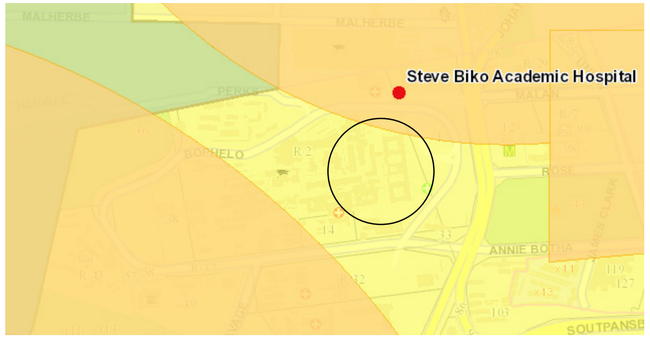
Building 2 currently serves as storage only and has no medical use. The facade rythm, original interior elements and the impressive interior verticality are valuable characteristics of the building. An original large courtyard has been filled in with structures which cuts off natural light and ventilation in parts of the building. The building sits atop a retaining wall which isolates it within the site.

Age	*Historical*	*Aesthetic*	*Use*	*Conflict*
Site		Building set on a retaining wall plinth	Site location is perfect for a primary maedical facility. Centrality and corner presence highlights the building	Spatial conflict created by retaining wall limiting access
Structure	Extensive changes were made to the building	Traditional masonry wall and timber roof construction. Thicker walls than normal	Structure is in tact	
Skin	Representative of the Union style. East facing patios are closed up	Details on facade: Plinth, pilasters, eave detailing	Skin intact and usable. Courtyard facades to be replaced	
Services				
Space Plan	U shaped courtyard was historically used for ventilation and natural light	Long and high hallways through out the building.	Courtyard design and room layouts reflec the historical focus on ventilation and natural light	
Stuff	Built in furniture ans original windows		Windows and furniture can be re-used	



PROJECT INFORMANTS: URBAN FRAMEWORK

The large-scale urban response and framework is driven by the Tshwane MSDF of 2021 which indicates that the precinct and surrounding areas are marked for high-density development as well as mixed-use scenarios centered on the precinct as a “Special Activity Area” and node of importance. The existing activity spine and public transport routes of Steve Biko Road is also dedicated to further densification and development which will connect the currently isolated precinct with the rest of the city. Various urban theoretical frameworks are implemented by the project to form the urban framework. Henri Levebvre’s concepts of the right to the city are implemented to create public spaces that are equally accessible by the public while facilitating healthcare and education and emphasizing public activities. Agency in the public space is elevated through the inclusion of public facing and engaging programs in the public realm and landscape. Public facilities are guided by the principles of new urbanism that focus on human centered public spaces, walkable neighborhoods and public interaction.



MSDF Density

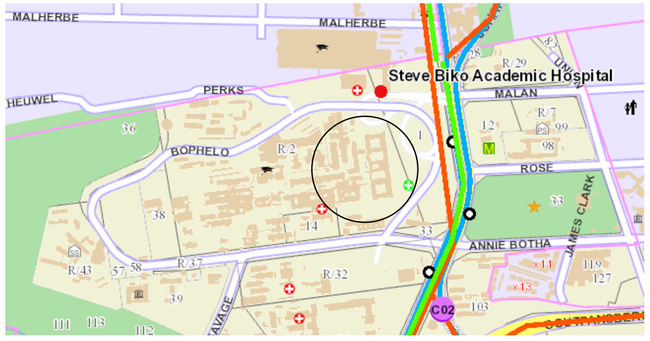
Density

High Density

High Density

Suburban Density

Suburban Density



Activity Street - Existing

Activity Street - Existing

Activity Street - Proposed

Activity Street - Proposed

Highway - Existing

Highway - Existing

Highway - Proposed

Highway - Proposed

Mobility Road - Existing

Mobility Road - Existing

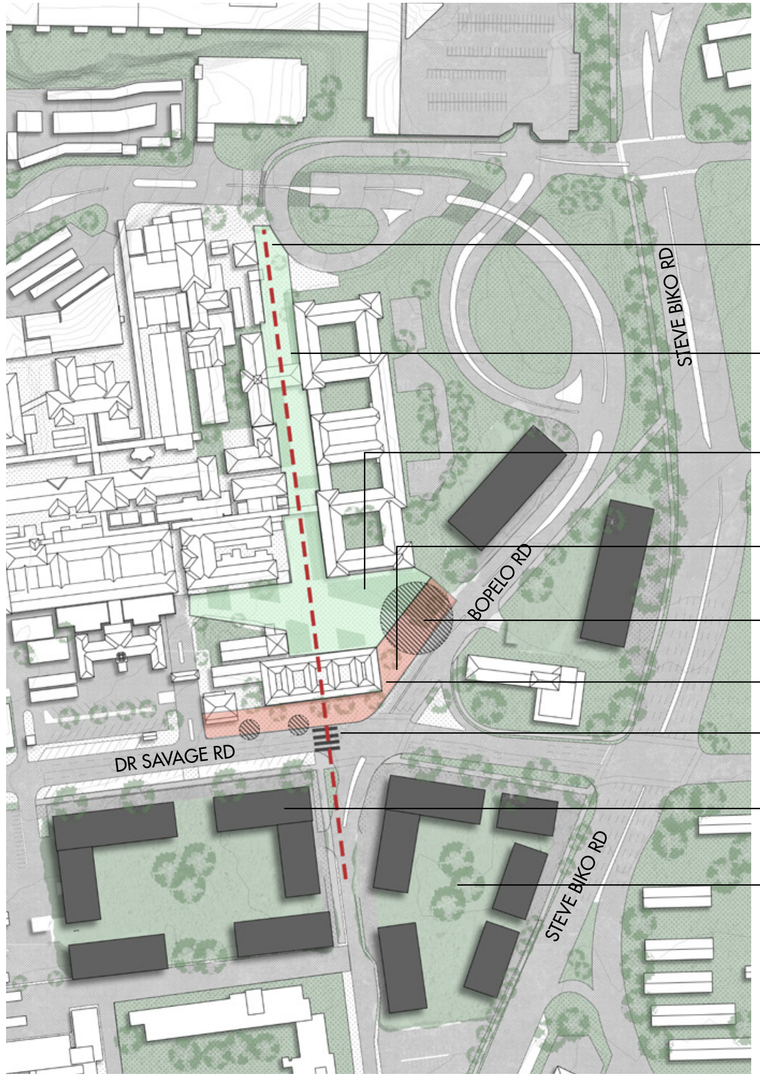
Mobility Road - Proposed

Mobility Road - Proposed

Mobility Spine - Existing

Mobility Spine - Existing

The existing development plans for the precinct allows for the implementation of high densiy mixed use programs which will result in resilient urban development. The important transportation routes close to the site connects the precint to the city via public transport.



Pedestrian axis through the site connecting the medical campus with the academic hospital

Pedestrian public space between the hospital buildings

Green spaces replace pavement and parking spaces

Removal of fences to open the public plaza

Transportation node to ease patient acccess to the hospital

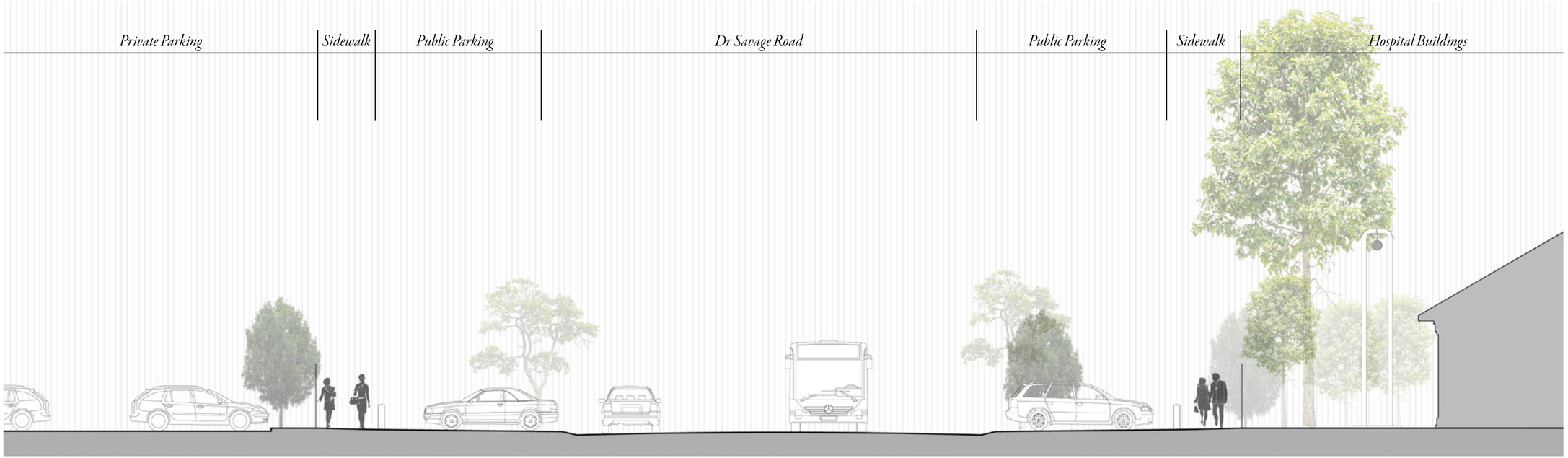
Street facing public space intergrating the buildings with pedestrian activity and routes

Improved pedestrian infrastructure

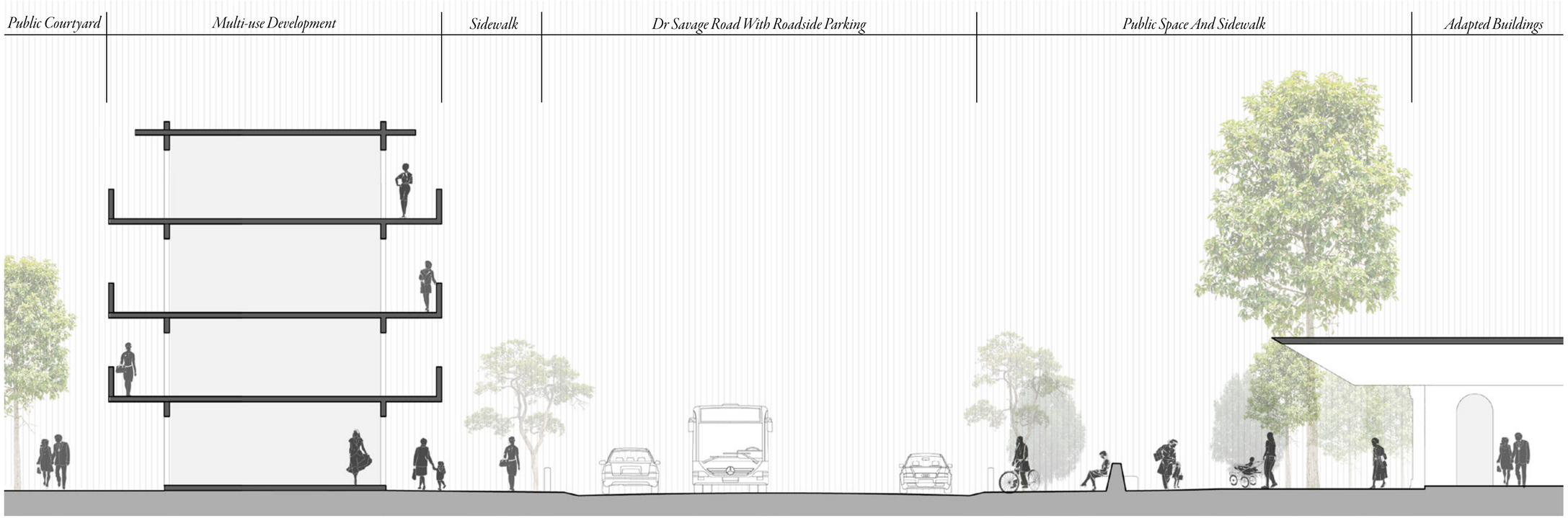
New mixed use developments (small retail and residential) in the place of underutilised parking spaces

Removal of the antiquated boiler room

Urban changes proposal



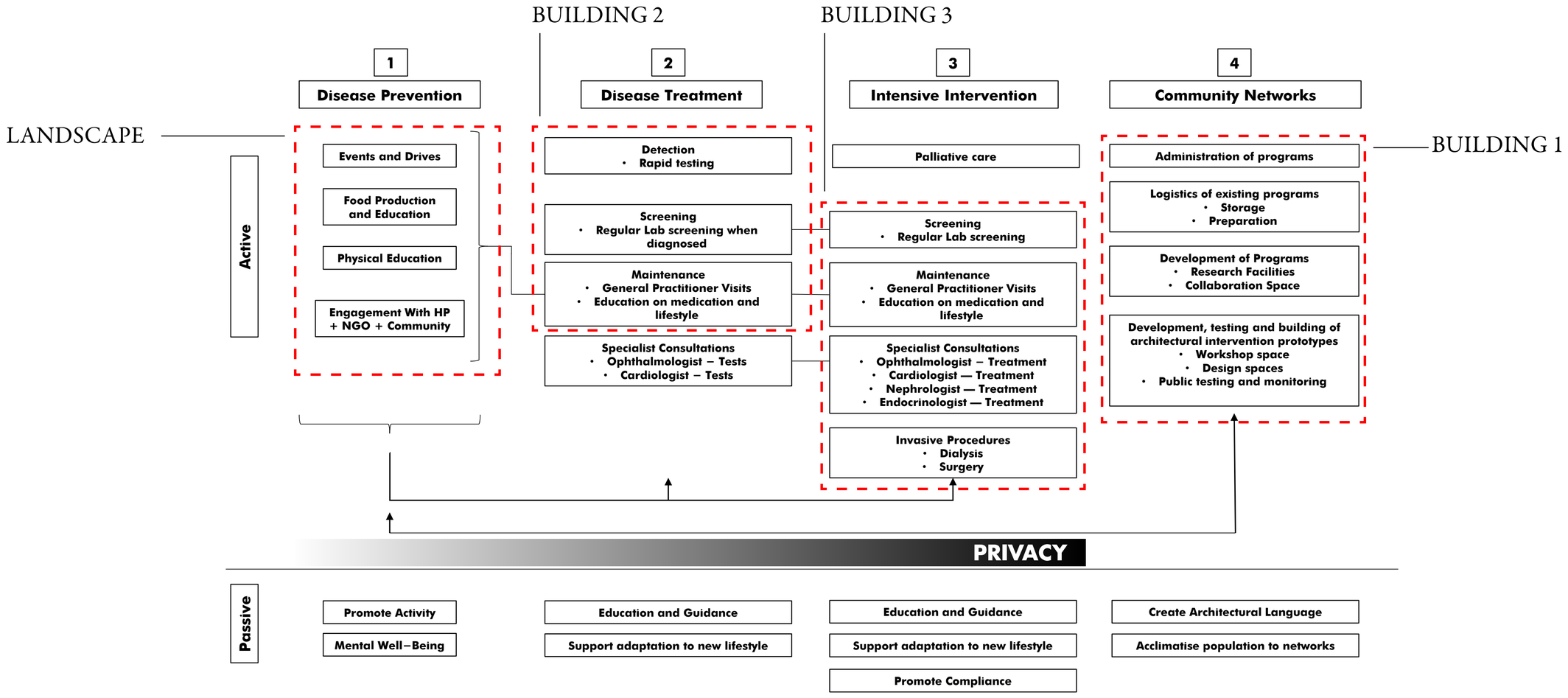
Existing Street Section A-A



Proposed Street Section A-A

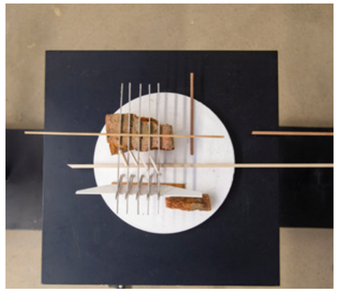
PROJECT INFORMANTS: PROGRAMME

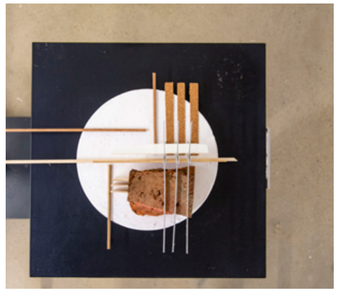
The project programs form an integrated system of public education, medical services, and architectural research and development. The first layer consists of active and passive public interactions that achieve public education concerning healthy lifestyles, diabetes prevention and diabetes treatment. The second layer consists of three tiers of medical intervention, primary – secondary- and Intensive medical care. The final layer that is interwoven between the first two consists of Architectural research and prototyping. This prototyping system allows architectural interventions to be designed and tested within different spatial conditions before it is implemented throughout the city in support of existing facilities and programs.



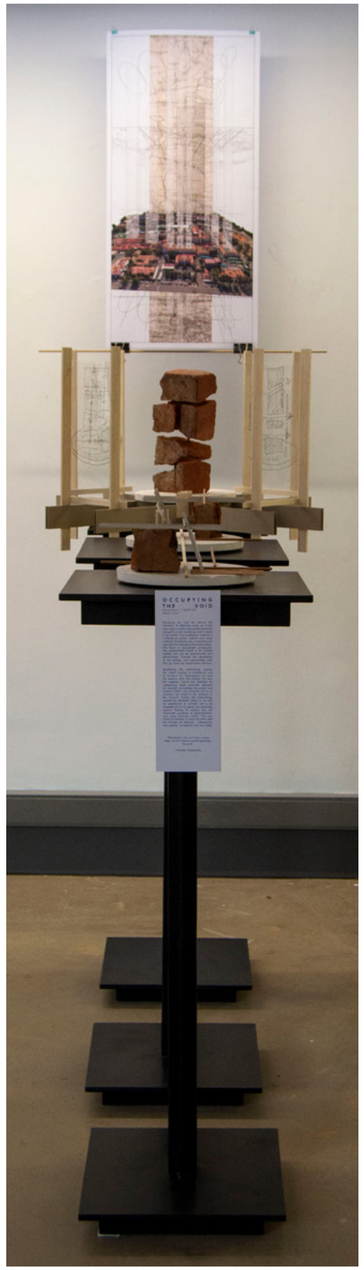
DESIGN ITERATION: PROVOCATION

The initial design investigation explored the concepts of utilizing interstitial spaces and abandoned materials to create new experiences, forms, and realities. The mediums utilized are separated into three categories that explore various forms of deconstruction and arrangement to create new meaning and understanding. Existing elements are clearly defined and deconstructed to form new assemblies. These assemblies serve different functions by creating differing viewpoints to examine the reconstruction of the existing.





The effect of this investigation on the project was substantial in guiding the direction investigated. The concepts of adaptive reuse, material reassembly and the use of leftover or interstitial spaces forms some of the core themes of the project. The realization of the effect of spatial reassembly and the importance of recognizable symbology in the changed context provides the foundation of the project's approach to the reconfiguration of existing spaces. The investigation revealed the importance of material and textural languages concerning existing fabric and the sensitive nature thereof in the users taxonomy of changes and changed contexts. The provocation guided the project to the field of adaptive reuse within a historically sensitive context.

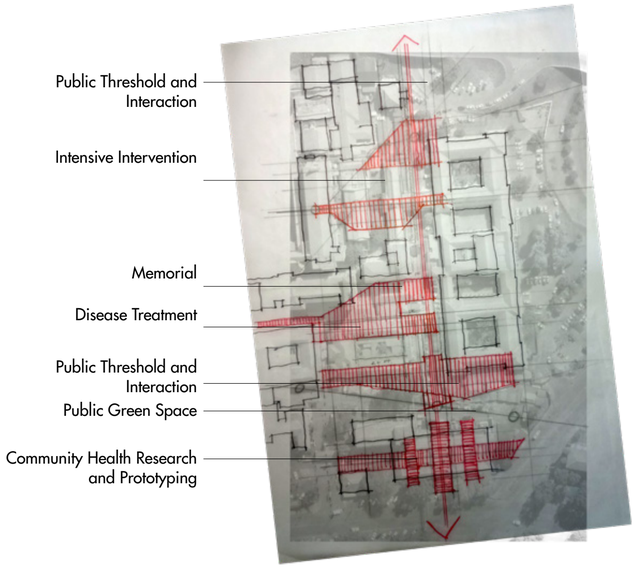


DESIGN ITERATION: FIRST

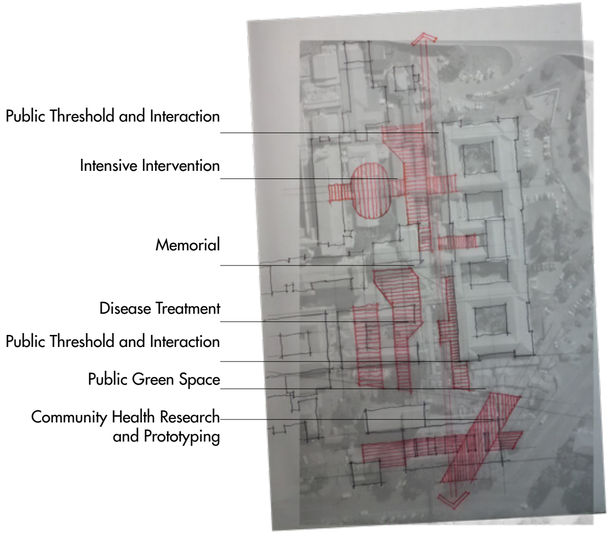
The first design iteration focused on the larger-scale usage of the site. The complex program involving various medical intervention levels and prototype research and manufacturing facilities was organized on the site and integrated with public space.

The public spaces were zoned to create boulevards and plazas between the hospital buildings. The function of these was to improve urban space articulation and provide flexible spaces where public activities could take place to improve public health education. An axis through the site was defined to connect other programs within the precinct and to improve urban circulation.

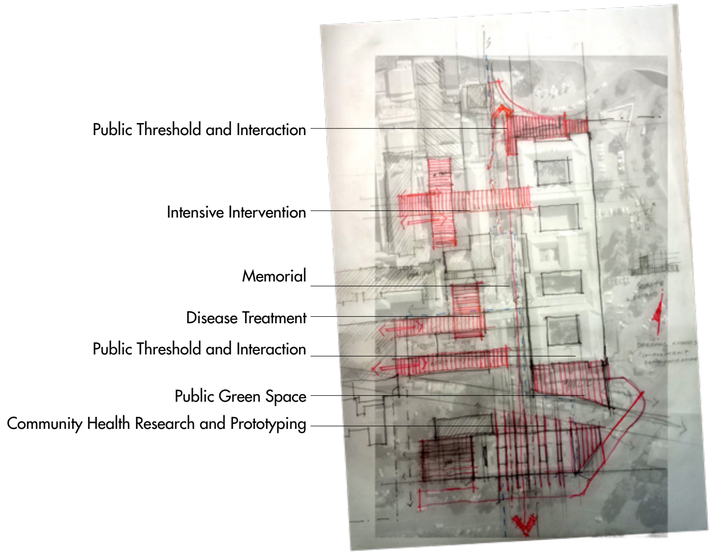
The programs were organized on the site by the hierarchy of medical intervention intensity along the internal boulevard that spans the North–South axis. This allows for varying levels of privacy for the buildings. The buildings that were to be used as re-used structures were identified and the conceptual response to the existing fabric was investigated.



Version 1

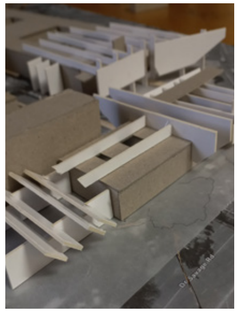


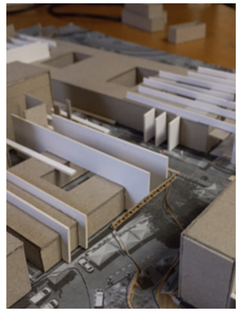
Version 2

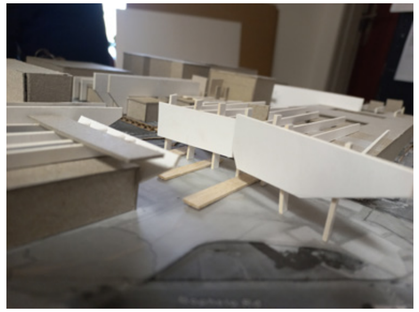


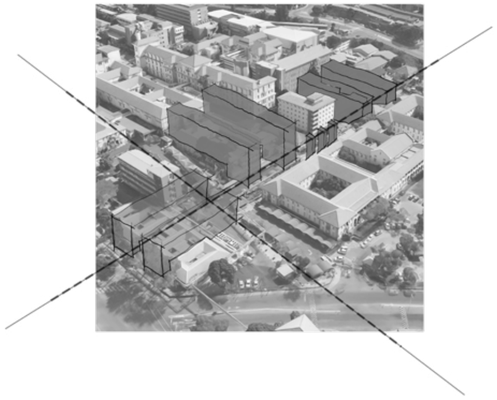
Version 3

Version 1







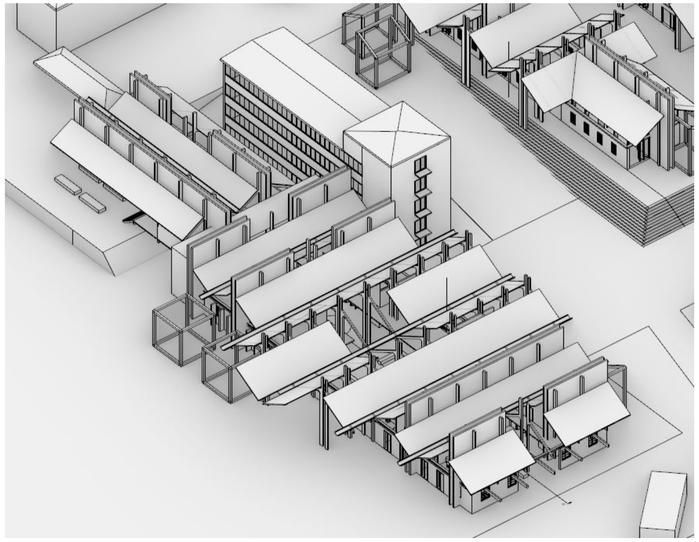


Concept image

Reflection: The zoning allocated for the programs was too large for the intended use. The construction technology that will be used needs to integrate with the existing building fabric as opposed to contrasting.

DESIGN ITERATION: SECOND

The second design iteration reduced the scope of the project and focused on the reuse of structures and materials and the construction system to be used. The concept developed focused on the insertion of spaces into the existing buildings by hollowing out the structures and reusing the internal materials and roof materials to compile a new structural system. This system is centred around cavity walls that serve as spatial and service anchors that cut through the existing buildings. The roof and first floor structure consist of mass timber frames and slabs fixed to the core walls. The buildings were programmed to have open and accessible ground floors with private functions on the first floor which was a new addition. The ground floor external walls of the existing buildings were to be kept as heritage elements of importance. The form exploration focused on the existing façade patterns and rhythm and the new roofs followed the existing roof angles. The programs were detailed for each building and the result was a clear definition and hierarchy in privacy and intimacy of the programs throughout the buildings. The Southern building housed the prototyping research offices, community meeting spaces, relocated shops and workshops. The central building on the site housed doctor's consultation rooms, rapid testing facilities, physio rooms and a laboratory. The final Northern building housed physio rooms, specialist consultation rooms and a dialysis clinic. The prototype manufacturing facility was placed on the main street façade to enable public interaction and recognition and to highlight its importance.



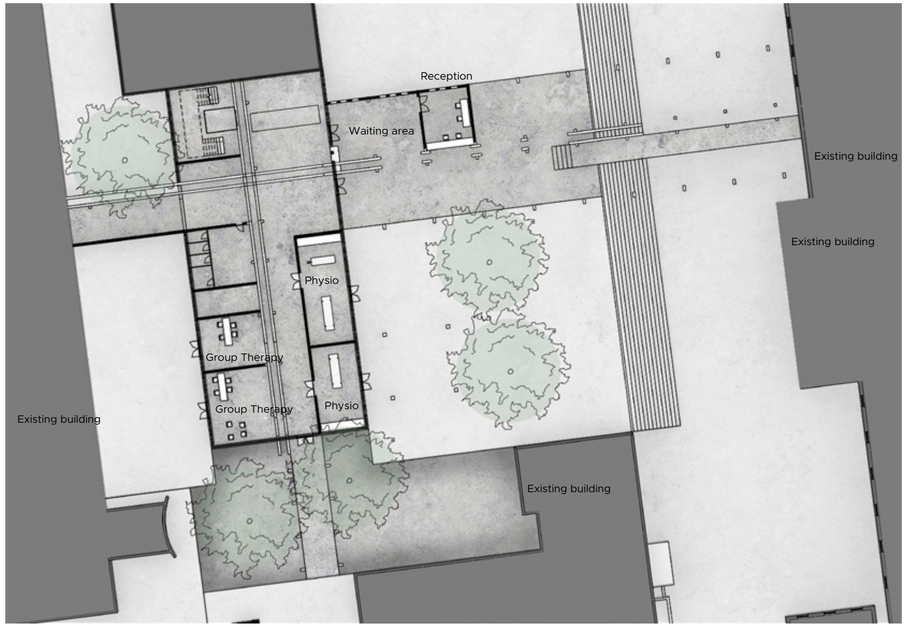
1 Building 1 houses The community healthcare and intervention program offices and workspaces.

Building 1 ground floor

Building 1 first floor

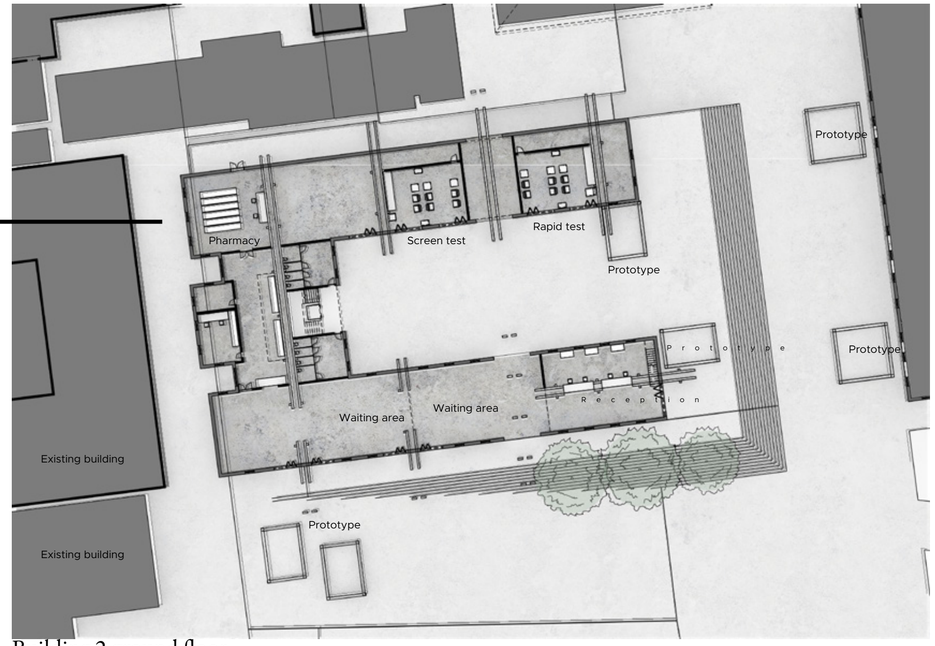
site plan indicating buildings adapted and prototype testing stations

DESIGN ITERATION: SECOND



Building 3 ground floor

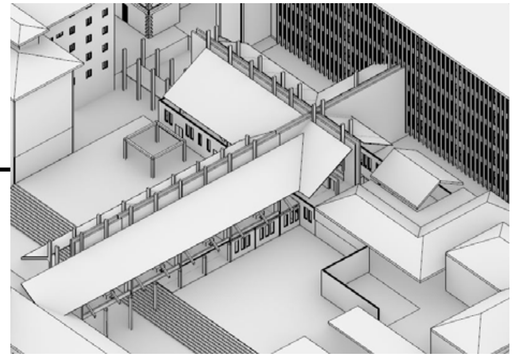
2 Building 2 provides the first line of medical services. Basic testing and general consultations are provided

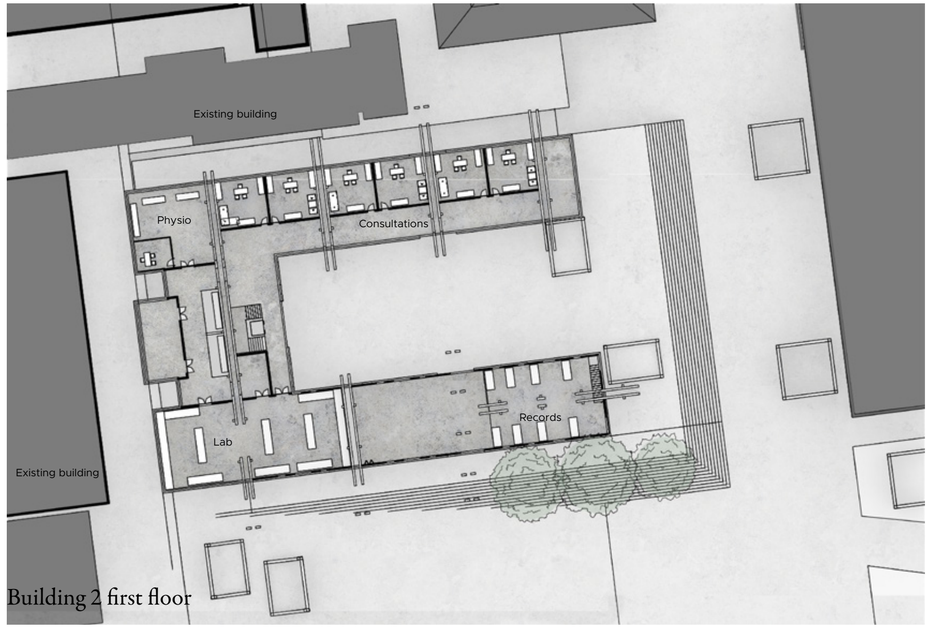


Building 2 ground floor

Building 3 first floor

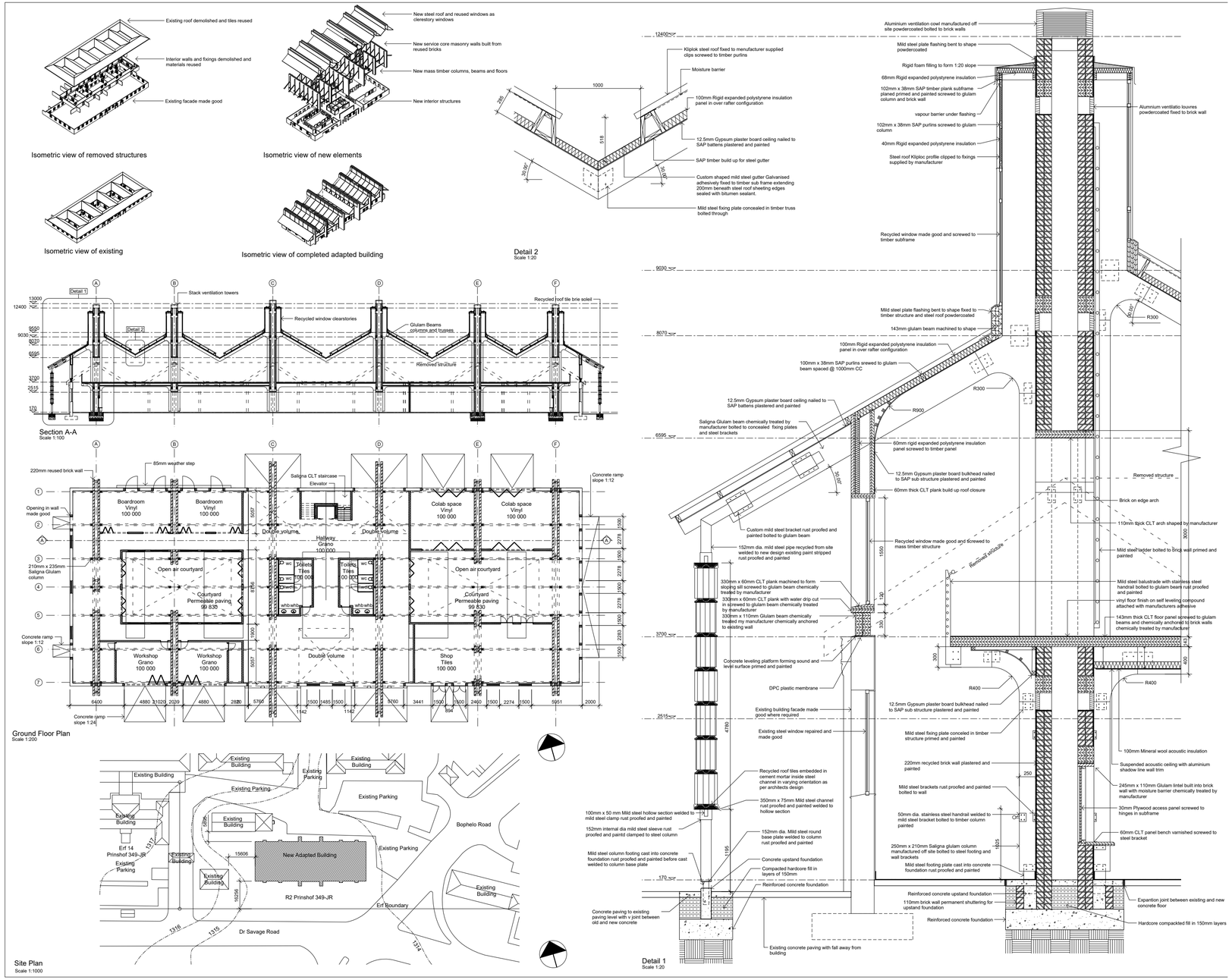
3 Building 3 provides more intensive medical services. Specialist consultation, therapy and dialysis are programmed for the space.





Building 2 first floor

DESIGN ITERATION: SECOND



The construction system relies on the reuse of most of the original buildings. By hollowing out and reusing the material the building can take a new form and function. Fucos was placed on natural ventilation through solar chimneys which formed the structural backbone of the design.

Reflection: The scale of the architectural interventions was still too large with unnecessary open space within the buildings and too much built space for the required programs. The buildings were experienced as isolated features on the site with no interconnected spaces or threads connecting the programs. The heritage response to the building was destructive and insensitive, while the reuse of materials seemed sustainable, much of the existing buildings were not required to be demolished and could be used as -is with slight changes thus avoiding superficial sustainability through structural reuse.

DESIGN RESOLUTION

Responding to the reflections of the previous design iterations, significant changes were made to the project design resolution. Changed and added informants include: the urban design resolution on a finer scale, project environmental impact through building mass and material use, building performance (natural -ventilation and -daylight), integration of existing services and the focus on human-centred design within the buildings and the landscape to achieve a healthy and healing environment.

Reflecting the depth and complexity of the site, the project concept pivoted towards a layered approach. The existing buildings form anchor points within the site which contain the interventions and medical programs. These are augmented and extended with a combination of adaptive reuse strategies. The connecting landscape connects these nodes together while functioning as a public gathering space and the host to prototype testing stations. The existing services (steam and electricity) threading through the site are re-routed through new structures to become integrated with the design and layered system. The services framework provides the opportunity to house semi-public- and rest- spaces and to improve the prototype testing stations.

the architectural approach focuses on the existing material and qualities on the site and of the existing buildings and intervenes in an additive system to increase available space and reconfigure the existing programmes. The additions borrows form ques and spatial qualities from the existing architecture while contrasting the materiality to enforce a distinction between the old and new. The architecture remains focused on the human scale and the personal interaction and experience of the user.

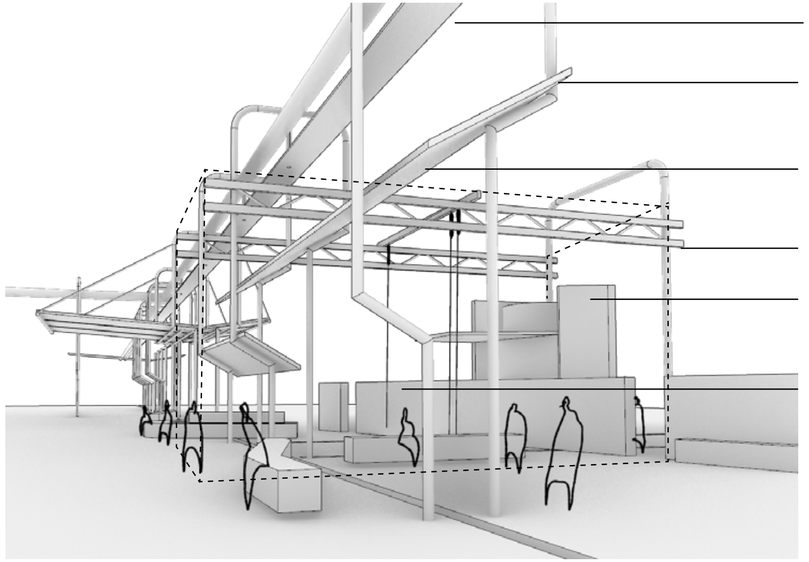
The structural system is a combination of advanced mass timber technologies with traditional masonry methods. This combination allows for rapid construction on a site where construction will be time sensitive. The material choice reflects the focus on creating healing and healthy spaces where the human scale modularity of bricks and the natural quality of timber creates a palette that psychologically improves spatial experience.

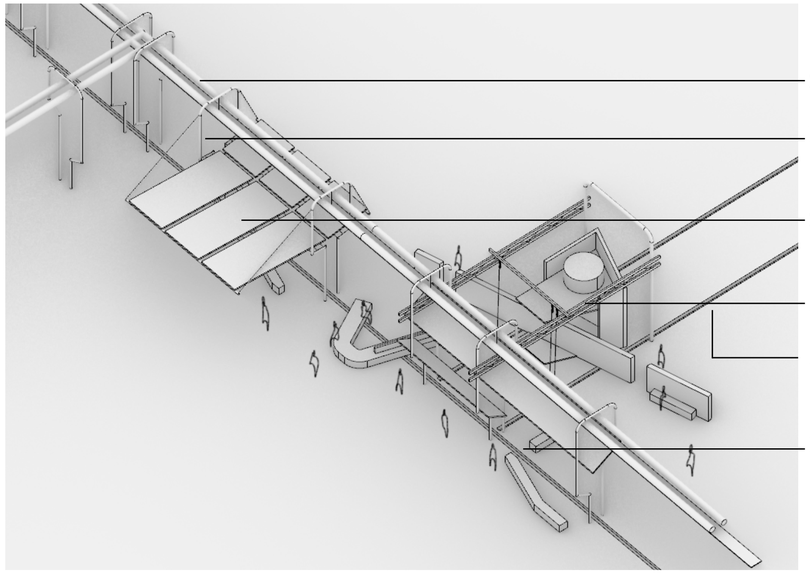
The layer of landscaping weaving through the site consists of a combination of planting areas, public meeting areas and resting areas. This essential component drives the urban integration of the site with its context while providing quality spaces for the public and users. The exterior spaces take on similar importance to the structures by providing areas for community education, interaction and exchange, and active spaces for external programmes. The landscape thus forms the backbone of the the disease prevention layer by promoting healthy lifestyles and community interaction and education.

The final interconnected layer consists of the overhead services and the intergrated prototyping stations. The existing services are re-routed into linear structures that span the site and continue beyond. These structures are multifunctional and provides spatial opportunities such as overhead covering, public seating and user wayfinding. The construction of these elements reflects the existing steel elements on the site and reuses the material the old structures.

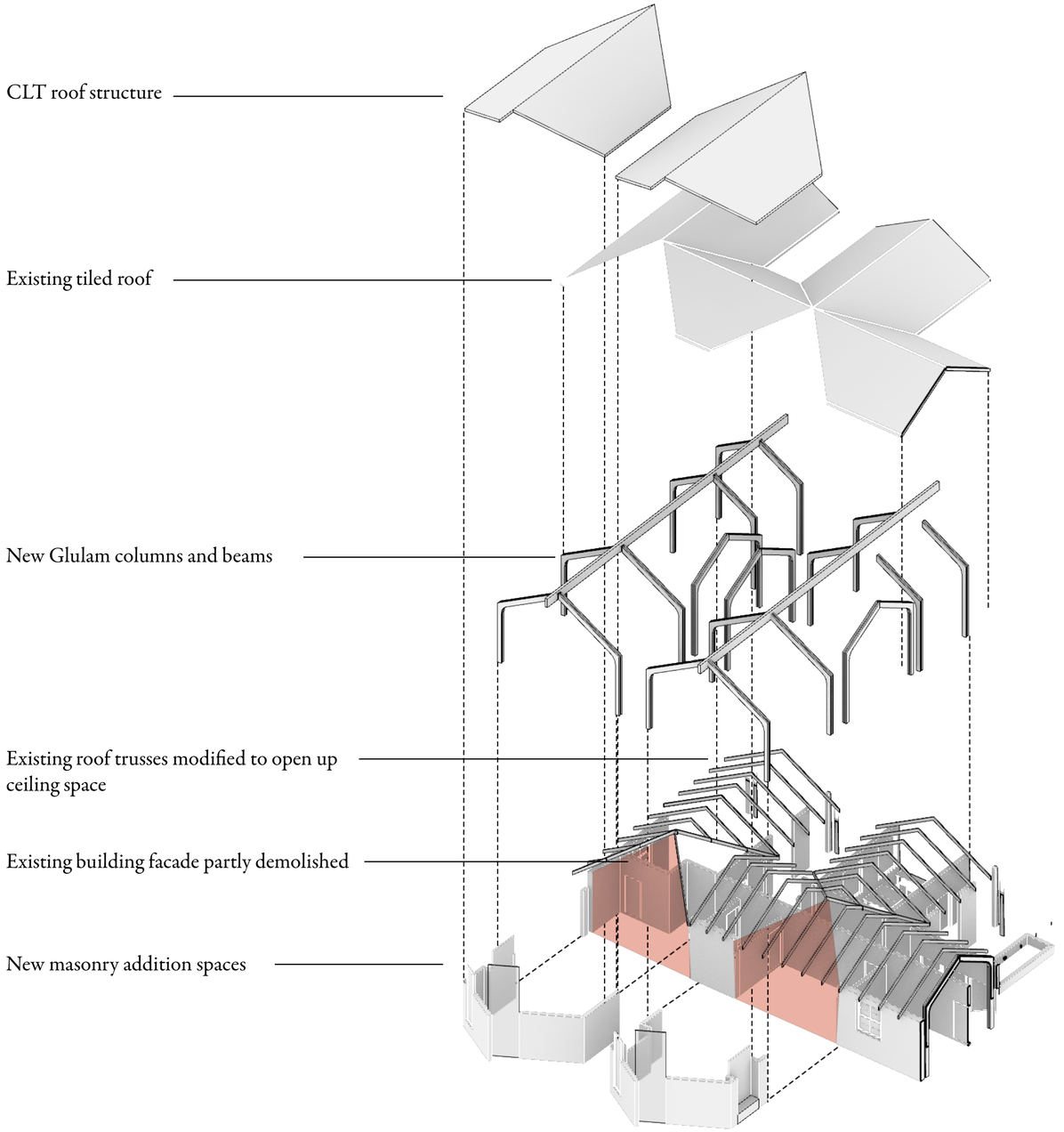
This final layer also contains the vitally important prototyping testing infrastructure that is positioned throughout the site. The locations are determined by the selection of spatial context needed for the testing eg. High traffic pedestrian spaces, adjacent to green spaces, proximity to certain medical programmes etc. These basic structures provide various functions to the testing procedures such as hoisting support for construction, flexible services, spatial demarcation and information gathering.

DESIGN RESOLUTION

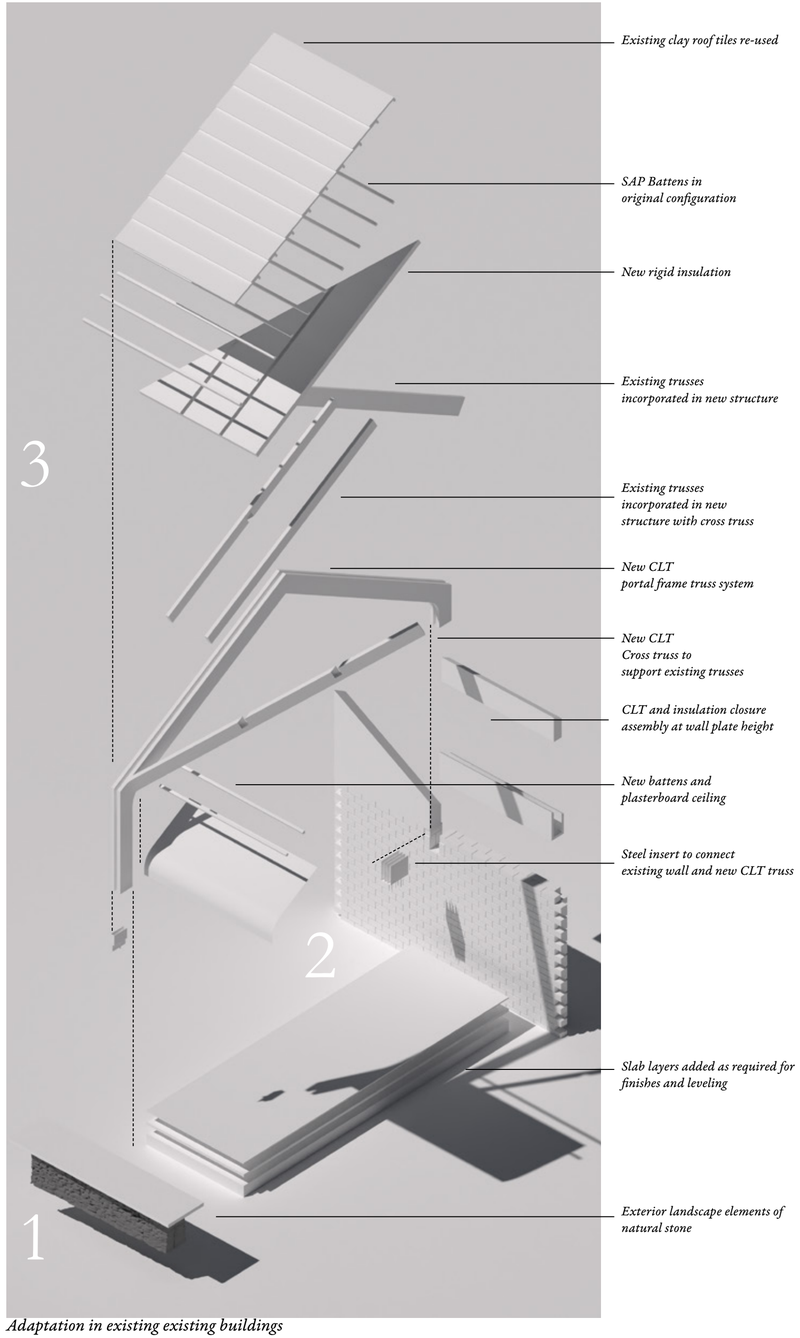




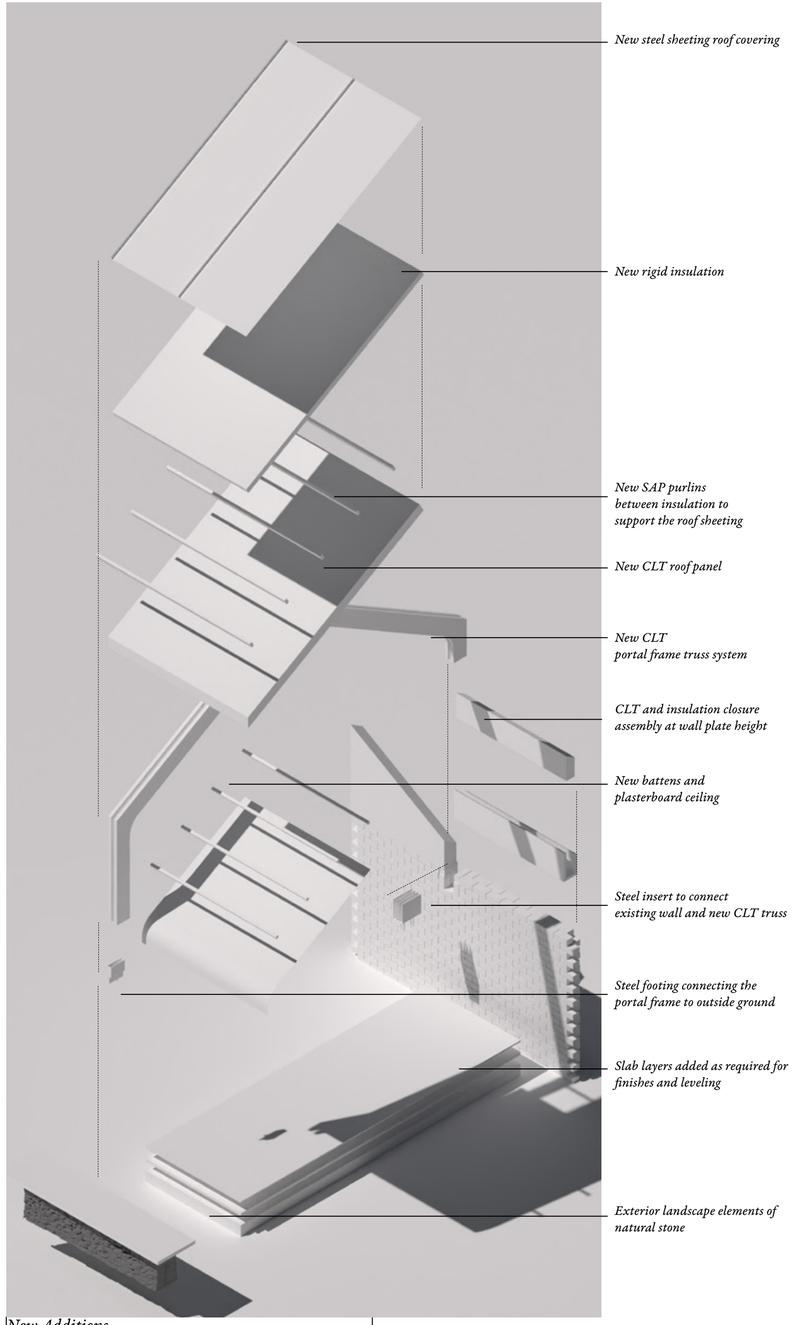
Services intergration with prototype testing



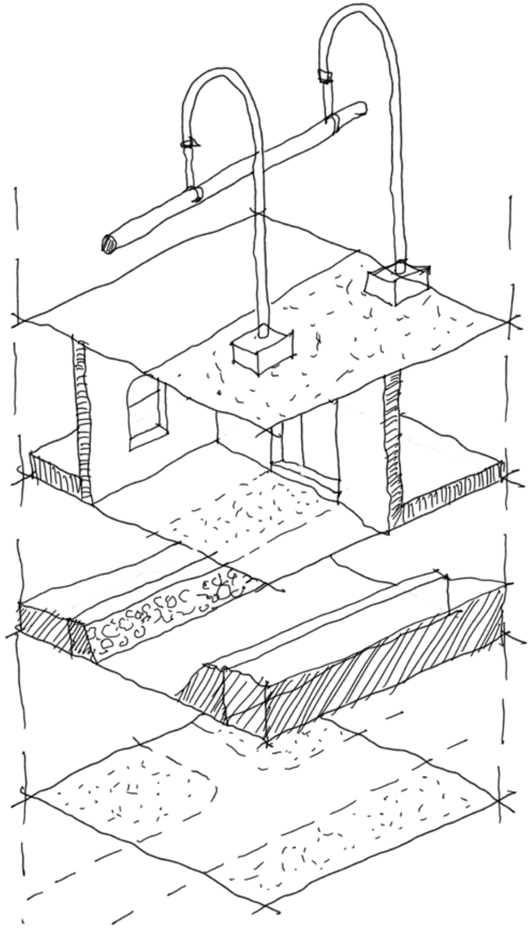
Addition construction system



Adaptation in existing existing buildings



New Additions



Existing buildings and site layers

BUILDING PERFORMANCE ANALYSIS
NATURAL VENTILATION IN MEDICAL FACILITIES

Introduction

Ventilation in healthcare buildings has changed over time due to the realisation of the patient benefits and the advancement of technology that improved air conditioning feasibility. Artificial ventilation enabled architects to design larger spaces that are interconnected which are seldom connected to the outside. This advancement led to the current medical facility prioritising artificial ventilation over natural ventilation with rooms supplied solely with fresh and temperature-treated air. This prioritisation of artificial ventilation led to problematic climatic conditions in many spaces in healthcare buildings. Circulation, gathering and consultation areas often do not have adequate ventilation as the energy expenditure focus of artificial ventilation is used for areas such as wards and surgeries.

Natural ventilation for healthcare buildings was prioritised in the design of 19th-century hospitals. It was noted that natural air circulation and natural light decreased patient healing time and increased well-being while reducing communicable disease infections. These observations are backed by contemporary science which also highlights various advantages of natural ventilation such as energy efficiency, comfort, odour control, functional resilience, emergency preparedness and sustainable principles.

This investigation attempts to integrate natural ventilation into new architectural additions at the Tshwane District Hospital thus replacing and avoiding artificial ventilation for the project.

Standards and Status-quo

The South African standards for building ventilation are dictated by the SANS 10400 part-O regulations. The regulations specify detailed requirements for healthcare buildings. The additions to the building can be classified as examination rooms which require 12 air changes per hour (SANS, 2011: 18). Other requirements can be obtained through literature, the comfortable air velocity should be between 1 – 2m/s (Roghanchi, Kocsis & Sunkpal, 2016). The standards of air changes per hour do however not paint the complete picture of airflow through a room. Other methods such as "local mean age of air" (LMA) (indicating the time air remains in position) and "local air change effectiveness" (indicating how well the air is flowing through the space) (ACE) provide much more detailed images of the movement of air through a room.

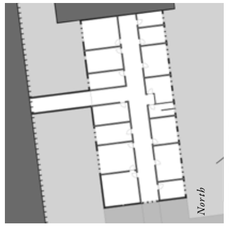
Combining these metrics provides us with the requirements of: (12 air changes)/(60 minutes) =1 air change every 5 minutes (LMA)

Context and existing building fabric

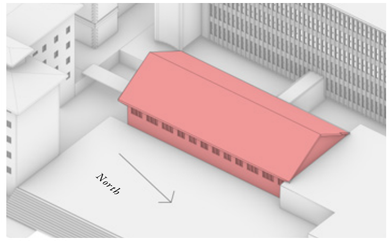
The existing radiology building is located on the Northern end of the Tshwane district hospital site. The building is oriented from North to South with longer facades facing East and West. The existing floor plan is divided with a central hallway with the only natural light being on the end of the hallway. The room windows are located on one side of all rooms limiting cross ventilation. No mechanical ventilation is present.

Site photos from East

Site photos from East



Existing Plan



Existing Building

Testing Methodology

The methodology followed during the investigation focused on the schematic representation of the existing and new spaces within simulation software to determine the following metrics where possible:

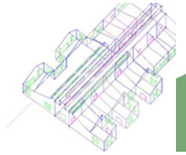
- *Air velocity (between 1 and 2 M/s)*
- *LMA (higher is better)*
- *ACE (closest to 1 is better)*
- *Direction of air movement (from clean to dirty)*
- *Distribution of heat (away from usage spaces)*

The simulation software used is IES-VE with local weather files provided by IES.
The investigation steps were as follows:

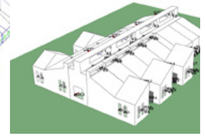
1. *Model the existing building and simulate to determine the existing state.*
2. *Model the first iteration of the additions and simulate to determine shortcomings.*
3. *Model the second iteration and simulate to confirm if the adjustments were sufficient and that the required ventilation levels were achieved.*

The questions guiding the assesment for the iterations were obtained from the World Health Organisation guide to natural ventilation (2009: 8):

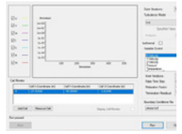
1. *Does the system provide sufficient ventilation rate as required?*
2. *Is the overall airflow direction in a building from clean to dirty zones (e.g. isolation rooms or areas of containment, such as a laboratory)?*



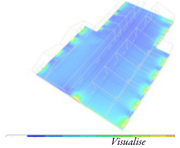
1. Model



2. Gather environmental information



3. Simulate

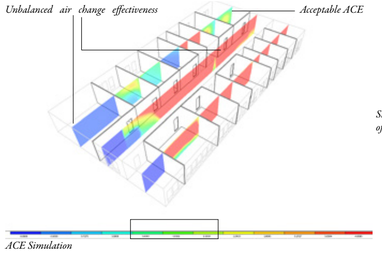


4. Visualise

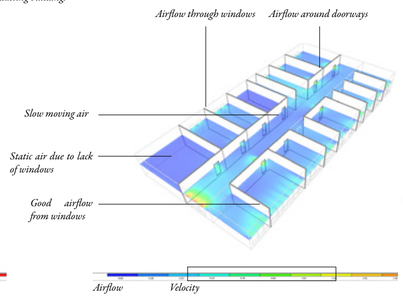
Existing Building

The simulation of the existing building shows a clear lack of ventilation, cross ventilation and air exchange. This is due to the positioning and size of the windows, the lack of cross ventilation fenestration and a hallway that cannot be naturally ventilated. The Eastern facade of the building ventilates remarkably better due to the prevailing winds on site from the East.

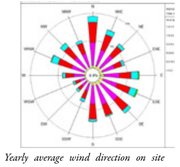
The results indicate that any intervention would need to address the lack of ventilation in the existing building.



ACE Simulation



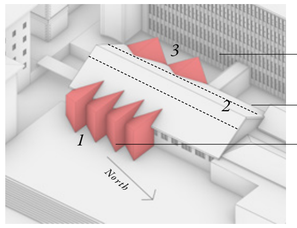
Airflow Velocity



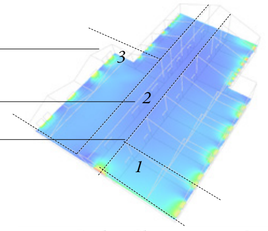
Yearly average wind direction on site

First Iteration

The first iteration removes the interior ceiling while adding consultation rooms on the Eastern facade and a dialysis clinic on the Western facade. Preliminary window and door openings are added to enable testing.

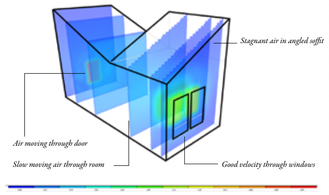


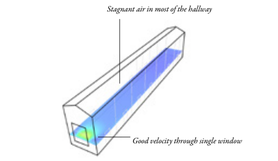
Dialysis Clinic
Hallway
Consultation Rooms

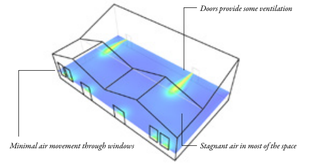


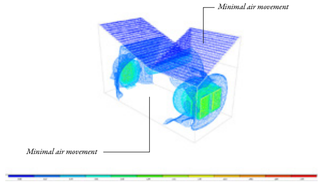
Consultation Rooms 1	Hallway 2	Dialysis Clinic 3

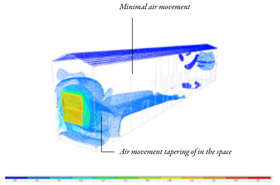
Air velocity simulation

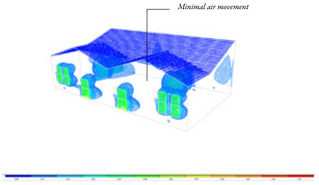




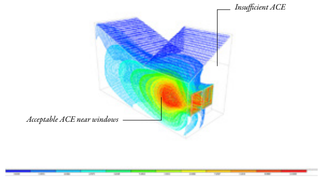


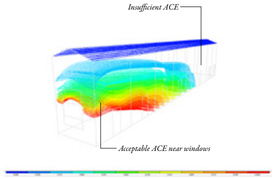


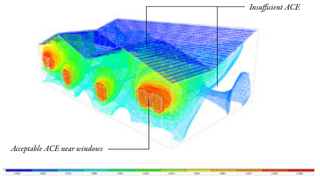




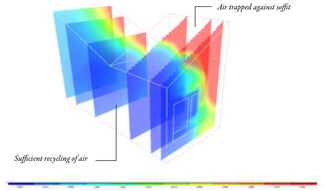
ACE simulation

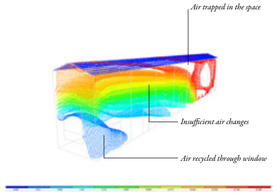


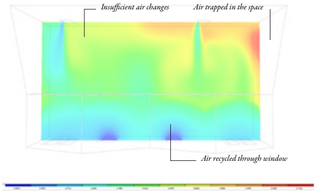


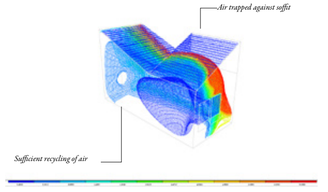


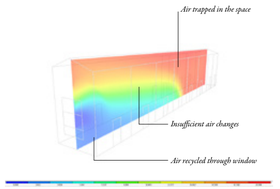
LMA simulation

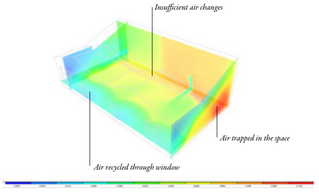






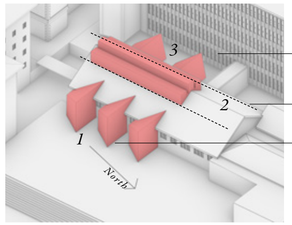






Second Iteration

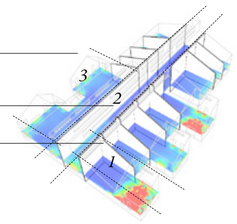
The second iteration focuses on refining and improving the schematic design of the three mentioned spaces through various strategies.



Dialysis Clinic

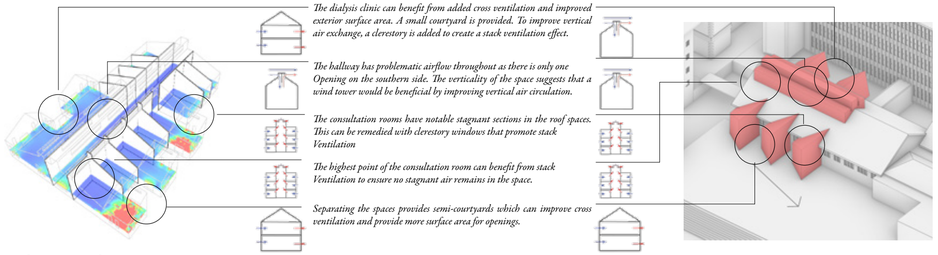
Hallway

Consultation Rooms



Improvement Strategies

The three investigated spaces fall short of the required ventilation performance of medical facilities. The improvement of these spaces were done in accordance with the recommended natural ventilation strategies proposed by the World Health Organisation. While the strategies include natural and hybrid systems, only natural ventilation systems were employed in the iteration namely: Cross ventilation, wind towers and stack ventilation.



The dialysis clinic can benefit from added cross ventilation and improved exterior surface area. A small courtyard is provided. To improve vertical air exchange, a clerestory is added to create a stack ventilation effect.

The hallway has problematic airflow throughout as there is only one Opening on the southern side. The verticality of the space suggests that a wind tower would be beneficial by improving vertical air circulation.

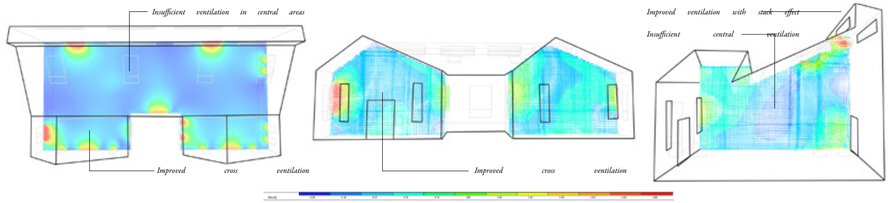
The consultation rooms have notable stagnant sections in the roof spaces. This can be remedied with clerestory windows that promote stack Ventilation

The highest point of the consultation room can benefit from stack Ventilation to ensure no stagnant air remains in the space.

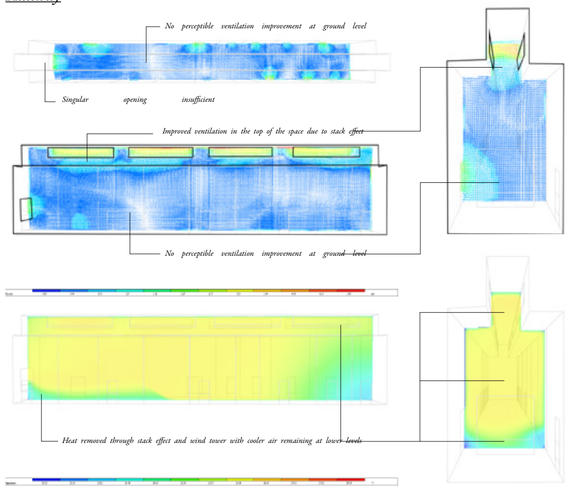
Separating the spaces provides semi-courtyards which can improve cross ventilation and provide more surface area for openings.

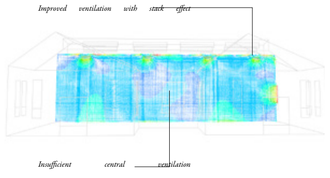
Simulation Results

Dialysis Clinic



Hallway

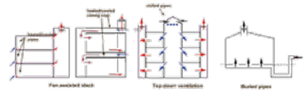




O b s e r v a t i o n s

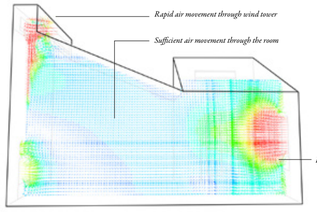
Initial observations of the two spaces tested indicates that the implementation of natural ventilation strategies performed less than ideal. The dialysis clinic remains under ventilated due to the position of the facade openings. Due to the prevailing wind direction, minimal input and thus through flow of air is seen. The depth and size of the space are also potential draw backs.

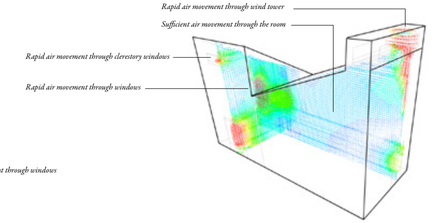
The hallway similarly experiences insufficient airflow with the wind tower addition. It can be speculated that the ground level air input is not enough to create sufficient cross ventilation and vertical air movement. Due to the position of these spaces, hybrid solution will have to be investigated to achieve the desired ventilation metrics. Buried air supply pipes and fan assisted stack ventilation are possible solutions.

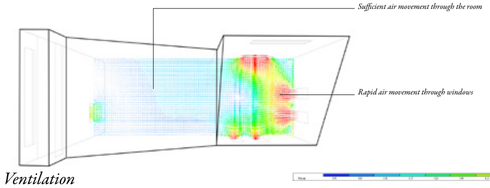


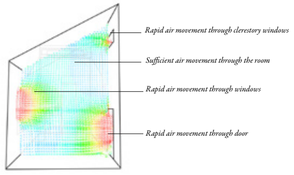
WHO recommended hybrid systems

Consultation Rooms



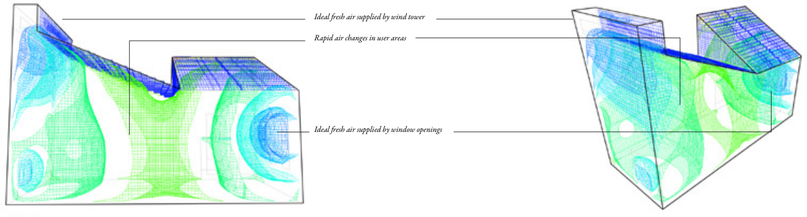




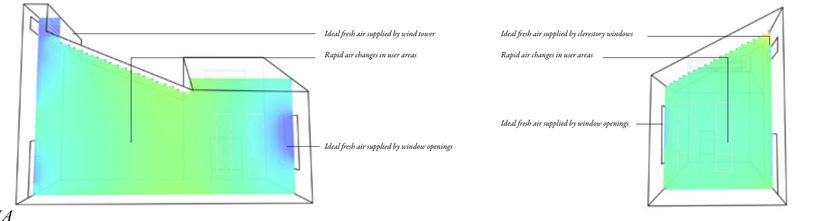


Ventilation

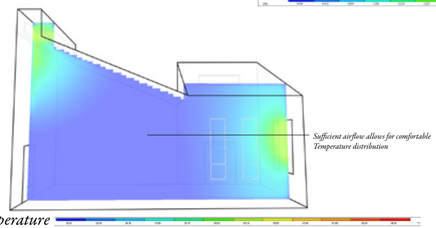
ACE



LMA



Temperature



Observations and Conclusion

The iterations to the consultation rooms were remarkably more successful than the other rooms. Improved cross ventilation and stack effect due to the courtyards, clerestory windows and wind towers ensures that the air changes in the space is well within the desired range.

The improvement of natural ventilation of a building is a complex undertaking that requires an in depth approach. The realisation that ventilation consists of more that "air changes per hour" results in complex solutions that combines strategies according to the individual room requirements and spatial context. Further investigation into natural ventilation solutions are required for context with less than ideal conditions such as rooms that are not within the wind path or do not have exterior facing boundaries.

Hobday, R. A. & Dancer, S.J. 2013. Roles of sunlight and natural ventilation for controlling infection: historical and current perspectives. Journal of Hospital Infection. 84(4):271–282. DOI: 10.1016/j.jhin.2013.04.011.

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SANS. 2011. The application of the national building regulations. Part O, Lighting and ventilation. Pretoria: SABS Standards Division.

World Health Organization. 2009. Natural ventilation for infection control in health-care settings. Available: https://iris.who.int/handle/10665/44167 [2023, October 19].

Building 1: Research and development.
Floor Plan

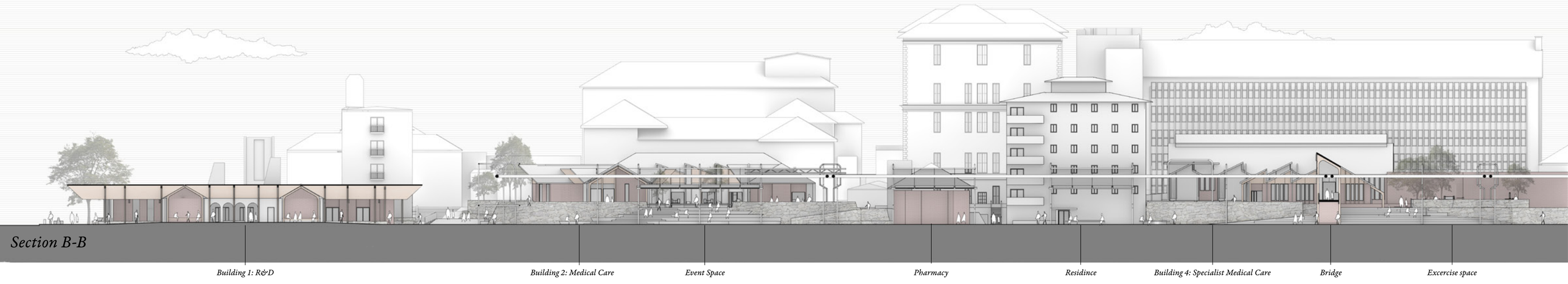
Building 2: Reception & Services

Building 3: Primary and Secondary Medical Care

Building 4: Specialist Treatment Ground Floor Plan

Building 4: Lower Ground Floor Physio and Psycological care


Section A-A
Workshop
Pause area
Office
Courtyard with wind tower
Open Circulation
Public canteen
Shop


Section B-B
Building 1: R&D
Building 2: Medical Care
Event Space
Pharmacy
Residince
Building 4: Specialist Medical Care
Bridge
Excercise space

Positive and negative pressure zones increases passive ventilation through louvres

143 mm thick CLT structural aassembly bolted to walls and floor with steel brackets. Assembled with hidden connection plates.

100mm Thick CLT balustrade and handrail installed in sections bolted to steel brackets chemically anchored to existing structure.

CLT assembly roof with translucent sheeting sylights. Sheeting overlaps sides and is waterproofed. Bent steel end flashing with waterproof membrane on both ends. Aluminium Louvressupported by Glulam beam. screwed to extention timber piece.

Existing roof tiles re-used on 38x70 SAP battens srecwed to 100 mm thick CLT roof panel with water proof membrane between elements with 80 mm expanded polistyrene insulation screwed to underside of CLT panel. Assembly

SAP sub structure to hold plaster board

SAP sub structure to hold plaster board

CLT timber filler piece

CLT composite Roof. 143mm Saligna CLT board screwed to walls with 80mm rigid expanded polystyrene insulation board with SAP battens screwed to CLT board to hold steel sheeting with water proofing membrane.

CLT composite wall. 143mm Saligna CLT board screwed to floor and roof with 80mm rigid expanded polystyrene insulation board with SAP battens screwed to CLT board to hold steel sheeting with water proofing membrane.

Metal composite end flashing with overlap top and bottom with angled drip on bottom. Waterproofing membrane to run from top to bottom and sealed at top.

Reinfirced concrete retaining wall with compacted soil backfill and permeable geopipe filtration. Wall water proofed on soil side with reinforced waterproofing membrane.

85mm Concrete pasing slab on compacted soil. Slope to run to grassed ares.

Natural stone wall embedded in mortal against reinforced concrete retianing wall with timber bench screwed to steel bracket embedded in stone wall with rond steel bars.

Galvanised steel services column cast into reinforced concrete.

Walkway

Specialist consultation room: Cardiologist

Psychologist

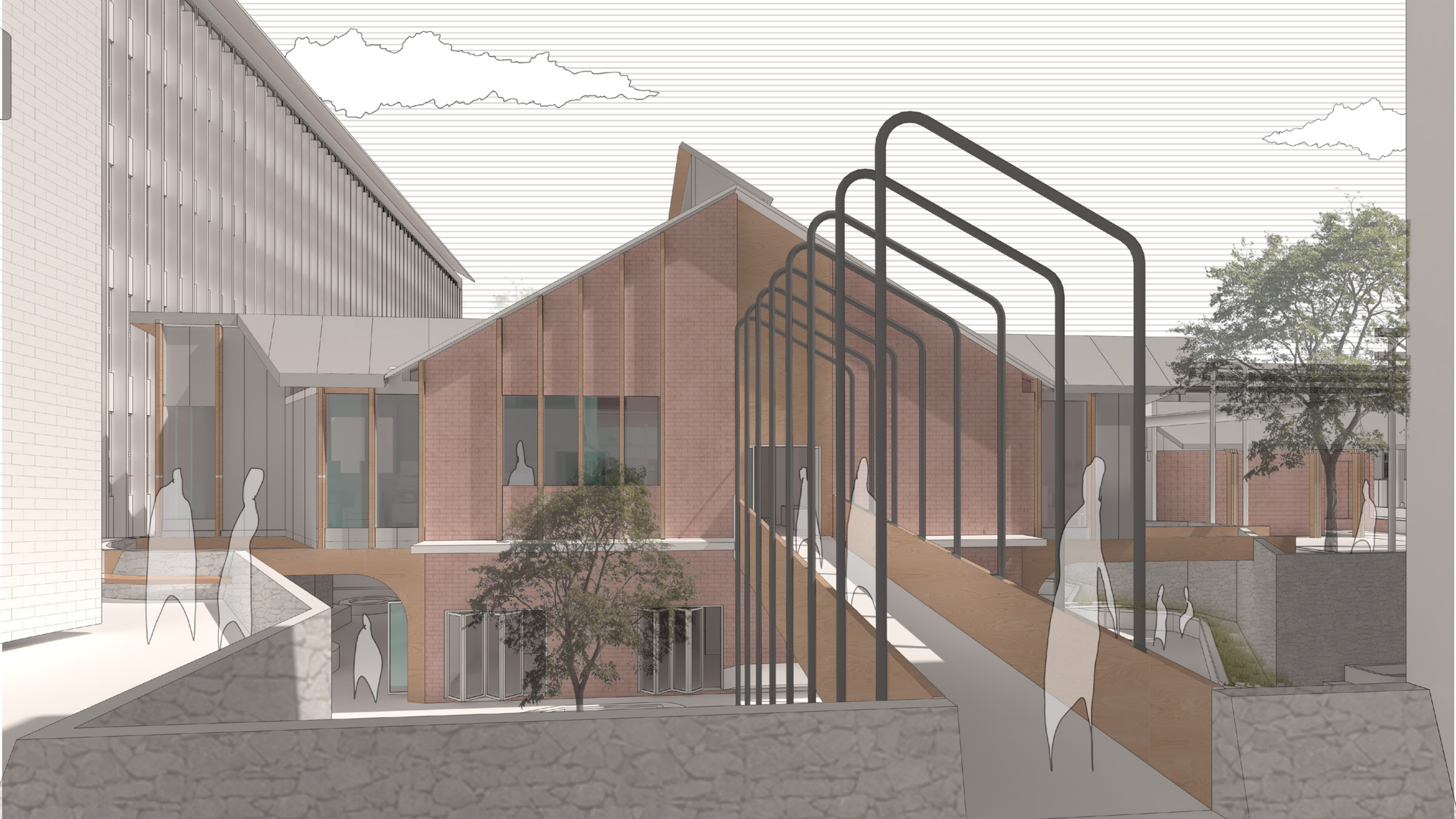
Hallway and Waiting area

Physio Therapy

Exterior Physio Space

Section C-C

Scale 1: 20



CONCLUSION AND REFLECTION

This project aimed to interrogate how architecture is conceived by suggesting alternate models of building and making spaces for very specific programmes. It simultaneously de centralizes its target while envisioning a core destination from where this change can be generated and sustained. A critical characteristic of the project is the focus on the importance of the existing. Existing architecture, networks, programmes and systems are pushed and pulled by new structures and additions to form stronger and more meaningful relationships that can perform better and provide improved healthcare services. Although the project vision remained mostly intact, the approaches and attempts at resolution varied drastically throughout the investigation. Various informants such as the architectural heritage of the site and building performance shifted the project in different directions and resulted in better solutions. The meaningful integration of urban principles revealed the great potential that South African hospitals have to act as public spaces. The benefits of this cannot be understated as the resulting normalization and public engagement with health consciousness have the potential to vastly improve the quality of life for all. The re-envisioning of public healthcare is an important topic in South Africa's current context. With the imbalance of healthcare access and quality for underprivileged people at an all-time high, the question needs to be asked how architecture can contribute to a solution. This project shows that such a solution will most likely come in an unrecognizable form.

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Piotie, P, Webb, E & Rheeder, P. 2021. Our research shows gaps in South Africa's diabetes management programme.

World Health Organization. 2016. Global report on diabetes. Geneva: World Health Organization. Available from: https://apps.who.int/iris/handle/10665/204871 [Accessed 11 April 2023]. World Health Organization. 2021.