

Figure 7.1 Early Technical Exploration Author 2015

VII

TECHNICAL DEVELOPMENT

7.1 INTRODUCTION: A Normative Position

“...an assemblage that is firmly attached to the ground and that provides total or nearly total shelter for machines, processing equipment, performance of human activities, storage of human possessions, or any combination of these.”

(Merritt and Ricketts, 2001:1.2)

“The method and processes involved in connecting the above-mentioned assemblage of materials and components to form a building is the domain of Building Construction.”

(Merritt and Ricketts, 2001:1.2).

According to Conway and Roenisch (2005), the subject of materials and construction concerns not only the wide range of materials used, but also their production and the nature of the building (Conway and Roenisch, 2005:110). One could thus divide the energy imbedded in construction into two spheres, one being natural embodied energy (the processes involved in its production) and subjective energy of how it responds to the user. This combined energy as a system designed to maintain equilibrium, will impact the influx context in which it is placed and will, in turn, absorb the counter-impact of its context.

This dissertation places emphasis on the urban user’s socio-economic condition forming an equally important - if not greater - part of this context. This places the subject of building construction to be viewed as a complex living entity and as part of a greater (urban) ecology. According to this view, the structural approach of building should reflect aspects of flexibility and resilience, as opposed to mono-functional and internalised prototypes.

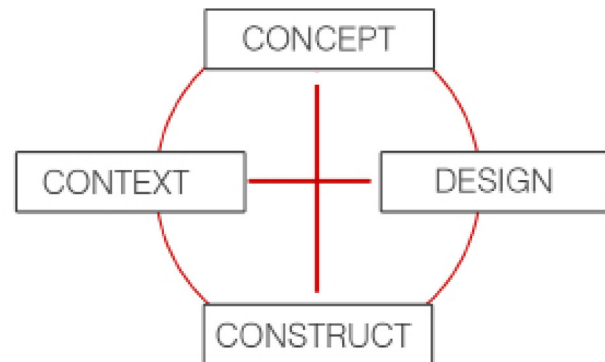
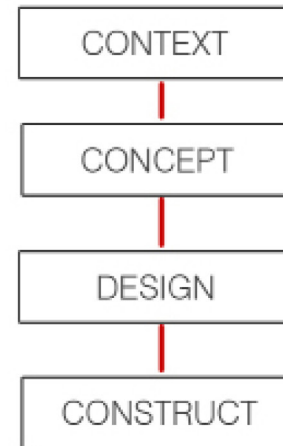


Figure 7.2 Normative position Author 2015

When construction fails to be mindful of this fluctuating (urban) environment, it may eventually become unresponsive towards its socio-economic context (Groak.1993:187), ultimately resulting in an unsustainable mechanism. A building could then eventually be perceived as alien to its context if the socio-economic atmosphere evolves beyond the building's ability to absorb such change. This possibility highlights the importance of resiliency and flexibility as a main concern to the technological intention of the scheme. If architectural construction involuntarily reflects how a building responds to its associated context(s), it implies that: "It's not if it speaks, but how and what it speaks." Therefore, not considering what and how the technological process communicates not only results in a waste of valuable resources and energy, but presents an opportunity where construction may be programmed or manipulated to serve a specific objective. Ideology imbedded in the built form and various typologies of Pretoria already declares such a strategy effective.

The structural approach of the dissertation then builds on this heritage of programmed architecture and explores the possibilities which may arise out of a partial reverse of "agenda-based architecture". The scheme therefore does not propose a total abstraction to Pretoria's modernist typologies, but rather explores the incision, extraction, processing and redistribution thereof, so as to generate a responsive archetype. Likewise, current and up-to-date technologies are not to be considered, due to the fact that they are made available, but should originate from an investigation of what the context and concept require and how to supplement these criteria in the most sustainable manner possible.

According to Berge (2000), a mechanism in traditional development theory, coined as phaedomorphosis, implies that development may take a step back to earlier and less specialised technologies in order to take a new line of development at a later stage. Therefore, progress does not always demand taking a step forward (Berge, 2000:48). The abovementioned approach to architectural technology provides a feasible solution in securing future levels of flexibility and resilience whilst progressively facilitating current needs. Regarding the relationship that exists between built form and urban environments as an organic fluctuating system ultimately relates to biological systems and enters the theoretical territory of biomimicry. Gruber (2011), ascribes the resiliency of biological structures to the limited range of materials utilised in a multi-functional manner in order to secure its survival (Gruber, 2011:97).

The process and methods of construction thus become more than a linear process of jumping from the intangible abstract to the tangible structural, but develops – in similarity to space and aesthetics – as a language of communicating the philosophy behind the architectural intent, whilst securing levels of resiliency so as to absorb and contribute to change. This suggests a more coplanar and integrated process to ensure the integrity and socio-economic appropriateness of construction decisions. This dissertation explores the manner in which architecture through technology may act as a responsive vehicle for transporting alternative ideas towards urban renewal.

7.2 TECHNE: General Structural Concept

As an overarching structural concept, the building is to represent an “urban expansion joint”. The architecture is cast into the void that has occurred through a fractured relationship between introverted, mono-functional and individualistic orientated buildings. The intervention or soft matter to be inserted within the marginal space that exists between opposing hard matter, is to represent a temporary and flexible intermediate.

As an “expansion joint”, the intervention acts as an intermediate entity between distinct objects (existing buildings and plinth), and enables the synthesis of programmes, additional connections and further expansion of the structural system. Where the new building meets the plinth, it is regarded as a point of friction or impact. This event is accentuated by allowing the plinth to impact the building, and vice-versa. The intervention not only utilises the existing structural properties of the site to enable its existence, but furthers this notion by providing existing infrastructure as a flexible structural prosthesis that may allow for future structural readaptation and reinterpretation.

The architecture then not only aims to be resilient through its own structural approach, but also intends to give back and heighten the general resiliency and flexibility of the site it is to occupy.

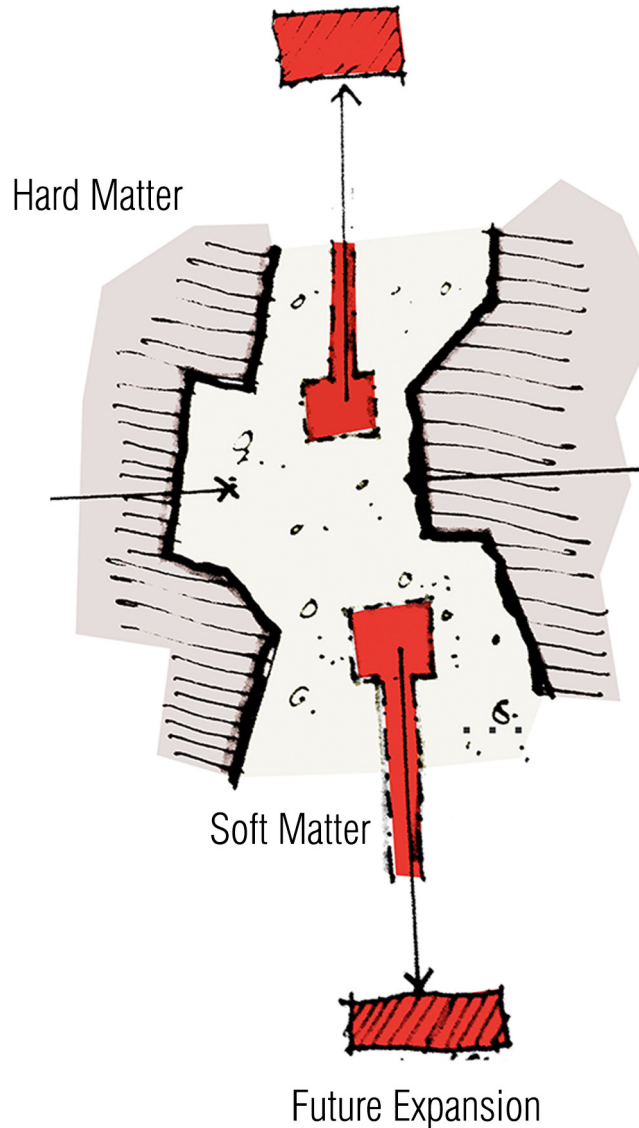


Figure 7.3 Structural Concept Author 2015

7.3 CONCEPT: Primary Structure and Skin

To accomplish this, a hierarchy of temporariness is established and translates as a technical concept defined as primary structure and skin. This concept guides all choices regarding materiality, fixing of components and the finishing and aesthetic effect of materials.

7.3.1 Primary Structure:: Flexible Permanency

Primary structure consists of foundation, columns, floors and service infrastructure. As the architecture is guided by ideas of temporariness and consumerism, the main structural elements represent the section of the building that may be left behind for readaptation and to soften the initial state of inaccessibility and lack of adaptability currently associated with the plinth.

As extending structure is provided to the site, this element also carries with it a degree of temporariness to maximise the flexible nature of the architecture. The same approach is applied to the services and sustainable strategies to be applied to the scheme.

Services to be “left behind,” in the case of possible future readaptation, provide a halfway platform for more sustainable developments to launch from and to expand.

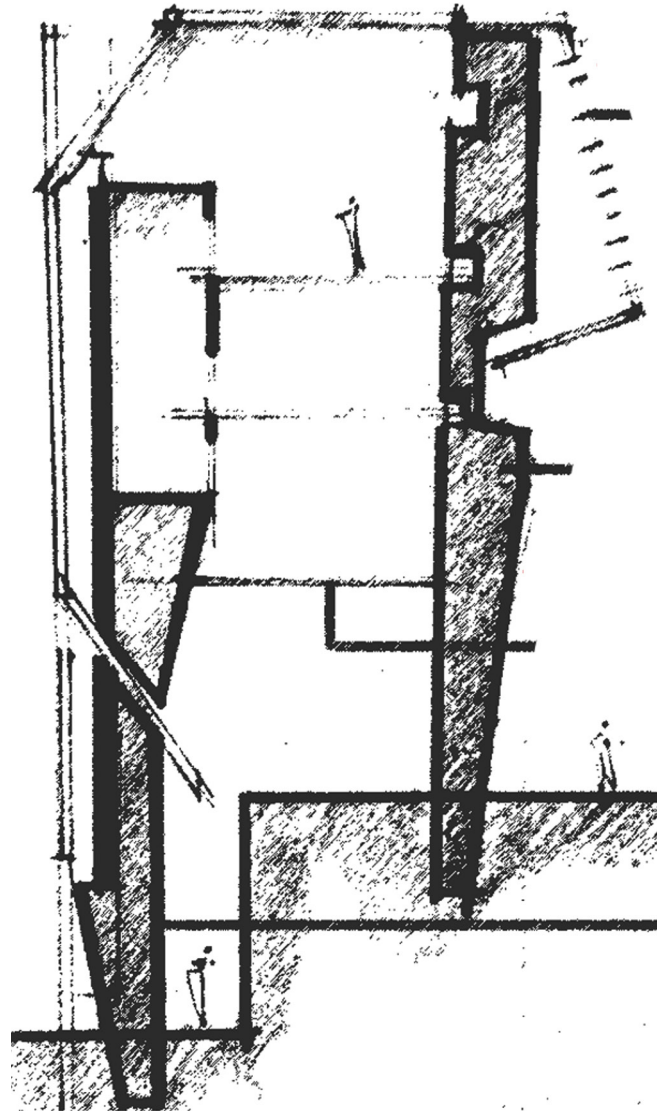


Figure 7.4 “Structure and Skin’ Author 2015

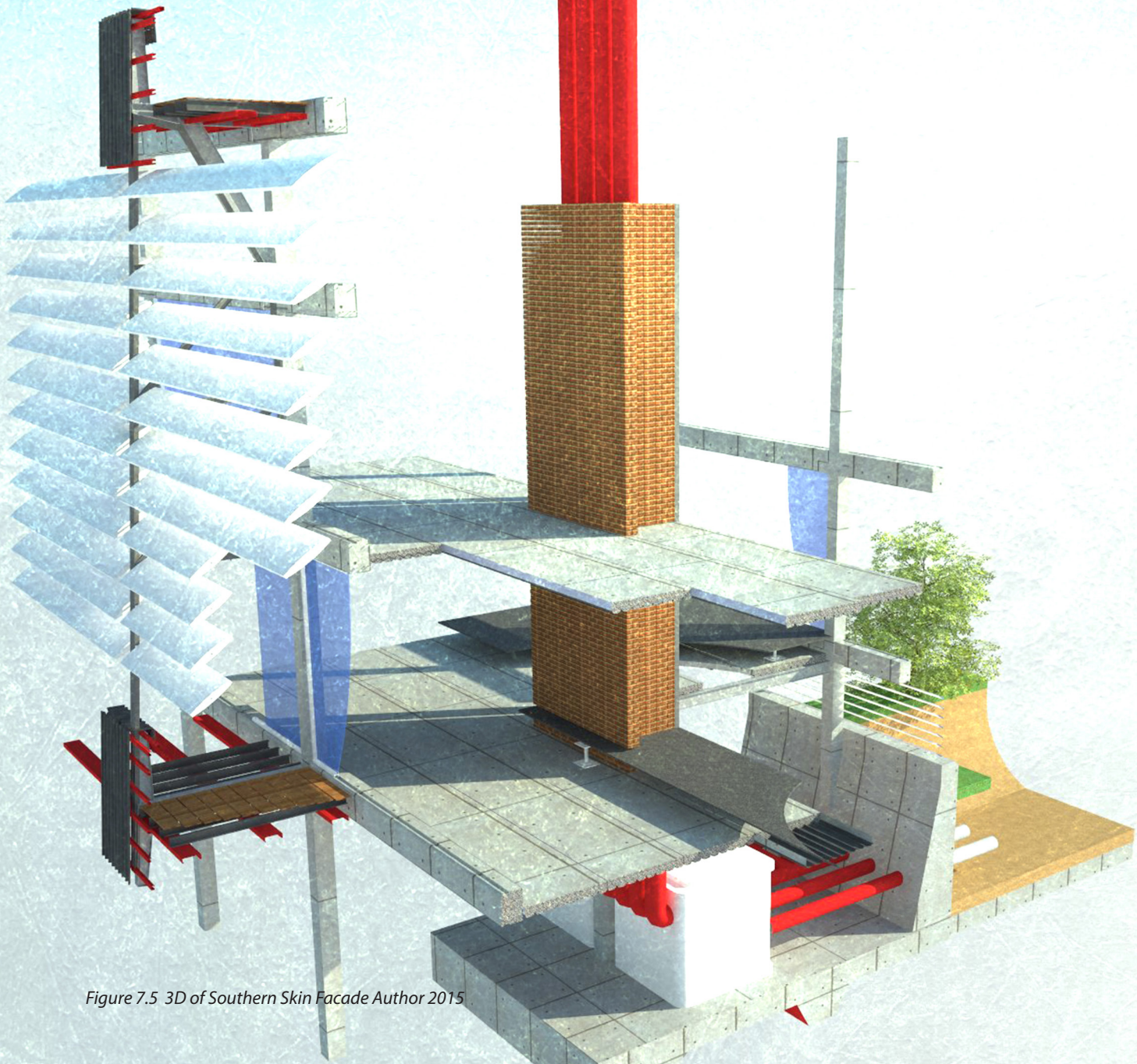


Figure 7.5 3D of Southern Skin Facade Author 2015

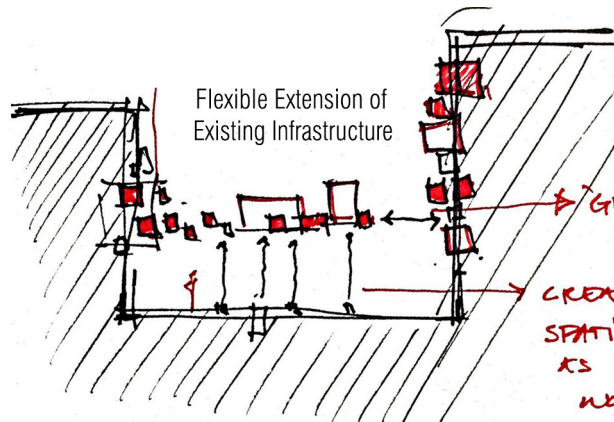


Figure 7.6 "Extension of Existing Infrastructure" Author 2015

7.3.2 Secondary Structure -Skin: Responsive Control

Skin becomes the element that controls the level of the building's responsiveness and adaptability, exposing and concealing structure where it is deemed effective. Skin acts as lifting the skirt on what essentially translates as the modernist principles, as imbedded in Le Corbusier's Domino House. A simple box-like structure, which consists of a floor-column configuration, is assembled through slender columns, elevated and supported above its foundation plane. This approach aims at an architectural contrast and reconfiguration of the modernist heritage of Pretoria and demonstrates the potential of extroverted architecture as a tool towards a responsive urban element. The roof of the new building will form part of the skin, where its temporariness is to suggest a future vertical extension of the structure. The roof cover blends with the temporariness of the skin as it is applied to the southern facade, providing little visual distinction between the two elements.

7.4 STRUCTURAL ORDERING : A Technical Response to Design Concept

The ordering of the structural system will translate the design concept of incision, extraction, processing and redistribution, with the main aim of integrating public with built form. Existing structure is to be punctured so as to allow for the new and temporary growth that will feed off the information - this event is to be celebrated architecturally through the ordering of the structural system.

As the conceptual approach stems from the principle of entropy, the building's various requirements in terms of structural intensity will be ordered as decreasing from a high-density structural system to a low-density structural system, so as to clarify the design's intent of transcending from an internalised (static) mode into an extroverted (animated) public domain. Components of the building's program are ordered in a descending manner according to the intensity of their respective structural requirements.

The metaphorical high-pressure zone is located where the new structure is to extend from the existing High Court Chambers building and decreases as the building extends towards the western and south-eastern edge of the plinth in an L-shaped formation. In accordance with this concept, the dense grid-column configuration, as required by the proposed library extension, will be located in close proximity to the point of incision. From there, the building's structural ordering will disintegrate into a more dispersed structural arrangement as program requirements decrease in its structural requirements, such as offices, board-rooms, research facilities and lounges. This disintegration of structural intensity is to reach a climax where the auditorium will extend beyond the eastern edge of the plinth and will appear to be hovering above the sidewalk level, accentuating the main threshold into the plinth site.

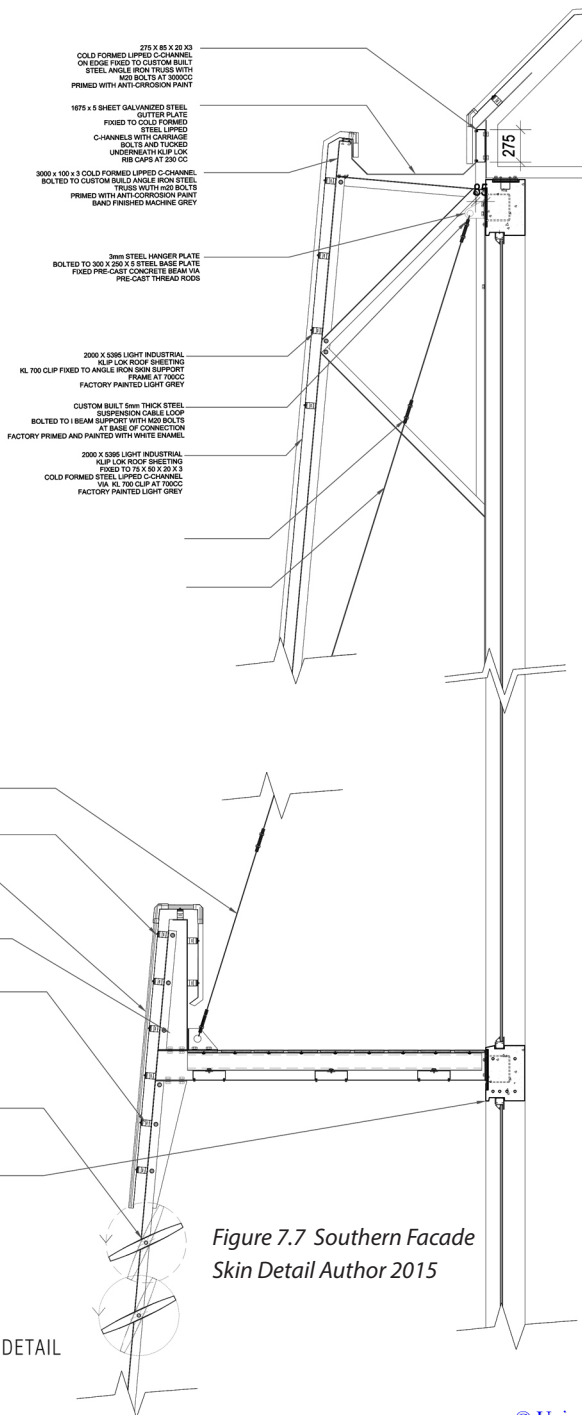


Figure 7.7 Southern Facade Skin Detail Author 2015

SOUTHERN SKIN DETAIL
SCALE 1:20

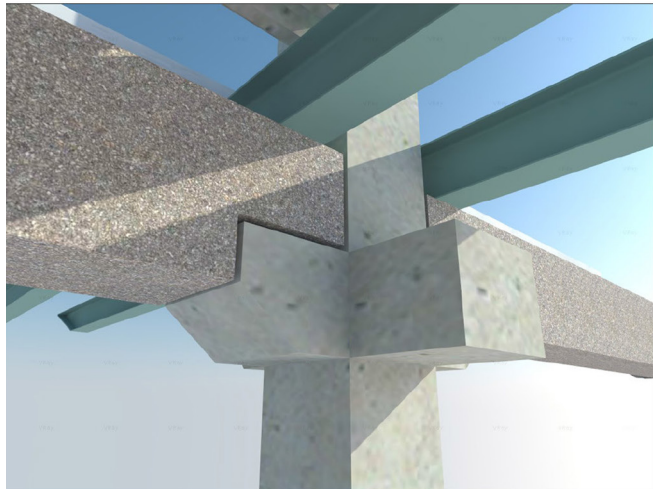


Figure 7.8 Alterable Column and Beam System Author 2015

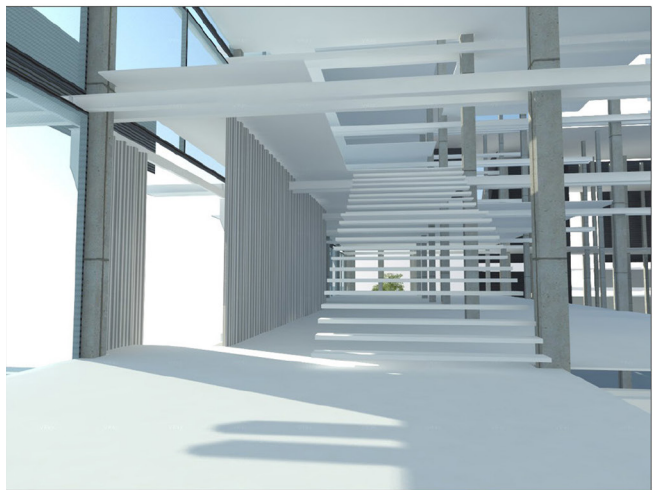
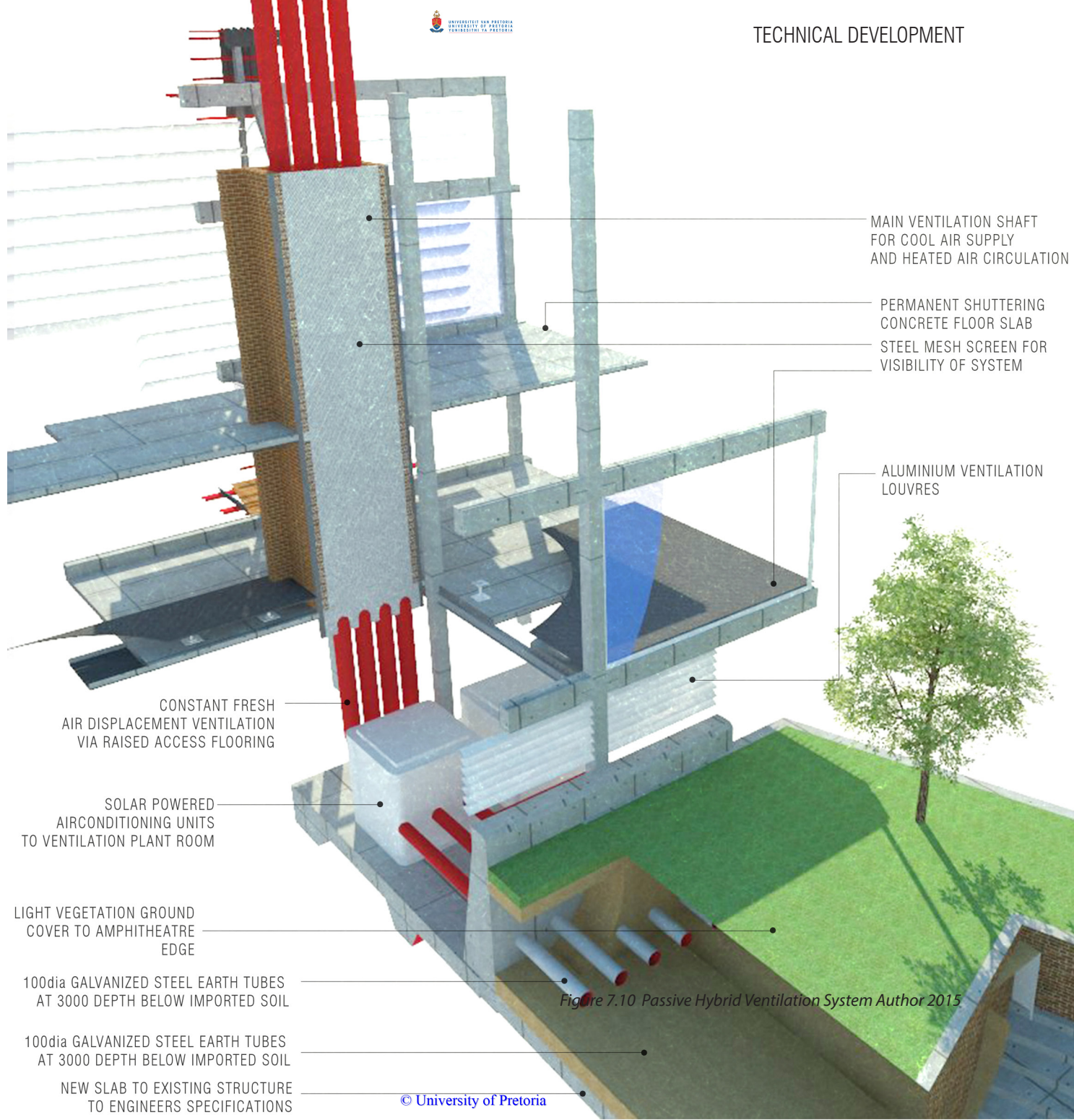


Figure 7.9 Skin as Spatial Construct Author 2015



MAIN VENTILATION SHAFT FOR COOL AIR SUPPLY AND HEATED AIR CIRCULATION

PERMANENT SHUTTERING CONCRETE FLOOR SLAB
STEEL MESH SCREEN FOR VISIBILITY OF SYSTEM

ALUMINIUM VENTILATION LOUVRES

CONSTANT FRESH AIR DISPLACEMENT VENTILATION VIA RAISED ACCESS FLOORING

SOLAR POWERED AIRCONDITIONING UNITS TO VENTILATION PLANT ROOM

LIGHT VEGETATION GROUND COVER TO AMPHITHEATRE EDGE

100dia GALVANIZED STEEL EARTH TUBES AT 3000 DEPTH BELOW IMPORTED SOIL

100dia GALVANIZED STEEL EARTH TUBES AT 3000 DEPTH BELOW IMPORTED SOIL

NEW SLAB TO EXISTING STRUCTURE TO ENGINEERS SPECIFICATIONS

Figure 7.10 Passive Hybrid Ventilation System Author 2015

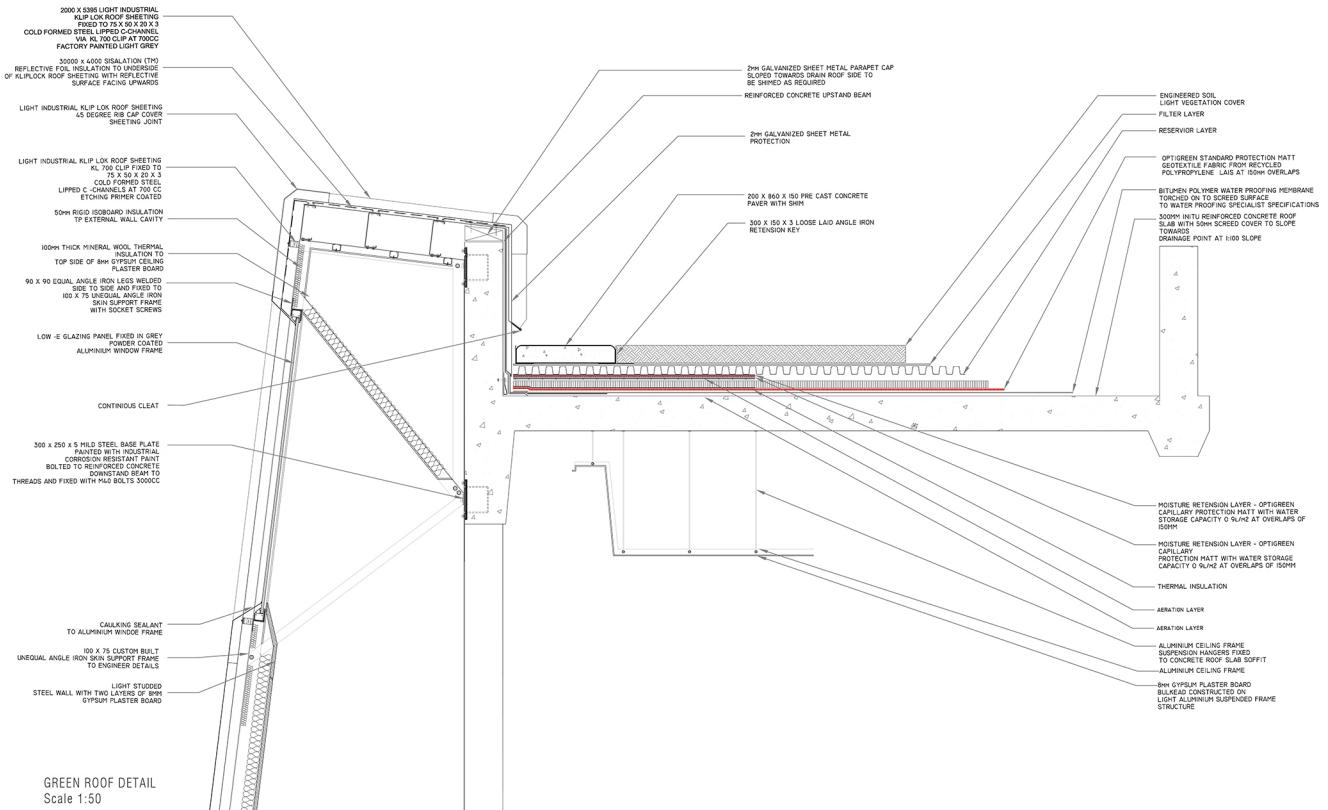


Figure 7.11 Green Roof and Skin Detail Author 2015

By lifting the entire building above plinth level, the structural ordering will be exposed to public visibility from street level and will be made accessible to the plinth user by programming the space generated by the colonnade underneath the new building.

7.5 SUSTAINABILITY APPROACH

Due to the location and environmental character of the site, the scheme will not be able to fully rely on passive heating, cooling and ventilation strategies and consequently proposes a hybrid system which mediates between passive and mechanical systems. Here the notion of phaedomorphosis (as mentioned in 7.1) comes into play, where conventional and existing systems are incorporated and aided by sustainable technologies, so as to allow the building to be strengthened passively at a later stage as new technological solutions may develop.

Due to the fact that the southern facade overlooks Vermeulen Street, conventional methods of allowing cool air into the building from the south are deemed impractical. Factors such as carbon dioxide-saturated air and increased levels of air temperature associated with urban atmospheres raise issues of interior building discomfort, as well as a general health risk for building occupants. The proposed system will consist of a solar-powered air conditioning system to supply displacement ventilation – made possible by raised access flooring – at comfortable temperatures during winter and summer months.

To reduce energy strain on air conditioning and solar power supply during summer months, geo-thermal earth tubes will be installed into the plinth with an intake air filter at a distance of 50 metres away from entering the building envelope.

This system is to supply a constant flow of fresh air to the solar powered air conditioning units at approximately 18 to 28 degrees Celsius, lowering the temperature difference to be adjusted by the A/Cs. Imported earth onto the plinth for the purposes of installing the geo-thermal tubes – at a minimum depth of 3 metres – will be integrated into public green pockets onto the public plinth.

To aid in the circulation of air throughout the building's interior spaces, solar-assisted stack towers with PV-panel powered extraction vents will be provided to the northern facade of the building to supplement the air conditioning system in providing an adequate airflow exchange rate. Horizontal solar screen louvers, positioned at optimum distances away from the northern facade, will allow for solar heat gain to penetrate the building during winter months and reduce this effect during summer months.

Strategically-located double volumes throughout the interior of the building will allow for winter sun to penetrate lower levels where floors are partially increased in thermal mass, providing comfort during winter. Building components such as services, green spaces, circulation and water storage facilities will be incorporated as solar buffers on the southwestern portion of the street facade.

The auditorium, which will be limited in vertical fenestration due to privacy and traffic noise reduction, will be located to the eastern portion of the southern facade so as to limit the building's exposure to direct eastern and southeastern sunlight.

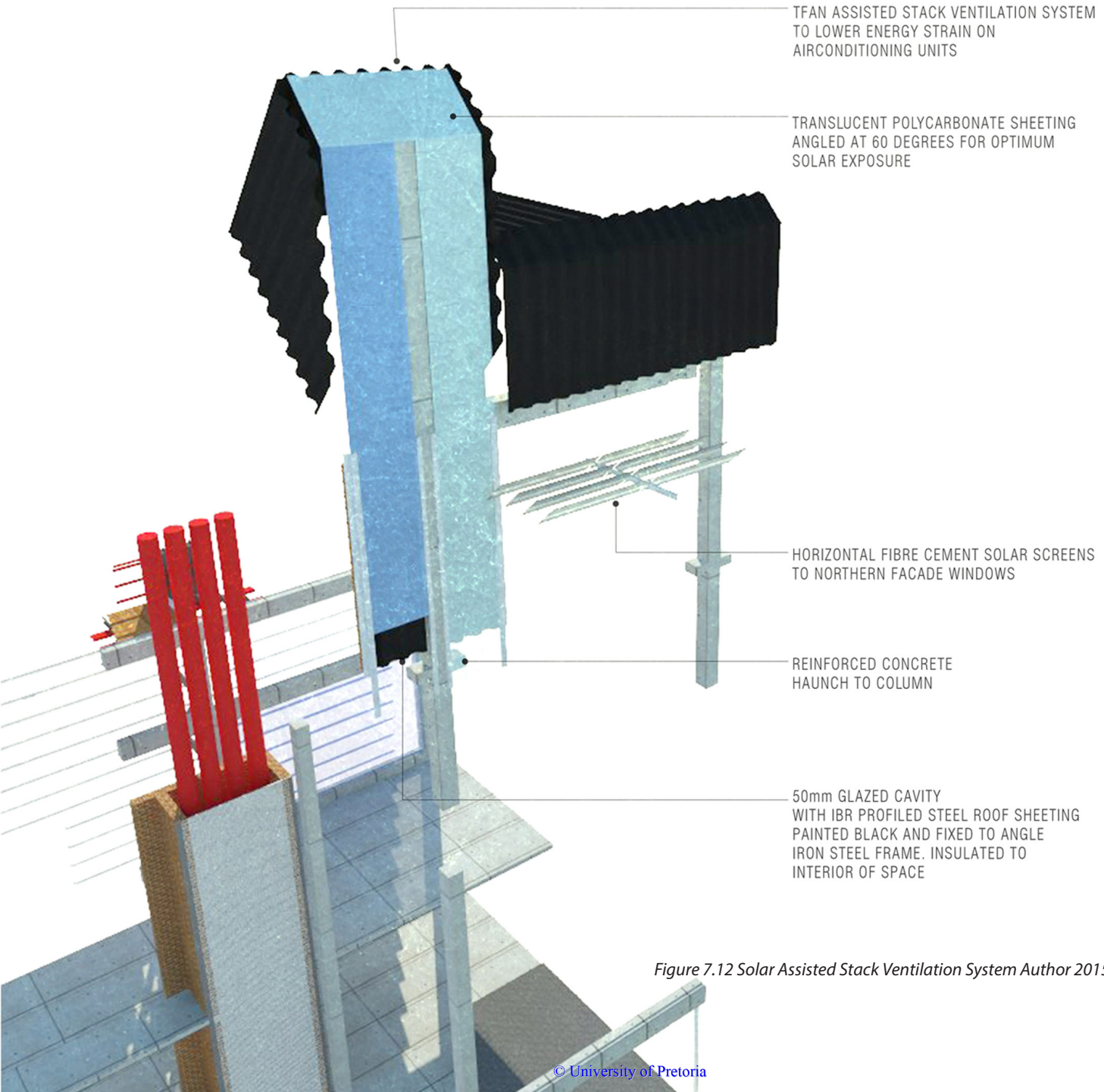


Figure 7.12 Solar Assisted Stack Ventilation System Author 2015

The extraction system of the solar assisted stack towers will be disabled during winter months. The heated air that these towers channel will be captured and recycled throughout the interior spaces, again reducing the amount of energy required by the air conditioning system to adjust for comfortable interior temperatures. The redistribution of hot air will follow the same channels of displacement ventilation through raised access flooring, with the geothermal earth tubes supplying constant heat-processed fresh air into interior spaces. Due to the fact that the site under investigation does not receive the optimum amount of natural light, building elements and materials should not only provide the optimum sunlight penetration into space, but should also be adaptable to suit the flexibility and level of user-control the building strives for.

As part of the scheme's intension to clarify its position on utilising existing infrastructure, it will incorporate the existing plinth surfaces, as well as the new building's roof area, into a combined mechanism for rainwater harvesting. This system will not stand alone as primary access in providing sanitary, consumer, and irrigation needs, but aims at decreasing the building's dependency on conventional and existing water supply to the site. This process will then allow for the partially sustainable maintenance of building services, as well as public green space to be introduced onto the site. The storage and processing of collected water will be made visible and partly accessible to the public as a didactic component to the scheme, with regards to sustainability and the readaptation possibilities of marginal space.

7.6 MATERIALITY

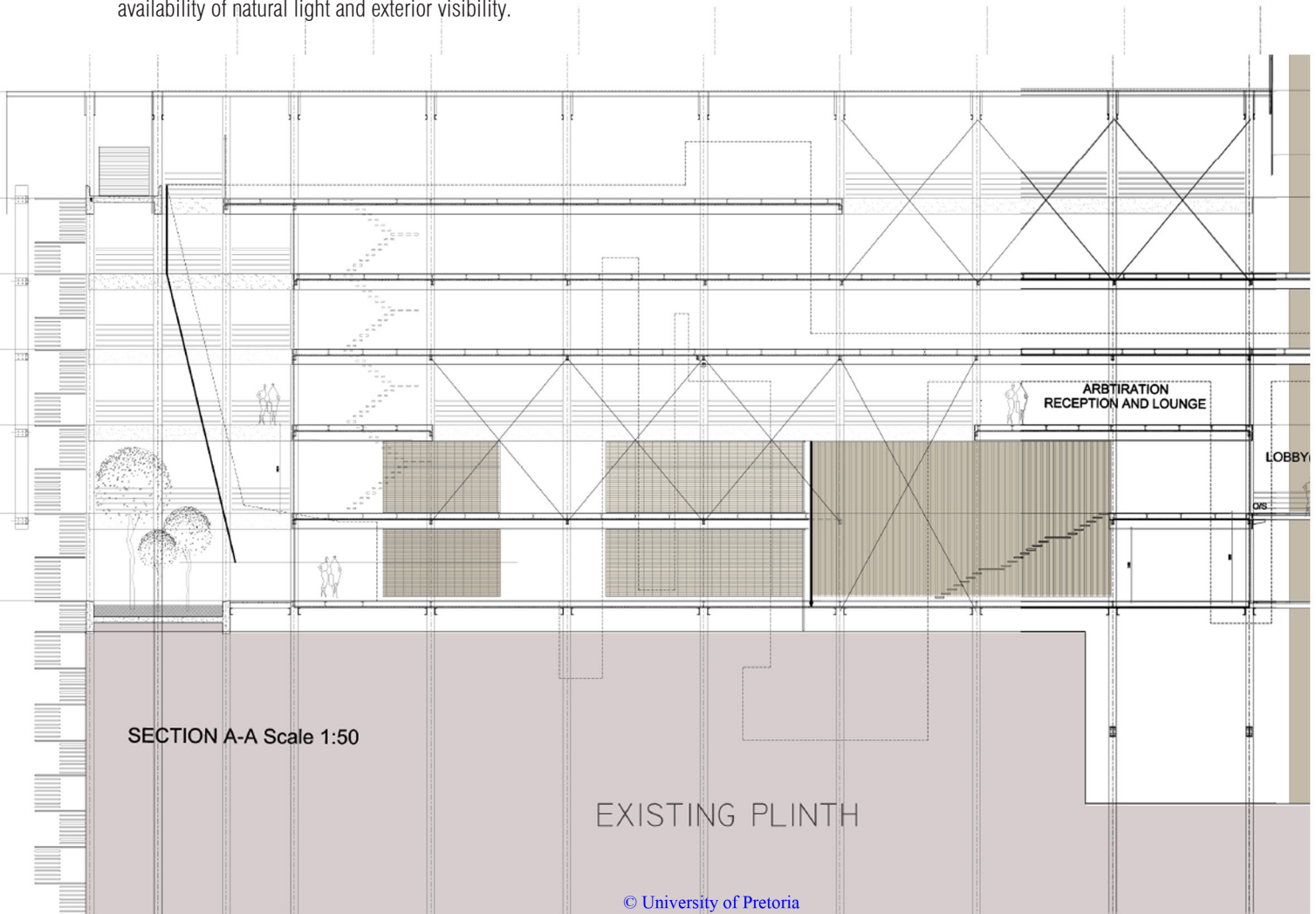
The selection of building material depends on its categorisation into either Structure or Skin and rests on the temporariness of what the building should represent, where some of the building elements are deemed to be more permanent than others.

Sustainability in terms of the future reuse and reassembly of materials becomes the main criteria for selection. The primary structural system consists of vertical access and utility mains and insitu concrete columns with intermediate T-haunch sections, which provide multiple connection possibilities.

Allowing for the possibility of future alterations to floor levels and positioning, the building allows itself to facilitate different programs as variations in its urban context might require. By increasing the variations in which the structure may be ordered, the embodied energy of materials and components can be capitalised on more intensively. Pre-cast concrete beams, supported on the T-haunches, provide lateral support and bracing to the exterior rows of columns and aid in connecting the secondary steel-beam structure which provides the support for a permanent shuttering floor base.

Tertiary elements include glazing, raised access flooring, interior partitioning, ceilings, balconies, horizontal and vertical solar screen louvres and the truss-skin extension of the roof sheeting to form part of the southern skin facade. Structural support of these elements will be provided by attaching to the primary structural system of concrete columns, beams and permanent shuttering floors. The skin of the building is suggestive of pulling away from the main structural system, of which the materiality is to speak of lightness, flexibility and adaptability. It therefore becomes a method in which the new building is to contrast against the hard, introverted and heaviness of the site's materiality, and highlights the project's nature of extending out of the existing built fabric.

This approach also guides the structural connections that allow the new building to gain access to existing structures. The concept of incision is to be suggested by the overall formalistic effect that the structure generates. In reality, the structure will have minimal impact where thresholds are made into existing buildings. These connections and the manner in which they are fixed to the existing buildings, will play on the contrast that exists between the lightness of the new building and the heaviness of the existing site materiality. Extending steel elements will provide bridge platforms to allow access into the existing buildings. The fixing of where these “light” elements are joined to the “hard” materiality of masonry and concrete will be exposed and made visible to the user. Exposed light frame steel trusses will connect the skin of the building to its heavier structural components at column-based intervals, and through this contrast, will add to the rhythmic collaboration of and light and heavy building elements. To reduce the staticness of the screen, it will be enabled to perform purposes in controlling the climatic control of interior spaces. Sections of the screen will therefore consist of adjustable screen louvres to allow the user to control the availability of natural light and exterior visibility.



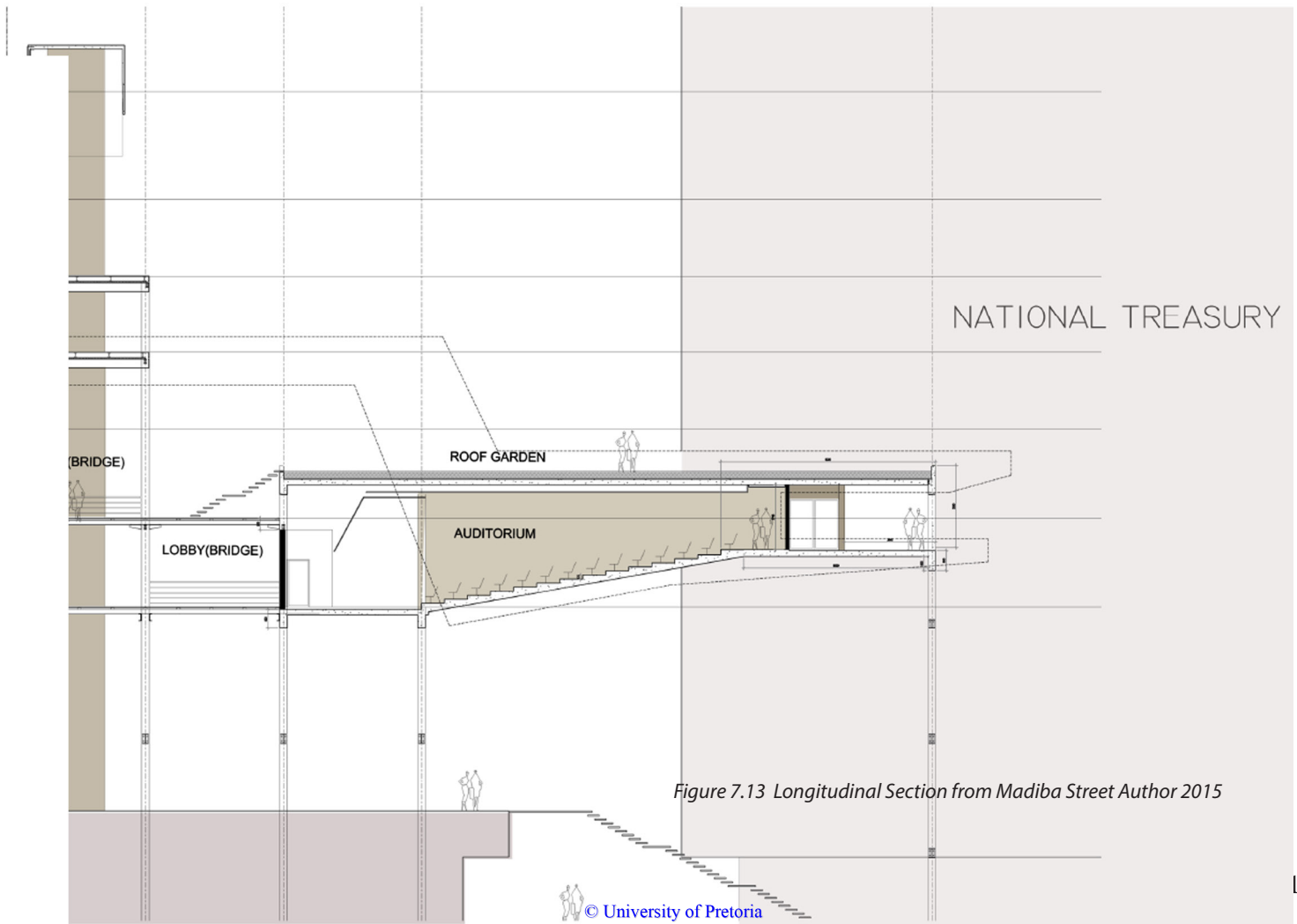
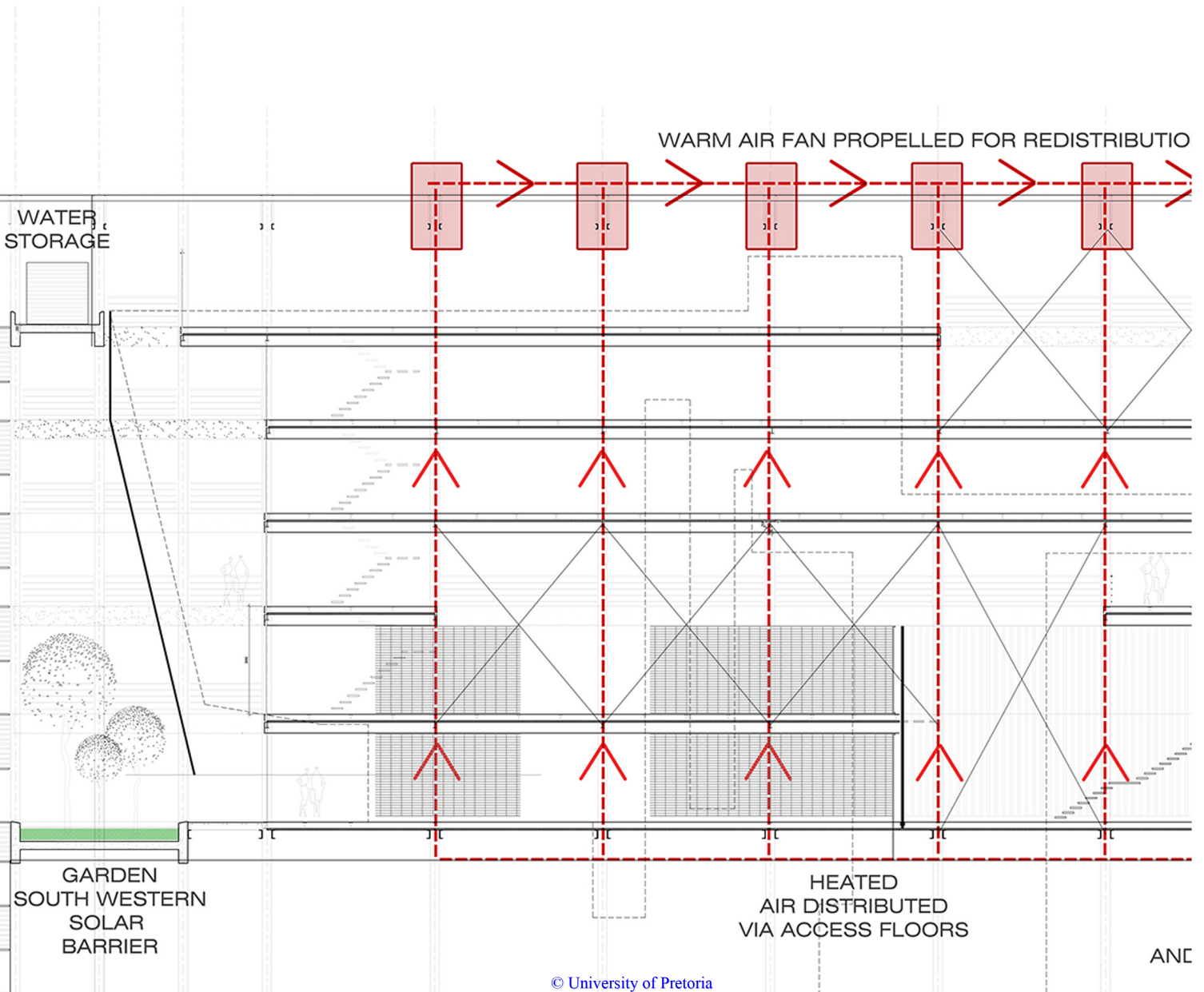


Figure 7.13 Longitudinal Section from Madiba Street Author 2015

Figure 7.14 Passive Heating Strategy as Part of Hybrid System Author 2015



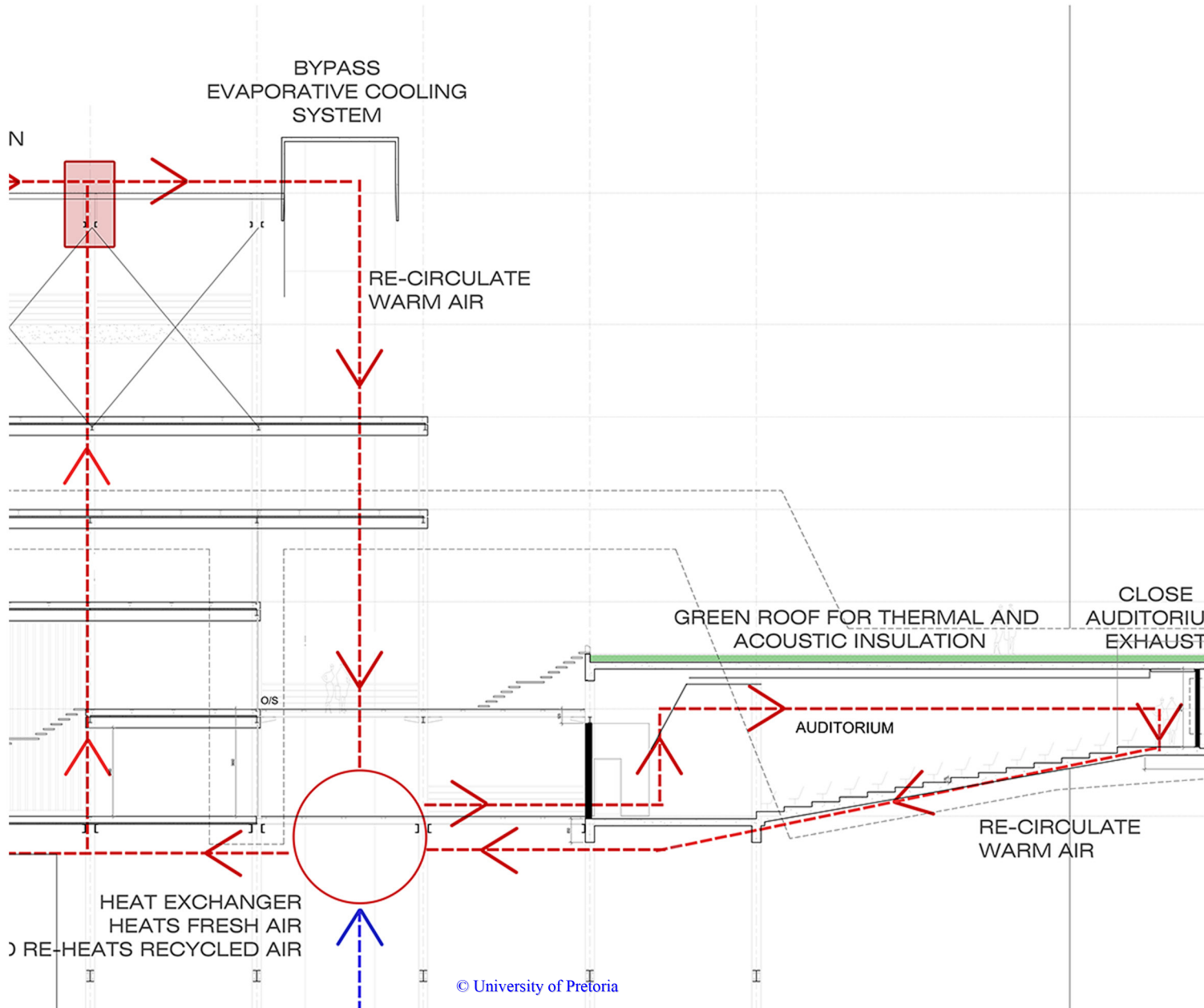


Figure 7.15 Passive Cooling Strategy as part of Hybrid System Author 2015

