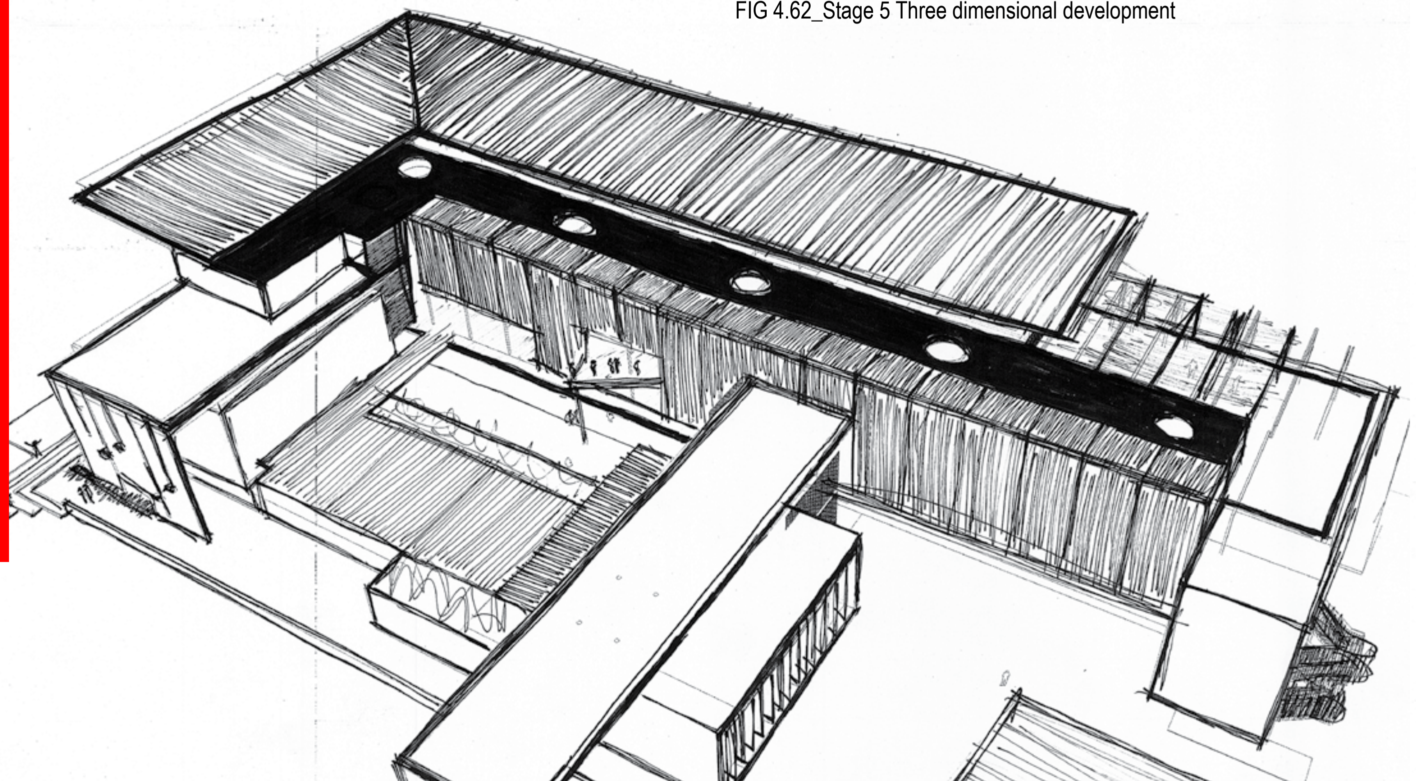
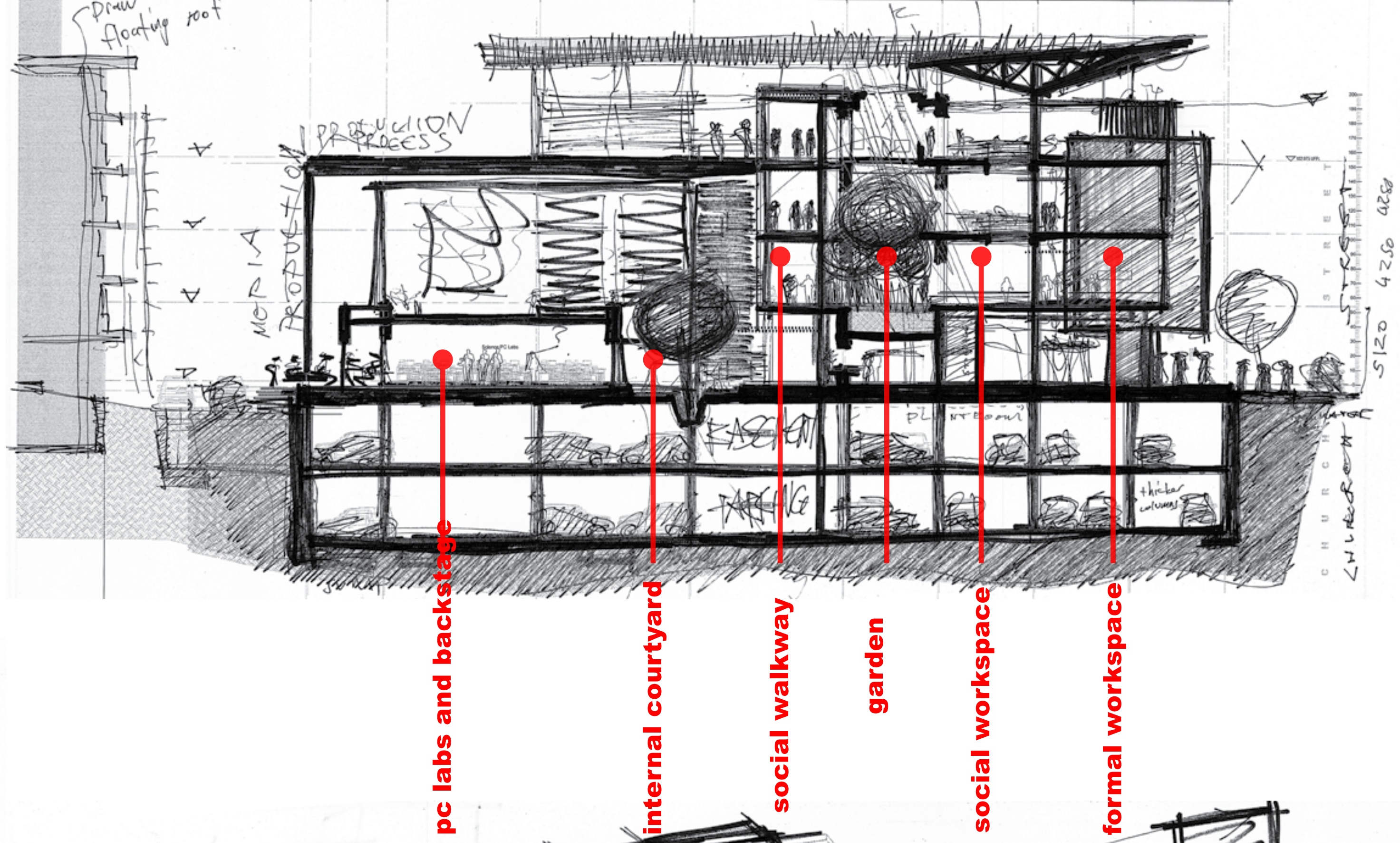
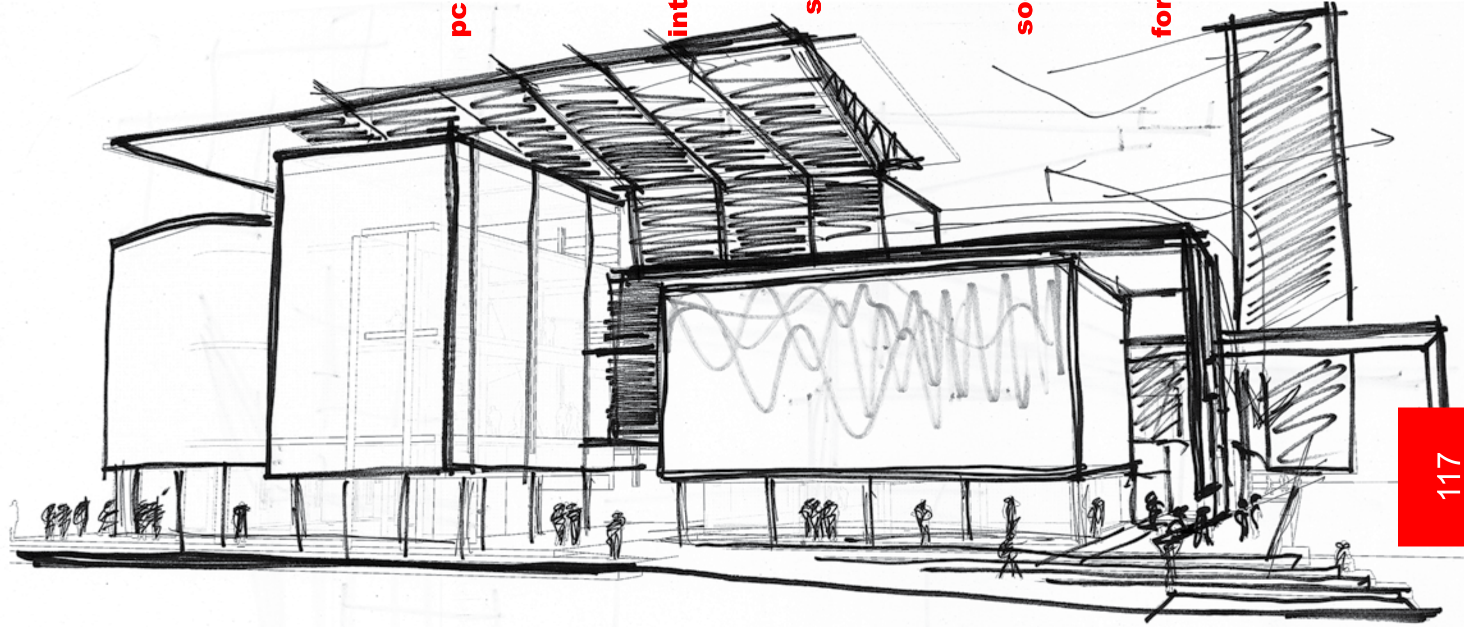
Stage 5

- Programmatically this stage **concluded the design process;** as discussed with Prof. Diederichs.
- The auditorium was replaced with a **roof terrace multipurpose hall** above the classrooms: transgression from classroom to social classroom.
- **Libraries celebrated** on the prominent corner on Nelson Mandela Drive as the final product.
- **Circular rings** in the flat roofs **above garden spaces** were discovered by overlapping sketch plans.
- This however, shares a **similar interest as the Brazilian Modernism of Norman Eaton's earlier work**, one of the pioneer architects in Pretoria during the 1940's and 1950's: puncturing floating roofs with organic shapes above roof gardens.

FIG 4.62_Stage 5 Three dimensional development







Chapter

5

This chapter conveys the technical investigation done for the dissertation. The earlier conceptual phases established a thought process which guided the functionality of various design decisions made. Precedents have been chosen for the technical documentation which also relate back to the design development. Analysis of built examples highlights the scope of the design as a whole.

Theoretical argument served as the basis from which technological decisions were made. Technological aspects were examined in terms of the current architectural language of the urban campus as well as theoretical argument to strengthen the design process of the dissertation. The current technological language of the Eaton Louw- and Gordon Leith buildings served as important precedent: experiential factors in terms of space, light, materiality, mass, aging, gravity and nature were consequently implemented to make the user aware of these phenomena.

STRUCTURAL GRID

The primary structure consists of a concrete frame and beam system which supports the floor slabs. The design of a basement parking layout during concept stage 2 played a pivotal role in the design process which had to respond according to the site geometry. Column spacing towards Church Street in the East-West direction is at 9m spacing. Structural rhythm on this facade consists of a 4.5m interval skin which wraps around the building. This is further emphasized with a 9m mass grid pulling out of the facade. Diagonal to this is the 5.6m grid according to the parking layout, allowing for more flexibility during the design process. The change in parking grid towards the northern half of the site responded towards the change in built fabric above. This resulted in a 9x9m grid with the flexibility supporting elements at 3m intervals. The primary columns (550x550mm) support the forces from the roof structure. Secondary columns (490x490mm) support the brick boxes and flat roofs above. Circular reinforced concrete columns (460mm dia.) support the sculptural facade and walkway which allows for spatial continuity.

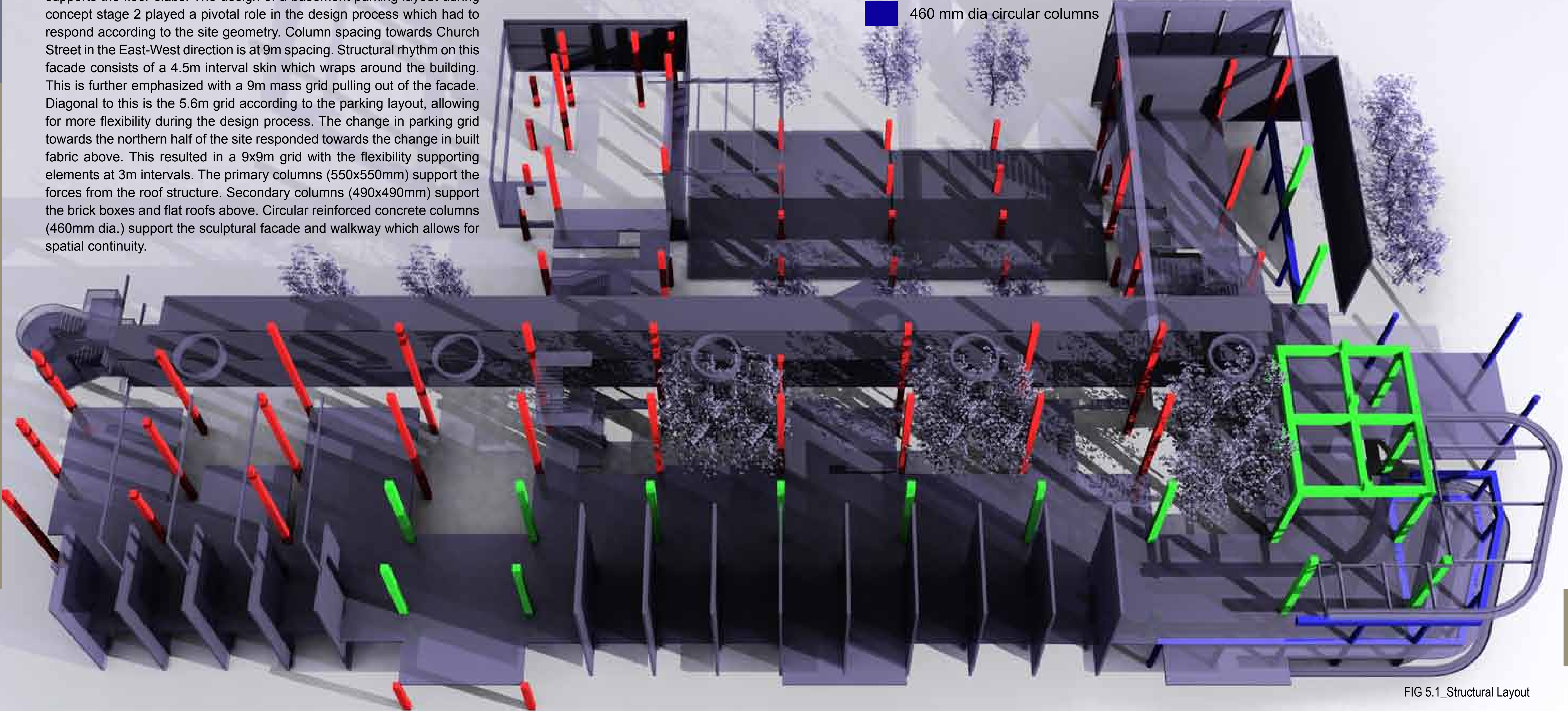


FIG 5.1_Structural Layout

Fins

During the earlier design stages the southern facade was shaded by lightweight clip-on mesh fins connected to the primary columns for early morning and late afternoon sun penetration and glare during summer months. This was further developed, contributing towards a stronger architectural language. The idea of "fin" became the primary ordering system for the functional programming of spaces when mirrored towards the inside.

The material change-over towards concrete resulted in these fins to become structurally supportive elements, using the forces of gravity to balance the structure. This resulted in the elimination of columns in the front facade, emphasizing the urban stage's design approach of in- and external spatial transisions. Discussion with engineer concluded that this element as well as the floors will be a cast-in-situ.

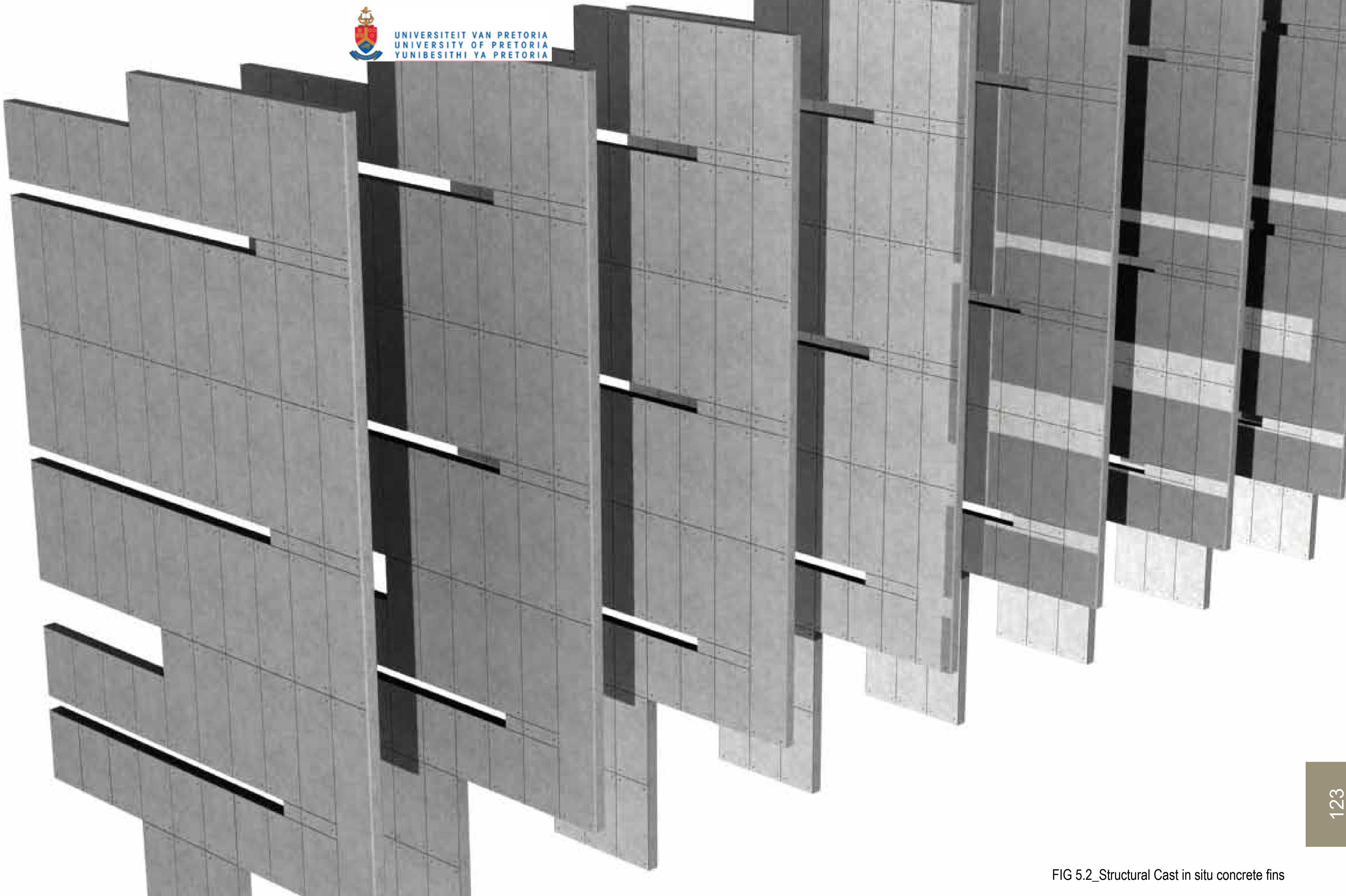
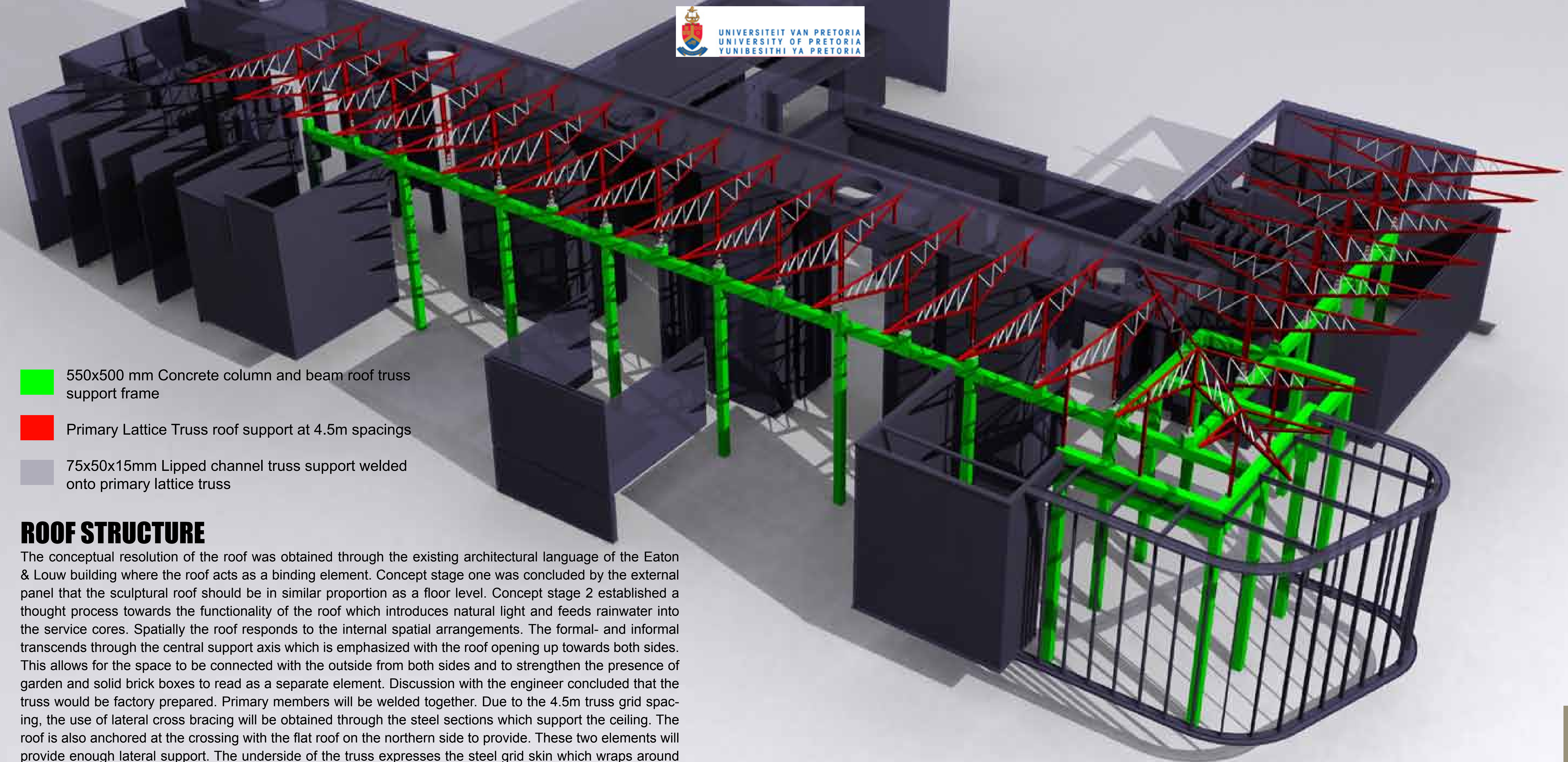


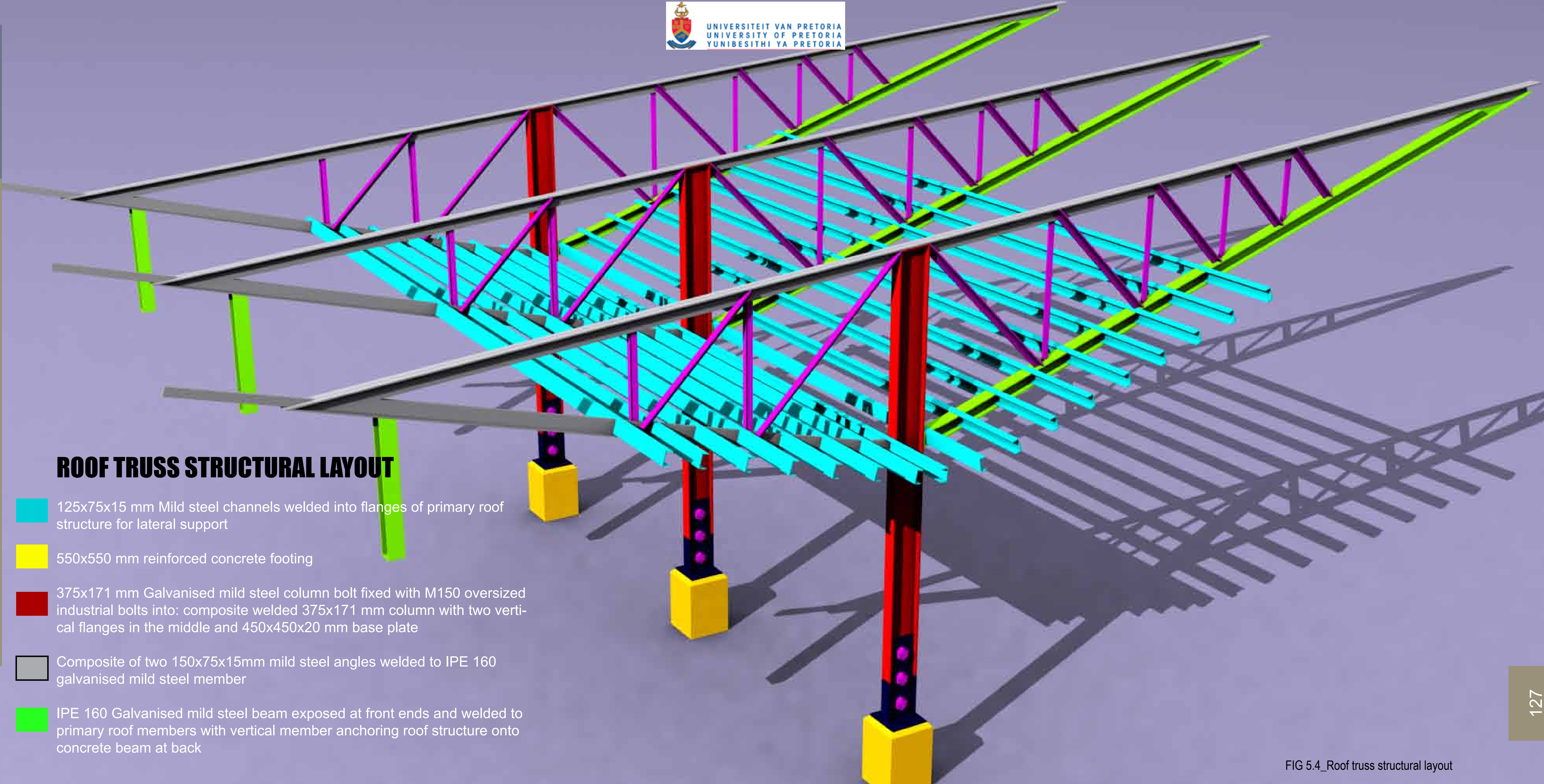
FIG 5.2_Structural Cast in situ concrete fins



ROOF STRUCTURE

The conceptual resolution of the roof was obtained through the existing architectural language of the Eaton & Louw building where the roof acts as a binding element. Concept stage one was concluded by the external panel that the sculptural roof should be in similar proportion as a floor level. Concept stage 2 established a thought process towards the functionality of the roof which introduces natural light and feeds rainwater into the service cores. Spatially the roof responds to the internal spatial arrangements. The formal- and informal transcends through the central support axis which is emphasized with the roof opening up towards both sides. This allows for the space to be connected with the outside from both sides and to strengthen the presence of garden and solid brick boxes to read as a separate element. Discussion with the engineer concluded that the truss would be factory prepared. Primary members will be welded together. Due to the 4.5m truss grid spacing, the use of lateral cross bracing will be obtained through the steel sections which support the ceiling. The roof is also anchored at the crossing with the flat roof on the northern side to provide. These two elements will provide enough lateral support. The underside of the truss expresses the steel grid skin which wraps around the concrete skeleton of the building. Initially all truss members is similar in proportion. The turn on the corner however, will require bigger truss members to support the longer spans.

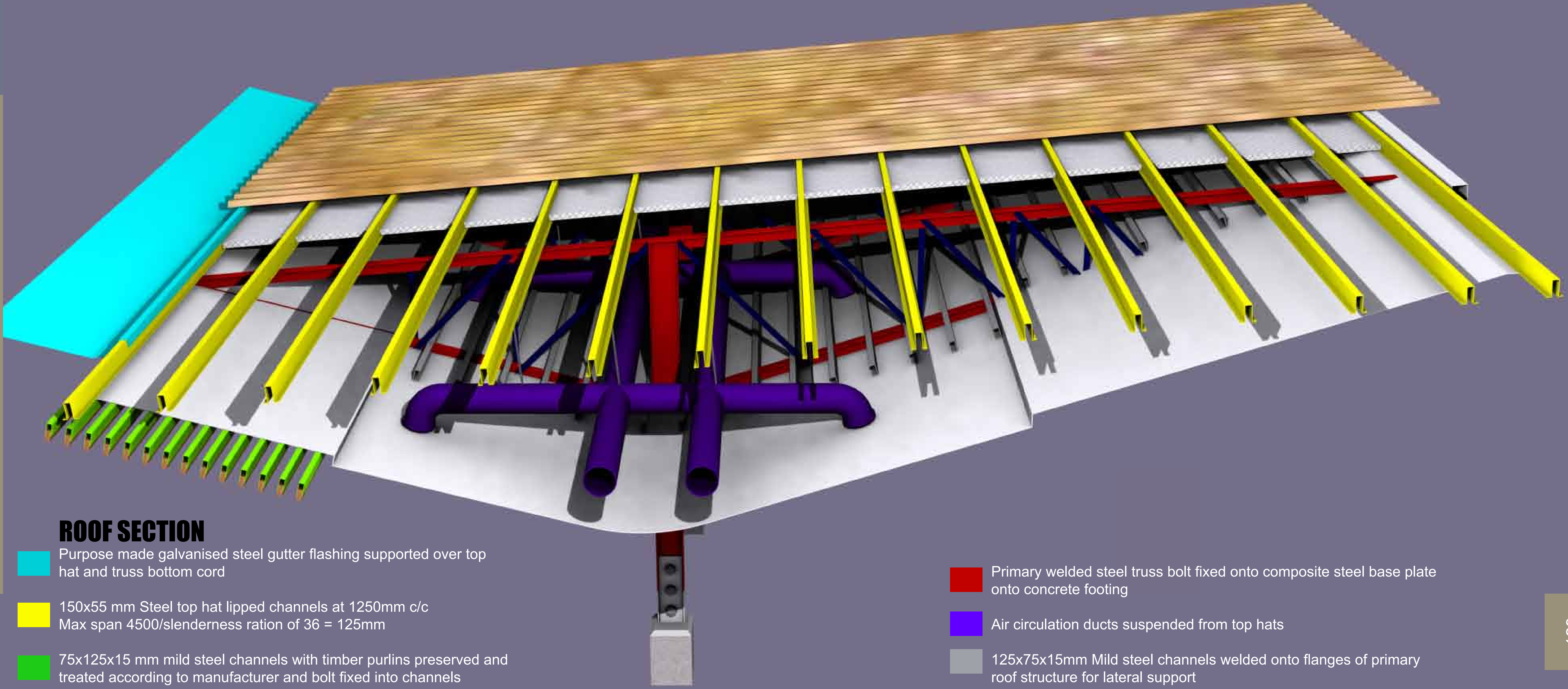
FIG 5.3_Roof structural layout and support members



ROOF TRUSS STRUCTURAL LAYOUT

- 125x75x15 mm Mild steel channels welded into flanges of primary roof structure for lateral support
- 550x550 mm reinforced concrete footing
- 375x171 mm Galvanised mild steel column bolt fixed with M150 oversized industrial bolts into: composite welded 375x171 mm column with two vertical flanges in the middle and 450x450x20 mm base plate
- Composite of two 150x75x15mm mild steel angles welded to IPE 160 galvanised mild steel member
- IPE 160 Galvanised mild steel beam exposed at front ends and welded to primary roof members with vertical member anchoring roof structure onto concrete beam at back

FIG 5.4_Roof truss structural layout



ROOF SECTION

Purpose made galvanised steel gutter flashing supported over top hat and truss bottom cord

150x55 mm Steel top hat lipped channels at 1250mm c/c
Max span 4500/slenderness ration of 36 = 125mm

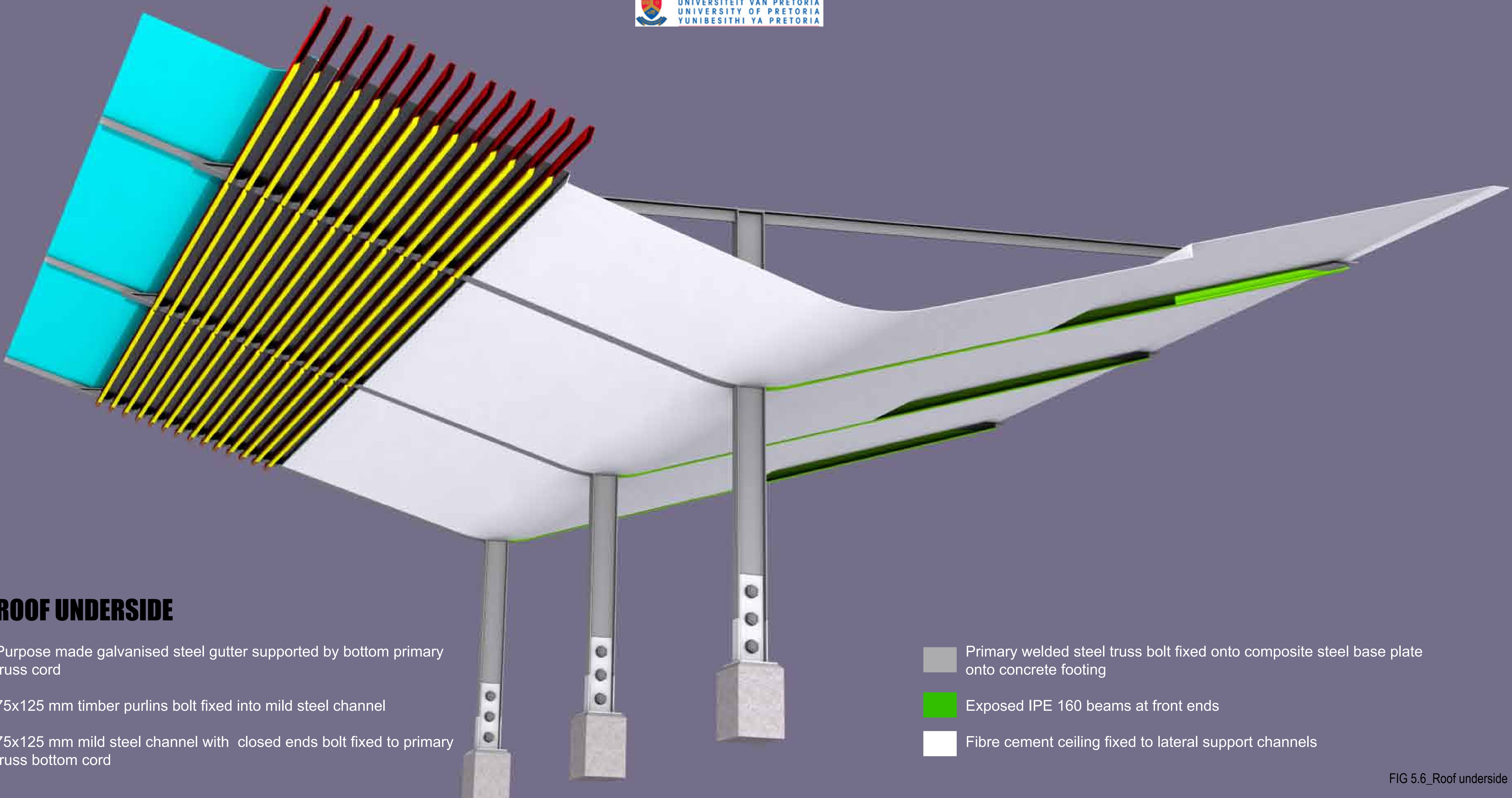
75x125x15 mm mild steel channels with timber purlins preserved and treated according to manufacturer and bolt fixed into channels

Primary welded steel truss bolt fixed onto composite steel base plate onto concrete footing

Air circulation ducts suspended from top hats

125x75x15mm Mild steel channels welded onto flanges of primary roof structure for lateral support

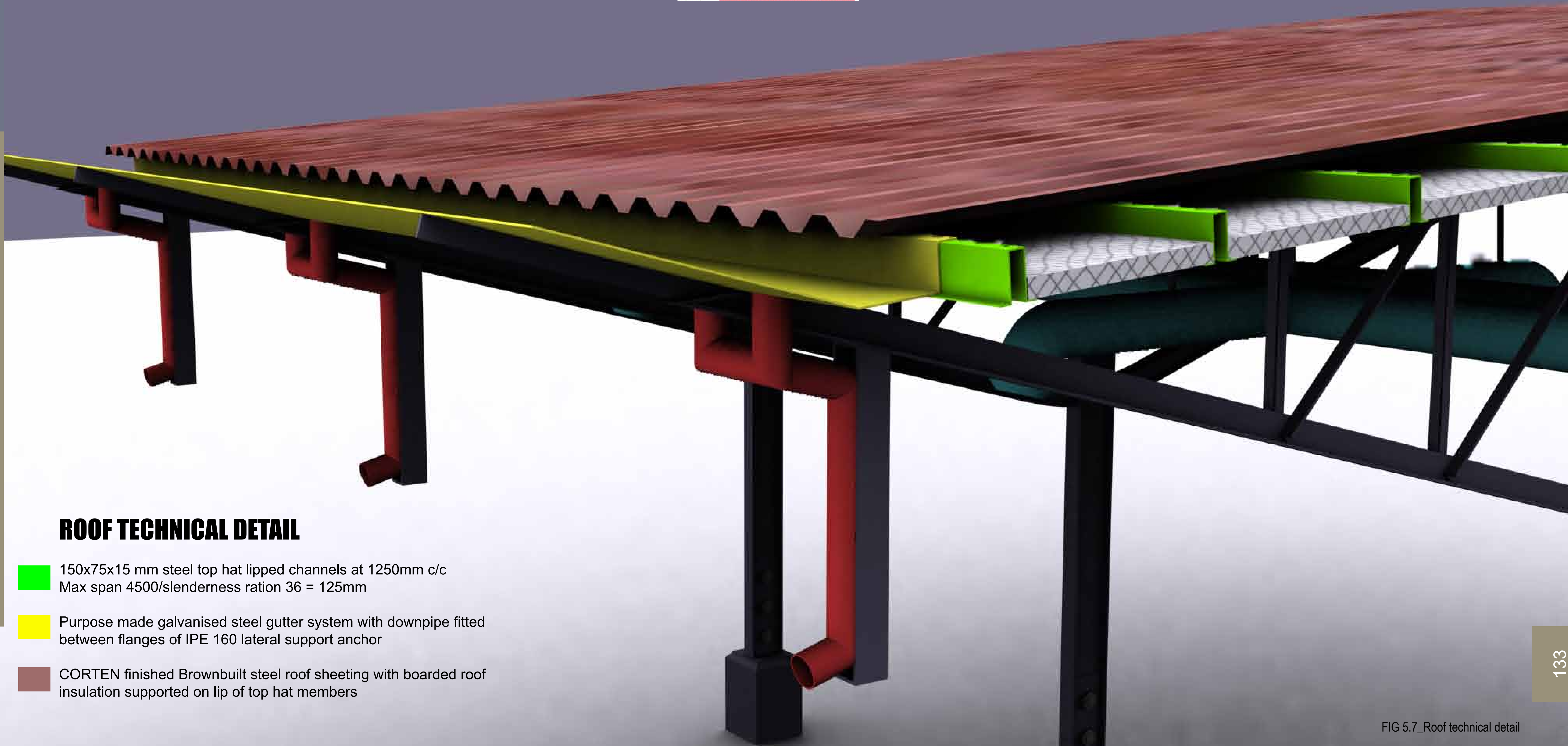
FIG 5.5_Roof section



ROOF UNDERSIDE

- Purpose made galvanised steel gutter supported by bottom primary truss cord
- 75x125 mm timber purlins bolt fixed into mild steel channel
- 75x125 mm mild steel channel with closed ends bolt fixed to primary truss bottom cord
- Primary welded steel truss bolt fixed onto composite steel base plate onto concrete footing
- Exposed IPE 160 beams at front ends
- Fibre cement ceiling fixed to lateral support channels

FIG 5.6_Roof underside



ROOF TECHNICAL DETAIL

150x75x15 mm steel top hat lipped channels at 1250mm c/c
Max span 4500/slenderness ration 36 = 125mm

Purpose made galvanised steel gutter system with downpipe fitted between flanges of IPE 160 lateral support anchor

CORTEN finished Brownbuilt steel roof sheeting with boarded roof insulation supported on lip of top hat members

FIG 5.7_Roof technical detail

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Infill and circulation support systems

Brick infill plays an important role in the experiential qualities of the building. This adds to spatial experience which transcends from a tectonic into stereotomic elements which form the entrance into a transparent open floor volume. The wall has been designed to read as a separate mass element and not as infill between the concrete structures.

The thick mass punctured by openings was obtained through the language of the Gordon Leith building. Together with the concrete frame of the building, this resulted in a thick-cavity. Functionally the thermal qualities towards the north side of the building are satisfied within the context of the Pretoria climate. The cavities within the walls provide space for acoustic insulation of the recording studio on Nelson Mandela Drive.

The circulation network is separated from this mass wall, structurally consisting out of an interconnected steel beam frame connected to the concrete structure of the building. The transition between mass and tectonic is emphasized with a translucent element which creates a social connection with circulation spaces above.

The external circulation network is wrapped with a mesh skin which reads as a separate mass element from the outside. This was obtained through the tectonic brick mass skin of the Eaton & Louw buildings, emphasizing experiential qualities in terms of being a light filter and controlling solar heat. Together with this, the circular rings above garden spaces, creates shadows which falls onto the mass wall, enhancing sensory experiences.

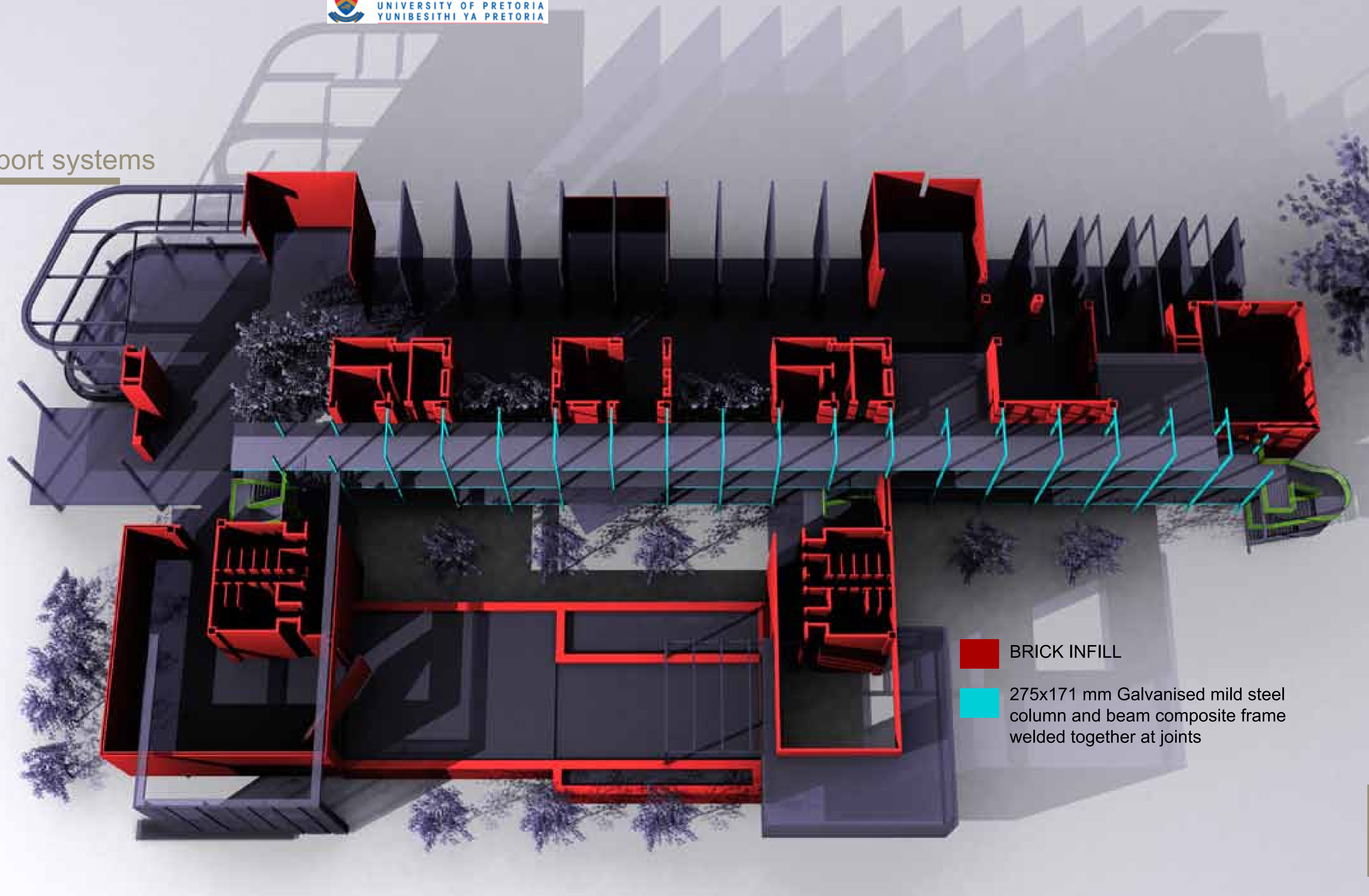
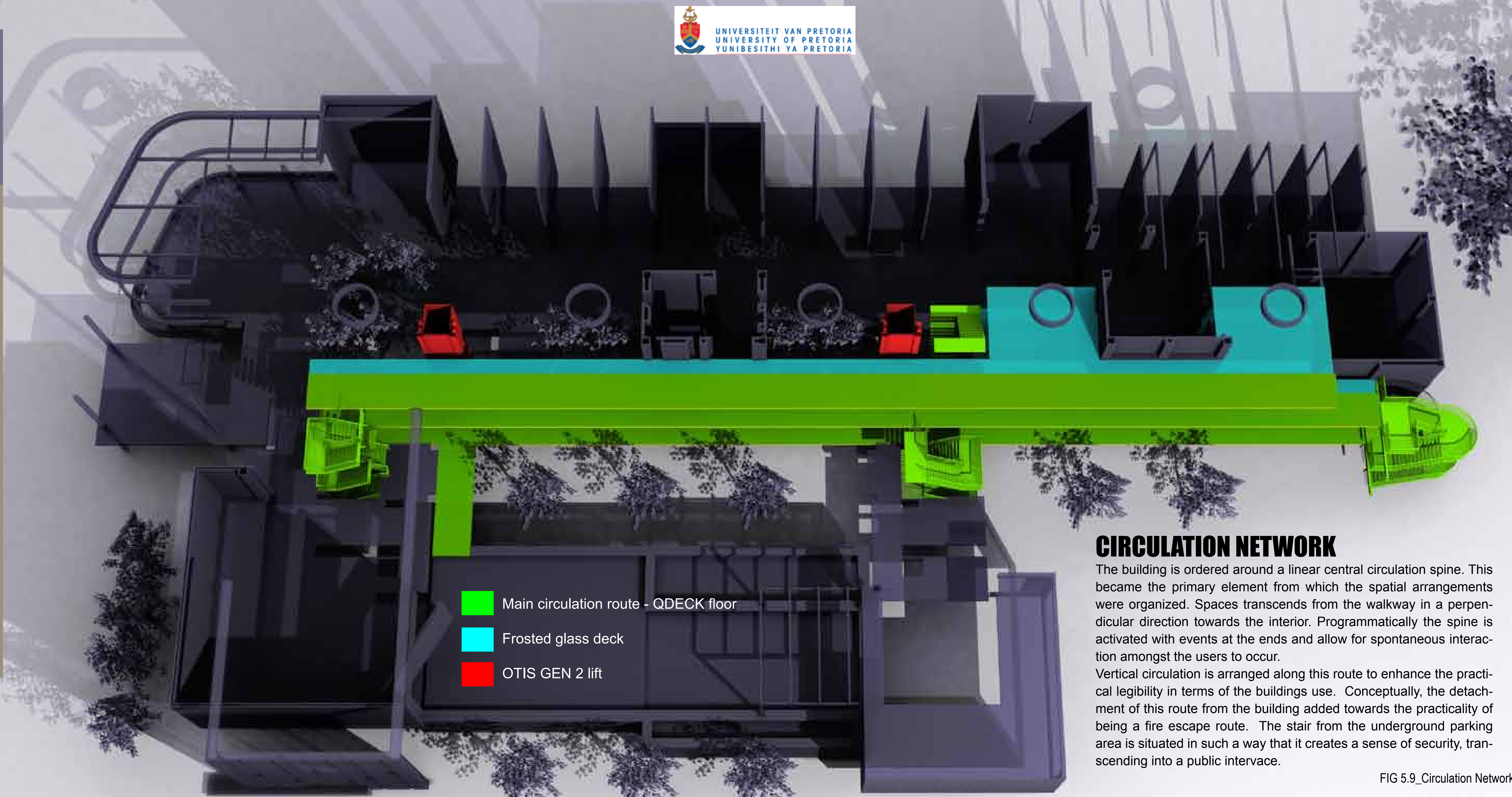


FIG 5.8_Brick infill and circulation support



CIRCULATION NETWORK

The building is ordered around a linear central circulation spine. This became the primary element from which the spatial arrangements were organized. Spaces transcends from the walkway in a perpendicular direction towards the interior. Programmatically the spine is activated with events at the ends and allow for spontaneous interaction amongst the users to occur.
Vertical circulation is arranged along this route to enhance the practical legibility in terms of the buildings use. Conceptually, the detachment of this route from the building added towards the practicality of being a fire escape route. The stair from the underground parking area is situated in such a way that it creates a sense of security, transcending into a public intervace.

FIG 5.9_Circulation Network

Service cores

The stereotomic brick boxes adjacent to the walkway provided the opportunity to use as an integrated service core for the office areas. This allowed for ease of access and maintenance. The requirements of downpipes within the mass cavity walls of the brick boxes is calculated which feeds rainwater into underground storage tanks. Firefighting equipment such as hose reels and fire hydrants is integrated into all service cores providing legible and ease of access in case of emergency.

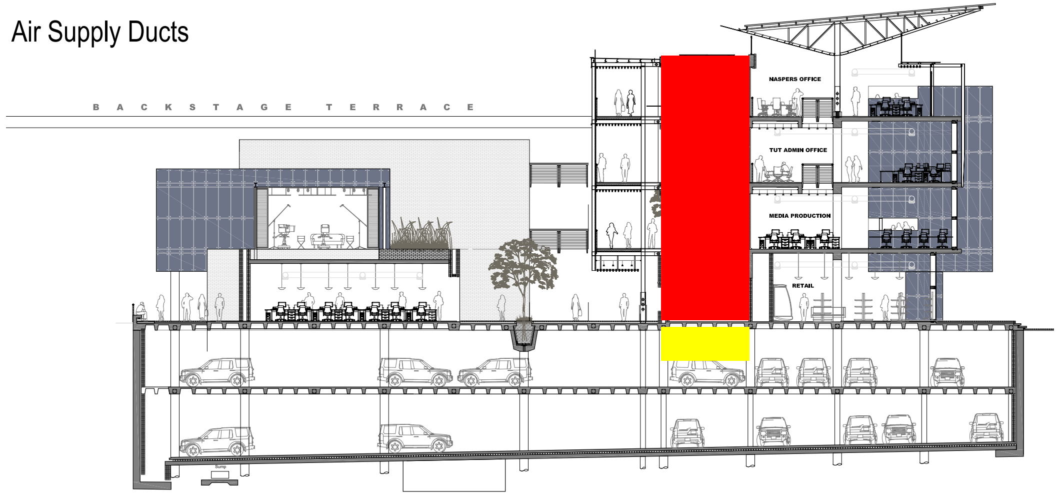
Fresh air supply runs within these cores to feed office spaces, Due to the openness of the building which creates natural air circulation, a mechanically ventilated fresh air system is implemented. Natural and fresh air intake unit is located at the western end of the building. Pipes feed this air into a water tank, cooling the air before it's distributed into the building. This does not provide air-conditioned air, but will assist with fresh air requirements.

Programmatically the office service core is separated from the wet core to optimize natural ventilation and maximum floor area. The natural rainwater system is discussed in the next section.

Service Core

Air Supply Ducts

FIG 5.10_Air service core diagram



Water systems

The site falls roughly 1m from Church Street towards the Eaton Louw building (north). Hard surface above the new proposed underground parking provided the opportunity to slope the whole surface area and collect storm water accordingly. This was not used as the roof dimension of the intervention was enough to harvest natural water for refuse rooms and air-cooling plant. Storm water from the roof surfaces is collected, stored and filtered in a storage tank directly below the ablution facilities and underground parking floor.

Daily amounts of water can be pumped with a submersible pump, driven by solar energy, into a holding tank located directly above the ablution facilities. This will provide enough head pressure to fill all water closets and refuse rooms. The holding tank method can be implemented for an evaporative cooling system (sprinklers) around public square. This however, will not be used as it is a potential health risk.

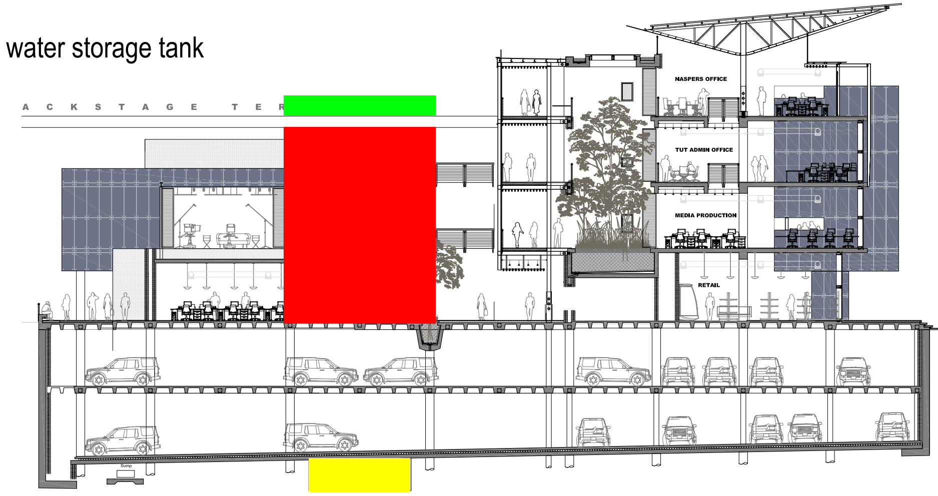
The supply of hot water for kitchen areas and be obtained by means of solar water heaters. To avoid heat loss, these units are located above all kitchen areas, where roof up stands provide the additional visual barrier. (Ryker, 2007: 71) All other storm water on the site is connected to the municipal outlet in order to release overflow, daily use and prevent floods.

Wet Core

Undergroung water storage tank

Holding tank

FIG 5.11_Wet core diagram



Precedents

This building is specifically chosen as it challenges the monolithic, enclosed architecture of the context in a humane and contemporary manner. The idea of urban stage benefits from the buildings transparency which encourages social consciousness and interaction.

While similar in proportional experience; the dissertation draws heavily upon the circulation network of the law Faculty which is designed to be a city of buildings organized along a street. Spatially it becomes a series of courtyards arranged along a public walkway. This provides the primary ordering system to which spatial programming relates to. The concept of “campus within a campus” (Deckler, 2006: 107) also shares similar interests with the dissertation as safety and security is of concern.

The linear route has been expressed to create a narrative between interior and exterior spatial experiences. This route is separated from the building which leaves interior spaces unhindered, whilst also serving as a social interactive space.

The dissertation shares the same interior scale of the law faculty. Open-air courtyards inside the building expresses a village like scale of naturally planted squares surrounded by colonnades carrying shading elements. These courtyards also provide a sense of orientation, time of day, and allow air circulation.

The entrance is located at the narrowest point of the circulation route which provides views through the building. This hosts an example of mass to opening ratio.

The rigid window placement in the mass outer wall also compliments a rich architectural tectonic relationship between the stereotomic mass. Auditorium and lecture rooms push out of the rigid building as sculptural forms which contrasts the linear envelope is of interest as well.

The transparency and openness of the library compliments the dissertation as it creates a sense of interaction, awareness, participation and encourages the idea of event.

LAW FACULTY UNIVERSITY OF PRETORIA STUDIOKRUGERROOS ARCHITECTS

FIG 5.11_External walkway and roof canopy

FIG 5.12_External walkway

FIG 5.13_Sculptural staircase

FIG 5.14_Internal courtyard

FIG 5.15_Internal courtyard and staircase

FIG 5.16_External balcony

TOLPLAN HEAD OFFICE LYNNWOOD_PRETORIA_THOMAS GOUWS ARCHITECTS

These precedents were chosen to display the means in which architects addressed facade transition, roof, gutter and structural spans.

The first precedent, Tolplan Head Office, is chosen by means of its facade articulation. Rectangular columns transgress out of a brick wall into horizontal fins with steel sections supporting a lightweight mono-pitch roof which reads as a separate plane. This allows for a spatial connection whereas exterior space transcend into the interior. The fins also act as an early morning, late afternoon shading element in the summer. Weaver's nest builds on the spatial transition of the Tolplan office. The external circulation spine is experienced as dwelling within nature. This progresses into a solid mass, played down to human scale which opens up into a "dramatic sky room" connecting to the outside.

Regular geometry adds to the design, strengthening its legibility and coherence. The liveliness of the roof serves as the pavilion's binding element. This frames spatial transitions between built fabric and natural landscapes.

The structural spans of the Tolplan Office and Weaver's Nest, leaves internal spaces unhindered and allows for the space to open up towards the outside.

The Diamond Hill Toll Plaza's floating roof canopy is achieved with a steel lattice truss construction which leaves the road unhindered by structural supports. The exposed underside adds a industrial, yet sculptural quality to the canopy.

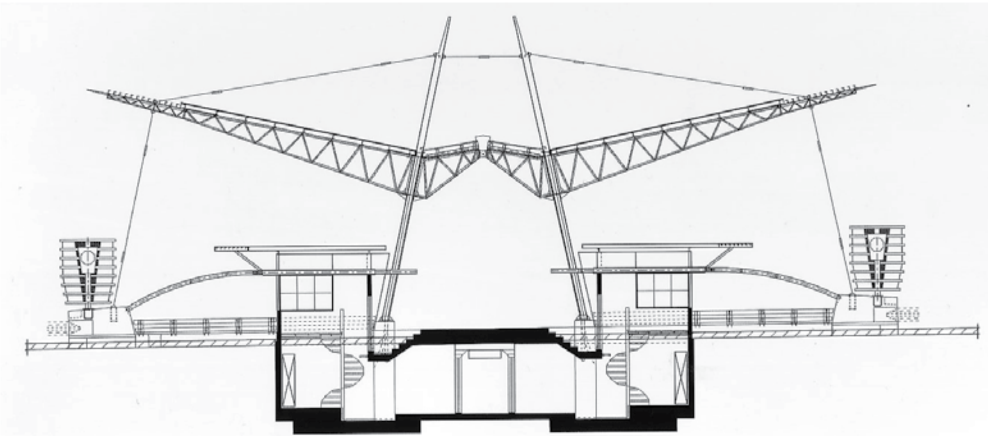
FIG 5.18_Honesty towards properties of material mebers shown in differential grids.

FIG 5.19_Concrete elements for solar control and spatial directionality supports a lightweight framing roof element.

FIG 5.20_Sculptural roof with gutter edge line

FIG 5.21_Open circulation transcends into human scale mass with binding roof as opening guiding internal and spatial directionality.

FIG 5.17_Sculptural roof with gatture edge line



DIAMOND HILL TOLL PLAZA_N4_GAUTENG_MATTHEWS & ASSOCIATE ARCHITECTS

WEAVER'S NEST CAPE TOWN_SONJA PETRUS SPAMER ARCHITECTS

NIEHAUS ART GALLERY CLAREMONT_CAPE TOWN_NORBERT ROZENDAL

The library facade's technical resolution of the Media Lab draws upon the structurally glazed facade and adjustable shuttering system of thie IDMM Link building.

The facade is treated with a Pilkington four-point structural glazing system. Spider clamps attached to supporting frames with steel posts as support, allows for the glazed panels to articulate around a curve. The structure of the mechanical regulated shutter system is re-interpreted with a GKD Media Mesh infill as layering and shading element for the curved glazing skin of the Media Lab.

The material tectonic applied in the dissertation draws heavily upon the Tolplan Office. The Niehaus Art Gallery also compliments the intended theoretical approach towards the aging qualities of architectural design. The weathered materiality is strengthened with attention to detail consisting of flush joining in order to read as a singular solid mass element. These two precedents with its combinations of timber, steel, glass, concrete and bricks provided a platform from which architectural materials were used in the design process.

Transparent glass floor is a popular architectural element in contemporary design. This consist of laminated glass or reinforced glass panels combined with a steel various frame supports. Frosted glass blurs visual images, but still transmits natural light. This system was implemented as it complements the design concept and social qualities of media production.

FIG 5.22_Niehaus art gallery

FIG 5.23_Niehaus art gallery roof detail

FIG 5.24_Niehaus art gallery roof and sculptural facade

FIG 5.25_IIDMM facade

FIG 5.26_Frosted glass deck underside

FIG 5.27_Frosted glass deck support detail

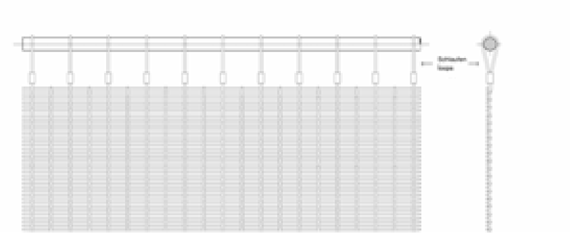
IIDMM LINK BUILDING CAPE TOWN_GABRIEL FAGAN ARCHITECTS

FROSTED GLASS WALKWAY

Gkd creativeWEAVE mesh facades

The southern facade displays the various facets of media production from being a student to a professional journalist. The corner of Church Street and Nelson Mandela Drive displays the final product to create a sense of arrival into the cultural district and inner city. By embedding this technology into the architectural design communicates the idea of urban stage giving it a more dynamic quality than merely a static display system, delivering constant cultural messages.

Media Mesh is essentially a transparent stainless steel wire mesh with interwoven LED (light emitting diodes) light profiles which uses 20 times less energy than the average light bulb. This enables the screen to reflect images, text and even video. The grouping of the three primary colors creates image pixels. The resolution of the image is dependent upon distance of view and pixel density. This is determined by the vertical and horizontal spacing of the lamella or stainless steel tubes encapsulating the LED profiles.



Adequate viewing distance can be obtained from 20-30 meters away. The transparent nature of the mesh allows for internal experiences to still connect with the outside, keeping the integrity of the design to form part of. The advantages of Media Mesh include:
-diversity in size and means of application
-adds to sensory qualities of the building
-daylight display capabilities
-weather resistant
-low power use, maintenance and long life span

Discussion with the GKD representative, Catherine van Blerck, concluded that the media mesh along the curve facade must span vertically and the top and bottom brackets of the mesh be supported in a steel frame. (www.gkd.co.uk)