

Chapter

This chapter deals with the technical investigation conducted for the dissertation. Various technical aspects have been three-dimensionally illustrated so that the reader can visualise these technical aspects as an integrated whole throughout the spatial design of the project. Relevant precedents have been included so that the body of work done for the technical documentation can be understood through an analysis of informed built examples. These examples were chosen so that the principal aspects highlighted within them can be reinterpreted within the scope of the design.

5

Tectonic development

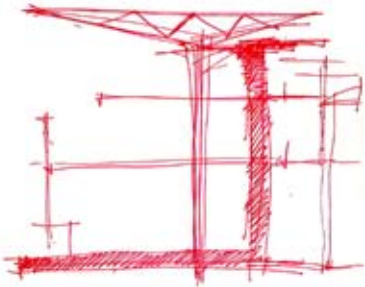


FIG 5.1_Tectonic section illustrating the essence of the structural logic

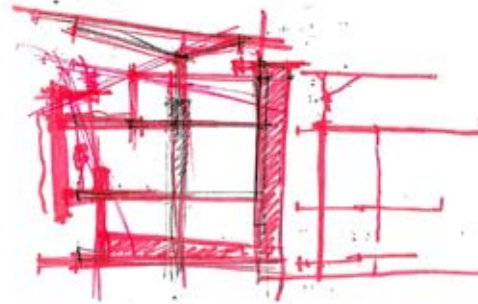


FIG 5.2_Tectonic language illustrated on diagrammatic section

The tectonic development was guided by the theoretical argument so that each of the technical aspects could relate back and appropriately strengthen the design. The experiential aspect of the design provides the basis for the design decisions. It was important that these experiences occur on a human scale so that the user can be made aware of the materiality, spatiality, massing and light quality within the architecture. Resulting from this the materials chosen had not only to convey the tectonic and conceptual approach, but also had to satisfy the practical cost, construction and thermal requirements of the project.

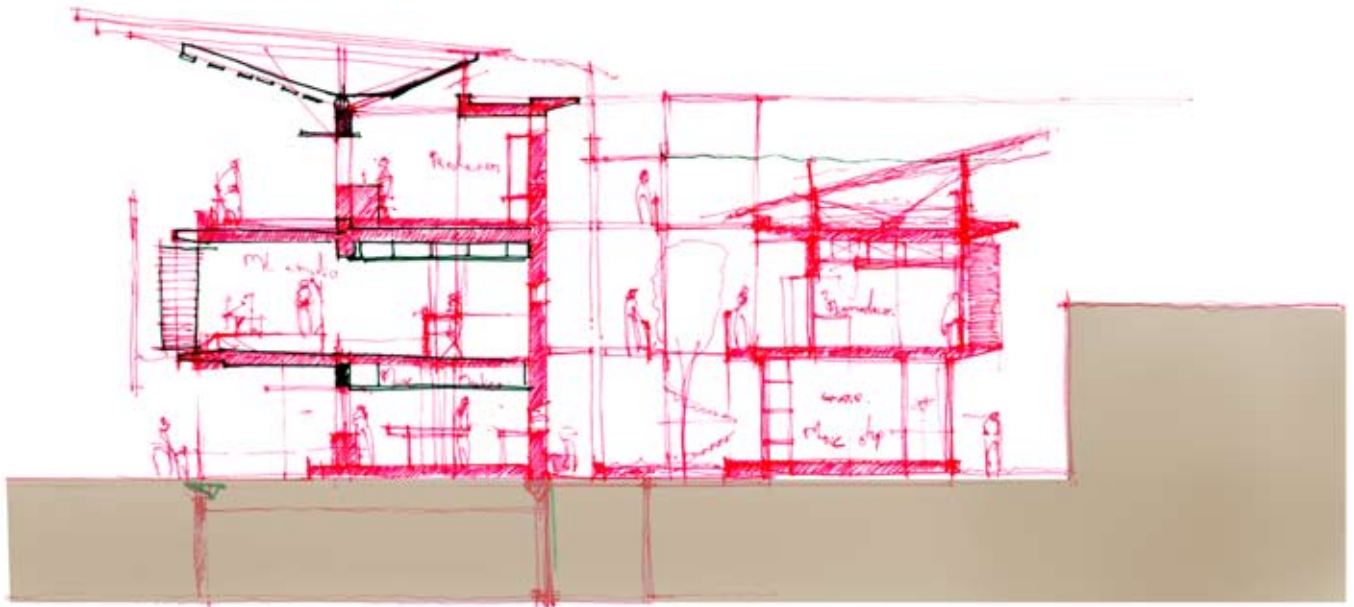


FIG 5.3_Section through MK Live room

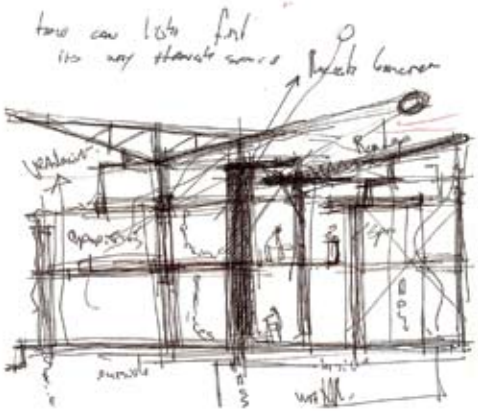


FIG 5.4_Structural system explored in relation to sun angles

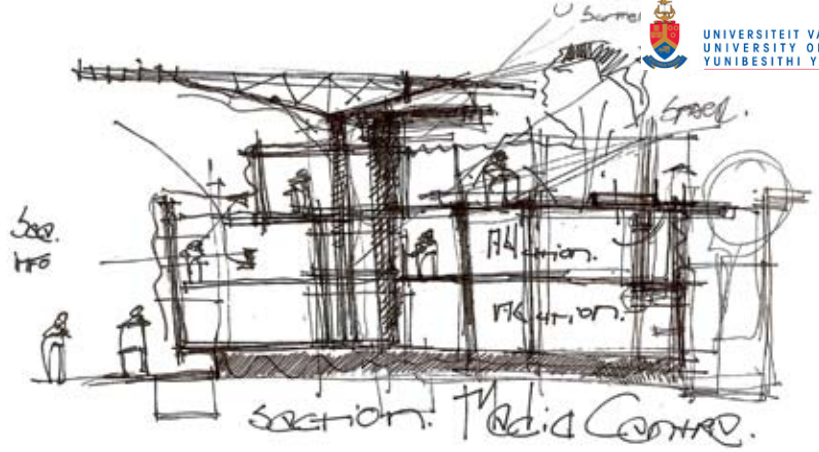


FIG 5.5_Spatial section through Resource library

The development process shown illustrates the process the design underwent to simplify the various facets of the design so that all parts collectively form part of a legible structural system. Due to the fact that the design, on a site scale, incorporated a super-level basement, the structural spacing of the basement was projected vertically so that a readable order within the building can be seen.

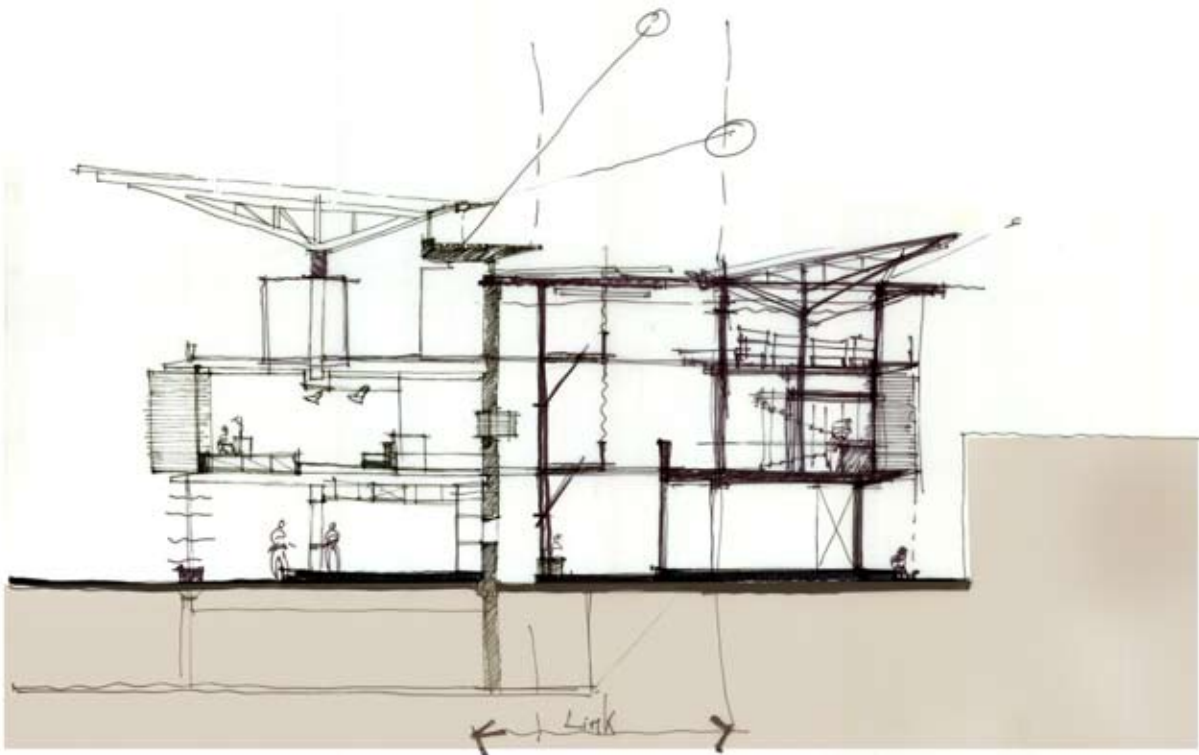


FIG 5.6_Section taken through recording booths and MK live room

STRUCTURAL GRID

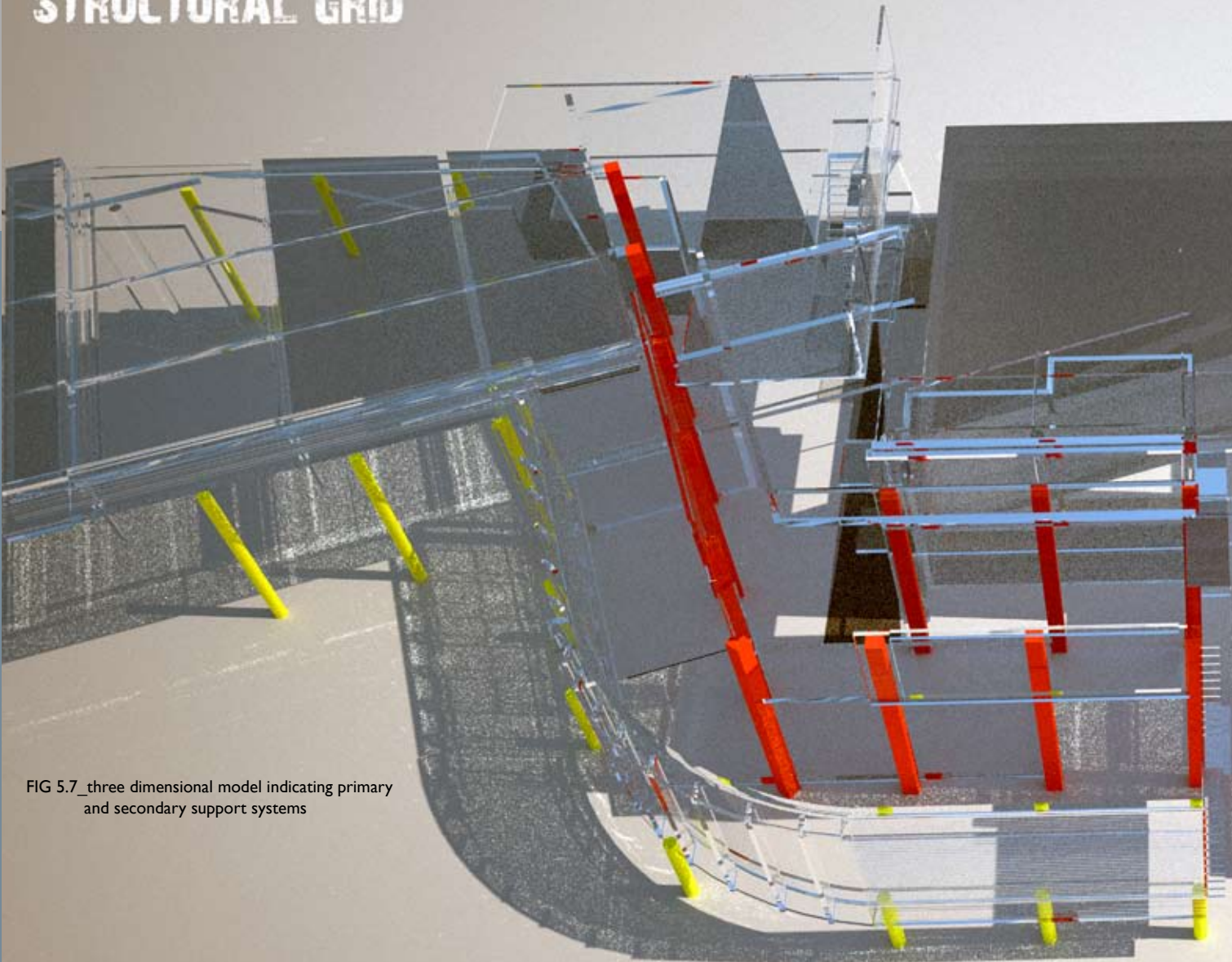
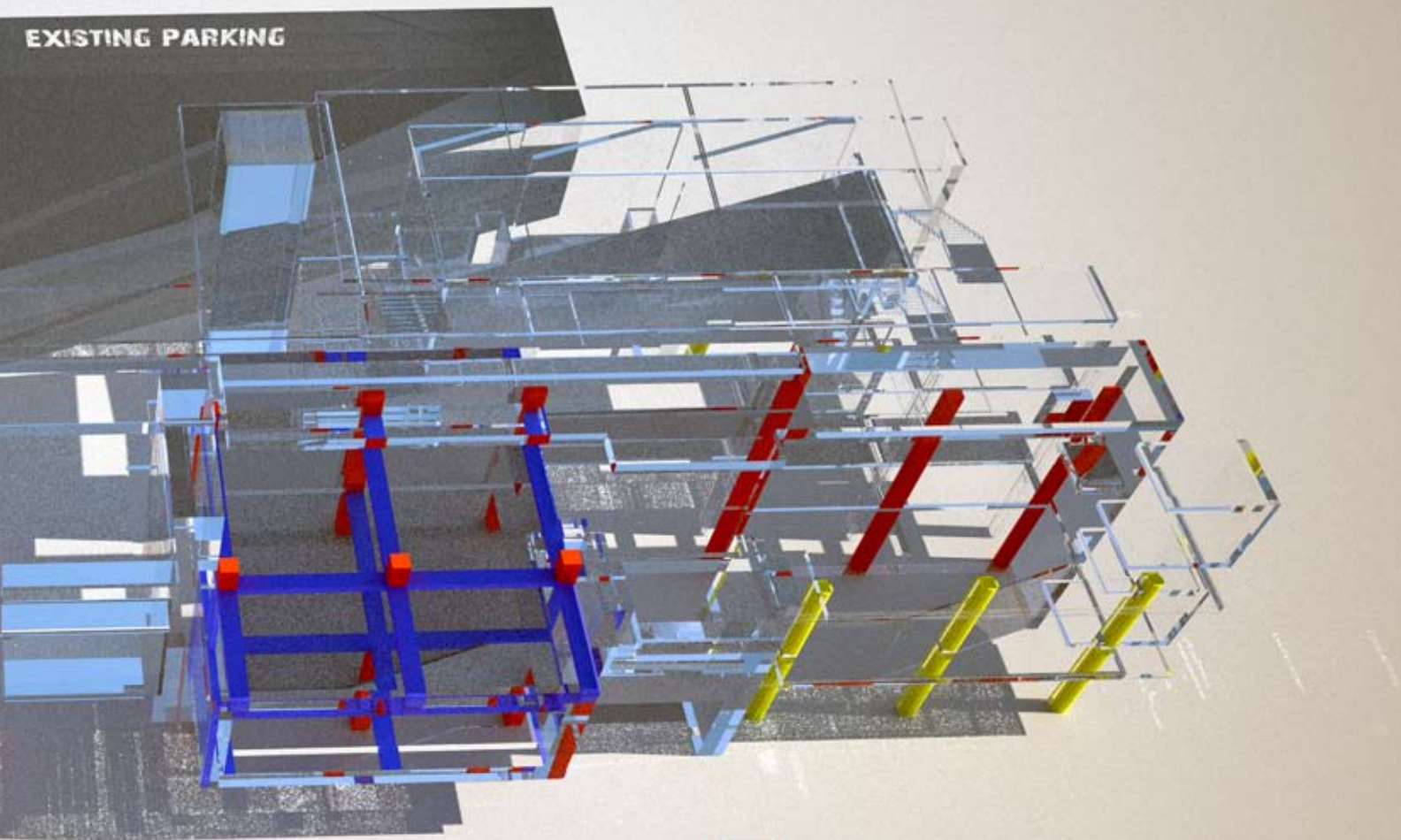


FIG 5.7_three dimensional model indicating primary and secondary support systems

The primary structural system employed within the building is a concrete frame and beam system with concrete flat slabs between floors. The layout of the basement is done in such a way that the column spacings are at intervals of 5 and 8 metres in an east-west orientation and a 6 metres spacing in a north-south direction. A structural rhythm of 558 can be seen in the front façade. This provides the opportunity for the structural system to articulate the primary and secondary entrances with the 8 m spacing. The primary columns are rectangular in shape due to the immense forces applied to the structure from the roof. The secondary columns are circular in shape to allow a spatial continuity between the internal and external space. The projected concrete cantilever was designed in conjunction with a structural engineer.



PRIMARY 550MM X 550MM REINFORCED CONCRETE COLUMNS

SECONDARY 460MM DIAMETER REINFORCED CIRCULAR CONCRETE COLUMNS

550MM X 650MM REINFORCED CONCRETE BEAMS SUPPORTING CONCRETE CANTILEVER

BRICK INFILL AND CIRCULATION SUPPORT SYSTEM

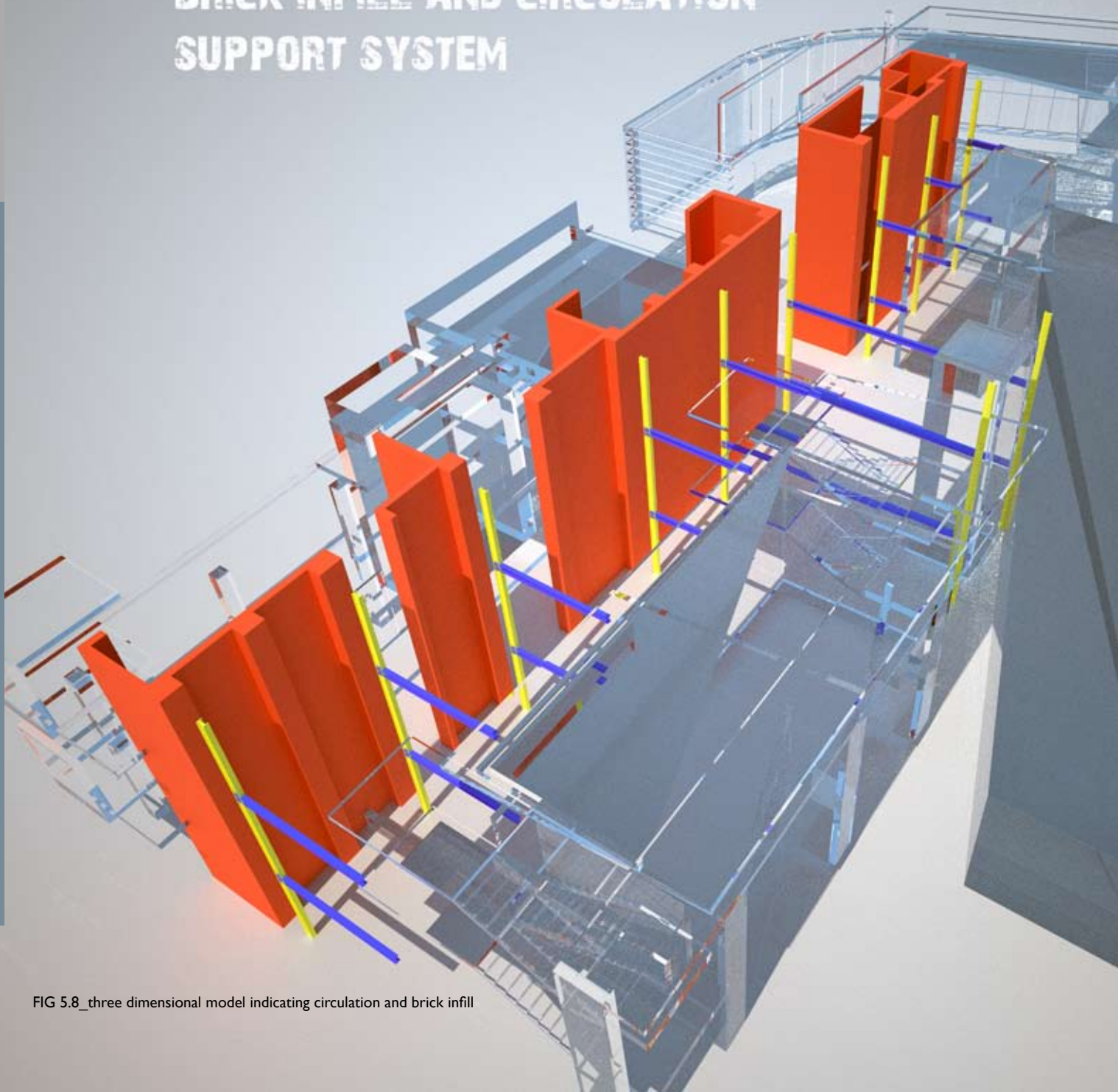


FIG 5.8_three dimensional model indicating circulation and brick infill



MASONRY INFILL THE WALL



**254MM X 171MM GALVANISED MILD STEEL
VERTICAL SUPPORTING COLUMNS**



**254MM X 171MM GALVANISED MILD STEEL
HORIZONTAL BEAMS**

The **WALL HIGHLIGHTED IN RED** plays an important role, not only in the conceptual approach of the building, but also in the tectonic and experiential language thereof. Due to the fact that the primary structural system consists of concrete columns and beams, the wall has been designed to read as a singular brick mass and not as brick infill with the concrete frame visible, as is often the case with concrete-framed buildings.

This has resulted in a substantial thick cavity-wall construction. The thickness of the wall provides the necessary acoustic requirements needed within the recording studios. The thermal mass that the wall provides also satisfies the thermal properties required within a building located within the Pretoria context. The circulation is separated from the wall and comprises a secondary structural system of steel columns and beams. Due to the experiential aspects of the building the chosen articulation for the circulation resulted in a morphology that can be described as a light filter.

Due to the directly northern location of the building it was important for the detached circulation network not to block light from the building interiors but allow the required sunlight and shade requirements within the building to filter through. The circulation route was designed in such a way that it drapes dramatic shadows onto the wall mass, creating a sensory experience as one moves along the linear arrangement.

CIRCULATION NETWORK

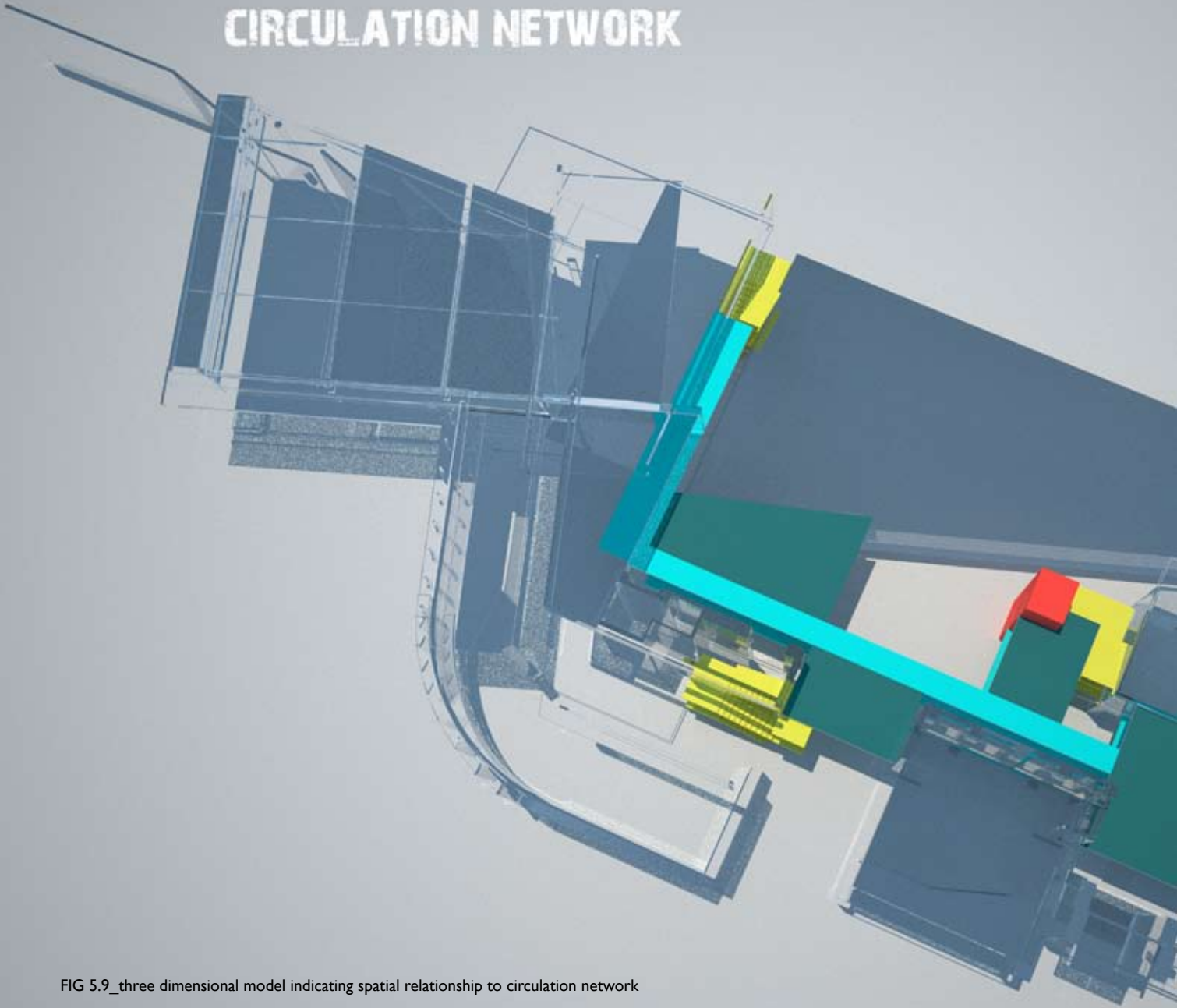


FIG 5.9_three dimensional model indicating spatial relationship to circulation network



OTIS GEN 2 LIFT



STAIRCASES



PRIMARY CIRCULATION SPINE



NETWORK OF SPACES ATTACHED TO PRIMARY CIRCULATION SPINE

The building is ordered around a linear organisational arrangement of circulation. The image illustrates the relationship of spaces along the route. The spatial directionality changes at point (A). This is the result of the programmatic layout of the studio control tower, which is visually connected across the internal courtyard. Resulting from this, the spatial order intersects the linear circulation and the orientation changes to accommodate the functional requirement situated at the back of the building.

For ease of public use the vertical circulation networks are situated at the end points of the circulation route, with the primary circulation located to the right of the internal courtyard. The externally detached circulation routes add to the safety of occupants in case of a fire.



R oof

The technical resolution of the primary roof has played a pivotal role in the chosen technology employed for the roof. As can be seen from the chosen process diagrams, a thorough investigation into the structural arrangement of the trusses has been undertaken so that they are only centrally supported. Initially the response was to follow the perpendicular angle to the circulation. Because the primary roof responds to both geometries, this approach resulted in an inefficient roof truss construction increasing in size to accommodate the two geometries.

As can be seen on the following pages, a simpler approach to the roof grid was adopted, allowing for the primary roof to respond only to the diagonal grid. This allowed for the standardisation of roof trusses, with each truss identical.

Spatially the roof responds to the conceptual approach and opens out towards the stage and film studios, which reflect the climax in the performing arts industry. The roof is separated from the wall element. This allows for the space to be connected from the two sides of the intervention, strengthening the presence of the wall as a separate element.

The underside of the truss spatially portrays trueness to the constructed form of the roof. This creates a spatial experience with efficient southern light within the spaces, but also allows winter sun to filter into the interior of the building while unwanted summer sun is excluded from the interior of the office space due to the correct amount of overhang provided by the designed gutter.



FIG 5.10 Projected truss sketch exploring roof orientating responding to perpendicular grid

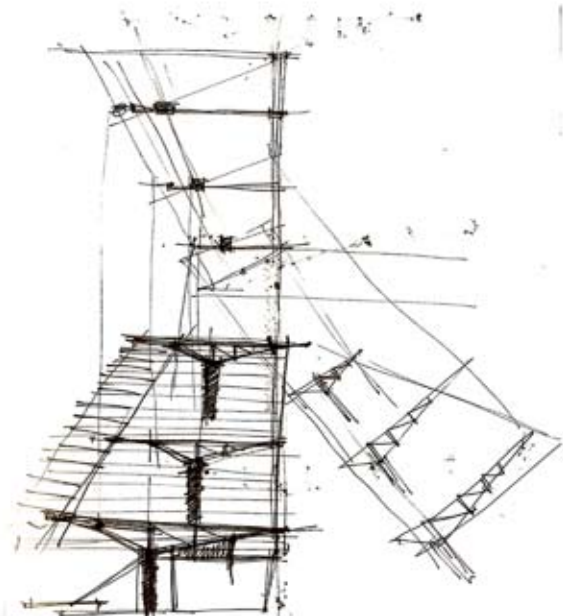


FIG 5.11 Roof development sketch

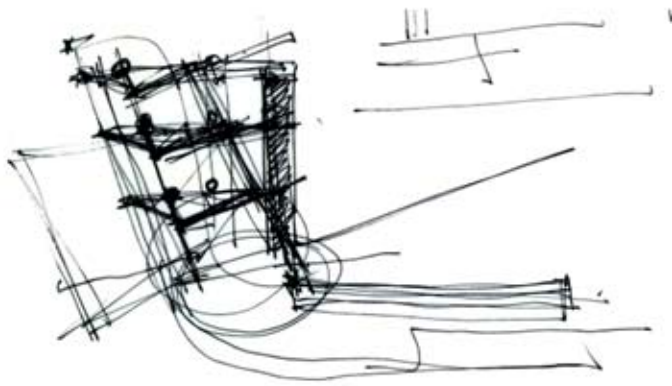


FIG 5.12_Roof plan diagram

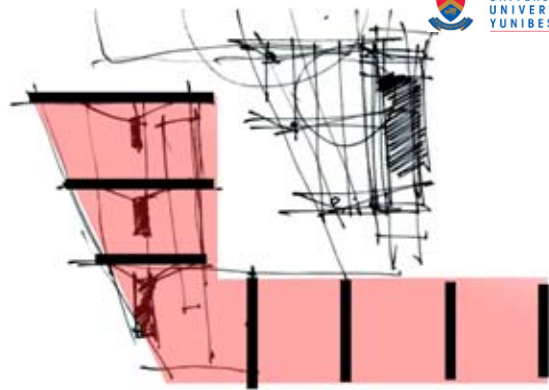


FIG 5.13_Roof plan diagram indicating initial roof shape responding to both grids

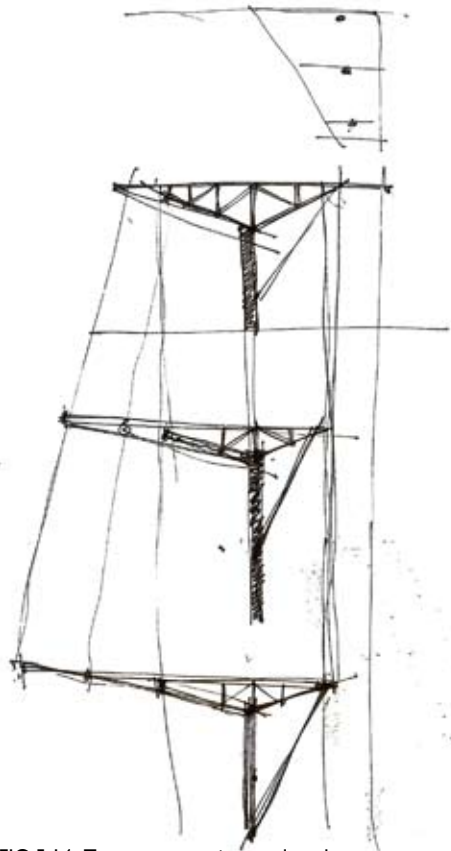


FIG 5.14_Truss construction explored

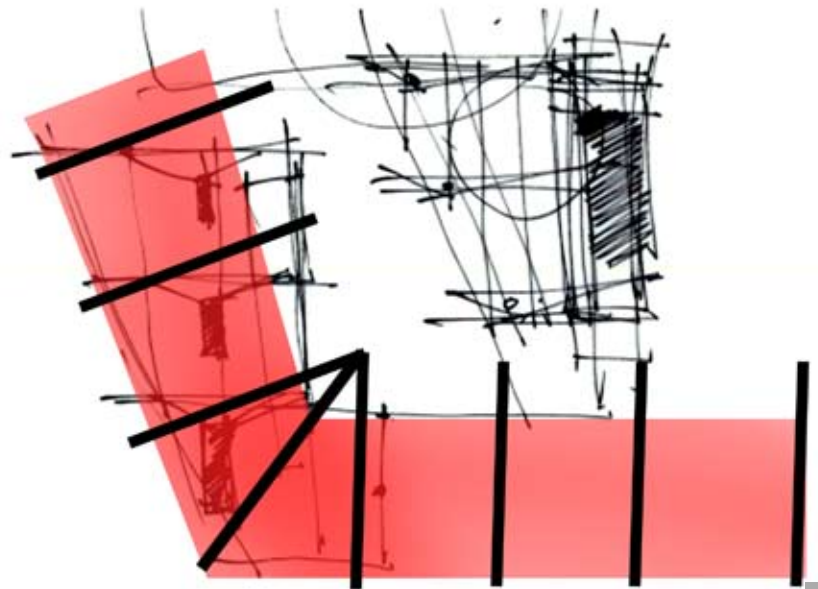


FIG 5.15_Diagrammatic roof plan of intended truss spacing with resulting roof form

ROOF CONSTRUCTION

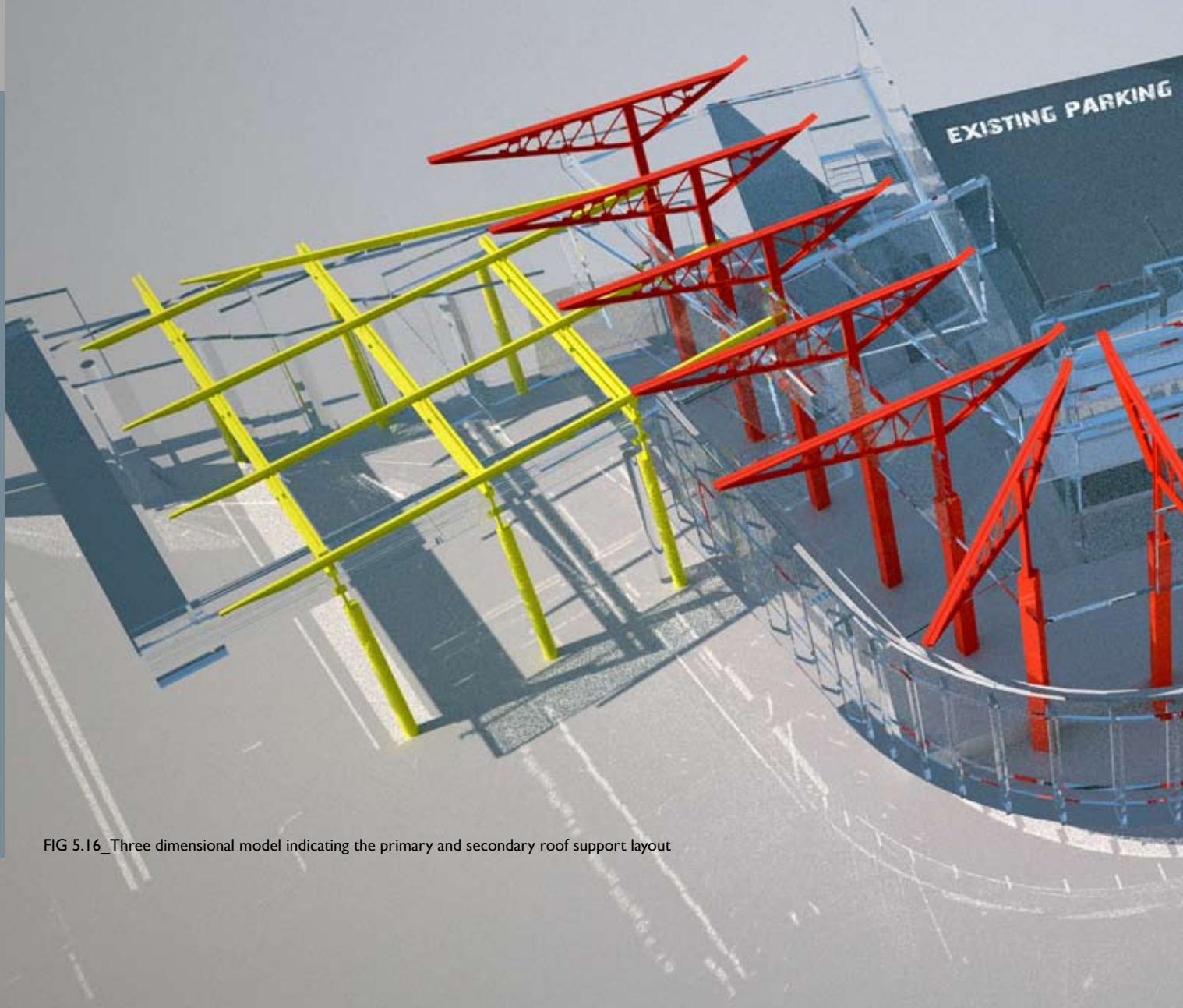
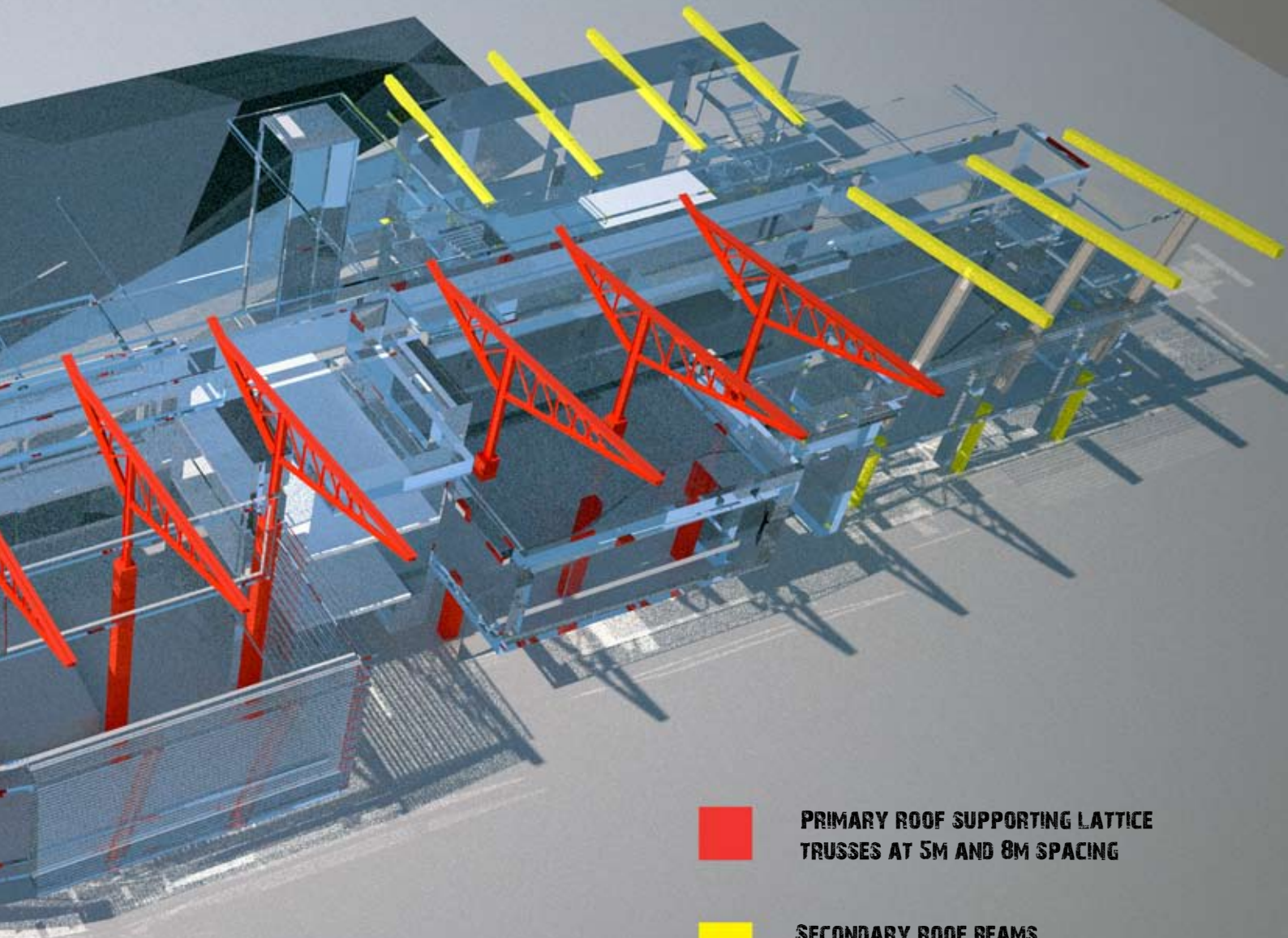


FIG 5.16_Three dimensional model indicating the primary and secondary roof support layout



PRIMARY ROOF SUPPORTING LATTICE TRUSSES AT 5M AND 8M SPACING



SECONDARY ROOF BEAMS

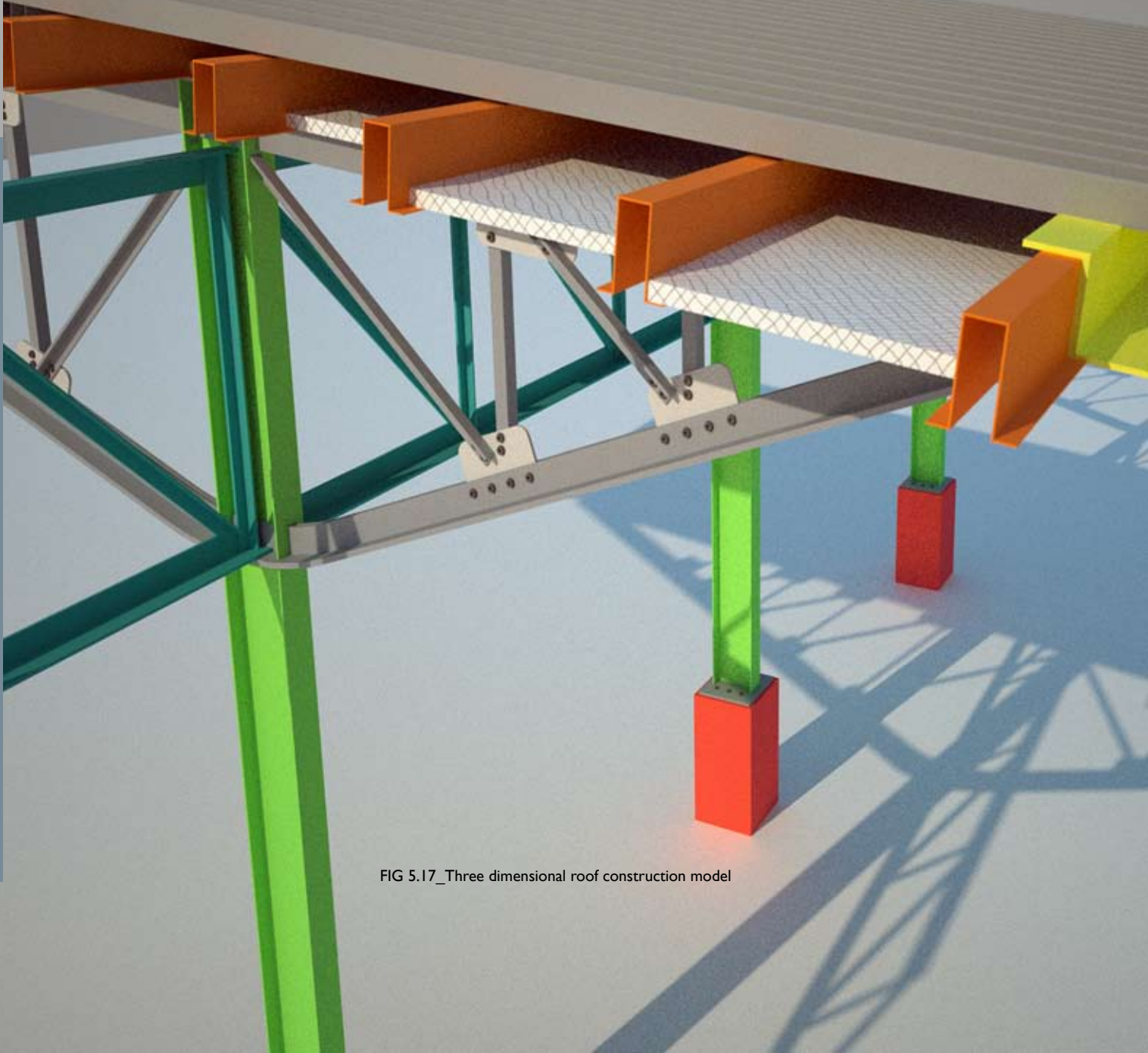


FIG 5.17_Three dimensional roof construction model



550MM X 550MM REINFORCED CONCRETE COLUMNS



**356 X 171X 51MM GALVANIZED STEEL
COLUMN WELDED ONTO 450 X 450 X 20MM
BASE PLATE**



**228 X 100MM LIGHT GAUGE STEEL TOP HAT LIPPED
CHANNELS AT 1100MM CENTERS**

Purlin size: Max span 8000mm/slenderness ratio of 35 $8000/35 = 228\text{mm} \times 100\text{mm} \times 4$ purlin



**PURPOSE MADE GALVANISED MILD STEEL STRUCTURAL
GUTTER FLASHING SUPPORTED OVER TOP HAT SECTION**

Gutter size: Roof 3 area Main roof: = $841,66\text{m}^2$
 $140\text{mm}^2/\text{m}^2$ required by building regulations
Total Gutter required for roof3:
 $841,66\text{m}^2 \times 140 = 117832,4 \text{ mm}^2$
Current gutter area: $229243,88\text{mm}^2$



**BROWNBUILT GALVANIZED MILD STEEL ROOF SHEETS
WITH 1200 X 600MM SAGEX BOARDED ROOF INSULATION
SUPPORTED BETWEEN TOP HAT SECTIONS**

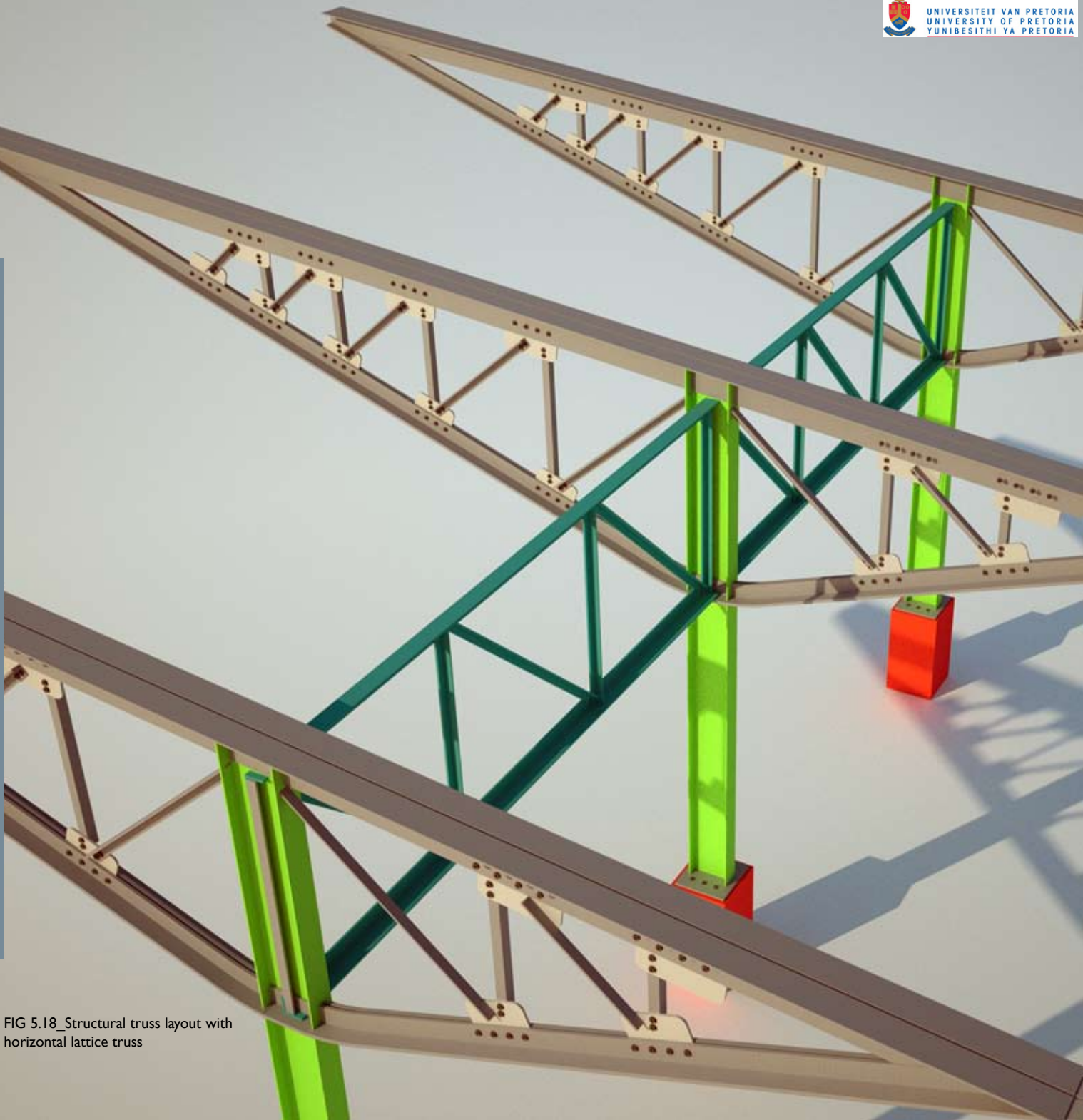


FIG 5.18 Structural truss layout with horizontal lattice truss



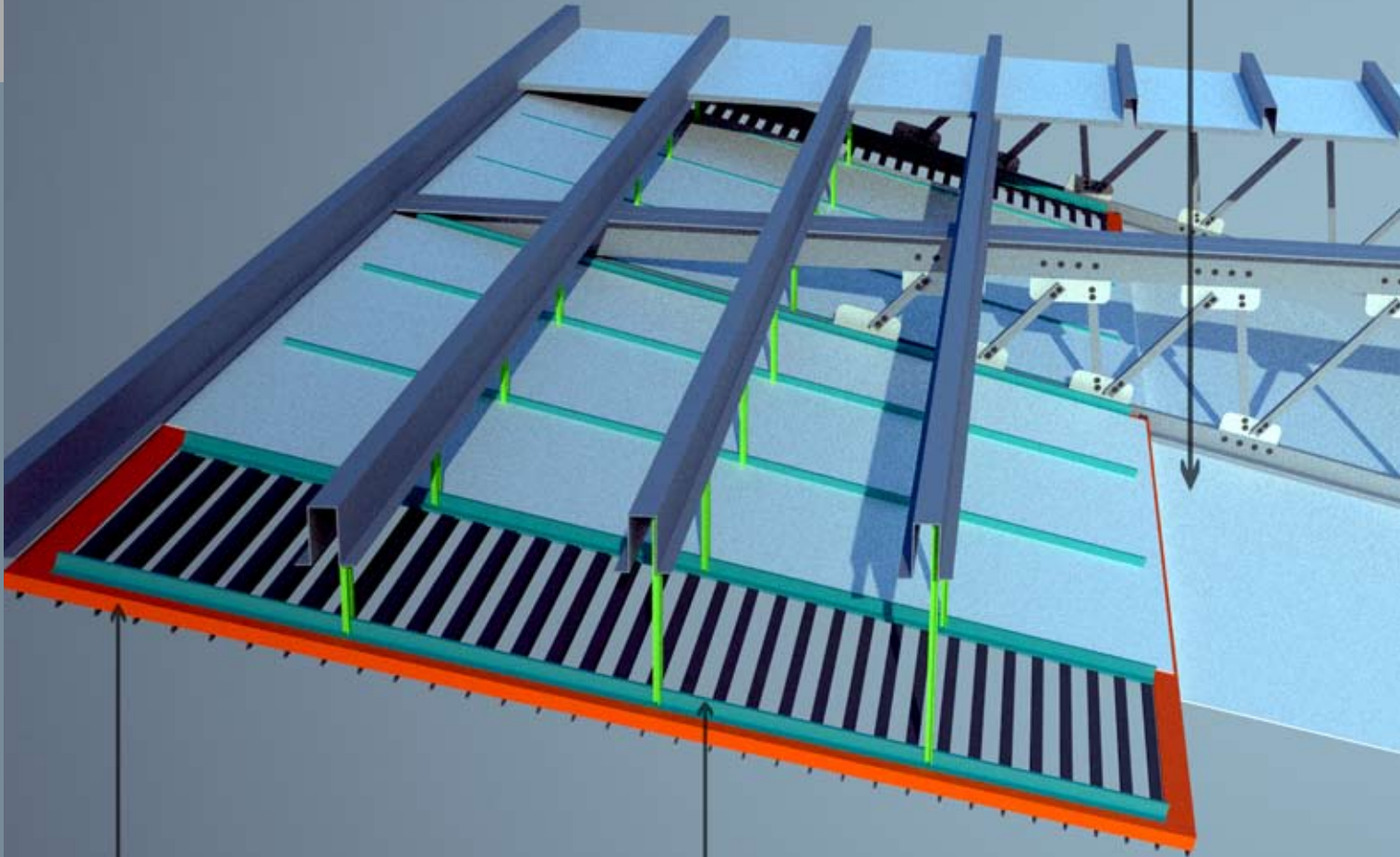
2X MILD STEEL ANGLES BOLTED TO FORM TOP SUPPORTING MEMBER WITH 2X STEEL ANGLES AS BOTTOM SUPPORTS WITH DIAGONAL AND VERTICAL STEEL ANGLE STRUTS BOLTED TO GUSSET PLATE TO COMPLETE PURPOSE MADE STEEL LATTICE TRUSS

HORIZONTAL LATTICE TRUSS SUPPORTED AT TRUSS INTERVALS TO PROVIDE LATERAL BRACING TO ROOF CONSTRUCTION

356 X 171X 51MM GALVANIZED STEEL COLUMN WELDED ONTO 450 X 450 X 20MM BASE PLATE

550MM X 550MM REINFORCED CONCRETE COLUMNS

FIBER CEMENT CEILING



**GALVANISED MILD STEEL ANGLE
FRAME SUSPENDED FROM PURLINS
AT 1250MM CENTERS**

**2 X GALVANISED MILD STEEL ANGLE
INTERMEDIATE SUPPORTS AT 1250MM
CENTERS**

FIG 5.19_Three dimensional roof construction detail

**PURPOSE MADE GALVANISED MILD STEEL
STRUCTURAL GUTTER FLASHING SUPPORTED
OVER TOP HAT SECTION**

Gutter size: Roof 3 area Main roof: = 841,66m²
140mm²/1m² required by building regulations
Total Gutter required for roof3:
841,66m² x 140 = 117832,4 mm²
Current gutter area: 229243,88mm²
Gutter is adequately sized

**GALVANISED MILD STEEL
ANGLE INTERMEDIATE
SUPPORTS AT 1250MM
CENTERS**

**GALVANISED MILD STEEL ANGLE
FRAME SUSPENDED FROM PURLINS
AT 1250MM CENTERS**

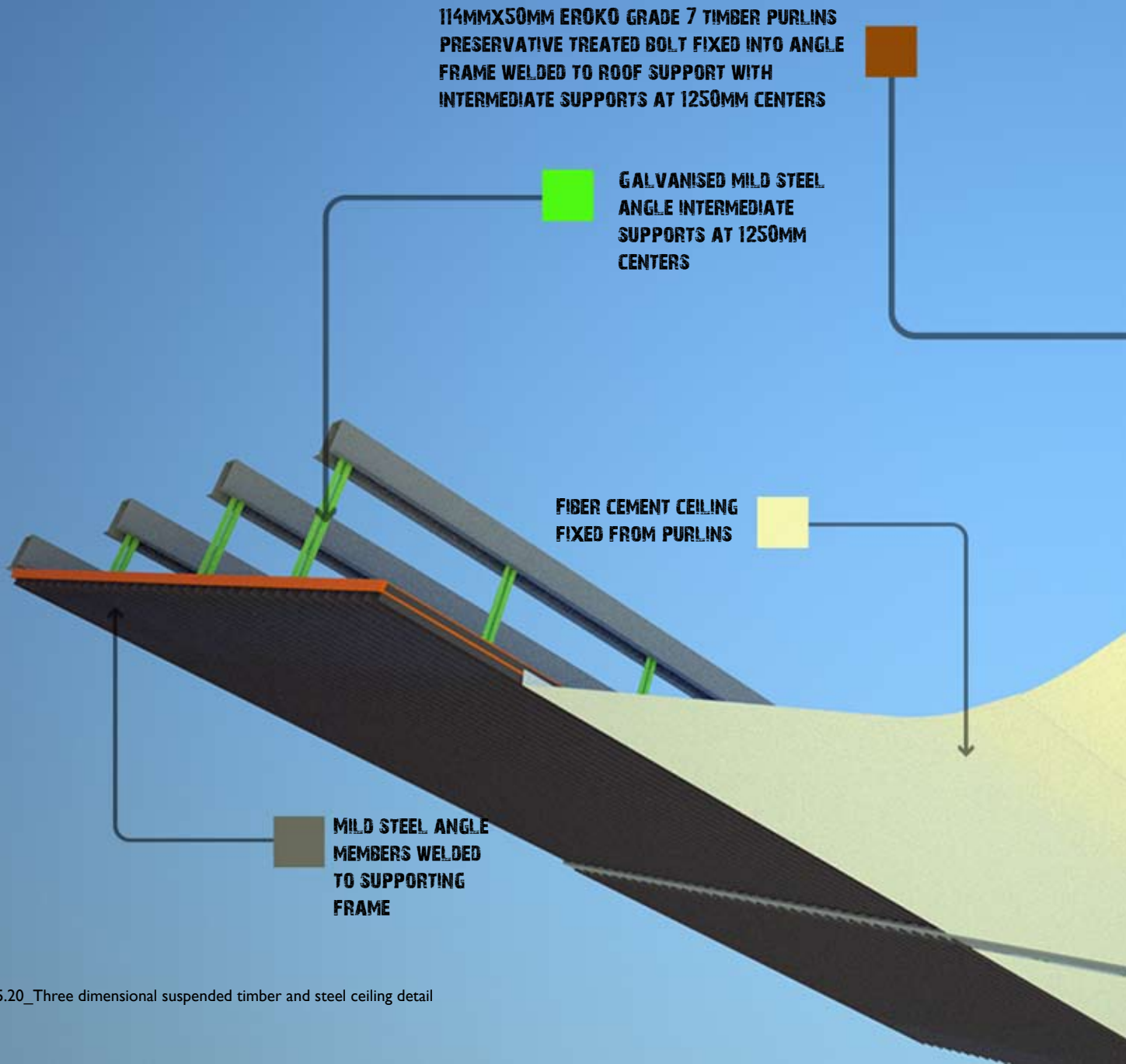
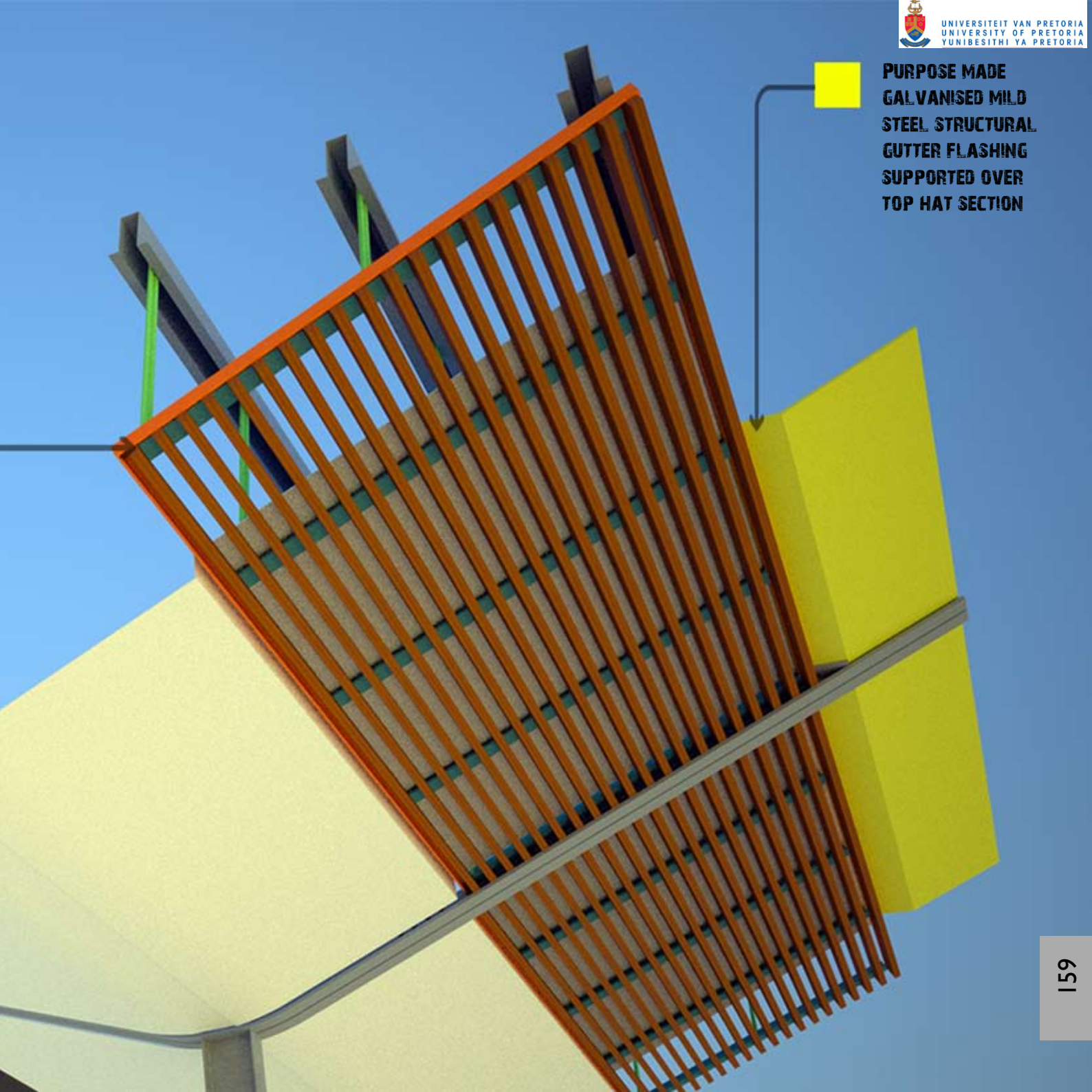


FIG 5.20_Three dimensional suspended timber and steel ceiling detail

**PURPOSE MADE
GALVANISED MILD
STEEL STRUCTURAL
GUTTER FLASHING
SUPPORTED OVER
TOP HAT SECTION**



Service cores

Due to the thickness and mass of the wall it was possible to adopt an integrated systems approach. The primary service cores are arranged within the wall, providing easy access to these cores via the external circulation. This allows for ease of maintenance.

The large amounts of rainwater collected from the roofs of the building were calculated and the downpipe requirements were satisfied by providing downpipes within the articulated brick columns.

Water catchment on the larger designed urban activity space, including roof runoff, was channelled to a central catchment tank. From this the water was stored in three separate tanks servicing each building's intermediate requirement.

Due to the slender section of the building, designed with a large internal courtyard, fresh air replenishment is provided by means of a mechanically regulated fresh air system. Fresh air intakes are situated behind the building and draw fresh air through a piped system located within the water tank, cooling down the fresh air to just below the natural air temperature before it is distributed within the building. This system does not provide air-conditioned air, but assists in the fresh air requirements for internal spaces. Due to the program of the building, care should be taken to ensure that all air handling units are fitted with a sound muffler to minimise unwanted noise that would disturb the recording processes.

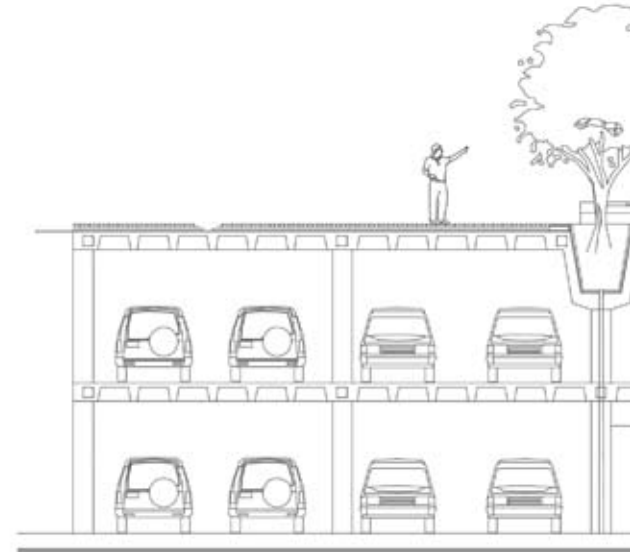
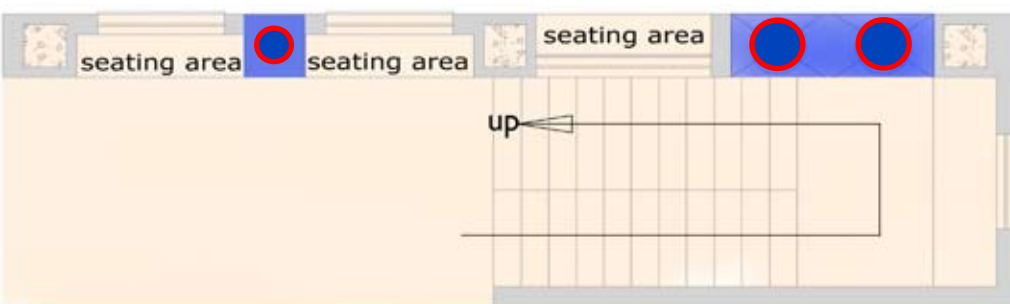
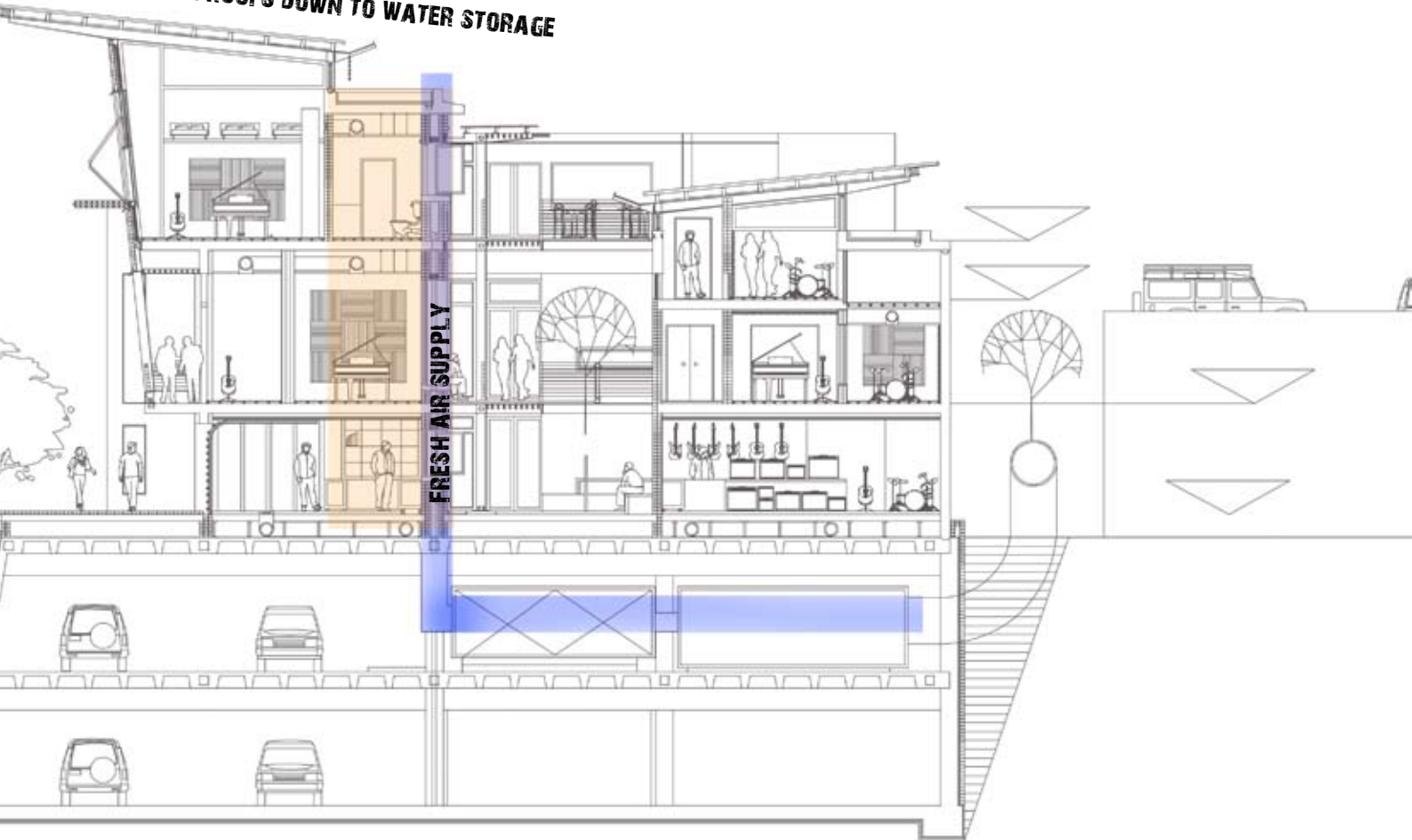


FIG 5.21 _Integrated services illustration

DOWNPIPES IN BRICK CAVITY

RAINWATER FROM ROOFS DOWN TO WATER STORAGE



**VERTICAL SERVICE
SHAFTS**

FIG 5.22_Integrated services shown on plan

VENTILATION SYSTEM

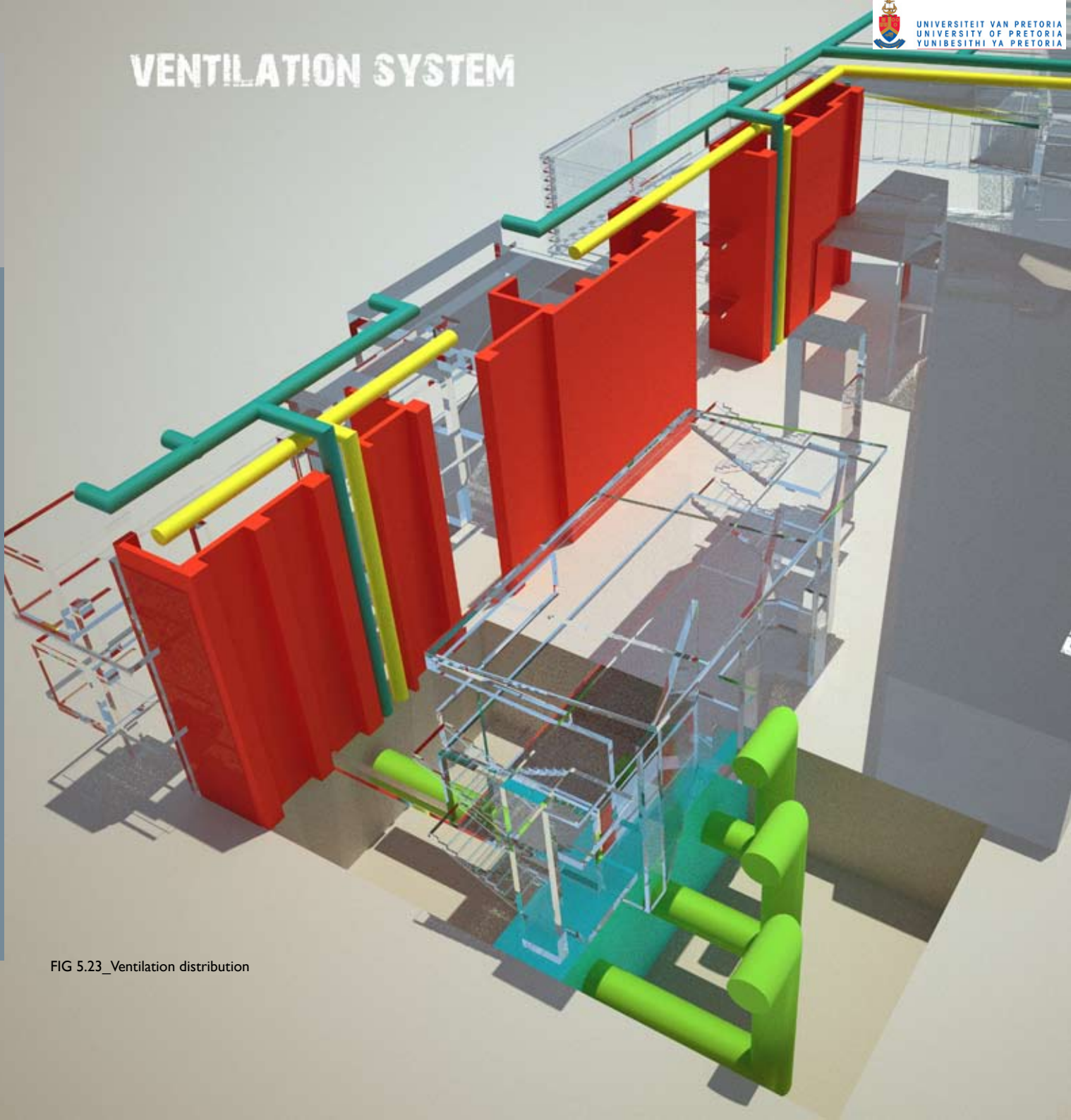


FIG 5.23_Ventilation distribution



BRICK INFILL TECTONICALLY AND SPATIALLY DEFINING THE WALL AS THE ORDERING SYSTEM CONNECTING THE VARIOUS PROGRAMMATIC REQUIREMENTS OF THE BUILDING INCLUDING THE INTEGRATED SERVICING SYSTEMS HOUSED WITHIN IT



DEPLETED AIR DRAWN IN THROUGH AIR INTAKES LOCATED WITHIN SUSPENDED CEILING AND FLOOR CAVITIES ENHANCING PASSIVE VENTILATION THROUGH BUILDING



FRESH AIR SUPPLY SYSTEM LOCATED WITHIN SUSPENDED CEILING AND FLOOR CAVITIES



FRESH AIR INTAKES LOCATED BEHIND BUILDING TO ENSURE THAT COOLER OXYGEN RICH AIR ARE DRAWN IN



DUE TO THE LARGE AMOUNT OF HARVESTED WATER ON SITE OXYGEN RICH ARE DRAWN THROUGH RADIATOR SYSTEM LOCATED WITHIN WATER TANK TO ALLOW FRESH AIR SUPPLY TO BE COLDER THAN AMBIENT AIR TEMPERATURE

P recedents

The precedent was chosen on the basis of the façade system, which addressed the same design problem of a curved glazed façade that requires a changeable shuttering system, as seen on the curved resource library façade on my building. The circular plan of the building faces directly west. This corresponds to the western orientation of the curved façade on my building. Due to the large amounts of glazing on the circular façade of the building, a mechanical moveable shutter system has been incorporated in front of the glazed wall.

The Pilkington four-point structural glazing system used allows for the glazing to articulate the curve by means of separate panels structurally joined by steel supporting frames, with spider clamp glazing supports attached to the steel posts and glazed panels. This sets up a readable structural rhythm extenuating the curve in a rectangular order. This allows for maximum visibility through the façade because there are no window mullions. The mechanically regulated shutter system allows for the internal light requirement to be altered to suit the specific spatial requirement at a certain time of day.

The shutter articulation adds to the layering effect of the curved façade, which gives the perception of planes sliding over each other around a curve.

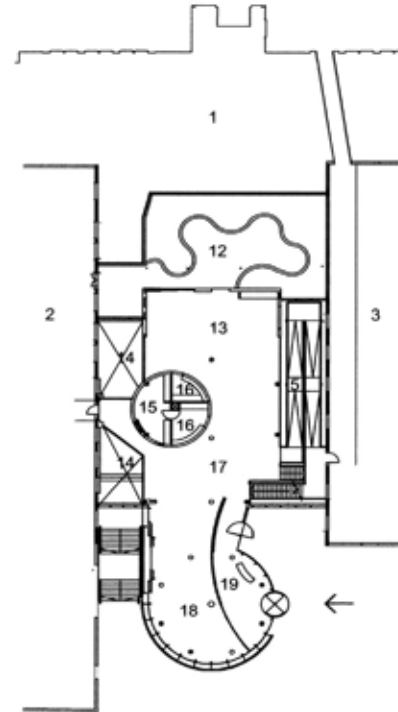


FIG 5.36_Ground floor plan



FIG 5.30_Pilkington structural glazing system with moveable shutters



FIG 5.31_Facade definition accentuates curved geometry



FIG 5.32_Glazing clamp detail



FIG 5.33_Mechanical movement system



FIG 5.34_Mechanical movement system on facade

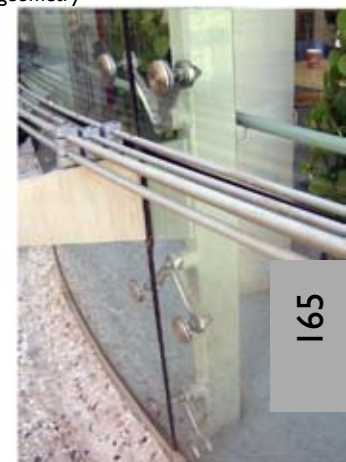


FIG 5.35_External appearance

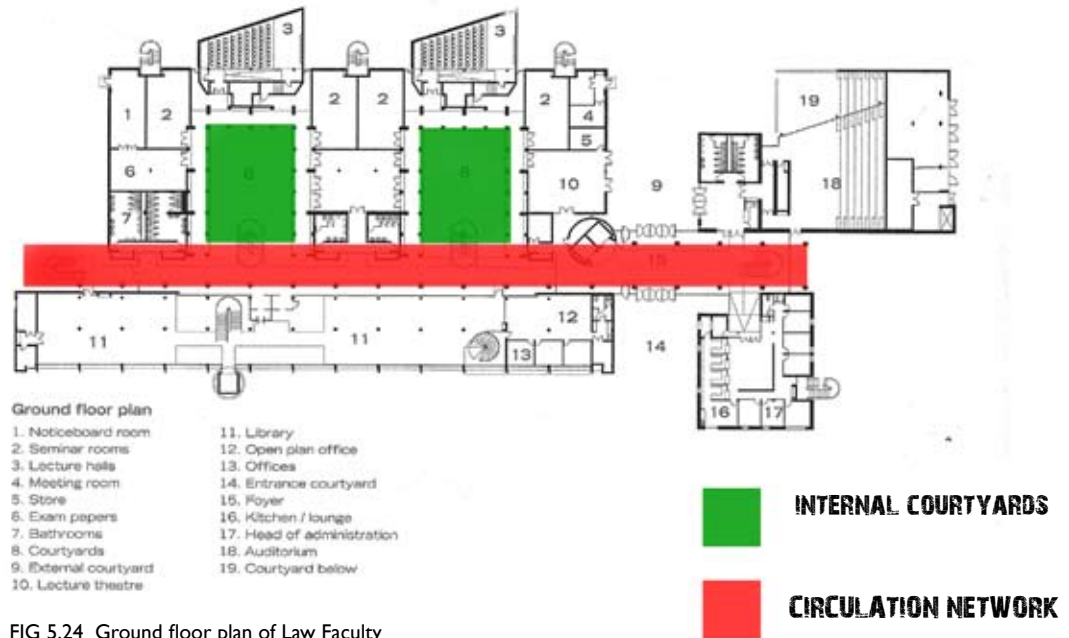


FIG 5.24_Ground floor plan of Law Faculty

The circulation within the building is arranged in a linear fashion. According to the analysis of the building in the book, *Contemporary South African Architecture in a Landscape of Transition*, the building is organised along a street with a series of courtyards arranged along a public walkway. This provides the ordering system to which the spatial arrangement relates. The articulation of this linear circulation route has had an important impact on the way that the circulation system has been designed within my building. The relationship between the internal and external spaces has effectively been articulated and creates an enticing experience as one progress along the linear route. This circulation is separated from the rest of the building. This allows the walkway to be used as a public space, allowing the internal functions to continue unhindered. The orientation of the building is the same as the orientation of our site a few hundred metres away. This allows the opportunity to experience the nature of the internal courtyards first hand.

The part of the building that faces north is also the same height as the existing parking found behind my site. Thus the spatial experience within these courtyards bears strong similarities to the intended experience envisaged for my building. The construction method adopted for the walkways is concrete columns with steel beams with a q-deck floor construction. This allows for a concrete finish on the walkway. Within the scope of my building the functional programme situated along the walkway requires a good quality light to enter the building. Thus the circulation was designed in such a way that it would be durable, but allow light through as opposed to the solidity found within the Law faculty circulation construction. The entrance block to the right provides a good indication of the massing to opening ratio intended for the wall in my building. Although the materiality is different, the placement of the windows within the mass wall is an important architectural tectonic to allow the windows to read as punctures within the massing by placing them further back within the wall, as opposed to on the external facade. The relationship of wall to openings is arranged in such a way that more wall is read than opening.



FIG 5.25 Internal spatiality of courtyards



FIG 5.26 Detached construction detail of circulation network



FIG 5.27 Detached external circulation



FIG 5.28 Wall articulation



FIG 5.29 Wall massing show in relation to context

APARTHEID MUSEUM JOHANNESBURG GAPP ARCHITECTS DESIGNED BY MASHEBANE ROSE ARCHITECTS

The materiality envisaged for my project draws inspiration from the illustrated two projects. Due to the philosophical approach of an ageable building it was important to illustrate how the chosen material tectonic of exposed brickwork can provide a specific weathered character to the experience of such a wall. The combination off-shutter concrete, timber, galvanised steel and flush jointed face brick provides the architectural materiality employed within the design realisation of my project.

The first project illustrated is the Apartheid Museum in Johannesburg, designed by Mashebane Rose Architects. In this project the brickwork provides a uniform textured mass onto which dramatic shadows and textures can be draped.

The second example is located in Cape Town. It was designed by Norbert Rozendal and is called the Niehaus Gallery. It uses the same material tectonic as seen in the Apartheid Museum, but on a much smaller scale with more attention to detail and designed connections between materials. The brickwork has aged over time and it is this weathered materiality that exemplifies the materiality envisaged for the brickwork used in my design. In both examples the brickwork is read as a singular mass due to the fact that the bond is unified throughout without over-complex brick articulation, as is often the case with face brick buildings. This unified mass is strengthened by the flush jointing employed so that the bricks form a collective whole and not separate entities, as is the case with scraped joints.

NIEHAUS GALLERY CAPE TOWN NORBERT ROZENDAL



FIG 5.37_Materiality used



FIG 5.40_Weathered materiality of brickwork



FIG 5.38_Wall provides textured canvas for shadows to drape upon

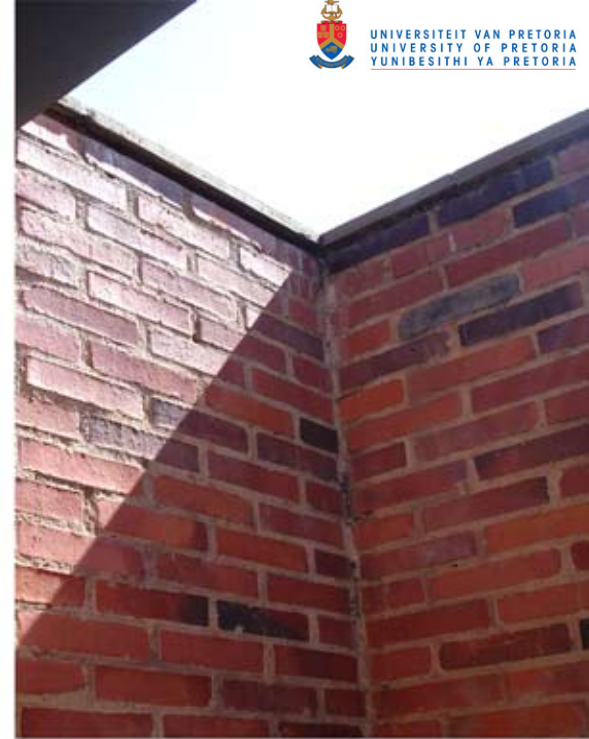


FIG 5.39_Flush jointed brickwork used



FIG 5.41_Combination of materials provides a rich material palette



FIG 5.42_Concrete and brickwork provides stereo tonic language

The final three precedents were all chosen on the basis of the way that the various designers have addressed issues regarding the roof construction, gutter edge detailing and structural spans within the illustrated projects. The first project is a residential house designed by Elphick Proome Architects called Alpik Studio. This project was selected because of the way the designer addressed the gutter to sculpturally form part of the formal language of the roof. This approach allows for the roof edge to continue as a singular edge condition framing the gutter.

**DIAMOND HILL TOLL PLAZE N4 HIGHWAY GAUTENG MATHEWS
AND ASSOCIATES ARCHITECTS**

The second project was designed by Daffonchio and Associates Architects and is called The Cradle Restaurant. This project reflects the same structural span achieved by a steel lattice truss, allowing the space to open out towards the view without structural supports hindering the spatial continuity.

The final project, designed by Matthews and Associates in conjunction with Karlien Thomashoff, reflects the same roof construction. The exposed underside of the lattice trusses provides an understanding of the formal language envisaged for the exposed trusses in my project. This tectonic creates an industrial but still sculptural feel to the roof as a freely supported canopy.



FIG 5.45_Industrial tectonic of exposed steel lattice trusses

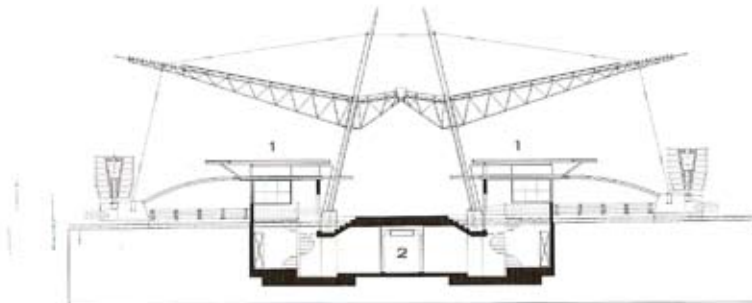


FIG 5.46_Cross section trough roof construction



FIG 5.43_Gutter edge condition



FIG 5.44_Roof and gutter forms uniformly articulated roof edge condition



FIG 5.47_Unsupported span achieved by lattice truss construction



FIG 5.48_Roof underside

THE CRADLE RESTAURANT WORLD HERITAGE SITE GAUTENG
DAFFONCHIO AND ASSOCIATES ARCHITECTS

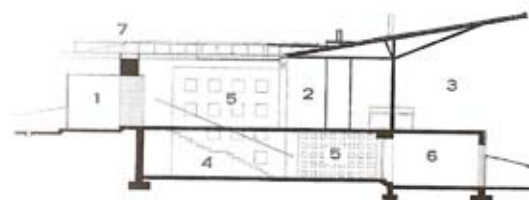


FIG 5.49_Cross section through restaurant roof

- Section A
1. Entrance
 2. Restaurant
 3. Deck
 4. Collar
 5. Stone Age tool display
 6. Private dining area
 7. Louvres & polycarb roof sheeting

