CHAPTER 6

TECHNICAL DEVELOPMENT

This chapter continues to explore the relationship between mass and void and the concept of an architecture that empowers through its technical resoulution. It explores its construction, its systems and its materiaility.

6.1 THE TECHNICAL CONCEPT

STEREOTOMIC VS TECHTONIC

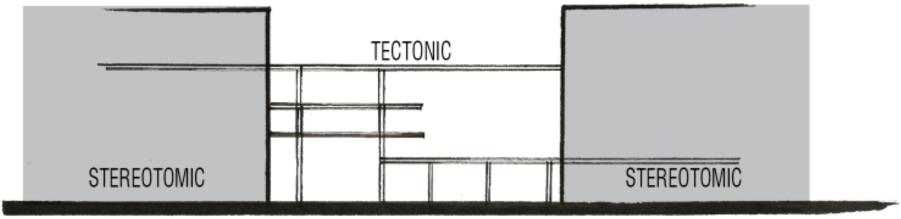


FIGURE 6.1 TECHNICAL CONCEPT DIAGRAM

The technical resolution of the architectural intervention continues with its theme of empowerment. This idea is translated spatially through the interplay between mass and void. Figure 6.1 is a parti diagram that illustrates the architectural intent of a tectonic insert in a sterotomic context.

The insert reacts to the existing architectural language and materiality by contrasting its characteristics. It distinguishes itself from the 1940s art deco style facade,which is seemimgly heavy and impenatrable, by being light and visually accessible. The brick and concrete stereotomic structure of the retail and residential is integrated with the light tectonic connecting made of steel and glass.

Figure 6.2 illustrates the various elements that make up the site in relation to the technological concept.

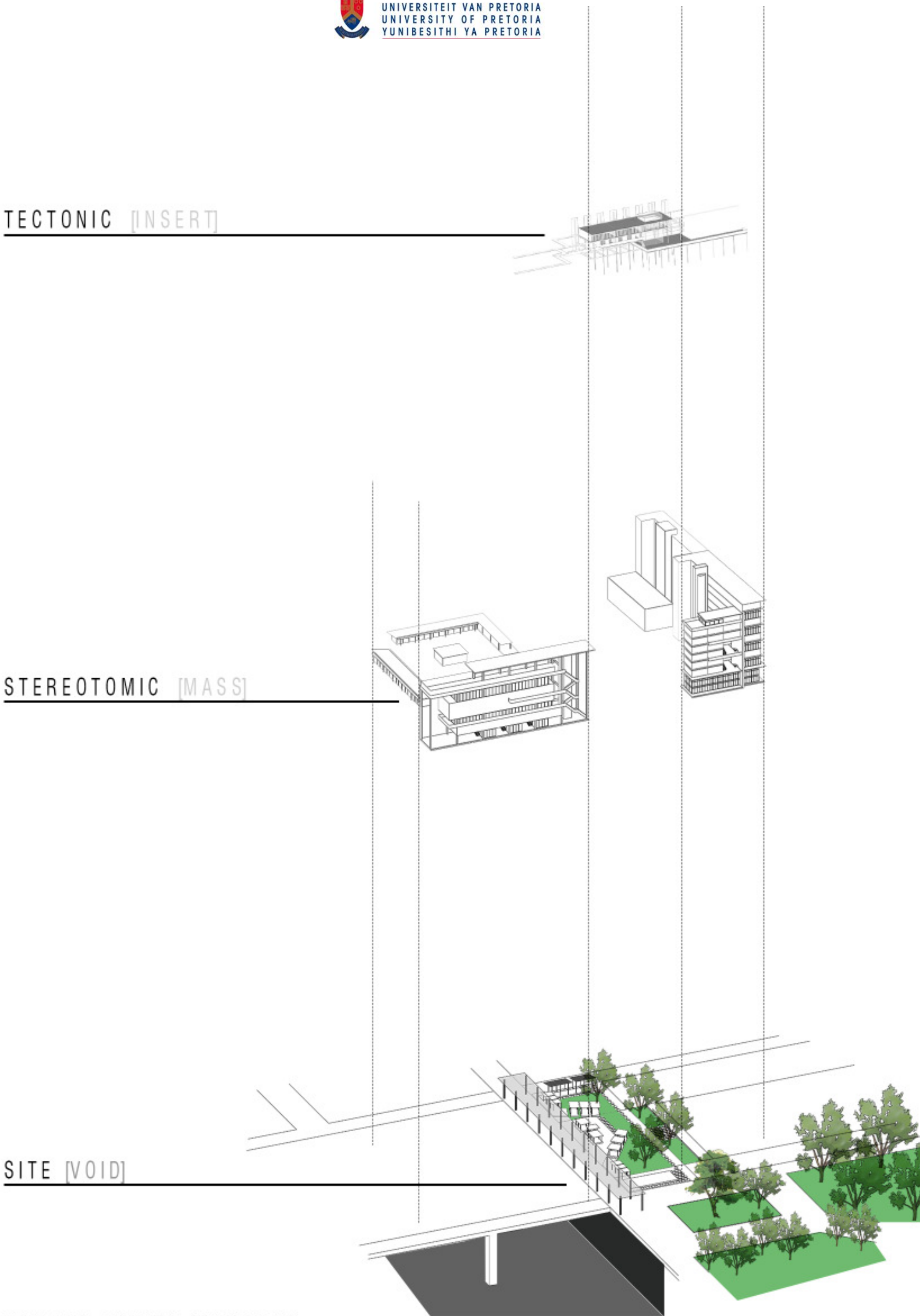


FIGURE 6.2 TECHNICAL CONCEPT AXO
Exploded axonometric illustrating the project in its conceptual structural parts

TOOLS OF EMPOWERMENT

The architetural insert itself is made up of four main elements, namely the frame, the plane the mass, the link, and the skin. Together they look to create an architecture that empowers. Each element acts as a tool that either defines, integrates or occupies space.

1. THE FRAME

The steel structure is the first element that is used to define space. The beams integrate the two masses and the columns ground the structure, creating an urban frame that begins to empower the void.

2. THE PLANE

Horizontal planes span accross the void as extensions of the existing structures floors and roofs. This element creates the illusion of the existing planes extending into the void and becoming part of it. The space that is to be occupied is determined and its edges defined.

3. THE MASS

Programmed masses occupy the spaces inbetween the planes, interconnecting the separate planar elements to create walls floors and roofs. The objects give volume to the space and define the inbetween spaces.

4. THE LINK

Circulation walkways act as the overiding intergrating element. These walkways wrap in and around the retail structure and connect to the residential through the bridge insert.

5. THE SKIN

The shading elements on the eastern and western facades act as a secondary integrating element that contains the space and gives it an edge.

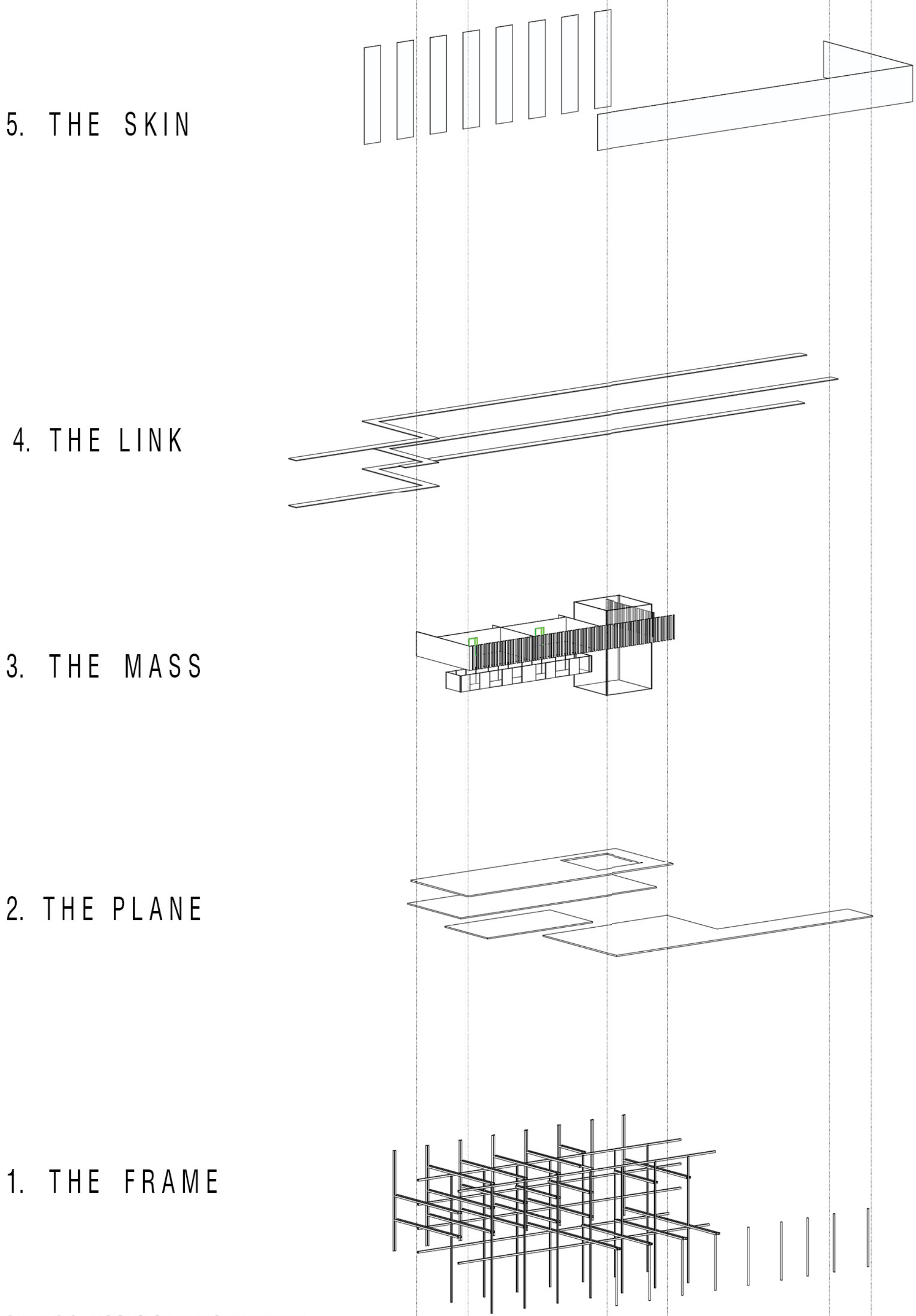


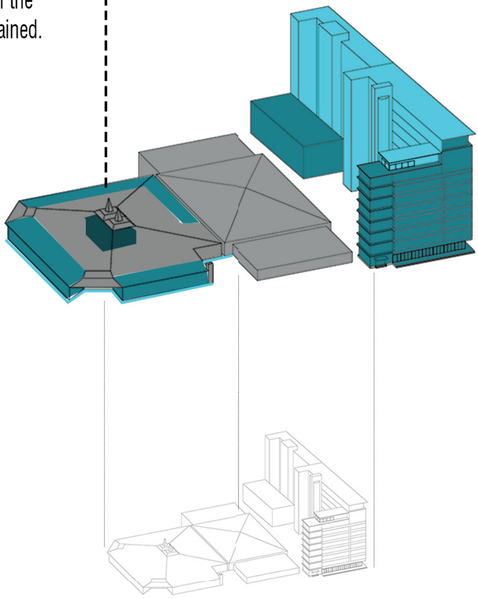
FIGURE 6.3 TOOLS OF EMPOWERMENT
Exploded axonometric of the structure in its isolated architectural elements

6.2 THE OLD AND NEW

EXISTING CONDITION

PRIMARY STRUCTURE
The primary structure consists of the external wallsroof and ground slab. The roof is demolished the external walls get opening to outside and slab is retained.

SECONDARY STRUCTURE
The secondary structure consists of the internal division walls, these are retained.



Existing structure

Renovated

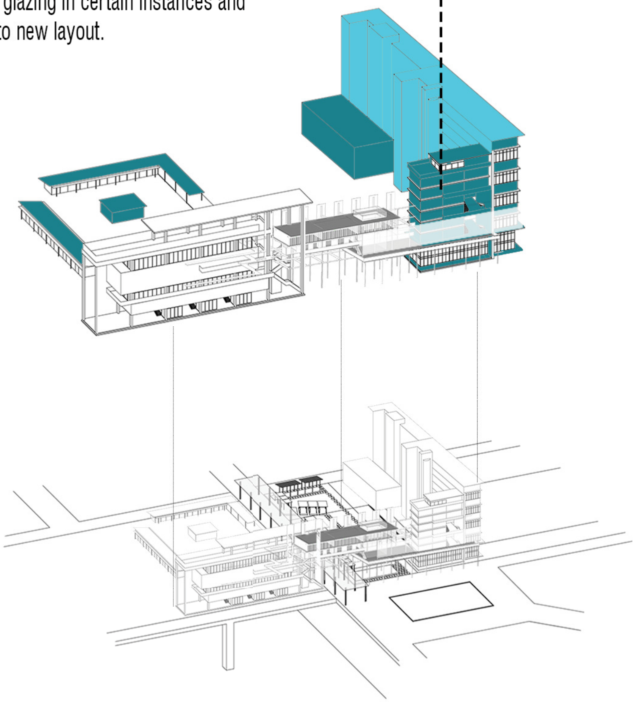
Demolished

FIGURE 6.4 APPROACH TO EXISTING STRUCTURE
Diagram illustrating what is to be kept, demolished or renovated

NEW CONDITION

PRIMARY STRUCTURE
The primary structure is made up of a column and slab system.
The structure column grid is used as is. Double volumes are created in certain spaces which require holes to be cut out of the existing slab. This is done within the grid as to not affect the structural integrity.

SECONDARY STRUCTURE
The secondary structure consists of the external brick infill and the internal division walls. Brick infill is replaced with glazing in certain instances and division walls are demolished according to new layout.



Existing structure

Renovated

New Intervention

FIGURE 6.5 THE INTERVENTION
Diagram illustrating what is existing, renovated or new

6.3 THE MATERIALITY

STRUCTURAL STEEL

STEEL FINISHES

MESH SCREEN ELEMENTS

TRANSLUCENT GLAZING

STEEL CLADDED JAGGED FACADE

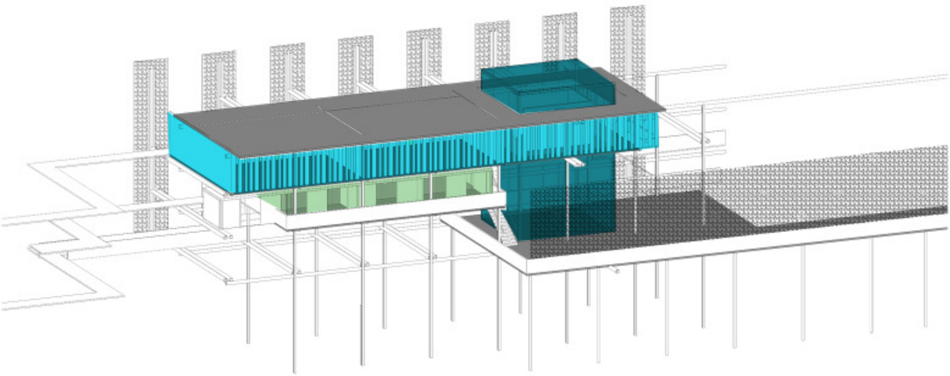
COMPOSITE LAMINATE LOUVRES AND DECK

6.4 THE ADAPTABLE SYSTEM

Adaptability is an important aspect of this project. In an environment that is dynamic and ever-changing, it is vital that the structure is able to adapt to accommodate the growing communities needs.

The architectural intervention is constructed out of a steel frame system that stands on its own. This system was chosen because of the materials ability to be constructed quickly in a a city environment , and its ability to be dissembled or expanded upon.

Between the planes that span between the two structures their are 3 enclosed masses. These masses have their own characteristics and materiality determinded by their program. However, they each make use of an adaptable frame system that allows the space to transition according to the scenario at hand.



MASS 1
The Light Box

MASS 2
The classrooms

MASS 3
The social partitions

FIGURE 6.6 THE ADAPTABLE MASSES
Diagram indicating the location of the 3 masses in the structure

M A S S 1
THE LIGHT BOX

The light box acts as a tool to orientate yourself in the building, it is a guiding element that draw attention to the space it occupies, it is a lightsource and landmark in its surroundings. This mass acts as a unifying element, connecting all four planes,integrating the larger structure.

The light box also has function and purpose outside of its aesthetic characteristics. It is an event and presentation space that opens up onto the deck level, and a resource centre on the higher levels. Panels on floor level have the ability to rotate and stack to open up area to the social deck space (figure 6.7).

The materiality and construction of the mass went through various interations in order to respond to the various requirements of its function. Each iteration was analysed according to these requirements, until an optimal system was developed.

The frame is constructed using 200 x 200 hollow square sections

The panels are fixed to rails on the underside of the square sections.

Panels on floor level are adaptable,other panels are fixed, and window panels are installed for ventilation.

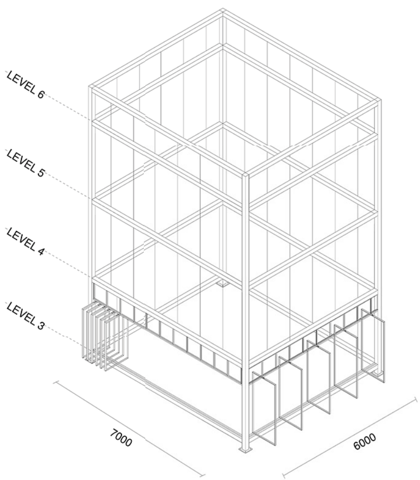


FIGURE 6.7 THE LIGHT BOX
3D illustrating the structural frame of the box and the adaptable panel system in place.

ITERATION 1

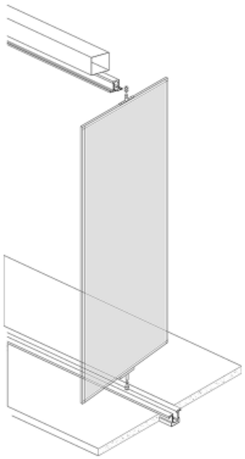


FIGURE 6.8 PANEL OPTION 1
Translucent glazing panel on the external skin

MATERIALITY
Steel frame structure with translucent glazing movable panels

EASE OF ADAPTABILITY
System is able to rotate and be stacked in order to open/close space up accordingly

LIGHTBOX AESTHETIC
Translucent glazing allows the mass to glow in the night time

SOLAR HEAT GAIN AND HEAT LOSS
In the summer structure is sufficiently shaded with screens and overhangs to keep the interior cool. In the winter however there would be significant heat loss.

ACOUSTIC COMFORT
Glazing is not a good acoustic material. Sound would be lost in the presentation space and the put-side noise would filter into the space.

ITERATION 2

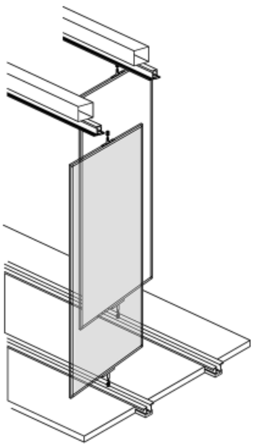


FIGURE 6.9 PANEL OPTION 2
double skin system with translucent glazing on the external skin and SIPS panel on the internal skin.

MATERIALITY
Translucent glazing on the external panel and a SIPS panel in the internal skin.

EASE OF ADAPTABILITY
System becomes tedious to manage with too many levels of control, the second layer takes away from the functional area available for use.

LIGHTBOX AESTHETIC
Lighting between the two skins allows for the box to glow even when the internal panel is closed

SOLAR HEAT GAIN AND HEAT LOSS
SIPS (structural insulated panel system) is able to contral thermal heat lossduring the winter. In the summer there is a risk of heat being trapped between the two skins. creating an uncomfortable threshold space.

ACOUSTIC COMFORT
Internal skin can be closed to allow for a better acoustic environment.

ITERATION 3

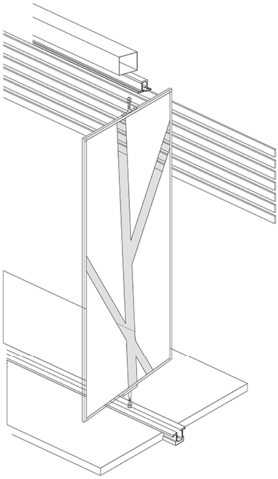


FIGURE 6.10 PANEL OPTION 3
SIPS panel with glazing cut out

MATERIALITY
Steel frame structure with SIPS panel and cut out glazing and adaptable timber louvre internal skin

EASE OF ADAPTABILITY
The single shopfront system accomanied with the timbre louvre system allows many possibilities. The rollershutter system of the timber louvres allows second skin to completely dissapear into ceiling and does not take away space from the internal area.

LIGHTBOX AESTHETIC
Even with less glazing the glowing lightbox effect can still be created. Patterned facade creates an addition-al recognizable feature on the box.

SOLAR HEAT GAIN AND HEAT LOSS
Structure is sufficiently shaded with screens and overhangs to keep the interior cool. SIPS panel allows additional thermal comfort with only 10% of the facade allowed for glazing. The rollershutter timber louvre system provides an additional layer of shading and can block out sun completely according to the need of the space

ACOUSTIC COMFORT
SIPS panel as well as the timber louvre system both allow for an acoustically comfortable environment additionally to the acoustic ceiling and and flooring panels

MASS 2
THE CLASSROOMS

The same system is then applied to the formal classroom spaces. The three classroom spaces are divided by movable gypsum board panels that allow the space to become a larger teaching hall, or 3 smaller intimate classrooms. The flexibility of the system allows for flexibility in the teaching program, empowering the educators and learners to adapt the space as they need it.

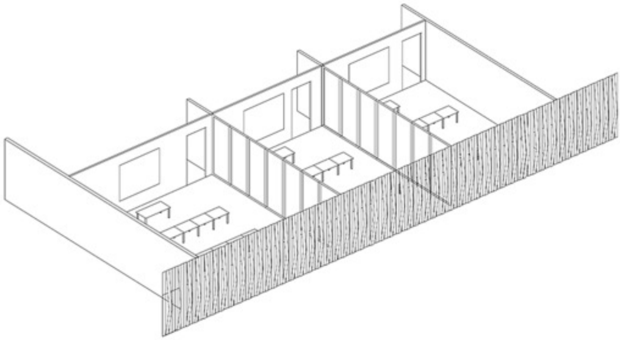


FIGURE 6.11 SCENARIO 1
Separating panels are closed creating 3 smaller classroom spaces

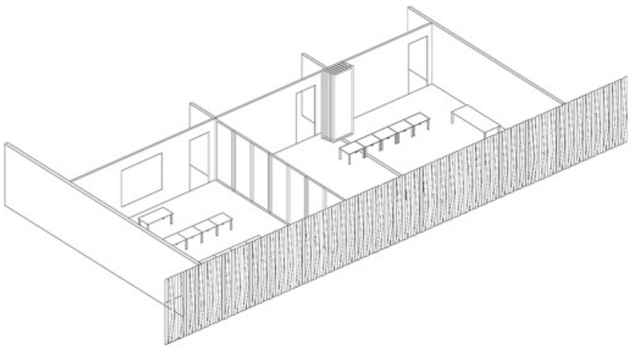


FIGURE 6.12 SCENARIO 2
Separating panels are opened and pushed to the side to create one larger classroom space and a smaller classroom

MASS 3
THE SOCIAL PARTITIONS

A level up from the deck is the social learning area, this space is subdivided into smaller more intimate spaces that encourage discussion, debate and peer learning. A combonation of solide panels, glazed panels and mesh screen panels make up the system. Solid panels define the more quiet spaces needed for individual work, while the screen and glazed panels define the more social spaces where learners and educators can socialise and discuss in an informal setting.

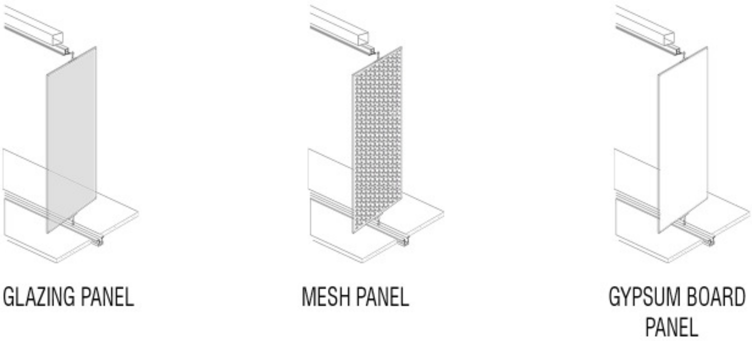


FIGURE 6.13 MATERIAL PALLETE OF ADAPTABLE PANELS

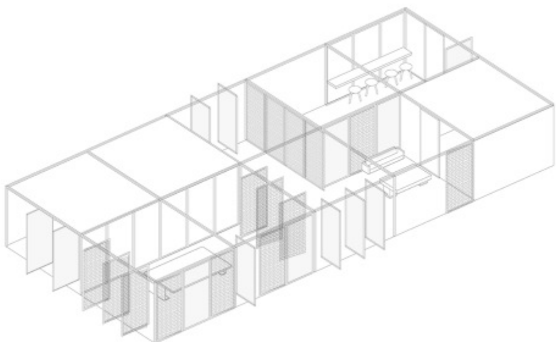


FIGURE 6.14 THE SOCIAL LEARNING MODULES
3D diagram indicating the social learning structural system that can allow for various levels of public-privacy based on the materiality of the screen

6.5 THE WATER SYSTEM

The economic centre consists of a service core which needs to be supplied with water as well as a series of kitchenettes for staff and students. This building is not a 24hr building which minimises its water usage.

Figure 6.15 illustrates the various water sources considered on site which is then to be reused accordingly. Rainwater, grey water and manucipal water are the 3 primary sources of water that is used. The rainwater is collected on site and reused for irrigation and to feed the handwash basins. The grey water is reused in the WCs and urinals and the manucipal water is used for drinking and food preparations.

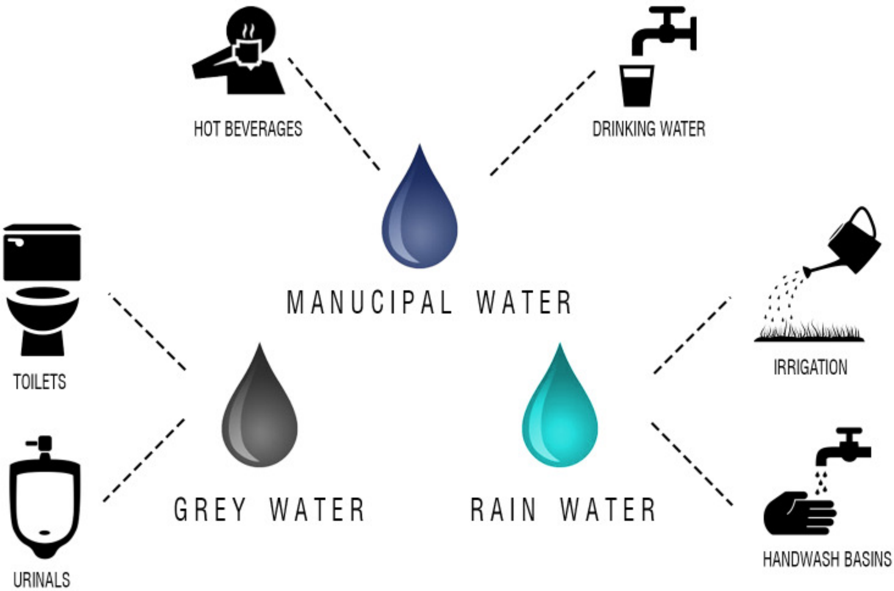


FIGURE 6.15 WATER SOURCES
Diagram illustrating the various water sources and how they are utilised

RAINWATER HARVESTING

The parapet roofs of Joubert Park act as an ideal tool for collecting rainwater, this is translated into the language of the architectural intervention. The roofs and decks are designed to be able to collect the maximum amount of rainwater.

Rainwater will be collected and funneld through the structures drainage system into a below surface tank. There is will be filtered and treated with a ultraviolet purification system, and stored until it is needed. A solar pump will then pump the water up to the surface where it will be used.

Appendix A contains the water budget which indicates the water yield vs demand. The rainwater budget remained positive with the yield being able to suplly the demand through out the year. Access water could be used in the residential units.

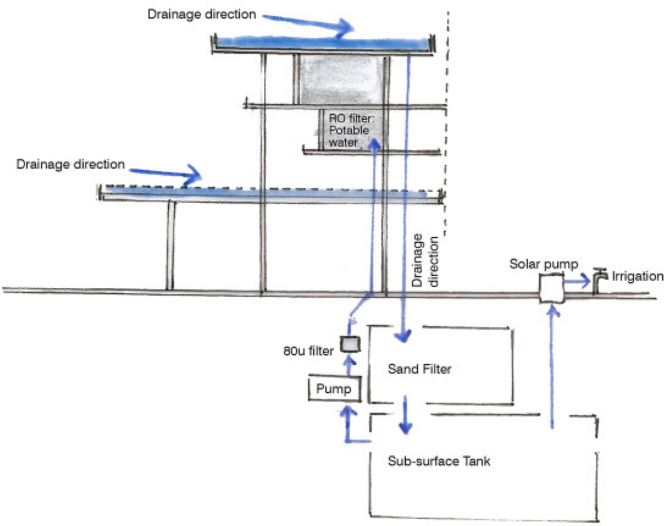


FIGURE 6.16 RAINWATER HARVESTING DIAGRAM
Diagram illustrating the collection, cleaning and storing of rainwater.

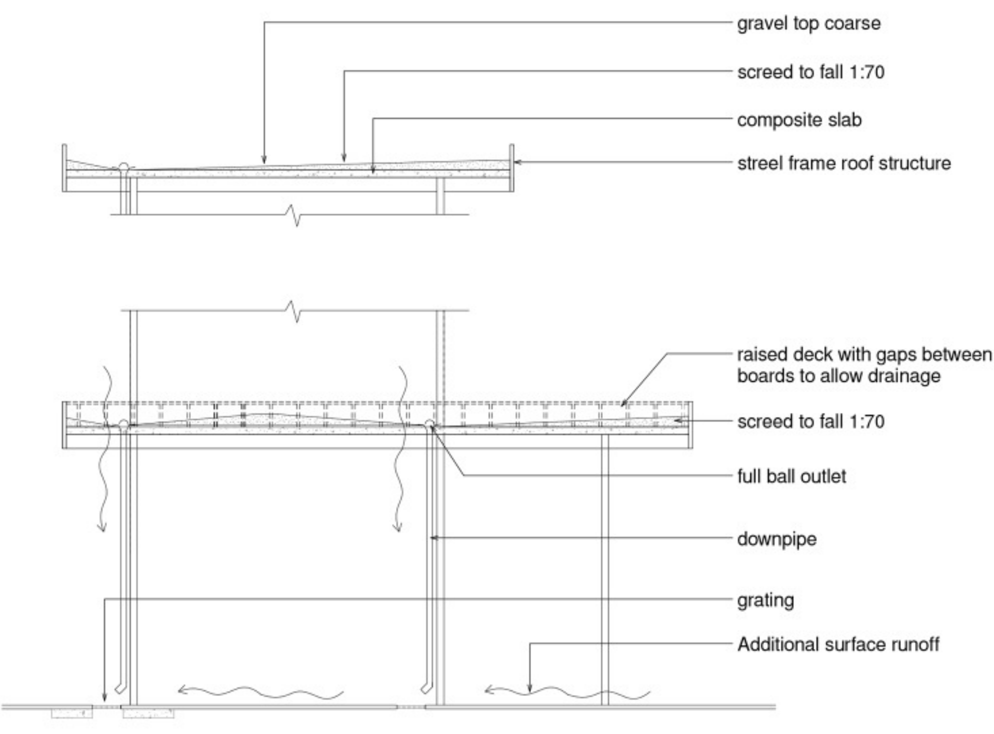


FIGURE 6.16 DRAINAGE DETAILS
Diagram illustrating the roof and deck drainage systems

6.6 THE SUSTAINABILITY PRINCIPLES

Under the lens of spatial justice, sustainability can be considered as an important factor in creating just and equitable spaces in the inner-city. Sustainability does not only refer to the passive design strategies that help the building function optimally, but it is also the effect that the broader principles of sustainability have on social and economic issues in the lives of those living in Joubert Park. It is about creating sustainable living and working conditions in the city that can assist and empower the existing community to thrive in their environment.

This section explores the physical passive design strategies in place and investigates their tangible and intangible outcomes.

ORIENTATION

The most basic passive design principle is the correct orientation of the structure. The optimum orientation of a building in the southern hemisphere is north. However, as the project is located within an existing city block, within an existing city fabric, the optimum orientation in this scenario cannot be achieved. The building runs along a north-south axis which leaves it exposed to eastern and western light. While the orientation may not be ideal, there are design strategies that can be used to protect the structure from the harsh morning and evening light.

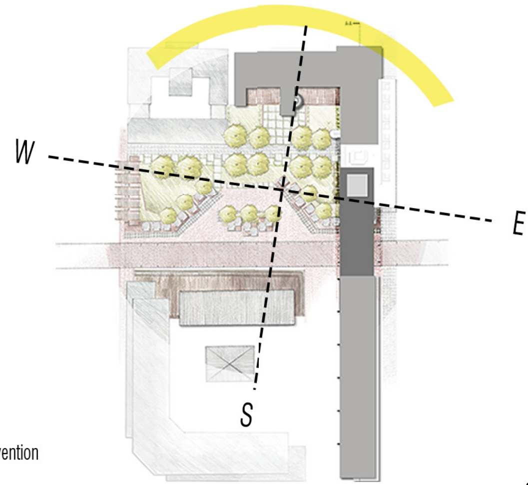


FIGURE 6.18 ORIENTATION
Diagram illustrating the east west orientation of the intervention

SOLAR STUDY

In the summer (figure 6.19) we find that the internal courtyard is over exposed to sunlight, however the internal spaces are protected through the use of over-hangs and screening devices.

In winter (figure 6.21) the courtyard space is partly shaded due to the highrise structures around the space and the low angle of the sun. The buildings on site make use of materials that are well insulated and can protect the structures from the winter cold.

The site performs optimally during the march and september solstice where the spaces are balanced with sunlight and shade.

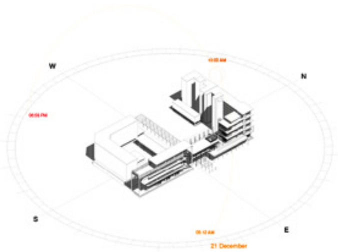


FIGURE 6.19 SUMMER SOLSTICE
Solar study of the site during the 21 December summer solstice

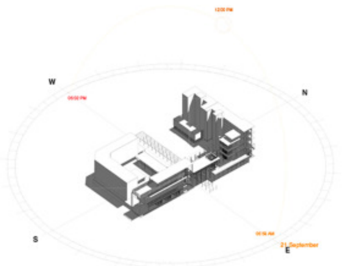


FIGURE 6.20 SPRING SOLSTICE
Solar study of the site during the 21 September spring solstice

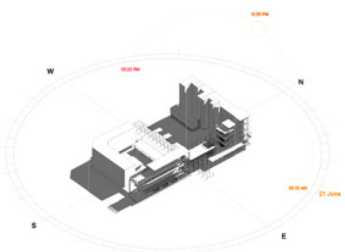
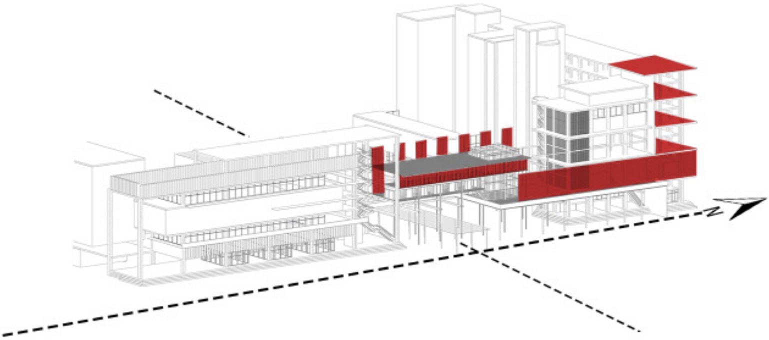


FIGURE 6.21 WINTER SOLSTICE
Solar study of the site during the 21 June winter solstice

SOLAR STRATEGIES



Solar shading strategies were put in place to protect the facades from excess solar heat gain in the summer months and from the harsh eastern and western sunlight.

NORTHERN FACADE

Existing overhangs that form balcony areas create sufficient coverage for the internal space. In the summersunlight is prevented from entering the space, additional louvres are used to protect the bottom levels. In the winter sun is allowed into the space.

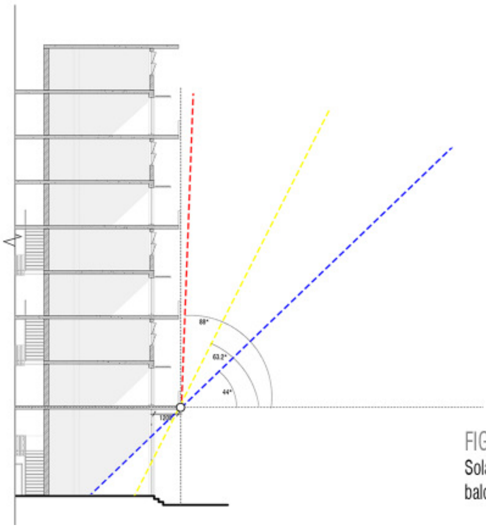


FIGURE 6.22 NORTH FACADE SOLAR STUDY
Solar study of the north facing facade that makes use of overhang and balconey spaces to protect the internal space from summer sun

EASTERN FACADE

A larger mesh screen shades the open deck that is exposed to the morning eastern light. This screen acts as a shading device with good solar properties, without being a physical visual barrier.

The facade of the classrooms are stepped to block direct eastern morning light but allow in indirect light from the side glazing panels. This facade is clad with insulated SIPS panels that block out direct sunlight and insulate the internal space.

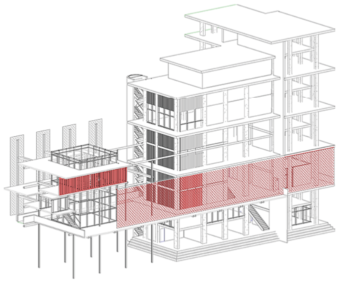


FIGURE 6.23 EASTERN SHADING DEVICES
Diagram illustrating the shading strategies on the eastern facade

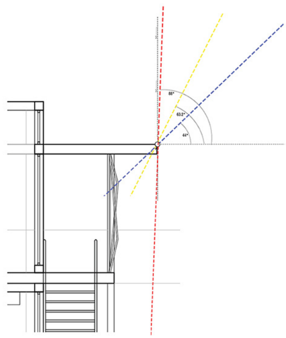


FIGURE 6.24 SOLAR STUDY
Solar study of the east facing facade that makes use of the stepped jagged facade and overhang protection

WESTERN FACADE

Large mesh fins span accross the entire western facade of the building shading the structure from unwanted afternoon sun, preventing heat gain in the summer. In the winter fins can be rotated to allow the sun in.

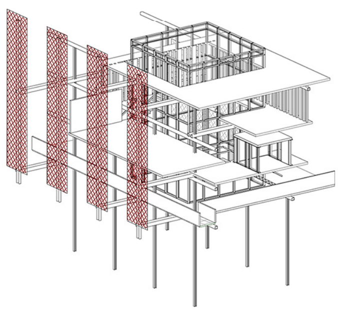


FIGURE 6.25 WESTERN SHADING DEVICES
Diagram illustrating the shading strategies on the western facade

THERMAL MASS

Given the challenges regarding the orientation of the building, thermal comfort becomes and important strategy in order to obtain a comfortable living environment. Thermal heat gain in the summer and thermal heat loss in the winter are two of the biggest challenges the structure faces. In order to counteract these issues thermal strategies have been put in place that ensures a cool interior during the hotter months and a warm interior in the colder months.

Thermally insulated cladding will be used on the steel structure to enclose the interior spaces. This panel consists of 3 layers which is then fixed to the substructure of the building. In figure 6.26 we see that it consists of an external skin, a central insulation material, and an internal skin.

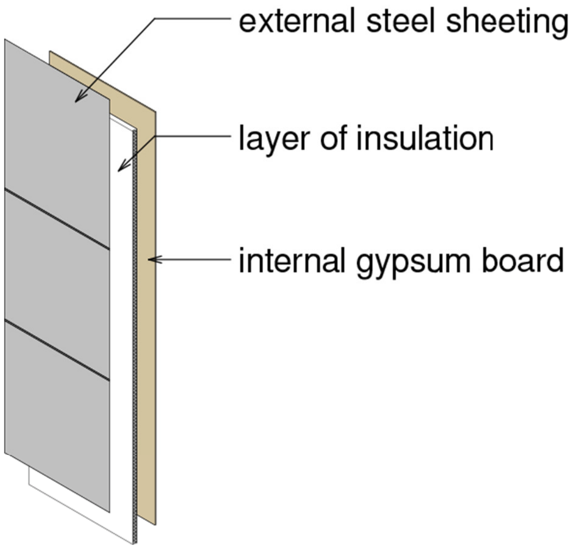


FIGURE 6.26 INSULATED SANDWHICH PANEL SYSTEM
Diagram illustrating the layers of the insulated cladding panel

VENTILATION

Johannesburg CBD has a North Westerly wind at an average of 31 knots. The wind will run along the length of the building and not push up against it.
The depth of the building is less than 15m to allow for natural ventilation. Cross ventilation becomes possible with openings on the windward and leeward sides.

As illustrated earlier in the chapter the structure consists of three masses. The top floor, the classroom spaces, contains fenestration on both the windward and leeward edges, the depth of the space is 6m which allows for natural cross ventilation. The middle floor structure is an adaptable screen system, where screens can be opened or closed to control the airflow through the space. The third mass, the glass box, consists of both openable screens and windows that an be opened to alow airflow when the screens need to be closed.

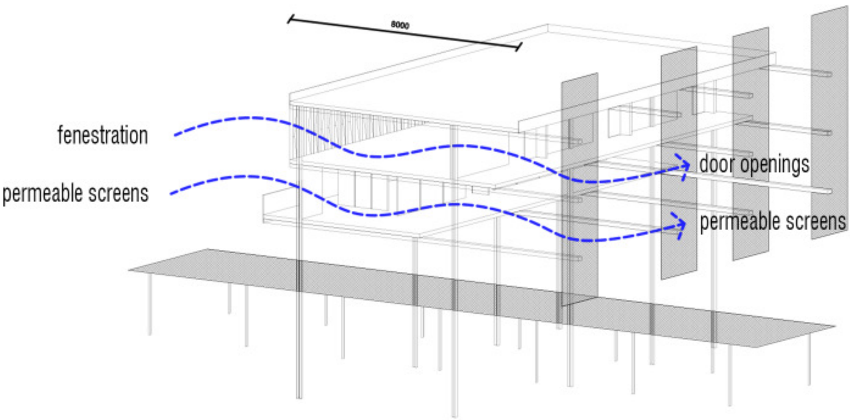


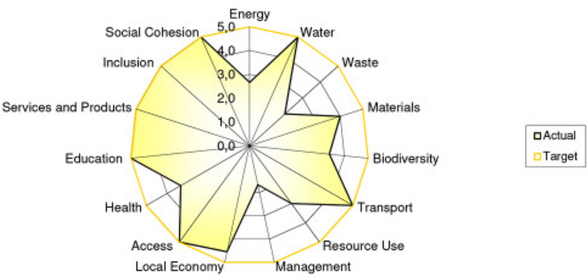
FIGURE 6.27 NATURAL CROSS VENTILATION
Cross-section through the building the openings that allow cross ventilation

SUSTAINABLE BUILDING ASSESSMENT ANALYSIS

In order to evaluate the social and economic sustainability of the project we made use of the SBAT system as a means of assessing the building and its impact on the social, economic and environmental climate of the area.

The assessment summarised in figure 6.28 shows how the project performs strongly socially in terms of the projects influence on social cohesion and inclusion, accessibility, empowerment through education and supporting and developing local businesses. The project is well located in the inner city and looks to link the social and economic amenities on site. This has resulted in a 4.7/5 for social sustainability. Economically the project lost points with regards to the management plan in place, the tool suggests a detailed management plan for the expenses of the structure that was not yet considered in the project.

In terms of the buildings environmental sustainability, the project performed adequately taking into account water resources, renewable energy sources and local modular and adaptable materials. The project also works within a brownfield site and aims to improve the coditions of the existing structures on site. However, the building failed to consider watse management systems and integrating appropriate biodiversity.



SB4 Environmental, Social and Economic Performance	Score
Environmental	3,4
Economic	3,8
Social	4,7
SBAT Rating	4,0

FIGURE 6.28 SBAT ASSESSMENT GRAPH
Graph illustrating the buildings social, environmental, and economic sustainability

6.7 THE TECHNICAL DETAILS

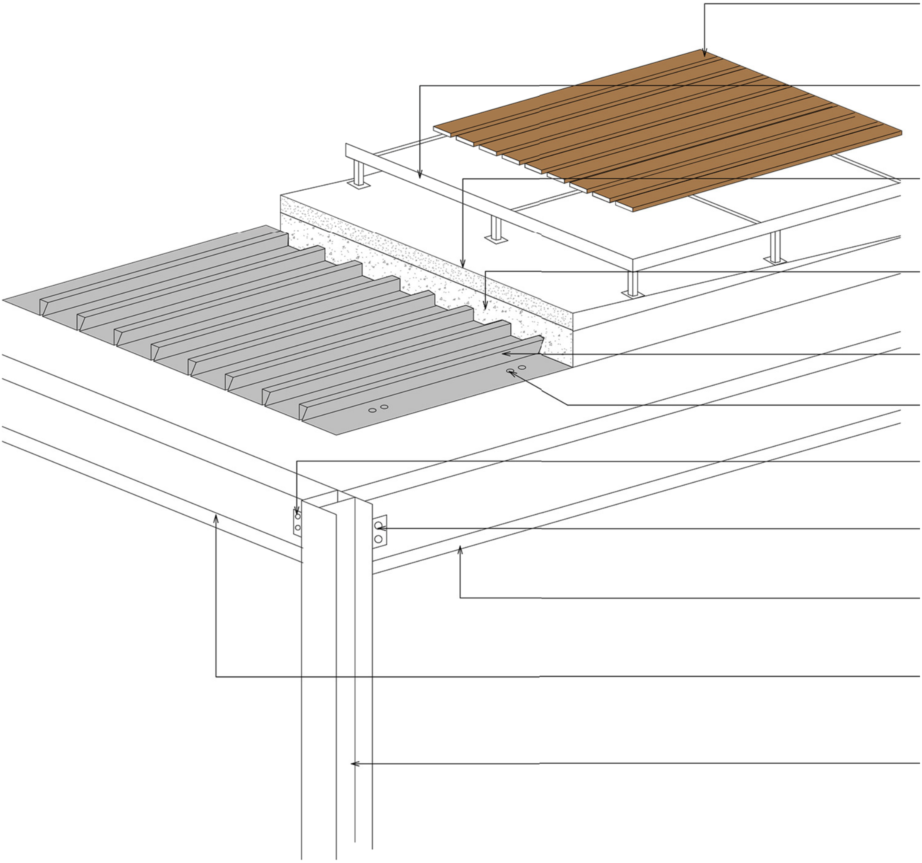


FIGURE 6.29 DECK DETAIL
Axonometric illustrating the various components of the deck

— 75 X 16 BALAU TIMBER DECKING MEMBERS FIXED TO STEEL SUBSTRUCTURE WITH 25 SPACING

— 600 X 600 STEEL ACCESS FLOORING GRID SYSTEM FIXED TO TOP OF CONCRETE

— SCREED WITH 1:70 FALL TOWARDS RAINWATER OUTLET

— 25 MPA CONCRETE CAST 85 THICK OVER CREST OF DECKING RIBS

— RIBBED METAL DECKING WITH 150 X 51 PROFILE RIVETED TO TOP FLANGE OF BEAM

— RIVET

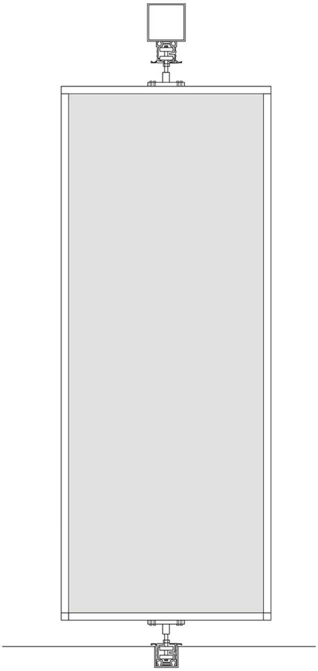
— M20 STEEL BOLT FIXING BEAM TO COLUMN

— ANGLE CLEAT SECTION CONNECTING STEEL BEAM TO COLUMN

— 254 X 146 X 35 STEEL CROSS BEAM SECTION @ 2500 CENTRES FIXED TO COLUMN

— 305 X 102 X 25 STEEL I-BEAM SECTION @ 5000 CENTRES FIXED TO COLUMN WITH M20 STEEL BOLT AND A ANGLE CLEAT SECTION

— 152 X 152 X 23 H-SECTION COLUMN ON A 5 X 8 GRID



DETAIL A
ADAPTABLE PANEL SYSTEM

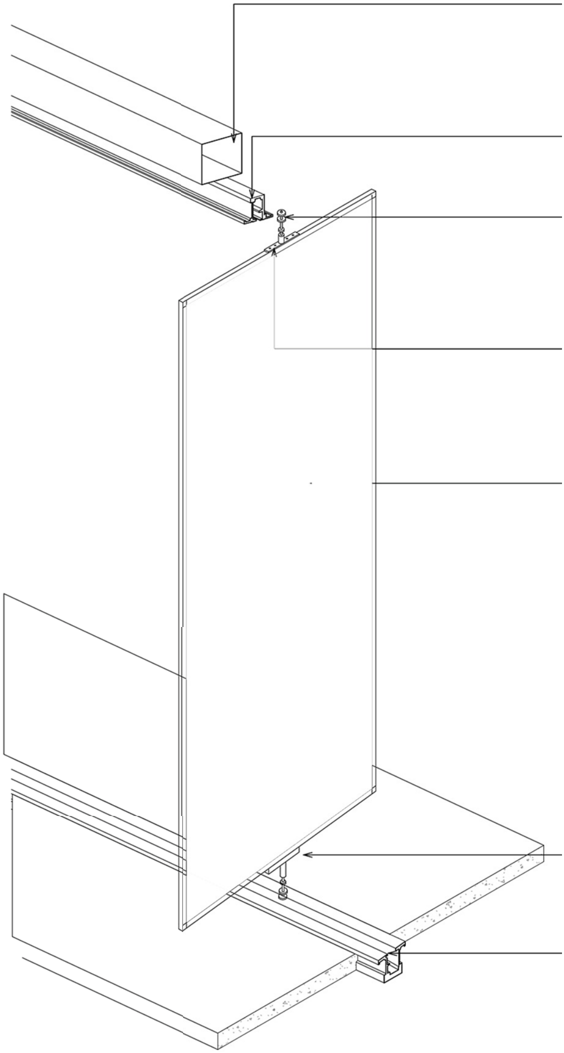


FIGURE 6.30 ADAPTABLE INSULATED PANEL DETAIL
Axonometric illustrating the adaptable panel system

200 X 200 HOLLOW SQUARE STEEL SECTION BEAM

82 - 125 X 88 ALUMINIUM STEEL TRACK WELDED
TO UNDERSIDE OF BEAM

MOVABLE CARRIERE MECHANISM THAT ALLOWS THE
GLASS SCREEN TO ROTATE AND SLIDE

TOP CARRIER PLATE CONNECTING THE MECHANISM
TO THE THE FRAME OF GLASS

12 SIPS PANEL IN ALUMINIUM STEEL FRAME FIXED TO
ROTATING MECHANISM

BOTTOM CARRIER PLATE CONNECTING THE MECHANISM
TO THE THE FRAME OF GLASS

82-125 X 88 CONCEALED ALUMINIUM STEEL TRACK
RECESSED IN CONCRETE SLAB

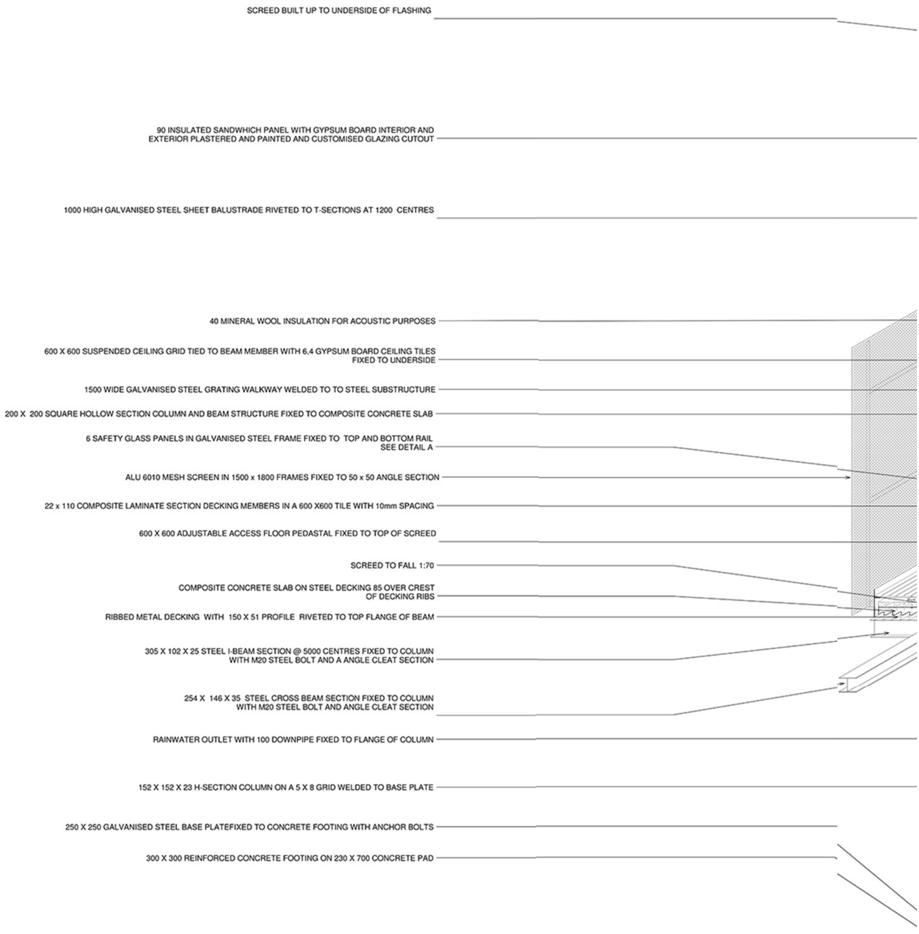


FIGURE 6.31 DETAIL CROSS SECTION
Section perspective through light box segment of the structure