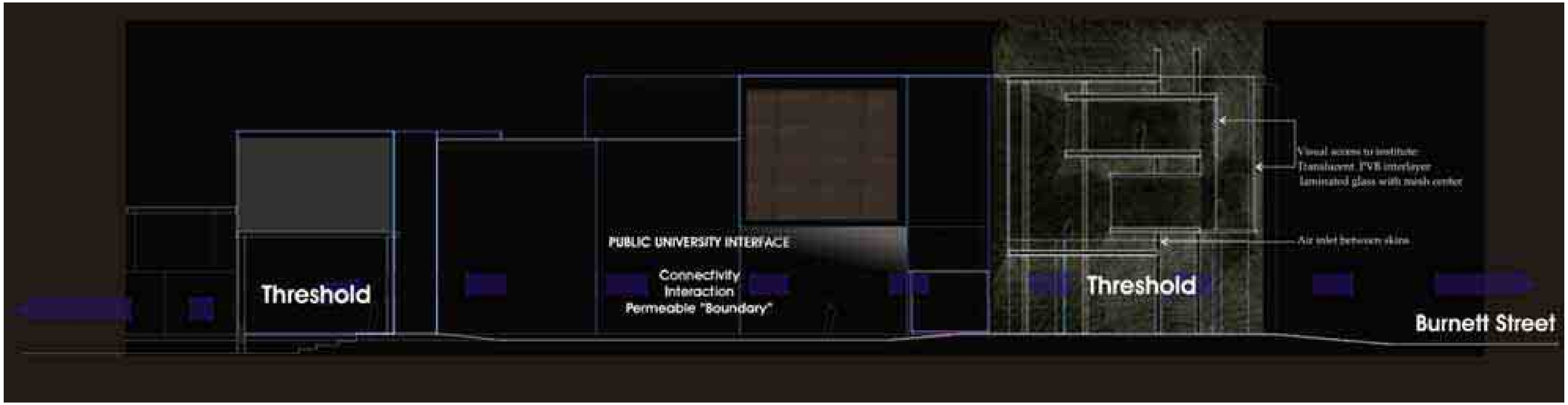

Threshold
PUBLIC UNIVERSITY INTERFACE
Connectivity
Interaction
Permeable "Boundary"
Threshold
Visual access to institute
Translucent PVB interlayer
laminated glass with mesh center
Air inlet between skins
Burnett Street

1. INTRODUCTION

In order to understand how a research facility operates, the actual thought process of research is investigated and incorporated within the facility layout. The process is understood in sequence, where certain sequences in the thought process are adjusted to suite the new found idea as the idea is developed. This treatment has been utilised in the language of the various external façades, material selection and flexibility of vertical circulation, without compromising security.

The technical report highlights technical design decisions in a sequential approach of experience, from arrival to departure of the proposed development. Certain points of importance are discussed in detail to create an overall understanding of the building.

Discussed in the technical report are pertinent design decisions made relating to the technical resolve of the building. These are as follows:

- Site and demolition work
- Precedents
- Material selection
- Structure
- Facade treatment
- Services
- Drainage- ground floor level changes
- Thermal comfort systems

2. PRECEDENT STUDY

5.01

- Mediatheque in Sendai, Tokyo by Toyo Ito & Associates.

Influence: The use of a glazed double skin south façade overlooking the main road extends up over the structural floor slabs. The division between indoor and outdoor urban space appears to be dissolved. Spatial form is also articulated by the horizontal lines of the floors.

5.02

- Housing development in Tokyo by Akira Watanabe Architects & Associates.

Influence: The use of slender dimensioned steel members for the vertical circulation staircase, seemingly transparent and sophisticated. The patterns casts on the textures surrounding it creates a play of light and shadow.

5.03

- Carré d'Art- Languedoc Roussillon, France by Lord Norman Robert Foster.

Influence: The proportions of the building express its commanding presence, expressing the forms by articulating the horizontals through the arrival steps and roofing shading device.

5.04

- Gauteng municipal commercial building by Gap Architects.

Influence: A simple building, using local building techniques, is articulated to appear more contemporary by the incorporating an outer mesh skin.

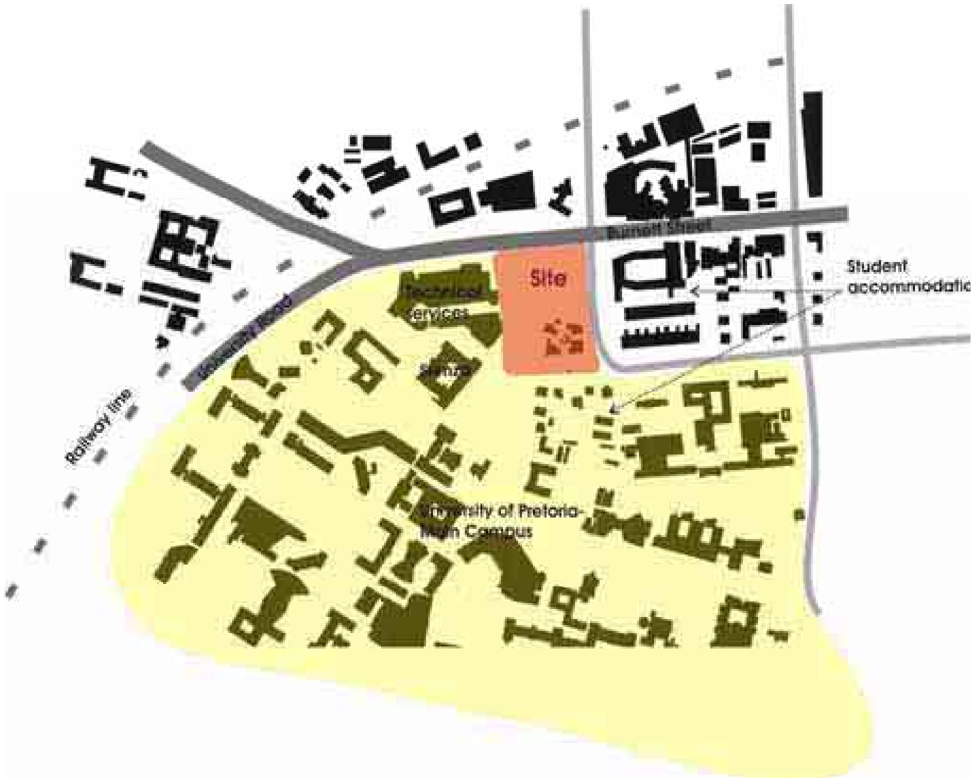
3. SITE AND DEMOLITION

The selected site is currently a parking lot for the University of Pretoria students and staff. There are no existing structures located on it. It is located adjacent to the 2.5 storey Technical Services building and the Scienza building, a single storey structure to the east, as well as adjacent to single storey buildings to the south. The single storey buildings were once demarcated for demolition, but have been preserved as heritage structures. These are to be renovated to house the Tourism Department.

The physical site has a gradual slope towards the north-west. The slope has no influence on the design considerations due to its negligible fall. All level changes on the site are created by design decisions, specifically the raised northern threshold. The Technical Services building's ground floor plan is raised by 1.2m above the Burnett Street side walk - presumably as an attempt to reduce excavation requirements for its basement level. This level is maintained and incorporated with the collaborative research ground floor, raised in a similar fashion to maintain continuity on the commercial street edge. Basement parking access has been restricted to the existing Festival Street secured entry, to ensure controlled vehicular entry to the university.

Site works will involve the removal of the existing asphalt and concrete parking surface, demolition of centered garages between the Festival Houses and the removal of surrounding barrier fences to the north, south and east.

5.05



4. MATERIAL SELECTION

Concrete, steel, glass and brick have been selected as the primary materials to be used for the infill, roof and super structure of the building, creating a robust and flexible structure to serve the variable needs of the constantly changing research departments and maintain structural integrity under unforeseen loading.

Concrete (and brick, where concrete is not the most suitable chose) has been selected to support the mass. Steel has been chosen to support the north facing outer curtain wall span and the main vertical circulation span. Face-brick and plastered brick with mortar are utilised for the infill of the conventional concrete column and slab system, which makes up most of the building, to create depth and texture to the building's surface. These construction materials and techniques were selected for the following reasons:

- Robust structure
- Flexibility
- Aesthetics
- Locally produced material
- Locally prevalent building technique equals labour intensive workforce
- Speed of construction equals reduced cost
- Response to philosophical approach

In the design investigation treatise, it became evident that research facilities are normally represented in high-tech constructed architecture. In this case, the development not only facilitates the research facility, but also serves as a social and commercial space. Such developments are traditionally softer spaces, constructed of a concrete structure with brick and mortar infill. Materials had to, therefore, be appropriately applied along relevant edges. Thus the building becomes able to communicate its function to the users and passerby's coherently.

Distorting the boundaries between the university and its urban surroundings is one philosophical approach highlighted in the design investigation treatise. The means by which this is accomplished and to what degree, is highlighted by the following elements:

- Structure
- Façade treatment
- Appropriate positioning of various functions

5. STRUCTURE

The column grid of the thresholds and the barriers of the building vary for the following reasons:

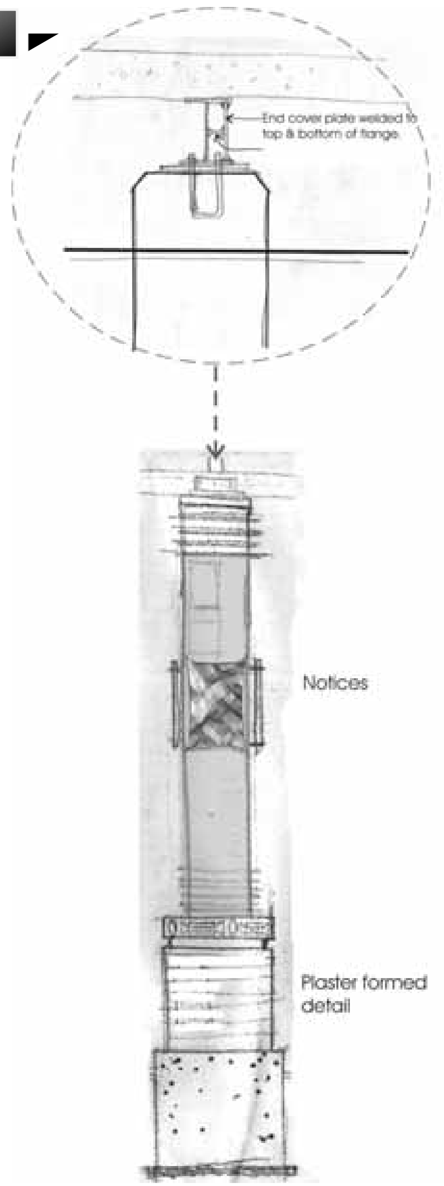
Threshold 1- The column grid includes both wider spans (10mx 9m) and narrower spans were required (5mx4.5m), with one way spanning beam fixed to them. The wider spans are incorporated so as to free up the ground floor (public realm) and to maximise the various floor plans, flexible to change for future requirements. This allows the public to witness the transformations. The beams are specified so as to carry 10m spans, to ensure flexibility in the possibility of adding new columns to further divide spaces.

Box steel columns fixed by means of a steel plate have been chosen for the glazed wall fixing, as opposed to cylindrical sections, so as to allow uniform technology to be used for the fixing of extra floor slabs, should more floor space be required. Thus, the building is able to extend inward.

Therefore, the use of steel sections for beams are utilised, and pre-cast, post reinforced floor slabs are used to ensure easy removal/addition and fixing of slabs.

The rest of the building consists of shallow column grid depths to enable the ability to form offices with infill walling at a 5mx5m interval column spacing.

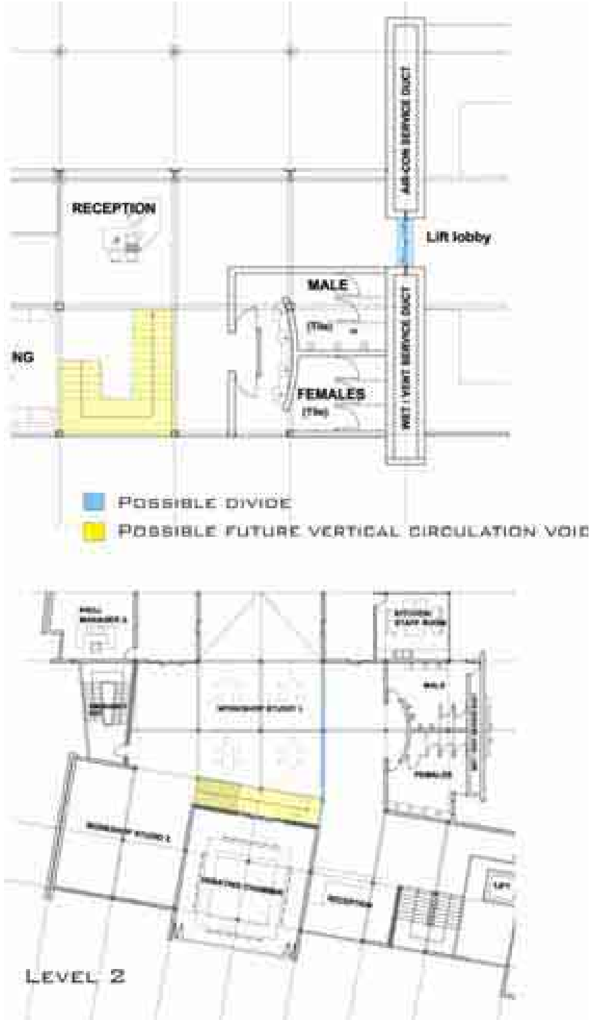
5.06



6. VERTICAL CIRCULATION

The structure is designed with numerous voids which allow for the building to further divide into three independent research departments at every level.

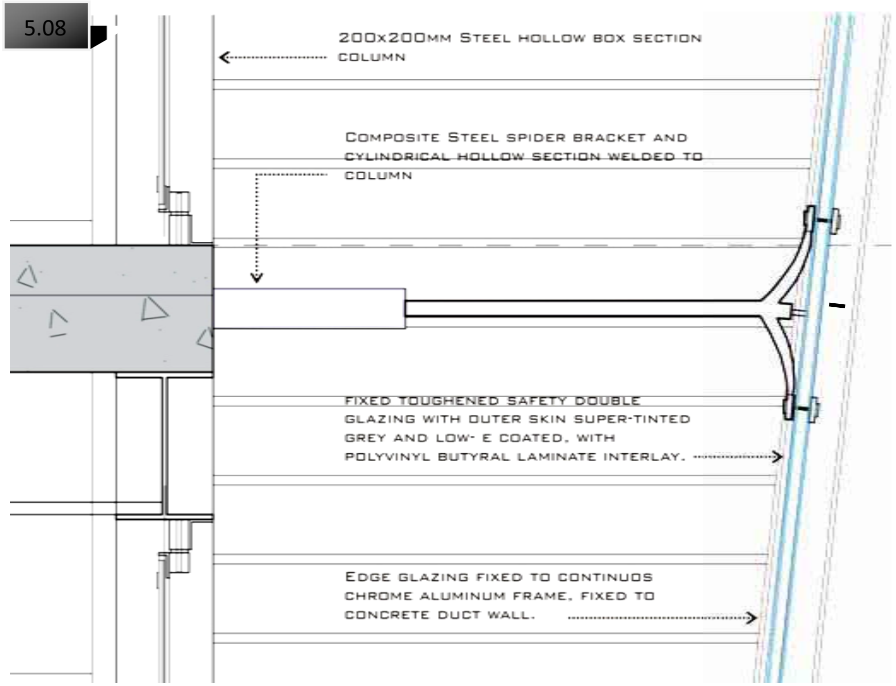
5.07



7. FAÇADE TREATMENT

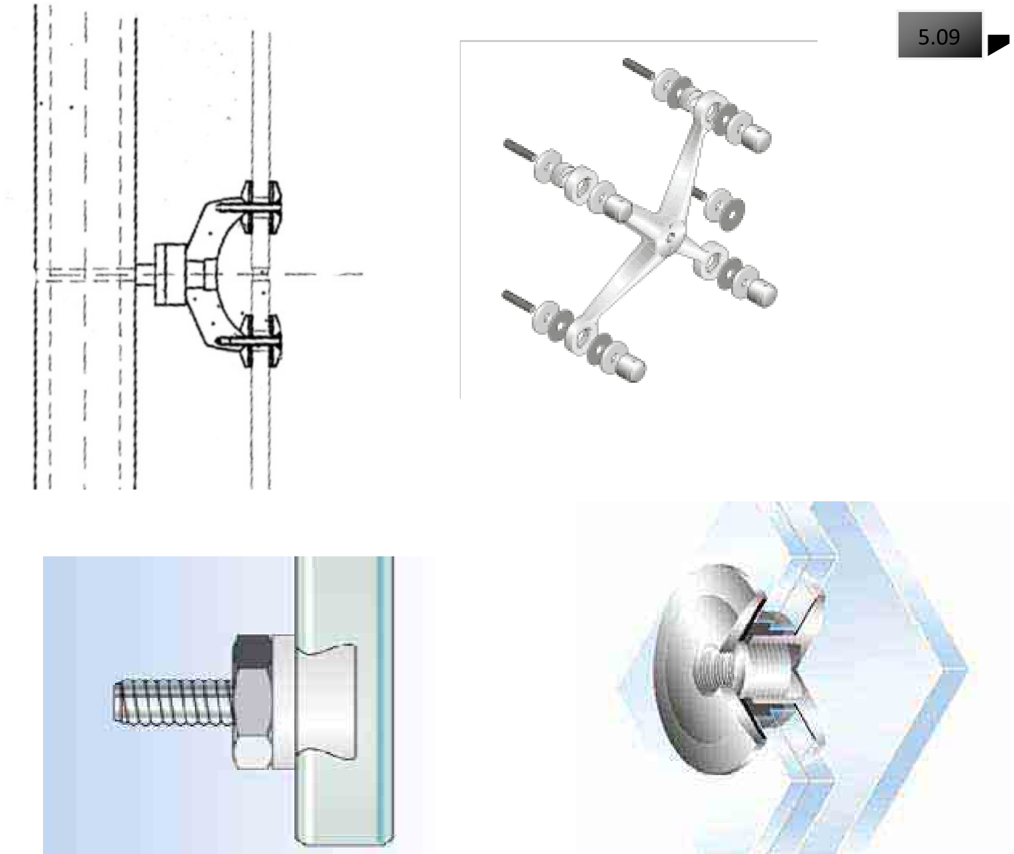
The Burnett Street facade is designed to communicate to the commercial spine edge, through the use of contemporary building techniques. Both north facing glazed walls not only serve to convey a particular aesthetic, but also to reflect the surroundings and internal activities, especially in the evening when it is illuminated from within, allowing the co-existence of internal and external spaces and maximising passive surveillance, as well as acoustic and insulating properties.

5.08



The envelope consists of two skins of glazing with a spacer enclosing a sealed air space between. The primary glazing acts as an acoustic and solar screen. The specification is as follows: fixed, toughened safety double glazing with an outer skin of super-tinted grey that is low e-coated, with polyvinyl butyral laminate interlay.

5.09

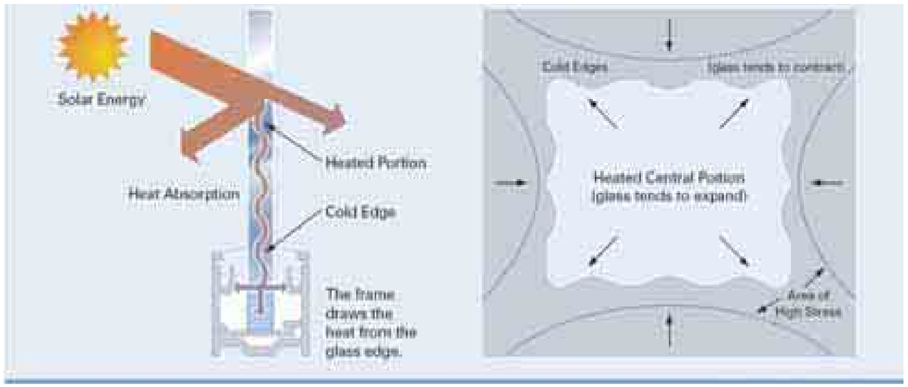


The primary skin is held in place by spider brackets, and is waterproofed by applying structural silicone where the glass edges meet.

The avoidance of the use of a perimeter frame for the skin most exposed to solar radiation, will protect the skin from thermal breakage as a result of heat difference. Thermal stress is caused when the central area of the glass is heated (naturally or artificially) and expands, while the glass edges remain cool, resisting expansion.

Thermal breakage is a result of an excessive build-up of thermal stress in annealed glass. The amount of thermal stress depends upon the temperature difference between the hottest and coldest areas of the glass, as well as on the distribution of the temperature gradient across the glass.

EFFECTS OF THERMAL STRESS 5.10



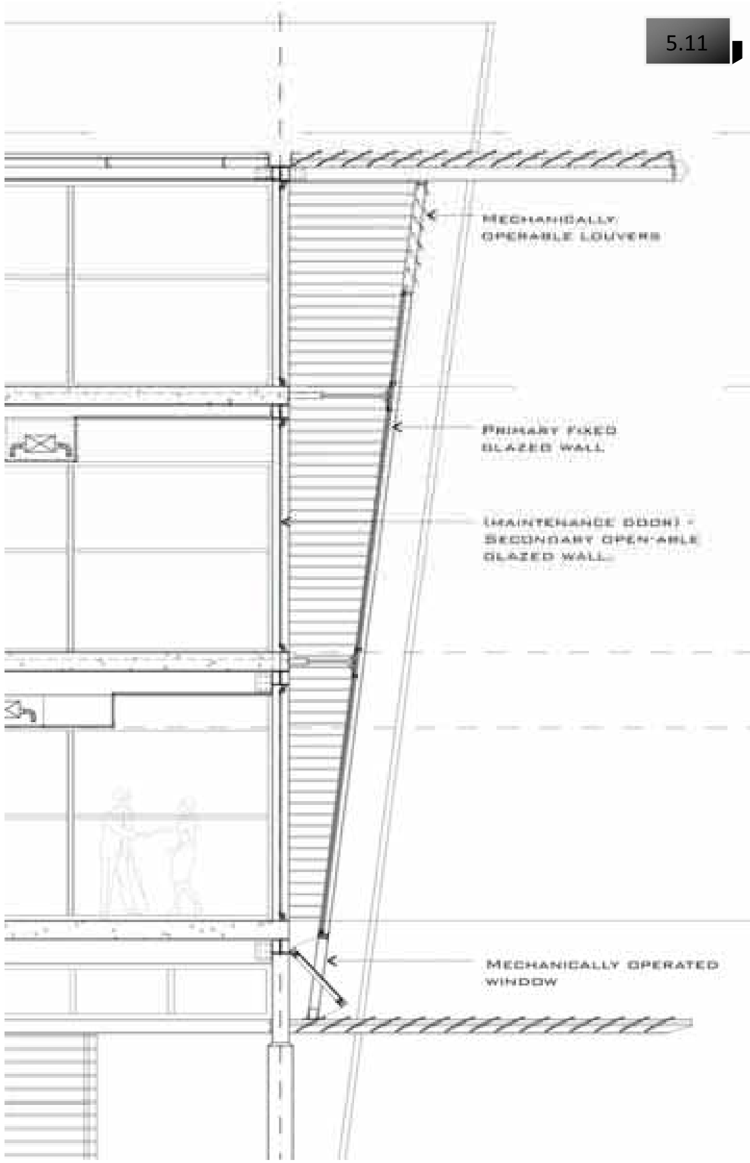
The low-emittance (Low-E) coated surface is to face into the gap between the glass layers. It blocks a significant amount of this radiant heat transfer, thus lowering the total heat flow through the window.

The secondary skin acts as a manually operable desiccant to the “spacer,” and solar-screen. The specification is as follows: low-emittance coated 6mm toughened glass. The skin is allowed to open so as to dehydrate the sealed air space and increase natural cross-ventilating air movement when required, while cooling the primary skin.

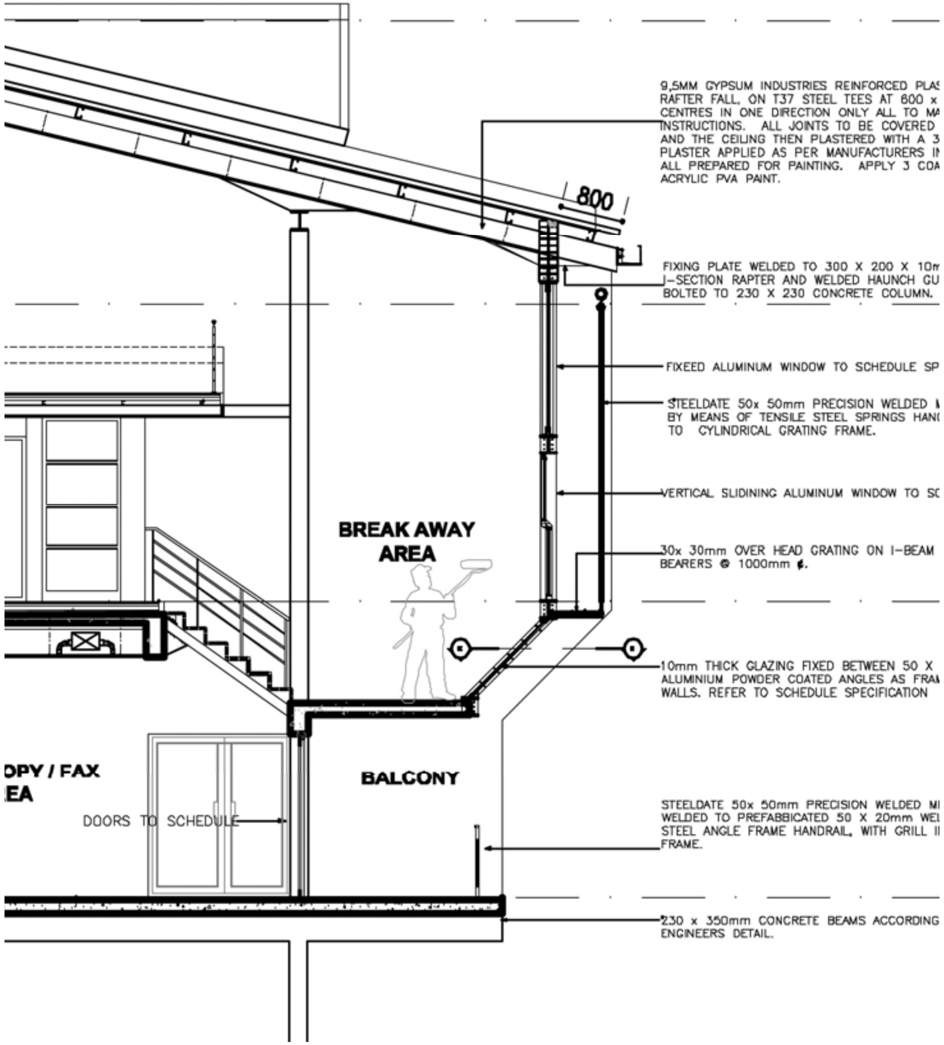
The secondary skin is fixed into aluminum frames. The perimeter seals consist of a combination of butyl primary seal and cured silicone secondary seal.

The thermal performance of insulating glazing depends mainly on the solar energy transmittance through the glazing, the reflectance of the glazing (measured by the shading coefficient), the ratio of the solar heat gain through the glazing to the solar heat gain or loss through the width of the air space, and the material and configuration of the spacer around the perimeter of the unit.

For these reasons, the spacer has been designed larger than a regular window glazing, while the open-able secondary skin acts as a service door to servicing the primary skin from every level without scaffolding on the outside.



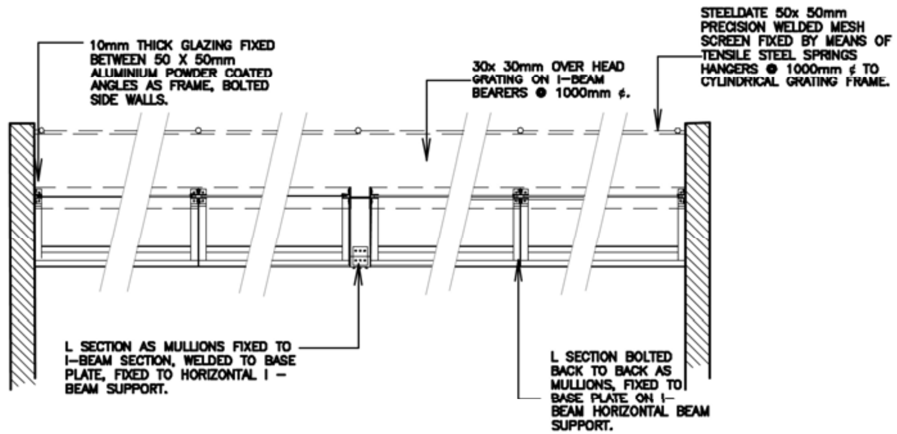
The air space reduces heat gain and loss of the north facing façade, as well as sound transmission, which gives the IG unit superior thermal performance and much needed road facing acoustical characteristics compared to single glazing. Acoustic performance of exterior building envelope assemblies is expressed in terms of the Outdoor—Indoor Transmission Class (OITC) rating. In general, a higher fenestration OITC rating is attained by incorporating laminated glass and insulating glass assemblies because the laminate reduces vibration and the air space limits sound transmission.



5.12

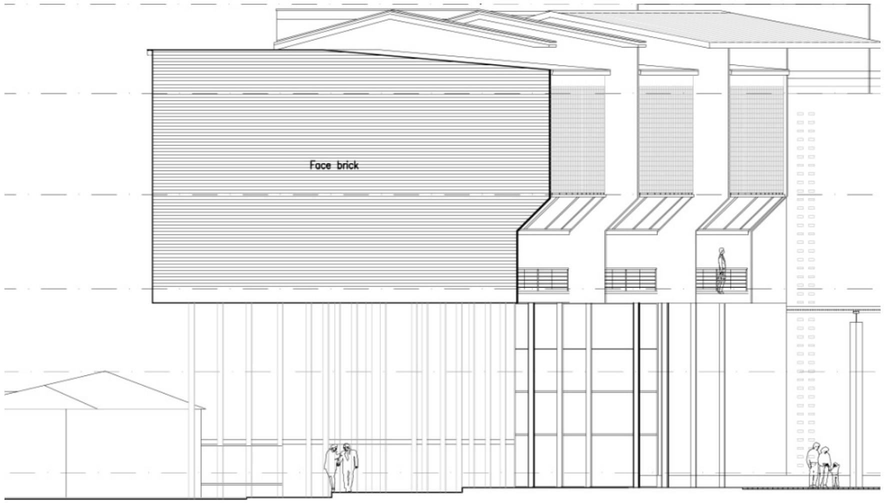
The square facing the north façade

In order to maximise the amount of light entering the building, the glazed façade is slanted outward, accommodating the balcony below. A mesh screen is incorporated into the design as a conceptual element, speaking to the idea of dissolving barriers. Occupants on the ground floor progress towards the university secured entrance, the transparency begin to blur, without completely disappearing. The screens technical function is to break up the north light, 500mm away from the glazed façade and fixed to grating and side walls.



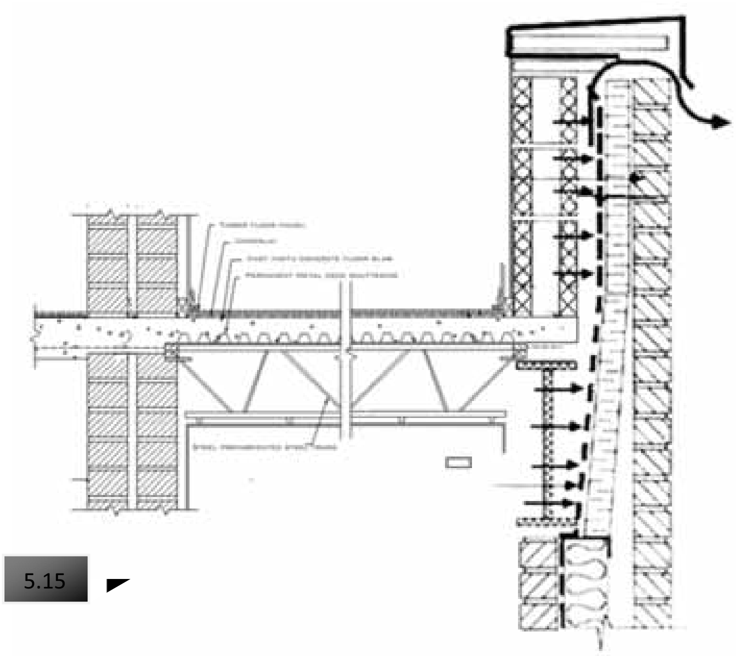
5.13

Section E - E



5.14

EAST ELEVATIONS



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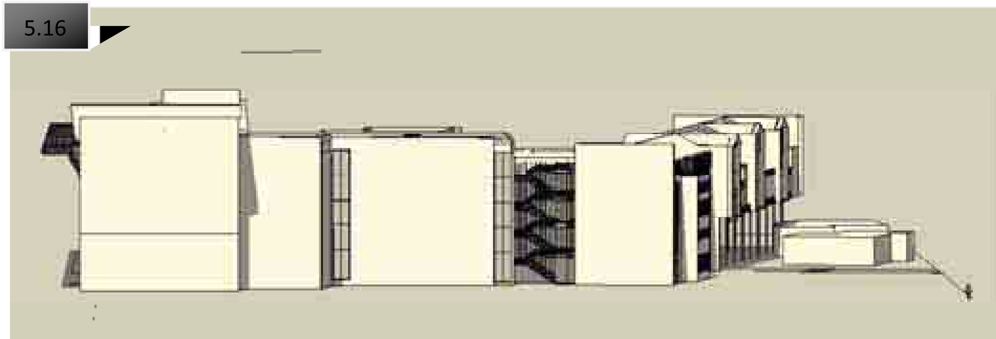

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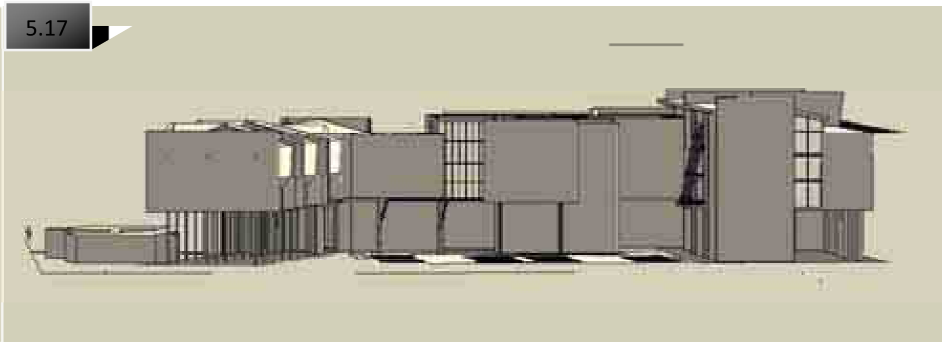
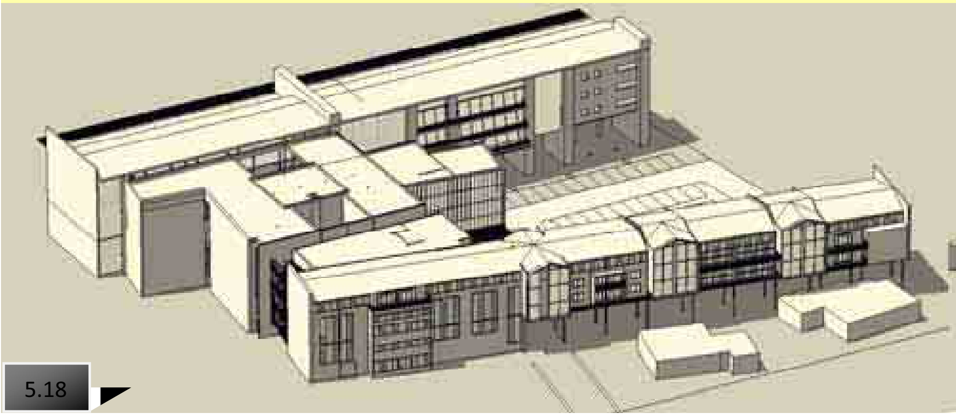


5.17

The western façade comprises mainly of 500mm wide brick cavity walls. These act as bearers to the prefabricated steel truss carrying the reinforced concrete roof slab. The walls insulate the building from the harsh western sun and have acoustic insulation properties with regard to the lecture rooms. Fig 5.15 illustrates a typical detail through the western walls.

Finally, the southern façade, with the pitched roofs and traditional building techniques, is designed to at least slightly resemble and relate to the proposed Tourism Department in the heritage buildings.



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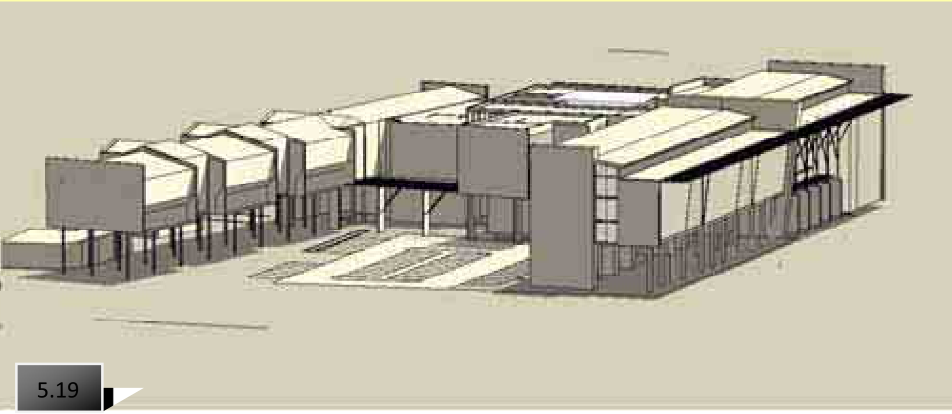


5.19

There is a definite contrast of elevational treatment, relating to the various edges. Fig 5.19 illustrates the initial views any new visitor from the outside the university would first encounter- that of transparency.

8. SERVICES

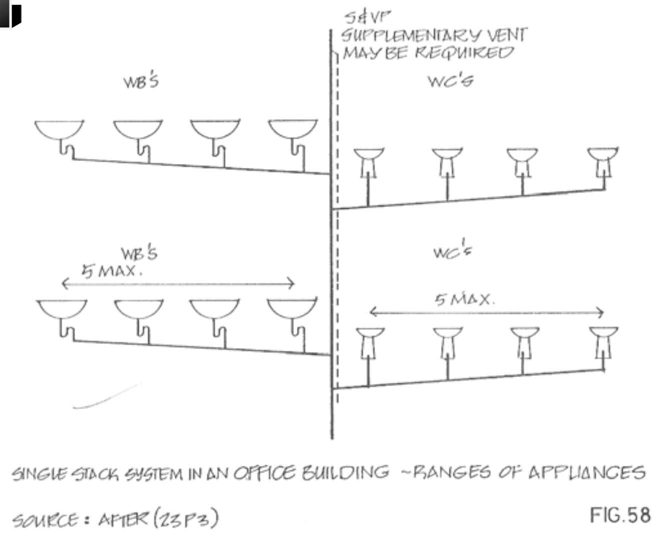
Traditional building techniques and materials have been applied to the square-facing façades. These have been employed with a contemporary aesthetic to them by using a linear texture application. This forms a minimalist aesthetic, allowing the building to facilitate human activities detailed with pergolas, mesh screens and changing paving colour and texture. Texture that is understood subconsciously by the user and relates to human activities is added.

The introduction of the Square access concrete walls echoes the sentiments of the philosophical approach, introducing a second layering threshold and acting as a gateway entry. In the process of research, we cross a boundary that signifies the distinction between an old thought and a new more developed idea. In crossing this boundary, the new idea carries with it all previous ideas that lead to its inception. These walls, therefore, act as layers which allow visual and physical access in a linear movement as to where the user is coming from and where the user is headed. This is accentuated by the 5.5m length of the gateway walls into the inner public pedestrian social realm (the Square), from the vehicular dominated street edge.

The visual penetration of these walls is another philosophical point discussed in the treatise. As one moves away from these walls towards the commercial activities offered, one begins to lose partial view from between the walls of from where one has come. This symbolises the focus on the new idea, where some ideas need to be disregarded- the movement from the beginning (the liminal/becoming) to the new point of being, as discussed in the theoretical treatise.

5.20

5.21



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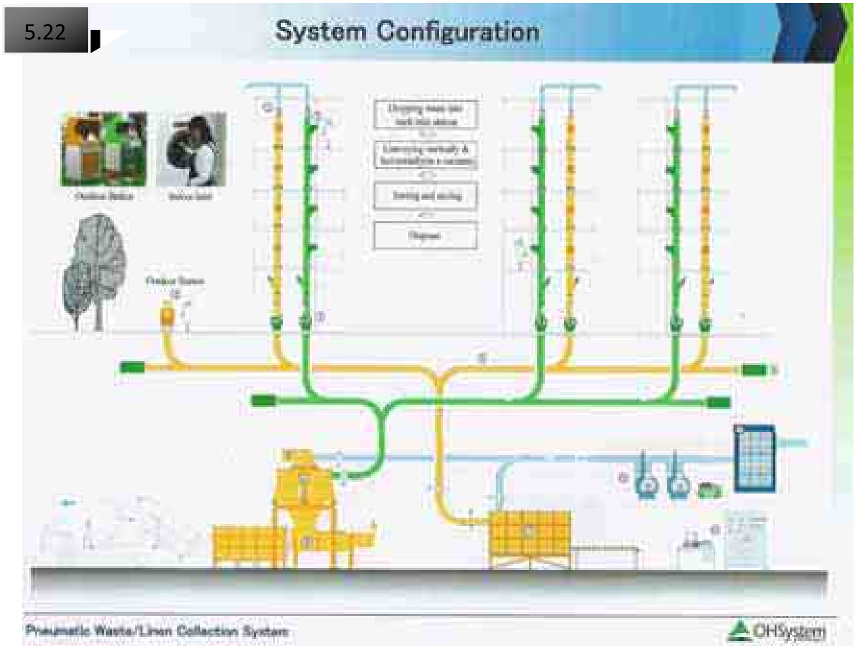
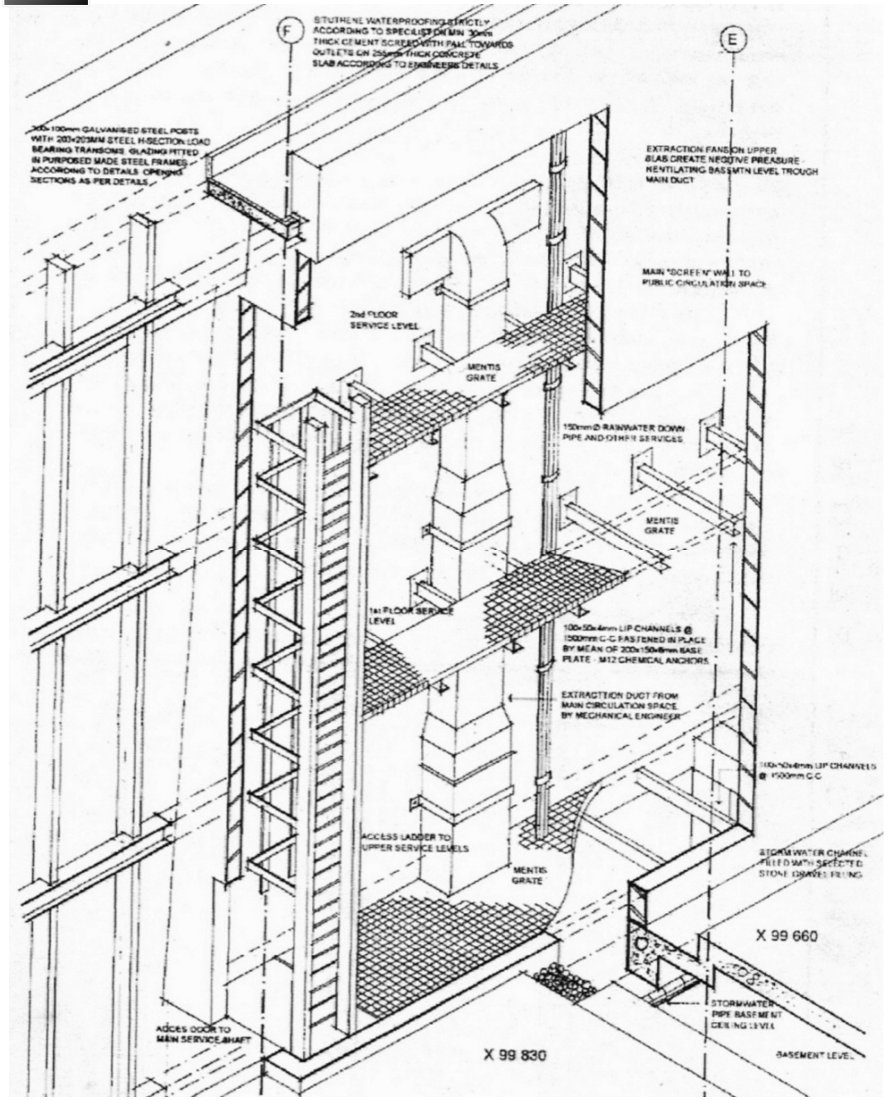


<u>The technical functions of the walls are to act as service ducts:</u>

- To accommodate natural air supply to all levels of the north threshold structure, assisted by air-conditioned supply from the chiller room on the basement level. Mechanical systems are to be designed by a mechanical engineer.
- To accommodate rainwater pipes from a photovoltaic cladded roof, collected via storm water pipes below the ground floor slab at basement ceiling level in order to be filtered and reused in the chiller room.
- To serve as a vertical electrical supply duct through-out the building, linked to the power room beneath the stairs at basement level.
- To act as a vertical super-structure, constructed of prefabricated concrete, to free up the ground floor at the threshold area.
- To house a Pneunatic Waste Collection duct system for paper disposal, to be collected into 700mm wide trolleys at ground floor for sorting. (Fig. 5.22)
- As waste water and sanitation central cores. Three central service cores have been located throughout the building. The service ducts are vertically ventilated. Access to the ducts is at ground floor level, and upper floors are accessed via an access ladder (indicated in the figure below by M. Sutherland, Thesis 2002 doc 2:72).

Fig 5.21 illustrates typical stack system utilized in the building.

5.23



9. THERMAL COMFORT

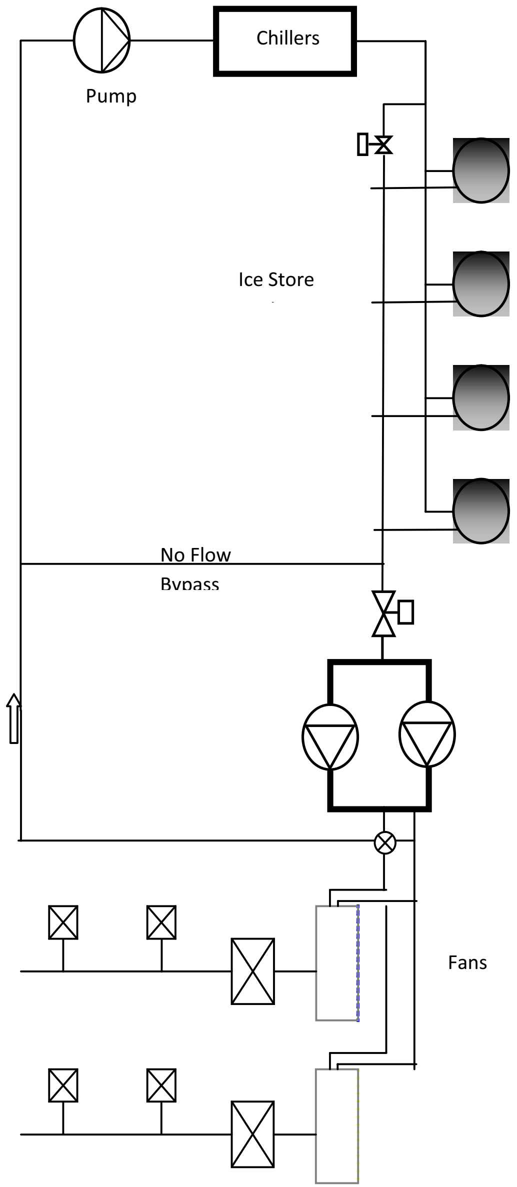
The mechanically assisted ventilation system consists of extraction ducts (to extract warm spent air) and fresh air supply ducts (replacing spent air with water chilled, humidified, fresh air) moving up the central duct carried horizontally under the ceilings.

This thermal storage system essentially shifts electricity loads to off-peak periods with significantly lowers costs. The system uses a standard chiller to produce ice (produced in off-peak periods) which significantly lowers costs and does not require any complicated duct system beyond the conventional duct systems. Water is circulated through the pile during the day to produce chilled water that would normally be the daytime output of the chillers.

A new twist is that this technology uses ice as a condensing medium for refrigerant. In this case, regular refrigerant is pumped to coils where it is used. Instead of needing a compressor to convert it back in to a liquid, however, the low temperature of the ice is used to chill the refrigerant back in to a liquid. This type of system allows existing refrigerant-based HVAC equipment to be converted to Thermal Energy Storage systems, something that could not previously be done easily with chill water technology. In addition, unlike water-cooled chill water systems that do not experience a tremendous difference in efficiency from day to night, this new class of equipment typically displaces the daytime operation of air cooled condensing units. In areas where there is a significant difference between peak daytime temperatures and off-peak temperatures, this type of unit is typically more energy efficient than the equipment it is replacing.

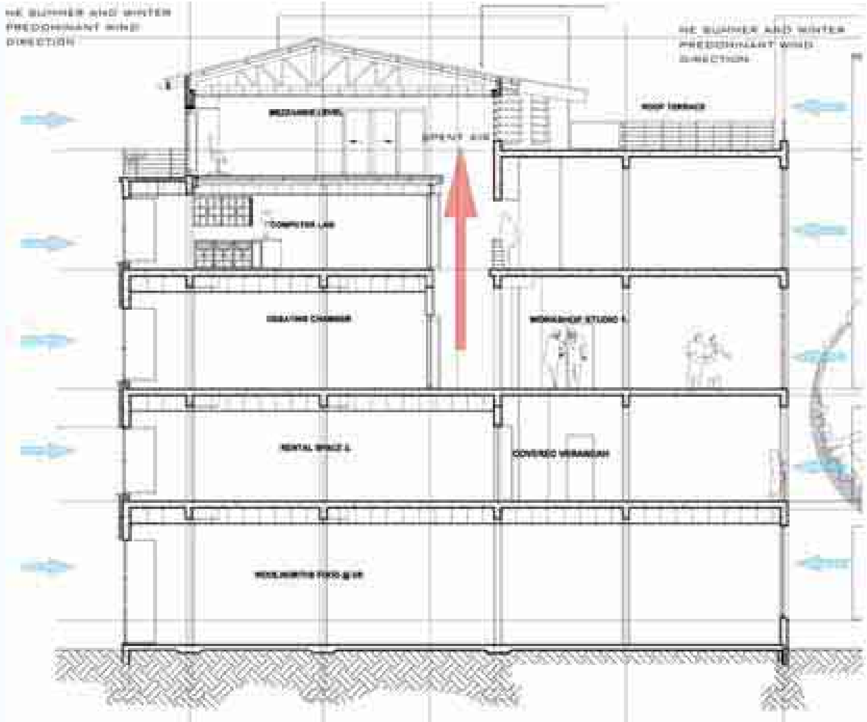
The flow diagram shows a typical storage plant.

5.24

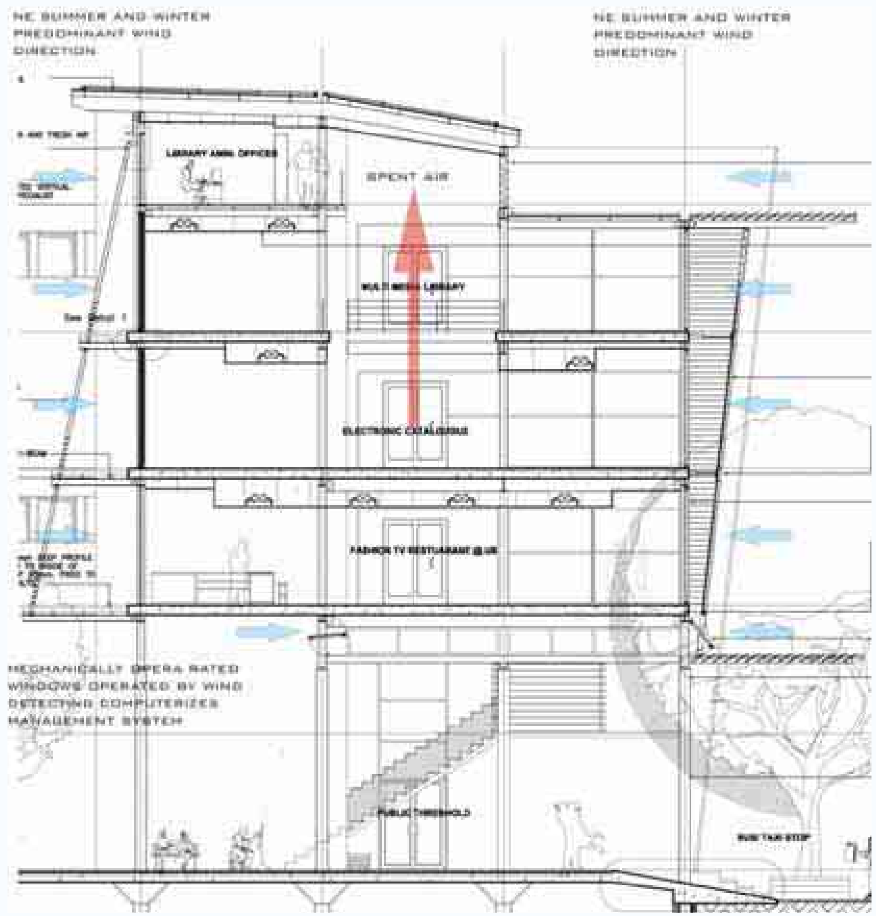


In addition to the air extraction and supply devices, numerous other environmental controlling systems have been incorporated to ensure user comfort. These are as follows:

- Structural mass – a cavity wall that acts as a barrier from the harsh western sun.
- North facing insulated double skin wall to keep internal spaces cool in summer and hold the heat in winter.
- Expansive use of glazing on the south façades.
- The building has been orientated so as to take advantage of the summer north-eastern and south-eastern prevalent winds, as well as the winter south-western winds- with winds with the highest intensity coming predominantly from the south of Pretoria.
- The depths are kept shallow at a minimum of 10m and a maximum of 15m to encourage the efficiency of cross ventilation.


NE SUMMER AND WINTER PREDOMINANT WIND DIRECTION
NE SUMMER AND WINTER PREDOMINANT WIND DIRECTION
SPENT AIR
ROOF TERRACE
COMPUTER LAB
WORKSHOP STUDIO 1
COVERED VERANDAH

5.25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NE SUMMER AND WINTER PREDOMINANT WIND DIRECTION
LIBRARY ADMIN. OFFICES
SPENT AIR
MULTI MEDIA LIBRARY
FASHION TV RESTUARANT @ UB
MECHANICALLY OPERA RATED WINDOWS OPERATED BY WIND DETECTING COMPUTERIZED MANAGEMENT SYSTEM
PUBLIC THRESHOLD

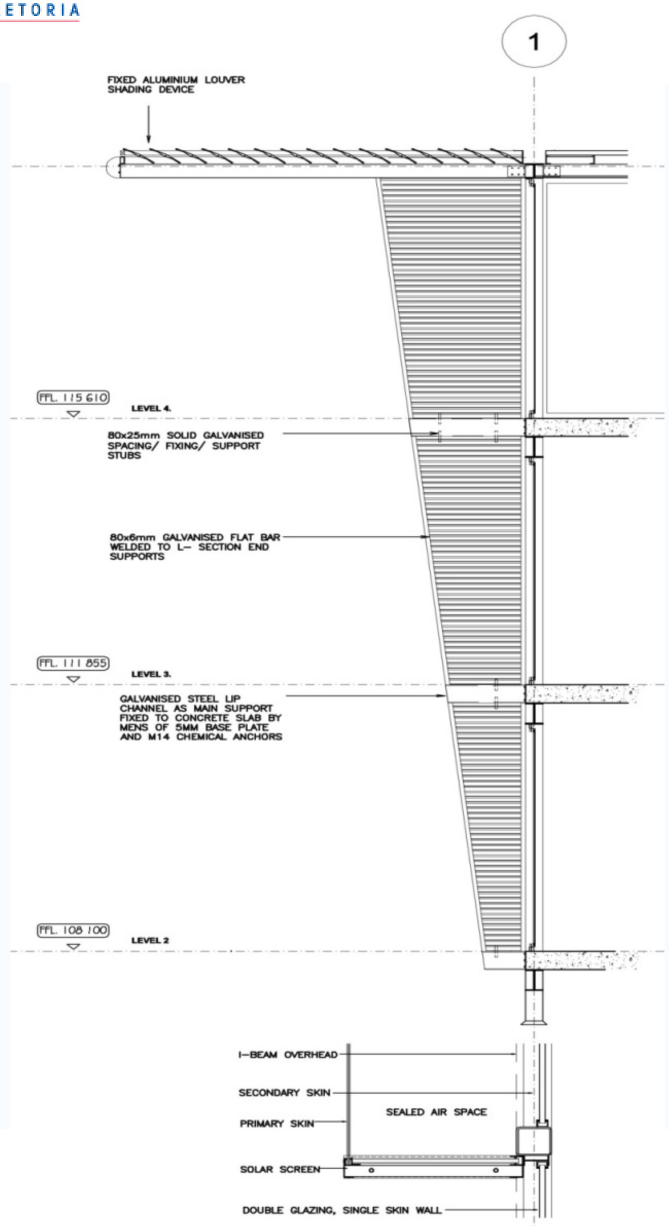
5.26

Solar screens

In an effort to limit internal spaces from exposure to the western sun, activities which require little to no natural light have been positioned to the west of the building. These include lecture theatres, laboratories, conference rooms and exhibition spaces.

Where transparency of the threshold could not be avoided, as a result of the philosophical discourse, solar screens were employed to protect glazed surfaces from exposure.

The use of these galvanized steel bars welded to I-sections allow for the continuity of transparency, while layering the minimalist aesthetic of the northern façade when approached from University Road.



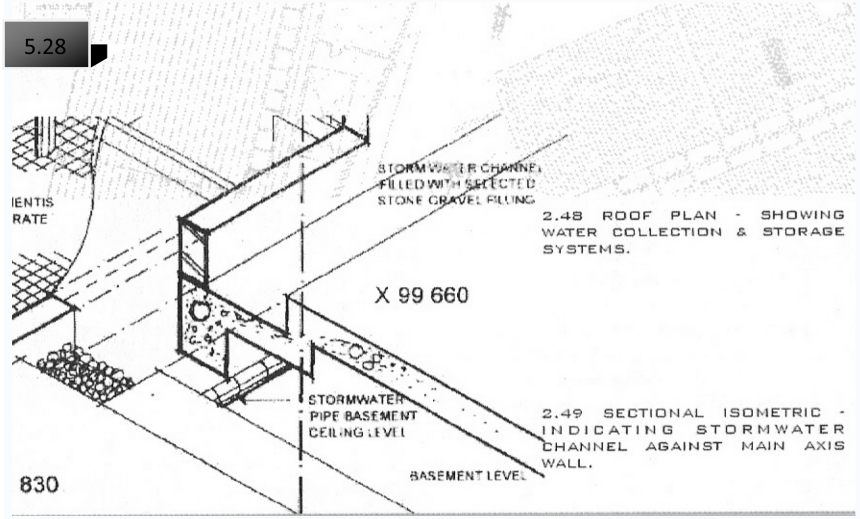
5.27

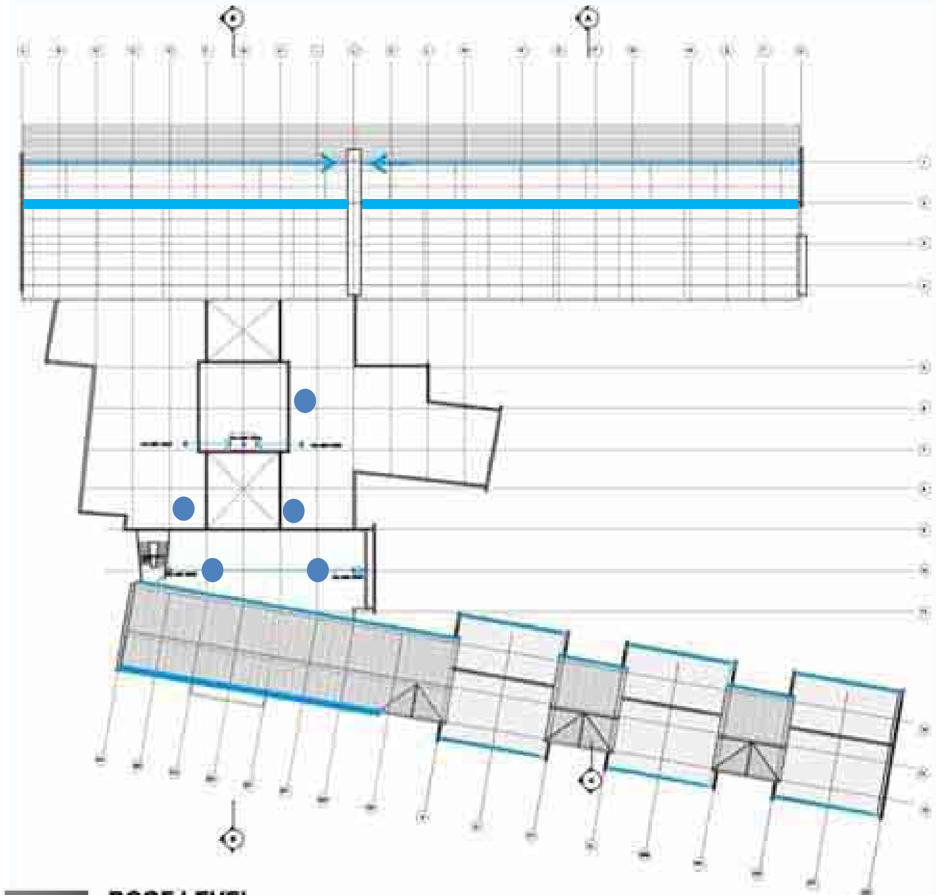
SOLAR SCREEN DETAIL
Scale 1:20

10. STORMWATER

The water off the roof slabs will be collected into the ducts to be used as a non-drinkable grey water source for toilets, urinals and landscaping. The grey water is to be directed into subsurface storage tanks. From the storage tanks the water will be pumped to other storage tanks on structurally strengthened concrete roof slabs near service cores (refer to roof plan). Ground level storm water is to be directed, via paving laid to fall, to join the municipal connection at the corner of Festival and Burnett Street.

5.28





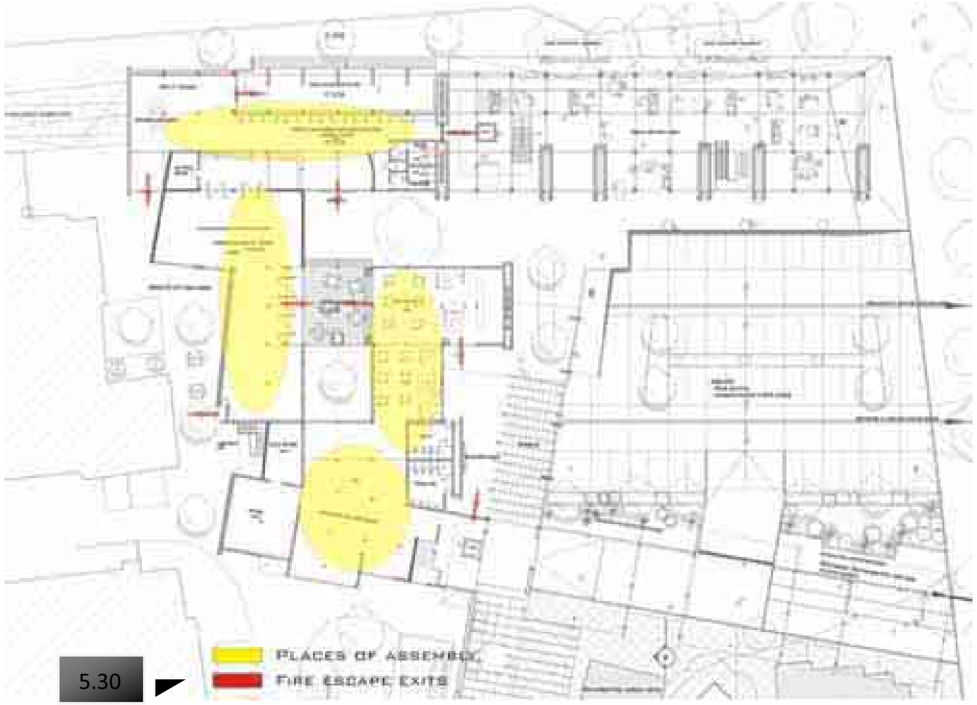
5.29 ROOF LEVEL

11. FIRE SAFETY

The following structural stability guidelines are to be adhered to:

- Offices and administration = 60min
- Places of assembly = 120min
- Service ducts = 120min

Firefighting equipment to be installed in the building must adhere to national building regulations.



5.30

Ground Floor Plan – Illustrating fire escape exits at ground floor level to either public or private external spaces.

Fire escapes are a maximum of 45m travelling distance to the closest exit point.

No staircase forming part of the escape route has direct access to the basement.

Lifts do not form part of the escape route.

The minimum width of a staircase, stipulated by building regulations of 1200mm, is exceeded throughout the building- the narrowest being 1500mm.

5.31

12. PAVERS

Typical upper floor plan – Illustrating fire escape routes to staircases to ground floor level to either public or private external spaces.

5.32

Colonial style stone company's paving products of equivalent local product.

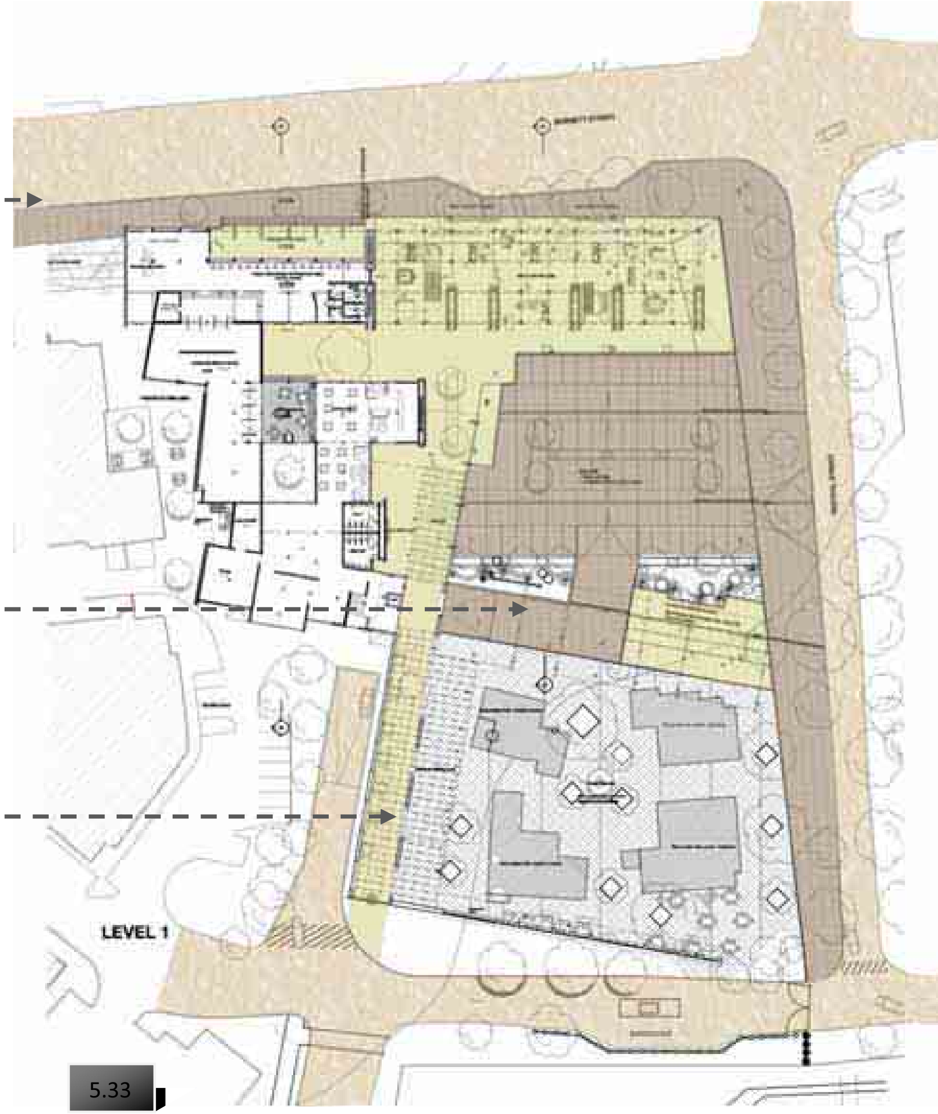
Road paving entering the Hatfield district hub should be considered, in order to slow down cars and also to signal entry into the district.

Walkway paving is to match the Square's paving, so as to integrate and indicate the Square as a public realm. A different colour of a similar paving should be used to indicate parking bay spacing and, therefore, also rentable area for the weekend formalised market.

The development's public areas and walkways are to be paved with pavers of a singular colour, varying in sized to create pattern; to be designed by landscape specialist. This ensures easy orientation for users.

Pavers to the west are to match the existing pavers.

Treat ground underneath pavers with an approved weed-killer. Pavers to be laid on 50 mm clean river sand with a 1:100 fall away from the building, or as specified. Fill joints with class 1 cement mortar and strike off with a jointer. All paver layouts, mixed colour and sizes to be designed by landscape specialist.



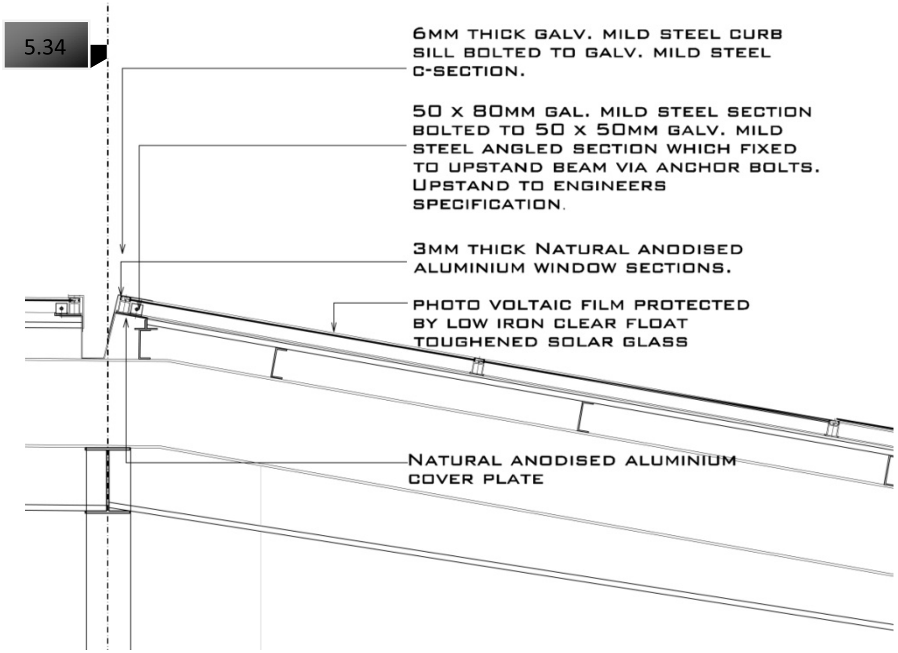
5.33

13. SOLAR PANELS

Thin film photovoltaic paneling is situated on the expansive north-facing roof. They are covered with low iron clear float toughened solar glass, which allows higher energy transmittance of about 91% compared to ordinary glass, provides excellent light diffusion, which decreases reflection, allows higher light transmission at an acute incidence angle and lower absorption by the glass itself.

The panels double up as a shading device, allowing dappled light to penetrate through diamond shaped spaces between them. The power sourced from the panels will be battery stored in the power room at basement level in order to power lights. The photovoltaic panels supplement municipal power and are, therefore, not the only source of electrical supply. Depending on the available power stored that day, they may also supplement landscape lighting on the development.

5.34



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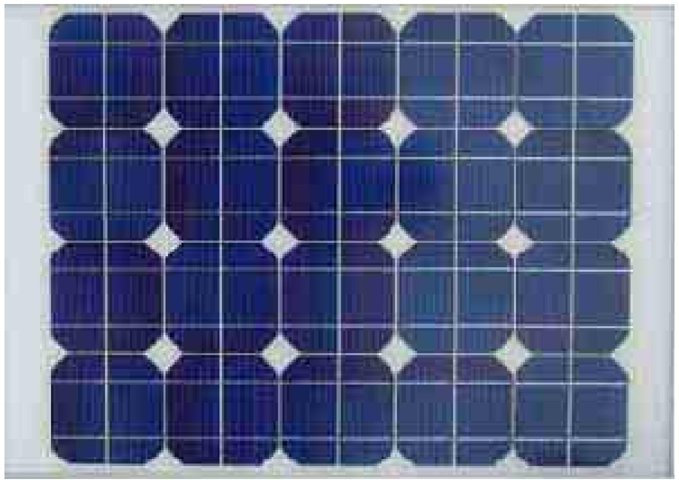

New technology- Photovoltaic film