UNIVERSITEIT VAN PRETORIA
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7

TECHNICAL INVESTIGATION

7.1 Introduction

The technical investigation and resolution in the students research facility is driven by the theories of architectural surface. Thus the investigation in to structure, systems and the rest of the technical components investigated in this chapter have focused on the design and development of an architectural surface as described in chapter 3.

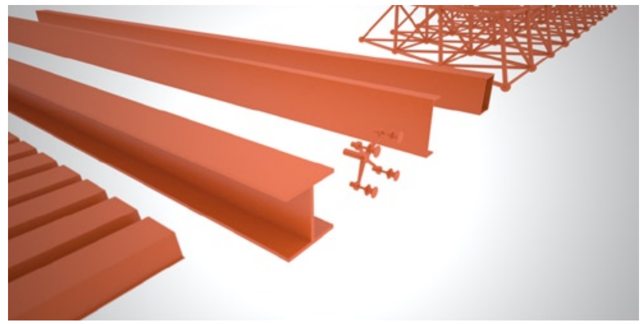


Figure 7.1: Main structural components

7.2 Structure

The flexibility and adaptability that is required in today's research facility required the development of a bespoke structural system that could deliver these two important requirements. The provision of free space, without the impediment of structural elements is the main aim of the structural system.

The structural system comprises 5 main components including; foundation pads, main support columns, diagrid lattice frame, floor slabs and the space frame roof structure. (Se figures 4,5 and 14-21)

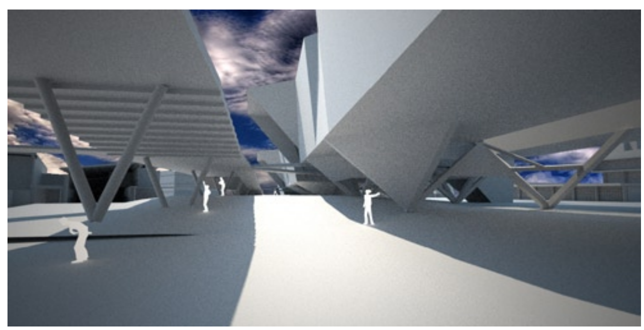


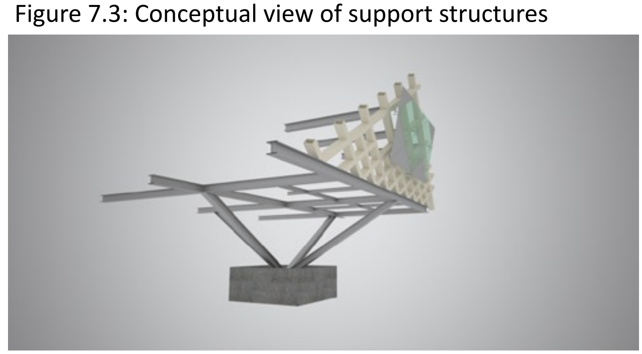
Figure 7.2: Conceptual rendering of main support Structures

7.2.1 Foundations

The entire structure is supported on eighteen foundation pads, six pads per research unit. The foundation pads are each 4x4x1m in size, they need to be constructed at a minimum base depth of 1.5m from natural ground level or where suitable bearing capacity is found. The foundation pads should be constructed of reinforced insitu cast concrete as per engineer's details.

The foundation pads act as `growth pods` for the rest of the structure to grow from. Due to this requirement they are recessed and need to be drained to a suitable geotextile ground drainage system and pump away, this is to prevent to contact of the structural steel system with water. (See Figures 4,5)

Figure 7.3: Conceptual view of support structures



7.2.2 Main Support columns

The main support columns or pyramids are constructed using 305x305x20mm mild steel H-profiles. The columns are fixed to the base support structure and foundation pads as shown in details Section A-A and F, they are painted to a matt finish in in-tumescent paint to attain a fire rating of 120 minutes.

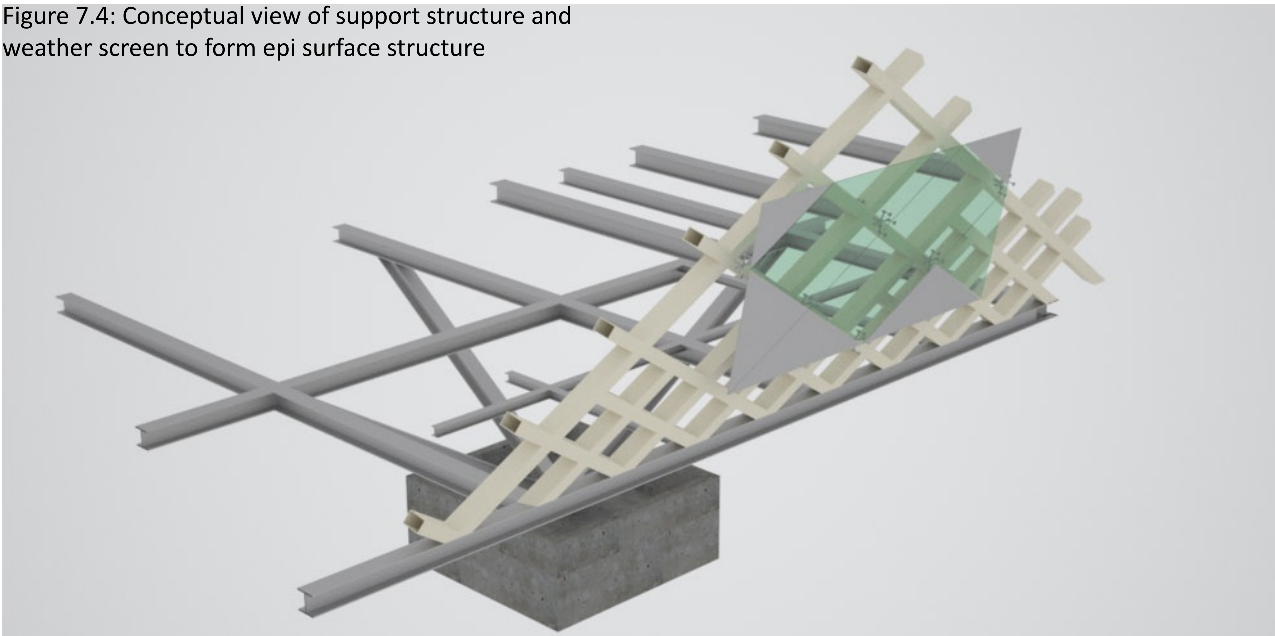


Figure 7.4: Conceptual view of support structure and weather screen to form epi surface structure

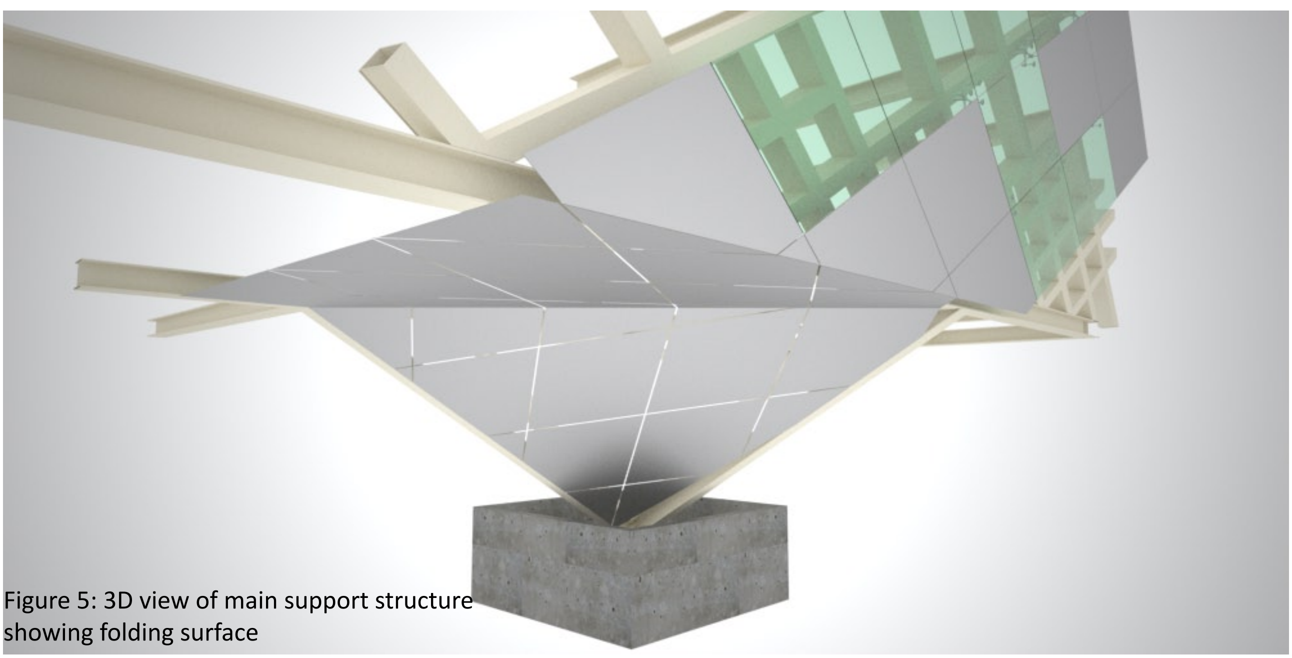


Figure 5: 3D view of main support structure showing folding surface

7.2.3 Lattice diagrid frame

The lattice diagrid structure is employed to transfer slab loads from envelope (surface) and atrium to the foundation pads. The surface structure thus liberates internal space from the imposed constrains of structure.

200x300x10mm Mild steel rectangular hollows sections are the structural components that are used in the lattice frame assembly. The diagrid lattice structure forms the surface structure of the facility that folds, wraps, encloses and supports the spatial requirements of the research facility.

The frame assembly is developed in a three tier hierarchy comprising primary, secondary and tertiary structural elements. The primary structural elements are designed to be contiguous and transfer most of the gravity loads. They are fully welded with 6mm fillet weld at their intersection, braced and joined where they intersect with custom manufactured X-brace plates. The brace plates are manufactured from 10mm mild steel sheets and are fully welded to the connections using 6mm fillet welds. In the hierarch of elements the secondary structural elements provide a support service to the primary elements as well as a stiffening service to the entire structure. Lastly the tertiary elements serve as stiffening in fill panels as well as solar shading devices where required due to their dense nature. (See figures 9,10,13 and 14 - 21)

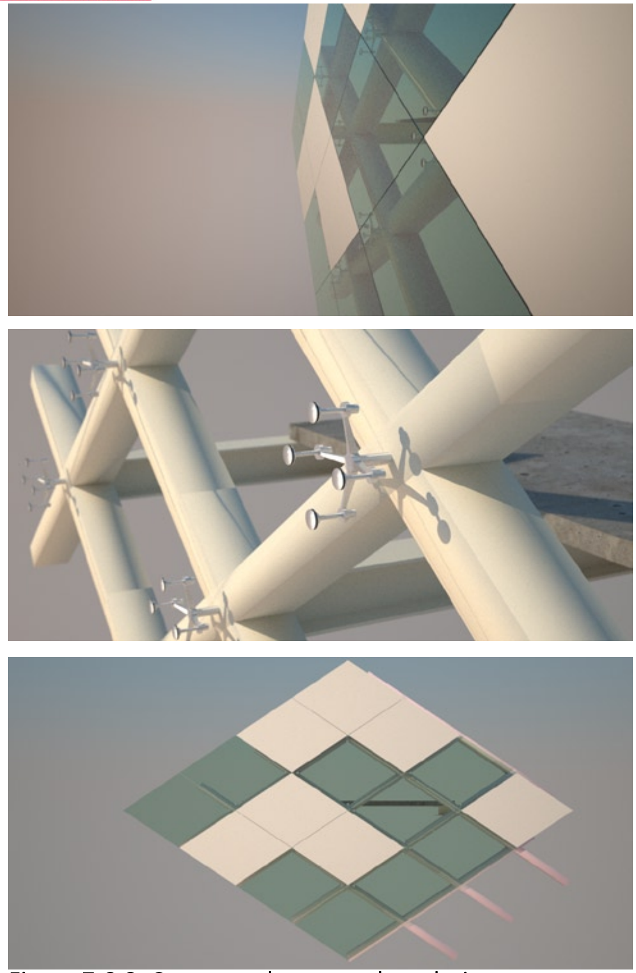


Figure 7.6-8: Conceptual structural renderings

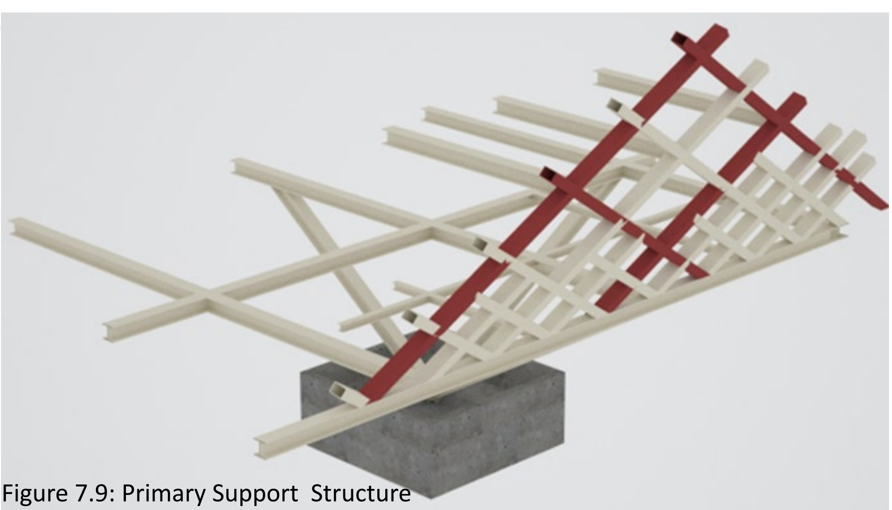


Figure 7.9: Primary Support Structure

Figure 7.10: Secondary Support Structure

7.2.4 Floor Slabs

Due to the spatial and structural requirements of the research facility it required a floor slab system that is lightweight, slim, provides long enough single spans and structural stiffness to the facility. The system that is employed throughout the facility is that of composite floor deck system.

Composite floor deck systems as employed in the research facility comprise a number of components. These components include a structural 1mm gauge galvanized mild steel deck, A142 anti crack mesh, cast insitu concrete and shear studs. The total slab depth is 130mm over a 3m single span. Connection between composite floor slabs and supporting beams is achieved thru the welding of shear studs to the structure at 300mm centres and a minimum of 100mm from the slabs edge. A maximum coverage of 30mm and minimum 15mm is to be achieved over the applied anti-crack mesh, with a minimum end lap of 300mm

Supporting and transferring loads from the composite floor slabs are 305x305x10mm H-profile beams @ 3000mm centres, these beams are fully connected to the facade and atrium lattice frames using 6mm fillet welds and connection plates where required. (See figures 11,12)

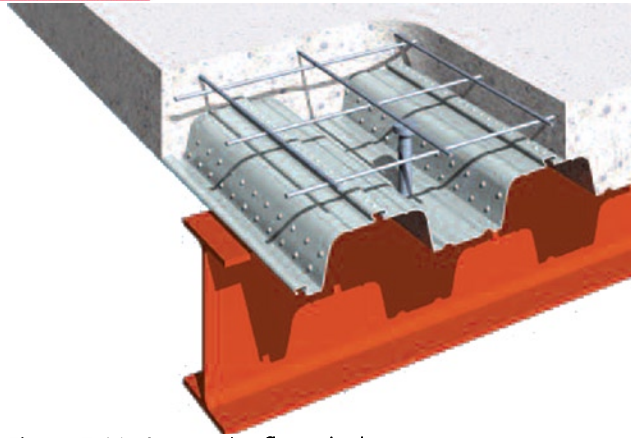


Figure 7.11: Composite floor deck components

Figure 7.12: Photograph of floor before finish

Figure 7.13:Tertiary Support Structure

Structural assembly diagrams

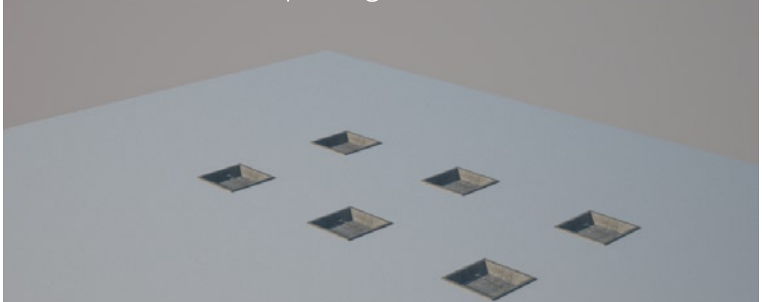


Figure 7.14:

1 FOUNDATION PADS

- 4000x4000x1000mm Reinforced concrete foundation as per engineers specifications

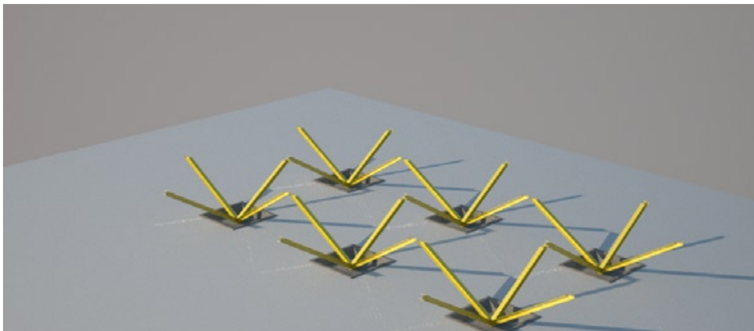


Figure 7.15:

2 MAIN SUPPORT COLUMNS

- 305x305mm H-profile main support columns primed and painted with intumescent paint to a mat finish, connected to pads as per detail F. Bottom 150mm of columns and gusset plate connections to be painted with bitumen based paint as water proofing

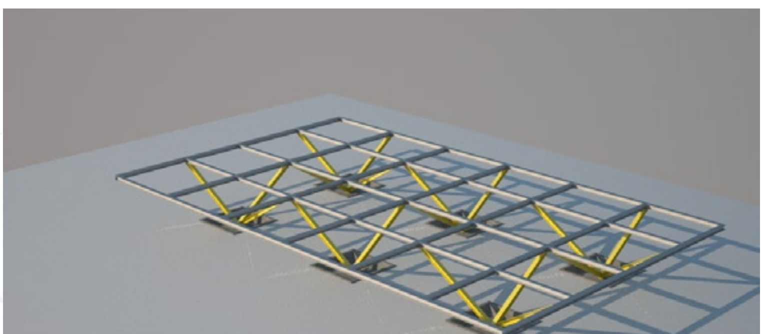


Figure 7.16:

3 PRIMARY BASE BEAM

- 305x305mm H-profile primary base beams form the main platform that supports the upper structure and transfers all loads to the support columns and foundations. Sett out to main structural grid

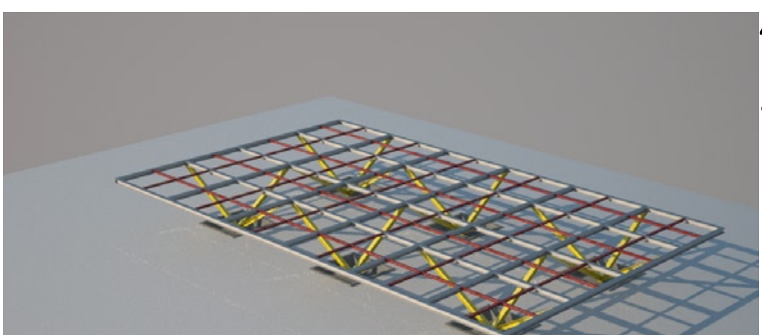


Figure 7.17:

4 SECONDARY BASE BEAMS

- 152x152mm H-profile secondary base beams

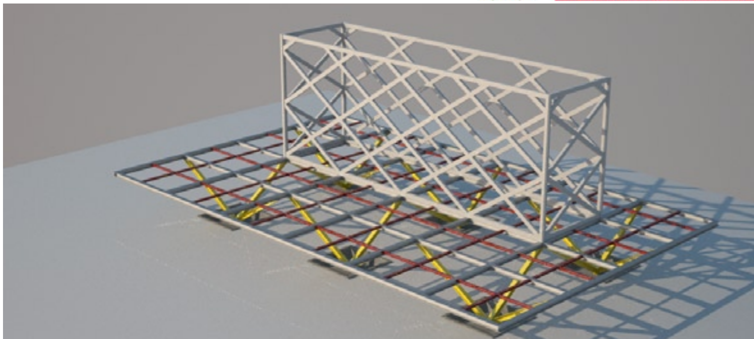


Figure 7.18:

5 ATRIUM LATTICE FRAME

• 300x200x10mm mild steel RHS atrium lattice frame is the only internal support structure within the spatial confines of the facility

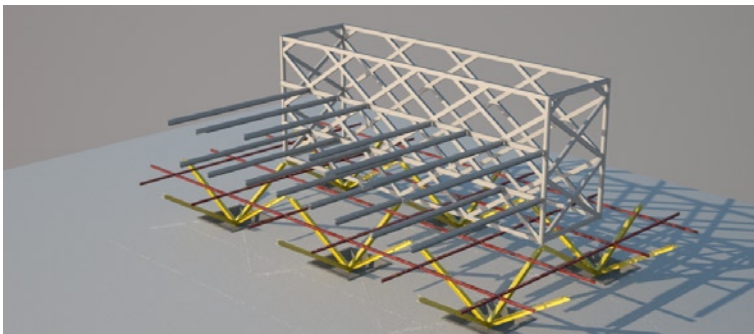


Figure 7.19:

6 FLOOR BEAMS

• 305x305mm H-profile beams act as main floor slab support structure and connect external surface lattice frame to the atrium lattice frame

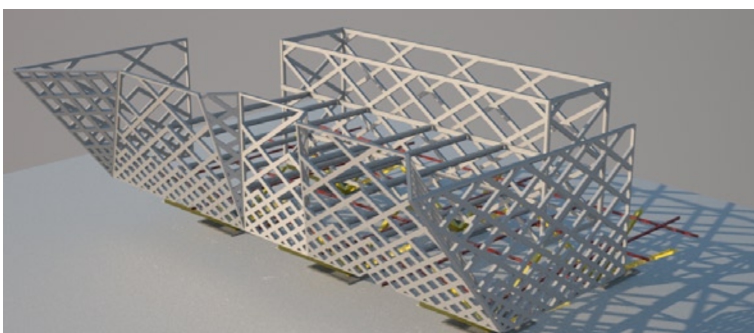


Figure 7.20:

7 MAIN FACADE LATTICE FRAME

• 300x200x10mm mild steel RHS atrium lattice frame serves as the main structural component in the facility

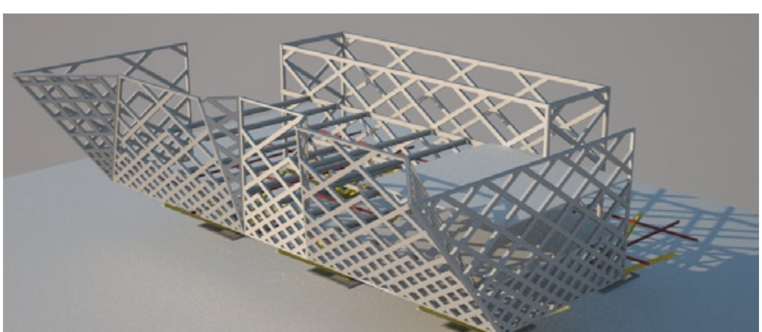


Figure 7.21:

8 FLOOR SLABS

130mm Composite cast insitu concrete floor slabs .

7.2.5 Roof Structure

A space frame roof structure presented to be the most suitable structural solution to the requirements of the facility. The space frame has numerous qualities that make it an appropriate structural selection including long spans with relative small depth, light weight, easy construction, materials efficiency and space for services accommodation. The only negative consideration when using a space frame is the fact that they are difficult to design.

I chose to use the diagrid space frame structure; it seamlessly integrates with the diagrid lattice frame of the architectural surface as well as providing the most efficient span to depth ratio for a space frame structure.

Mero-TSK is the proposed node system for the space frame construction, it is modular and the system comprising 40mm mild steel tube as cord and bracing members with cast round node points. The proposed finish to the space frame is a powder coat finish.

The total roof deck structure is made up out of:

1 - Space Frame

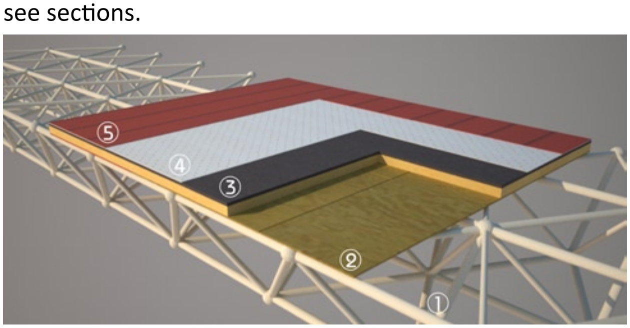
2- 12mm Plywood decking

3 - 100mm Kingspan K11 Insulating roof board

4 - Breather membrane

5 - Zinc Standing seam roof cladding

Figure 7.25: 3D view of proposed Roof structure make up, see sections.



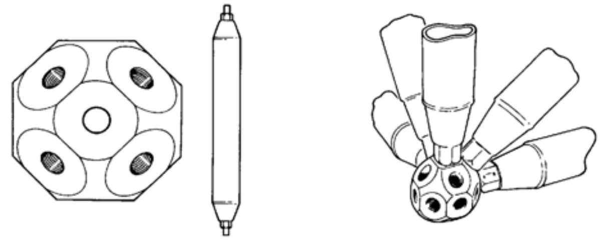


Figure 7.22: Mero TSk node system

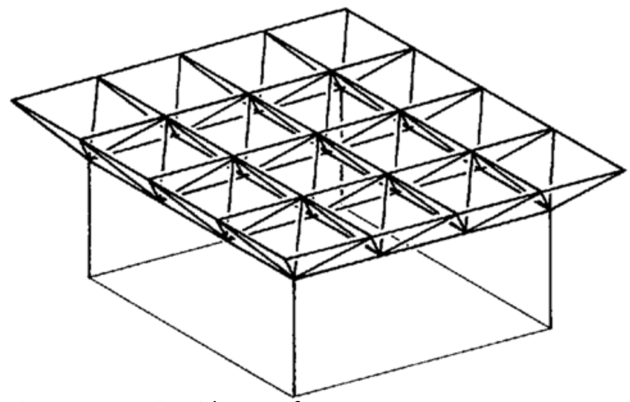
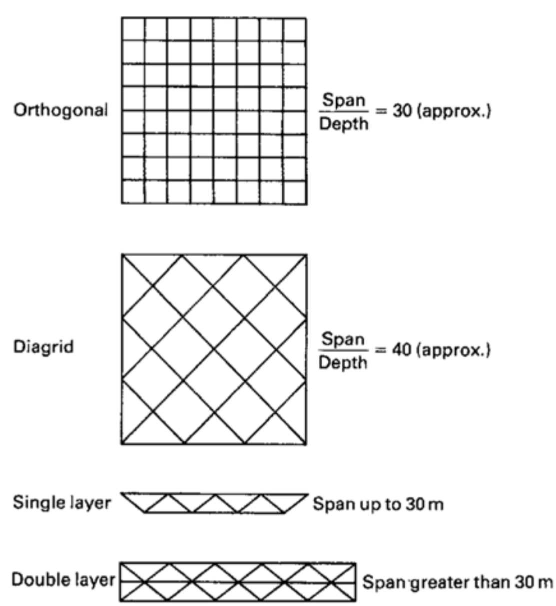


Figure 7.23: Diagrid space frame structure

Figure 7.24: Common space frame span to depth ratios



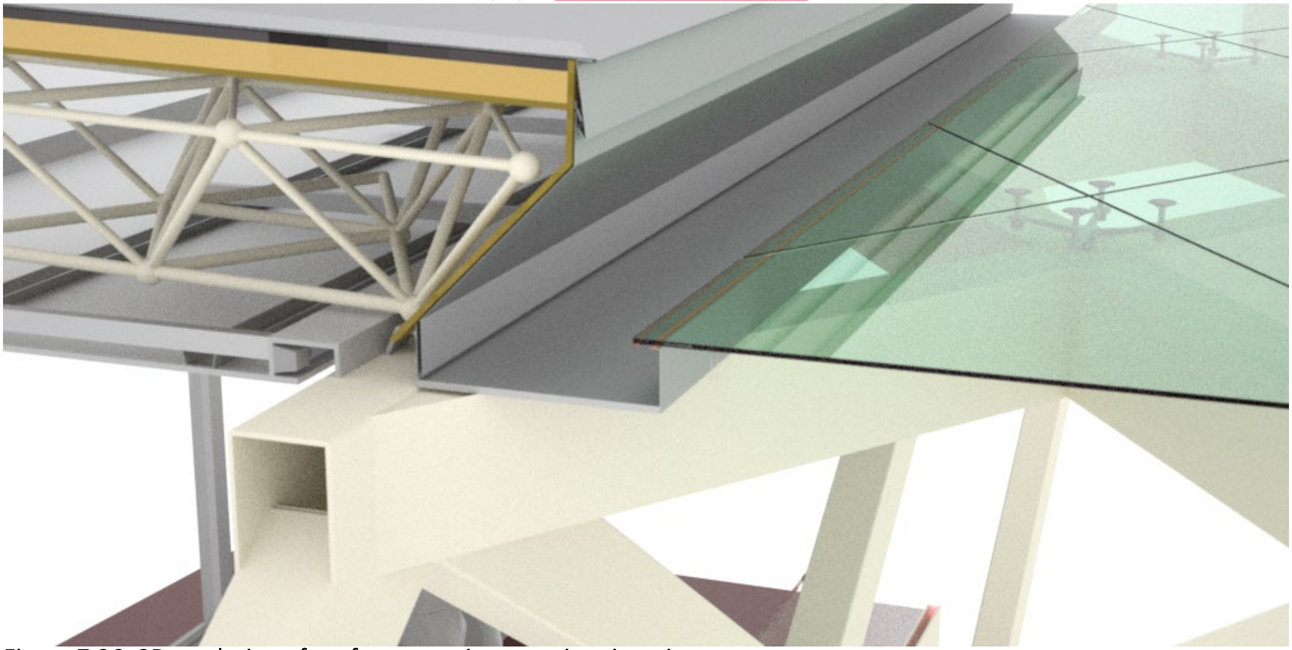
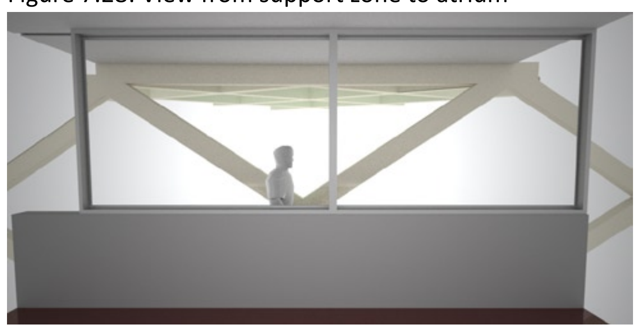


Figure 7.26: 3D rendering of roof construction at atrium junction

Figure 7.27: View of atrium structure and glazing

Figure 7.28: View from support zone to atrium



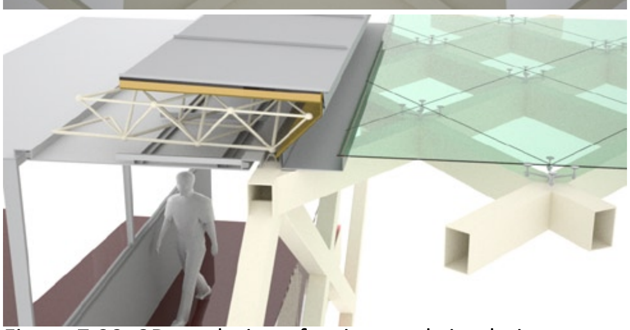


Figure 7.29: 3D rendering of atrium and circulation zones

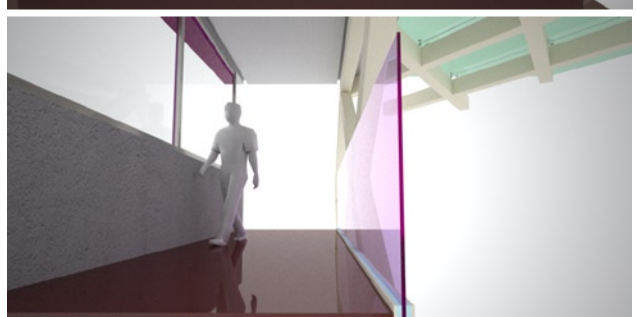


Figure 7.30: View of atrium circulation space

7.3 Facility Planning

6.3.1 Introduction

Research facilities in their simplest form present a complex planning task to any designer. In today climate of technology change and output driven research environments, planning of an optimal functioning research facility becomes all the more complex. Some of the key guiding principles of contemporary research lab design and my research facility include:

Design for change – All decisions should be made on the premise that functions, staff, space and location will change. (Griffin,2005)

Design for the computer – More and more task today are completed in the virtual environment (Griffin,2005)

Break down barriers – Involve scientist from various disciplines (Griffin,2005)

Facilitate creativity – Designers can bring scientists together by facilitating chance encounters (Interaction), and providing inspiring spaces (Griffin,2005)

Design Generic not specific – Laboratories should be generic in size and layout and based on the optimum lab module size, to accommodate various layout and uses (Griffin,2005)

Connectivity – Celebrate circulation throughout the facility, place in public zone to facilitate a sense of community (Griffin,2005)

While keeping the above mentioned design object tives in mind the facility is planned around 5 key zones:

A – Research and Support zone

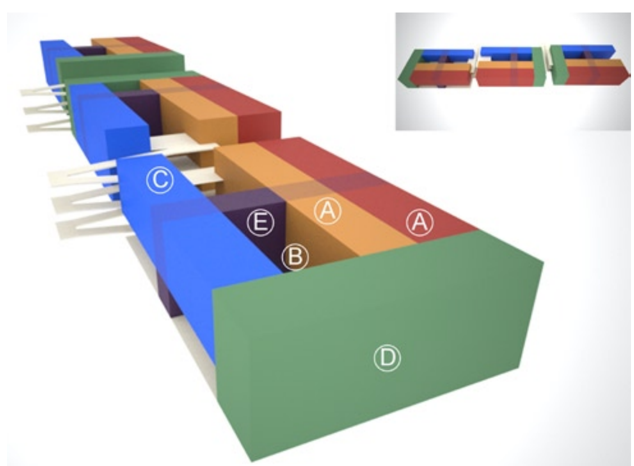
B – Connective Atrium (communal street) zone

C – Academic, Interactional and support zone

D – Building Services Core zone (Horizontal Circulation, Services riser, mechanical and plant rooms, Bathrooms and Main entrances)

E – Transitional Spaces zone

Figure 7.31: Zone planning diagram



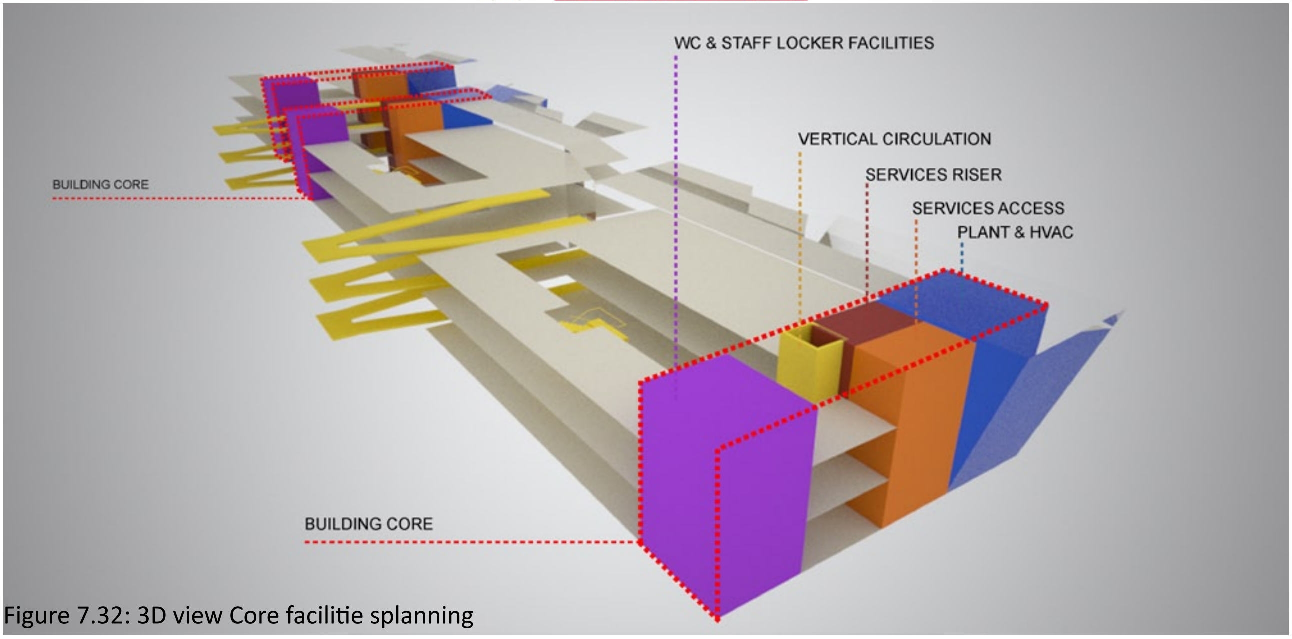


Figure 7.32: 3D view Core facilitie splanning

6.3.2 Zone Planning

Structural Module development

Planning of the research and research support zones required the study of numerous case studies to attain the optimum and most flexible research module size. The module size that was deemed most suitable to flexible research environments is that of 3mx3m and its duplicated of 6mx6m. Thus any subdivision within this spatial module would be applicable to research spatial requirements. The research support zone, the zone where all shared equipment and facilities is located requires the same module size of 3m as well as a 2m circulation width.

From these two planning module sizes the structural grid for the facility was determined. The structural grid reads as 6m(research module) – 5m(support & circulation) – 6m(atrium) - 5m(interaction & academic) in a south to north direction and a consistent 6m structural module from west to east only changing to 5m where main entrance are located.

Further to the structural module development the facility is subject to horizontal and vertical zone development.

Horizontal Zones

Interaction is one of the key driving forces behind the horizontal zone development of the facility. Planning as to ensure that different users in the facility are giving more opportunity to interact and meet, either by choice or chance.

As mentioned earlier the building is divided in to five key horizontal zone A-E.

Zone A can be defined as the research zone where all research labs and research support zones are located.

Zone B the linear connective atrium is designed as the communal spill out space within the facility. Productive and inventive research takes place in facilities where a sense of community exists and change encounters are facilitated. The atrium space is designed as a communal `street`, a main spine from where and onto where all functions and spaces in the facility join on to and open on to.

Zone C is defined as the academic and interactional support zone. This zone contains the programmatic functions that incorporate the rest of the academic environment from students to lecturers and researchers and is a multi disciplinary, multifunctional zone (can be seen as the community hall zone)

Zone D is the only fixed zone in the facility in terms of structure. The fixed core zone is classified as the only in adaptable space within the facility; it contains the vital services that are required for a research facility to function. This zone contains the Horizontal Circulation, Services riser, mechanical and plant rooms, Bathrooms and Main entrances.

Zone E, Transitional spaces abuts with and intersects zone B (atrium) directly, this zone is orientated to key external views as discussed earlier. Within this zone is located vertical circulation staircases and transition spaces. The location of this zone within the near middle of each unit and the location of the vertical circulation serves to enhance the sense of community.

Vertical Zones

Spatial division from public to private is the main purpose of the vertical zone implementation within the facility. Three distinct vertical zones are identifiable within the research zones, public spaces at the lowest level; including teaching laboratories, the atrium zone and open project labs. The second level is known as the open lab zone, where open research labs and more private functions are located, the third level is known as the closed lab zone. Within the closed lab zone more private and sensitive research is undertaken, as well as more private functions needed in the other zones.

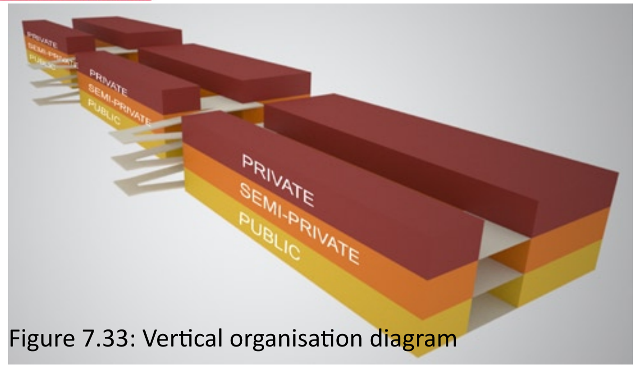


Figure 7.33: Vertical organisation diagram

7.4 Climate control

Climate control in the research facility is designed to achieve optimum comfort for all occupants at all times. Comfort can be described as a balance of four key elements:

Light - visual environment
Heat – Thermal environment
Noise – Acoustic environment
Smell – Air quality
(http://www.battlemccarthy.com/Double%20Skin%20Website/environmentalchar/doubles... ,10/09/2008)

The climate control design for research facility is optimised to give equal importance and attention to each of the above for factors. Due to the energy intensive nature of a research facility it is important to employ as many sustainable climate control techniques as possible where possible throughout the facility.

7.4.1 Ventilation (Thermal, Acoustic, Visual, Air quality)

The ventilation strategy for the research facility is a hybrid system; because of the HVAC recruitments of certain functions within the program it is not possible to do a 100% passive ventilation system. The ventilation design system comprises two systems, mechanically ventilated zones and assisted passive ventilation zones as indicated in the ventilation diagrams. The ventilation system is designed around a deep surface envelope system. (See diagrams 34-40)

The passive ventilation system in the facility is based on the stack effect or buoyancy ventilation, assisted by hybrid (solar and mains) powered heat extractor linked to BMS when required.

The use of a deep surface envelope has one drawback that is the initial capital input required to construct such a system. However the positive benefits out way the negatives by far especially in a Research

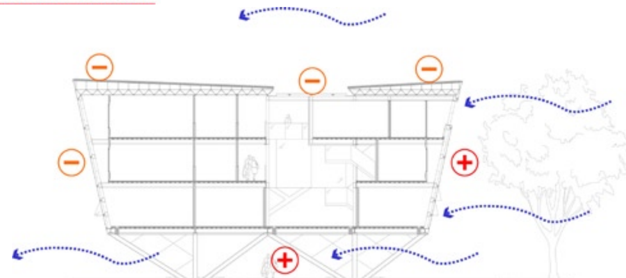


Figure 7.34: Prevalent wind direction effect on air pressure and passive ventilation

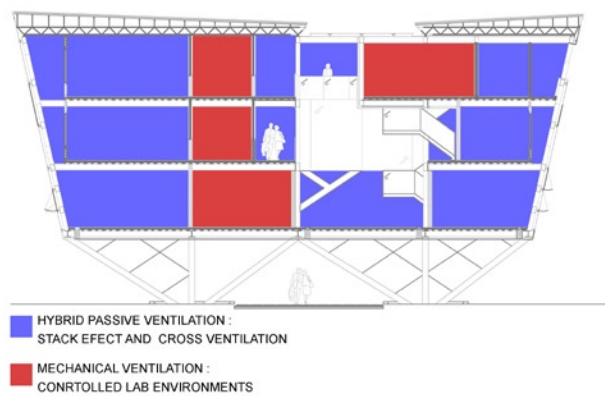


Figure 7.35: Ventilation zones

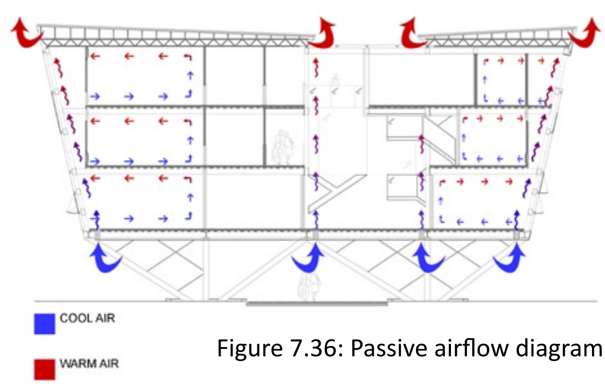


Figure 7.36: Passive airflow diagram

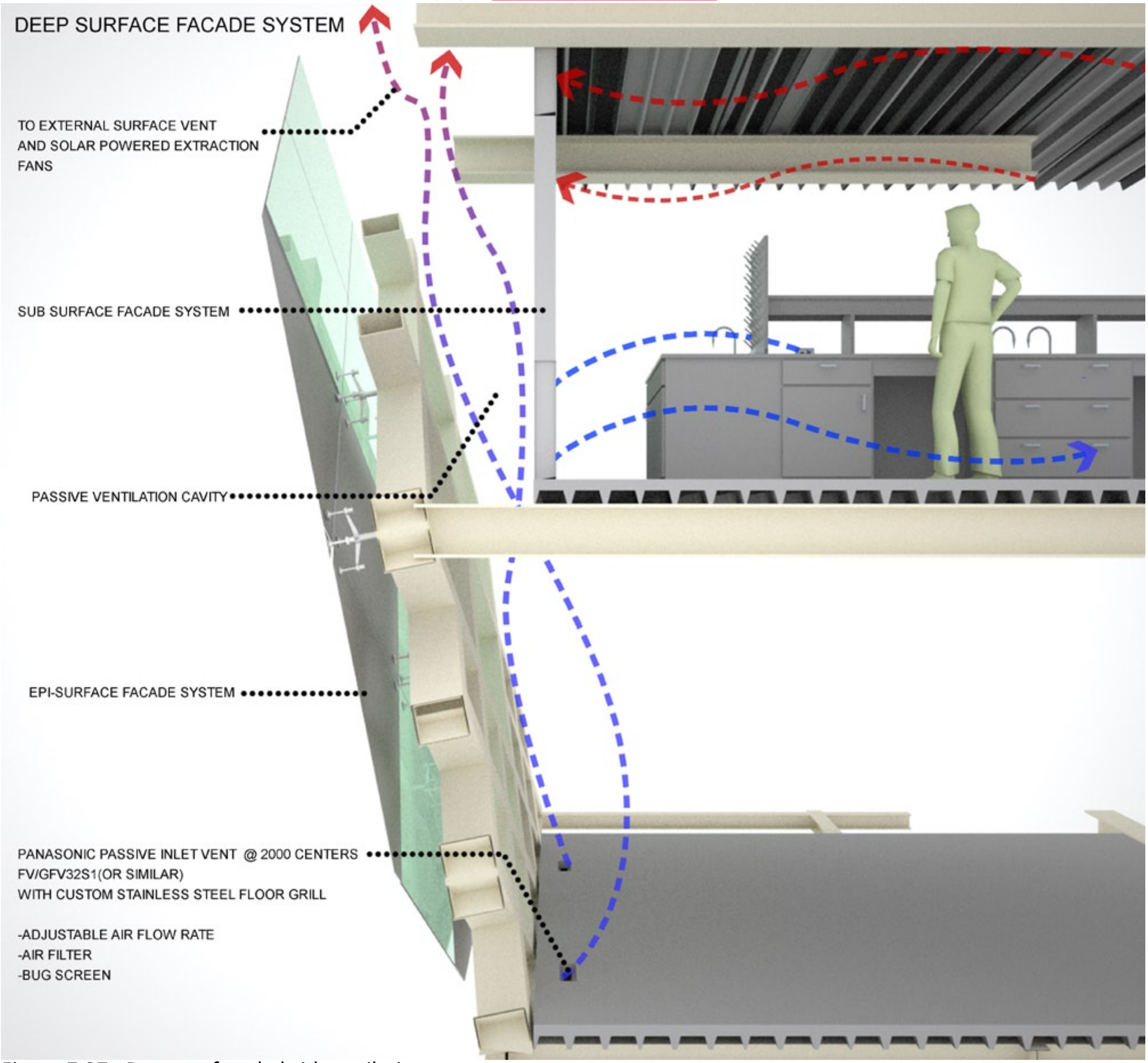


Figure 7.37: Deep surface hybrid ventilation system

A. Natural ventilation – Both passive day time and night time cooling

B. Better acoustic insulation - With a deep surface facade it is possible to achieve excellent acoustic insulation with the windows open, comparable with that obtained in traditional glass facades with the windows closed.

C. Reduced heating and cooling energy requirements - In winter, the air in the deep surface is heated by the sun, as a result improving both the heat insulating functions of the facade and its thermal performance, as well as reducing heating costs. With natural ventilation, so-called night cooling can significantly reduce the costs of air-conditioning in the summer

D. Security – Ventilation can take place at all time without creating a security risk the occupants of the facility

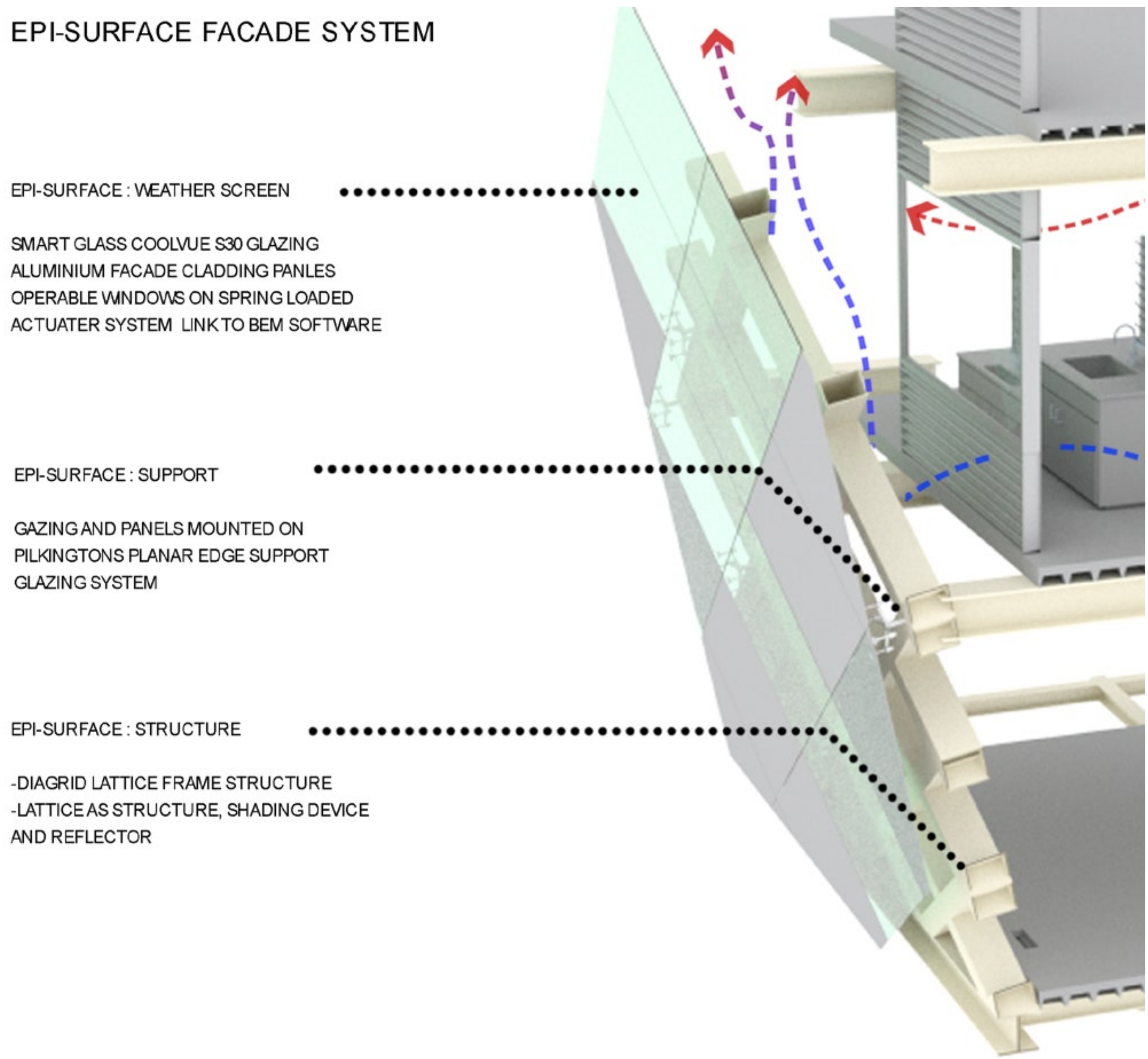


Figure 7.38: External components to deep surface (weather screen)

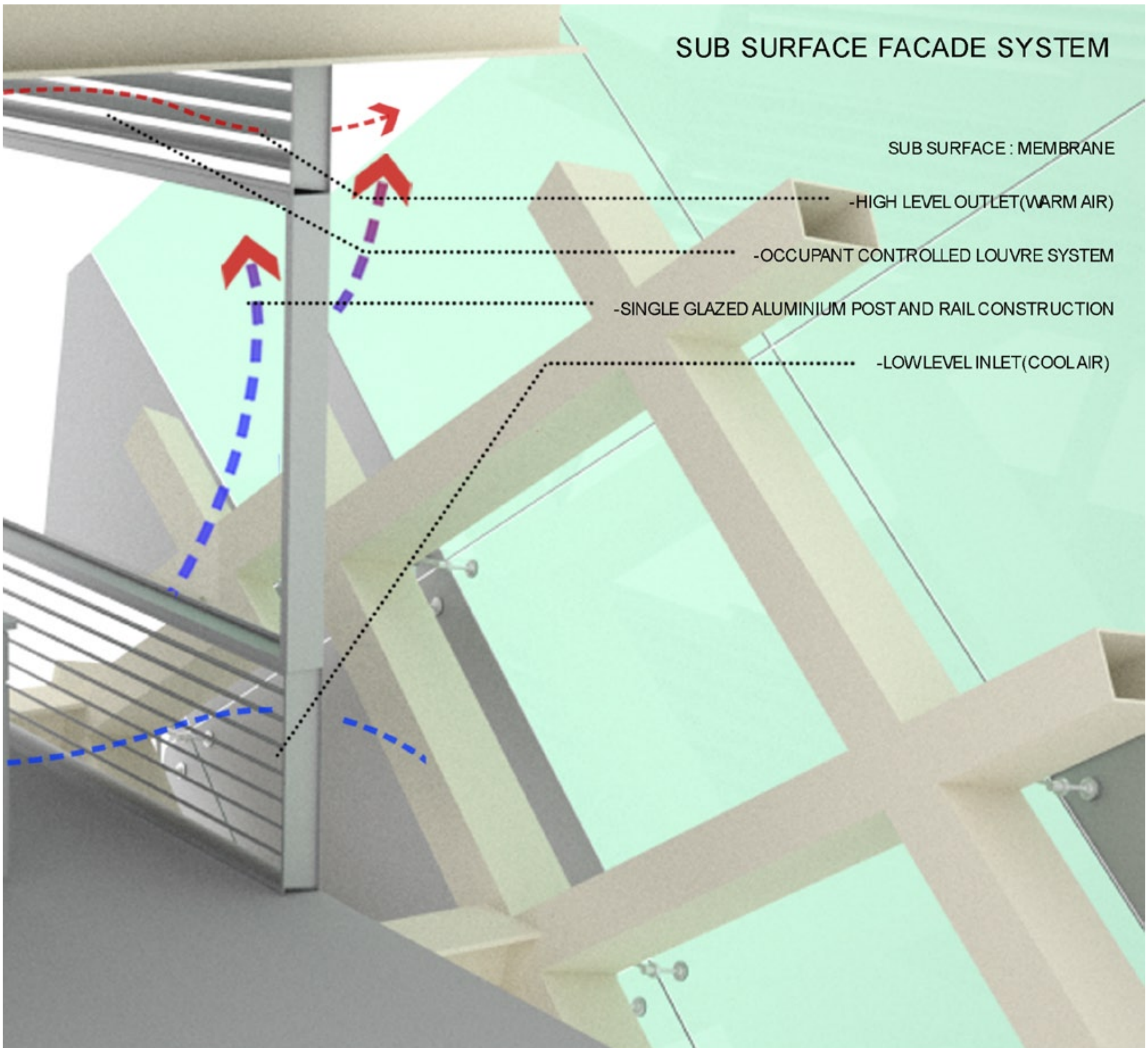


Figure 7.39: Internal components to deep surface (sub surface membrane)

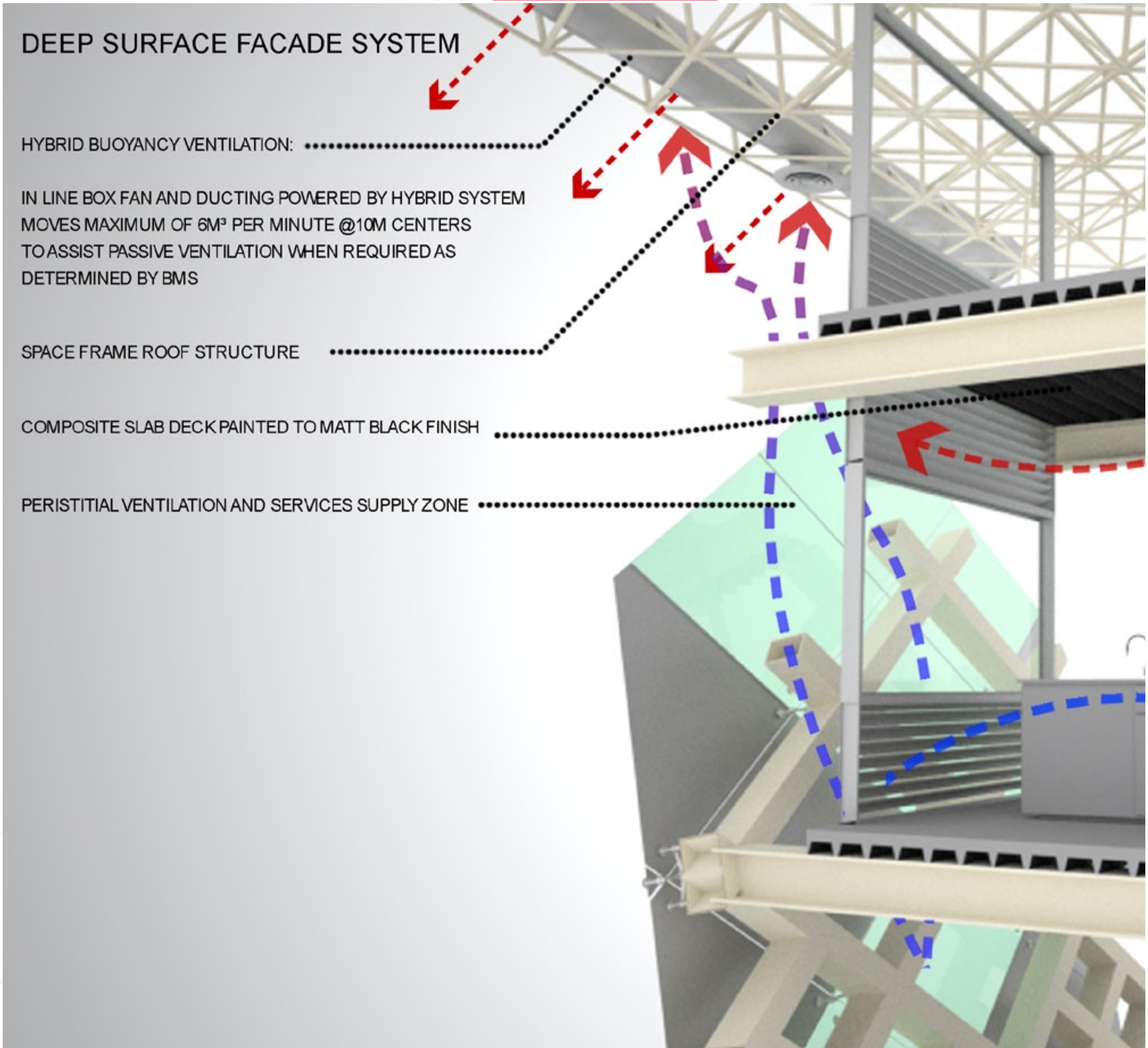


Figure 7.40: Hybrid passive ventilation components

7.4.2 Daylighting (Visual, Thermal)

Natural daylight is psychological important in buildings, it boost occupants mood and creates a more habitable environment. It is a free and natural source of energy and lighting that has been used as an integral part of the lighting design in the facility. Further is dovetails very well with the passive ventilation strategy of the facility.

Research facilities have very specific Daylighting requirements including:

As much natural light as possible
Views for users and researchers
Minimal direct lighting and glare
Minimal heat gain

To address these requirements the facility is designed with the following Daylighting strategies to achieve optimal working conditions for the users of the facility. See diagrams

1. The surface of the facility is angled and undulates between 9 and 18° (See figures 43-45)

2. The use of solar shading devices where required, including aluminium facade cladding panels and lattice structure (See figure 38)

3. Orientation, the facility is orientated as close to North as possible. The facility is turned 31 degrees from true north due to site constraints(visual arts sun requirements) and design requirements. (views, axis and context). This exposes the southern facade to wester summer sun from 16:00 pm in the afternoon. (f.46-49)

4. The use of an optimised glazing strategy, this includes the use of Smart glass coolvue clear on the envelope (Visible light transmission - 72%, 53% solar energy elimination and 99% UV ray block). Smart glass Solarshield S30 (Visible light transmission - 29%, 59% solar energy elimination and 99% UV ray block) on all glazed atrium areas (See figures 41,42)

The Daylighting system works in a symbiotic relationship with the proposed passive ventilation strategy.

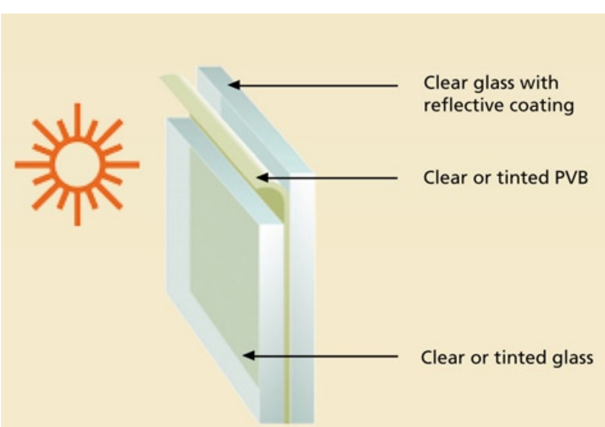


Figure 7.41: Smart glass Solarvue components

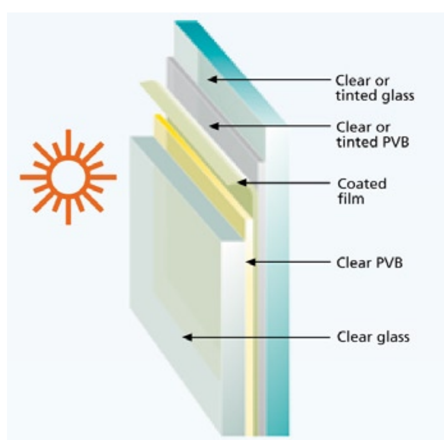


Figure 7.42: Smart glass Coolvue components

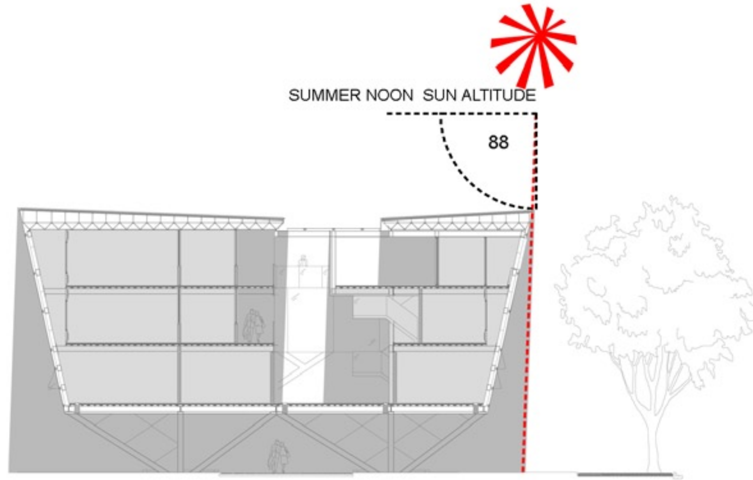


Figure 7.43: Summer noon solar incidence angle

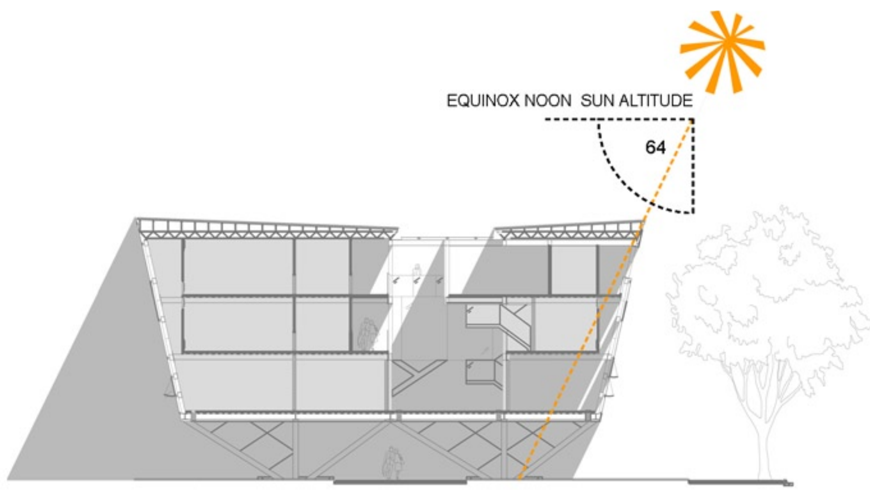


Figure 7.44: Equinox noon solar incidence angle

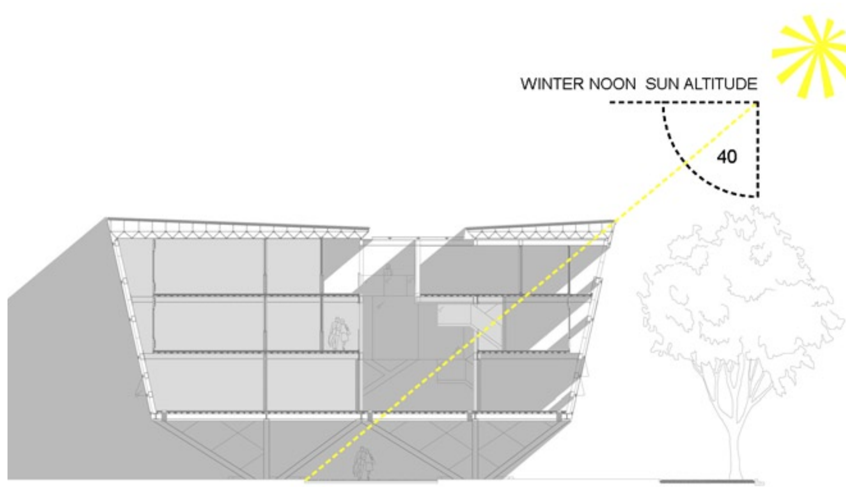
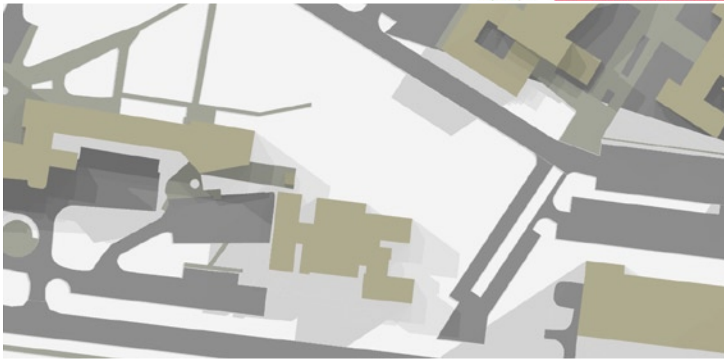
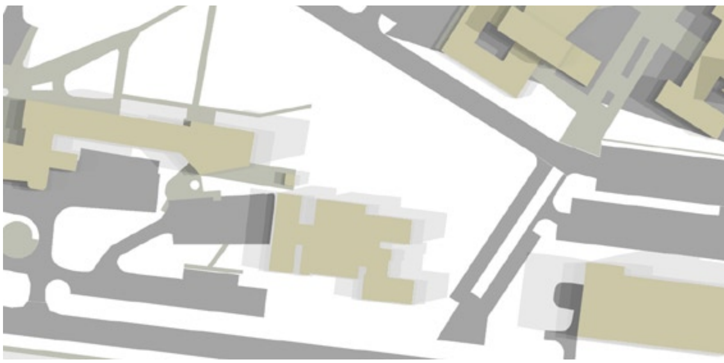


Figure 7.45: Winter noon solar incidence angle



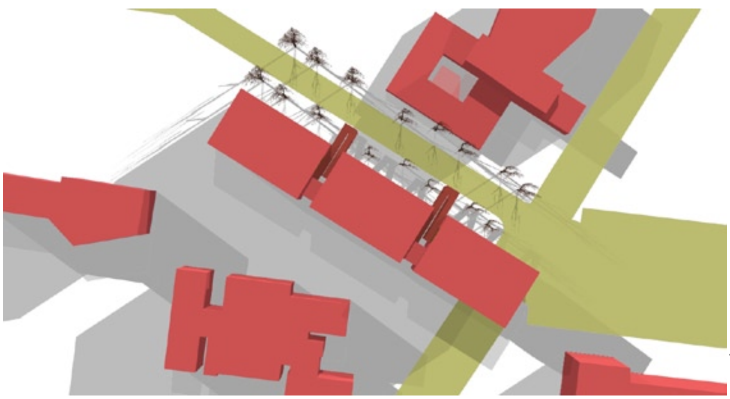
• Site in winter shows good exposure to northern sun. Visual arts department needs to be considered to prevent obstruction of northern sun

Figure 7.46: Winter shadow analysis on site before intervention



• Site in summer shadow analysis indicates that western afternoon sun might create thermal control issues

Figure 7.47: Summer shadow analysis on site before intervention



• Proposal winter shadow analysis indicates no obstruction of neighbours norther sun exposure. Project receives good winter sun to norther facade

Figure 7.48: Winter shadow analysis after intervention

• Proposal summer shadow analysis indicates that preventative measures need to be employed on western facade to guard against afternoon sun from 16:00 pm. The atrium glazing will also require special attention

Figure 7.49: Summer shadow analysis after intervention

7.5 Storm water Management

Storm water disposal from the facilities roof structure is done in accordance with SABS 0400 building regulations with special attention to sections RR2 and RR3. All calculations as shown in figure 50 are done in accordance it he section RR3.1 and RR3.2. Storm water run off is collected from the roofs surface to main drainage gutters, transported to downpipes and from there to a storage tank system. As is discussed in section 7.9 of this chapter the water will be used for landscape irrigation purposes.

Due to the internal location of the gutters the system is fitted with overflows at regular intervals to prevent infiltration in to the building when critical drainage levels are exceeded.

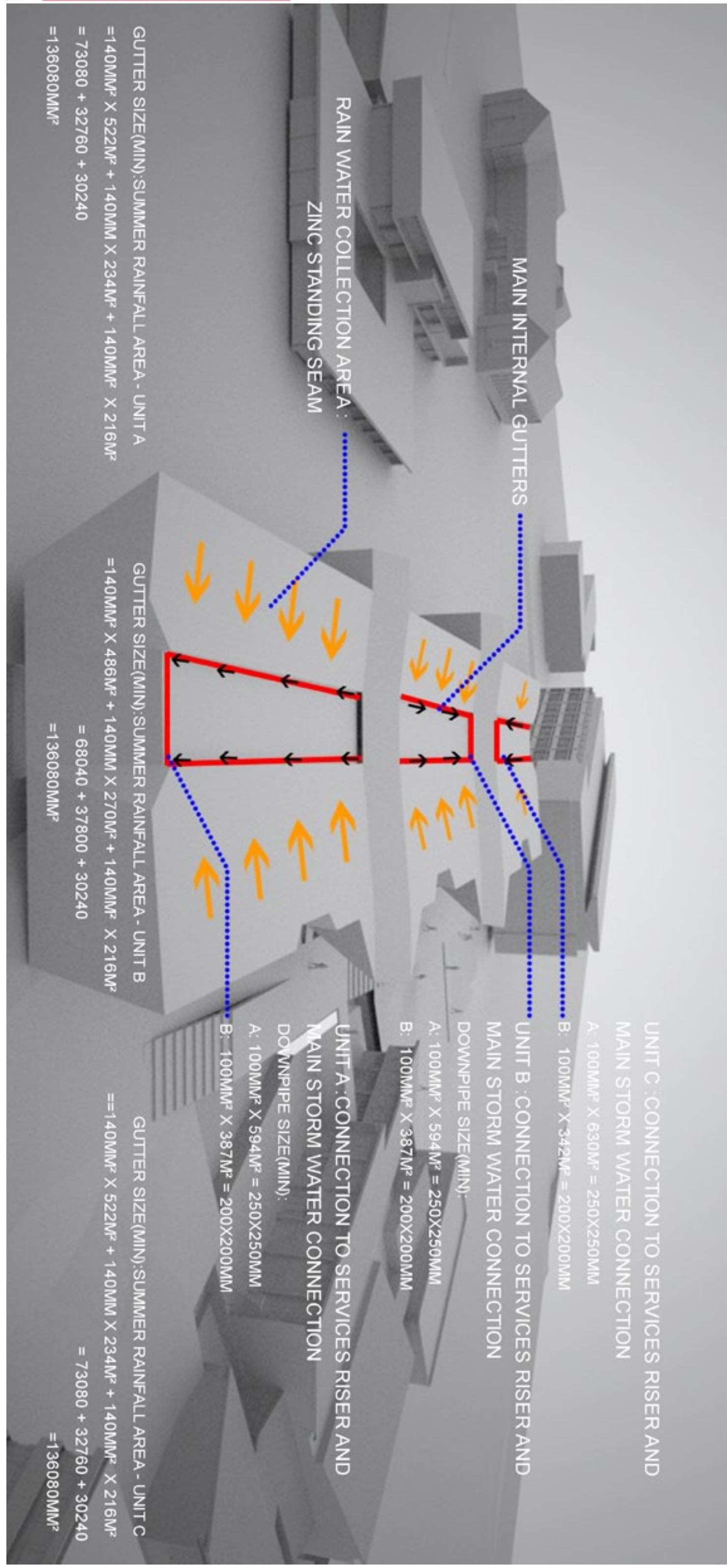


Figure 7.50: Storm water drainage system

7.6 Materials

Architectural surface has a particular significance when material and finishes choice are investigated. Choosing materials that embody the theory of deep surface and allow its manifestation is of utmost importance in this facility. Furthermore, being a research facility the materials pallet was also informed by strict performance criteria in terms of durability, chemical and fire resistance. While keeping these strict parameters in mind it was very important to make materials selections that lend themselves to the establishment of inspiring environments. The overriding parameter that was kept in mind throughout the materials selection and design process was that of sustainability. Materials selection and design are not two separate fields of practice but need to be an integral process to achieve truly innovative results.

Figure 7 51: OMA`s Seattle library steel structure

Figure 7.52: Concrete

6.6.1 Materials Pallet

6.6.1.1 Structural Elements

Structural Steel

Mild steel members were chosen for the structure due to the intricate and complicated nature of the structural system. It provides an ease of construction that would not be achieved by using reinforced concrete on the specific structure. The second reason that a steel structure was chosen was for aesthetic reasons, to achieve a slim and light structure; a structure system that is flexible and allows open and transparent spatial contexts to be evoked without the need for internal supports.

Reinforced Concrete

Concrete is used sparingly throughout the elevated structure of the facility and is only used where required for the structural bearing elements such as floor slabs and foundation pads.

Composite Floor Deck

The galvanised mild steel floor deck system that is employed in the facility was chosen for functional reasons. Firstly the ease of construction, that comes with the sacrificial shutter system of the composite slab. Secondly the slim depth of the slab allows the accommodation of services required in a research facility and allows greater floor to ceiling heights. Lastly the slim nature of the deck helps to lighten the structure of the facility.


Figure 7.53: Composite floor slab

Space Frame Roof Structure

As discussed earlier in this chapter in more detail the space frame structure was chosen for its relative long span to depth ratio and light weight structure. The proposed finish to the space frame is a powder coat finish to match the rest of the steel structure.


Figure 7.54:Space frame structure

Pilkington's Planar Glazing System

This point fixed glazing system was chosen as it allows the creation of flush frame less facade elements. The fittings are manufactured in 316 stainless steel. Secondly it lends its self to the creation of complex surface shapes.


Figure 7.55: Pilkingtons planar glazing system

6.6.1.2 Envelope (Epi-Surface)

Glazing

Glass forms a major part of the external envelope system. It is employed due to its blank canvas properties, becoming a reflective pallet for the surrounding environment as well permitting views in to and out of the structure. The glass that was chosen is the Smart Glass Coolvue product, it was consciously chosen as part of the climate control strategy.

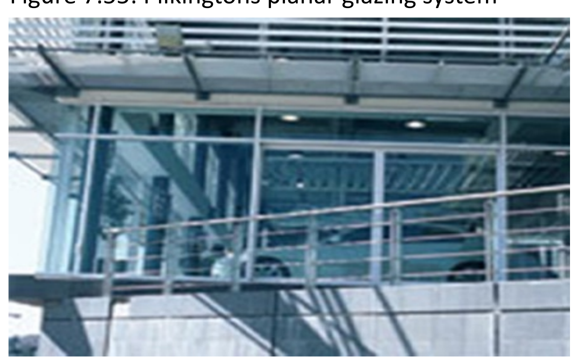


Figure 7.56: Smart glass coolvue glass

Figure 7.57: Composite aluminium cladding panels

Figure 7.58:Zinc standing seam roof cladding

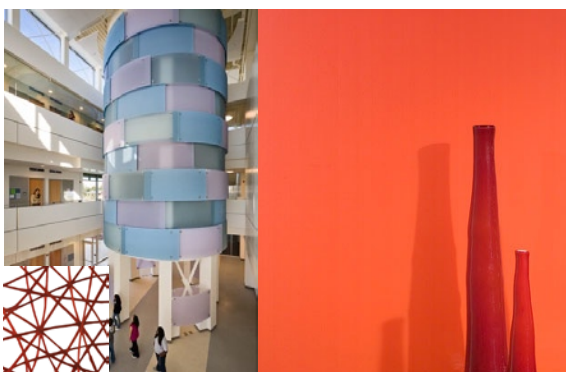


Figure 7.59: Ecoresin cladding panels

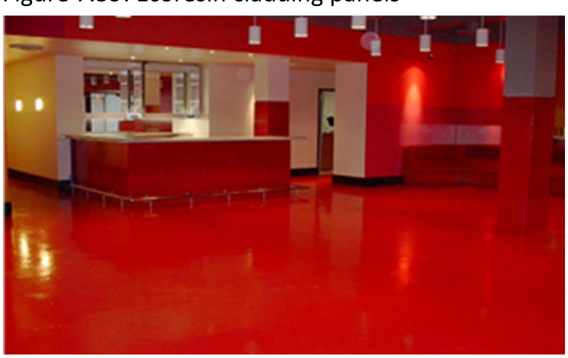


Figure 7.60: Epoxy resin floor finish

Composite Aluminium Cladding

As with previous material choices, thermal and aesthetic concerns influence the selection of the product for the external facade. The panel provides a blank canvas that allows the environment to `paint` on the facade of the building as times of day and seasons change. It has great thermal performance and is light weight and has good weathering resistance. It consists of two 0.5mm aluminium skin laminated to a mineral insulation core to create a rigid panel.

Zinc Standing Seam roof cladding

This roof cladding system was chosen to facilitate a `seamless` transition from the facade surface to the roof surface. As well as the system's ability to conform to complicated forms, its excellent weather proofing and longevity.

6.6.1.3 Finishes

Resin cladding panels

The resin panels chosen to clad the interior `tube` structures was chosen due to its aesthetic qualities of colour, light transmission and vibrancy. It will be used to create unique interior characters in each of the research units. It is also a sustainable material that consists of 40% post industrial recycled materials and is itself recyclable at the end of its life.

Epoxy Resin Floor Finishes

Chemical resistance non permeability is an imperative for research facility floors. The epoxy resin floor finish adheres to these strict requirements, as well as affords the opportunity to introduce colour in to the usually sterile research environments.

Lighting

Lighting plays an integral part of the facilities design and development. An LED colour cycling flood light system will be employed on the external surface from the interior. This will illuminate the building at night and make it a focal point in the campus landscape.
Recessed lighting details are incorporated behind the eco resin cladding panels on each of the tubes to create a unique glowing effect.
Other lighting details throughout the facility are to be in keeping with the investigation of Deep surface and architectural surface. The use of recessed light fittings and custom edge lighting details will be employed to achieve this effect.

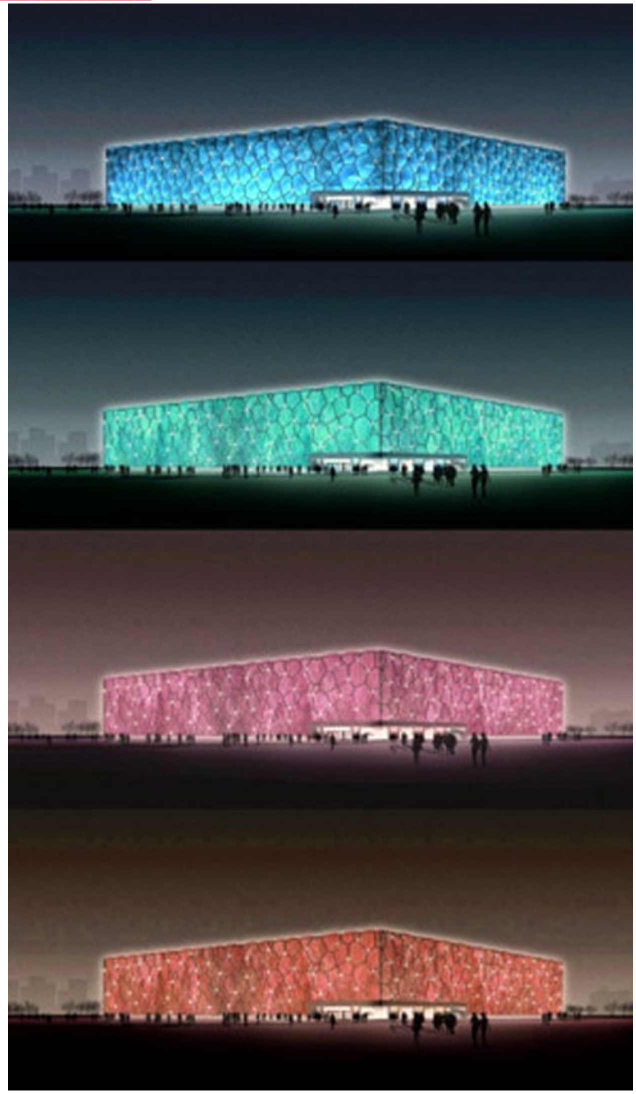
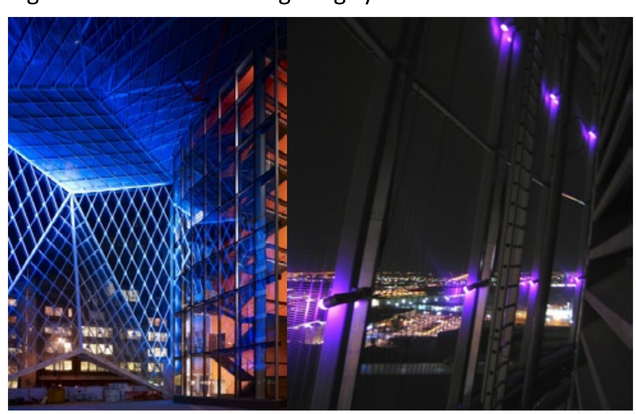


Figure 7.61: RGB LED facade lighting

Figure 7.62: LED facade lighting systems



7.7 Services Design

The design of the services supply system in a research facility is of great importance and requires careful planning to ensure the optimal performance and flexibility for future change and growth.
(Griffin, 2005)
The main services that need to be looked at include:

Water- supply, storage and treatment
Electric supply
Gas supply and storage
HVAC systems
Fire detection and treatment

6.8.1 SANITARY, PLUMBING AND DRAINAGE

The design of drainage and sanitary services in a research facility is a highly technical exercise that needs to be undertaken by specialist services engineers; however the following are general guidelines to achieve satisfactory results. Sanitary, plumbing and drainage facilities that: (Griffin, 2005)

Can accommodate the modular laboratory arrangement
Do not require venting through upper floors for the addition of isolated fixtures
Complies with the relevant standards
Is cost effective
Has the option to be installed in multilevel facilities and can accommodate additional levels
Is constructed out of materials that are easily re configured
Is designed to act in insulation of the municipal water supply to prevent contamination
Has a waste water treatment plan.

6.8.2 WATER SYSTEMS

Once again water systems in research facility are much more complex than that of the standard building requiring specific design and planning some of the main issues to keep in mind include: (Griffin, 2005)

The reticulated water supply for a research building comprises three types:
1. Potable (Hot and Cold)
2. Non-potable (Hot &Cold)
3. Analytical grade(Hot &Cold)

Each water supply system outlet is fitted with a flow control device to:
Conserve water, eliminate water hammer, provide reliable and predictable flow control at the tap and allow consistent tapware throughout the facility.

6.8.3 AIR HANDLING SYSTEMS

Air handling systems need to provide to the main functions effectively and efficiently this includes air quality and Thermal control. (Griffin, 2005)

6.8.4 ELECTRICAL SUPPLY

The power supply for a laboratory environment should consist of the following elements (Griffin, 2005)

Properly rated and protected incoming supply;
Spare capacity for system expansion and peak loading;
Flexible reticulation systems to ensure maximum usage of laboratory space; and
The use of backup power supplies such as diesel generators and interruptible power supplies to enable basic operation of the facility during a power failure.

6.8.5 SERVICES SUPPLY

Services main supply runs are to take place in the peristitial cavity of the deep surface with branches to a unitstrut ceiling grid system. The branches supply flexible connection point in the lab @ 3000mm centres, thus 24 flexible connection points per lab. This system allows the most adaptable services supply solution for an ever evolving facility. (Griffin, 2005)

7.8 Codes and Standards

The major construction and structural works that are to be undertaken on this project needs to conform to the relevant statutory requirements as well as the building codes and standards.

The three major structural systems in the facility comprise steel work, glasswork and reinforced concrete. The following are the relevant standards for the above mentioned systems to adhere to:

STEELWORK

SABS 1431 - Weldable structural steel
SABS 044 - Welding
SABS 064 - Preparation of steel surfaces for coating
SABS 14713 - Structural steel component design
SABS 0400 - Fire protection of steel work
SABS 1319 - Paint primer
SABS 684 Structural steel paint
SABS 1700 - Fasteners
SABS 1282 - High strength bolts, nuts and washers

GLASSWORK

SABS 1263 - Safety glazing materials
SABS 1305 - sealing compounds silicone based
SABS 0137 - Installation of glazing materials

REINFORCED CONCRETE

SABS 1083 - Aggregates for concrete
SABS 0109 - Concrete floors part 1 & 2
SABS 0161 - Design of foundations for buildings
SABS 0100 - Structural use of concrete
SABS 920 - Steel bars for reinforcement of concrete

7.9 Sustainable Parameters

Sustainable design has been the buzz word in architecture in recent years. However I believe it is no longer just a buzz word or the topic of the moment, it has become an integral part of architectural design and the key performance criteria for contemporary design.

Further to this statement I would not have included a section on sustainable design in this study if it were not of utmost importance in the design of my building. Research laboratories use 5 to 10 more resources than a office building of the same size. Hence sustainability is a key component in the design of a new research facility for the university, and was a key indicator in all design decisions.

Designing a sustainable research facility requires the implementation and adherence to five key performance criteria; Site and Context, Energy Efficiency, Water Management, Materials and Design. Each of the above mentioned areas of concern played a major role in the development of my research laboratory.

Most of the above mentioned criteria have been discussed in previous chapters without making direct reference to a sustainable strategy, the following sections will set out the sustainable performance criteria and strategies as employed in the research laboratory

7.9.1 Site and Context

Numerous site and contextual parameters are discussed earlier in this chapter, other influencing factors for the site selection include:

A. The location of the site close to public transport
B. The accessibility of the site by pedestrians on campus.
C. Provision of bicycle storage facilities on the site.

7.9.2 Energy Efficiency

Energy efficiency is determined by various components of the design, including climate control, orientation, daylighting and appliances.

The key indicators focussed on the design include:

A.Daylighting, with a focus on maximizing northern exposure, enhanced daylighting with minimal glare as discussed in section 7.4.2 of this chapter.

B. Climate control with a focus on passive systems as set out in section 7.4.1.

C. The implementation of a Building Management System, that can control the indoor building environment. The BMS system will focus to a greater extent on the passive ventilation system and lighting, with the implementation of lighting sensors and automatic dimming in all spaces.

D. Energy efficient appliances are to be used throughout the facility.

E. The implementation of passive energy systems such as solar water heaters to all common areas including bathrooms and kitchens.

7.9.3 Water Management

Water conservation is of grave importance in our country, along with the water management protocols and systems as set out in sections 6.8.1, 6.8.2 and 7.5 the following systems are to be implemented in the research facility:

A. All bathroom and laboratory water supply fittings are to be fitted with low flow fittings.

B. All Urinals in the facility are to be waterless

C. Toilets are to be dual flush(3L&6L).

7.9.4 Materials

Where possible all materials should be from local manufactures and sources, materials should be recyclable and contribute to a healthy and low embodied energy interior environment.

7.9.5 Design

Design plays an unmistakable role in the sustainability of a research facility, it depends on two characteristics two achieve a stainable rating; Structure and Space.

A. Spatially the facility is designed to be as adaptable and flexible as possible, to accommodate future changes in spatial requirements and technological advancements as discussed in section 7.1,2,3 and chapter 6.

B. Structurally the facility provides the conditions of flexibility and adaptability mentioned above. Secondly the structure of the building is design to facilitate ease of deconstruction at the end of its life.