CHAPTER 8 - TECHNICAL RESOLUTION

CHAPTER 8: Technical Resolution

8.1 Introduction

This chapter serves as an introduction to the technical documentation of the 'i-hub' building. The following pages will provide insight into the detailed design and technical assembly of the building itself. Developing the design to a detailed level, will aid in formulating an idea of what the appearance of the building will be on completion, as well as how the various technical elements of the building work and therefore contribute to the ultimate successful functioning of the building on a daily basis.

The technical resolution of this building will be demonstated in the following six sections. These include:

8.2) Material Selection

8.3) Conceptual Landscape Design

8.4) Construction Methods and Assembly Techniques

8.5) Servicing Systems

8.6) Environmental Design and Sustainability

8.7) Drawings and Details

8.2 Material Selection

The material selection for the 'i-hub' is influenced by the function of the builidng and the experience that it aims to generate for those using its facilities. The contemporary, state-of-the-art materials have been selected in contrast with the materials used in the construction of the historical buildings found on site. By doing so, the historical buildings of Pretoria Station, will be emphasised.

Materials have also been selected for their tactility and sensual qualities, capable of enticing emotions and responses in the building's users.

8.2.1 Steel


Fig 8.1


Fig 8.2


Fig 8.3.1


Fig 8.3.2

INSPIRATION

The use of steel in the construction of the 'i-hub' building, is motivated by:

1) The material's great versatility and workability.
2) Its incredible durability when protected by a galvanic coating or a layer of paint.
3) Its 'weightless' quality will bring a lightness to the design.
4) Its practicality with regards to standard prefabrication, on-site installation and ease of connection.

Fig 8.1 to Fig 8.3.2 adjacent show precedents that were studied while conceptualising the design of the 'i-hub's shading skin.

Fig 8.1 shows the Airspace Tokyo building by Beige Architecture. Light is diffused through the layers of the facade and into the building beyond. (www.coolboom.net)

Fig 8.2 shows the same building at night. (www.coolboom.net)

Fig 8.3.1 shows an exhibition pavilion in Santiago, by Assadi and Pulido Architects. This precedent is of particular interest as it too contrasts with the historical building adjacent. (www.notcot.org)

Fig 8.3.2 shows a view of the same pavilion at night. (www.notcot.org)

The Use of Steel in the Design

Fig 8.4.1 shows typical I-section to be used in the steel construction of the building. (SAISC 2008)

Fig 8.4.2 shows a typical H-section to be used in the steel construction of the building. (SAISC 2008)

Fig 8.4.3 shows a typical welded steel hollow section to be used in the construction of the rigid auditorium frame. (SAISC 2008)

The actual steel construction, as well as connection methods and components will become evident in the pages that follow.


Fig 8.4.1

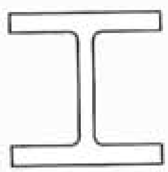
Fig 8.4.2

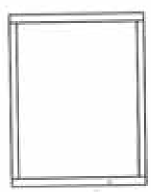
Fig 8.4.3

8.2.2 Concrete

Fig 8.5

Fig 8.6

The building's structural frame is made primarily of 'cast-in-situ' concrete. The concrete will be left exposed so as to demonstrate the materiality of it and increase the tactility of the building's concrete surfaces. Exposed concrete surfaces and polished concrete floors will increase the thermal mass of the building resulting, in cooler, more comfortable interior spaces. The contrast between the concrete and the steel work creates interesting an appealing textural effects.

Fig 8.7

Fig 8.8

Fig 8.9

The Use of Concrete in the Design

Fig 8.5 shows the off-shutter concrete of the UP Centenary Building by Earthworld Architects. (photo by author)

Fig 8.6 shows how users are able to interact directly with the UP Law Building's facades. (photo by author)

Fig 8.7 shows the treatment of the concrete floors in the UP Centenary Building by Earthworld Architects. (photo by author

Fig 8.8 shows how vertical concrete elements become features within the facade of the UP Law Building. (photo by author)

Fig 8.9 shows the reccesses and protrusions of the concrete floor slabs and columns of the UP Law Building. (photo by author)

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SMARTGLASS
intelligent solutions for design genius


Fig 8.10


Fig 8.11


Fig 8.12

Fig 8.13 shows the solar protection qualities of CoolVue glass. (SmartGlass Product Brochure)

Fig 8.14 shows the various different protective layers that make up the glass. (SmartGlass Product Brochure)

Fig 8.15 shows a picture of the Siemens building in Midrand by Louw Apostelellis Bergenthuin. This building has a dark tint of ColourVue protecting its interiors from the sun. (SmaertGlass Product Brochure)

Fig 8.16 shows the KSDP Pentagraph Offices in Johannesburg, by KSDP Pentagraph. (SmartGlass Product Brochure)

Fig 8.17 shows the different characteristics of the product. (SmartGlass Product Brochure)

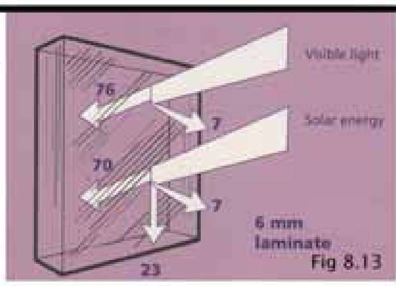


Fig 8.13

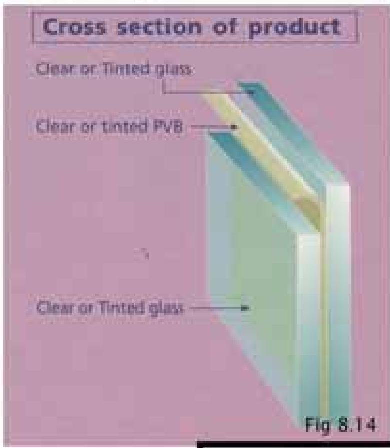


Fig 8.14

INSPIRATION

Fig 8.10 Exterior view of an office building by Murtinhoys Associdos Arquitectos. (www.archdaily.com)

Fig 8.11 Interior fixing detail. (www.archdaily.com)

Fig 8.12 View from within. (www.archdaily.com)


Fig 8.15

Technical Specifications

Glazing Type 1 - SmartGlass COLOURVUE

COLOURVUE is a laminated safety glass 'which introduces the joy of colour ' (SmartGlass Brochure), into a design and combines aesthetic appeal with safety, security, solar and UV protection.

The glass in manufactured locally by PFG Building Glass (located in Springs, Gauteng). two layers of clear glass (or body tinted float glass) are pressure and heat bonded together, with one or more layers of PVB (Polyvinyl Butyral). The less layers, the lighter the tint. The more layers the darker the tint, and therefore the less radiant solar energy enters the building.

A wide range of colours are avaliable and one is able to customise the colour of the glass to a certain extent.

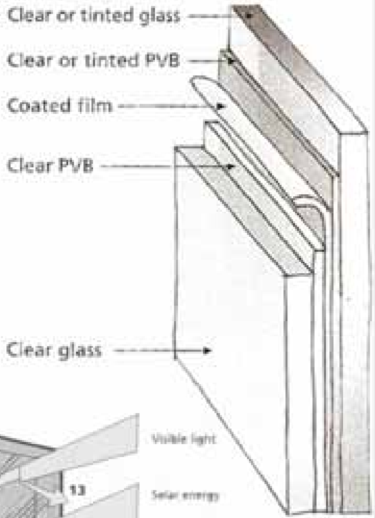
Standard Sizes of the 6.38mm thick glass: 2400x2000

WHERE? This glass will be used in the curtain walling of the North-Western corner of the building, the most exposed to harsh afternoon sun.


Fig 8.16

Fig 8.17

Fig 8.18



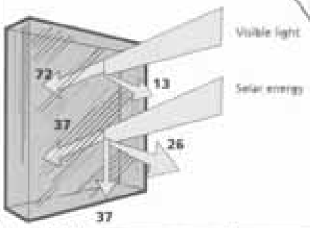


Fig 8.19

SECURITY	
SAFETY	
SOLAR CONTROL	
U.V. PROTECTION	
SOUND CONTROL	
DECORATIVE CHALLENGES	
BUILDING AESTHETICS	
ENERGY SAVING	

Fig 8.20 Table showing the characteristics of the COOLVUE product (SmartGlass Brochure)

Glazing Type 2 - SmartGlass COOLVUE

COOLVUE is a clear or tinted glazing option that allows for natural daylighting requirements while reducing the heat gain that is associated with ordinary clear glass. COOLVUE allows more than 70% natural light transmission, while reducing solar heat gain by up to 50%, as well as cutting out 99.5% of damaging short-wave UV radiation (see Fig. 8.19 - SmartGlass Brochure).

COOLVUE is manufactured by 'sandwiching a wavelength-selective heat rejecting coating between two layers of polyvinyl butyral (PVB) and glass (see Fig. 8.18 - SmartGlass Brochure). This layered combination of heat-reducing materials ensures that the glazed facades of the 'i-hub' do not effect the energy efficiency of the building negatively.

COOLVUE also has the added benefit of sound transmission reduction. This characteristic is beneficial to the 'i-hub' application due to the business and therefore high noise levels of its location.

GLAZING SELECTED - Clear (maximum transparency required)
PVB SELECTED - Clear (maximum tranparency required)
NOMINAL THICKNESS - 6.76mm
MAXIMUM SIZE - 2440x2000mm

WHERE? COOLVUE Clear will be used in all the 'i-hub's clear glazing applications. After consultation with a professional, double-glazing was decided against due to the presence of the zincalume shading skin that eliminates most of the direct solar heat from entering the building.

Fig 8.21

Fig 8.22

Fig 8.23

SECURITY	
SAFETY	
SOLAR CONTROL	
U.V. PROTECTION	
SOUND CONTROL	
DECORATIVE CHALLENGES	
BUILDING AESTHETICS	
ENERGY SAVING	

Glazing Type 3 - SmartGlass ARMOURSCREEN

ARMOURSCREEN is a silk-screened, coloured, toughened safety glass, five times stronger than ordinary float glass. This integral strength makes ARMOURSCREEN highly resistant to external impacts. Its toughness allows it to be used in interior and exterior applications where structural strength is a requirement.

The silk-screening can be done in a variety of custom designs and colours. It is also beneficial in that it reduces direct light transmission into spaces beyond, therefore reducing glare and radiant solar heat gain.

ARMOURSCREEN is incredibly durable as it is UV-stabilised, weather-proof, resistant to corrosion and easy to clean. It can however, not be cut or worked after it has been toughened. Any drilling or cutting must be done before the toughening process takes place. It is therefore important to be proactive when designing using this product. Constant correspondence between the architect and the glass manufacturer is therefore required.

NOMINAL THICKNESS - 6mm
MAXIMUM SIZE - 2000x1500mm
APP. kg/m^2 - 15

WHERE? ARMOURSCREEN will be used in the 'i-hub's balustrading (interior and exterior), public lift finishing and glazed office partitions.

Fig 8.21 Gencor balustrading, Johannesburg by TC Design. (SmartGlass Brochure)
Fig 8.22 Balustrades at the Hilton Hotel in Durban by FGG Architects. (SmartGlass Brochure)
Fig 8.23 Table showing the characteristics of the ARMOURSCREEN product. (SmartGlass Brochure)

8.2.4 Zincalume

Fig. 8.24 The above images show various application in which zincalume steel has been used. (Bluescope Steel Brochure)

Zincalume is an improved steel product that has a lifespan of up to 4 times longer than ordinary galvanised steel. This is due to the double coating protection of a zinc and aluminium coat given to the base steel. The coating consists of 55% aluinium, 43.5% zinc and 1.5% silicon (see Fig 8.2.25 below). The aluminium provides a corrosion resistant physical barrier between the enviornment and the base steel, while the zinc protects the edges of the steel when being cut and worked. The galvanic action of the zinc results in this product being able to 'heal itself' over time. This characteristic allows for the product to be laser cut, as will be done prior to installation, in the design of the 'i-hub's shading skin. Zincalume contributes to lowering heat gain as it reflects heat and sunlight effectively, therefore lowering the temperature of the building's interior. This will be particularly beneficial on the exposed Western side of the'i-hub' building where much glazing is present.

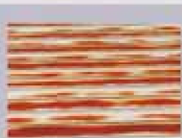
It is light-weight and therefore easy to handle and install. It can be fastened to a galvanised steel frame by using galvanised steel fasteners. As with all metals, the zincalume sheeting should not be exposed to other metals such as copper or brass due to the chemical effects that these metals have on one another.

It is avaliable in flat sheet form, from Bluescope Steel in Cape Town. The flat sheets can then be cut, profiled and worked as desired. Flat sheets will be used in the 'i-hub's shading skin design. Zincalume can also be painted with a water-based acrylic paint, without using a primer, therefore decreasing costs. The zincalume shading 'skin' of the 'i-hub' will be painted so as to reduce glare in an environment that calls for high visibility and minimal discomfort. Zincalume is also non-combustible ensuring that it will not contribute to the spread of flames in the event of a fire.

Fig 8.25 below shows a table comparing the performance of Zincalume steel with that of ordinary galvanised steel. It is clear to see from this comparison that the Zincalume steel is the preferable product for this application (Bluescope Steel Brochure).

Fig 8.26

Performance Comparison

	ZINCALUME® steel	Galvanised steel (G.I.)
Coating Elements	 Double protection of zinc and aluminium coating	 Single protection
After 240 Hours of Salt Spray Testing (Conducted in accordance to the ASTM test method B117 and AS1580)	 No sign of red rust	 Significant signs of red rust
After 20 Years of Atmospheric Exposure	 No sign of red rust	 Shows significant red rust

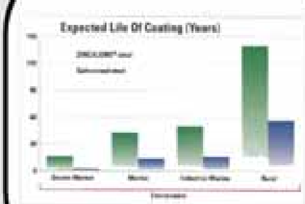


Fig 8.27

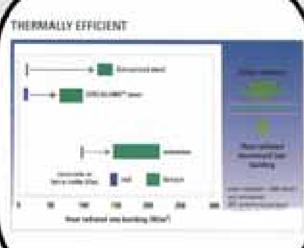


Fig 8.28

Fig 8.25 shows the raw zincalume product in flat sheet form. (Bluescope Steel Brochure)
Fig 8.27 compares the coating life expectancy of Zincalume Steel (shown in green) with that of normal galvanised steel (shown in blue). (Bluescope Steel Brochure)
Fig 8.28 demonstrates the zincalume steel is thermally more efficient than a number of other products previously used. (Bluescope Steel Brochure)

8.2.5 GKD Architectural Mesh

GKD Architectural Mesh is a lightweight, transluscent, woven, metallic, stainless steel fabric that is iridecent in character. **"In the interplay of weather conditions - light and shadow, clouds, sun and rain, the mesh seems to come alive and to breathe, to vibrate'** (GKD Design Guide Edition 3/99).

Due to the way in which the mesh is woven, and its own structural integrity, it can be tensioned in one direction while retaining stablility in the other. Coupled with the appropriate framing system, GKD Architectural Mesh can be used in a number of applications ranging from sunscreens to balustrading, ceilings, 'doors' and 'walls'.

Due to the stainless steel's high resistance to vitually all weather and environmental conditions, the material requires practically no maintenence. It does not discolour over time and can be cleaned with brushes and non-abrasive, alkaloid cleaning agents.

The mesh is avaliable in a number of different patterns that vary in opaqueness depending on the level of transparency that is desired.

WHERE? This product will be used in the ceiling treatment of the 'i-hub'building to partially conceal services. It will also be used for the balustrading of the stairways as well as in roller-shutter doors for the Craftmarket and sun protection shutters on the West of the Restaurant's Second Level.

Fig 8.29

Fig 8.30

Fig 8.31

Technical Resolution

Fig 8.29 to Fig 8.31 show a number of different ceiling applications in which GKD Architectural Mesh has been used, with varying effects. It is intended to create a similar effect in the treatment of the 'i-hub's ceiling (GKD Design Guide Edition 3/99)

Fig 8.32 shows the fixing and detailing of a vertical GKD Architectural Mesh sunscreen. (GKD Design Guide Edition 3/99)

Fig 8.33 shows an image of how GKD Architectural Mesh can be used both vertically and horizontally in combination. (GKD Design Guide Edition 3/99)

Fig 8.34 shows how GKD Architectural Mesh can be used in roller-shutter door applications. This treatment will be applied to the roller-shutter doors enclosing the Stalls of the Craft Market in the 'i-hub' building. (GKD Design Guide Edition 3/99)

Fig 8.32

Fig 8.33

Fig 8.34

Material Samples

Fig 8.35 shows the Sambesi Type Mesh that will be used in the 'i-hub's stairway balustrades, roller-shutter doors and sun protection shutters.

Fig 8.36 shows the Lago Type Mesh, which is slightly denser and will therefore be used in the ceiling treatment.

Auditorium

Offices and Conference Rooms

Ceiling Type 1 - Gyptone Bend Line 7

TECHNICAL DATA:
Board Size: 900 x 2400mm
Hole Size: 6mm x 8mm
Perforation Area: 14%
Light Refelection: 70% (white)
Relative Humidity: 70%
Thickness: 6.5mm
Weight: 5kg/m^2
Suspension Grid: T37K

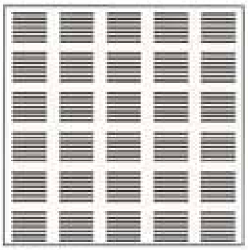


Fig 8.37

Gyptone Bend Line 7 (see Fig 8.37 for plan view), is a suspended ceiling board system that allows for curves and arched shapes. It is also possible to create large uniform surfaces devoid of visible joins and grids. The effect is therefore clean and elegant, suited for use in spaces that are acoustically sensitive such as the 'i-hub's hovering auditorium (see Fig 8.38). The ceiling is used in combination with a mineral wool backing (such as Isover's Aerolite Glasswool product seen in Fig 8.40, Isover Insulation Solutions Product Brochure), in order to reduce sound penetration and increase sound absorption where necessary.

Fig 8.38- The effect of the ceiling when installed. (DonnCeil Brochure)

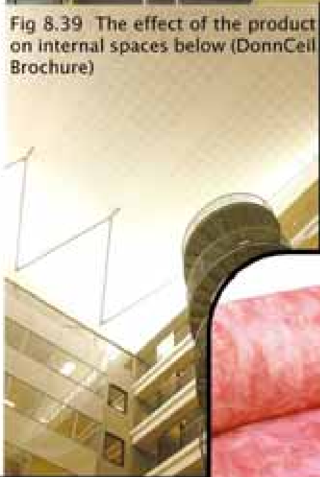


Fig 8.39 The effect of the product on internal spaces below (DonnCeil Brochure)

Ceiling Type 2 - Gyptone Bend Line 6

TECHNICAL DATA: (as above)
Board Size: 1200 x 2400mm
Perforation Area: 13%
Light Refelection: 70% (white)
Thickness: 12.5mm
Weight: 7.8kg/m

The Gyptone Bend Line 6 product is designed specifically for offices and areas where acoustic ambience is important (see Fig 8.39). This suspended system, when used in the 'i-hub' application, does not need to be insulated further as the insulated concrete slab above the ceiling reduces sound penetration substantially (Fig 8.41, DonnCeil Brochure).

Both types of ceiling boards are supplied unpainted. The boards should be painted with a white emulsion paint in order to increase light reflectivity.

Fig 8.40

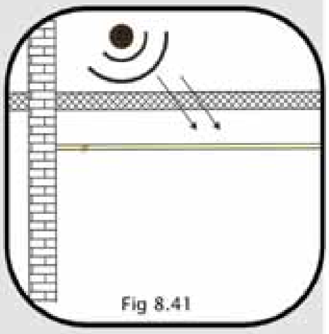


Fig 8.41

Installation

Fig 8.42 shows the concept of a suspended ceiling system. It is evident from this image how easily the panels can be removed when maintenance needs to be done. (DonnCeil Brochure)

Fig 8.43 shows the T37K grid system that is used in fixing both the 'i-hub's Auditorium ceilings, as well as the Office and Conference Room ceilings in place. A flush plastered finish is used in both cases. DonnCeil Brochure)

Fig 8.43

25mm x 25mm galvanized steel angle used as a hanger

T37 main Tee: is the primary beam of a mechanical ceiling suspension system.

Fig 8.42


Fig 8.44

GypWall Silent 52

Internal partition walls will be used in the Office areas, as well as the Auditorium walls of the 'i-hub' building. They will be used in conjunction with the suspended ceiling systems that have already been described.

The use of dry-walling systems, particularly in the case of the 'i-hub' office areas, allows for the space to be adaptable depending on the tenants requirements and flexible with regards to alterations that are often made when new tenants move into existing spaces.

The **GypWall Silent 52** dry walling system offers excellent sound reduction, particularly beneficial for the boardroom and auditorium spaces, as well as a two hour fire rating, ensuring the safety of the 'i-hub's users in the event of a fire.

The dry-walling system is non-load bearing and made up of two layers of 12,5mm Rhino-Firestop board on each side of a metal support stud. The cavity between is filled with a wire mesh surfaced mineral blanket (such as Isover's Cavitybatt Glasswool product seen in Fig 8.45, Isover Insulation Solutions Product Brochure), to improve sound reduction. This insulation not only improves the acoustical qualities of the space it encloses, but is also self-supporting and will therefore not sag over time. When installed, the wall measures approximately 114mm in thickness and has a mass of around 50kg/m². (See Fig 8.49 below)


Fig 8.45

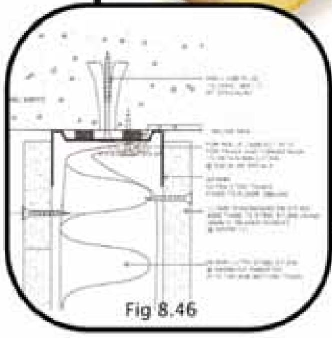


Fig 8.46

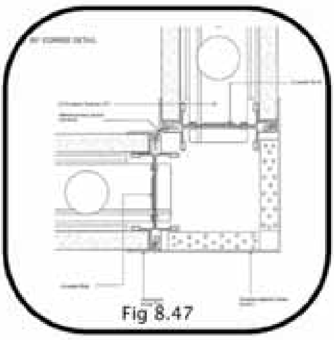


Fig 8.47

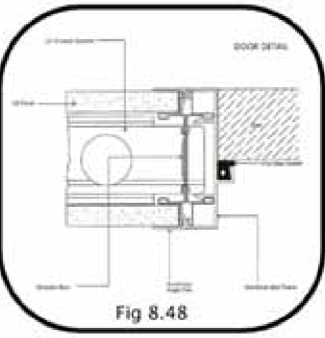


Fig 8.48

Fig 8.44 shows the metal sub-structure of a dry wall partition system. (GypWall System Solutions Product Brochure)

Fig 8.45 Isover's CavityBatt Glasswool insulation. (Isover Insulation Solutions Product Brochure)

Fig 8.46 Typical detail showing the connection between a dry wall partition and a concrete column. (GypWall System Solutions Product Brochure)

Fig 8.47 Typical detail showing a corner connection. (GypWall System Solutions Product Brochure)

Fig 8.48 Typical door detail. (GypWall System Solutions Product Brochure)

Fig 8.49 shows the various components and the construction of the GypWall Silent 52 system. (GypWall System Solutions Product Brochure)

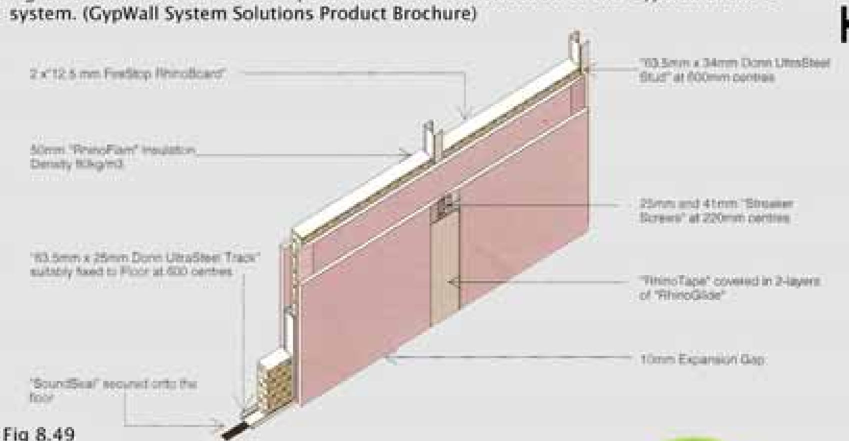


Fig 8.49

Technical Specifications

Technical Resolution

8.2.8 Plexiglas


Fig 8.50


Fig 8.51

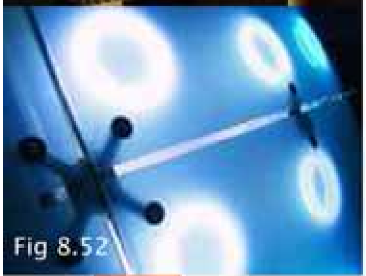


Fig 8.52

INSPIRATION

Plexiglas is an acrylic product manufactured by Degussa, and is similar to Perspex. It is avaliable locally from Maizey's Plastics situated throughout the country. The Plexiglas product range includes solid, multi-skin and corrugated sheets, as well as tubes, rods films and foams. In the case of the 'i-hub' Plexiglas sheets will be used. The SATINICE range of colours and finishes has been explored as it offers the degree of translucence and the quality of finish that is required by the design (see Fig 8.53 and 8.54 below). The acrylic sheets are cast (in which case they have one satin surface and can not be molded), or extruded (in which case they have two satin surfaces and can be worked into exciting shapes). This application calls for cast sheets as only one surface will be exposed. The sheets will not be molded or worked for the 'i-hub' application. Plexiglas can be used for interior and exterior applications as it is corrosion resistant, scratch resistant, thermally resistant and durable. It does not contribute to the spread of flame in the event of fire, but it becomes unstable above 140 degrees Celsius and when it is structurally altered due to the application of heat, there is no way of regaining its original properties.

Plexiglas SATINICE is avaliable in a wide range of colours and customisation is also possible on request. The sheets are homogenously coloured and can therefore be bonded effectively. The colour that has been chosen is Ice Green 6C03 DC , as it is neutral and subtle, possessing a slightly green undertone that will compliment the zincalume shading 'skin' and contrast with the coloured glass of the North-Western facade. The main reason for the selection of this material is the excellent light diffusion properties that it possesses. The material consists of tiny diffuser beads that continually change the propagation of light giving rise to interesting and intriguing effects (see Fig 8.2 and 8.2 below).

Ice Green 6C03 DC sheets are avaliable in thicknesses of up to 40mm with a standard maximum sheet size od 4000x2000mm. Sheets are delivered to site already cut to size on request.

WHERE? The hovering 'i-hub' auditorium and the transitional structure at the building's most Southern point.


Fig 8.53

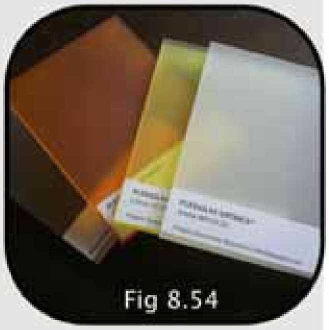


Fig 8.54


Fig 8.55

Samlples and Studies

Fig 8.50 An image of the Marble Lofts Residence in Atlanta by Rufledge Alock Architects. This design incorporates the use of 3Form transluscent products. (www.3form.eu)

Fig 8.51 shows Dan Gottlieb and Penny Herscovitch's 'Flexicomb' design. This luminaire possess a beautifully layered, tactile quality. (www.scophy.files.workpress.com)

Fig 8.52 shows a detail similar that which will be used in the fixing of the Plexiglass SATINICE sheets to the 'i-hub' structure. This image shows the vibrant lighting effects that are possible when using transluscent materials. (www.arcspace.com)

Fig 8.53 shows a number of different Plexiglas products that are avaliable. (Degussa Product Brochure)

Fig 8.54 shows a number of different samples and colours that were investigated when developing the design of the 'i-hub's transluscent elements. (photo by author)

Fig 8.55 shows the experimentation that was done with regards to the diffusion of light through the Plexiglas SATINICE sheets and the effects that are created as a result. (photo by author)

8.2.9 Fixing Techniques

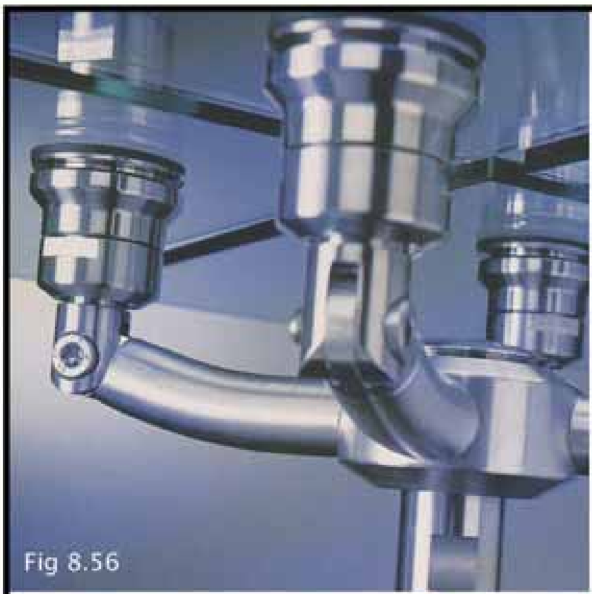


Fig 8.56

Various different fixing systems were investigated with regards to the fixing of the Plexiglas auditorium cladding, the Plexiglas to be used in the transitional structure of the building's Southern most point, as well as various glazed balustrades throughout the building. Fig 8.56 to Fig 8.60 show the range of products avaliable on the market.

The method specific to the 'i-hub' application, is seen in Fig 8.56 (DOORMA Product Borchure). The 'front' view of this spider clamp system is seen in Fig 8.58 (DOORMA Product Borchure). This clamp system will be supported by a steel sub-frame, fixed to the main structural frame of the building.

This type of fixing system allows panels to be replaced easily in the event of any damage occuring. Joints between the panels will be sealed with a clear silicon so that expansion and contraction of the material can happen without complications.

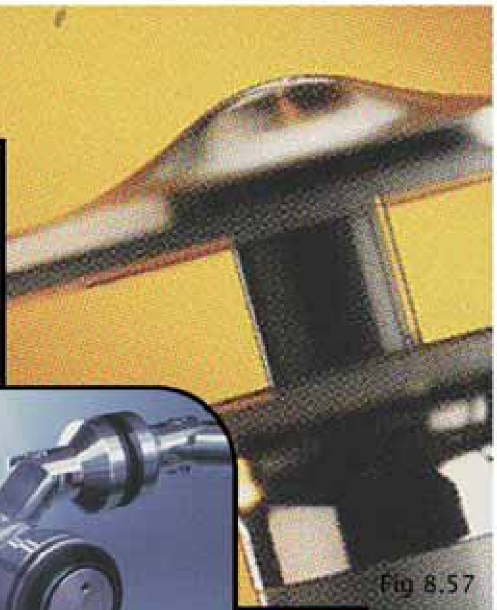


Fig 8.57


Fig 8.58


Fig 8.59


Fig 8.60

Technical Specifications

Fig 8.57 shows a Rodan end clamp. (DOORMA Product Brochure)

Fig 8.58 Manet construct system with two single point fixings. (DOORMA Product Brochure)

Fig 8.59 Rodan tensile tie system. (DOORMA Product Brochure)

Fig 8.60 Loop system. (DOORMA Product Brochure)

8.2.10 Colour Pallette

A neutral colour pallette has been chosen to ensure that the building forms a backdrop for Station activities, as opposed to the other way around. The neutral colour pallette will contrast with the rich textures of the historical buildings, and their importance will then be emphasised.

Fig 8.61 COLOUR PALLETTE FOR THE 'i-hub'. (Dulux Range)

Fig 8.62 COLOUR PALLETTE FOR THE 'i-hub'. (Plascon

Conclusions

The selection of various materials has been governed not only by their practical application capabilities, but also by the tactile and sensual qualities they possess. The materials selected are to reveal the construction of the building to its users, enticing them to touch, feel and explore all of its spaces further. The materials used will make the building 'come to life', particularly at night, and create and environment, neutral in colour, but rich in sensual appeal.

8.3 Landscape Design Concept

Fig 8.63 **SITE PLAN**
Scale 1:1000

The Landscape

The landscape plan above (Fig 8.63) briefly reflects the concept behind the design of the 'i-hub's surrounding landscape. The building, with its neutral pallette creates a backdrop around which everyday Station activities occur. It is therefore in the lanscape where contrasts are created and rich, textural effects echo a traditional African landscape. The Historical Sunken Garden will be re-instated once the basement construction is complete. The majority of this square is hard landscaping as most movement occurs here. The Eastern Secondary Square is mostly soft landscaping and encourages slower movement and lingering. The landscape design concept ties the whole site together and links the public squares to one another.

The textural effects, particulary present in the paving techniques used, are continuous throughout the ground floor of the building. This creates the effect of the building being anchored to the landscape and therefore forming an integral part of it.

The tree species that have been selected, while functional and practical, add to the welcoming and inviting environment that is being created in a previously harsh environment. The tree species themselves encourage different responses and stimulate various experiences in the users of this landscape.

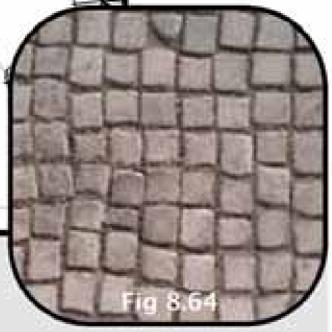


Fig 8.64


Fig 8.65

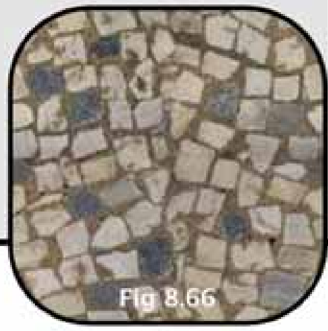


Fig 8.66

Concept Development

Tree Species


Fig 8.67 Fig 8.68 Fig 8.69

A - Albizia Adiantifolia

Commonly known as the Piernief tree, it offers mottled shade by forming a flat canopy above the ground. The space created under this tree's canopy suggests movement and protection and will therefore be used along the busy Western facade of the building.


Fig 8.70 Fig 8.71 Fig 8.72 Fig 8.73 Fig 8.74

B - Caesalpinea Ferrea

Commonly knows as the Leopard tree, this fast growing species has thick foliage, characteristic bark and prominent yellow flowers. Due to these strong characteritics, It is truly an excellent feature tree. It suggests lingering and encourages users to draw close, to touch it's bark and to rest under it. The Leopard tree will be used within the landscaping of each of the public squares adjacent to the building.


Fig 8.75 Fig 8.76 Fig 8.77 Fig 8.78

C - Celtis Africana

Commonly knows as the White Stinkwood tree, this species, with its light bark and dense canopy also encourages one to linger and sit beneath it. For this reason, it too will be used in the landscape design of both public squares flanking the building, placed strategically to encourage gathering.

Textures


Fig 8.79


Fig 8.80


Fig 8.81

Fig 8.64 to Fig 8.66 and Fig 8.79 to 8.81 show various different textures that will be used throughout the lansdcape and the ground floor of the building (www.amazingtextures.com).

The paving techniques will continue into the building, as if the 'i-hub' were part of the landscape itself. Smoother textures that create safe surfaces for quick movement, will be used in areas where large groups of people move at a fast pace. These areas included the Eastern and Western walkways as well as the interior of the building on ground level. Mottled and uneven surfaces will be used in areas where slow meandering or gathering is encouraged. These areas typically include the spaces within the public squares themselves, beneath the trees and along the edges of walkways.

8.4 Construction Methods and Assembly Techniques

8.4.1 Structural Grid

The building is designed from the basement up. The standard size of parking bay (5m x 2,5m as stipulated by the municipality) and th standard backing spaces (7.5m as stipulated by the municipality) for vehicles had to be taken into consideration with regards to the successful functioning of the basement parking space. The column grid is calculated according to the standards mentioned above and their spacing allows for the clearance of these critical dimensions.

The structural grid is therefore laid out from centre to centre as shown in Fig 8.82 adjacent. Fig 8.83 shows the structural grid imposed on the building's super-structure.

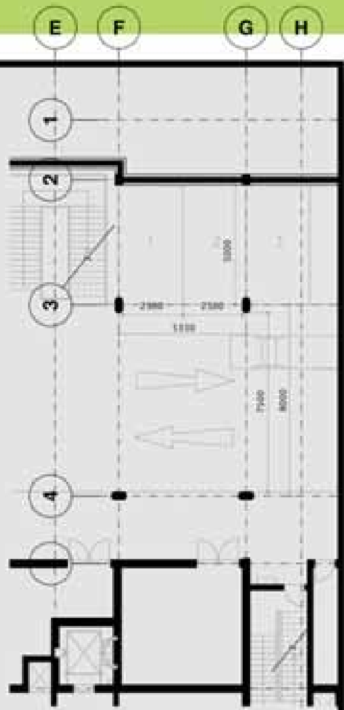


Fig 8.82
STRUCTURAL GRID DIMENSIONS

8.4.2 Basement Construction

The area of the site falls on a quartzite and shale soil formation. It is therefore best that the load transmitted by the columns is spread as evenly as possible over the entire area of the site. A raft foundation system is ideal for this application, in these soil conditions, as it forms one continuous structure throughout (Fig 8.84 to 8.85).

However, due to the extensive landscaping that will occur on top of the basement slab, it is neccessary to collect as much water as possible in order to irrigate it. For this reason the retaining wall system needs to be an open one that allows water to seep through from the outside. This occurs through a system of *no fines concrete blocks* that absorb water from the surrounding soil and allow it to seep through weep holes in the basement retaining wall, down towards the basement floor slab. The no fines concrete layer absorbs this water and guides it to secondary channels. The water is gathered in one main channel and pumped into the storage tanks in the corner of the basement. Excess water that is not absobed by the no fines concrete blocks flows downward to the coarse aggregate just above the raft foundation and enters the geopipe that guides the water to the closest municipal stormwater channel (Fig 8.86 below).

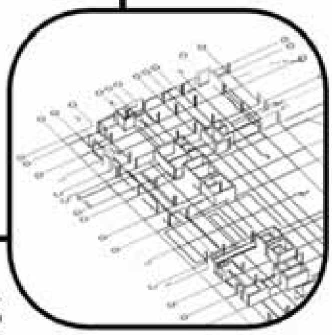


Fig 8.83
STRUCTUAL GRID

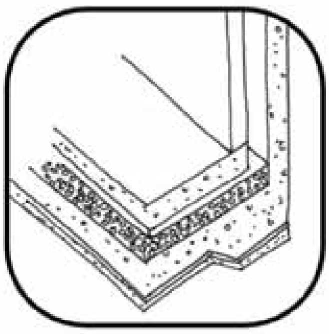


Fig 8.84
RAFT FOUNDATION
& RETAINING WALL

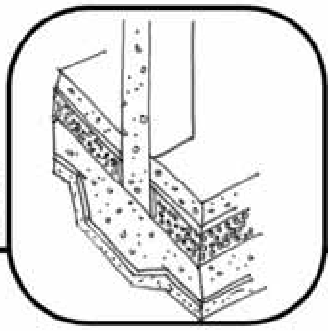


Fig 8.85
RAFT FOUNDATION &
RC COLUMN

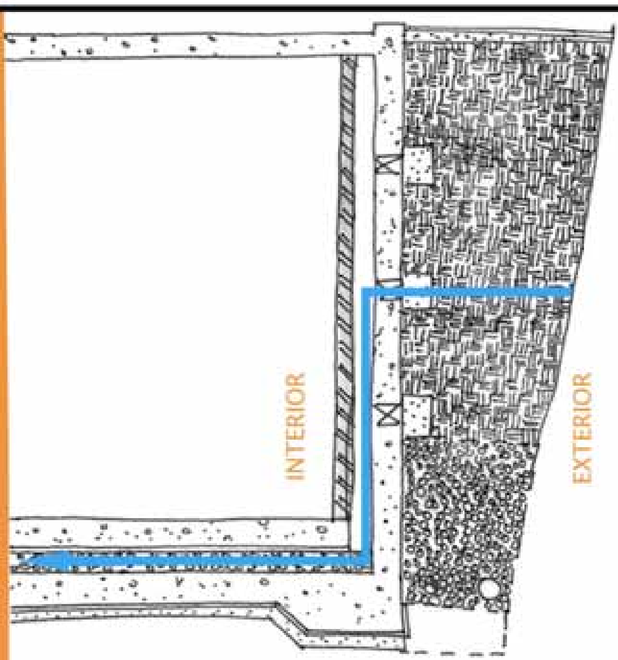


Fig 8.86 TYPICAL BASEMENT CONSTRUCTION
showing the flow of water into the system

8.4.3 Concrete Column and Slab Construction

a) Concrete Columns
Three different type of re-inforced concrete columns are used in the 'i-hub's structure:

1. Rectangular 330x460 RC columns: primarily used in the basement and where the columns is concealed in a cavity wall.
2. Elliptical 330x460 RC columns: primarily used in the areas of the basement directly under the 'i-hub' building and in the building itself where the columns are exposed. The slight curve of an elliptical column gives the concrete a softer, plastic quality that is so desired in this design.
3. Elliptical 330x840 RC columns are located along gridline C, North Block. These columns support the composite structure of the Mezzanine Levels. The size renders them a prominent structural element and therefore a strong feature in the design.

b) Concrete Slabs
255mm (3 brick courses), *cast-in-situ* reinforced concrete slabs, with two-way spans, are used throughout the design. They are supported at 5330mm and 8000mm centres by the columns described above. This type of slab construction was chosen, as much of the concrete structure will be off-shutter concrete and therefore exposed. The quality of the concrete needs to be high and work can be controlled and monitored carefully with this method as the project progresses.

Fig 8.89 to Fig 8.91 show the progression of the 'i-hub's column and slab construction three dimensionally.

Fig 8.87 DIFFERENT COLUMN TYPES

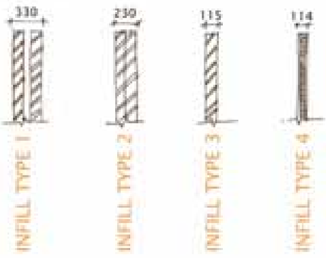


Fig 8.88 DIFFERENT INFILL WALL TYPES

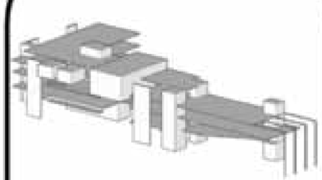


Fig 8.89

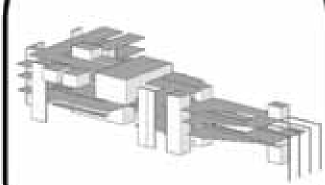


Fig 8.90

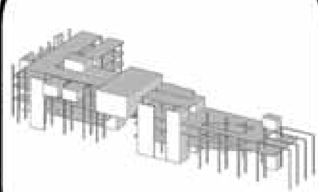


Fig 8.91

Concept Drawings

The infill material used is non-load-bearing brickwork with a small percentage of dry-wall partitioning:

1. 330mm brick cavity walls: primarily used around the service cores and to conceal the rectangular 330x460 RC columns.
2. 230mm brick walls are used internally, around lift shaft and fire escape stairs (forming a fire barrier), as well as in the construction the the Craft Market and Restaurant facades.
3. 115mm brick walls are used in the ablution facilities.
4. 114mm dry wall partition systmes are used in the Office areas and Auditorium Wall Construction.

Most of the building's interior and exterior walls are plastered and painted. It is for this reason that standard stock bricks can be used. It is only in the Craft Market Area where facebrick (FBX) is used. Although the use of plastered walls results in higher maintenance, the building's context calls for an exterior that has a neutral an unimposing pallette that sets a backdrop for everyday activities and the play between historical and contemporary architecture.

8.4.4 Roof Construction

The construction of the 'i-hub's roof is two fold:

a) Flat Concrete Roof
The flat concrete roof is a *cast-in-situ* structure that provides thermal mass thus reducing heat gain within the building. It also aids in the harvesting of water that is collected in the basement and used to irrigate the lanscape. It is also on this structure that the air conditioning units and solar heating units are placed. Concrete roof construction is ideal for this as it provides a flat surface, on which to construct a plinth to mount these systems, as well as providing a noise barrier when they are operational. The slab is 255mm (3 brick courses) thick and spans from column centre to column centre. The top of the slab has a insulative screed to a minimum fall of 1:60 to 45 degree fullbore outlets. These outlets allow water to enter the 100mm diameter downpipes that are cast into the reinforced concrete columns.

b) Light Steel and Shading 'Skin' Structure
The light steel stucture comprised of a steel truss structure bolted to the upstand of the flat concrete roof on one side and supported by a 254x254x73 H-beam on the other. The trusses are spaced at 1300mm centres. 125x75x8 galvanised steel angle irons are welded to the truss. Bolted to these are 125x65x20x2 galvanised steel lipped channels, which carry the Kliplok 700 Chromadeck roof sheets. The roof is insulated by 25mm thick Isoboard fixed between the galvanised steel lipped channels. The 5 pitch ensures that rainwater is transfreed effectively to the flat concrete slab for collection.

The zincalume shading skin is then attatched to the steel structure by means of a galvanised steel frame system that is incorporated into the truss structure at roof level.

The roof structure also incorporates ribbon skylighting that is set between the upstands of the flat concrete slab, or between the flat concrete slab upstand and the light steel structure. The construction of the skylights optimises the entry of natural light into the building from above.

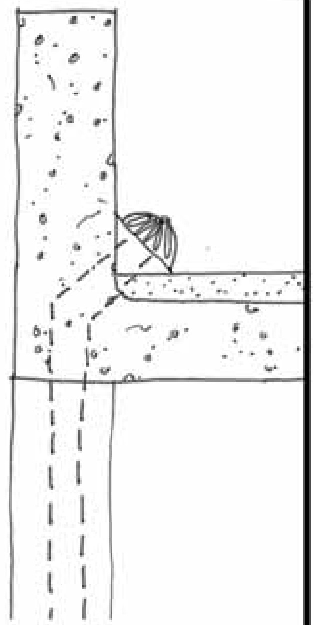
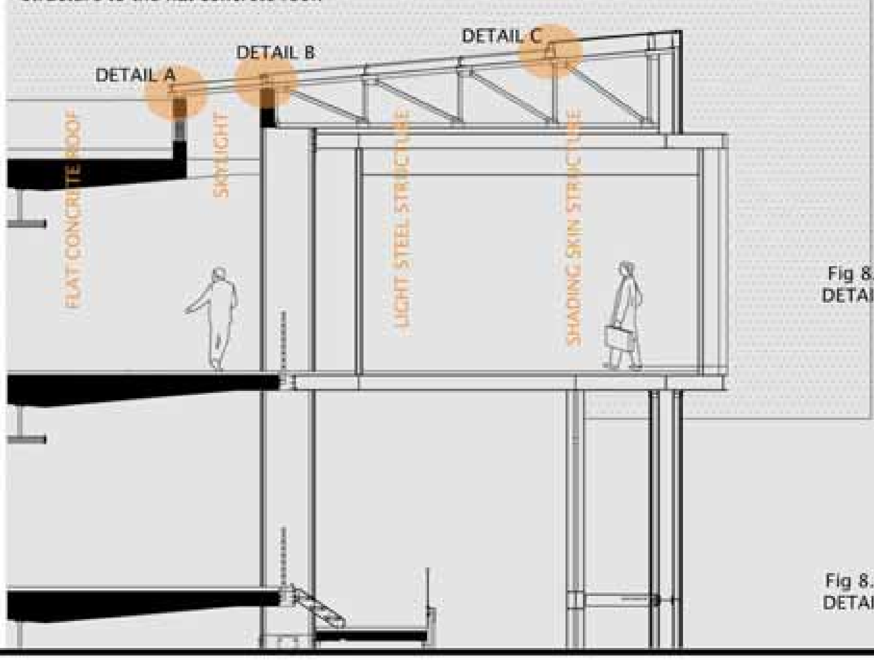


Fig 8.92
DISPOSAL OF RAINWATER FROM THE FLAT CONCRETE ROOF

Concept Drawings

Fig 8.96 SECTION THROUGH THE NORTH-WESTERN BLOCK showing the transition from shading skin to light steel structure to the flat concrete roof.



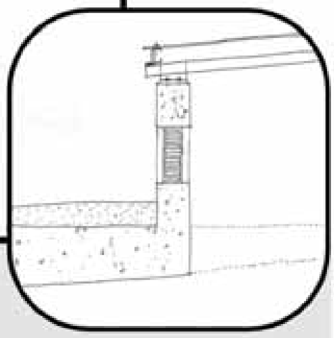


Fig 8.93
DETAIL A

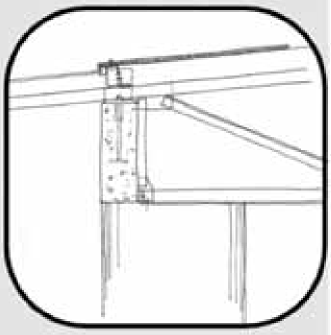


Fig 8.94
DETAIL B

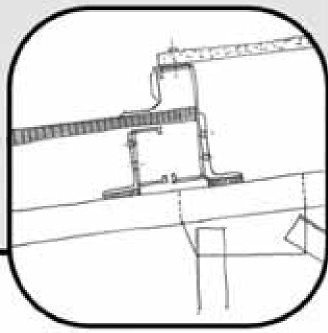


Fig 8.95
DETAIL C

8.4.5 Auditorium Construction

The 'i-hub' Auditorium structure is made up of two layers:

1. Inner Structural Frame
This frame is made up of 20mm galvanised steel plates, custom welded to form 500x500 hollow tubes. These tubes are welded together to form the sub-structure (seen in Fig 8.99). This rigid steel frame is supported, via bearing pads, on 540x540 RC columns (Fig 8.100). Tensile forces are transferred by the diagonal members that tie the top and bottom beams together. The rigid frame allows the auditorium to move as an entire unit and gives rise to the perception of 'hovering' or 'hanging'. A composite steel deck and stepped structure is secured to the rigid inner structural frame by means of I-beams that span across it (see Fig 8.102). This forms the base of the auditorium. The roof of the auditorium is also a composite slab with upstands that allow for ventilation of the cavity. Air conditioning units are housed on the roof slab as the auditorium is mechanically ventilated.

Acoustically treated, dry-wall partitioning forms the outer walls of the Auditorium Structure.

2. Outer Plexiglas Frame
The outer frame is made of Plexiglas (Ice Green) panels that are secured in place with spider clamps attatched to the inner structural frame by means of their own framing system (Fig 8.103). The gaps between the panels are sealed with clear silicon.

Although the use of an acoustically designed inner skin, renders the auditorium's internal noise levels acceptable, the outer skin enhances the quality of quietness within the space.

The outer frame is lit from within at night, making the whole structure glow while 'hovering', suspended in mid-air. The detailing of this structure allows for it to be light enough to achieve the desired effect, while still being functional.

Fig 8.97 UP campus building by Braam Le Roux. (photo by author)

Fig 8.98 UP campus building by Braam Le Roux. (photo by author)

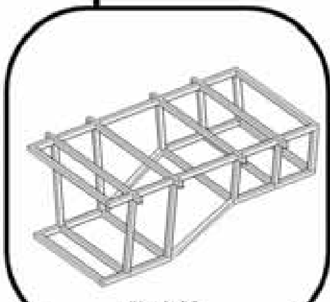


Fig 8.99

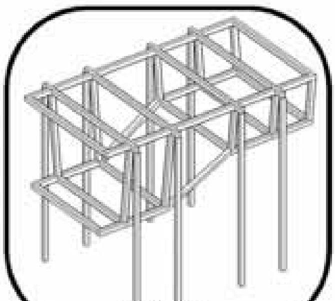


Fig 8.100

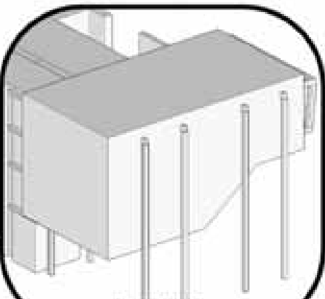


Fig 8.101

Concept Drawings

Fig 8.102 CROSS-SECTION THROUGH THE AUDITORIUM showing the importance of sight lines.

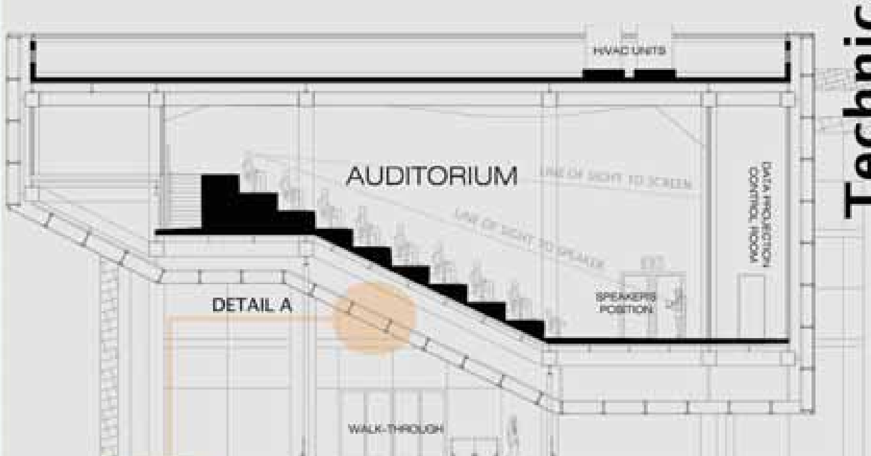


Fig 8.103 DETAIL A. (DOORMA BROCHURE)

Technical Resolution

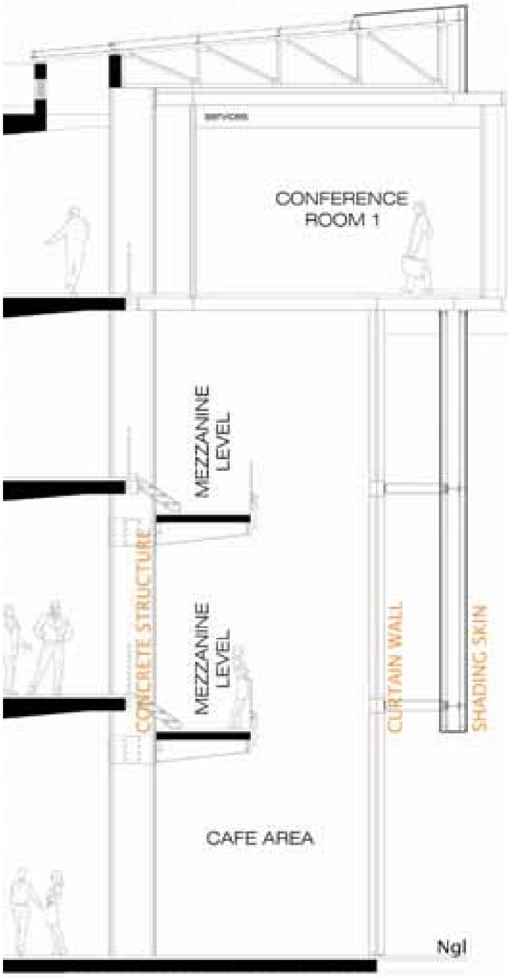


Fig 8.104 SECTION THROUGH THE NORTH-WESTERN CURTAIN WALL showing various different connection methods.

8.4.6 Curtain Walling and Connections

The ColourVue and CoolVue panels that have been specified for use in the 'i-hub' building are held in place by exposed steel members. The glazing itself is effective in creating user interaction with the building's edges. It is however, the way in which the steel framing these panels is connected, that adds a raw, tactile quality to the building's detailing.

Curtain walls prevail on the Northern and North-Western facades of the 'i-hub'. The zincalume shading skin, along with its frame, connect to these curtain walls, shielding them from direct solar radiation.

The steel that supports the shading skin as well as that which supports the glass, in fixed by various means explored in Fig 8.105 to Fig 8.108 (SAISC 2008). Once assembled, all steel components are to receive a coat of protective, light-coloured paint.

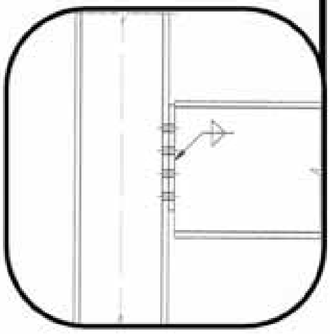


Fig 8.105 STEEL CONNECTION welded end plate to column flange (SAISC 2008:15.4)

Fig 8.109 LAW BUILDING FACADE University of Pretoria Campus by Kruger Roos Architects. (photo by author)

Fig 8.110LAW BUILDING WALKWAY CONNECTION University of Pretoria Campus by Kruger Roos Architects. (photo by author)

Fig 8.111 UP Campus Building by Braam Le Roux. (photo by author)

Fig 8.112 COLUMN AND WALKWAY CONNECTION University of Pretoria Campus by Kruger Roos Architects. (photo by author)

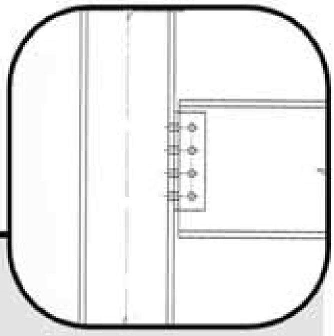


Fig 8.106 STEEL CONNECTION welded end plate to column flange (SAISC 2008:15.4)

Precedents

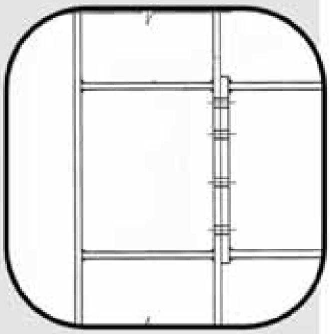


Fig 8.107 STEEL CONNECTION column with web stiffeners and welded flush end plate. (SAISC 2008:15.4)

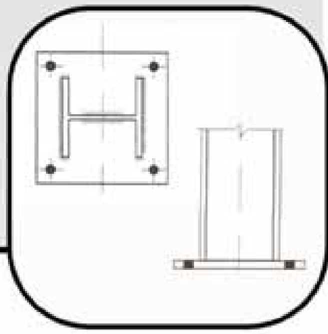


Fig 8.108 STEEL CONNECTION large welded base plate with M16 bolts. (SAISC 2008:15.11)

The services and systems that are incorporated into the design of a building are integral to its everyday functioning. It is the integration of these systems that render the environment of the building comfortable of not. They are also responsible for the majority of the energy consumed by the building when operational. For this reason, it is important to consider alternative methods of providing fresh air, heat and disposing of waste products. It is also important to be forward-thinking while at the same time, sensitive to methods that are currently used in practice. This will ensure that the building is a model for the latest systems, but also that these systems can be properly maintained by knowledgeable professionals familar with the industry.

8.5.1 Waste Water Disposal

All sanitary fixtures within the building are optimised to reduce the waste of water. These include low-flow shower heads, dual flushing toilets and waterless, odourless urinals.

A two-pipe plumbing system, located in the ducts linked to the ablution facilities, as grey water is collected from the wash hand basins and showers and channelled to be store in a grey water collection tank in the basement (Fig 8.114 below). The grey water collection stack will be ventilated at roof level. The water will be used to irrigate the landscape from below the soil (as opposed to spraying which can cause problems due to the presence of chemicals within the water). In this way the grey water is mixed with the stormwater collected from the building's roof and diluted. Due to the public nature of the building and the broad range of functions that the building contains, for quality control purposes, it has been decided that water from the building's kitchens will not be incorporated into the grey water system of collection.

The waste water from the kitchen facilities will feed into the soil water system and enter the municipal sewer system. The soil water stack will be ventilated at roof level (Fig 8.113 adjacent).

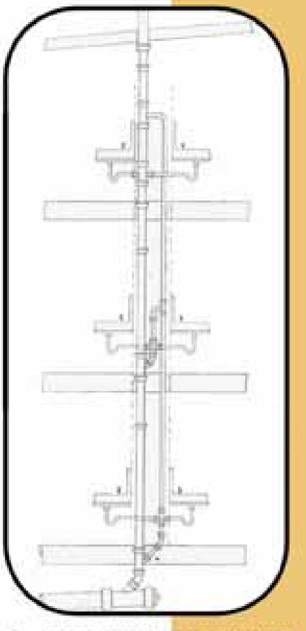


Fig 8.113 SOIL WATER PLIMBING SYSTEM connecting to the municipal sewer system. (www.chestofbooks.com/plumbing)

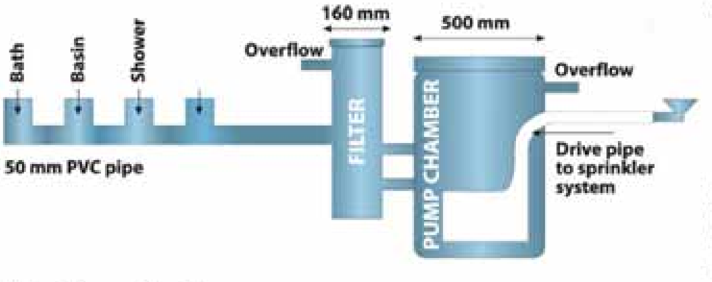


Fig 8.114 DIAGRAM SHOWING THE FUNCTIONING OF A GREY WATER COLLECTION SYSTEM. (www.greenearthconsulting.co.za)

8.5.2 Water Heating Systems

Pretoria is located optimally with regards to receiving a high percentage of solar radiation year round. Although the initial costs of implementing solar technolgies are higher, the long-term cost saving far out-weigh the initial captital invested. Solar energy is clean and free. It is for the above mentioned reasons that this technology is being applied as part of the water heating system of the 'i-hub' building.

Fig 8.115 SOLAR GEYSER -K250d. (www.solargeysers-sa.co.za)

Due to the capacity, as well as the mixed-use nature of the building, the system of heating water is two fold:

a) Solar Geysers

Solar geysers are used to heat water for the ablution facilites, as well as for the smaller kitchen spaces. The SolarTech Direct Water Heating K-250d is a theromosyphon - close coupled system that operates by using two flat plate solar collectors of 2m each.The storage tank has a capacity of 250 litres and weighs 75kg's (see Fig 8.115 above). Ten K-250d units will be located in strategic places on plinths on the 'i-hub's flat concrete roof.

b) Electic Geysers

The water provided by the solar geysers is supplemented by water heated by electic geysers, particularly in the large, restaurant and cafe kitchen spaces.

Duratherm Kompakt D250L 400Kpa electical geysers will be installed (Fig 8.116 adjacent). This electrical geyser is manufactured by using a combination of steel and plastic (PEX coating), rendering it corrosion resistant and virtually maintenance-free.

Fig 8.116 ELECTIRAL GEYSER - Duratherm Kompakt D250L 400Kpa (www.sustainable.co.za)

In order to optimise electic geyser efficiency, a gyeser blanket is to be installed to insulate the main tank. The geyser pipes too, should be insulted to prevent unnecessary heat losses. The geyser should also be installed vertically as apposed to horizontally to increase energy efficiency (www.sustainable.co.za/energy-efficeincy/geyser-eficency.html). All electical geyses that are installed are to have a timer that controls the geyser's operating hours, thus reducing electrical costs. For optimal geyser efficiency, the theromstat is to be set to 60 degrees Celsius (www.sustainable.co.za/energy-efficeincy/geyser-eficency.html).

The use of solar geysers, coupled with electic geysers where needed, will greatly reduce the energy usage of the builidng and electrical costs will drop.

8.6.3 Energy Efficent Lighting

The building is designed specifically to be lit naturally via strategically placed windows and skylights. Artificial lighting is required specifically in the Service Cores of the building, the Conference Rooms, the Auditorium, as well as the Basement.

Energy saving fixtures will be applied. LED (Light Emitting Diodes technology will be mainly used in the down-lighting of public spaces. Compact flourescents (CFL's) will be used in office, meeting and auditorium spaces where a higher, task-specific level of lighting is required. All light fittings are to be linked to a timer system that will ensure that lights are only operational when they are needed. The application of this technology will require a larger capital output. Any money spent initially will be re-imbursed through the savings that will be made with regards to electrical costs in the long run.

8.5.4 Fire Alarm System

According to SABS 0400 Part TT31, the building will be equipped with a fire detection system and a manually activated alarm system that can be activated in the event of an emergency.

According to SABS 0400 part TT36, the building does not need to be fitted with a sprinkler system. Smoke ventilation happens naturally, through openable windows and louvres at roof level, in accordance with SABS 0400 Part TT 42.

8.5.5 Air Conditioning Systems

Kam Sing Wong of Ronald Lu & Partners, Hong Kong, stated at the Green Building Conference 2009, that "Solar thermal energy has perhaps the greatest potential of all solutions to transform global energy issues, as it is a highly efficient way of both heating and cooling...it is an interesting paradox of South Africa's sunny climate, that the very source of heat, which necessitates cooling, can be used to cool buildings", (www.greenbuilding.co.za).

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The i'-hub' building uses a number of systems to promote a comfortable environment with regards to air temperature and ventilation. The air-conditioning system is two-fold:

a) Solar Powered Air-Conditioning

Although many of the 'i-hub' building's public spaces are volumous and open up to the outside environment, and are therefore naturally ventilated using the stack effect, a solar powered system is used if the indoor environment become anything but optimal. This system of ventilating is relatively new on the South African market. It is currently being tested by the South African supplier, Voltas Technologies, and is proving to be highly successful (www.greenbuilding.co.za/ndex.php/Notice-Board).

The system involves the use of solar-assisted absoption chillers suitable for the South African climate, that have a heating/cooling capacity of between 1700 and 2000KW.

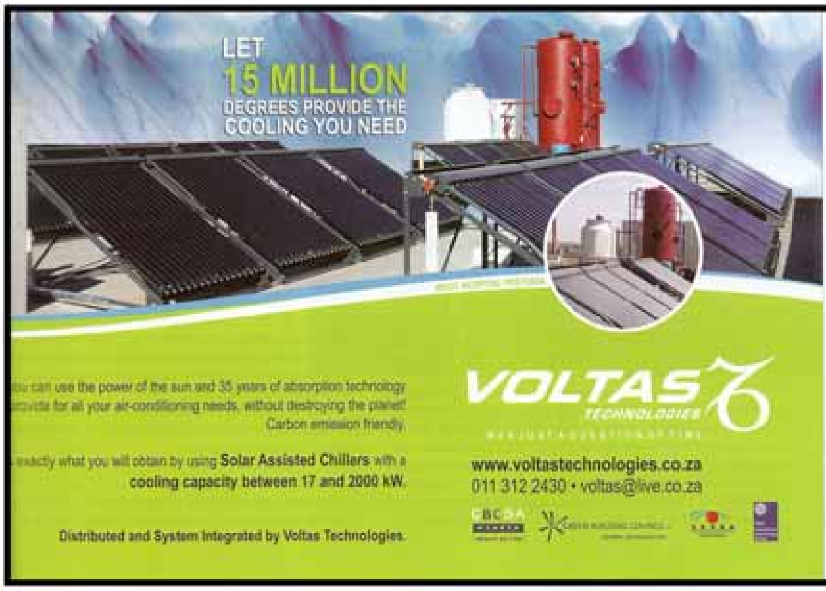


Fig 8.117 SOLAR POWERED COOLING SYSTEM ADVERTISEMENT BY VOLTAS TECHNOLOGIES - this application involves the cooling/heating of a hospital in Moot, Pretoria. (Architecture South Africa September/October 2009:71)

This system will be used to provide fresh, cool air to the public spaces of the building's North-Western Block, as well as the restaurant to the South. Ducting will direct air through the suspended ceiling cavity where outlets in the floor slab above will allow air to filter from the floor slab up. Cooling the lower level of each floor, where movement through the building occurs, results in only the necessary air being cooled. As the air near the floor heats up, it will rise through the building's internal volumes and be expelled through louvres at roof level.

Fig 8.118 A ROOF PACK WITH THE ACCESS PANEL REMOVED. (www.daikin.co.za)

Fig 8.119 AIR OUTLET FAN. (www.daikin.co.za)

b) Split Air-Conditioning System

The LG MULTI V system (Fig 8.22) of air-conditioning consists of a system made of of a:

1. An external roof-top package unit housing the refridgerant cycle and coil unit (Fig 8.20),
2. Air ducts, and
3. Concealed ceiling air terminals (Fig 8.21 adjacent).

Technical Resolution

This system has been chosen as it eliminate the necessity of a plant room, as it can be accommodated on the flat concrete roof of the 'i-hub' building. Also, it requires only minimal duct space. This system will be used to ventilate the Service Cores, Offices, Boardrooms, Conference Rooms, as well as the main Auditorium Space.

This system can provide either heating and cooling. It is also possible to control each space seperately, therefore optimising user comfort.

Fig 8.120 CONCEPT OF SPLIT AIR-CONDITIONING. (Architecture South Africa September/October 2009:21)

8.5.6 Diagramatic Representation

The floor plan adjacent (Fig 8.25) shows, schematically, a typical layout for the 'i-hub' building's service systems. It is clear to see from this diagram how the service interact with one another, forming an integral part of the functioning of the building.

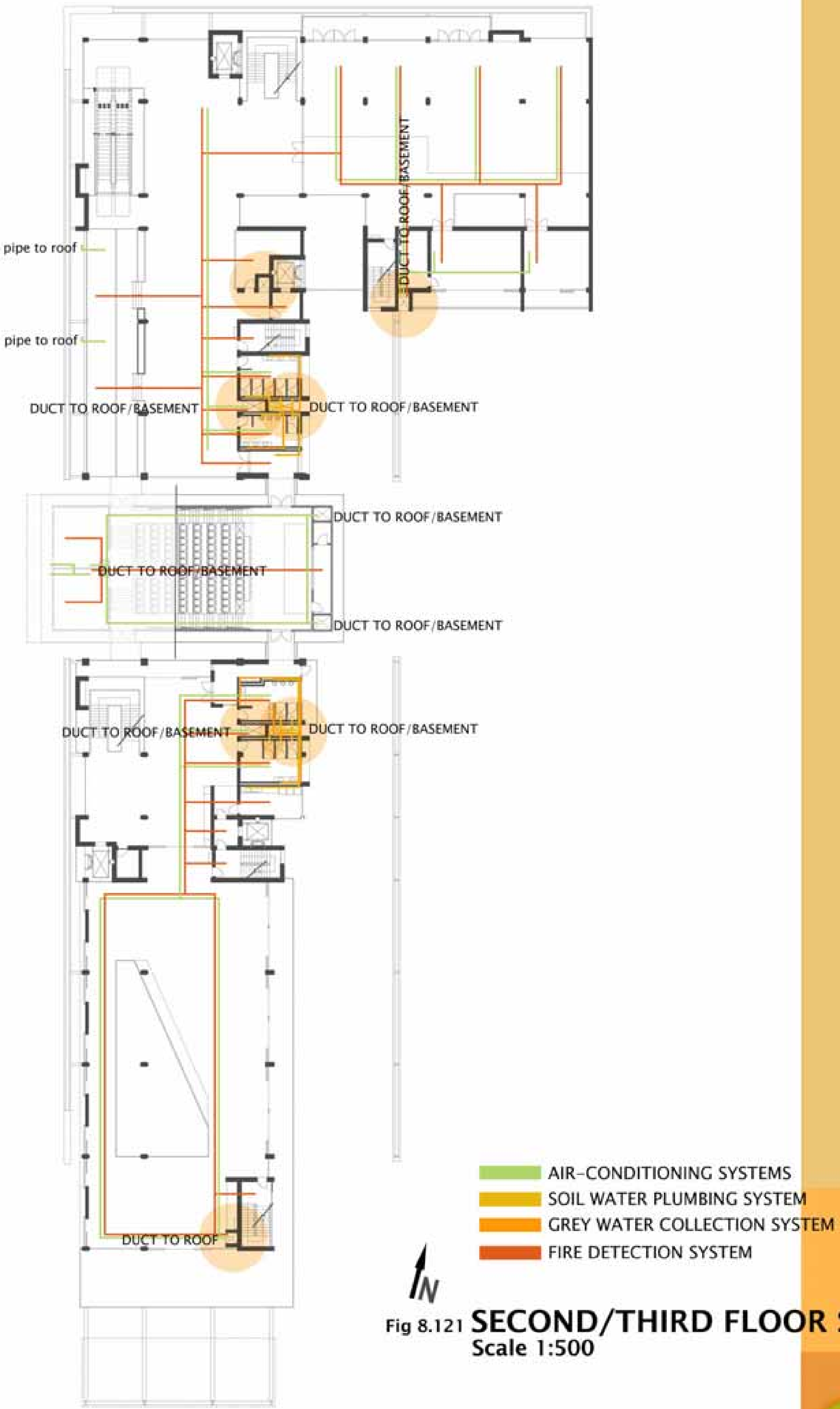


Fig 8.121 **SECOND/THIRD FLOOR SERVICES**
Scale 1:500

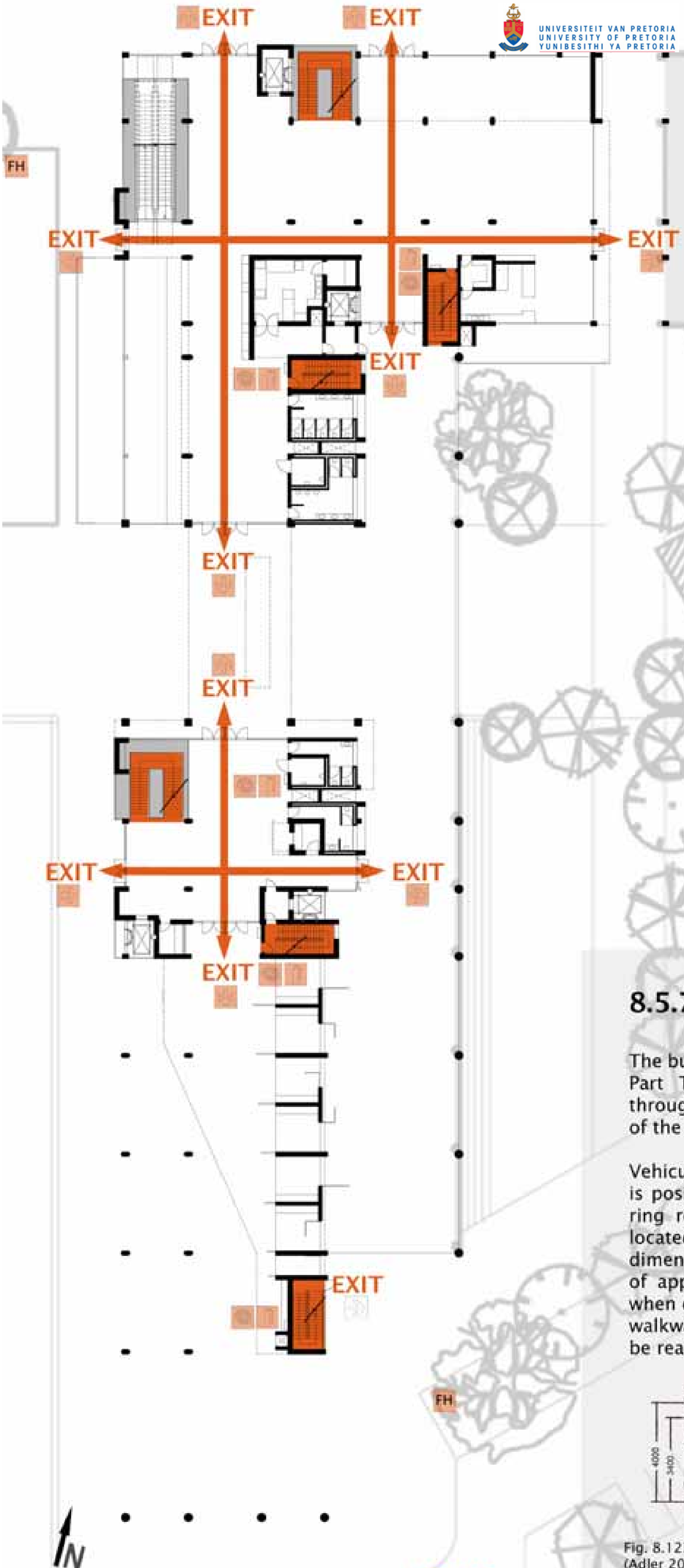


Fig 8. 122 GROUND FLOOR FIRE PLAN

8.5.7 Fire Fighting Provision

The building is designed, according to SABS 0400 (1990) Part T, to have a number of fire fighting points throughout the building, that are able to reach every part of the structure and beyond, in the event of a fire.

Vehicular access to the site, in the case of an emergency, is possible from Scheiding Street to the North, and the ring road to the South, where fire hydrants (FH) are located to supply water for any fire fighting effort. The dimensions of a fire vehicle, with a turning circle radius of approximately eight metres, have been considered when designing the surrounding landscape and outdoor walkways so as to ensure all points of the building can be reached. (Fig 8.127 below)

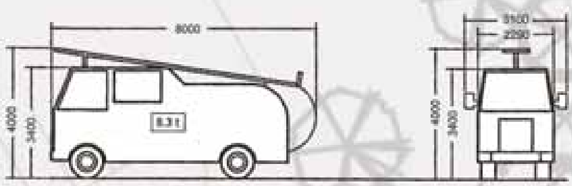


Fig. 8.123 above show a medium sized fire fighting vehicle's dimensions (Adler 2001:4-2)

Fig 8.124 **SECOND FLOOR FIRE PLAN**
Scale 1:500

FIRE EQUIPMENT - LEGEND

2x9kg dcp

One 9kg Dry Chemical Powder (DCP) is provided as per SABS 0400 (1990) Part TT37, for every 200m of floor area. The DCP's are located in pairs and found in the vacinity of the Fire Hose Reels.

FHR

One fire hose reel (FHR) is provided as per SABS 0400 (1990) Part TT34, for every 500m or floor area. The FHR's are located at the exits leading to the fire escape stairs.

Signage is provided throughout the building to guide users to fire exits in the event of a fire. The signage system is to be applied according to SABS 0400 (1990) Part TT29.

Distances to escape routes are no more than 45m as stipulated by the SASA 0400 (1990) Part TT16. Width of feeder and escape routes, as well as the directional swing of fire escape doors are in accordance with regulation.

8.6 Environmental Design and Sustainability

8.6.1 Introduction

It is becoming increasingly important as a designer, to minimise the negative effects that buildings have on the environment. The earth's non-renewable resources are quickly being consumed. Alternative ways of providing services to buildings needs to be investigated with rigor. The following chapter seeks to explore various passive design principles that aid in lessening the energy consumption of the 'i-hub' building.

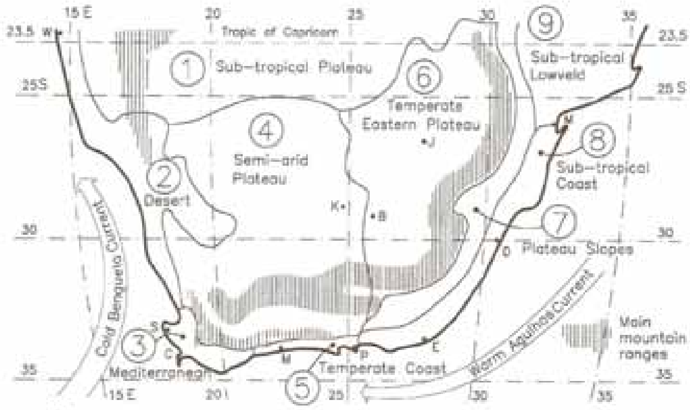


Fig 8.125 shows the climatic zones of South Africa. (Napier 2000)

6 TEMPERATE EASTERN PLATEAU

SUMMER RAINFALL mm	125 to 375
WINTER RAINFALL mm	62 to 250
JANUARY TEMPERATURES °C	20 to 25
JULY TEMPERATURES °C	10 to 15
PREVAILING WINDS	N-E in summer & N-E to N-W in winter
RELATIVE HUMIDITY (%)	30 to 50 in E
HOURS SUNSHINE (%)	60 to 80 in W

Fig 8.126 shows the characteristics of zone 6, where Pretoria is located. This information aids in making decisions related to passive design elements within the building. (Napier 2000)

JOHANNESBURG & PRETORIA Latitude (nearest) 26° South
Both cities taken as longitude 25.5°E (Add 4.5° or 18 minutes to solar time)

Solar times		*06.00*	*08.00*	*10.00*	*12.00*	*14.00*	*16.00*	*18.00*
Clock times		06.18	08.18	10.18	12.18	14.18	16.18	18.18
Azimuth	21/12	112E	101E	91E	0	91W	101W	112W
Altitude	21/12	10	35	63	88	63	35	10
Azimuth	21/3 & 9	90E	76E	53E	0	53W	76W	90W
Altitude	21/3 & 9	0	26	51	65	51	26	0
Azimuth	21/6	-	55E	34E	0	34W	55W	-
Altitude	21/6	-	14	32	40	32	14	-

Fig 8.127 Solar angles for the city of Pretoria. (Napier 2000)

Climate Conscious Design

To lower energy demand, the following design prinicples are considered in the 'i-hub's design:

8.6.2) Orientation and Solar Control
8.6.3) Thermal Mass Insolation
8.6.4) Natural Ventilation
8.6.5) Rain Water Collection
8.6.6) Stormwater Disposal
8.6.7) SBAT Analysis

8.6.2 Orientation and Solar Control

Although the preferable orientation for the South African situation is North-South, the proposed site and the Spatial Development Framework that was established, calls for a building form that is predominantly East-West facing. The Northern edge of the site is optimised, however, the Eastern and Western facades of the builiding are exposed to harsh solar raditation throughout the day, giving rise to uncomfortable internal building conditions. It is neccessary to shade the building, particularly on the Eastern and Western facades.

A number of different shading systems were investigated (evident in Fig 8.128 to Fig 8.131) in order to make a decision regarding the system to be used to shade the 'i-hub' building. Vertical shading devices are the most effective for the Eastern and Western facades of a building. Horizontal shading devices are most effective when used on the Northern facade. It it for these reasons that the i'hub's Eastern and Western facades are wrapped in a lightly coloured, continuous perforated zincalume 'skin' that allows difused natural light to penetrate, but prevents harsh direct solar raditation from entering the building (the development of this concept is outlined below). This shading device becomes an integral part of the design language of the building, contributing not only to the practical functioning of the building, but its aesthetic appeal too. The Northern facade is also wrapped in the perforated zincalume 'skin', although a lot less dense, it protects the predominantly glazed facade from heating up and radiating this heat inwards. The balconies on the second and third levels protude out from the building's fabric, but are recessed behind the perforated shading skin. The balconies therefore function as horizontal overhangs, protecting the offices from direct solar radiation (see Fig 8.132 below). The Southern facades of the building are largely glazed and open in nature, to allow maximum penetration of indirect sunlight and to facilitate a contrast between the continual shading protection present on the other facades of the building.

The ColourVue and CoolVue glass that is used in the facade design reduces solar heat gain due to polyvinyl butyral (PVB) interlayers. The multi-layered glazed units remain cooler and therefore transmit less heat into the interior of the building.


Fig 8.128
(www.archipelagoes.com)


Fig 8.129
(www.pvresources.com)


Fig 8.130
(www.aeonline.ae)


Fig 8.136
(www.aeonline.ae)

Fig 8.132 shows the progressive development of the perforated zincalume shading device. The development is as follows:

A - It is clear to see that without any form of protection from Eastern and Western sun exposure, much solar radiation enters the building.

B - A single layer of perforated zincalume sheeting is suspended in front of the glazed facade to protect it from direct solar radiation. The single layer of protection allows a small amount of direct sunlight to reach the glazing and radiate into the building's interior. Although the lightly coloured zincalume sheeting reflects much heat and light, it too becomes warm and radiates this heat towards the building.

C - The perforated shading skin now becomes a double system made up of two layers with a naturally ventilated cavity between. This system is effective as direct sunlight penetration is minimised, diffused natural light is allowed to enter the building, and although the outer skin becomes warm, the inner skin prevents the heat from radiating inwards. The presence of an inner skin results in the creation of a buffer zone between the heat of the exterior and the cooler interior.

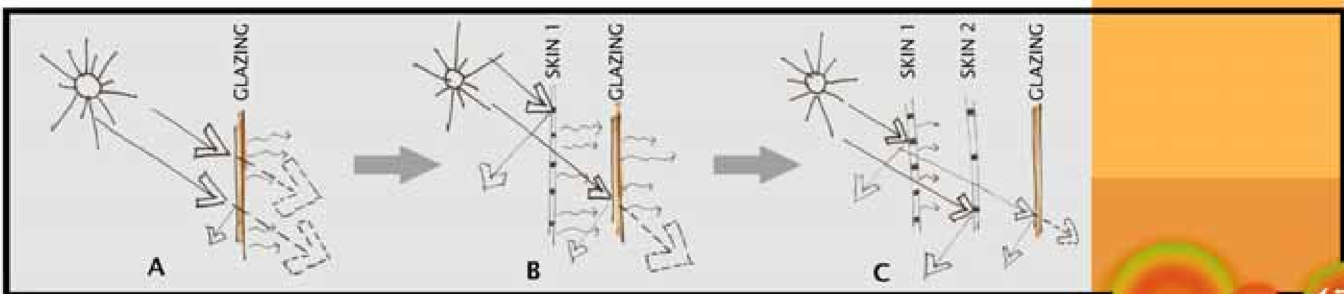


Fig 8.132 Zincalume shading skin development.

8.6.3 Thermal Mass Insolation

Due to the nature of the site, the Western facade calls for large amounts of glazing that promote interaction on the busiest side of the building. The Eastern side of the building uses the principle of thermal mass insulation. The 'i-hub's service cores are enclosed with cavity walls that reduce heat transmission into the building, as well as to the spaces beyond (Fig 8. 138 adjacent). Addiitional insulation within the cavity wall was decided against as these walls do receive a substantial amount of shading from the covered walkway running parallel, and are not exposed to extreme heat conditions.

Solid brick walls are used internally, particularly in the cases of kitchen and service area where much heat is generated internally. The solid brick walls prevent heat that is produced inside the building from being transmitted into the spaces adjacent (Fig 8.139 adjacent)

Concrete slabs are left exposed as far as possible (Fig 8.140), except where minimal suspended ceilings are required in which to run services. The exposure of the cool surfaces of the thick concrete slabs cause a reduction in the temperature of the air that comes into contact with them. The flat roof slab is insluated with a layer of EPS: Lightweight Insulating Mortar (Politerm Blu by Isover, Isover Insulation Solutions Brochure). It is non-falammable and substantially reduces the transmission of heat through the roof of the builidng, the part exposed to the most harsh sunlight.

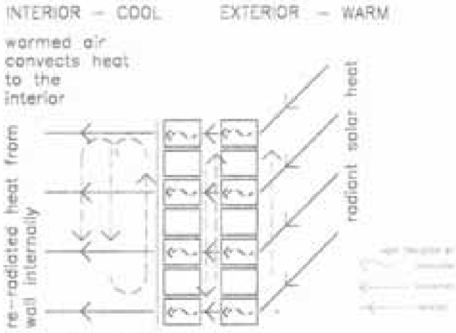


Fig 8.133 The transmisiion of heat during the day, through a CAVITY BRICK WALL - plastered internally, reduces the transmission of heat due to the presence of a cavity. (Napier 2000:4.1.5)

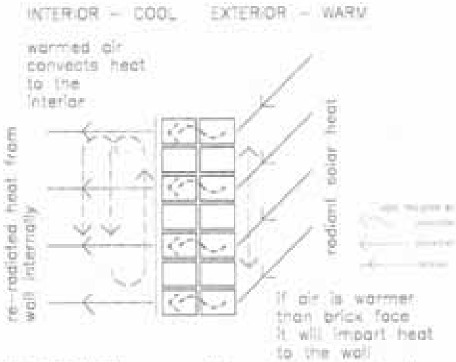


Fig 8.134 The transmission of heat during the day, through a SOLID BRICK WALL - plastered internally. (Napier 2000:4.1.3)

Fig 8.135 The exposed concrete slab of a UP Centenary Building by Earthworld Architects. (photo by author)

8.6.4 Natural Ventilation

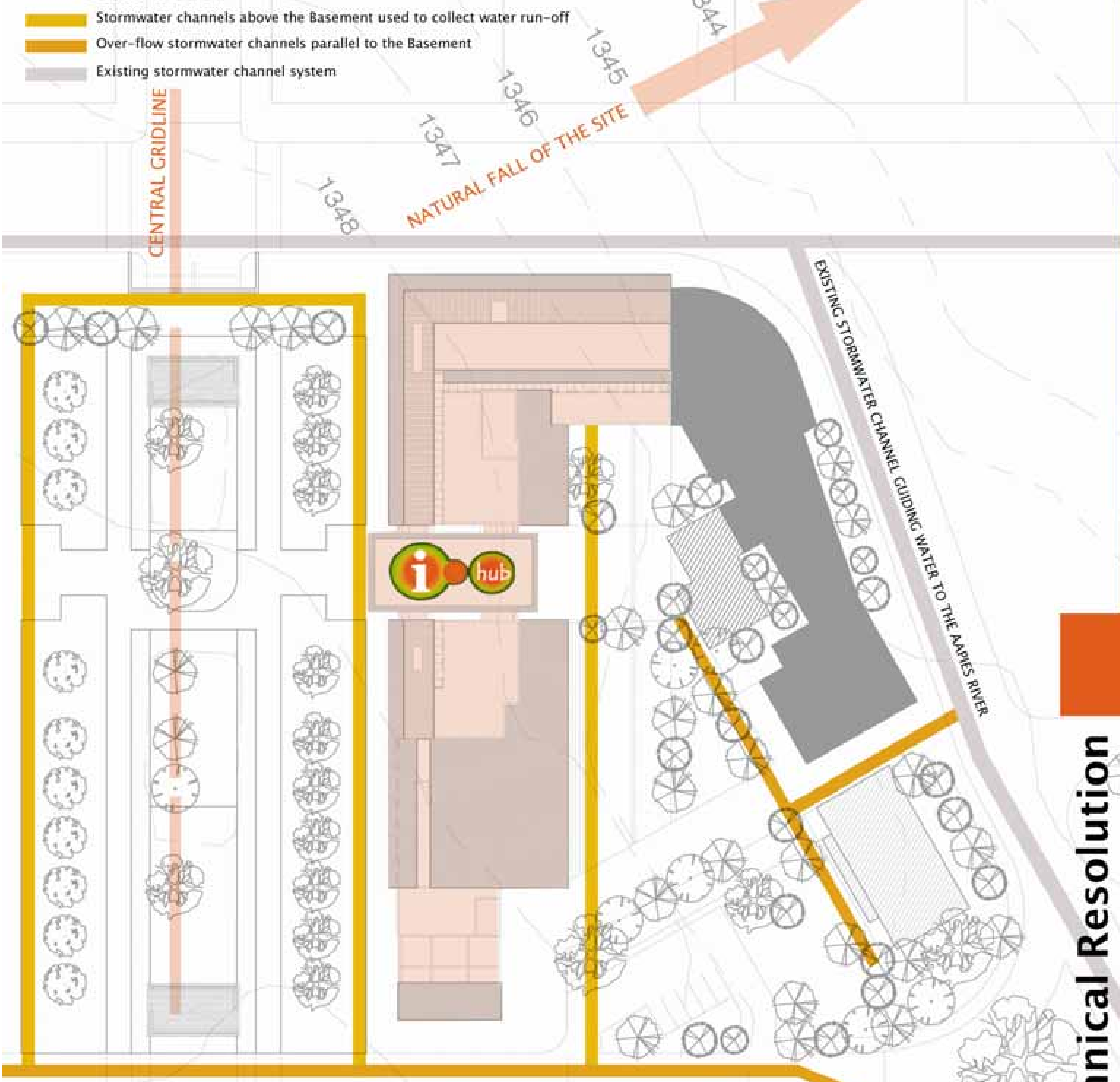
Pretoria's prevailing winds occur from the South to South-East in summer and the West to North-West in Winter. Due to the location and orientation of the building, these wind conditions can be harnessed and used to naturally ventilate the environment.

Although mechanical ventilation is provided in many of the spaces throughout the building, natural ventilation is promoted therefore minimising the use of mechanical systems and thus reducing energy costs. The building is naturally ventilated using cross-ventilation and the Stack Ventilation Principle.

The Stack Principle

"...warm air rises and cool air falls. This movement is enhanced firstly if the temperature differential between warm and cool is greater and secondly, if there is a greater height in the space in which the air moves..." (Napier 2000:5.2)

Fig 8.136
SITE PLAN - STORMWATER LAYOUT
Scale 1:1000



8.6.5 Rain Water Collection

The building itself is designed to collect and channel water into collection tanks located in the Basement. This happens via the rain water downpipes that are cast into the builidng's columns. All water falling within the parameters of the Basement slab is channelled to the collection tanks. The water collection tanks are fitted with an overflow outlet in case of excess water that exceeds their carrying capacity. The Basement slab is designed with a gradient that divides the Historial Sunken Garden Square in half (see the central gridline indicated on the plan site plan adjacent for the location of this divide), giving rise to two water collection points on either side The water that is collected in this way is used to irrigate the landscape on top on the Basement slab and thus the system becomes self-sustaining.

8.6.6 Stormwater Disposal

There are also stormwater channels located parallel to the Basement system that channel water that falls outside of its parameters (See Fig 8.4.4.4 above). These channels also cater for the overflow of excess water in extreme rainfall scenarios. This system connects all the stormwater channels to the existing municipal storm water system that runs South-West towards the Aapies River channel (See Fig 8.136 - Site Plan adjacent). According to the SABS 0400 (1990) Part R, access points are located at no more than 40m intervals alond the length of the stormwater drains to ensure ease of inspection and maintenance.


Fig 8.137
(www.hermann-vwe.de)


Fig 8.138
(www.image.vn)


Fig 8.139
(www.rooflite.com)


Fig 8.140
(www.inhabitat.com)

8.6.7 Natural Lighting

The 'i-hub' building is flooded with natural light. This light does not only enter via the building's facades, but by means of skylights in the roof structure. Light diffused from above and reflected off surfaces on its way into the building causes softer and more interesting lighting effects.

Some of the precedents studied are shown in Fig 8.137 to Fig 8.140 adjacent.

8.6.8 SBAT Analysis

The Sustainable Building Assessment Tool (SBAT) was developed by the Council for Scientific and Industrial Research (CSIR) in 1999. It is therefore relevant to the South African Context and can be used as a tool in planning sustainable environments, supporting design decisions with regards to sustainability issues and ensuring that exisitng buildings fulfill the criteria established by government and other organisations regarding sustainability policies. This assessment tool not only takes the design and construction of the builidng into consideration, but also the operation and refurbishment/demolition.

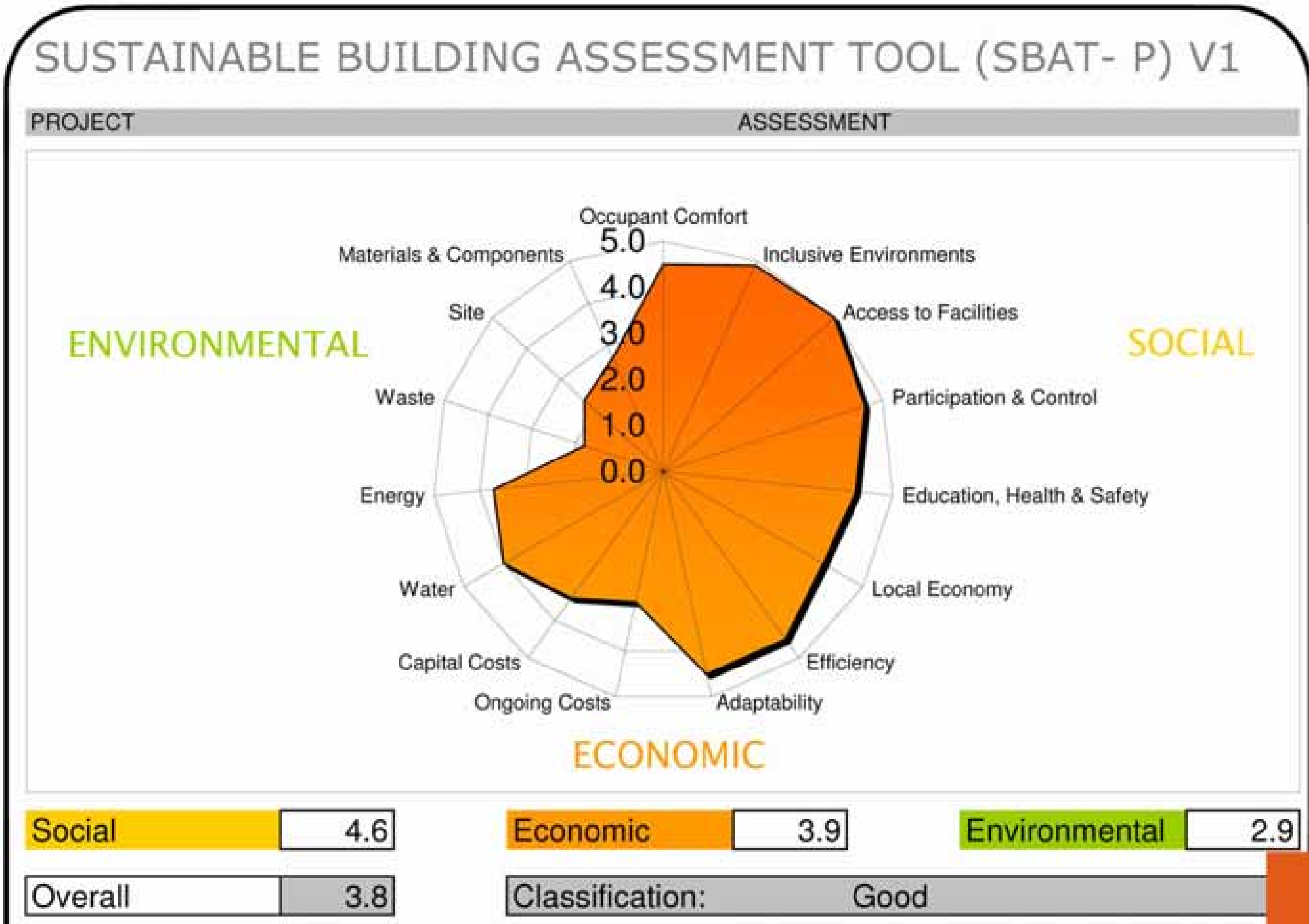


Fig 8.141 Shows the results of the SBAT Assessment for the 'i-hub' @ Pretoria Station Square. It is clear to see from the chart that the building performs well socially and economically, but falls short with regards to environmental aspects. (Gibberd)

The SBAT Tools centres around the concept of a 'triple-bottom line consideration' (Gibberd). These include:

Social Sustainability: To ensure that the building contributes to the surrounding community, it should respond socially with regards to occupant comfort, inclusivity, accessibility, user participation (throughout the building's life-cycle), as well as educational health and safety of its users.

Economic Sustainability: In order for the building to perform well in this area, it should contribute to the local economy, be efficient during occupation, be both adaptable and flexible, have minimal cost output when in use (these can be minimised by recycling, metering and continual maintenance), as well as contributing financially to the community's needs and the research of innovative sustainable strategies.

Environmental Sustainability: To ensure that the building performs well in this regards, it should incorporate efficient water management strategies, energy efficient systems (through the use of non-renewable resources), waste management systems, a holistic treatment of the buidling and the environment around it, as well as materials and components that do not contribute to the depletion of the earth's ozone layer.